



PLAM BEACH COUNTY WATER UTILITIES DEPARTMENT

**PLANT NO. 9 EASTERN HILLSBORO CANAL
AQUIFER STORAGE AND RECOVERY WELL SYSTEM**

VOLUME 1 – TECHNICAL SPECIFICATIONS

**PBCWUD PROJECT NO. WUD 98-66
MONTGOMERY WATSON PROJECT NO. 1098093
KIMLEY-HORN PROJECT NO. 44100017**

OCTOBER 2000



**Kimley-Horn
and Associates, Inc.**



MONTGOMERY WATSON

**BOARD OF COUNTY COMMISSIONERS
PALM BEACH COUNTY, FLORIDA**

**PLANT NO. 9 EASTERN HILLSBORO CANAL
AQUIFER STORAGE AND RECOVERY WELL SYSTEM
Project No. WUD 98-66**

**CONTRACT DOCUMENTS
BIDDING REQUIREMENTS, CONTRACT FORMS,
CONDITIONS OF THE CONTRACT, AND
TECHNICAL SPECIFICATIONS**

**Palm Beach County Water Utilities Department
P.O. Box 16097
West Palm Beach, FL 33416-6097**

**2065 Prairie Road
West Palm Beach, FL 33406**

Bids will be received at the office of the Palm Beach County Water Utilities Department, Engineering Building "K", Palm Beach County, Florida, located at 2065 Prairie Road, West Palm Beach, Florida 33406 at the time and on the date specified in the Advertisement for Bids.

**BOARD OF COUNTY COMMISSIONERS
PALM BEACH COUNTY, FLORIDA**

**PLANT NO. 9 EASTERN HILLSBORO CANAL
AQUIFER STORAGE AND RECOVERY WELL SYSTEM
PROJECT NO. WUD 98-66**

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ADVERTISEMENT FOR BID

Sealed Bids, consisting of the Primary Bid Documents, will be received by the Board of County Commissioners, Palm Beach County, Florida, until 2:00 P.M. on Tuesday, November 21, 2000 at the Palm Beach County Water Utilities Department located at 2065 Prairie Road, Building "K", West Palm Beach, Florida. The Primary Bid Documents received by this time will be opened the following day, Wednesday, November 22, 2000, in accordance with the Invitation to Bid and Instructions to Bidders, at or after 2:00 p.m. in the Large Conference Room in the Engineering Building. This 24-hour delay is to permit Bidders additional time to submit the required Supplemental Bid Documents which evidence Bidder's efforts to meet the requirements of the County's M/WBE Ordinance and other contract provisions specified in the Invitation to Bid or Instructions to Bidders. Failure to submit the Supplemental Bid Documents prior to or within this twenty-four hour period will result in the rejection of the Bid and return of the Bid Bond.

The bids will be for furnishing all materials, labor, supervision, equipment, supplies, fees, expertise, and services necessary for the construction of:

PLANT NO. 9 EASTERN HILLSBORO CANAL AQUIFER STORAGE AND RECOVERY WELL SYSTEM

Project No.: WUD 98-66

Engineer of Record: Lyle Munce, P.E. at Montgomery Watson

The work consists of: Construction of a five (5) million gallon per day aquifer storage and recovery well, monitoring wells, below grade vaults and outfall structure to the Hillsboro Canal.

All conditions and requirements for bid submission, consideration, and award are contained in the Contract Documents. The Contract Documents will be available for inspection and purchase beginning October 23, 2000, and may be obtained from Jennifer McMahon, Montgomery Watson, 490 Sawgrass Corporate Parkway, Suite 300, Sunrise, Florida 33325.

A non-refundable service charge of \$100.00 per set of plans and specifications is required. Checks are to be made payable to "Montgomery Watson." Partial sets will not be available.

The overall goal for M/WBE participation is 8% overall with a minimum of 3% with black businesses. The remaining 5% of the total can be met through the use of any M/WBE certified by Palm Beach County. This goal is a minimum and no rounding will be permitted.

At the time of bid submission each bidder, and all identified subcontractors, must possess all professional licenses or certifications required by the State of Florida and/or Palm Beach County, as applicable, for the purpose of performing the specified work.

Bid proposals must be submitted on the forms provided by Palm Beach County and accompanied by a proposal guaranty in favor of Palm Beach County in the amount of not less than five percent (5%) of the bid price. A performance and payment bond (100%) will be required within fourteen calendar days of the Notification from Owner.

Bidders are invited to attend a non-mandatory pre-bid conference to be held on Wednesday, November 8, 2000 at 10:00 A.M. at the address listed below. A non-mandatory site visit will be scheduled at the conclusion of this conference. Attendance at this pre-bid conference is recommended and encouraged.

Palm Beach County Water Utilities Department
Southern Region Operations Center
13026 Jog Road
Delray Beach, FL 33446

The Board of County Commissioners reserves the right to waive any bid irregularities, informalities, or technical deficiencies and to reject any and all bids.

ATTEST:

DOROTHY H. WILKEN, CLERK

BOARD OF COUNTY COMMISSIONERS
PALM BEACH COUNTY, FLORIDA
BY: MAUDE FORD LEE, Chair

PUBLISH: Palm Beach Post

Sunday: October 22, 2000

Sunday: October 29, 2000

END OF SECTION

INVITATION TO BID

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Project Number: WUD 98-66

ARCHITECT/ENGINEER OF RECORD: Lyle Munce, P.E. at Montgomery Watson

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A non-refundable service charge of \$100.00 per set of plans and specifications is required. Checks are to be made payable to "Montgomery Watson." Partial sets will not be available. Bidders requiring plans and specifications mailed must provide an express mail account number Montgomery Watson. The bill will be charged to the recipient's account. Plans and Specifications may also be examined at the following locations:

Palm Beach County Resource Center (561) 863-0895

Palm Beach County OSBA (561) 616-6840

FW Dodge Plan Room, West Palm Beach (561) 697-3801

Construction Market Data (CMD) (954) 565-7905

Florida East Coast Builders Exchange (561) 631-5095

The overall goal for M/WBE participation is 8% overall with a minimum of 3% with black businesses. The remaining 5% of the total can be met through the use of any M/WBE certified by Palm Beach County. This goal is a minimum and no rounding will be permitted.

At the time of bid submission each bidder, and all identified subcontractors, must be properly certified and licensed in the State of Florida and/or Palm Beach County, as applicable, for the purpose of performing the specified work.

Bid proposals must be submitted on the forms provided by Palm Beach County and accompanied by a proposal guaranty in the form of a certified check, cashier's check, money order or a bid bond in favor of Palm Beach County in the amount of not less than five percent (5%) of the bid price. A performance

and payment bond (100%) will be required of the successful bidder within fourteen days of the Notification from Owner. All bids and required supplemental bid documents must be submitted in separate sealed envelopes as described in the INSTRUCTIONS TO BIDDERS.

Bidders are invited to attend a pre-bid conference to be held on Wednesday, November 8, 2000 at 10:00 A.M. at the address listed below. A site visit will be scheduled at the conclusion of this conference. Attendance at this pre-bid conference is recommended and encouraged.

Palm Beach County Water Utilities Department
Southern Region Operations Center
13026 Jog Road
Delray Beach, FL 33446

In accordance with F.S. 287.133 (2) (a), persons and affiliates who have been placed on the convicted vendor list may not submit bids, contract with, or perform work (as a contractor, supplier, subcontractor or consultant) with any public entity (i.e. Palm Beach County) in excess of Ten Thousand dollars (or such other amount as may be hereafter established by the Florida Division of Purchasing in accordance with F.S. 287.017) for a period of 36 months from the date of being placed on the convicted vendor list.

The Board of County Commissioners reserves the right to waive any bid irregularities, informalities, or technical deficiencies and to reject any and all bids.

PALM BEACH COUNTY
INSTRUCTIONS TO BIDDERS
PROJECT NO: WUD 98-66

SECTION DESCRIPTIONS

1. DEFINITIONS
2. LICENSES, OCCUPATIONAL LICENSES, POLICY REGARDING SUBCONTRACTORS
3. BIDDER'S REPRESENTATIONS
4. BIDDING DOCUMENTS
5. BIDDING PROCEDURE
 - 5.3 MINORITY/WOMEN BUSINESS ENTERPRISE PROGRAM
6. CONSIDERATION OF BIDS AND AWARD OF CONTRACT
7. TIME
8. VOLUNTARY PARTNERING
9. PUBLIC BID DISCLOSURE COMPLIANCE
10. CONSTRUCTION INCENTIVE PROGRAM
11. EARLY COMPLETION INCENTIVE
12. LIQUIDATED DAMAGES
13. DEPARTMENT SPECIFIC INSTRUCTIONS

1.0 Definitions

1.1 Addenda are written or graphic instruments issued by the County via the Department prior to the submission of bids which modify or interpret the bidding documents by additions, deletions, clarifications, or corrections or other type of modifications. Addenda will become part of the Contract Documents when the Contract is executed. Bidders, upon receiving addenda, shall insert same into the Bidding documents.

1.2 An Additive or Deductive Bid Item is an amount stated in the Bid to be added to or deducted from the amount of the Base Bid if the corresponding change in the work, as described in the Bidding Documents, is accepted by the County.

1.3 The Base Bid is the sum stated in the Bid for which the Bidder offers to perform the work described in the Bidding Documents as the base, to which work may be added or from which work may be deducted for sums stated in Additive or Deductive Bid Items.

1.4 A Bid is a complete and properly signed offer to do the work or designated portion thereof, for the sums stipulated therein, submitted in accordance with the Bidding Documents.

1.5 The term Bidder means one who submits a Bid directly to the County, as distinguished from a sub-bidder who submits a bid to a Bidder.

1.6 Bidding Documents include the Invitation to Bid, Instructions to Bidders, Index of Drawings, the Bid Form and Attachments, Bid Bond and Contract Forms, the Contract conditions (General and Supplemental), technical specifications, drawings, exhibits thereto and any Addenda issued prior to the date designated for receipt of bids.

1.7 The Contract Documents for bidding of the Work consist of the following:

1. Bidding Requirements - Invitation to Bid, Instructions to Bidders, Index of Drawings, Bid Form and Attachments, and Bid Bond

2. Contract Forms - Contract, performance bond, public construction bond, and form of guarantee

3. Contract Conditions - General Conditions, Supplemental Conditions, and Special Conditions, if any.

4. Technical Specifications

5. Addenda

6. Drawings/Plans

1.8 The term Contractor shall mean the person or entity who is the successful bidder and who executes a contract with Palm Beach County and who is identified in the Contract and is referred to throughout the Contract Documents. Contractor may mean the Contractor or his authorized representative, as the contract context requires.

1.9 The term County or Owner shall mean the Board of County Commissioners of Palm Beach County, Florida.

1.10 The term Day or Days shall mean a calendar day or calendar days. A calendar day begins at 12:00:00 midnight and ends 24 hours later at 11:59:59 p.m.

1.11 The term Department shall mean the Palm Beach County, Water Utilities Department, 2065 Prairie Road, West Palm Beach, FL. 33406 Telephone No. (561) 641-3429.

1.12 A Lump Sum and Unit Price Bid is the sum stated in the Bid for which the Bidder offers to perform the work described in the Bidding Documents containing lump sum and unit price work items. For the purpose of determining the Base Bid amount on a Lump Sum and Unit Price Bid, the unit price costs multiplied by the estimated quantities contained in the Bidding Documents and the lump sum shall be added together.

1.13 Palm Beach County, is a political subdivision of the State of Florida, as represented by its Board of County Commissioners (hereinafter called "County")? Where the word "approval" is mentioned, "approval" shall mean action by the Board of County Commissioners, or designated representative.

1.14 The term Work as used herein refers to the construction and services required by the Contract Documents and include all labor, materials, equipment, and services provided by the Contractor to fulfill the Contractor's obligations.

2.0 Licenses, Occupational Licenses, Policy Regarding Subcontractors

2.1 Bidders and their proposed subcontractors of any tier regulated by the Florida Construction Industry Licensing Board or the Construction Industry Licensing Board of Palm Beach County shall be properly qualified and licensed/certified by the appropriate Board or Boards as required by Florida Statute Chapter 489, or Special Act, Laws of Florida Chapter 67-1876 prior to the time of submission of the bid. As a minimum requirement, the Bidder, subcontractors of any tier, and specialty contractors, as a specific requirement of this Contract, are required to have a Palm Beach County Contractor's Certificate of Competency for the particular work to be performed prior to the time of submission of the Bid regardless of any exemptions granted elsewhere. State of Florida Contractor's Certification /Registration license numbers or Palm Beach County Certificate Numbers must be listed at the applicable places on the Bid Form. Any bid, which is submitted by a contractor who fails to comply with this section at the time the bid, is submitted, or which lists a subcontractor who is not in compliance with this section at the time the bid is submitted, will be rejected as non-responsive.

2.2 The Contractor, subcontractors of any tier, and specialty contractors must have a valid Palm Beach County occupational license at the time of bid submission, except where provisions of F.S. 205.065 apply.

2.3 It is Palm Beach County's policy to discourage contractors from seeking new subcontractor pricing after the award of a County contract, which practice is sometimes known as bid or subcontractor shopping. In order to facilitate this policy, Bidders are required to identify, in the Supplemental Bid Documents, the subcontractors which Bidder, as the contractor, intends to use to perform the contract.

2.3.1 No Contractor, having been awarded any contract based upon the Contractor's response to an invitation to bid, request for proposal, request for qualifications, or other solicitation for competitive selection wherein the Contractor listed the subcontractors which the Contractor intended to use in performing such contract, shall replace any subcontractor listed in the Contractor's response to such request without having first demonstrated good cause, acceptable to the County in its sole discretion. The replacement of any M/WBE subcontractor shall also conform to the requirements of Palm Beach County's M/WBE Ordinance and paragraph 5.3.8 of these Instructions to Bidders.

2.3.2 No Contractor, having been awarded any contract based upon the Contractor's response to an invitation to bid, request for proposal, request for qualifications, or other solicitation for competitive selection wherein the Contractor listed the elements of work which the Contractor intended to perform with its own forces, shall perform such work with a subcontractor without having first demonstrated good cause, acceptable to the County in its sole discretion, for utilizing such subcontractor.

2.3.3 Contractor agrees that neither the County's acceptance nor rejection of the Contractor's request to replace or add any subcontractor shall give rises to any liability of any kind on the part of the County.

3.0 Bidder's Representations

3.1 Each Bidder by making his Bid represents that:

3.1.1 Bidder has satisfied itself, by personal examination of the location of the proposed Work and by thorough examination of the Contract Documents, that Bidder understands all requirements of the Work. In addition, Bidder has, to the extent Bidder determined to be necessary, satisfied itself regarding the accuracy of the estimate of the quantities of the Work to be done; and shall not at any time after the submission of a Bid dispute or complain of such estimate nor the nature or amount of Work to be performed. Bidder is familiar with, and certifies that all work shall comply with, all Federal, State and Local laws, ordinances, rules and regulations that in any way affect the cost, progress or performance of the Work. Failure of a Bidder to be familiar with applicable laws, ordinances, rules and regulations will in no way relieve Bidder from the responsibility of complying with the applicable laws, ordinances, rules and regulations.

3.1.2 The County will make copies of such reports and drawings that are referenced in the Contract Documents available to any Bidder on request. Those reports and drawings are not part of the Contract Documents, but the Bidder is entitled to review the technical data contained therein for general information purposes only. County does not represent that the conditions reflected in such reports and drawings are the conditions which contractor will experience, but are based on best information available to the County.

3.1.3 Bidder assumes responsibility for having determined to its satisfaction, prior to the submission of its Bid, the conformation of the ground, the character and quality of the substrata, the types and quantity of materials to be encountered, the nature of the groundwater conditions, the character of equipment and facilities needed preliminary to and during the execution of the Work, the general and local conditions and all other matters which can in any way affect the Work of this Project. The prices established for the Work to be done will reflect all costs pertaining to the Work.

3.1.4 By submission of its Bid, each Bidder affirms that it has, at its own expense, performed any additional examinations, investigations, explorations, tests, or studies and obtained any additional information and data which pertain to the physical conditions (surface, subsurface and underground utilities) at or contiguous to the Site or otherwise, prior to Bidding which may affect the cost, progress or performance of the Work and which the Bidder deems necessary to determine its Bid for performing the Work in accordance with the time, price, and other terms and conditions of the Contract Documents and/or it has satisfied itself with respect to such conditions and it shall make no claims against the County or the Engineer if on carrying out the Work it finds that the actual conditions do not conform to those indicated.

3.1.5 On request, the County will provide each Bidder access to the Site to conduct such investigations and tests, as each Bidder deems necessary for submission of its Bid. Bidder shall schedule such access in advance with the County by contacting the Department. Upon completion of such additional field investigations and tests, each Bidder shall completely restore disturbed areas to a condition equal to or better than the conditions, which existed prior to performance of the additional field investigations and tests.

3.1.6 The lands upon which the Work is to be performed, rights-of-way and easements for access thereto and other lands designated for use by the Contractor in performing the Work are identified in the Contract Documents. All additional lands and access thereto required for temporary construction facilities or storage of materials, equipment and supplies are to be provided by the Contractor. Easements for permanent structures or permanent changes in existing structures are to be obtained and paid for by the County, unless otherwise provided in the Contract Documents.

3.1.7 The submission of a Bid will constitute an incontrovertible representation by the Bidder that the Bidder has complied with every requirement of these Instructions to Bidders, that, without exception, the Bid is premised upon performing the Work required by the Contract Documents and that such means, methods, techniques, sequences, or procedures of construction as may be indicated in or required by the Contract Documents are sufficient in scope and detail to indicate and convey an understanding of all terms and conditions for performance of the Work.

3.1.8 The Bidder shall not be entitled to any additional compensation or time extensions based upon alleged differing conditions that in the opinion of the Engineer and/or the County should have been reasonably anticipated by the Bidder.

3.1.9 The Bidder understands and agrees that the quantities of work or material stated in unit price items are supplied only to give an indication of the general scope of the Work and the County does not expressly or by implication agree that the actual quantity of the Work or material will correspond therewith. The County reserves the right after award to increase or decrease the quantity of any unit price item by an amount up to and including twenty-five percent (25%) of the bid quantity, without a change in the unit price, and reserves the right to delete any bid item, in its entirety, or to add additional bid items up to and including an aggregate total amount not to exceed fifteen percent (15%) of the contract price.

3.2 As provided in Florida Statute 287.133(2)(a) a person or affiliate who has been placed on the convicted vendor list following a conviction for a public entity crime may not submit a bid on a contract to provide any goods or services to a public entity, may not submit a bid on a contract with a public entity for the construction or repair of a public building or public work, may not submit bids on leases of real property to a public entity, may not be awarded or perform work as a contractor, supplier, subcontractor, or consultant under a contract with any public entity, and may not transact business with any public entity in excess of the threshold amount provided in s. 287.017 for CATEGORY TWO for a period of 36 months from the date of being placed on the convicted vendor list. By entering into this contract or performing any work in furtherance hereof, the contractor certifies that it, its affiliates, suppliers, subcontractors and consultants who will perform hereunder have not been placed on the convicted vendor list maintained by the State of Florida Department of Management Services within the 36 months immediately preceding the date hereof. This notice is required by F.S. 287.133 (3) (a).

3.3 The Bidder must be an equal employment opportunity employer. Each Bidder must complete, sign and furnish with his Bid the statement titled "Statement of Participation in Contracts Subject to Nondiscrimination Clause", which is incorporated in the Bid Form or attached thereto. Failure to furnish this statement will be cause for rejection of the Bid.

3.3.1 Pursuant to Executive Order 11246, as amended, Palm Beach County does have an Affirmative Action Program in connection with equal employment opportunities. It is recommended that those Bidders who have not initiated an Affirmative Action Program give consideration toward pursuing such programs.

3.4 The undersigned does hereby declare that it is the only person or persons interested in said Bid; that it is a genuine Bid not made in the interest of or on behalf of any undisclosed person, firm or corporation and is not submitted in conformity with any agreement or rules of any group, association, organization or corporation; that it is made without any connection with any person submitting another Bid for the same Contract; that this Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid; that the Bid is in all respects fair and without collusion, fraud, or mental reservations; that no official of the County or any person in the employ of the County is directly or indirectly interested in said Bid or in the supplies of Work to which it relates, or in any portion of the profits thereof; and that Bidder has not sought by collusion to obtain for itself any advantage over any other Bidder or over the County.

4.0 Bidding Documents

4.1 Copies

4.1.1 Bidders may obtain complete sets of the Bidding Documents from Montgomery Watson as indicated in the Invitation to Bid in the number desired and for the cost stated therein.

4.1.2 Bidders shall use complete sets of Bidding Documents in preparing Bids; the County assumes no responsibility for errors or misinterpretations resulting from the use of incomplete or illegible sets of Bidding Documents.

4.1.3 The County, by making copies of the Bidding Documents available on the above terms, does so only for the purpose of obtaining Bids on the work and does not confer a license or grant for any other use. All information contained in the Bidding Documents is the sole property of the County and any unauthorized use is prohibited by law.

4.2 Interpretation or Correction of Bidding Documents

4.2.1 Bidders shall promptly notify the County in writing of any ambiguity, inconsistency or error, which is discoverable upon examination of the Bidding Documents or of the site and local conditions.

4.2.2 Bidders requiring clarification or interpretation of the Bidding Documents shall make a written request which shall reach the County at the address listed in the Invitation to Bid at least ten calendar days prior to the date for receipt of Bids. Bidders requesting clarification or interpretation of the Bidding Documents shall supply the Department with all information requested by the Department which the Department requires to issue a clarification or

interpretation. Bidders finding discrepancies, errors, and/or omissions or having doubt as to the intent of the technical portions of the Contract Documents shall at once notify the Architect/Engineer of Record and provide a copy to the Department. Bidder's questions relative to bidding requirements, bidder qualification and contract award shall be directed to the Department. The Department, in its sole discretion, shall determine if a clarification or interpretation of the Bidding Documents is required.

4.2.3 Any interpretation, clarification, correction, or change of the Bidding Documents will be made only by Addendum. Written instructions regarding discrepancies, omissions or unclear intents shall be sent to all Bidders' who have received bid documents from Palm Beach County. Interpretations, corrections or changes to the Bidding Documents made in any other manner will not be binding, and Bidders shall not rely upon such interpretations, corrections and changes.

4.2.4 Governing Order of Contract Documents - The Contract Documents include various divisions, sections and conditions which are essential parts for the work to be provided by the successful Bidder. A requirement occurring in one is as binding as though occurring in all. They are intended to be complementary and to describe and provide for a complete work. In case of discrepancy, the following precedence will govern the interpretation of the Contract Documents prior to award of the contract.

1. Addenda
2. Bidding Requirements
3. Special Conditions
4. General Conditions
5. Technical Specifications/Drawings/Plans
6. Bidders Response

After award, change orders, supplemental agreements, and revisions to plans and specifications will take precedence over any of the above. Detailed plans shall have precedence over general plans. In the event that any conflicts cannot be resolved by reference to this Governing Order of Contract Documents provision, then County shall resolve the conflict in any manner which is acceptable to County and which comports with the overall intent of the Contract Documents.

4.2.5 Whenever reference is made to actions being performed with respect to dates and times set forth in the Invitation to Bid, such reference shall always be interpreted as including, by inference, "or as may be modified by pre-bid addenda".

4.3 Addenda

4.3.1 Addenda will be mailed, delivered or faxed to all who are known by the Department to have received a complete set of Bidding Documents.

4.3.2 Copies of Addenda will be made available for inspection at the Department where Bidding Documents are on file for that purpose.

4.3.3 No Addenda will be issued later than five work days prior to the date for receipt of Bids except an Addendum withdrawing the request for Bids, one which includes postponement

of the date for receipt of Bids, one whose content is limited to the listing of additional approved manufacturers and substitutions, or one which contains minor clarifications or changes.

4.3.4 Prior to submission of its Bid, each Bidder shall ascertain that it has received all Addenda issued. The Bidder shall acknowledge receipt of all addenda by completing the acknowledgment space provided on the Bid Form.

5.0 Bidding Procedure

5.1 Form and Style of Bids

5.1.1 Bids shall be submitted on forms furnished by the County. Changes or additions to the Bid, recapitulations or changes in the work bid upon, alternative proposals, or any other modifications of the Bid Form, Attachments to the Bid Form, or the Supplemental Bid Documents, which are not specifically called for in the Bid Documents may result in the County's rejection of the bid as non-responsive to the Invitation to Bid.

5.1.2 All blanks on the Bid Form and enclosures to the Bid Form shall be filled in by typewriter or manually printed in ink.

5.1.3 In the event there are unit price bid items provided in the Bid Form and the "amount" indicated for a unit price bid item does not equal the product of the unit price and quantity, the unit price shall govern and the amount will be corrected accordingly. In the event there is more than one bid item in the Bid Form and the total indicated therein does not agree with the sum of the prices bid for the individual items, the prices bid on the individual items shall govern and the total for the schedule will be corrected accordingly. Where so indicated by the make-up of the Bid Form, sums shall be expressed in both words and figures, and in case of discrepancy between the two, the amount written in words shall govern.

5.1.4 Any interlineation, alteration or erasure must be initialed, in ink, by the signer of the Bid Form.

5.1.5 All requested, Additive or Deductive Bid Items shall be bid. If no change in the Base Bid is required, enter "No Change."

5.1.6 The Bidder shall provide on Attachment No. 3 to the Bid Form, the names and license or certificate numbers of subcontractors who will perform that portion of work which will be performed by non-M/WBE subcontractors.

5.1.7 Each page of the Bid Form and Attachments to the Bid Form shall include, where requested, the legal name of the Bidder. The Bid Form shall also contain a statement whether the Bidder is a sole proprietor, a partnership, a corporation, or some other legal entity, and shall be signed by the person or persons legally authorized to bind the Bidder to a contract.

5.1.8 In the event a Bid is submitted by two or more Bidders as a joint venture, such Bid shall be submitted in strict accordance with all applicable laws of the State of Florida, State Contractor License Law, and Rules and Regulations of the State Contractor's Board.

5.1.9 No person, firm or corporation shall be allowed to submit, or have an interest in, more than one Bid for the same work unless alternate bids are specifically called for. A person,

firm or corporation that has submitted a subbid to a Bidder is not, however, disqualified from submitting a subbid or quoting prices to other Bidders or submitting a prime Bid.

5.1.10 The following forms, together, comprise a Bid and must be submitted at the times identified in 5.4:

PRIMARY BID DOCUMENTS

BID FORM
ATTACHMENT NO. 1 BID BOND

SUPPLEMENTAL BID DOCUMENTS

ATTACHMENT NO. 2 MINORITY AND WOMEN BUSINESS ENTERPRISE
 SCHEDULES
ATTACHMENT NO. 3 LIST OF SUBCONTRACTORS
ATTACHMENT NO. 4 TRENCH SAFETY

Omission of any of these attachments from the bid submission, or failure to properly complete any portion of the required forms, or failure to deliver the attachments at or before the times specified in paragraph 5.4 may be cause to reject the entire Bid.

5.2 Bid Security, Project Bonds, Insurance, and Indemnity

5.2.1 Each Bid shall be accompanied by a BID SECURITY (in the form of, at Bidder's option, cashier's check, certified check, money order or Bid Bond in favor of the County) in the amount of at least five percent (5%) of the bid price pledging that the Bidder will within fourteen (14) days after Notification from Owner, enter into a contract with the County on the terms stated in its Bid and will furnish bonds as described hereunder covering the faithful performance of the Contract and the payment of all obligations arising thereunder. Should the Bidder refuse to enter into such Contract or fail to furnish the required bonds and insurance, the amount of the bid security shall be forfeited to the County as liquidated damages, not as penalty. If a Bidder fails to execute a Contract for the project, the Bidder may be suspended or debarred from bidding on future projects for a period of two (2) year, in accordance with the Palm Beach County Purchasing Ordinance. The County may further pursue any and all remedies available against the Contractor for damages resulting from its failure to enter into a contract.

5.2.2 The bid bond shall be written on the Bid Bond form, included as part of the Bidding Documents, and the attorney-in-fact who executes the bond on behalf of the surety must be licensed to do business in the State of Florida and shall affix to the bond a certified and current copy of his power of attorney. If a bid bond is submitted on a form other than that provided, such submission may result in the bid being declared non-responsive. Checks and money orders shall be made payable to Palm Beach County Board of County Commissioners.

5.2.3 The County will have the right to retain the bid security of Bidders to whom an award is being, or may be, considered until either (a) the Contract has been executed and the bonds and insurance have been furnished, or (b) the specified time has elapsed so that Bids may be withdrawn, or (c) all Bids have been rejected.

5.2.4 Bond Requirements

5.2.4.1 The Bidder shall furnish bonds covering the faithful performance of the Contract and the payment of all obligations arising thereunder in such form and amount as the County may prescribe. Bonds may be secured through the Bidder's usual sources provided the Surety must be authorized to do business in the State of Florida.

5.2.4.2 Prior to execution of a Contract, and not later than fourteen (14) calendar days after Notification from Owner, the successful Bidder shall furnish contract bonds to the Department, on the forms provided in the bidding documents, as follows:

1. Public Construction Bond in the Amount of 100% of the Contract Price.
2. Guarantee

Such Public Construction Bond shall incorporate by reference all of the terms and conditions of the Contract Documents, including but not limited to the Contractor and Surety's obligation for liquidated damages as well as Surety's acknowledgment regarding any and all provisions addressing or regarding "no damages for delay", as provided for in the General Conditions.

5.2.4.3 The Surety Company, in addition to the above requirements, shall be currently listed with the United States Department of Treasury for an amount greater than the contract amount. The Contractor, at the time of his execution of the contract, shall provide, with his Contract Bonds, a copy of the Surety Company's current valid Certificate of Authority issued by the United States Department of the Treasury under ss 31, U.S.C. 9304-9308.

5.2.4.4 The bonds shall be written on the forms included in the Contract Documents provided by the Department.

5.2.4.5 The Bidder shall require the attorney-in-fact who executes the required bonds on behalf of the Surety to affix thereto a certified and current copy of his Power of Attorney, reflecting his/her authority as Power of Attorney in the State of Florida.

5.2.5 Insurance Requirements - Prior to execution of a Contract and not later than fourteen (14) calendar days after Notification from Owner, the successful Bidder shall furnish to the Department certificates of insurance evidencing the existence of current valid, and binding insurance policies for the limits and coverage in accordance with the requirements delineated in the General Conditions, where such insurance is to be provided by Contractor, or as otherwise modified within the Contract Documents, together with a declaration of deductible amounts applicable to each type of insurance provided, acceptable to County.

5.2.6 Indemnification - The Bidder shall include in its price the sum of Twenty Dollars (\$20.00) to be paid by the County to the Contractor with the first Periodical Estimate for Partial Payment as consideration for the indemnification set forth in the general conditions, as required by Florida Statute §725.06.

5.3 Minority/Women Business Enterprise Program

5.3.1 - Policy - It is the policy of the Board of County Commissioners of Palm Beach County, Florida that Minority and Women Business Enterprises (M/WBEs) have the maximum practical opportunity to participate in the competitive process of supplying goods and services to

the County. To that end, the Board of County Commissioners enacted ordinances which set forth the County's requirements for the M/WBE program. Such ordinances are codified in the Palm Beach County Code at Sections 2.71 through 2.80.13. Compliance with the requirements contained in this section shall result in a bidder being deemed responsive to M/WBE requirements. The M/WBE provisions of the Palm Beach County Code, as amended, are applicable to this solicitation, and shall have precedence over the provisions of this solicitation in the event of a conflict.

5.3.2 - M/WBE Goals - The County's established goal for M/WBE participation for this solicitation, inclusive of all alternates and change orders, is set forth in Paragraph 1.4 of the Bid Form. If minimum categorical goals have been established they are also stated in Paragraph 1.4 of the Bid Form. These goals are minimums and no rounding will be accepted.

5.3.3 - Ranking of Responsive Bidders - Bidders who meet the established goals or exercise sufficient good faith efforts to do so, as provided on M/WBE Schedule 3, will be deemed to be responsive to M/WBE requirements. When evaluating bids for award in which the apparent low bidder is determined to be non-responsive to the M/WBE requirements, the County will award the contract to the low bidder responsive to M/WBE requirements as long as the bid does not exceed the low bid, otherwise responsive to the bid requirements, by ten percent. In any procurement where the low bid exceeds \$1,000,000.00 but is less than \$10,000,000, the contract shall be awarded to the lowest bidder responsive to M/WBE requirements provided that bid does not exceed the low bid, otherwise responsive to the bid, by \$100,000 plus one percent of the total bid in excess of \$1,000,000. In any procurement where the low bid exceeds \$10,000,000, the contract shall be awarded to the lowest bidder responsive to the M/WBE requirements provided that the bid does not exceed the low bid, otherwise responsive to the bid, by \$10,000 plus one percent of the total bid in excess of \$1,000,000 up to \$10,000,000 and plus two percent of the total bid in excess of \$10,000,000.

5.3.4 - Bid Submission Requirements - Bidders are required to submit with their Supplemental Bid Documents the appropriate M/WBE schedules in order to be deemed responsive to the M/WBE requirements. M/WBE documentation to be submitted is as follows:

5.3.4.1 - Schedule 1 - List of Proposed M/WBE Subcontractors - This list shall contain the names of all M/WBE subcontractors intended to be used in performance of the contract if awarded. The type of work to be performed by each subcontractor and the dollar value shall also be specified.

5.3.4.2 - Schedules(s) 2 - Letter(s) of Intent to Perform as a M/WBE Subcontractor - One Schedule 2 for each M/WBE Subcontractor listed on Schedule 1 shall be completed and executed by the proposed M/WBE Subcontractor. Additional copies may be made as needed.

5.3.4.3 - Schedule 3 - Statement of Good Faith Efforts

This Schedule shall be submitted if the goals established for this solicitation are not met.

NOTE: A prime bidder certified by Palm Beach County as a M/WBE must complete Schedules 1 and 2 if they propose to use any M/WBE subcontractors. M/WBE bidders are not exempt from meeting goals. The amount of work to be done by a M/WBE prime bidder's own forces may be counted toward goal attainment, but such amounts must be identified in the bid submittal. Failure to submit the necessary M/WBE documentation to establish that the goals have been

met or good faith efforts have been exercised may result in the M/WBE bidder being deemed non-responsive to the M/WBE requirements.

5.3.5 - M/WBE Certification - Only those firms certified by Palm Beach County at the time of bid opening shall be counted toward the established M/WBE goals. **IT TAKES UP TO SIXTY (60) DAYS TO BECOME CERTIFIED AS A M/WBE WITH PALM BEACH COUNTY.** If a firm is certified by another jurisdiction, a request may be submitted to the Office of Small and Minority/Women Business Assistance in advance of the bid submittal deadline for validation of that certification by Palm Beach County. However, such firms will not be counted toward goal attainment unless certification is approved prior to bid opening. It is the responsibility of the bidder to confirm the certification of any proposed M/WBE; therefore, it is recommended that bidders contact the Office of Small and Minority/Women Business Assistance at (561) 233-1550 to verify certification.

5.3.6 - M/WBE Supplier - All bidders may count sixty percent (60%) of their expenditures to certified M/WBE suppliers that are not manufacturers, provided that the M/WBE supplier(s) performs a commercially useful function.

5.3.7 - Responsibilities After Contract Award - All bidders hereby assure that they will meet the M/WBE participation percentages submitted in their respective bids with the subcontractors contained on Schedules 1 & 2 and at the dollar values specified. Bidders agree to provide any additional information requested by the County to substantiate M/WBE participation.

The successful bidder shall submit "M/WBE Activity Form" (Schedule 4) and "M/WBE Payment Certification Forms" (Schedule 5) with each payment application. Failure to provide these forms may result in a delay in processing payment or disapproval of the invoice until they are submitted. The "M/WBE Activity Form" is to be filled out by the Prime Contractor and the "M/WBE Payment Certification Forms" are to be executed by the M/WBE firm to verify receipt of payment.

5.3.8 - M/WBE Substitutions - After contract award, the successful bidder will only be permitted to replace a certified M/WBE subcontractor who is unwilling or unable to perform. Such substitution must be done with other certified M/WBEs in order to maintain the M/WBE percentages submitted with the bid. If a bidder cannot find a certified M/WBE to replace the originally proposed M/WBE, the bidder must establish that they exercised good faith efforts in an attempt to do so. Requests for substitutions must be submitted to the Department and the Office of Small and Minority/Women Business Enterprise.

5.4 Timing of Submission of Bid Documents

5.4.1 - The following Primary Bid Documents must be submitted by the date and time specified for the submission of bids in the Invitation to Bid. Submission of these documents after the date or time specified in the Invitation for Bid will result in the documents being rejected and returned to the bidder:

1. Bid Form
2. Bid Bond - Attachment No. 1 To Bid Form

5.4.2 The following Supplemental Bid Documents must be submitted prior to or within twenty-four (24) hours after the date and time specified for the submission of bids in the Invitation for Bids. Failure to submit the Supplemental Bid Documents timely will result in rejection of the bid and return of the bid bond.

1. M/WBE Subcontractors - Schedules No. 1, 2, and, if applicable, 3 - Attachment No. 2 To Bid Form
1. List of Subcontractors - Attachment No. 3 To Bid Form
2. Trench Safety - Attachment No. 4 To Bid Form

5.4.3 The list of M/WBE subcontractors to be used on the subject contract, Attachment 2, Schedule 1 - Participation for M/WBE Contractors and, for each MBE or WBE firm that is listed in Schedule 1, a letter of "Intent to Perform" (Attachment 2, Schedule 2 - Letter of Intent to Perform as Minority or Women Contractor) must be included with the Supplemental Bid Documents.

The Bidder shall provide, on Schedule No.1 of Attachment No. 2 to the Bid Form, the firm name of each subcontractor listed. Receipt of this form by the County does not imply or grant approval for the use of any subcontractor. The Contractor is completely responsible for ensuring that all subcontractors performing work pursuant to this contract are licensed and otherwise qualified.

To be responsive to the M/WBE requirements a bidder must meet either the stated goals based on the total contract amount or submit, with the Supplemental Bid Documents, a properly completed M/WBE schedule 3 which demonstrates good faith efforts.

5.5 Submission of Bids

5.5.1 The Primary Bid Documents package and Supplemental Bid Documents package shall each be enclosed in a sealed opaque envelope. Each envelope shall be addressed as follows:

Project Number: WUD 98-66
Contractor's Bid Proposal for: PLANT NO. 9 EASTERN HILLSBORO CANAL
AQUIFER STORAGE AND RECOVERY WELL SYSTEM
Water Utilities Department
2065 Prairie Road, Building "K"
West Palm Beach, Florida 33406

No responsibility will be attached to the County for premature opening of or failure to open a bid not properly identified. If the bid is sent by mail, the sealed envelope shall be enclosed in a separate mailing with the notation "SEALED BID ENCLOSED" on the face thereof.

5.5.2 Bids, including those sent by mail, must be received and deposited at the designated location prior to the time and date for receipt of Bids indicated in the Invitation to Bid, or any extension thereof made by Addendum. Bids received after the time and date for receipt of Bids will be returned unopened.

5.5.3 The Bidder shall assume full responsibility for timely delivery at the location designated for receipt of Bids.

5.5.4 Oral, telephonic, fax, or telegraphic Bids are invalid and will not receive consideration.

5.6 Modification or Withdrawal of Bid

5.6.1 A Bid may not be modified, withdrawn, or canceled by the Bidder for the period after opening of Bids as stipulated on the Bid Form and each Bidder so agrees in submitting his Bid.

5.6.2 Prior to the time and date designated for submission of the Primary Bid Documents, any Bid submitted may be modified or withdrawn by notice to the party receiving Bids at the place and prior to the time designated for submission of the Primary Bid Documents. Such notice shall be in writing over the signature of the Bidder and received by the Department before the date and time set for submission of the Primary Bid Documents; and it shall be worded so as not to reveal the amount of the original Bid.

5.6.3 Withdrawn Bids may be resubmitted up to the time designated for the submission of the Primary Bid Documents provided that the resubmitted bid is fully in conformance with these Instructions to Bidders.

5.6.4 Bid security shall be in an amount sufficient for the Bid as modified or resubmitted.

6.0 Consideration of Bids and Award of Contract

6.1 Opening of Bids - The Bids received on time will be opened publicly and will be read aloud twenty-four (24) hours after the time and date identified for submission of the Primary Bid Documents at the location specified.

6.2 Rejection of Bids - The Board of Palm Beach County Commissioners reserves the right to reject any and all Bids, and/or to re-advertise, to waive any irregularities, informalities or technicalities therein, to negotiate Contract terms with the successful Bidder, to disregard all non-conforming, non-responsive, unbalanced or conditional Bids, or to accept any Bid which in the County's sole judgement will best serve the public interest. County reserves the right to cancel the award of any Contract at any time before the execution of said Contract by all parties without any liability against the County. **In consideration of the County's evaluation of submitted Bids, the Bidder, by submitting its Bid, expressly waives any claim to damages or legal remedy, of any kind whatsoever, in the event the County exercises its rights provided for in this subsection.**

6.3 Award of Contract

6.3.1 Award will be made to the lowest, responsive, responsible Bidder. To be considered responsive, the Bid must conform in all respects to the conditions of the Invitation to Bid, to the Instructions to Bidders, Palm Beach County Code Sections 2-51 through 2-54, as amended and to Florida law. To demonstrate qualifications to perform the Work, each Bidder must be prepared to submit within two (2) days of the County's request, The Post Bid Information as may be called for herein. Each Bidder must, upon request, provide evidence that, as of the date of Primary Bid Document submission, Bidder, and the listed subcontractors, were qualified to do business in the State of Florida and Palm Beach County.

6.3.2 Bid tabulations and Notification from Owner, with recommended awards, will be posted at the location where bids were opened, for review by interested parties prior to submission through the appropriate approval process to the Board of County Commissioners for approval of award, and will remain posted for a period of five (5) business days. Failure to file a protest to the Director of Purchasing during the 5 day posting period shall constitute a waiver of proceedings under the referenced County ordinance.

6.3.3 The County of Palm Beach, in accordance with Title VII of the Civil Rights Act of 1964, affirmatively ensures that in any contract entered into pursuant to the Invitation to Bid, minority business enterprises will be afforded full opportunity to submit bids and will not be discriminated against on the grounds of race, color, or national origin in consideration of award.

6.3.4 The dollar amount for award of this Contract shall be the Base Bid plus or minus any or all alternates selected by the County. Palm Beach County reserves the option to award or rebid alternates in any sequence or at any time deemed to be in the best interest of the County.

6.3.4.1 The amounts for each bid alternate shall constitute an ongoing and open offer and the prices stated in the bid proposal shall be maintained for a minimum period of one year, or the duration of the contract whichever is shorter. If the County opts to accept an alternate within the time frame identified above but after the time at which such activity fits into the Contractor's approved schedule so as to cause a time or monetary impact, the cost of the alternate can be adjusted accordingly. However, in no instance shall the Contractor be entitled to extended home office overhead costs as a result of the County exercising this option.

6.3.5 Bids which are determined by the County to be unbalanced bids or which contain unbalanced line item pricing when compared to competitor's bids for the same item and standard industry prices, and which significantly deviate from the County's determination of acceptable line item pricing, may be rejected by the County in accordance with established County procedures. The County has a formal, written policy against front end loaded projects. A copy of this policy is available upon request.

6.4 Disqualification of Bidders - Any of the following causes is considered sufficient to disqualify a Bidder, and reject its proposal.

1. Interest by the same person in more than one bid.
2. Collusion among or between bidders.
3. Unbalanced bids; that is bids in which the price bid is out of all proportion to the other bids received.
4. Lack of responsibility on the part of the Bidders. (For example, no bidder would be considered responsible if it had recently failed to satisfactorily carry out any previous contract with Palm Beach County).
5. Lack of experience or capital on the part of the Bidder. Evidence of experience, ability, financial standing and machinery available may be required of any bidder.
6. Substantial evidence of bad character or dishonesty.
7. Lack of current applicable certification and/or license for the purpose of performing the specified work.
8. Any cause listed under Section 2-80.4 of the Palm Beach Count Code as amended.
9. History of unsuccessful claims asserted by Bidder against public owners in the State of Florida, such as to establish a trend of improperly asserted claims.
10. Any other cause which, as a matter of law renders the Bid non-responsive or non-responsible.

7.0 Time - Time is of the essence in all contract documents. The successful Bidder, shall enter into a Contract with the County, shall commence the work to be performed under the Contract on the date set by the County in the written notice to proceed, and shall continue the work with due diligence and shall agree to complete the entire work as specified in the Bid Form.

8.0 Voluntary Partnering - The objective of partnering is to establish a partnership charter and action plan between the County and Contractor to identify and achieve reciprocal goals. This

partnership will not change the legal relationship of the parties to the Contract nor relieve either party from any of the terms of the Contract. This partnership will be bilateral in make-up and only if participation is desired by the Contractor. Any cost associated with developing this partnership must be agreed to by both parties, in writing and will be shared equally.

If both the County and Contractor agree to partnering, the County's representative and the Contractor's representative will meet and plan a partnering development seminar/team building workshop. At this planning session, arrangements will be made to select a facilitator, determine workshop attendees, develop an agenda and location. Participants shall include the Architect/Engineer and key project personnel, representatives of the subcontractors, utilities, regulatory agencies and others will be invited. Management personnel consisting of the Director-level head of the County and a Corporate Officer or other person representing ownership of the Contractor, and of the Architect/Engineer of Record shall also participate in the partnering workshop and its implementation.

Follow-up workshops may be held throughout the duration of the Contract as agreed to by the County and Contractor.

9.0 Public Bid Disclosure Compliance - All fees including, but not limited to, certificate of occupancy permit fees and inspection fees payable by the Contractor to the County by virtue of this project will be waived by the County. Permits and fees which are required by the State of Florida or any state agency, or by any other governmental agency are not waived. The requirement that all contractors and subcontractors of any tier be properly licensed or certified is not waived and no fees required to be paid by any contractor or subcontractor related to licensing and certification are being waived. All contractors and subcontractors, identified in the bid documents, who work in trades required to be licensed or certified by the Palm Beach County Construction Industry Licensing Board are required to have such licenses or certificates in place at the time of bid submission.

10.0 Cost Savings Incentive - If the Bid Form indicates that the Cost Savings Incentive is in effect for this contract, then the Costs Savings Incentive provisions of General Condition 74 shall apply.

11.0 Early Completion Incentive - If the Bid Form indicates that the Early Completion Incentive is in effect for this contract, then the following provisions shall apply:

As an additional incentive to complete the project in a timely manner, the County shall pay the Contractor an incentive for early completion if the contract is finally completed more than 30 days ahead of schedule. The money shall be due for every consecutive calendar day the contract is completed prior to the final completion date provided for herein. The Early Completion Incentive shall be paid at the per diem rate set forth in the Bid Form and shall be capped at forty-five days, i.e., in no event shall the payment period of the Early Completion Incentive exceed a period of forty-five days.

12.0 Liquidated Damages - If the Bid Form indicates that liquidated damages apply to this contract then they will be assessed at the rate(s) set forth in the Bid Form. County and Contractor agree that time is of the essence in the performance of this contract and agree that the damages which County will suffer in the event that Contractor finishes this project after the completion dates set forth in this agreement are certain but will be difficult, if not impossible, to quantify. Therefore, Contractor and County agree that the rate(s) set forth on the bid form are a reasonable estimate of the amount of damages which County will suffer in the event Contractor does not timely complete the Contract. Contractor and County agree that these liquidated damages shall be assessed as damages, as provided in the Contract Documents, and that they are not, and shall never be considered to be, a penalty.

13.0 Department Specific Instructions

13.1 During the course of the Project, Contractor can expect to receive and agrees to execute, when required, certain project related documents in a form substantially similar to those attached as Appendix A to the General Conditions.

13.2 The Department may require the submission of the Post-Bid Information required by section 6.3.1 of these Instructions to Bidders to be submitted in substantially the form attached as Appendix B to the General Conditions. The Department may, in its sole discretion, require more or less information than the information required by Appendix B and Contractor agrees to provide such information as Department may require.

13.3 If Contractor wants to have the Department consider the use of alternate or "or equal" products other than those specified in the contract documents, then Contractor shall submit such products to the Department along with Contractor's Primary Bid Documents, utilizing the forms contained in Appendix C to the General Conditions. However, Contractor shall not base its bid on these proposed products. Contractor's Bid must be based on the products specified in the Contract Documents or it will be rejected as non-responsive!

13.4 Contractor acknowledges that failure to comply with the conditions, specifications, or terms of this contract, or failure to timely and responsibly correct such non-compliance, will result in referral of the matter to the Director of Purchasing for consideration of suspension or debarment in accordance with the provisions of Palm Beach County Code Section 2.54(e).

END OF SECTION

**ADDENDUM NO. 1
BOARD OF COUNTY COMMISSIONERS
PALM BEACH COUNTY, FLORIDA
PLANT NO. 9 EASTERN HILLSBORO CANAL AQUIFER STORAGE AND
RECOVERY WELL SYSTEM
PROJECT NO. WUD 98-66
NOVEMBER 14, 2000**

To: Prospective Bidders and Others Concerned
Project No. 98-66

Subject: Addendum No. 1 to the Contract Documents
Bids Received: NOVEMBER 21, 2000 until 2:00 P.M.
Bid Opening: NOVEMBER 22, 2000 at 2:00 P.M.

Note: Receipt of Addendum No. 1 must be acknowledged on BID FORM (Item 1.5, Page Bid Form 3).

Contract Specifications:

- 1) INSTRUCTION TO BIDDERS, Article 4.2.4, add the following sentence after the listing of precedence:

“The CONTRACTOR shall proceed with the most stringent interpretation of the Contract Documents should a conflict, difference, or inconsistency exist between the drawings and specifications.”

- 2) INSTRUCTION TO BIDDERS, Article 5.5.1, delete “The Primary Bid Documents package and Supplemental Bid Documents package shall each be enclosed in a sealed opaque envelope.” and add the following

“The Primary Bid Documents package and Supplemental Bid Documents package shall each be enclosed in a sealed opaque envelope and labeled “Primary Bid Proposal” and “Supplemental Bid Proposal,” respectively.

- 3) INSTRUCTION TO BIDDERS, Article 11.0, delete “...shall be capped at forty-five days, i.e., in no event shall the payment period of the Early Completion Incentive exceed a period of forty-five days.” and replace with the following:

“...shall be capped at thirty days, i.e., in no event shall the payment period of the Early Completion Incentive exceed a period of thirty days.”

- 4) BID FORM, Article 1.4, delete “...<If minimum categorical goals have been established they should be stated here.>”

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BOARD OF COUNTY COMMISSIONERS
PALM BEACH COUNTY, FLORIDA
PLANT NO. 9 EASTERN HILLSBORO CANAL AQUIFER STORAGE AND
RECOVERY WELL SYSTEM
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NOVEMBER 14, 2000

BID FORM, Article 1.4, delete "...inclusive of all alternates and change orders, is 8%" and add the following:

"...inclusive of all alternates and change orders, is 8% overall with 3% Black participation."

- 5) BID FORM, Article 1.6.1, delete "The Liquidated Damages rate is \$1,500 per day through the date of certification of Substantial Completion" and all the following:

"The Liquidated Damages rate is \$2,500 per day through the date of certification of Substantial Completion."

- 6) BID FORM, Article 1.6.1 – second paragraph, delete "The Liquidated Damages rate is \$750 per day" and add the following:

"The Liquidated Damages rate is \$1,500 per day."

- 7) BID FORM, Article 1.8, delete the entire article and add the following:

1.8 "The Early Completion Incentive is in effect for this Contract. The Incentive shall be paid at the rate of **\$1,500 per day** for each calendar day, as described in the Instructions to Bidders for a period not to exceed a maximum of thirty days."

- 8) BID FORM, PROPOSAL, replace in its entirety with the attached BID FORM, PROPOSAL.

- 9) BID FORM-18, ATTACHMENT 3 TO BID FORM, replace in its entirety with the attached BID FORM-18.

- 10) SECTION 01025, MEASUREMENT AND PAYMENT, replace it its entirety with the attached SECTION 01025, MEASUREMENT AND PAYMENT.

- 11) SECTION 01311, CPM CONSTRUCTION SCHEDULE, Article 1.8. INCLEMENT WEATHER PROVISIONS OF THE SCHEDULE paragraph A. (Page 7), delete ". . .number of days of delay due to...": and add the following

"...number of days of critical path due to..."

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- 12) SECTION 01510, TEMPORARY UTILITIES, Article 3.4 WATER SUPPLY, Paragraph B (Page 2), add the following sentence to the end of the paragraph:
- “OWNER to provide temporary potable water service connection at aerial water main crossing of Hillsboro Canal near FAMW.”
- 13) SECTION 01510, TEMPORARY UTILITIES, Article 3.7 INSTALLATION OF COMMUNICATIONS, paragraph C (Page 3), delete “...involve toll or message unit charges shall be billed...” and replace with the following:
- “...involve toll or message unit charges, over \$100 per month, shall be billed...”
- 14) SECTION 01590, FIELD OFFICE, EQUIPMENT, AND SERVICES, Article 2.1 FIELD OFFICE, paragraph B (Page 1), add the following sentence to the end of the paragraph:
- “Unit shall be of recent manufacture, less than two years old.”
- 15) SECTION 01590, FIELD OFFICE, EQUIPMENT, AND SERVICES, Article 2.2 FIELD OFFICE FURNISHINGS, paragraph A (Page 2), delete “...furnish the following items in good condition...” and replace with:
- “...furnish the following items in new condition...”
- 16) SECTION 01590, FIELD OFFICE, EQUIPMENT, AND SERVICES, Article 2.2 FIELD OFFICE FURNISHINGS, paragraph A (Page 2), delete “...bookshelves” and replace with:
- “...bookshelves, metal only.”
- 17) SECTION 01590, FIELD OFFICE, EQUIPMENT, AND SERVICES, Article 2.2 FIELD OFFICE FURNISHINGS, paragraph A (Page 2), delete “...White Board (dry-erasable ink type, 36” x 60”)” and replace with:
- “...White Board (dry-erasable ink type, 36” x 60”), pens and eraser.”
- 18) SECTION 01590, FIELD OFFICE, EQUIPMENT, AND SERVICES, Article 2.3 FIELD OFFICE SERVICES, paragraph A (Page 2), add the following sentence to the end of the paragraph:

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“Wood stairs and landing required as per OSHA.”

- 19) SECTION 01590, FIELD OFFICE, EQUIPMENT, AND SERVICES, Article 2.3 FIELD OFFICE SERVICES, paragraph D (Page 2), delete “...shall be swept, dusted, and waste...” and replace with:

“...shall be swept, mopped, dusted, and waste...”

- 20) SECTION 02140, DEWATERING, Article 2.1 EQUIPMENT, Paragraph A (Page 1), add the following sentence to the end of the paragraph:

“Pumps used for dewatering activities shall be electrically driven and provided with a sound enclosure as required to reduce noise to 60 dB or less at the property line.”

- 21) SECTION 02565, DUCTILE IRON PIPE, Article 2.5 DESIGN OF PIPE, Paragraph A (Page 4), delete “...pipe furnished shall be ductile iron pipe, mortar-lined...” and replace with the following:

“...pipe furnished shall be ductile iron pipe, double mortar-lined...”

- 22) SECTION 05500, MISCELLANEOUS METALWORK, Article 1.1 THE REQUIREMENT, Paragraph A (Page 1), add the following sentence to the end of the paragraph:

“All steel metalwork, bolts, etc. shall be 316 stainless steel unless otherwise noted.”

- 23) SECTION 11000, EQUIPMENT GENERAL PROVISIONS, Article 1.1 THE REQUIREMENT, Paragraph A (Page 1), add the following sentence to the end of the paragraph:

“All metals and metalwork shall be 316 stainless steel unless otherwise noted.”

- 24) SECTION 11189, SUBMERSIBLE TURBINE PUMPS, replace in its entirety with the attached SECTION 11189.

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- 25) SECTION 15000, PIPING, GENERAL Article 1.1 THE REQUIREMENT, Paragraph A (Page 1), add the following sentence to the end of the paragraph:

“All piping shall be 316L stainless steel unless otherwise noted.”

- 26) SECTION 15006, PIPE SUPPORTS, Article 1.1 THE REQUIREMENT, Paragraph A (Page 1), add the following sentence to the end of the paragraph:

“All pipe supports shall be 316L stainless steel unless otherwise noted.”

- 27) SECTION 15202, BUTTERFLY VALVES, Article 2.3 HIGH PERFORMANCE (HP) BUTTERFLY VALVES, Paragraph B1 (Page 4), delete “1. Manufacturers:” and replace with the following:

“1. Manufacturers or Equal:”

- 28) SECTION 16110, RACEWAYS, Article 3.3 CONDUIT APPLICATION, Paragraph A (Page 15), delete in its entirety and replace with the following:

“A. Diameter: Minimum $\frac{3}{4}$ inch, unless otherwise noted.”

- 29) SECTION 16110, RACEWAYS, Article 3.3 CONDUIT APPLICATION, Paragraph C (Page 15),

“1. PVC coated rigid galvanized steel.”

- 30) SECTION 16110, RACEWAYS, Article 3.3 CONDUIT APPLICATION, Paragraph D, Item 1 (Page 15), delete in its entirety.

- 31) SECTION 16110, RACEWAYS, Article 3.3 CONDUIT APPLICATION, Paragraph K-M Page 16, delete in its entirety and replace with the following:

“K. Conduits between VFDs and motors shall be PVC coated rigid galvanized steel (inside and outside).

L. Interior Equipment Area: PVC coated rigid galvanized steel.”

- 32) SECTION 17150, REMOTE TELEMETRY UNITS AND APPURTENANCES, Article 2.4 PANEL, Paragraphs A (Page 4), add the following sentence to the end of the first sentence:

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“...unless otherwise shown on Drawings.”

- 33) SECTION 17150, REMOTE TELEMETRY UNITS AND APPURTENANCES, Article 2.4 PANEL, Paragraphs B (Page 4), add the following sentence to the end of the paragraph:

“...unless otherwise shown on Drawings.”

- 34) SECTION 17150, REMOTE TELEMETRY UNITS AND APPURTENANCES, Article 2.5 HILLSBORO ASR WELL AND WATER TREATMENT PLANT 9S CONTROL SYSTEM INTERFACE PROGRAMMING, Paragraphs A-D (Pages 4-5), delete in its entirety and replace with the following:

“A. The interface to the existing Water Treatment Plant 9S Control system is not shown on the project drawings. Programming of the plant control system for control of the ASR well is not part of this project and shall be done by others. The CONTRACTOR shall include, as part of their bid, time to attend two coordination meetings.”

Contract Drawings:

- 1) Sheet C-1 shall be deleted in its entirety and replaced with Sheet C-1 attached.
- 2) Sheet C-2 shall be deleted in its entirety and replaced with Sheet C-2 attached.
- 3) Sheet C-3, Section B, replace the weir elevation of 8.0' with 10.0'. Replace the dimension of 6'4" from the bottom of the structure to the top of the weir with a dimension of 8'4".
- 4) Sheet G-6 shall be deleted in its entirety and replaced with Sheet G-6 attached.
- 5) Sheet GM-2, shall be deleted in its entirety and replaced with Sheet GM-2 attached.
- 6) Sheet M-1 shall be deleted in its entirety and replaced with Sheet M-1 attached.
- 7) Sheet M-2 shall be deleted in its entirety and replaced with Sheet M-2 attached.

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- 8) Sheet E-3 shall be deleted in its entirety and replaced with Sheet E-3 attached.
- 9) Sheet E-6, ASR Control Panel Dead Front Detail Description, delete "316 Stainless Steel 14 Gauge control cabinet, modified NEMA 12 Construction" and replace with "316 Stainless Steel 12 Gauge control cabinet, modified NEMA 4X Construction".
- 10) Sheet I-2, Submersible Recovery Pump, Total Dynamic Head shall be changed from 180 feet to 215 feet.

Board of County Commissioners
Palm Beach County, Florida

BY: /s/ Maude Ford Lee, Chair

Project No.: WUD 98-66

Project Name: Plant No. 9 Eastern Hillsboro Canal Aquifer Storage and Recovery Well System

PROPOSAL

This Contract is a **LUMP SUM PRICE WITH UNIT ADJUSTMENTS CONTRACT**. Adjustments will be made for changes to the bid quantities based upon geologic conditions encountered during the drilling operations. **ADDITIONS and SUBTRACTIONS** will be made to the **TOTAL LUMP SUM PRICE** based on these adjustments. The **BIDDER** is to include all costs that may be anticipated during the duration of this contract. Each **BIDDER** shall include all extras the costs necessary to provide the quantity and quality of Work required by the Drawings and Technical Specifications.

ASR WELL ASR-1

Item	Description
1.0	For drilling, testing, development, and completion of one Aquifer Storage and Recovery well having 24-inch diameter casing set to 1,080 feet below land surface (bls) and an open hole completion interval to 1,200 feet bls, with all appurtenances, in accordance with the Technical Specifications and Drawings.

The total LUMP SUM PRICE for the project *Item 1.0* will be _____.

(In Words) _____.

ADDITIONS and SUBTRACTIONS to the TOTAL LUMP SUM PRICE will be made based on the following adjustment items:

Item	Description	Unit Price	/ Unit*
(* Lf = Linear Foot, Cf = Cubic Foot, Hr = Hour. Ea = Each)			
1.1	Drilling more or less than 1,200 feet of 12.25-inch diameter pilot hole	\$ _____	/ Lf
1.2	Reaming more or less than 200 feet of 44-inch diameter borehole	\$ _____	/ Lf
1.3	Furnishing and installing more or less than 200 feet of 34-inch diameter casing	\$ _____	/ Lf

1.4	Furnishing and emplacing more or less than 5,000 cubic feet of mixed cement in the annular spaces	\$ _____	/ Cf
1.5	Reaming more or less than 880 feet of 34-inch diameter borehole	\$ _____	/ Lf
1.6	Furnishing and installing more or less than 1,080 feet of 24-inch diameter casing	\$ _____	/ Lf
1.7	Obtaining more or less than 275 feet of 4-inch diameter core in the pilot borehole.	\$ _____	/ Lf
1.8	Performing more or less than 2 single-packer or straddle-packer pumping tests	\$ _____	/ Ea
1.9	Reaming more or less than 120 feet of 24-inch diameter borehole	\$ _____	/ Lf
1.10	Performing more or less than 120 hours of well development.	\$ _____	/ Hr
1.11	<i>For performing acidification in the ASR well in accordance with the technical specifications</i>	\$ _____	/ Ea
1.12	Performing more or less than 40 hours of OWNER or ENGINEER directed extra work- rig and crew	\$ _____	/ Hr
1.13	Performing more or less than 40 hours of OWNER or ENGINEER directed standby time	\$ _____	/ Hr

Floridan Aquifer Monitor Well FAMW-1

Item	Description
2.0	For drilling, testing, development, and completion of one Floridan Aquifer Monitor well having 6-5/8-inch diameter casing set to 1,080 feet below land surface (bls) and an open hole completion interval to 1,200 feet bls, with all appurtenances, in accordance with the Technical Specifications and Drawings.

The total LUMP SUM PRICE for the project *Item 2.0* will be _____.

(In Words) _____.

ADDITIONS and SUBTRACTIONS to the TOTAL LUMP SUM PRICE will be made based on the following adjustment items:

Item	Description	Unit Price	/ Unit*
(* Lf = Linear Foot, Cf = Cubic Foot, Hr = Hour)			
2.1	Drilling more or less than 1,650 feet of 12.25-inch diameter pilot hole	\$ _____	/ Lf
2.2	Reaming more or less than 200 feet of 34-inch diameter borehole	\$ _____	/ Lf
2.3	Furnishing and installing more or less than 200 feet of 24-inch diameter casing	\$ _____	/ Lf
2.4	Furnishing and emplacing more or less than 5,500 cubic feet of cement in the annular spaces or pilot hole	\$ _____	/ Cf
2.5	Obtaining more or less than 435 feet of 4-inch diameter core in the pilot borehole.	\$ _____	/ Lf
2.6	Reaming more or less than 975 feet of 24-inch diameter borehole	\$ _____	/ Lf
2.7	Furnishing and installing more or less than 975 feet of 14-inch diameter casing	\$ _____	/ Lf
2.8	Performing more or less than 6 single-packer or straddle-packer pumping tests	\$ _____	/ Ea
2.9	Furnishing and installing more or less than 1,080 feet of 6-5/8-inch diameter casing	\$ _____	/ Lf
2.10	Performing more or less than 80 hours of well development.	\$ _____	/ Hr
2.11	Performing more or less than 40 hours of OWNER or ENGINEER directed extra work- rig and crew	\$ _____	/ Hr
2.12	Performing more or less than 40 hours of OWNER or ENGINEER directed standby time	\$ _____	/ Hr

Mobilization/Demobilization

Item Description

3.0 For mobilizing to the site and demobilizing from the site, including insurance, bonds, drilling containment structures, and pad monitor wells.

The total LUMP SUM PRICE for the project *Item 3.0* will be _____.

(In Words) _____.

Underground Vaults/Structures

Item Description

4.0 This item includes all underground structures including the ASR well vault, the control valve vault, outfall structure, FAMW vault, and lift station including all structural and mechanical appurtenances, yard piping, and site work associated with these vaults/structures.

The total LUMP SUM PRICE for the project *Item 4.0* will be _____.

(In Words) _____.

Electrical and Instrumentation and Controls (I&C)

Item Description

5.0 This item is for all electrical and I&C work associated with this project.

The total LUMP SUM PRICE for the project *Item 5.0* will be _____.

(In Words) _____.

Allowances for Additional Work Not Shown or Specified

Item Description

6.0 Permit Fee Allowance	<u>\$15,000</u>
7.0 Landscaping Allowance	<u>\$75,000</u>
8.0 Electrical and Instrumentation Allowance	<u>\$40,000</u>
9.0 Piping, Structures, Mechanical Allowance	<u>\$50,000</u>

Project General

<u>Item</u>	<u>Description</u>	
10.0	Bonus for Early Completion (\$1,500 per day, max 30 days)	<u>\$45,000</u>
11.0	Indemnification	<u>\$ 100</u>

The total LUMP SUM price for this project is the sum of items 1.0 through ~~10.0~~ 11.0 excluding adjustment items 1.1 – 1.12 and 2.1 – 2.12.

The total LUMP SUM PRICE for the *total* project will be \$ _____.

(In Words) _____.

Acknowledgment is hereby made of the following Addenda received subsequent to issuance of Plans and Specifications:

Addendum No. _____ Dated: _____ Addendum No. _____ Dated: _____

Dated this _____ day of _____ 2000.

Name of Organization: _____

By: _____

Title: _____

ATTACHMENT 3 TO BID FORM

PROJECT NUMBER: WUD 98-66

**PROJECT NAME: PLANT NO. 9 EASTERN HILLSBORO CANAL
AQUIFER STORAGE AND RECOVERY WELL SYSTEM**

DATE:

LIST OF SUBCONTRACTORS

A list of subcontractors to be utilized on the project shall be provided herein. This list of subcontractors and their license numbers shall be included with the Supplemental Bid Documents. Refer to Instructions to Bidders, Paragraph 5.4. If the Bidder is to perform the labor component with its own forces, the Bidder shall list its own name on the appropriate line. The Contractor shall complete all categories that apply. Categories that do not apply shall be marked "N/A". Suppliers or off-site fabricators are not to be listed.

The purpose of this list is to discourage "sub-shopping" in general, and to provide a basis for the implementation of the substitution provisions of this Contract (Instructions to Bidder 2.3). The receipt of this Attachment in no way constitutes approval or disapproval by the County of any subcontractor listed. Failure to furnish all information may result in rejection of bid.

Following are the subcontractors to be used if the undersigned is awarded the contract.

<u>CONTRACTOR</u>	<u>LICENSE/CERTIFICATE NO.</u>
ASBESTOS ABATEMENT _____	_____
CONCRETE _____	_____
EARTHWORK _____	_____
PAVING _____	_____
UNDERGROUND UTILITIES _____	_____
MASONRY _____	_____
STRUCTURAL STEEL _____	_____
CARPENTRY _____	_____
ROOFING SYSTEM _____	_____
GLASS & GLAZING _____	_____
PAINTING _____	_____
PLUMBING _____	_____
HEATING/AIR CONDITIONING _____	_____
PLANT 9S ELECTRICAL <u>C.C. Controls</u> _____	_____
ELECTRICAL _____	_____
FIRE SUPPRESSION _____	_____
INSTRUMENTATION _____	_____

Bidding Contractor: _____

Signed By: _____

SECTION 01025 - MEASUREMENT AND PAYMENT

PART 1 -- GENERAL

1.1 SCOPE

- A. Payment for the various items of the Bid Schedule, as further specified herein, shall include all compensation to be received by the CONTRACTOR for furnishing all tools, equipment, supplies, and manufactured articles, and for all labor, operations, and incidentals appurtenant to the items of work being described, as necessary to complete the various items of the WORK all in accordance with the requirements of the Contract Documents, including all appurtenances thereto, and including all costs of permits and cost of compliance with the regulations of public agencies having jurisdiction, including Safety and Health Requirements of the Occupational Safety and Health Administration of the U.S. Department of Labor (OSHA). This includes, but is not limited to, all materials, tools, labor, equipment, supplies, permits, removal and disposal of waste or excess materials, etc. Separate payment will not be made for any item that is not specifically set forth in the Bid Schedule, and all costs therefore shall be included in the prices named in the Bid Schedule for the various appurtenant items of work.

1.2 CONSTRUCTION OF THE ASR WELL ASR-1 - Bid Item No. 1.0

- A. No measurement shall be made for this item.
- B. Payment shall be made at the lump sum price named in the Bid Schedule which shall constitute full compensation for drilling, testing, development, and completion of one (1) Aquifer Storage and Recover well having a 24-inch diameter casing set to 1,080 feet below land surface (bls) and an open hole completion interval to 1,200 feet bls, with all appurtenances and miscellaneous work in accordance with the Contract Documents.

1.3 DRILL MORE OR LESS PILOT HOLE THAN SPECIFIED - Bid Item No. 1.1

- A. Measurement for addition or subtraction to payment for drilling the pilot hole more or less than 1,200 feet from land surface to total depth of 12.25-inch diameter pilot hole will be based upon the number of linear feet of pilot hole drilled, tested, and accepted, all in accordance with the Contract Documents.
- B. Additions or Subtractions to payment for drilling the pilot hole more or less than 1,200 feet from land surface to total depth will be at the unit price per linear foot indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.

1.4 REAM PILOT HOLE TO NOMINAL 44-INCH DIAMETER - Bid Item No. 1.2

- A. Measurement for addition or subtraction to payment for reaming of the pilot hole to a nominal 44-inch diameter will be based upon the number of linear feet more or less than 200 feet of pilot hole reamed, tested, and accepted, all in accordance with the Contract Documents.
- B. Additions or subtractions to payment for reaming the pilot hole to nominal 44-inch diameter shall be at the unit price per linear foot more or less than 200 feet as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.

1.5 FURNISH AND INSTALL 34-INCH DIAMETER CASING - Bid Item No. 1.3

- A. Measurement for addition or subtraction to payment for furnishing and installing 34-inch diameter steel casing will be based on the number of linear feet more or less than 200 feet of casing installed, tested, and accepted, all in accordance with the Contract Documents.
- B. Addition or subtraction to payment for furnishing and installing 34-inch diameter steel casing shall be at the unit price per linear foot more or less than 200 feet as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.

1.6 FURNISH AND INSTALL CEMENT AND ADDITIVES IN THE ANNULAR SPACES - Bid Item No. 1.4

- A. Measurement for addition or subtraction to payment for furnishing and emplacing the cement with up to 2% calcium chloride and 4% bentonite or other approved additives in the casing annuli will be based on the number on cubic feet of cement more or less than 5,000 cubic feet installed, tested, and accepted, all in accordance with the Contract Documents.
- B. Addition or subtraction to payment for furnishing and emplacing the cement shall be at the unit price per cubic foot more or less than 5,000 cubic feet as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents

1.7 REAM PILOT HOLE TO NOMINAL 34-INCH DIAMETER - Bid Item No. 1.5

- A. Measurement for addition or subtraction to payment for reaming of the pilot hole to a nominal 34-inch diameter will be based upon the number of linear feet of pilot hole more or less than 880 feet reamed, tested, and accepted, all in accordance with the Contract Documents.
- B. Addition or subtraction to payment for reaming the pilot hole to nominal 34-inch diameter shall be at the unit price per linear foot more or less than 880 feet as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.

1.8 FURNISH AND INSTALL 24-INCH DIAMETER SURFACE CASING - Bid Item No. 1.6

- A. Measurement for addition or subtraction to payment for furnishing and installing 24-inch diameter steel casing will be based on the number of linear feet more or less than 1,080 feet of casing installed, tested, and accepted, all in accordance with the Contract Documents.
- B. Addition or subtraction to payment for furnishing and installing 24-inch diameter steel casing shall be at the unit price per linear foot more or less than 1,080 feet as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.

1.9 CORE SAMPLES - Bid Item No. 1.7

- A. Measurement for addition or subtraction to payment for collecting core samples shall be based on the number of feet of core more or less than 275 feet completed and accepted, all in accordance with the Contract Documents.
- B. Addition or subtraction to payment for collecting core samples shall be at the unit price per foot more or less than 275 feet as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.

1.10 SINGLE OR STRADDLE PACKER TESTS - Bid Item No. 1.8

- A. Measurement for addition or subtraction to payment for single or straddle packer tests shall be based on the number of tests performed more or less than two (2) all in accordance with the Contract Documents.
- B. Addition or subtraction to payment for performing single or straddle packer tests shall be at the unit price per test more or less than two as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.

1.11 REAM PILOT HOLE TO NOMINAL 24-INCH DIAMETER - Bid Item No. 1.9

- A. Measurement for addition or subtraction to payment for reaming of the pilot hole to a nominal 24-inch diameter will be based upon the number of linear feet more or less than 120 feet of pilot hole reamed, tested, and accepted, all in accordance with the Contract Documents.
- B. Addition or subtraction to payment for reaming the pilot hole to nominal 24-inch diameter shall be at the unit price per linear foot more or less than 120 feet as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.

1.12 WELL DEVELOPMENT - Bid Item No. 1.10

- A. Measurement for addition or subtraction to payment for well development will be based on the number of hours of direct airlifting, pump surging and/or reverse airlifting actually used to develop the well more or less than 120 hours, all in accordance with the Contract Documents.
- B. Addition or subtraction to payment for well development shall be at the unit price per hour more or less than 120 hours as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.

1.13 WELL ACIDIZATION - Bid Item No. 1.11

- A. Measurement for addition to payment for well acidization will be based on the number of ASR well acidizations performed in accordance with the Contract Documents.

- B. *Addition to payment for well acidization shall be at the unit price per acidization as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.*

1.14 STANDBY TIME WITH RIG AND CREW WORKING - Bid Item No. ~~1.14~~ 1.12

- A. Measurement for addition or subtraction to payment for standby time will be based on the number of hours actually spent on standby more or less than 40 hours at the direction of the OWNER or ENGINEER in accordance with the Contract Documents.
- B. Addition or subtraction to payment for standby time shall be at the unit price per hour more or less than 40 hours as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.

1.15 STANDBY TIME WITH NO RIG AND CREW - Bid Item No. ~~1.12~~ 1.13

- A. Measurement for addition or subtraction to payment for standby time will be based on the number of hours actually spent more or less than 40 hours on standby at the direction of the OWNER or ENGINEER in accordance with the Contract Documents.
- B. Addition or subtraction to payment for standby time shall be at the unit price per hour more or less than 40 hours as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.

1.16 CONSTRUCT FLORIDAN AQUIFER MONITOR WELL FAMW-1 - Bid Item No. 2.0

- A. No measurement shall be made for this item.
- B. Payment shall be made at the lump sum price named in the Bid Schedule which shall constitute full compensation for drilling, testing, development, and completion of one (1) Floridan Aquifer Monitor Well having a 6-5/8-inch diameter casing set to 1,080 feet below land surface (bls) and an open hole completion interval to 1,200 feet bls, with all appurtenances and miscellaneous work in accordance with the Contract Documents.

1.17 DRILL MORE OR LESS PILOT HOLE AS SPECIFIED - Bid Item No. 2.1

- A. Measurement for addition or subtraction to payment for drilling the pilot hole to a nominal diameter of 12.25-inch as specified from land surface to total depth will be based upon the number of linear feet of pilot hole more or less than 1,650 feet drilled, tested, and accepted, all in accordance with the Contract Documents.
- B. Addition or subtraction to payment for drilling the pilot hole to a nominal diameter of 12.25-inch as specified from land surface to total depth more or less than 1,650 feet will be at the unit price per linear foot indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.

1.18 REAM PILOT HOLE TO NOMINAL 34-INCH DIAMETER - Bid Item No. 2.2

- A. Measurement for addition or subtraction to payment for reaming of the pilot hole to a nominal 34-inch diameter will be based upon the number of linear feet more or less than 200 feet of pilot hole reamed, tested, and accepted, all in accordance with the Contract Documents.**
- B. Addition or subtraction to payment for reaming the pilot hole to nominal 34-inch diameter shall be at the unit price per linear foot more or less than 200 feet as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.**

1.19 FURNISH AND INSTALL 24-INCH DIAMETER CONDUCTOR CASING - Bid Item No. 2.3

- A. Measurement for addition or subtraction to payment for furnishing and installing 24-inch diameter steel casing will be based on the number of linear feet more or less than 200 feet of casing installed, tested, and accepted, all in accordance with the Contract Documents.**
- B. Addition or subtraction to payment for furnishing and installing 24-inch diameter steel casing shall be at the unit price per linear foot more or less than 200 feet as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.**

1.20 FURNISH AND INSTALL CEMENT ADDITIVES IN THE ANNULAR SPACES OR PILOT HOLE - Bid Item No. 2.4

- A. Measurement for addition or subtraction to payment for furnishing and emplacing the cement with up to 2% calcium chloride and 4% bentonite or other approved additives in the casing annuli or pilot hole will be based on the number on cubic feet of cement more or less than 5,500 cubic feet installed, tested, and accepted, all in accordance with the Contract Documents.**
- B. Addition or subtraction to payment for furnishing and emplacing the cement and additives in the casing annuli or pilot hole shall be at the unit price per cubic foot more or less than 5,500 cubic feet as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.**

1.21 CORE SAMPLES - Bid Item No. 2.5

- A. Measurement for addition or subtraction to payment for collecting core samples shall be based on the number of feet of core completed and accepted more or less than 435 feet, all in accordance with the Contract Documents.**
- B. Addition or subtraction to payment for collecting core samples shall be at the unit price per foot more or less than 435 feet as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.**

1.22 REAM PILOT HOLE TO NOMINAL 24-INCH DIAMETER - Bid Item No. 2.6

- A. Measurement for addition or subtraction to payment for reaming of the pilot hole to a nominal 24-inch diameter will be based upon the number of linear feet more or less than 975 feet of pilot hole reamed, tested, and accepted, all in accordance with the Contract Documents.
- B. Addition or subtraction to payment for reaming the pilot hole to nominal 24-inch diameter shall be at the unit price per linear foot more or less than 975 feet as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.

1.23 FURNISH AND INSTALL 14-INCH DIAMETER CASING - Bid Item No. 2.7

- A. Measurement for addition or subtraction to payment for furnishing and installing 14-inch diameter steel casing will be based on the number of linear feet more or less than 975 feet of casing installed, tested, and accepted, all in accordance with the Contract Documents.
- B. Addition or subtraction to payment for furnishing and installing 14-inch diameter steel casing shall be at the unit price per linear foot more or less than 975 feet as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.

1.24 SINGLE OR STRADDLE PACKER TESTS - Bid Item No. 2.8

- A. Measurement for addition or subtraction to payment for single or straddle packer tests shall be based on the number of tests more or less than six (6) tests performed all in accordance with the Contract Documents.
- B. Addition or subtraction to payment for performing single or straddle packer tests shall be at the unit price per test more or less than six (6) as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.

1.25 FURNISH AND INSTALL 6-5/8-INCH DIAMETER CASING - Bid Item No. 2.9

- A. Measurement for addition or subtraction to payment for furnishing and installing 6-5/8-inch diameter fiberglass casing will be based on the number of linear feet more or less than 1,080 feet of casing installed, tested, and accepted, all in accordance with the Contract Documents.
- B. Addition or subtraction to payment for furnishing and installing 6-5/8-inch diameter fiberglass casing shall be at the unit price per linear foot more or less than 1,080 feet as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.

1.26 WELL DEVELOPMENT - Bid Item No. 2.10

- A. Measurement for addition or subtraction to payment for well development will be based on the number of hours of direct airlifting, pump surging and/or reverse airlifting actually used to develop the well more or less than 80 hours, all in accordance with the Contract Documents.

- B. Addition or subtraction to payment for well development shall be at the unit price per hour more or less than 80 hours as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.

1.27 STANDBY TIME WITH RIG AND CREW WORKING - Bid Item No. 2.11

- A. Measurement for addition or subtraction to payment for standby time will be based on the number of hours actually spent on standby more or less than 40 hours at the direction of the OWNER or ENGINEER in accordance with the Contract Documents.
- B. Payment for standby time shall be at the unit price per hour indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents. For all items, this includes, but is not limited to, all materials, tools, labor, equipment, supplies, permits, removal and disposal of waste or excess materials, etc. necessary to remain on standby in accordance with the Contract Documents.

1.28 STANDBY TIME WITH NO RIG AND CREW - Bid Item No. 2.12

- A. Measurement for addition or subtraction to payment for standby time will be based on the number of hours actually spent on standby more or less than 40 hours at the direction of the OWNER or ENGINEER in accordance with the Contract Documents.
- B. Payment for standby time shall be at the unit price per hour more or less than 40 hours as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.

1.29 MOBILIZATION/DEMobilIZATION ALLOWANCE (INSURANCE, BONDS, PERMITS, TEMPORARY PADS, PAD MONITOR WELLS) – Bid Item 3.0

- A. No measurement shall be made for this item.
- B. Payment for mobilization, demobilization, insurance bonds, permits, temporary containment pad, pad modification, and pad monitor wells will be made at the lump sum price named in the Bid Schedule which shall constitute full compensation for obtaining all required insurance, bonds and permits in accordance with the Contract Documents. This amount will also constitute full compensation for mobilization and demobilization, temporary containment pad, pad modification, and pad monitor wells as outlined in the Contract Documents. No more than 65% percent of the amount set aside for this item may be claimed as mobilization.

1.30 UNDERGROUND VAULTS/STRUCTURES – Bid Item 4.0

- A. No measurement shall be made for this item.
- B. ~~Payment for mobilization, demobilization, insurance bonds, permits, temporary containment pad, pad modification, and pad monitor wells will be made at the lump sum price named in the Bid Schedule which shall constitute full compensation for obtaining all required insurance, bonds and permits in accordance with the Contract Documents. This amount will also constitute full compensation for mobilization and demobilization, temporary containment pad, pad modification, and pad monitor wells as outlined in the Contract Documents. No more than 65% percent of the amount set aside for this item~~

~~may be claimed as mobilization.~~ All underground structures including the ASR well vault, the control valve vault, outfall structure, FAMW vault, and lift station including all structural and mechanical appurtenances, yard piping, and site work associated with these vaults/structures in accordance with the Contract Documents.

1.31 ELECTRICAL/INSTRUMENTATION AND CONTROLS (I&C) – Bid Item 5.0

- A. No measurement shall be made for this item.
- B. ~~Payment for mobilization, demobilization, insurance bonds, permits, temporary containment pad, pad modification, and pad monitor wells will be made at the lump sum price named in the Bid Schedule which shall constitute full compensation for obtaining all required insurance, bonds and permits in accordance with the Contract Documents. This amount will also constitute full compensation for mobilization and demobilization, temporary containment pad, pad modification, and pad monitor wells as outlined in the Contract Documents. No more than 65% percent of the amount set aside for this item may be claimed as mobilization.~~ All electrical, instrumentation, and controls work associated with this project in accordance with the Contract Documents.

1.32 PERMIT FEE ALLOWANCE – Bid Item 6.0

- A. Payment for this item will be made for only the amount that can be substantiated with receipts *plus five (5) percent CONTRACTOR markup for overhead and profit.*

1.33 LANDSCAPING ALLOWANCE – Bid Item 7.0

- A. Payment for this item will be made for only the amount that can be substantiated with receipts *plus five (5) percent CONTRACTOR markup for overhead and profit.*

1.34 ELECTRICAL AND INSTRUMENTATION – Bid Item 8.0

- A. Payment for this item will be made for only the amount that can be substantiated with receipts *plus five (5) percent CONTRACTOR markup for overhead and profit.*

1.35 PIPING, STRUCTURES, MECHANICAL – Bid Item 9.0

- A. Payment for this item will be made for only the amount that can be substantiated with receipts *plus five (5) percent CONTRACTOR markup for overhead and profit.*

1.36 BONUS FOR EARLY COMPLETION – Bid Item 10.0

- A. *Payment for this item shall be in accordance with Article 11.0 in Instructions to Bidders.*

1.37 INDEMNIFICATION – Bid Item ~~10.0~~ 11.0

- A. No measurement shall be made for this item.
- B. Payment shall be made at the lump sum price identified in the Bid Schedule, which shall constitute full compensation for indemnification of the OWNER and the ENGINEER.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

- END OF SECTION -

SECTION 11189 - SUBMERSIBLE TURBINE PUMPS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall furnish, install and test motor-driven submersible turbine pumps and all appurtenant work, complete and operable, in accordance with the requirements of the Contract Documents.
- B. The requirements of Section 11100 – Pumps, General apply to this section.
- C. The Supplier shall examine the site conditions, intended application, and operation of the pump system and recommend the pump, which will satisfy the indicated requirements.

PART 2 -- PRODUCTS

2.1 WELL PUMPS

A. Identification:

- 1. Pump Name: ASR Recovery Pump
- 2. Pump Number: P – 01
- 3. Quantity: 1
- 4. Location: ASR Well Vault

B. Operating Conditions:

- 1. Duty - Continuous
- 2. Drive - Constant Speed
- 3. Ambient Environment - Submerged
- 4. Ambient Temperature (degrees F) - 32 to 104
- 5. Ambient relative humidity (percent) - 40 to 100
- 6. Fluid Service - Raw Water
- 7. Fluid Temperature (degrees F) - 70 to 85
- 8. Fluid pH range - 6 to 9
- 9. Fluid specific gravity - 1.0
- 10. Fluid viscosity (absolute) (centipoises at 60 deg. F) - 1.2
- 10. Project site elevation - 15
(ft. above m.s.l.)
- 12. Minimum available NPSH (Feet) 50

C. Performance Requirements:

1. Maximum shut-off head (ft)	-	420
2. Design flow capacity (gpm)	-	3500
3. Design flow pump head TDH (ft)	-	225 215
4. Design flow minimum pump/motor wire-to-water efficiency, (percent)	-	66
5. Maximum flow capacity, (gpm)	-	4000
6. Maximum flow pump head TDH, (ft) ± 10 feet	-	175
7. Minimum flow capacity, (gpm)	-	1400
8. Minimum flow pump head TDH, (FT) ± 10ft	-	350
9. Maximum pump speed, (rpm)	-	1770
10. Motor size, (hp)	-	250

D. Pump Dimensions:

1. Nominal setting depth below well head flange, (ft)	-	100
2. Maximum outside diameter of bowls, (in)	-	17.0
3. Minimum Discharge Diameter (in)	-	12
4. Discharge Flange Rating ANSI (psi)	-	150
5. Inside Diameter of well casing, (in)	-	23

2.2 PUMP REQUIREMENTS

A. Pump Construction: Construction of submersible turbine pumps shall conform to the following requirements:

1. Bowl	-	Stainless steel type CF8M. The exterior surfaces of the bowl units shall be coated in accordance with Section 09800, "Protective Coatings." Bowl shall be flanged, bolted type.
2. Impeller	-	Stainless steel type CF8M, enclosed type, secured to bowl shaft with stainless steel tapered sleeve collet. Impeller shall be statically and dynamically balanced.
3. Casing wear rings	-	Nitronic 50 or CD4M-Cu stainless steel
4. Bowl shaft	-	Type 316 stainless steel

5. Bowl bearings discharge case and suction case
 - Rubber cutlass bearing with Type 316 SS shell.
6. Suction Case
 - Stainless steel type CF8M
7. Discharge Case
 - Stainless steel type CF8M, an up-thrust plug or washer shall be provided to limit up-thrust.
8. Pump-Motor Coupling
 - Stainless steel with keyway
9. Cable Guard
 - Stainless steel
10. Fasteners
 - Stainless Steel, ASTM A193 grade B8M

B. **Column Pipe:** Column pipe shall be 12 inch diameter schedule 40S 40S type 316L stainless steel with ANSI 150 lb. flanges. Each 20 foot section shall be fitted with a stainless steel centralizer.

C. **Discharge Head:** Well discharge head shall be fabricated of type 316L stainless steel, schedule 10S as shown. The flange column pipe shall be fastened to the flange well head. The column pipe shall be attached to the top of the well casing as indicated on the drawings. A well casing adapter flange will be required as shown.

2.3 WELL PUMP MOTOR

A. The pump manufacturer shall supply the pump-motor assembly and shall accept unit responsibility for this assembly. The pump manufacturer shall mate pumps and motors and adjust the pump thrust plug.

B. The motor shall be of the 'squirrel cage' induction type, suitable for reduced voltage starting. The motor shall be liquid filled and be rated at 460-volt, 3-phase, 60 Hertz for continuous operation. Mercury-seal motors are not acceptable. The motor horsepower rating shall not be exceeded at pump design flow. It shall have a service factor of *not less than 1.0* which shall not be exceeded over the full range of pump operation specified from shut-off to maximum flow. The *1.0* service factor shall be achieved at a minimum cooling flow velocity of 0.5 1.5 fps. with 77°F water.

C. The motor shall be equipped with fill liquid lubricated radial and Kingsbury type thrust bearings. The motor thrust bearing shall be sized to carry the weight of all rotating parts plus the unbalanced thrust of the pump, regardless of the direction of rotation. A mechanical shaft seal shall be provided in the motor housing to prevent loss of fill liquid. Motor shall be equipped with a pressure relief valve, drain plug and filling device.

D. Motor materials of construction shall be as follows:

1. Outer housing – Stainless steel with cast iron end bells, epoxy coated
2. Shaft - stainless steel
3. Coupling - stainless steel
4. Fasteners - stainless steel

- E. The motor power factor shall not be less than 0.75 at pump design flow. Motor starter overload relays shall be sized for motor full load current for +/- 10 percent voltage range.
- F. The submersible motor cable shall be a flat cable, with factory splices only allowed in the well. The cable shall be sized to limit voltage drop to no more than 2.5 percent at full load current. The outer jacket of the cable shall be watertight over its entire length and be suitably supported from the column pipe.
- G. Motor winding insulation shall be rated for continuous duty at not less than 130 °C.

2.4 WATER LEVEL INDICATOR

- A. The CONTRACTOR shall supply a submersible pressure transducer with a cord of sufficient length to reach from the setting depth shown to the control panel. Transducer and transmitter shall be as specified in Division 17.

2.5 SPARE PARTS: Furnish the following spare parts for each pump:

- A. One set of all bowl discharge case, and suction case bearings
- B. One set of all wear rings
- C. Two sets of all gaskets and o-rings

2.6 SUPPLIERS

- A. Pumps shall be manufactured by:

1. **Byron Jackson Pumps (Flowserve)**
2. **Floway Pumps**
3. **Goulds Pumps (ITT)**
4. **Ingersoll Dresser Pump Co. (Flowserve)**
5. **Johnston Pump Co.**
6. **Peerless (Sterling)**

- B. Motors shall be manufactured by:

1. **Byron Jackson,**
2. **Hitachi, or equal.**
3. **Pleuger.**

PART 3 — EXECUTION

3.1 INSTALLATION

- A. Pumping equipment shall be installed in accordance with approved procedures submitted with the shop drawings. In all cases manufacturers' requirements shall be met.

- B. General installation requirements shall be as specified for "Execution" in Section 11100, "Pumps, General."

3.2 MANUFACTURER'S SERVICE REPRESENTATIVE

- A. **Erection and Startup Assistance:** Service and instruction assistance by the manufacturer's engineering representative for each pump shall be provided by the CONTRACTOR during the following periods:
 - 1. One day during erection
 - 2. As required but not less than one day of service assistance during startup.

- END OF SECTION -

**PALM BEACH COUNTY
BID FORM AND ATTACHMENTS
PROJECT NO. WUD 98-66**

SECTION DESCRIPTION

- 1.0 BID FORM
- 2.0 BID BOND - Attachment No. 1
- 3.0 MINORITY & WOMEN BUSINESS ENTERPRISE SCHEDULES - Attachment No. 2
- 4.0 LIST OF SUBCONTRACTORS - Attachment No. 3
- 5.0 TRENCH SAFETY - Attachment No. 4

BID FORM

PALM BEACH COUNTY PROJECT NO.: WUD 98-66
DATE:

To: Palm Beach County Board of County Commissioners
Water Utilities Department
2065 Prairie Road, Building "K"
West Palm Beach, Florida 33406

From: The Haskell Company
111 Riverside Avenue
Jacksonville, Florida 32202

Gentlemen:

1.1 Having carefully examined the Bid and Contract Documents and Drawings for the Project entitled **PLANT NO. 9 EASTERN HILLSBORO CANAL AQUIFER STORAGE AND RECOVERY WELL SYSTEM**, PROJECT NO.: WUD 98-66 as well as the premises and conditions affecting the work, and confirming that the site was visited, as required, by

JAMES M. PELLEGRINO on NOVEMBER 17, 2000
(Name of Person) (Date)

the undersigned hereby declares that no person or persons, firm or corporation, other than the undersigned, are interested in this proposal as principals, and that this proposal is made without collusion with any person, firm, or corporation, and we have carefully and to our full satisfaction examined the Contract Documents, and that we have made a full examination of the location of the proposed work and the source of supply of materials, and we hereby agree to furnish and pay for all materials, labor, supervision, equipment, supplies, fees, expertise, and services necessary to fully complete all work in accordance with all requirements of the Contract Documents and in accordance with all applicable codes and governing regulations within the time limit specified in this proposal for the following lump sum (fixed price) Base Bid.

Price: TWO MILLION SEVEN HUNDRED SEVENTY THREE THOUSAND SIX HUNDRED EIGHTY AND -00/100
(written out)

(\$ 2,773,680.00) which sum is hereinafter referred to as the
(numeric) "Base Bid".

1.2 The undersigned acknowledges that it has included with its Bid the required Bid Security for not less than five percent (5%) of the total amount of its Base Bid.

1.3 The Bidder shall be bound by the terms of its Bid Proposal for a period of one hundred twenty (120) calendar days from the date of the bid opening and may not withdraw its Bid within that time period. If the County issues a Notification from Owner within the above 120 day period, then the Bidder will be bound by the Bid Proposal as submitted. If the County fails to issue a Notification from Owner to the successful Bidder within the above identified 120 day period, the successful bidder will not be required to honor its Bid Proposal unless otherwise agreed to by both parties.

County anticipates, but does not guarantee the award of bid and written notice to proceed within ninety (90) calendar days of Notification from Owner, absent the filing of a timely bid protest.

1.4 The County's established goal for M/WBE participation for this solicitation, inclusive of all alternates and change orders, is 8%.* This goal is a minimum and no rounding will be accepted. < If minimum categorical goals have been established they should be stated here.>

*with 3% Black participation.

1.5 It is agreed that the undersigned has received all addenda complete as issued by the County and that related costs are included in the bid submitted. The undersigned acknowledges receipt of said addenda as follows:

Addendum # 1 dated 11-14-00 Addendum# _____ dated _____
Addendum # _____ dated _____ Addendum# _____ dated _____

1.6 Time is of the essence. The undersigned Bidder agrees that, if awarded the Contract hereunder, it shall commence the work to be performed under the Contract on the date set by the County in its written notice to proceed, continuing the work with diligence and shall Substantially Complete all work under this contract in not more than 240 days calendar days. Final completion shall be within 30 days of Substantial Completion. The undersigned agrees that, if awarded the Contract, it will complete said separable portions of work in accordance with such date. Substantial Completion is defined in the General Conditions.

1.6.1 Should the Contractor (or in the event of a default, its Surety) fail to achieve Substantial Completion by the contractually established date, the County will suffer damages, the amount of which is difficult if not impossible to ascertain, and the County shall be entitled to Liquidated Damages as specified for each calendar day beyond the Contractual end date, until certification of Substantial Completion and acceptance has been given by the County. The Liquidated Damages rate is ~~\$1,500.~~ per day through the date of certification of Substantial Completion. \$2,500.00

Should the Contractor (or in the event of a default, his Surety) fail to achieve Final Completion within thirty days from the date of Substantial Completion, the County will suffer damages, the amount of which is difficult if not impossible to ascertain, and the County shall be entitled to Liquidated Damages as specified for each calendar day greater than thirty beyond the date certified for Substantial Completion. The Liquidated Damages rate is ~~\$750.~~ per day. \$1,500.00

Liquidated Damages due the County may be deducted from payments due the Contractor, or may be collected directly from the Contractor or his surety or sureties. The liability of the Contractor and its Surety or Sureties for delay damages shall be joint and several. These provisions for liquidated damages shall not prevent the County, in case of the Contractor's default, from terminating the right of the Contractor to proceed as provided in General Conditions.

1.7 The Costs Savings Incentive provisions of the General Conditions are in effect for this Contract.

\$1,500.00

1.8 The Early Completion Incentive is in effect for this Contract. ~~If the Incentive is in effect, the Incentive shall be paid at the rate of \$750. for each calendar day, as described in the Instructions to Bidders, for a period not to exceed a maximum of 30 days.~~ ~~thirty~~ ~~thirty~~ The

1.9 If the undersigned is notified of the acceptance of this bid, the Bidder agrees to execute within fourteen (14) calendar days, a Contract for the above work, complete with all required insurance certificates and bond forms. The undersigned further agrees to furnish a sufficient and satisfactory bond on the form herein provided, in the sum of not less than 100% of the contract price of the work as indicated by the contract prices shown herein.

1.10 Statement of Participation in Contracts Subject to Nondiscrimination Clause:
The Bidder shall complete the following statement by checking the appropriate boxes:

The Bidder has has not () participated in a previous contract subject to the nondiscrimination clause prescribed by Executive Order 10925, or Executive Order 11114, or Executive Order 11246.

The Bidder has has not () submitted all compliance reports in connection with any such contract, due under the applicable filing requirements; and that representations indicating submission of required compliance reports signed by proposed subcontractors will be obtained prior to award of subcontracts.

If the Bidder has participated previously in a contract subject to the nondiscrimination clause and has not submitted compliance reports due under applicable filing requirements, the Bidder shall submit a compliance report on Standard Form 100, "Employee Information Report, EEO-1" prior to the award of the Contract.

1.11 The undersigned does hereby declare that the Bid covers all expenses of every kind incidental to the completion of said Work and the Agreement therefor, including all claims that may arise through damages or other causes whatsoever. The undersigned does hereby declare that it shall make no claim on account of any variation from any estimate in the quantities of Work to be done, nor on account of any misunderstanding or misconception of the nature of the Work to be done or the grounds, subsurface conditions, or place where the Work is to be done.

1.12 ENCLOSURES:

ATTACHMENT #1	BID BOND
ATTACHMENT #2	MINORITY AND WOMEN BUSINESS ENTERPRISE SCHEDULES
ATTACHMENT #3	LIST OF SUBCONTRACTORS
ATTACHMENT #4	TRENCH SAFETY

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Respectfully Submitted,

The Haskell Company
(Name of Bidding Firm)

111 Riverside Avenue

Jacksonville, Florida 32202

(904) 357-4868
(Address & Phone Bidding Firm)

By: [Signature]
(Authorized Signature) Norman C. Anderson

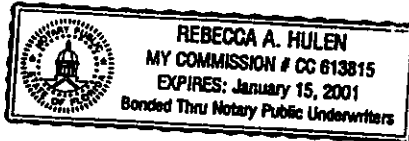
Project Director
(Title)

State of Florida
County of Duval

Subscribed and Sworn to (or affirmed) before me on 11-17-00 (date) by Norman C. Anderson (name).

He/She (is personally known) to me or has presented [Signature] (type of identification) as identification.

[Signature]
Notary Public Signature and Seal
Print Notary Name and Commission Number



Above Bidder is:

) Corporation () Partnership/Joint Venture () Sole Proprietorship

CONTRACTOR DATA:

Bidder's License or Certificate Number (as applicable): CG-C051098

Contractor's Federal Tax No: 59-1101537

Project No.: WUD 98-66

Project Name: Plant No. 9 Eastern Hillsboro Canal Aquifer Storage and Recovery Well System

PROPOSAL

This Contract is a **LUMP SUM PRICE WITH UNIT ADJUSTMENTS CONTRACT**. Adjustments will be made for changes to the bid quantities based upon geologic conditions encountered during the drilling operations. **ADDITIONS** and **SUBTRACTIONS** will be made to the **TOTAL LUMP SUM PRICE** based on these adjustments. The **BIDDER** is to include all costs that may be anticipated during the duration of this contract. Each **BIDDER** shall include all extras the costs necessary to provide the quantity and quality of Work required by the Drawings and Technical Specifications.

ASR WELL ASR-1

Item	Description
1.0	For drilling, testing, development, and completion of one Aquifer Storage and Recovery well having 24-inch diameter casing set to 1,080 feet below land surface (bls) and an open hole completion interval to 1,200 feet bls, with all appurtenances, in accordance with the Technical Specifications and Drawings.

The total LUMP SUM PRICE for the project Item 1.0 will be 584,480.00

(In Words) FIVE HUNDRED EIGHTY FOUR THOUSAND FOUR HUNDRED EIGHTY AND -00/100

ADDITIONS and **SUBTRACTIONS** to the **TOTAL LUMP SUM PRICE** will be made based on the following adjustment items:

Item	Description	Unit Price	/ Unit*
(* Lf = Linear Foot, Cf = Cubic Foot, Hr = Hour. Ea = Each)			
1.1	Drilling more or less than 1,200 feet of 12.25-inch diameter pilot hole	\$ <u>83.20</u>	/ Lf
1.2	Reaming more or less than 200 feet of 44-inch diameter borehole	\$ <u>78.00</u>	/ Lf
1.3	Furnishing and installing more or less than 200 feet of 34-inch diameter casing	\$ <u>78.00</u>	/ Lf

1.4	Furnishing and emplacing more or less than 5,000 cubic feet of mixed cement in the annular spaces	\$ <u>26.00</u>	/ Cf
1.5	Reaming more or less than 880 feet of 34-inch diameter borehole	\$ <u>67.60</u>	/ Lf
1.6	Furnishing and installing more or less than 1,080 feet of 24-inch diameter casing	\$ <u>104.00</u>	/ Lf
1.7	Obtaining more or less than 275 feet of 4-inch diameter core in the pilot borehole.	\$ <u>145.60</u>	/ Lf
1.8	Performing more or less than 2 single-packer or straddle-packer pumping tests	\$ <u>10400.00</u>	/ Ea
1.9	Reaming more or less than 120 feet of 24-inch diameter borehole	\$ <u>67.60</u>	/ Lf
1.10	Performing more or less than 120 hours of well development.	\$ <u>390.00</u>	/ Hr
1.11	<i>For performing acidification in the ASR well in accordance with the technical specifications</i>	\$ <u>2600.00</u>	/ Ea
1.12	Performing more or less than 40 hours of OWNER or ENGINEER directed extra work- rig and crew	\$ <u>416.00</u>	/ Hr
1.13	Performing more or less than 40 hours of OWNER or ENGINEER directed standby time	\$ <u>416.00</u>	/ Hr

Floridan Aquifer Monitor Well FAMW-1

Item	Description
2.0	For drilling, testing, development, and completion of one Floridan Aquifer Monitor well having 6-5/8-inch diameter casing set to 1,080 feet below land surface (bls) and an open hole completion interval to 1,200 feet bls, with all appurtenances, in accordance with the Technical Specifications and Drawings.

The total LUMP SUM PRICE for the project Item 2.0 will be 645,398.00

(In Words) SIX HUNDRED FORTY FIVE THOUSAND THREE HUNDRED NINETY EIGHT AND 00/100

ADDITIONS and SUBTRACTIONS to the TOTAL LUMP SUM PRICE will be made based on the following adjustment items:

Item	Description	Unit Price	/ Unit*
(* Lf = Linear Foot, Cf = Cubic Foot, Hr = Hour)			
2.1	Drilling more or less than 1,650 feet of 12.25-inch diameter pilot hole	\$ <u>83.20</u>	/ Lf
2.2	Reaming more or less than 200 feet of 34-inch diameter borehole	\$ <u>67.60</u>	/ Lf
2.3	Furnishing and installing more or less than 200 feet of 24-inch diameter casing	\$ <u>78.00</u>	/ Lf
2.4	Furnishing and emplacing more or less than 5,500 cubic feet of cement in the annular spaces or pilot hole	\$ <u>26.00</u>	/ Cf
2.5	Obtaining more or less than 435 feet of 4-inch diameter core in the pilot borehole.	\$ <u>145.60</u>	/ Lf
2.6	Reaming more or less than 975 feet of 24-inch diameter borehole	\$ <u>57.20</u>	/ Lf
2.7	Furnishing and installing more or less than 975 feet of 14-inch diameter casing	\$ <u>52.00</u>	/ Lf
2.8	Performing more or less than 6 single-packer or straddle-packer pumping tests	\$ <u>10400.00</u>	/ Ea
2.9	Furnishing and installing more or less than 1,080 feet of 6-5/8-inch diameter casing	\$ <u>36.40</u>	/ Lf
2.10	Performing more or less than 80 hours of well development.	\$ <u>390.00</u>	/ Hr
2.11	Performing more or less than 40 hours of OWNER or ENGINEER directed extra work- rig and crew	\$ <u>416.00</u>	/ Hr
2.12	Performing more or less than 40 hours of OWNER or ENGINEER directed standby time	\$ <u>416.00</u>	/ Hr

Mobilization/Demobilization

Item Description

3.0 For mobilizing to the site and demobilizing from the site, including insurance, bonds, drilling containment structures, and pad monitor wells.

The total LUMP SUM PRICE for the project Item 3.0 will be 340,000.00

(In Words) THREE HUNDRED FORTY THOUSAND AND — 00/100

Underground Vaults/Structures

Item Description

4.0 This item includes all underground structures including the ASR well vault, the control valve vault, outfall structure, FAMW vault, and lift station including all structural and mechanical appurtenances, yard piping, and site work associated with these vaults/structures.

The total LUMP SUM PRICE for the project Item 4.0 will be 721,202.00

(In Words) SEVEN HUNDRED TWENTY ONE THOUSAND TWO HUNDRED TWO AND — 00/100

Electrical and Instrumentation and Controls (I&C)

Item Description

5.0 This item is for all electrical and I&C work associated with this project.

The total LUMP SUM PRICE for the project Item 5.0 will be 257,500.00

(In Words) TWO HUNDRED FIFTY SEVEN THOUSAND FIVE HUNDRED AND — 00/100

Allowances for Additional Work Not Shown or Specified

Item Description

6.0 Permit Fee Allowance	<u>\$15,000</u>
7.0 Landscaping Allowance	<u>\$75,000</u>
8.0 Electrical and Instrumentation Allowance	<u>\$40,000</u>
9.0 Piping, Structures, Mechanical Allowance	<u>\$50,000</u>

Project General

<u>Item</u>	<u>Description</u>	
10.0	Bonus for Early Completion (\$1,500 per day, max 30 days)	<u>\$45,000</u>
11.0	Indemnification	<u>\$ 100</u>

The total LUMP SUM price for this project is the sum of items 1.0 through ~~10.0~~ 11.0 excluding adjustment items 1.1 – 1.12 and 2.1 – 2.12.

The total LUMP SUM PRICE for the total project will be \$ 2,773,680.00.

(In Words) TWO MILLION SEVEN HUNDRED SEVENTY THREE THOUSAND SIX HUNDRED EIGHTY AND
00/100

Acknowledgment is hereby made of the following Addenda received subsequent to issuance of Plans and Specifications:

Addendum No. 1 Dated: 11-14-00 Addendum No. Dated:

Dated this 20th day of November 2000.

Name of Organization: The Haskell Company

By: 
Norman C. Anderson

Title: Project Director

ATTACHMENT 1 TO BID FORM

PROJECT NO.: WUD 98-66
PROJECT NAME: PLANT NO. 9 EASTERN HILLSBORO CANAL
AQUIFER STORAGE AND RECOVERY WELL SYSTEM
DATE: NOVEMBER 21, 2000

BID BOND

STATE OF FLORIDA

COUNTY OF PALM BEACH

KNOW ALL MEN THESE PRESENT: That we, THE HASKELL COMPANY
(hereinafter called "Principal"), and SEABOARD SURETY COMPANY (hereinafter called
"Surety") are held and firmly bound unto Palm Beach County, a Political Subdivision in the State of Florida,
(hereinafter called "County") in the sum of FIVE PERCENT AMOUNT BID Dollars, (\$ 5% AMOUNT BID),
lawful money of the United States of America, for the payment of which sum will and truly to be made, we
bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly be these
presents;

WHEREAS, the "Principal" contemplates submitting or has submitted a bid to the Board of County
Commissioners, Palm Beach County, Florida, for furnishing and paying for all necessary labor materials,
equipment, machinery, tools, apparatus, services, all state workmen's compensation and unemployment
compensation taxes incurred in the performance of the Contract, means of transportation for and complete
Construction of: PLANT NO. 9 EASTERN HILLSBORO CANAL AQUIFER STORAGE AND RECOVERY
WELL SYSTEM (Project Number: WUD 98-66), in the County of Palm Beach, State of Florida; and

WHEREAS, it was a condition precedent to the submission of said bid that a certified check
cashier's check, money order or bid bond in the amount of five percent (5%) of the base bid be submitted
with said bid as a guarantee that the bidder would, if given a Notification from Owner, enter into a written
contract with the County, and furnish a public construction bond in an amount equal to one hundred
(100%) of the total Contract, within fourteen (14) consecutive calendar days after the County Issues the
Notification from Owner.

NOW THEREFORE, THE CONDITIONS OF THIS OBLIGATION ARE SUCH that, if the bid of the
"Principal" herein is accepted and said "Principal", within fourteen (14) consecutive calendar days after
written notice being given of such acceptance, (i) enter into a written contract with the County and (ii)
furnishes a public construction contract bond in the amount equal to one hundred percent (100%) of the
total contract amount and in a form satisfactory to the County, then this obligation shall be void. If the
Principal fails to complete (i) and (ii) above, the sum herein stated shall be due and payable to the
"County", and the "Surety" herein agrees to pay said sum immediately upon demand of the "County", in
good and lawful money of the United States of America, as liquidated damages for failure of said
"Principal".

IN WITNESS WHEREOF, the said THE HASKELL COMPANY as "Principal"
herein, has caused these presents to be signed in its name, by its _____,
and attested by its _____, under the corporate seal, and the said
SEABOARD SURETY COMPANY as "Surety" herein, has caused these presents to be signed in its name, by its
ATTORNEY-IN-FACT, and attested by its corporate Seal, this 21ST day of NOVEMBER 20 00.

ATTEST:

(SEAL)

TITLE:

(Contractor Name)
THE BASKELL COMPANY

By: *[Signature]*

ATTEST:

Jennifer Ann Young
Jennifer Ann Young
MY COMMISSION # CCA65506 EXPIRES
July 21, 2001



TITLE: JENNIFER ANN YOUNG, NOTARY PUBLIC
STATE OF FLORIDA

(SEAL)

SEABOARD SURETY COMPANY

(Surety Name)

By: *[Signature]*
DENISE TAYLOR, ATTORNEY-IN-FACT

[Signature]
Florida Resident Agent
DENISE TAYLOR

INQUIRIES: (813) 281-2095

Seaboard Surety Company
St. Paul Fire and Marine Insurance Company
St. Paul Guardian Insurance Company
St. Paul Mercury Insurance Company

United States Fidelity and Guaranty Company
Fidelity and Guaranty Insurance Company
Fidelity and Guaranty Insurance Underwriters, Inc.

Power of Attorney No. 20025

Certificate No.

KNOW ALL MEN BY THESE PRESENTS: That Seaboard Surety Company is a corporation duly organized under the laws of the State of New York, and that St. Paul Fire and Marine Insurance Company, St. Paul Guardian Insurance Company and St. Paul Mercury Insurance Company are corporations duly organized under the laws of the State of Minnesota, and that United States Fidelity and Guaranty Company is a corporation duly organized under the laws of the State of Maryland, and that Fidelity and Guaranty Insurance Company is a corporation duly organized under the laws of the State of Iowa, and that Fidelity and Guaranty Insurance Underwriters, Inc. is a corporation duly organized under the laws of the State of Wisconsin (herein collectively called the "Companies"), and that the Companies do hereby make, constitute and appoint

James W. Dunn, David H. Carr, Mirna Ramos, Denise Taylor, James H. Hurst, Barbara N. Clindaniel, Penny E. Stockwell and Kimberly A. Waller

Tampa

Florida

of the City of Tampa, State of Florida, their true and lawful Attorney(s)-in-Fact, each in their separate capacity if more than one is named above, to sign its name as surety to, and to execute, seal and acknowledge any and all bonds, undertakings, contracts and other written instruments in the nature thereof on behalf of the Companies in their business of guaranteeing the fidelity of persons, guaranteeing the performance of contracts and executing or guaranteeing bonds and undertakings required or permitted in any actions or proceedings allowed by law.

IN WITNESS WHEREOF, the Companies have caused this instrument to be signed and sealed this 1st day of December 1999

Seaboard Surety Company
St. Paul Fire and Marine Insurance Company
St. Paul Guardian Insurance Company
St. Paul Mercury Insurance Company

United States Fidelity and Guaranty Company
Fidelity and Guaranty Insurance Company
Fidelity and Guaranty Insurance Underwriters, Inc.



John F. Phinney
JOHN F. PHINNEY, Vice President

Thomas E. Huibregtse
THOMAS E. HUIBREGTSE, Assistant Secretary

State of Maryland
City of Baltimore

On this 1st day of December 1999, before me, the undersigned officer, personally appeared John F. Phinney and Thomas E. Huibregtse, who acknowledged themselves to be the Vice President and Assistant Secretary, respectively, of Seaboard Surety Company, St. Paul Fire and Marine Insurance Company, St. Paul Guardian Insurance Company, St. Paul Mercury Insurance Company, United States Fidelity and Guaranty Company, Fidelity and Guaranty Insurance Company, and Fidelity and Guaranty Insurance Underwriters, Inc.; and that the seals affixed to the foregoing instrument are the corporate seals of said Companies; and that they, as such, being authorized so to do, executed the foregoing instrument for the purposes therein contained by signing the names of the corporations by themselves as duly authorized officers.

In Witness Whereof, I hereunto set my hand and official seal.

My Commission expires the 13th day of July, 2002.



Rebecca Easley-Onokala

REBECCA EASLEY-ONOKALA, Notary Public

This Power of Attorney is granted under and by the authority of the following resolutions adopted by the Boards of Directors of Seaboard Surety Company, St. Paul Fire and Marine Insurance Company, St. Paul Guardian Insurance Company, St. Paul Mercury Insurance Company, United States Fidelity and Guaranty Company, Fidelity and Guaranty Insurance Company, and Fidelity and Guaranty Insurance Underwriters, Inc. on September 2, 1998, which resolutions are now in full force and effect, reading as follows:

RESOLVED, that in connection with the fidelity and surety insurance business of the Company, all bonds, undertakings, contracts and other instruments relating to said business may be signed, executed, and acknowledged by persons or entities appointed as Attorney(s)-in-Fact pursuant to a Power of Attorney issued in accordance with these resolutions. Said Power(s) of Attorney for and on behalf of the Company may and shall be executed in the name and on behalf of the Company, either by the Chairman, or the President, or any Vice President, or an Assistant Vice President, jointly with the Secretary or an Assistant Secretary, under their respective designations. The signature of such officers may be engraved, printed or lithographed. The signature of each of the foregoing officers and the seal of the Company may be affixed by facsimile to any Power of Attorney or to any certificate relating thereto appointing Attorney(s)-in-Fact for purposes only of executing and attesting bonds and undertakings and other writings obligatory in the nature thereof, and subject to any limitations set forth therein, any such Power of Attorney or certificate bearing such facsimile signature or facsimile seal shall be valid and binding upon the Company, and any such power so executed and certified by such facsimile signature and facsimile seal shall be valid and binding upon the Company with respect to any bond or undertaking to which it is validly attached; and

RESOLVED FURTHER, that Attorney(s)-in-Fact shall have the power and authority, and, in any case, subject to the terms and limitations of the Power of Attorney issued them, to execute and deliver on behalf of the Company and to attach the seal of the Company to any and all bonds and undertakings, and other writings obligatory in the nature thereof, and any such instrument executed by such Attorney(s)-in-Fact shall be as binding upon the Company as if signed by an Executive Officer and sealed and attested to by the Secretary of the Company.

I, Thomas E. Huibregtse, Assistant Secretary of Seaboard Surety Company, St. Paul Fire and Marine Insurance Company, St. Paul Guardian Insurance Company, St. Paul Mercury Insurance Company, United States Fidelity and Guaranty Company, Fidelity and Guaranty Insurance Company, and Fidelity and Guaranty Insurance Underwriters, Inc. do hereby certify that the above and foregoing is a true and correct copy of the Power of Attorney executed by said Companies, which is in full force and effect and has not been revoked.

IN TESTIMONY WHEREOF, I hereunto set my hand this 21ST day of NOVEMBER, 2000



Thomas E. Huibregtse, Assistant Secretary

To verify the authenticity of this Power of Attorney, call 1-800-421-3880 and ask for the Power of Attorney clerk. Please refer to the Power of Attorney number, the above-named individuals and the details of the bond to which the power is attached.

ATTACHMENT 2 TO BID FORM

PROJECT NO.: WUD 98-66
PROJECT NAME: PLANT NO. 9 EASTERN HILLSBORO CANAL
AQUIFER STORAGE AND RECOVERY WELL SYSTEM
DATE: November 20, 2000

MINORITY AND WOMEN BUSINESS ENTERPRISE SCHEDULES

THESE SCHEDULES MUST BE COMPLETED AS APPLICABLE AND DEFINED IN INSTRUCTIONS TO BIDDERS SECTION 5.3 AND MUST BE SUBMITTED IN ACCORDANCE WITH PARAGRAPH 5.4.2 OF THE INSTRUCTIONS TO BIDDERS

- Schedule 1 - PARTICIPATON FOR M/WBE CONTRACTORS
- Schedule 2 - LETTER OF INTENT TO PERFORM AS A MINORITY SUBCONTRACTOR
- Schedule 3 - STATEMENT OF GOOD FAITH EFFORTS

ATTACHMENT 2 TO BID FORM

SCHEDULE 1 LIST OF PROPOSED MWBE SUBCONTRACTORS

Plant No. 9 Eastern Hillsboro
 PROJECT NAME: Canal Aquifer Storage & Recovery Well System PROJECT NO. WUD 98-66
 NAME OF PRIME BIDDER: The Haskell Company
 CONTACT PERSON: Norman C. Anderson PHONE NO: (904) 357-4868 FAX NO: (904) 357-4868
 BID DATE: November 21, 2000 DEPARTMENT: Water Utilities Department

Name, Address and Phone Number of MWBE	Type of Work To Be Performed	Subcontract Amount			Contractor's License/Certification Number	
		Women	Other (Please Specify)	Black		Hispanic
1. SUCA Pipe & Supply Co. PO Box 272482 Tampa, FL 33618	Supply pipe & fittings	\$ _____	\$ _____	\$ 83,211.00	\$ _____	_____
2. Integrity Well & Pump Co. 159 Windy Hill Lane Winchester, VA 22602	Well Drilling	\$ 1,365,075	\$ _____	\$ _____	\$ _____	_____
3.		\$ _____	\$ _____	\$ _____	\$ _____	_____
4.		\$ _____	\$ _____	\$ _____	\$ _____	_____
5.		\$ _____	\$ _____	\$ _____	\$ _____	_____
6.		\$ _____	\$ _____	\$ _____	\$ _____	_____

(Please use additional sheets if necessary) Total \$ 1,365,075 \$ _____ \$ 83,211.00 \$ _____

Total Bid Price \$ 2,773,680.00 Total Value of MWBE Participation \$ 1,448,286.00

NOTE: The amounts listed on this form must be supported by the Subcontractors prices included on Schedule 2 in order to be counted toward goal attainment. GOALS STATED IN THE BID REQUIREMENTS ARE MINIMUMS AND NO ROUNDING WILL BE ACCEPTED.

SCHEDULE 2

LETTER OF INTENT TO PERFORM AS A M/WBE SUBCONTRACTOR

PROJECT NO.: WUD 98-86

PROJECT NAME: Plant No. 9 Eastern Hillsboro Canal

Aquifer Storage and Recovery Wall System

TO: The Haskell Company
(Name of Prime Bidder)

The undersigned is certified by Palm Beach County as an (check one):

Black Business Enterprise Hispanic Business Enterprise _____

Women Business Enterprise _____ Other (Please Specify) _____

Date of Palm Beach County Certification: _____

The undersigned is prepared to perform the following described work in connection with the above project (Specify in detail particular work items or parts thereof to be performed): _____

VALVES, PIPES, FITTING & FLOWING

at the following price: _____
(Subcontractor's quote)

and will enter into a formal agreement for work with you conditioned upon your execution of a contract with Palm Beach County.

If undersigned intends to sub-subcontract any portion of this subcontract to a non-minority subcontractor or supplier, the amount of any such subcontract must be stated: \$ _____

The undersigned subcontractor understands that the provision of this form to prime bidder does not prevent subcontractor from providing quotations to other bidders.

SUCA PIPE SUPPLY
(Print name of M/WBE Subcontractor)

39-00-102093-58-8
(Print Subcontractor County License Number)

By: BARRON MADISON
(Signature)

Barron Madison
(Print name/title of person executing on behalf of M/WBE Subcontractor)

Date: 11/21/00

SCHEDULE 2

LETTER OF INTENT TO PERFORM AS A MWBE SUBCONTRACTOR
Plant No. 9 Eastern Hillsboro Canal
Aquifer Storage and Recovery Well System

PROJECT NO.: WUD 98-85

PROJECT NAME: _____

TO: The Haskell Company
(Name of Prime Bidder)

The undersigned is certified by Palm Beach County as an (check one):

Black Business Enterprise _____ Hispanic Business Enterprise _____

Women Business Enterprise Other (Please Specify) _____

Date of Palm Beach County Certification: Expires 7/31/01

The undersigned is prepared to perform the following described work in connection with the above project (Specify in detail particular work items or parts thereof to be performed): _____

Well drilling

at the following price: _____
(Subcontractor's quote)

and will enter into a formal agreement for work with you conditioned upon your execution of a contract with Palm Beach County.

If undersigned intends to sub-subcontract any portion of this subcontract to a non-minority subcontractor or supplier, the amount of any such subcontract must be stated: \$ N/A

The undersigned subcontractor understands that the provision of this form to prime bidder does not prevent subcontractor from providing quotations to other bidders.

Michael McEwen
(Print name of MWBE Subcontractor)

2106
(Print Subcontractor County License Number)

By: Peggy Shamblin
(Signature)

Peggy Shamblin, Office Admin.
(Print name/title of person executing on behalf of MWBE Subcontractor)

Date: 11/21/00

SCHEDULE #3

STATEMENT OF GOOD FAITH EFFORTS

BIDDER: The Haskell Company

PROJECT NO.: WUD 98-66 PROJECT NAME: Plant No. 9 Eastern Hillsboro Canal
Aquifer Storage and Recovery Well System

DATE: November 20, 2000

This form is to be completed if bidder fails to achieve the M/WBE goals established for this project. The bidder is allowed to use an alternate method that demonstrates the good faith efforts made to meet the goals established as long as all of the requested information is included. Failure to include all requested information shall result in the bid being determined as non-responsive to the M/WBE requirements.

The following list is not intended to be exclusive or exhaustive and the County will look not only at the different kinds of efforts the bidder has made, but also the quality, quantity, intensity and timeliness of those efforts. It is the responsibility of the bidder to exercise good faith efforts. Any act or omission by the County shall not relieve the bidder of this responsibility.

Criteria listed below are excerpted from Palm Beach County Code 2.71 through 2.80.13, as amended. A response is required to address each cited paragraph. Additional pages may be added as necessary.

1. Attendance at Pre-bid conference, if held:

yes no not held

2. Whether and when the bidder provided written notice to all certified M/WBEs listed in the Palm Beach County M/WBE Directory that perform the type of work to be subcontracted and advising the M/WBEs of the specific work the bidder intend to subcontract; that their interest in the contract is being solicited; and how to obtain information for the review and inspection of contract plans and specifications.

All letters from bidders to prospective M/WBE subcontractors must be post marked or fax recorded a minimum of 12 calendar days prior to the bid opening.

- Provide complete list of all M/WBEs solicited.
- Provide DATE letters were transmitted (M/WBEs will be canvassed as to who sent them letters and what date they were received.) Provide a copy of solicitation and all other letters sent to M/WBEs. Recommended information in your solicitation letter can include, but not be limited to, the following:

- Project specific information.
- Your willingness to assist with supply purchases.
- Bonding requirements of your firm.
- Any assistance your firm will be giving regarding bonding requirements, lines of credit and insurance requirements.
- Availability of specifications and plans through your office.

- Best time to reach you by phone (M/WBE firms will be canvassed regarding your responsiveness to their calls and project information they received from your firm.)
- Bid opening date and all addendum information.
- Your requirements/time frames/payment schedules.

Attachment 3A may be used to record the information required to show compliance with this section.

3. Whether the bidder selected feasible portions of work to be performed by M/WBEs, including, where appropriate, breaking contracts or combining elements of work into feasible units. The ability of the bidder to perform work with its own work force will not in itself excuse a bidder from making positive efforts to meet the established goals.

If appropriate, detail any subcontracting category that you have broken down to assist M/WBE firms and list firms that have been made aware of this reduced scope.

<u>Subcontracting Category</u>	<u>M/WBE Firm</u>
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

4. Whether the bidder considered all quotations received from M/WBEs and for those quotations not accepted, the bidder shall provide an explanation of why the M/WBE will not be used during the course of the contract. Receipt of lower quotation from non-M/WBE will not in itself excuse a bidders failure to meet project goals.

List all M/WBE firms who quoted this project; the amount quoted and the successful subcontractor (if not the M/WBE firm) and their quote.

<u>Name of M/WBE</u>	<u>M/WBE's Quote</u>	vs.	<u>Name of non-M/WBE Subcontractor Chosen</u>	<u>Subcontractors Quote</u>
_____	_____		_____	_____
_____	_____		_____	_____
_____	_____		_____	_____
_____	_____		_____	_____

5. Whether the bidder provided interested M/WBEs assistance in reviewing the contract plans and specifications.

Name the M/WBE firms provided assistance and describe how your firm provided such assistance.

6. Whether the bidder assisted interested MWBE firms in obtaining required bonding, lines of credit or insurance if such assistance was necessary.

If the project was above \$200,000 or exempt from the County's Bond Waiver Program, name the MWBEs assisted and describe the assistance provided.

7. Whether the bidder advertised in general circulation, trade association, and/or minority/women - focused media concerning the subcontracting opportunities.

The minority focused papers include:

Black

Florida Photo News
Palm Beach Gazette

Hispanic

El Latino Semanal
Alma Latina
La Voz Hispana
Pennysaver

List which papers carried your ad and attach a copy of the ad.

8. Whether the bidders followed up initial solicitations of interest by contacting MWBEs to determine with certainty whether the MWBE was interested.

Name the MWBE's you followed up with and describe your follow up efforts

9. Whether the bidder negotiated in good faith with interested MWBEs, not rejecting MWBEs as unqualified without sound reasons and based on a thorough investigation of their capabilities.

a) Provide a detailed statement of the reasons why subcontracts were not entered into with a sufficient number of MWBEs to meet the established

b) Provide a list of MWBE subcontractors you deemed unqualified and provide an explanation for the conclusion you reached.

c) For those M/WBE subcontractors contacted but determined to be unavailable, provide either:

i) a signed letter to the bidder from the M/WBE stating they are unavailable;

OR

ii) a statement from the bidder that the M/WBE subcontractor refused to submit a letter after a reasonable requests; and a detailed statement from the Bidder of the reasons for the bidder's conclusion.

10. Whether the bidder effectively used the services of available minority/women community organizations; minority/women contractors' groups; local, state and federal minority/women business assistance offices; and other organizations that provide assistance in the recruitment and placement of minority/women business enterprises.

The following is a partial list of M/WBE organizations that may be helpful in locating eligible M/WBEs.

<u>Organization</u>	<u>Phone</u>
Palm Beach Co. Office of M/WBE	561-233-1550
Department of Airport, DBE Program	561-471-7456
Florida Dept. of Labor & Employment	904-487-0915
Palm Tran, DBE Program	561-233-1166
Minority Contractors' Assn.	561-793-0476
N.A.W.I.C.	561-833-0333
Florida Dept. of Transportation	904-488-3145
Broward County Office of M/WBE	954-357-7800
Hispanic Human Resources	561-641-7400
Metropolitan Dade County	305-349-5960
PBC Resource Center, Inc.	561-863-0895
PBC School Bd. Office of Equity	561-624-2374
Broward Cty. School Board	954-765-6000
West Palm Beach, Office of M/WBE	561-659-8029
South FL. Water Mgmt. District	561-686-8800
North Broward Hospital District	954-847-4295

List minority/women organizations contacted.
(A minimum of three organizations must be contacted.)

Organization	Person Contacted	Date Contacted
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

11. Whether the bidder has utilized MWBE subcontractors on other County contracts within the past six months.

List any Palm Beach County projects your firm has performed in the last six (6) months, the MWBE subcontractors utilized and the dollar value of the MWBE's subcontractor.

<u>Project Name</u>	<u>MWBE Firms Used</u>	<u>Dollar Value</u>
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

12. Describe any additional efforts or circumstances which may assist the County in determining Good Faith Efforts.

**SCHEDULE 3A
MWBE SUBCONTRACTOR AND SUPPLIER MBE SOLICITATION SHEET**

FAILURE TO COMPLETE THIS SOLICITATION SHEET AND SUBMIT IT WITH BID MAY BE SUFFICIENT CAUSE FOR REJECTION OF THE BID. SUBMIT INFORMATION IN EACH COLUMN.
FAILURE TO COMPLETE AN AREA MAY RESULT IN A DETERMINATION THE BID IS NOT RESPONSIVE.

FIRM'S NAME: The Haskell Company PROJECT NAME: Plant No. 9 Eastern Hillsboro Canal Aquifer and Storage and Recovery Well System
 ADDRESS: 111 Riverside Avenue PROJECT NUMBER: WUD 98-66
Jacksonville, Florida 32202 PERFORMANCE BOND WAIVED: YES NO
 TELEPHONE: (904) 357-4868

INSTRUCTIONS: INFORMATION DETAILED ON SCHEDULE 3, ITEM #2 SHOULD AGREE WITH AND SUPPORT INFORMATION ON EACH FIRM LISTED BELOW. REFERENCE TO SCHEDULE 3, ITEM #8 MAY BE LISTED UNDER THE "REASONS FOR NOT USING THIS FIRM" COLUMN. LIST MWBE FIRMS SOLICITED TO PERFORM SUBCONTRACTING WORK OR TO SUPPLY MATERIALS.

Company Name & Contact Person	Address & Zip Code	Telephone No. & Area Code	Certification as MBE or WBE	Type of Subcontract Work or Materials	Date Contracted Cert. Mail, Fax. Phone No.	Quote Received	Dollar Amount	Reasons for Not Using This Firm
-------------------------------	--------------------	---------------------------	-----------------------------	---------------------------------------	--	----------------	---------------	---------------------------------

Contractor's contact with the Solicited Subcontractors and Suppliers should be at least 12 calendar days prior to the bid to ensure that the solicited firms have sufficient time to adequately prepare their bid.

PLEASE SUPPLY ANY OTHER INFORMATION WHICH MAY POSITIVELY IMPACT ON THE DETERMINATION OF YOUR FIRM AS A RESPONSIVE BIDDER ON ADDITIONAL SHEETS.

SIGNATURE: *[Handwritten Signature]* (AUTHORIZED REPRESENTATIVE) MWBE

ATTACHMENT 3 TO BID FORM

PROJECT NUMBER: WUD 98-66
PROJECT NAME: PLANT NO. 9 EASTERN HILLSBORO CANAL
AQUIFER STORAGE AND RECOVERY WELL SYSTEM

DATE:

LIST OF SUBCONTRACTORS

A list of subcontractors to be utilized on the project shall be provided herein. This list of subcontractors and their license numbers shall be included with the Supplemental Bid Documents. Refer to Instructions to Bidders, Paragraph 5.4. If the Bidder is to perform the labor component with its own forces, the Bidder shall list its own name on the appropriate line. The Contractor shall complete all categories that apply. Categories that do not apply shall be marked "N/A". Suppliers or off-site fabricators are not to be listed.

The purpose of this list is to discourage "sub-shopping" in general, and to provide a basis for the implementation of the substitution provisions of this Contract (Instructions to Bidder 2.3). The receipt of this Attachment in no way constitutes approval or disapproval by the County of any subcontractor listed. Failure to furnish all information may result in rejection of bid.

Following are the subcontractors to be used if the undersigned is awarded the contract.

	<u>CONTRACTOR</u>	<u>LICENSE/CERTIFICATE NO.</u>
ASBESTOS ABATEMENT	N/A	
CONCRETE	Self Perform	
EARTHWORK	Self Perform	
PAVING	N/A	
UNDERGROUND UTILITIES	Self Perform	
MASONRY	N/A	
STRUCTURAL STEEL	N/A	
CARPENTRY	N/A	
ROOFING SYSTEM	N/A	
GLASS & GLAZING	N/A	
PAINTING	N/A	
PLUMBING	N/A	
HEATING/AIR CONDITIONING	N/A	
PLANT 9S ELECTRICAL	C.C. Controls	
ELECTRICAL	Edwards Electrical	EC 0001100
FIRE SUPPRESSION	N/A	
INSTRUMENTATION	Rocha Controls	QB-0010762

Bidding Contractor: The Haskell Company

Signed By: 
Norman C. Anderson, Project Director

ATTACHMENT 4 TO BID FORM

PROJECT NO.: WUD 98-66
PROJECT NAME: PLANT NO. 9 EASTERN HILLSBORO CANAL
AQUIFER STORAGE AND RECOVERY WELL SYSTEM

DATE:

TRENCH SAFETY AFFIDAVIT

FAILURE TO COMPLETE THIS FORM MAY RESULT IN THE BID BEING DECLARED NONRESPONSIVE.

The Haskell Company (NAME OF CONTRACTOR) hereby provides written assurance that the Trench Safety Standards identified in the Occupational Safety & Health Administration's Excavation Safety Standards, (OSHA) 29 C.F.R. 1926.650 Subpart P will be adhered to during trench excavation in accordance with Florida Statute 553.60 through 553.64 inclusive (1990), "Trench Safety Act". The undersigned acknowledges that included in the various items of the proposal and in the Total Bid Price are costs for complying with the Florida "Trench Safety Act" as summarized below: (Attached additional sheets as necessary)

Schedule Item	Trench Safety Measure (Slope, Trench Shield, etc.)	Cost (Per Linear ft. of trench, or per sq. ft. of shoring)
Personal Protective Eqpmnt.	LS	\$2,000.00
Shoring	LS	\$8,000.00
Competent Person Training	LS	\$3,000.00
	TOTAL	\$13,000.00

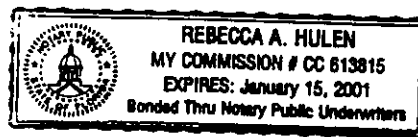
Norman C. Anderson November 20, 2000
 (Signature) Norman C. Anderson (Date)

Title: Project Director

State of Florida
 County of Duval

Subscribed and Sworn to (or affirmed) before me on the 20 day of November, 2000
Norman C. Anderson who is personally known to me or has presented _____
 (type of identification) as identification.

Rebecca A. Hulen
 Notary Public Signature and Seal
 Print Notary Name and Commission Number





STATE OF FLORIDA

DEPARTMENT OF BUSINESS AND PROFESSIONAL REGULATION

CONST INDUSTRY LICENSING BOARD
7950 ARLINGTON EXPRESSWAY
STE 300
JACKSONVILLE FL 32211-7467

(904) 727-6530

GOOD, TIMOTHY A
THE HASKELL COMPANY
PO BOX 43100
JACKSONVILLE

FL 32231-4100

DETACH HERE

AC# 5908146

STATE OF FLORIDA

DEPARTMENT OF BUSINESS AND PROFESSIONAL REGULATION
CONST INDUSTRY LICENSING BOARD

DATE	BATCH NUMBER	LICENSE NBR
07/12/2000	00900103	CG -C003375

The GENERAL CONTRACTOR
Named below IS CERTIFIED
Under the provisions of Chapter 489 FS.
Expiration date: AUG 31, 2002

GOOD, TIMOTHY A
THE HASKELL COMPANY
PO BOX 43100
JACKSONVILLE

FL 32231-4100

2000-2001 OCCUPATIONAL LICENSE TAX

LYNWOOD ROBERTS

OFFICE OF THE TAX COLLECTOR

CITY OF JACKSONVILLE and/or COUNTY OF DUVAL, FLORIDA

231 EAST FORSYTH STREET ROOM 130, JACKSONVILLE, FL 32202 PHONE: (904)630-2080 FAX: (904)630-1432

Note - A penalty is imposed for failure to keep this license exhibited conspicuously at your establishment or place of business.
This license is furnished in pursuance of chapter 770-772 City ordinance codes.

HASKELL CO, THE
PRESTON H HASKELL
ATTN TAX DEPT
111 RIVERSIDE AV
JACKSONVILLE, FL 32202-4917

ACCOUNT NUMBER: 016664-0000-8

LOCATION ADDRESS: 111 RIVERSIDE AV
32202-4917

DESCRIPTION: CONTRACTOR, ALL TYPES

County License Code: 770.307-001	County Tax: \$468.75
Municipal License Code: 772.309	Municipal Tax: \$1,031.25
	Total Tax Paid: \$1,500.00

VALID FROM OCTOBER 1, 2000 TO SEPTEMBER 30, 2001

RCPT# : 001/15/9050/0193/08092000 DATE: 8/08/2000 AMT: \$1,500.00

ATTENTION

The Following Construction Contractors Require Additional Licensure

ALARM
RESIDENTIAL
ELECTRICAL
MECHANICAL
GENERAL
UNDERGROUND UTILITY
REFRIGERATION

POOL
BUILDING
SHEET METAL
PLUMBING
CARPENTRY
HEATING

ALUMINUM/VINYL
ROOFING
SOLAR
IRRIGATION
WATER TREATMENT
AIR CONDITIONING

This is an occupational license tax only. It does not permit the licensee to violate any existing regulatory or zoning laws of the County or City. Nor does it exempt the licensee from any other license or permit required by law. This is not a certification of the licensee's qualification.



TAX COLLECTOR

THIS BECOMES A RECEIPT AFTER VALIDATION

State of Florida



Department of State

I certify from the records of this office that THE HASKELL COMPANY is a Florida corporation authorized to transact business in the State of Florida, qualified on January 21, 1983.

The document number of this corporation is G20498.

I further certify that said corporation has paid all fees due this office through December 31, 2000, that its most recent annual report/uniform business report was filed on March 6, 2000, and its status is active.

I further certify that said corporation has not filed a Certificate of Withdrawal.

Given under my hand and the
Great Seal of the State of Florida
at Tallahassee, the Capitol, this the
Twenty-sixth day of May, 2000



CR2EO22 (1-99)

Katherine Harris

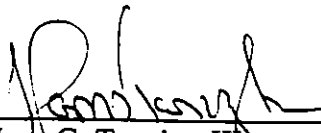
Katherine Harris
Secretary of State

**RESOLUTIONS OF THE BOARD OF DIRECTORS OF
THE HASKELL COMPANY**

On November 20, 2000, at a duly called special meeting of the Board of Directors of The Haskell Company (the "Company"), a Florida corporation, all of the directors of the Board of Directors of the Company were present. At such special meeting, the following resolution was adopted:

RESOLVED, that Norman C. Anderson, in his capacity as Project Director, is hereby designated and authorized to execute any and all documents necessary and appropriate to create a contract with Palm Beach County Utilities Department, Palm Beach, Florida that pertain to Plant No. 9 Eastern Hillsboro Canal Aquifer Storage and Recovery Well System Project No. WUD 98-66, on behalf of The Haskell Company.

DATED as of November 20, 2000.



Hans G. Tanzler, III
Secretary

C O N T R A C T

THIS CONTRACT, made and entered into this _____ day of _____, 20___, between PALM BEACH COUNTY, a political subdivision of the State of Florida, hereinafter referred to as the "County" and THE HASKELL COMPANY, hereinafter referred to as the "CONTRACTOR".

WITNESSETH:

That the said Contractor having been awarded the contract for the:

**PLANT NO. 9 EASTERN HILLSBORO CANAL
AQUIFER STORAGE AND RECOVERY WELL SYSTEM**

Project No.: WUD 98-66

in accordance with the Bid therefore and for and in consideration of the promises and of the covenants and agreements, and of the payments herein specified, to be made and performed by the Contractor and the County, the Contractor hereby covenants and agrees to and with the County to undertake and execute all of the said named work, in a good, substantial and workmanlike manner, and to furnish and pay for all materials, labor, supervision, equipment, supplies, fees, expertise, and services necessary to fully complete all work in accordance with all requirements of the Contract Documents and in accordance with all applicable codes and governing regulations, within the time limit specified in the Bid Form. The Contract Documents consist of the following documents which are incorporated herein by reference.

- A - Invitation to Bid, Instructions to Bidders, Bid Form and Attachments 1 through 4.
- B - Completed Bonds, Guarantee and Insurance Forms.
- C - General Conditions.
- D - Supplemental Conditions.
- E - Special Conditions.
- F - Technical Specifications.
- G - Addenda.
- H - Drawings.

Contractor agrees to accept as full compensation for the satisfactory performance of this Contract the sum of ~~TWO MILLION SEVEN HUNDRED SEVENTY THREE~~ THOUSAND SIX HUNDRED EIGHTY DOLLARS (\$2,773,680.00). The prices named in the Bid are for the completed work and all expense, direct or indirect, connected with the proper execution of the work and of maintaining the same until it is accepted by the Board of County Commissioners. It is understood that the Contractor holds and will maintain current appropriate certification and/or license for the purpose of performing the specified work pursuant to this Contract. The time limit for the Substantial Completion of all work under this contract shall be as stated in the Bid Form. The date

fixing the beginning of this period upon the calendar shall be established and stated in the Notice to Proceed.

IN WITNESS WHEREOF, the Board of County Commissioners of Palm Beach County, Florida, has made and executed this Contract on behalf of the said County and caused the seal of the said County to be affixed hereto, and the Contractor has hereunto set his hand and seal the day and year written. The Contractor represents that it is authorized to execute this contract on behalf of itself and its Surety.

ATTEST:
DOROTHY H. WILKEN, Clerk

PALM BEACH COUNTY, FLORIDA, A
Political Subdivision of the State of Florida

BOARD OF COUNTY COMMISSIONERS

BY: _____
Deputy Clerk

By: _____
(Chair)

APPROVED AS TO FORM AND LEGAL
SUFFICIENCY

'CONTRACTOR'

Assistant County Attorney

By: The Haskell Company
(Corporate Name)

Rebecca A. Hulen
(witness signature)

a Florida corporation
(insert state of corporation)

Rebecca A. Hulen
(witness name printed)

By: [Signature]
(signatory)

Rosemarie S. Kelly
(witness signature)

Norman C. Anderson
(print signatory's name)

Rosemarie S. Kelly
(witness name printed)

It's Project Director
(print title)

December 19, 2000
(date of execution)

(Corporate Seal)

END OF SECTION

PUBLIC CONSTRUCTION BOND

BOND NUMBER: 408112

BOND AMOUNT: \$2,773,680.00

CONTRACT AMOUNT: \$2,773,680.00

CONTRACTOR'S NAME: The Haskell Company

CONTRACTOR'S ADDRESS: 111 Riverside Avenue
Jacksonville, Florida 32202

CONTRACTOR'S PHONE: (904) 357-4868

SURETY COMPANY: SEABOARD SURETY COMPANY

SURETY'S ADDRESS: 600 N. WESTSHORE BLVD., SUITE 400
TAMPA, FL 33609

OWNER'S NAME: PALM BEACH COUNTY

OWNER'S ADDRESS: 2065 Prairie Road, Building "K"
West Palm Beach, Florida 33406

OWNER'S PHONE: (561) 641-3429

DESCRIPTION OF WORK: Construction of a five (5) million gallon per day aquifer storage and recovery well, monitoring wells, below grade vaults and outfall structure to the Hillsboro Canal.

PROJECT LOCATION: Hillsboro Canal approximately 1.5 miles west of State Road 7.

LEGAL DESCRIPTION: _____

BOND NUMBER 408112

PUBLIC CONSTRUCTION BOND

This Bond is issued simultaneously with a Performance Bond in favor of the County conditioned on the full and faithful performance of the Contract

KNOW ALL MEN BY THESE PRESENTS: that Contractor and Surety, are held and firmly bound unto Palm Beach County Board of County Commissioners
301 N. Olive Avenue
West Palm Beach, Florida 33401

as Obligee, herein called County, for the use and benefit of claimant as herein below defined, in the amount of

Dollars \$ 2,773,680.00
(Insert a sum equal to Contract Price)

for the payment whereof Principal and Surety bind themselves, their heirs, personal representatives, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS,

Principal has by written agreement dated December 15, 2000 entered into a contract with the County for

Project Name: PLANT NO. 9 EASTERN HILLSBORO CANAL
AQUIFER STORAGE AND RECOVERY WELL SYSTEM

Project No.: WUD 98-66

Project Description: Construction of a five (5) million gallon per day aquifer storage and recovery well, monitoring wells, below grade vaults and outfall structure to the Hillsboro Canal.

Project Location: Hillsboro Canal approximately 1.5 miles west of State Road 7

In accordance with Drawings and Specifications prepared by

PALM BEACH COUNTY WATER UTILITIES
2065 PRAIRIE ROAD, BUILDING "K"
WEST PALM BEACH, FLORIDA 33406
TELEPHONE: (561) 641-3429
FAX: (561) 641-3447

which contract is by reference made a part hereof in its entirety, and is hereinafter referred to as the Contract.

THE CONDITION OF THIS BOND is that if Principal:

1. Performs the contract dated December 15, 2000, ^{*Hillsboro Canal Aquifer Storage and Recovery Well System} between Principal and County for construction of Plant No. 9 Eastern*, the contract being made a part of this bond by reference, at the times and in the manner prescribed in the contract; and
2. Promptly makes payments to all claimants, as defined in Section 255.01(1), Florida Statutes, supplying Principal with labor, materials, or supplies, used directly or indirectly by Principal in the prosecution of the work provided for in the contract; and

3. Pays County all losses, damages (including liquidated damages), expenses, costs, and attorneys' fees, including appellate proceedings, that County sustains because of a default by Principal under the contract; and

4. Performs the guarantee of all work and materials furnished under the contract for the time specified in the contract, then this bond is void; otherwise it remains in full force.

5. Any changes in or under the contract documents and compliance or noncompliance with any formalities connected with the contract or the changes does not affect Surety's obligation under this bond and Surety waives notice of such changes.

6. The amount of this bond shall be reduced by and to the extent of any payment or payments made in good faith hereunder, inclusive of the payment by Surety of construction liens which may be filed of record against said improvement, whether or not claim for the amount of such lien be presented under and against the bond.

7. Principal and Surety expressly acknowledge that any and all provisions relating to consequential, delay and liquidated damages contained in the contract are expressly covered by and made a part of this Performance, Labor and Material Payment Bond. Principal and Surety acknowledge that any such provisions lie within their obligations and within the policy coverages and limitations of this Instrument.

8. Section 255.05, Florida Statutes, as amended, together with all notice and time provisions contained therein, is incorporated herein, by reference, in its entirety. This instrument regardless of its form, shall be construed and deemed a statutory bond issued in accordance with Section 255.03, Florida Statutes.

9. Any action brought under this instrument shall be brought in the state court of competent jurisdiction in Palm Beach County and not elsewhere.

Rebecca P. Fulton
Witness

THE HASKELL COMPANY
Principal (Seal)

Norman C. Anderson
Title Norman C. Anderson
Project Director

Kimberly A. Waller
Witness
KIMBERLY A. WALLER

SEABOARD SURETY COMPANY
Surety (Seal)

Denise Taylor
Title DENISE TAYLOR, ATTORNEY-IN-FACT AND
FLORIDA LICENSED RESIDENT AGENT

END OF SECTION

INQUIRIES: 813-281-2095

POWER OF ATTORNEY

Seaboard Surety Company
St. Paul Fire and Marine Insurance Company
St. Paul Guardian Insurance Company
St. Paul Mercury Insurance Company

United States Fidelity and Guaranty Company
Fidelity and Guaranty Insurance Company
Fidelity and Guaranty Insurance Underwriters, Inc.

Power of Attorney No. 20025

Certificate No.

KNOW ALL MEN BY THESE PRESENTS: That Seaboard Surety Company is a corporation duly organized under the laws of the State of New York, and that St. Paul Fire and Marine Insurance Company, St. Paul Guardian Insurance Company and St. Paul Mercury Insurance Company are corporations duly organized under the laws of the State of Minnesota, and that United States Fidelity and Guaranty Company is a corporation duly organized under the laws of the State of Maryland, and that Fidelity and Guaranty Insurance Company is a corporation duly organized under the laws of the State of Iowa, and that Fidelity and Guaranty Insurance Underwriters, Inc. is a corporation duly organized under the laws of the State of Wisconsin (herein collectively called the "Companies"), and that the Companies do hereby make, constitute and appoint

James W. Dunn, David H. Carr, Mirna Ramos, Denise Taylor, James H. Hurst, Barbara N. Clindaniel, Penny E. Stockwell and Kimberly A. Waller

Tampa

Florida

of the City of Tampa, State of Florida, their true and lawful Attorney(s)-in-Fact, each in their separate capacity if more than one is named above, to sign its name as surety to, and to execute, seal and acknowledge any and all bonds, undertakings, contracts and other written instruments in the nature thereof on behalf of the Companies in their business of guaranteeing the fidelity of persons, guaranteeing the performance of contracts and executing or guaranteeing bonds and undertakings required or permitted in any actions or proceedings allowed by law.

IN WITNESS WHEREOF, the Companies have caused this instrument to be signed and sealed this 1st day of December 1999

Seaboard Surety Company
St. Paul Fire and Marine Insurance Company
St. Paul Guardian Insurance Company
St. Paul Mercury Insurance Company

United States Fidelity and Guaranty Company
Fidelity and Guaranty Insurance Company
Fidelity and Guaranty Insurance Underwriters, Inc.



Handwritten signature of John F. Phinney, Vice President

JOHN F. PHINNEY, Vice President

Handwritten signature of Thomas E. Huibregtse, Assistant Secretary

THOMAS E. HUIBREGTSE, Assistant Secretary

State of Maryland
City of Baltimore

On this 1st day of December, 1999, before me, the undersigned officer, personally appeared John F. Phinney and Thomas E. Huibregtse, who acknowledged themselves to be the Vice President and Assistant Secretary, respectively, of Seaboard Surety Company, St. Paul Fire and Marine Insurance Company, St. Paul Guardian Insurance Company, St. Paul Mercury Insurance Company, United States Fidelity and Guaranty Company, Fidelity and Guaranty Insurance Company, and Fidelity and Guaranty Insurance Underwriters, Inc.; and that the seals affixed to the foregoing instrument are the corporate seals of said Companies; and that they, as such, being authorized so to do, executed the foregoing instrument for the purposes therein contained by signing the names of the corporations by themselves as duly authorized officers.

In Witness Whereof, I hereunto set my hand and official seal.

My Commission expires the 13th day of July, 2002.



Handwritten signature of Rebecca Easley-Onokala, Notary Public

REBECCA EASLEY-ONOKALA, Notary Public

This Power of Attorney is granted under and by the authority of the following resolutions adopted by the Boards of Directors of Seaboard Surety Company, St. Paul Fire and Marine Insurance Company, St. Paul Guardian Insurance Company, St. Paul Mercury Insurance Company, United States Fidelity and Guaranty Company, Fidelity and Guaranty Insurance Company, and Fidelity and Guaranty Insurance Underwriters, Inc. on September 2, 1998, which resolutions are now in full force and effect, reading as follows:

RESOLVED, that in connection with the fidelity and surety insurance business of the Company, all bonds, undertakings, contracts and other instruments relating to said business may be signed, executed, and acknowledged by persons or entities appointed as Attorney(s)-in-Fact pursuant to a Power of Attorney issued in accordance with these resolutions. Said Power(s) of Attorney for and on behalf of the Company may and shall be executed in the name and on behalf of the Company, either by the Chairman, or the President, or any Vice President, or an Assistant Vice President, jointly with the Secretary or an Assistant Secretary, under their respective designations. The signature of such officers may be engraved, printed or lithographed. The signature of each of the foregoing officers and the seal of the Company may be affixed by facsimile to any Power of Attorney or to any certificate relating thereto appointing Attorney(s)-in-Fact for purposes only of executing and attesting bonds and undertakings and other writings obligatory in the nature thereof, and subject to any limitations set forth therein, any such Power of Attorney or certificate bearing such facsimile signature or facsimile seal shall be valid and binding upon the Company, and any such power so executed and certified by such facsimile signature and facsimile seal shall be valid and binding upon the Company with respect to any bond or undertaking to which it is validly attached; and

RESOLVED FURTHER, that Attorney(s)-in-Fact shall have the power and authority, and, in any case, subject to the terms and limitations of the Power of Attorney issued them, to execute and deliver on behalf of the Company and to attach the seal of the Company to any and all bonds and undertakings, and other writings obligatory in the nature thereof, and any such instrument executed by such Attorney(s)-in-Fact shall be as binding upon the Company as if signed by an Executive Officer and sealed and attested to by the Secretary of the Company.

I, Thomas E. Huibregtse, Assistant Secretary of Seaboard Surety Company, St. Paul Fire and Marine Insurance Company, St. Paul Guardian Insurance Company, St. Paul Mercury Insurance Company, United States Fidelity and Guaranty Company, Fidelity and Guaranty Insurance Company, and Fidelity and Guaranty Insurance Underwriters, Inc. do hereby certify that the above and foregoing is a true and correct copy of the Power of Attorney executed by said Companies, which is in full force and effect and has not been revoked.

IN TESTIMONY WHEREOF, I hereunto set my hand this 15 day of December, 2000.



Thomas E. Huibregtse, Assistant Secretary

To verify the authenticity of this Power of Attorney, call 1-800-421-3880 and ask for the Power of Attorney clerk. Please refer to the Power of Attorney number, the above-named individuals and the details of the bond to which the power is attached.

ACORD CERTIFICATE OF LIABILITY INSURANCE PAGE 1 OF 2 DATE (MM/DD/YY) 15-DEC-2000

PRODUCER
 Willis Corroon Corporation of Florida
 7650 Courtney Campbell
 Causeway, Suite 920
 Tampa FL 33607
 (813) 281-2095

47572

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW.

Shari Segall
 INSURED

The Haskell Company
 P.O. Box 44100
 Jacksonville FL 32231-4100

COMPANIES AFFORDING COVERAGE	
COMPANY A	27855-006 (TAMP) Zurich American Insurance Company
COMPANY B	24678-001 (TAMP) Royal Indemnity Company
COMPANY C	
COMPANY D	

COVERAGES
 THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED, NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN. THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

CO LTR	TYPE OF INSURANCE	POLICY NUMBER	POLICY EFFECTIVE DATE (MM/DD/YY)	POLICY EXPIRATION DATE (MM/DD/YY)	LIMITS
A	GENERAL LIABILITY <input checked="" type="checkbox"/> COMMERCIAL GENERAL LIABILITY <input type="checkbox"/> CLAIMS MADE <input checked="" type="checkbox"/> OCCUR <input type="checkbox"/> OWNER'S & CONTRACTOR'S PROT	GLO297874900	31-JAN-2000	31-JAN-2001	GENERAL AGGREGATE \$ 2,000,000 PRODUCTS-COMP/OP AGG \$ 2,000,000 PERSONAL & ADV INJURY \$ 1,000,000 EACH OCCURRENCE \$ 1,000,000 FIRE DAMAGE (Any one fire) \$ 50,000 MED EXP (Any one person) \$ 5,000
A	AUTOMOBILE LIABILITY <input checked="" type="checkbox"/> ANY AUTO <input type="checkbox"/> ALL OWNED AUTOS <input type="checkbox"/> SCHEDULED AUTOS <input checked="" type="checkbox"/> HIRED AUTOS <input checked="" type="checkbox"/> NON-OWNED AUTOS	BAP297875100	31-JAN-2000	31-JAN-2001	COMBINED SINGLE LIMIT \$ 2,000,000 BODILY INJURY (Per person) \$ BODILY INJURY (Per accident) \$ PROPERTY DAMAGE \$
	GARAGE LIABILITY <input type="checkbox"/> ANY AUTO				AUTO ONLY - EA ACCIDENT \$ OTHER THAN AUTO ONLY: EACH ACCIDENT \$ AGGREGATE \$
	EXCESS LIABILITY <input type="checkbox"/> UMBRELLA FORM <input type="checkbox"/> OTHER THAN UMBRELLA FORM				EACH OCCURRENCE \$ AGGREGATE \$
A	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY THE PROPRIETOR/PARTNERS/EXECUTIVE OFFICERS ARE: <input type="checkbox"/> INCL <input type="checkbox"/> EXCL	WC297875000	31-JAN-2000	31-JAN-2001	<input checked="" type="checkbox"/> WC STATUTORY LIMITS <input type="checkbox"/> OTHER EL EACH ACCIDENT \$ 1,000,000 EL DISEASE-POLICY LIMIT \$ 1,000,000 EL DISEASE-EA EMPLOYEE \$ 1,000,000
B	OTHER Builders Risk	PST321843	31-JAN-2000	31-JAN-2001	Blanket Limit: \$75,000,000. \$2,500 ded/sep wind&flood All Risk subject to exclusion

DESCRIPTION OF OPERATIONS/LOCATIONS/VEHICLES/SPECIAL ITEMS
SEE ATTACHED

CERTIFICATE HOLDER
 Board of County Commissioners, Palm Beach Co., FL
 c/o Palm Beach Co. Water
 Utilities Dept., 2065
 Prairie Rd, PO Box 16097
 West Palm Beach FL 33416-6097

CANCELLATION
 SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING COMPANY WILL ENDEAVOR TO MAIL 30 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT. BUT FAILURE TO MAIL SUCH NOTICE SHALL IMPOSE NO OBLIGATION OR LIABILITY OF ANY KIND UPON THE COMPANY, ITS AGENTS OR REPRESENTATIVES.
 AUTHORIZED REPRESENTATIVE

Robert M. Allen

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW.

INSURED	47572	PRODUCER Willis Corroon Corporation of Florida 7650 Courtney Campbell Causeway, Suite 920 Tampa FL 33607 (813) 281-2095 Shari Segall
The Haskell Company P.O. Box 44100 Jacksonville FL 32231-4100		

COVERAGES
THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS MAY HAVE BEEN REDUCED BY PAID CLAIMS.

TYPE OF INSURANCE	POLICY NUMBER	POLICY EFFECTIVE DATE (MM/DD/YY)	POLICY EXPIRATION DATE (MM/DD/YY)	LIMITS
-------------------	---------------	----------------------------------	-----------------------------------	--------

DESCRIPTION OF OPERATIONS/LOCATIONS/VEHICLES/SPECIAL ITEMS
 Project: Plant No. 9 Eastern Hillsboro Canal Aquifer Storage and Recovery Well System
 Project No. WUD 98-66

It is agreed that the following are included as Additional Insureds as respects General Liability and Automobile Liability but solely in regards to work being performed by or on behalf of the Named Insured in connection with the project described herein:

The Board of County Commissioners, Palm Beach County, Florida (a political subdivision of the State of Florida)

Palm Beach County Water Utilities Department, its officers, directors, agents, and employees

The Engineer, its officers, agents, and employees

CERTIFICATE HOLDER

Board of County Commissioners, Palm Beach Co., FL
 c/o Palm Beach Co. Water
 Utilities Dept., 2065
 Prairie Rd, PO Box 16097
 West Palm Beach FL 33416-6097

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING COMPANY WILL ENDEAVOR TO MAIL 30 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT. BUT FAILURE TO MAIL SUCH NOTICE SHALL IMPOSE NO OBLIGATION OR LIABILITY OF ANY KIND UPON THE COMPANY, ITS AGENTS OR REPRESENTATIVES.

AUTHORIZED REPRESENTATIVE

[Signature]

FORM OF GUARANTEE

GUARANTEE FOR (Contractor and Surety Name) _____

We the undersigned hereby guarantee that the (PROJECT NAME AND NUMBER) Palm Beach County, Florida, which we have constructed and bonded, has been done in accordance with the plans and specifications; that the work constructed will fulfill the requirements of the guaranties included in the Contract Documents. We agree to repair or replace any or all of our work, together with any work of others which may be damaged in so doing, that may prove to be defective in the workmanship or materials within a period of one year from the date of Substantial Completion of all of the above named work by the County of Palm Beach, State of Florida, without any expense whatsoever to said County of Palm Beach, ordinary wear and tear and unusual abuse or neglect excepted by the County. When correction work is started, it shall be carried through to completion.

In the event of our failure to acknowledge notice, and commence corrections of defective work within five (5) calendar days after being notified in writing by the Board of County Commissioners, Palm Beach County, Florida, we, collectively or separately, do hereby authorize Palm Beach County to proceed to have said defects repaired and made good at our expense and we will honor and pay the costs and charges therefore upon demand.

DATED _____
(notice of completion filing date)

SEAL AND NOTARIAL ACKNOWLEDGMENT OF SURETY

Countersigned Resident Agent in Florida: _____ (Seal)
(Contractor)

_____ (Agent) By: _____ (Signature)

By _____ (Signature) _____ (Seal)
(Surety)

By: _____ (Signature)

END OF SECTION

GENERAL CONDITIONS

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1 Definitions

Wherever the words or terms defined in this section or pronouns used in their stead occur in the Specifications or other Contract Documents, they shall have the meanings herein given.

"Addendum" - A written explanation, interpretation, change, correction, addition, deletion, or modification of the Contract Documents issued in writing by the Engineer prior to opening the Bids.

"ADR" - Alternative Dispute Resolution.

"Agreement" - The written contract between the County and the Contractor covering the Work to be performed; when other documents are attached to the Agreement they become part of the Contract. The Agreement is also referred to as the Contract.

"Application for Payment" - The form furnished by the County which is to be used by the Contractor to request progress or final payment and which includes such supporting documentation as is required by the Contract Documents.

"Bonds" - Bid, Performance and Payment, and other instruments which protect against loss due to inability, failure or refusal of the Contractor to perform the Work specified in the Contract Documents.

"Change Order" - A document recommended by the Engineer, which is signed by the Contractor and the County and authorizes an addition, deletion, or revision in the Work, or an adjustment in the Contract Price or the Contract Time, issued on or after execution of the Agreement.

"Construction Manager" - The construction manager is an employee of the Contractor who shall be in attendance at the project site during performance of the Work and shall represent the Contractor. Communications given to the construction manager or decisions made by the construction manager shall be as binding as if given to or made by the Contractor. Important communications or decisions shall be confirmed in writing. Other communications or decisions shall be similarly confirmed on written request in each case.

"Contract Price" - The total monies payable by the County to the Contractor under the terms and conditions of the Contract Documents.

"Contract Time" - The number of successive calendar days stated in the Contract Documents for the completion of the Work.

"Defective Work" - Work that is unsatisfactory, faulty, or deficient; or that does not conform to the Contract Documents; or that does not meet the requirements of any inspection, reference standard, test, or approval referred to in the Contract Documents; or Work that has been damaged prior to the Engineer's recommendation of final payment.

"Drawings" - The drawings, plans, maps, profiles, diagrams, and other graphic representations which show the character, location, nature, extent and scope of the Work to be performed, which have been prepared and approved by the Engineer, and which are considered a part of the Contract Documents.

"Effective Date of the Agreement" - The date indicated in the Agreement on which it was executed, but if no such date is indicated it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

"Engineer" - PALM BEACH COUNTY WATER UTILITIES DEPARTMENT and its authorized agents, inspectors or representatives acting within the scope of duties entrusted to them by the County, and named as such in the Agreement.

"Field Order" - An order by the Engineer that does not impact the cost or time of performance of the Work.

"Final Acceptance" - The date the project is finally accepted by the Board of County Commissioners or their designee.

"General Requirements" - Division 1 of the Technical Specifications.

"Inclement Weather" - A normal work day during which the Contractor was unable to perform critical path work for a continuous period of more than four (4) hours during that day.

"Inspector" - The inspector shall be in attendance at the project site during performance of the Work and shall report to, and be under the direct supervision of, the Resident Engineer or Resident Project Representative. The inspector shall have no authority to permit deviation from or to modify any of the provisions of the Drawings or Specifications without the written permission or instruction of the Engineer.

"Laws and Regulations; Laws or Regulations" - Laws, rules codes, regulations, ordinances and/or orders promulgated by a lawfully constituted body authorized to issue such Laws and Regulations.

"Normal Working Hours" - Normal working hours shall consist of forty (40) hours per week with no more than eight (8) hours per day.

"Notice to Proceed" - The written notice issued by the County, or its authorized agents, to the Contractor authorizing the Contractor to proceed with the Work and establishing the date of commencement of the Contract Time.

"County" - Palm Beach County Board of County Commissioners, Palm Beach County, Florida.

"Partial Utilization" - Placing a portion of the Work in service for the purpose for which it is intended (or a related purpose) before reaching Substantial Completion for all the Work.

"Project" - The entire construction to be performed as provided in the Contract Documents.

"Resident Engineer" - (Same definition as for Resident Project Representative hereinafter).

"Resident Project Representative" - The resident project representative shall be in attendance at the project site during performance of the Work and shall represent the Engineer. Communications given to the resident project representative or decisions made by the resident project representative shall be as binding as if given to or made by the Engineer. Important communications or decisions shall be confirmed in writing. Other communications or decisions shall be similarly confirmed or requested in writing in each case.

"Shop Drawings" - All drawings, diagrams, illustrations, schedules, and other data which are specifically prepared by or on behalf of the Contractor to illustrate some portion of the Work, and all illustrations, brochures, standard schedules, performance charts, instructions, diagrams and other information prepared by a supplier and submitted by the Contractor to illustrate material or equipment for some portion of the Work.

"Specifications" - (Same definition as for Technical Specifications hereinafter).

"Subcontractor" - An individual, firm, or corporation having a direct contract with the Contractor or with any other Subcontractor for the performance of a part of the Work at the Site.

"Substantial Completion" - The date as determined by the Engineer, as evidenced by the Engineer's definitive Certificate of Substantial Completion, when the construction of the entire Project (or a specified part thereof) is sufficiently completed, in accordance with the Contract Documents, so that the entire Project (or a specified part) can be utilized for the purposes for which it is intended. When the entire Project is considered to be Substantially Complete, this does not constitute Final Acceptance or Final Completion of the entire Project.

"Supplier" - A manufacturer, fabricator, provider, distributor, materialman or vendor.

"Technical Specifications" - Those portions of the Contract Documents consisting of the General Requirements and written technical descriptions of materials, equipment, products, supplies, manufactured articles, standards and the execution of the Work.

"Underground Utilities" - All pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasement containing such facilities which have been installed underground to furnish any of the following services or materials: water, sewage and drainage removal, electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, traffic, or other control systems.

"Work Directive" - A written directive to the Contractor, issued on or after the Effective Date of the Agreement, signed by the County and recommended by the Engineer, ordering an addition, deletion or revision in the Work in response to an emergency or in the case of an inability to agree upon the amount of compensation of a requested change. The Contractor shall proceed upon receipt of a Work Directive to complete the work on a "cost plus" basis in accordance with Article 44, Paragraph A.3.C. A Work Directive may not change the Contract Price or Contract Time, but is evidence that the parties expect that the change directed or documented by a Work Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price and/or Contract Time.

"Written Amendment" - A written amendment of the Contract Documents, signed by the County and the Contractor on or after the Effective Date of the Agreement and normally dealing with the non-engineering or non-technical rather than strictly work-related aspects of the Contract Documents.

2 Preliminary Matters

When the Contractor delivers the signed Agreements to the County, the Contractor shall also deliver to the County such Bonds and Insurance Policies, Certificates or other documents as the Contractor may be required to furnish in accordance with the Contract Documents.

The County will furnish to the Contractor three (3) copies of the Contract Documents. Additional quantities of the Contract Documents will be furnished at reproduction cost.

The County and the Contractor in Section 8 of the Instructions to Bidders have the option to mutually agree to implement a partnering cooperative approach to problem solving.

3 Before Starting Construction

The Contractor shall submit to the Engineer for review those documents identified in the General Requirements of the Technical Specifications. Before undertaking each part of the Work, the Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures shown thereon and all applicable field measurements. The Contractor shall notify the Engineer, in writing, of all conflicts, errors, inconsistencies, or omissions which he may discover; and obtain specific instructions in writing from the Engineer before proceeding with any part of the Work affected thereby. The Contractor shall not take advantage of any apparent error or omission which may be found in the Contract Documents, but the Engineer shall be entitled to make such corrections therein and interpretations thereof, as he may deem necessary for the fulfillment of their intent. The Contractor shall be responsible for all errors in construction which could have been avoided by such examination and notification and shall correct at his own expense all Work improperly constructed through failure to notify the Engineer and request specific instructions.

4. Pre-construction Conference

Following the execution of the Agreement and prior to start of construction, a pre-construction conference will be scheduled by the Engineer, which must be attended by the Contractor. This conference will be held to review the above schedules, to establish procedures for handling shop drawings and other submissions, and to establish a working understanding between the Parties as to the Project. This conference may include representatives of the Engineer, County, local utilities, regulatory agencies, other contractors performing work in the area for the County, and any other party that may be deemed as necessary for the orderly performance of the Agreement. However, this does not relieve the Contractor of the responsibility of contacting local utilities and any other necessary agencies or contractors.

5 Intent and Amending Contract Documents

A. Intent

The Contract Documents comprise the entire Agreement between the County and Contractor concerning the Work. The Contract Documents are complementary, so that any Work exhibited in the one shall be executed just as if it has been set forth in all, in order that the Work shall be completed in every respect according to the complete design or designs as decided and determined by the Engineer.

It is the intent of the Contract Documents to describe the Work, functionally complete, to be constructed in accordance with the Contract Documents. Any work, materials, or equipment that may reasonably be inferred from the Contract Documents as being required to produce the intended result shall be supplied whether or not specifically called for.

In the event of a conflict, omission, error or discrepancy in the Contract Documents the Contractor shall promptly notify the Engineer. In resolving conflicts resulting from errors or discrepancies in any of the Contract Documents, the order of precedence shall be as set forth in Section 4.2.4 of the Instructions to Bidders.

The captions or subtitles of the several Articles and Divisions of these Contract Documents constitute no part of the context hereof, but are only labels to assist in locating and reading the provisions hereof.

From time to time during the progress of the Work, the Engineer may furnish supplementary drawings attached to a Change Order, a Field Order, a work Directive, or as a response to the Contractor's request for additional information, as he determines necessary to show changes or define the Work in more detail, and these also shall be considered as part of the Contract Documents.

B. Amending and Supplementing the Contract Documents

1. The Contract Documents may be amended to provide for additions, deletions and revisions in the Work or to modify the terms and conditions thereof in one or more of the following ways:
 - a. A formal Written Amendment
 - b. A Change Order
 - c. A Field Order
 - d. A work Directive

As indicated in Articles 44 and 49, Contract Price and Contract Time may only be changed by a Change Order.

2. In addition, the requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, in one or more of the following ways:
 - a. A Field Order
 - b. The Engineer's approval of a Shop Drawing or Sample, provided that Contractor has called such variation or deviation from the contract requirements to the attention of Engineer in a writing in accordance with GC 72, which specifically identifies the change.
 - c. The Engineer's written interpretation or clarification of the Intent of the Contract Documents.

6. Reuse of Documents

Neither the Contractor, nor any Subcontractor or Supplier, nor any other person or organization performing or furnishing any of the Work under a Contract with the County shall have or acquire any title to or ownership rights in any of the Drawings, Technical Specifications, or other documents (or copies of any thereof) prepared by the Engineer for use on the Work, and they shall not reuse any of them on extensions of the project or any other project without prior written consent of the County and the Engineer.

7. Occupying Private Land

The County shall furnish, as indicated in the Contract Documents, the Lands upon which the work is to be performed, Rights-of-way and easements for access thereto, and such other lands which are designated for the use of the Contractor. These Lands are shown on the Contract Drawings and it is the Contractor's Responsibility to perform the work within the legally described Limits of the Lands. The Contractor shall provide for all additional Lands and access thereto required for temporary Construction facilities or storage of equipment and materials.

The Contractor shall not (except after written consent from the proper parties) enter or occupy with personnel, tools, equipment or materials, any land outside the rights-of-way or property of the County. Upon request of the County, the Contractor shall give a copy of the written consent to the Engineer.

8 Work in State and County Rights-of-Way and Easements

When the Work involves the installation of sanitary sewers, storm sewers, drains, water mains, manholes, underground structures, or other disturbances of existing features in or across streets, rights-of-way, easements, or other property, the Contractor shall (as the Work progresses) promptly back-fill, compact, grade and otherwise restore the disturbed area to a basic condition which will permit resumption of pedestrian or vehicular traffic and any other critical activity or function consistent with the original use of the land. Unsightly mounds of earth, large stones, boulders, and debris shall be removed so that the site presents a neat appearance.

9 Work Adjacent to Telephone, Power, Water, Sewer, Drainage Cable TV and Gas Company Structures

In all cases where Work is to be performed near utilities including telephone, power, water, sewer, drainage, cable TV, or gas company facilities, the Contractor shall provide written notification to the respective companies of the areas in which Work is to be performed, prior to the actual performance of any Work in these areas, and shall take all actions necessary to protect such facilities from damage.

10 Use of Public Streets

The use of public streets and alleys shall be such as to provide a minimum of inconvenience to the public and to other vehicular and non-vehicular traffic. Any earth or excavated material spilled from trucks shall be removed by the Contractor and the streets cleaned to the satisfaction of the Engineer and the County Engineering Department, the Florida Department of Transportation, or other local agency having jurisdiction, as applicable.

11 Subsurface Investigation

In the preparation of the Contract Documents, the Engineer has relied on the reports and tests of subsurface conditions taken at the job site. Such reports are not guaranteed as to their accuracy or completeness and are not part of the Contract Documents.

The County and the Engineer do not warrant or guarantee the accuracy or correctness of this material with respect to actual subsurface conditions.

The Contractor shall be responsible for having determined to his satisfaction, prior to the submission of his Proposal, the nature and location of the Work, the conformation of the ground, the character and quality of the substrata, the types and quantity of materials to be encountered, the nature of the ground water conditions, the character of equipment and facilities needed preliminary to and during the execution of the Work, the general and local conditions and all other matters which can in any way affect the Work under this Contract. The prices established for the Work to be done will reflect all costs pertaining to the Work.

12 Obstructions

The information and data shown or indicated in the Contract Documents with respect to existing underground utilities at or contiguous to the site and reports of prior property ownership of the site are based on information and data furnished to the County or the Engineer by the owners of such Underground Utilities or others. The County and the Engineer are not responsible for the accuracy or completeness of any such information or data, and the Contractor shall have full responsibility for reviewing and checking all such information and data, for locating all Underground Utilities shown or indicated in the Contract Documents, for coordination of the Work with the owners of such Underground Utilities during construction, for the safety and protection thereof and repairing any damage thereto resulting from the Work, the cost of which will be considered as having been included in the Contract Price.

All water pipes, sanitary sewers, storm drains, force mains, gas mains, or other pipe, telephone or power cables or conduits, pipe or conduit casings, curbs, sidewalks, service lines and all other obstructions, whether or not shown, shall be temporarily removed from or supported across all excavations. Where it is necessary to temporarily interrupt services, the Contractor shall notify the Owner or occupant of such facilities, both before the interruption and again immediately before service is resumed. Before disconnecting any pipes or cables, the Contractor shall obtain permission from their owner, or shall make suitable arrangements for their disconnection by their owner. The Contractor shall be responsible for any damage to any such pipes, conduits or cables, and shall restore them to service promptly as soon as the Work has progressed past the point involved. Approximate locations of known water, sanitary, drainage, natural gas, power, telephone and cable TV installations along the route of new pipelines or in the vicinity of new work are shown, but are to be verified in the field by the Contractor prior to performing the Work. The Contractor shall uncover these pipes, ducts, cables, etc., carefully, by hand, prior to installing his Work. Any discrepancies or differences found shall be immediately brought to the attention of the Engineer in order that necessary changes may be made to permit installation of the Work.

13 Dimensions of Existing Structures

Where the dimensions and locations of existing structures are of critical importance in the installation or connection of new work, the Contractor shall verify such dimensions and locations in the field before the fabrication of any materials or equipment which is dependent on the correctness of such information.

14 Elevation Datum

The datum adopted by the Engineer is N.G.V.D. of 1929. All elevations on the Drawings or referred to in the Specifications refer to this datum.

15 Work to Conform

During its progress and on its completion, all Work shall conform truly to the lines, levels, and grades indicated on the Drawings or given by the Engineer and shall be built in a thoroughly substantial and workmanlike manner, in accordance with the Contract Documents and the written instructions or written directions given from time to time by the Engineer. In no case shall any Work in excess of the requirements of the Contract documents be paid for unless so approved in writing by an appropriately executed change order, work directive or written amendment.

All Work done without written instructions having been given therefor by the Engineer, done without proper lines or levels, or done during the absence of the Engineer, or his agent, will not be estimated or paid for except when such Work is authorized in writing by an appropriately executed change order, work Directive or written amendment. Work so done may be ordered uncovered or taken down, removed and replaced entirely at the Contractor's expense.

16 Location of Proposed Work

Piping and structures to be installed by contractor, will be located substantially as indicated on the Drawings, but the right is reserved by the County, acting through the Engineer, to make such modifications in location as may be found desirable to avoid interference with existing structures or for other reasons. Where fittings, etc., are noted on the Drawings, such notation is for the Contractor's convenience and does not relieve the Contractor from laying and jointing different or additional items where required without additional compensation.

17 Bonds

The successful Bidder shall, upon delivery of the executed Agreement to the County, deposit with the County a Public Construction Bond, in the form included in these documents, providing for the satisfactory completion of the Work and providing security for payment of all persons performing labor in connection with this Contract. Such bond shall be furnished in an amount equal to 100% of the amount of the Contract award as security for the faithful performance and payment of all Contractors' obligations under the Contract Documents. The form and conditions of the Bond and the Surety shall be acceptable to the County.

The bond shall be written by a Surety Company of recognized standing, licensed to do business in the State of Florida, and having a resident agent in the State of Florida. The Surety Company shall hold a current certificate of authority as acceptable surety on Federal Bonds in accordance with U.S. Department of Treasury, Fiscal Service, Bureau of Government Financial Operations, Circular 570, current revision, entitled, "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies". The bond shall be executed by an

Attorney-in-Fact for the Surety Company with a certified copy of his Power of Attorney attached to the Bonds.

The bonding limit of the Surety Company shall not exceed the limits indicated in the U.S. Department of Treasury listing unless the Surety Company submits a "reinsurance agreement form" indicating the amount above the bonding limit is insured by another Surety Company also on the U.S. Department of Treasury listing.

If the Surety Company on any Bond furnished to the County is declared, upon notification of the Insurance Agent, as bankrupt or becomes insolvent or its right or license to do business is terminated in the State of Florida, or it ceases to meet any of the requirements stated herein, the Contractor shall within ten (10) working days thereafter substitute another Bond and Surety Company at no cost to the County, both of which must be acceptable to the County. If the project is declared more than 90% complete by the Engineer and the County at the time of the Surety's bankruptcy or insolvency, the Contractor may, at the County's option, obtain a Maintenance Bond in the amount of 100% of the project cost, for the one (1) year warranty period after project completion. The Maintenance Bond shall be submitted on the form provided by the County and shall comply with all of the requirements for Performance and Payment Bonds stated herein.

Failure by the Contractor to substitute satisfactory Bonds under this section shall result in any or all of the following actions by the County:

1. Withholding of all applications for payment until satisfactory bonds are received and accepted, and/or;
2. Default in the Contract and cancellation as provided for in the Contract's default clause, and/or;
3. Suspension of the Contractor's name from the County's bid list for a period of not less than three (3) years from the date of Surety or Contract default.

18 Contractor's Insurance

Unless otherwise specified in this Contract, the Contractor shall, at its sole expense, maintain in full force and effect at all times during the performance of work hereunder, insurance coverage with limits not less than those set forth in the table below and with insurers and under forms of policies acceptable to the County. Contractor shall deliver to County Certificate(s) of Insurance evidencing that such policies are in full force and effect, not later than fifteen (15) calendar days after receipt of Notification of Intent to Award, but in any event, prior to execution of the Contract by County and prior to commencement of work on the project. Such certificate(s) shall adhere in every respect to the conditions set forth herein. All insurance shall be primary coverage with respect to the County and shall so state on the policy. Any insurance carried by the County, its consultants, or the Engineer, shall be excess insurance only.

The Contractor shall purchase and maintain during the life of this Contract, Worker's Compensation Insurance, including Employers Liability, to comply with all applicable state and federal laws covering all of its employees on the project, and in accordance with all of the limits, terms and conditions set forth herein. Contractor shall defend, indemnify and save the County and the Engineer harmless from any damages resulting to them for failure of Contractor to take out or maintain such insurance.

Contractor shall purchase and maintain during the life of this Contract Commercial General Liability Insurance in accordance with all of the limits, terms and conditions set forth herein.

Should any of the work hereunder involve watercraft owned or operated by Contractor, or any subcontractors, such shall be insured under the Commercial General Liability Policy or by other such liability insurance such as Protection and Indemnity.

Contractor shall purchase and maintain during the life of this Contract Comprehensive Automobile Liability Insurance covering all owned, non-owned and hired automobiles with all of the limits, terms and conditions set forth herein.

Should any of the Work hereunder involve the construction of a building and/or construction within an existing building, Contractor shall procure and maintain "ALL RISK" Builder's Risk Insurance, including, but not necessarily limited to fire, flood, wind or water damage, in accordance with all of the limits, terms and conditions set forth herein.

Should any of the Work hereunder involve the hauling and/or rigging of property in excess of \$500,000 or \$250,000 in transit, Contractor shall procure and maintain "ALL RISK" Transit or Motor Truck Cargo Insurance or a similar form of coverage insuring against physical damage or loss of property being transported, stored, moved, or handled by Contractor, or any subcontractors, pursuant to the terms of this Contract, subject to the limits, terms and conditions set forth herein.

Should any of the work hereunder involve aircraft (fixed wing or helicopter) owned or operated by Contractor, or any subcontractors, Contractor shall procure and maintain Aircraft Liability Insurance in accordance with the terms and conditions set forth herein.

The requirement contained herein as to types and limits, as well as County approval of insurance coverage to be maintained by Contractor are not intended to and shall not in any manner limit or qualify the liabilities and obligations assumed by Contractor under the Contract.

Certificates of Insurance must provide clear evidence that Contractor's Insurance Policies contain the minimum limits of coverage and terms and conditions set forth herein. All policies must be endorsed so that thirty- (30) days advance notification of cancellation and/or any material change(s) in coverage shall be provided to the Board of County Commissioners, Palm Beach County, Florida. Insurance shall remain in full force and effect until all work required to be performed under the terms of this Contract are satisfactorily completed as evidenced by final acceptance of the Work by Palm Beach County.

In the event that the insurance certificates provided hereunder indicate that the insurance shall terminate and lapse during the period of this Contract, then in that event, the Contractor shall furnish at least thirty (30) days prior to the expiration of such insurance, a renewed certificate of insurance as proof that equal and like coverage for the balance of the period of the Contract and any extension thereof is in effect. Contractor shall not continue to work pursuant to this Contract unless all required insurance remains in effect. County may, without liability to the Contractor, stop work and/or withhold payment to Contractor until coverage is reinstated.

Contractor shall deliver original Certificate(s) of Insurance to:

Palm Beach County Water Utilities Department
Engineering Division
P.O. Box 16097
West Palm Beach, FL 33416-6097

2065 Prairie Road, Building "K"
West Palm Beach, FL 33406

Notices of cancellation, terminations and alterations of said policies shall be delivered to:

Palm Beach County Water Utilities Department
 Contract Management Section
 P.O. Box 16097
 West Palm Beach, FL 33416-6097

2065 Prairie Road, Building "K"
 West Palm Beach, FL 33406

STANDARD CONSTRUCTION CONTRACT INSURANCE REQUIREMENTS

	<u>CONTRACTS LESS THAN \$500,000</u>	<u>CONTRACTS \$500,000 OR MORE</u>
COMMERCIAL GENERAL LIABILITY:		
Combined Single Limit Personal Injury	\$500,000 per occurrence	\$1,000,000 per occurrence
Bodily Injury and Property Damage		
Liability Required Coverages:		
Premises/Operations		
Independent Contractors		
Products/Completed Operations		
Contractual Liability		
Broad Form Property Damage		
X-C-U Coverages, if applicable		
WORKERS COMPENSATION AND EMPLOYER'S LIABILITY:	Statutory	Statutory
If work is on or contiguous to navigable bodies of water: U.S. Longshoremen's and Harbor	\$100/500/100 \$500/500/500	
Workers Act and/or Jones Act Endorsements		
If work involves water craft owned or operated by Contractor: Protection and Indemnity Coverage	\$5,000,000	per occurrence
If work involves hauling and/or rigging of property in excess of \$500,000:		
"ALL RISK" Transit or Motor Truck Cargo or similar form of insurance		Replacement cost coverage for highest value involved. Must contain a Waiver of Subrogation in favor of Palm Beach County
If work involves any type of aircraft (fixed wing or helicopter): Aircraft Liability		\$5,000,000 each occurrence bodily injury (including passenger)

and property damage

COMPREHENSIVE AUTO LIABILITY:

Combined Single Limit Bodily Injury and Property Damage (must include all owned, hired and non-owned vehicles)

\$500,000 per occurrence

\$500,000 per occurrence

BUILDER'S RISK:

"All Risk" including fire, flood, wind, water, vandalism and malicious mischief damage. Policy must specifically eliminate "Occupancy Clause". Must be endorsed to cover until final acceptance of project by the County. Sub-limits for any coverage are not acceptable if they are less than the total value of the project.

Limits equal to total project construction value. Contractor assumes all deductibles as ongoing cost of doing business. County is not providing any insurance on behalf of Contractor for loss or damage to work or to any other property of Contractor. If Contractor maintains any insurance for loss of or damage to Contractor's property, such must be endorsed to include a Waiver of Subrogation against Palm Beach County.

ADDITIONAL REQUIREMENTS FOR CERTIFICATES OF INSURANCE:

A. The certificate holder on the insurance certificate shall be "Board of County Commissioners, Palm Beach County, Florida" care of the Palm Beach County Water Utilities Department, 2065 Prairie Road, P.O. Box 16097, West Palm Beach, Florida 33416-6097.

B. The following paragraph shall appear unaltered on the Certificate of Insurance to guarantee that the Board of County Commissioners are named as additional insured:

"The Board of County Commissioners, Palm Beach County, Florida (a political subdivision of the State of Florida), are hereby named as additional insured under the terms of this policy."

C. The following paragraph shall appear unaltered on the Certificate of Insurance to guarantee that the Palm Beach County Water Utilities Department, its officers, directors, agents, and employees are named as additional insured:

"Palm Beach County Water Utilities Department, its officers, directors, agents, and employees are hereby named as additional insured under the terms of this policy."

D. The following paragraph shall appear unaltered on the Certificate of Insurance to guarantee that the Engineer, its officers, agents, and employees are named as additional insured.

"The Engineer, its officers, agents, and employees are hereby named as additional insured under the terms of this policy."

- E. Must clearly indicate project name and project number to which it applies.
- F. Must contain a provision that County is to be provided at least thirty (30) days prior written notice in the event of cancellation, non-renewal, or material adverse change(s) in coverage.
- G. Evidence of renewal coverage must be provided at least fourteen (14) days in advance of any policy that may expire during the term of this Contract.
- H. General Liability must state coverage is primary as respect to County and its authorized representatives and contain Cross Liability and Severability of Interest clauses.

19 Contractor's Responsibility

The Contractor shall supervise and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. The County and the Contractor in Article 12 of the Agreement have agreed to use a partnering cooperative approach to problem solving. The Contractor shall be solely and wholly responsible for the means, methods, techniques, sequences, and procedures of construction and safety precautions and programs incidental thereto. The Contractor shall be responsible to see that the finished Work complies accurately with the Contract Documents and for the good condition of the Work and materials until Final Acceptance by the County. The Contractor shall bear all losses resulting on account of the weather, fire, the elements, or other causes of every kind or nature prior to Final Acceptance.

The Contractor shall designate in writing and keep on the Work site at all times during progress of the Work, a technically qualified construction manager, who shall not be replaced without prior written notice to the County and the Engineer. The construction manager shall be the Contractor's representative at the site and shall have full authority to act on behalf of the Contractor. All communications given to the construction manager shall be as binding as if given to the Contractor. The Contractor shall issue all its communications to the County through the Engineer.

The Contractor's construction manager shall be present at the site of the Work at all times while Work is in progress. Failure to observe this requirement shall be considered as suspension of the Work by the Contractor until such time as a construction manager is again present at the site.

All materials shall be supplied and the Work shall be done in accordance with the rules, requirements, regulations and directives of various Building Departments and such other State, County, or City Departments having jurisdiction over the same and in accordance with the requirements of the representatives of the mortgagee or mortgagees, if any, or any other governmental bureau, agency, or department interested in this job either directly or indirectly. Contractor shall be responsible for making himself aware of any laws or ordinances which may affect Contractor's access to the project, the times of day when Contractor may prosecute the work, or in any other way affect Contractor's performance of the Work. County will not be liable to Contractor for any action of any other governmental or private entity or agency which impacts Contractor's costs or schedule for completing the Work.

Except as otherwise provided in this Article, the Contractor shall receive no additional compensation for overtime work, i.e., work in excess of eight (8) hours in any one calendar day or forty (40) hours in any one calendar week, even though such overtime work may be required under emergency

conditions and may be ordered by the Engineer in writing. Additional compensation will be paid to the Contractor for overtime work only in the event extra work is ordered by the Engineer and the change order specifically authorizes the use of overtime work and then only to such extent as overtime wages are regularly being paid by the Contractor for overtime work of a similar nature in the same locality.

All costs of field observations, inspection and testing performed by the Engineer during overtime work by the Contractor which is allowed solely for the convenience of the Contractor shall be borne by the Contractor, based upon Engineer's salary rates plus fringe benefits, overhead, profit and indirect costs in accordance with the terms of the Engineer's Agreement with the County. The County shall have the authority to deduct the cost of all such inspection and testing from any partial payments otherwise due to the Contractor.

Unless otherwise specified in the Contract Documents, the Contractor shall furnish and assume full responsibility for all materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, drainage, sanitary facilities, and all other facilities and incidentals necessary for the furnishing, performance, testing, start-up, and Final Completion of the Work. In emergencies affecting the safety or protection of persons or the Work or property at the site or adjacent thereto, Contractor, without special instruction or authorization from Engineer or County, is obligated to act to prevent threatened damage, injury or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby. If Engineer determines that a change in the Contract Documents is required because of the action taken in response to an emergency, a Work Directive or Change Order will be issued to document the consequences of the changes or variations.

20 Discontinuance of Construction

The Contractor agrees and guarantees to perform the above mentioned Work in accordance with the terms stated herein, irrespective of any strikes, lockouts, or stoppages, and the Contractor shall not employ men, means, materials, or equipment which may cause strikes, work stoppages, or any disturbances by workmen employed by the Contractor.

In the event the County is prevented from proceeding with any or all of this Work as stated in this Contract, due to a declaration of war, or national emergency, by the United States government, whereas the construction of the type contracted for herein is specifically prohibited by statute or governmental edict, or due to the stoppage of construction caused by any governmental agency, State, City, Town, or County regulations, orders, restrictions, or due to circumstances beyond the County's control, then the County herein reserves the right to either suspend the Work to be done for an indefinite period of time or to cancel this Agreement outright by giving notice by registered mail of such intention to the Contractor herein. In the event of any conditions above mentioned occurring after the Work herein has already been commenced, then the County herein shall be liable for only the cancellation or suspension without the addition of prospective profits or other charges whatsoever.

21 Guarantee

The Contractor guarantees that the Work and service to be performed under the Contract and all workmanship, materials, and equipment performed, furnished, used, or installed in the Work shall be free from defects and flaws, and shall be performed and furnished in strict accordance with the Contract Documents; that the strength of all parts of all manufactured equipment shall be adequate and as specified; and that performance test requirements of the Contract shall be fulfilled. The Contractor shall remedy all defects in the Work and shall repair, correct, or replace all damage to the other Work, persons or property resulting from failures covered by the guarantee. The guarantee shall remain in effect for one (1) year from the date of final acceptance unless a longer period is specified.

The County shall give notice of observed defects with reasonable promptness. Unremedied defects identified for correction during the guarantee period but remaining after its expiration shall be considered as part of the obligations of the guarantee. Defects in material, workmanship, or equipment which are remedied as a result of obligations of the guarantee shall subject the remedied portion of the Work to an extended guarantee period of one (1) year after the defect has been remedied. The Surety shall be bound with and for the Contractor in the Contractor's faithful observance of the guarantee.

22 Field Layout of Work

All Work under this Contract shall be constructed in accordance with the lines and grades shown on the Contract Drawings or as approved by the Engineer in writing. Elevation of existing ground, structures and appurtenances are believed to be reasonably correct but are not guaranteed to be absolute and therefore are presented only as an approximation.

All survey work for construction control purposes shall be made by a land surveyor registered in the State of Florida with demonstrated experience in the project area who shall be employed by the Contractor at his expense. The Contractor shall establish all base lines for the location of the principal component parts of the Work together with permanent benchmarks and temporary bench marks adjacent to the Work. Based upon the information provided by the Contract Drawings, the Contractor shall develop and make all detail surveys necessary for construction including establishment or construction of grid coordinates as shown on the Contract Drawings, location of property boundaries, stakes for all working points, lines and elevations.

The Contractor shall have the responsibility to carefully preserve all benchmarks, reference points and stakes. In case of destruction thereof by the Contractor resulting from his negligence, or for any other reason, he shall be held liable for any expense and damage resulting therefrom and shall be responsible for any mistakes that may be caused by the unnecessary loss or disturbance of such bench marks, reference points and stakes. Existing or new control points, property markers, and monuments that will be established or are destroyed during the normal causes of construction shall be re-established by the Contractor; and all reference ties recorded therefor shall be furnished to the Engineer. All computations necessary to establish the exact position of the Work shall be made and preserved by the Contractor.

23 Specifications

Where any materials, articles, items, equipment, or processes are specified by one or more trade or brand names, the substitution of unnamed materials, articles, items, equipment, or processes will not be allowed. Where the words "equivalent", "proper", "equal to", or "or Equal" are used, they shall be understood to mean that the referred to materials, items, equipment, articles or processes shall be the equivalent of, or equal to some other materials, items, equipment, articles or processes in the opinion or judgment of the Engineer. Unless otherwise specified, all materials, items, equipment, articles or processes shall be the best of their respective kinds and shall be in all cases, fully equal to samples acceptable to the Engineer. Even though the words "or equal" or other such expressions may be used in the Specifications, unless a substitute is accepted in writing by the Engineer, the Engineer shall have the right to require the use of such specifically designated material, equipment, items, articles or processes named in the Specifications.

24 Handling and Distribution

The Contractor shall, at his own expense, handle, haul and distribute all materials and all surplus materials on the different portions of the Work, as necessary. Suitable and adequate storage room for materials and equipment shall be furnished until the Final Acceptance of the Work.

Storage charges and demurrage charges by transportation companies and vendors, which result from delays in handling, shall be borne by the Contractor.

25 Storage of Materials

Suitable storage facilities shall be furnished by the Contractor. All materials, supplies and equipment intended for use in the Work shall be stored by the Contractor in accordance with the recommendations of the associated manufacturer or supplier to prevent damage from exposure, contamination by foreign substances, or vandalism. The Engineer may refuse to accept, or sample for testing, materials, supplies, or equipment that have been improperly stored. Materials, supplies and equipment found unfit for use shall not be incorporated in the Work and shall immediately be removed from the construction or storage site and replaced at no cost to the County.

Should the Contractor build temporary structures for housing workers, tools, machinery and supplies, they shall be permitted only at places acceptable under Local codes, Ordinances, Laws, Rules, and Regulations, and their surroundings shall be maintained at all times in a satisfactory and sanitary manner. On or before the completion of the Work, all such structure shall be removed in their entirety, together with all rubbish and trash, at the expense of the Contractor.

26 Salvaged and Excavated Materials

In the absence of special provisions to the Contract, salvaged and excavated materials, equipment or supplies that occur are the property of the County and shall be cleaned and stored as directed by the Engineer.

All excavated materials needed for back-filling operations or any other construction operation shall be stored on site. Where additional area is needed for stockpiling, it shall be obtained by the Contractor at no cost to the County.

27 Subcontracts

As soon as practical after execution of the Agreement, if not required in the Proposal, the Contractor shall notify the Engineer and request approval in writing, of the use of subcontractors proposed for the Work and shall not employ any that the Engineer may, within a reasonable time, determine are not performing the work in strict conformance with the Contract Documents, or approved changes thereto.

The Contractor agrees that he is as fully responsible to the County for the acts and omissions of his subcontractors and of persons either directly or indirectly employed by them, as he is for the acts and omissions of persons directly employed by him.

Nothing contained in the Contract Documents shall create any contractual relation between any subcontractor and the County.

The Contractor shall cause appropriate provisions to be inserted in all subcontracts relative to the Work to bind subcontractors to the Contractor by the terms of the General Conditions, the Supplemental General Conditions and other Contract Documents insofar as applicable to the Work of subcontractors, and to give the Contractor the same power as regards to terminating any subcontract that the County may exercise over the Contractor under any provision of the Contract Documents. The Contractor shall only Contract with bondable Subcontractors if the Subcontractor is performing work that represents more than 15% of the Work.

28 Permits

The Contractor shall, obtain all necessary permits, licenses, royalties, inspections and certificates pertaining to the Work and shall comply with all Federal, State, Municipal and local laws, ordinances, rules, regulations, orders, notices and requirements, whether or not provided by the Drawings, Specifications, General Conditions or other parts of the Contract Documents without additional charge or expense to the County and shall also be responsible for and correct at its own cost and expense, any violations thereof resulting from and in connection with its performance of the Work.

29 Employees

All labor described in these Specifications or indicated on the Drawings and the Work specified or indicated shall be executed in a thoroughly substantial and workmanlike manner by mechanics skilled in the applicable trades.

Any person employed on the Work who fails, refuses or neglects to obey the instructions of the Construction Manager in anything relating to this Work, or who appears to the Construction Manager to be disorderly, intoxicated, insubordinate, unfaithful or incompetent, shall upon the order of said Construction Manager, be at once discharged and not again employed in any part of the Work. Any interference with, or abuse or threatening conduct toward the Engineer or his inspectors by the Contractor or his employees or agents, shall be authority for the County to annul the Contract and re-let the Work. No intoxicating substance shall be allowed on the Work.

30 Florida Products and Labor

The Contractor's attention is called to Section 255.04, Florida Statutes, which requires that on public building contracts, Florida products and labor shall be used wherever price and quality are equal.

31 Equal Employment Opportunity

The Contractor shall not discriminate against employees or applicants for employment because of sex, race, color, religion, disability, age, ancestry, marital status, sexual orientation, or national origin. The Contractor will take affirmative action to ensure that applicants are employed and that employees are treated during employment, without regard to their sex, race, color, religion, disability, age, ancestry, marital status, sexual orientation, or national origin. Such action shall include but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of this nondiscrimination clause.

32 Sanitary Regulations

The Contractor shall provide adequate sanitary conveniences for the use of those employed on the Work. Such conveniences shall be made available when the first employees arrive on the Work, shall be properly secluded from public observation, and shall be constructed and maintained in suitable numbers and at such points and in such a manner as may be required by Local codes, Ordinances, Laws, Rules and Regulations.

The Contractor shall maintain the sanitary facilities in a satisfactory and sanitary condition at all times and shall enforce their use. He shall rigorously prohibit the committing of nuisances on the site of the Work, on the lands of the County, or on adjacent property.

The County and the Engineer shall have the right to inspect any building or other facility erected, maintained, or used by the Contractor, to determine compliance with these Sanitary Regulations.

33 Taxes

The Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by the Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

34 Contractor's Use of Premises

The Contractor's use of the project site shall be limited to its construction operations, including on-site storage of materials, on-site fabrication facilities, and field offices.

35 Accident Prevention

No laborer or mechanic employed in the performance of this Project shall be required to work in surroundings or under working conditions which are unsanitary, hazardous, or dangerous to his health or safety as determined under construction safety and health standards promulgated by the Secretary of Labor.

The Contractor shall appoint a qualified and experienced safety representative and shall exercise proper caution at all times for the protection of persons and property and shall be responsible for all damage to persons or property, either on or off the work site, which occur as a result of his prosecution of the Work. The safety provisions of applicable laws and building and construction codes shall be observed and the Contractor shall take or cause to be taken such additional safety and health measures as the Local Public Agency involved may determine to be reasonably necessary. Machinery, equipment and all hazards shall be guarded in accordance with the safety provisions of the "Manual of Accident Prevention in Construction" as published by the Associated General Contractors of America, Inc., to the extent that such provisions are not in conflict with applicable laws.

The Contractor shall maintain an accurate record of all cases of death, occupational disease, or injury requiring medical attention or causing loss of time from work, arising out of and in the course of employment on Work under the Contract. The Contractor shall promptly furnish the Local Public Agency with reports concerning these matters.

The Contractor shall indemnify and save harmless the County and the Engineer from any claims for damages resulting from property damage, personal injury and/or death suffered or alleged to have been suffered by any person as a result of any Work conducted under this Contract.

36 Precautions During Adverse Weather

During adverse weather, and against the possibility thereof, the Contractor shall take all necessary precautions to insure that the Work shall be done in a good and workmanlike condition and is satisfactory in all respects. When required, protection shall be provided by the use of tarpaulins, wood and building paper shelters, or other acceptable means. The Contractor shall be responsible for all changes caused by adverse weather, including unusually high winds and water levels and he shall take such precautions and procure such additional insurance as he deems prudent.

The Contractor may suspend construction operations at any time when, in his judgment, the conditions are unsuitable or the proper precautions are not being taken, whatever the weather or water level conditions may be, in any season.

37 Indemnification

In consideration of the amount listed in the Schedule of Prices Bid and other valuable consideration, the Contractor shall defend, indemnify and save harmless the County, its officers, agents, employees, and, from or on account of any injuries or damages, received or sustained by any person or persons during or on account of any operations connected with the construction of this Project; or by or in consequence of any negligent act or omission of the Contractor or his agents, employees, or subcontractors in whole or in part in connection with the same; or by use of any improper materials or by or on account of any use of any improper materials or by or on account of any act or omission of the said Contractor or his subcontractors, agents, servants or employees. Contractor agrees to indemnify and save harmless the County and the Engineer against any liability arising from or based upon the violation of any Federal, State, County or City laws, by-laws, ordinances or regulations by the Contractor, his subcontractors, agents, servants or employees. Contractor further agrees to indemnify and save harmless the County and the Engineer from all such claims and fees, and from any and all suits and actions of every name and description that may be brought against the County or the Engineer on account of any claims, fees, royalties, or costs for any invention or patent, and from any and all suits and actions that may be brought against the County or the Engineer for the infringement of any and all patents or patent rights claimed by any person, firm, or corporation.

The indemnification provided above shall obligate the Contractor to defend at his own expense or to provide for such defense, at the County's or Engineer's option, any and all claims or liability and all suits and actions of every name and description that may be brought against the County or the Engineer which may result from the operations and activities under this Contract whether the construction operations be performed by the Contractor, his subcontractor or by anyone directly or indirectly employed by either.

The Contractor further agrees to obtain, maintain and pay for such general liability insurance coverage as will insure the provisions of this Paragraph and other contractual indemnities assumed by the Contractor in this Contract.

The County will pay to the Contractor the specific consideration, in the amount stated in the Schedule of Prices Bid, within thirty (30) days of receipt by the County of the first Periodical Estimate for Partial Payment submitted by the Contractor. The Contractor shall acknowledge the receipt of payment and other good and valuable consideration from the County which has been paid to him as specific consideration for the indemnification provided herein and in accordance with the provisions of Chapter F.S.A., Section 725.06.

38 Non-assignable

This Agreement, nor any monies due hereunder, or any part thereof, shall not be assigned, transferred, or sublet by Contractor, nor shall County be liable to any assignee or transferee, or sublease, without the written consent of the County, and without consent to the assignment, transfer, or sublease, the County shall not release or discharge Contractor from any obligation hereunder. County shall not consider its approval to an assignment unless the Surety on the Contract Performance and Payment Bonds has informed the County in writing that it consents to the assignment.

39 Venue

This Agreement shall be governed by the laws of the State of Florida as now and hereafter in force. The venue for actions arising out of this Agreement is fixed in Palm Beach County, Florida. Should it become necessary for the County to engage an attorney to enforce this Agreement, the Contractor will pay the County all costs, including a reasonable attorney's fee.

40 Confidentiality

In the performance of the Work, the Contractor may be exposed to the confidential information of the County and others. The Contractor shall not disclose to anyone not employed by the County nor use, except on behalf of the County, any such confidential information acquired by it in the performance of the Work except as authorized by the County in writing and, regardless of the term of this Agreement, the Contractor shall be bound by this obligation until such time as said confidential information shall become part of the public domain. Information regarding all aspects of the County's business and information concerning the Work (either directly or indirectly disclosed to it or developed by it in the performance of the Work) shall be presumed to be confidential except to the extent that same shall have been published or otherwise made freely available to the general public without restriction. The Contractor also agrees that it will not disclose to the County any information it holds subject to any obligation or confidence to any third persons or parties.

41 Work by Others

The County may perform additional Work related to the Project by himself, or he may let other direct contracts therefor which shall contain General Conditions similar to these. The Contractor shall afford the other contractors who are parties to such direct contracts (or the County, if it is performing the additional work himself), reasonable opportunity for the introduction and storage of materials and equipment and the execution of the Work, and shall properly connect and coordinate his Work with theirs.

If any part of the Contractor's Work depends on proper execution or results upon the Work of any such other contractor (or County), the Contractor shall inspect and promptly report to the Engineer, in writing, any defects or deficiencies in such Work that render it unsuitable for such proper execution and results. His failure to so report shall constitute an acceptance of the other Work as fit and proper for the reception of his Work except as to defects and deficiencies, which may appear in the other Work after the execution of the Work under this Contract.

The Contractor shall do all cutting, fitting and patching of his Work that may be required to make its several parts come together properly and fit it to receive or be received by such other Work. The Contractor shall not endanger any Work of others by cutting, excavating or otherwise altering their Work and will only cut or alter their Work with the written consent of the Engineer and of the other contractors whose Work will be affected.

If the performance of additional Work by other contractors or the County is not noted in the Contract Documents prior to the execution of the Contract, written notice thereof shall be given to the Contractor by the Engineer prior to starting any such additional Work.

42 Engineer's Responsibility

The supervision of the execution of this Contract is vested wholly in the Contractor. The orders, instructions, directions, or requests of the County are to be given through the County's Engineer. The County's Engineer shall transmit them promptly to the Contractor as coming from the County and originating in the County. The Contractor shall designate a representative to receive such instructions, directions or requests in his absence and, failing to do so, will be held responsible for the execution of them.

The Engineer shall have the authority to suspend the Work wholly or in part for such period or periods as may be deemed necessary due to failure on the part of the Contractor to carry out orders given to perform any or all provisions of the Contract. This right of the Engineer to stop the Work shall not give

rise to any duty on the part of the Engineer to exercise this right for the benefit of the Contractor or any other party. The Contractor shall not suspend the Work and shall not remove any equipment, tools, lumber or other materials without the written permission of the County's Engineer.

The County's Engineer shall have free access to the materials and the Work at all times for measuring or observing the same, and the Contractor shall afford him all necessary facilities and assistance for so doing.

After written authorization to proceed with the Work, the Engineer shall:

1. Make visits to the site at intervals appropriate to the various stages of construction to observe the progress and quality of the executed Work and to determine, in general, if the Work is proceeding in accordance with the Contract Documents; not be responsible for the construction means, methods, procedures, techniques and sequences of construction and will not be responsible for the Contractor's failure to perform the construction Work in accordance with the Contract Documents; not be responsible for safety precautions and procedures in connection with the Work; and during such visits and on the basis of on-site observations, as an experienced and qualified design professional, will keep the County informed of the progress of the Work, will endeavor to guard the County against defects and deficiencies in the Work of the Contractor and may reject Work as failing to conform to the Contract Documents.
2. Issue with reasonable promptness such written clarifications or interpretations of the requirements of the Contract Documents (in the form of Drawings or otherwise) as the Engineer may determine necessary, which shall be consistent with or reasonably inferable from the overall intent of the Contract Documents.
3. Review samples, catalog data, schedules, shop drawings, laboratory, shop and mill tests of materials and equipment and other data, which the Contractor is required to submit, only for conformance with the design concept of the project and compliance with the information given by the Contract Documents, and assemble written guarantees, which are required by the Contract Documents.
4. Consult with and advise the County, act as the County's representative at the project site, issue all instructions of the County to the Contractor and prepare routine change orders as required.
5. Based on on-site observations, as an experienced and qualified design professional and on the review of the Contractor's applications for payment, determine the amount owing to the Contractor and approve in writing payment to the Contractor in such amounts; such approvals of payment to constitute a representation to the County, based on such observations and review of data comprising such applications, that the Work has progressed to the point indicated and that, to the best of its knowledge, information and belief, the quality of the Work is in accordance with the Contract Documents, subject to the results of any subsequent tests called for in the Contract Documents and any qualifications stated in the approval. Such partial and final payments will be as specified elsewhere herein except as modified in this paragraph.
6. Conduct, in the company of the County, a final inspection and an "eleventh month inspection of the Project for conformance with the design concept of the project and compliance with the information given by the Contract Documents, and

recommend to the County, in writing, acceptance of the Project for ownership and final payment to the Contractor in accordance with Article 59 "Final Payment and Acceptance."

The Engineer will be the initial interpreter of the requirements of the Contract Documents.

Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). The Engineer has agreed to participate in the use of a partnering cooperative approach to problem solving.

Neither the Engineer's authority to act under this Article or other provisions of the Contract Documents nor any decision made by the Engineer, in good faith either to exercise or not exercise such authority, shall give rise to any duty or responsibility of the Engineer to the Contractor, any Subcontractor, any Supplier, any Surety, or any other person or organization performing any of the Work.

Whenever in the Contract Documents the terms "as ordered", "as directed", "as required", "as allowed", "as reviewed", "as approved", or terms of the like effect or import are used, or the adjectives "reasonable", "suitable", "acceptable", "proper", or "satisfactory" or adjectives of the like effect or import are used to describe a requirement, direction, review, or judgment of the Engineer as to the Work, it is intended that such requirements, direction, review, or judgment will be solely to evaluate the Work for compliance with the Contract Documents, unless there is a specific statement indicating otherwise. The use of any such term or adjective shall not be effective to assign to the Engineer any duty or authority to undertake responsibility.

The authority and duties of the resident project representative are limited to examining the material furnished, observing the Work done, and reporting their findings to the Engineer. The Engineer does not underwrite, guarantee or insure the Work done by the Contractor. It is the Contractor's responsibility to perform the Work in all details in accordance with the Contract Documents. Failure by the Engineer or by any inspectors or other representatives of the County engaged in on-site observation to discover defects or deficiencies in the Work of the Contractor shall never, under any circumstances, relieve the Contractor from his liability therefor to the County. Inspectors shall have no authority to permit deviations from or to modify any of the provisions of the Drawings or Specifications without the written permission or instruction of the Engineer.

The Engineer, his representatives, employees, or any resident project representative in employment of the Engineer shall have no authority to supervise, direct, expedite or otherwise control and instruct or order the Contractor or his employees in the fulfillment of the Contractor's obligation. The County's instructions, orders, directions and/or orders to the Contractor shall be given only through the Engineer, or his employees.

The Engineer shall have the authority to disapprove or reject work which the Engineer believes to be defective or that the Engineer believes will not produce a completed project that conforms to the Contract Documents or that will prejudice the integrity of the construction of the completed Project as a functioning whole as indicated by the Contract Documents. The Engineer shall also have the authority to require special inspections or testing of the Work as provided in Article 51 of these specifications, whether the Work is fabricated, installed or completed.

If any Work (including the Work of subcontractors) that is to be inspected, tested or approved is covered without written concurrence of the Engineer, it must, if requested by the Engineer, be uncovered for observation. Such uncovering shall be at the Contractor's sole expense unless the

Contractor has given the Engineer timely notice of the Contractor's intention to perform such test or to cover the same and the Engineer has not acted with five (5) days in response to such notice.

If any Work is covered contrary to the written request of the Engineer, it must, if requested by the Engineer, be uncovered for the Engineer's observation and replaced at the Contractor's sole expense.

If the Engineer considers it necessary or advisable that covered Work be observed by the Engineer or inspected or tested by others, the Contractor, at the Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection or testing as the Engineer may require, that portion of the Work in question, furnishing all necessary labor, material and equipment. If it is found that such Work is defective, the Contractor shall bear all direct, indirect and consequential costs and damages of such uncovering, exposure, observation, inspection and testing and of satisfactory re-construction, including but not limited to fees and charges of engineers, attorneys and other professionals. However if such Work is found not to be defective, the Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Time, or both, directly attributable to such uncovering, exposure, observation, inspection, testing and re-construction; and if the parties are unable to agree as to the amount or extent thereof, the Contractor may make a claim therefor as provided in Articles 44 and 49.

The payment of any compensation, regardless of its character or form, or the giving of any gratuity, or the granting of any valuable favor, directly or indirectly, by the Contractor to any project representative, is strictly prohibited and any such act on the part of the Contractor will constitute a violation of the Contract.

43 Changes in the Work

Without invalidating the Agreement and without notice to any Surety, County may, at any time or from time to time, order additions, deletions, or revisions in the Work; these will be authorized by a Written Amendment, a Change Order, or a Work Directive Change. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).

If County and Contractor are unable to agree on the extent, if any, of an increase or decrease in the Contract Price or an extension or shortening of the Contract Time that should be allowed as a result of a Work Directive Change, a claim may be made thereof as provided in Article 44 or Article 49.

Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Time with respect to any Work performed that is not required by the Contract Documents as amended, modified and supplemented as provided, except in the case of an emergency as provided in Article 19.

County and Contractor shall execute appropriate Change Orders (or Written Amendments) covering:

- A. Changes in the Work which are ordered by County, or are required because of acceptance of defective work under Article 51 or correcting defective Work under Article 53, or are agreed to in writing by the parties;
- B. Changes in the Contract Price or Contract Time which are agreed to in writing by the parties; and,

- C. Changes in the Contract Price or Contract Time which embody the substance of any written decision rendered by Engineer pursuant to ADR, provided that, in lieu of executing any such Change Order, Contractor or County may litigate any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such ADR and litigations, Contractor shall carry on with the Work and adhere to the Progress Schedule as provided in Article 49.

If notice of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Time) is required by the provisions of any Bond to be given to a Surety, the giving of any such notice will be Contractor's responsibility, and the amount of each applicable Bond will be adjusted accordingly.

All changes to the contract must comply to Palm Beach County Board of County Commissioners Resolution R-89-633, any revisions thereto and any other policies enacted by the Board of County Commissioners in relation to contract changes.

44 Change of Contract Price

A. General

1. The Contract price constitutes the total compensation (subject to adjustments authorized in writing) payable to Contractor for performing the Work. All duties, responsibilities and obligations assigned to or undertaken by Contractor shall be at his expense without change in the Contract Price.
2. The Contract Price may only be changed by a Change Order. Any claim for an increase or decrease in the Contract Price shall be based on written notice delivered by the party making the claim to the other party and to the Engineer promptly (but in no event later than thirty (30) days) after occurrence of the event giving rise to the claim and stating the general nature of the claim. Notice of the amount of the claim with supporting data shall be delivered within sixty (60) days after such occurrence (unless the Engineer allows an additional period of time to ascertain more accurate data in support of the claim) and shall be accompanied by claimant's written statement that the amount claimed covers all known amounts (direct, indirect and consequential) to which the claimant is entitled as a result of the occurrence of said event. All claims for adjustment in the Contract Price shall be determined by ADR if County and Contractor cannot otherwise agree on the amount involved. No claim for an adjustment in the Contract Price will be valid if not submitted in accordance with this Article.
3. The value of any Work covered by a Change Order or of any claim for an increase or decrease in the Contract Price shall be determined in one of the following ways:
 - a. Where the Work involved is covered by unit prices contained in the Contract Documents, by application of unit prices to the quantities of the items involved.
 - b. By mutual acceptance of a lump sum (which may include an allowance for overhead and profit not necessarily in accordance with paragraph C.1).
 - c. On the basis of the Cost of the Work (determined as provided in paragraphs B.1 and B.2) plus a Contractor's Fee for overhead and profit (determined as provided in paragraphs C.1 and C.2).

B. Cost of the Work

1. The term Cost of the Work means the sum of all costs necessarily incurred and paid by Contractor in the proper performance of the Work. Except as otherwise may be agreed to in writing by County, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall include only the following items and shall not include any of the costs itemized in paragraph B.2.
 - a. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by County and Contractor. Payroll costs for employees not employed full time in the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits which shall include social security contributions, unemployment compensation, excise and payroll taxes, worker's or workmen's compensation, health and retirement benefits, bonuses, sick leave, vacation pay and holiday pay applicable thereto. Such employees shall include superintendents and foremen at the site. The expenses of performing Work after regular working hours, on Saturday, Sunday or legal holidays, shall be included in the above to the extent authorized by the County.
 - b. Costs of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and supplier's field services required in connection therewith.
 - c. Payments made by Contractor to the Subcontractors for Work performed by Subcontractors.
 - d. Cost of special consultants including but not limited to engineer's, architects, testing laboratories, surveyors, attorneys and accountants) employed for services specifically related to the Work.
 - e. Supplemental costs including the following:
 - (i) The proportion of necessary transportation, travel and subsistence expenses of Contractor's employees incurred in the discharge of duties connected with the Work.
 - (ii) Costs, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office and temporary facilities at the site and hand tools not owned by the workers, which are consumed in the performance of the Work, and costs less market value of such items used but not consumed which remain the property of Contractor.
 - (iii) Rentals of all construction equipment and machinery and the parts thereof whether rented from Contractor or others. The rental of any such equipment, machinery or parts shall cease when the use thereof is no longer necessary for completion of the Work or any portion thereof for which the equipment, machinery or parts are specifically required.
For special equipment and machinery such as power driven pumps, concrete mixers, trucks, front-end loaders, backhoes, and tractors, or other equipment required for the economical performance of the authorized Work, the Contractor shall receive

payment based on the weekly rate divided by 40 to arrive at an hourly cost. The weekly rate shall be from the latest edition of the Rental Rate Blue Book for Construction Equipment, published by Equipment Guide Book Co., reduced by twenty-five percent (25%). Equipment cost shall be calculated based upon the actual time used on the Work. If said Work requires the use of machinery not on the Work or not to be used on the Work, the cost of transportation, not exceeding a distance of one hundred (100) miles, of such machinery to and from the Work shall be added to the fair rental rate; provided, however, that this shall not apply to machinery or equipment already required to be furnished under the terms of the Contract.

(iv) Sales, consumer, use or similar taxes related to the Work, and for which Contractor is liable, imposed by Laws and Regulations.

(v) The cost of utilities, fuel and sanitary facilities at the site.

(vi) Minor expenses such as telegrams, long distance phone calls, telephone service at the site, expressage and similar petty cash items in connection with the Work.

(vii) Cost of premiums for additional Bonds and insurance required because of changes in the Work and for premiums for property insurance coverage within the limits of the deductible amounts established by County in accordance with Article 18.

2. The term Cost of Work shall not include any of the following:

- a. Payroll costs and other compensation of Contractor's officers, executives, principals (or partnerships and sole proprietorships), general managers, engineers, architects, estimators, attorneys, surveyors, auditors, accountants, purchasing and contract agents, expeditors, timekeepers, clerks and other personnel employed by Contractor whether at the site or in Contractor's principal office or a branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in paragraph B.1.a or specifically covered by paragraph B.1.d, all of which are considered administrative costs covered by the Contractor's fee.
- b. Expenses of Contractor's principal and branch offices other than Contractor's office at the site.
- c. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.
- d. Cost of premiums for all Bonds and for all insurance whether or not Contractor is required by the Contract Documents to purchase and maintain the same (except for the cost of premiums covered by subparagraph B.1.e.vii above).
- e. Costs due to the negligence of Contractor, any subcontractor, or anyone directly or indirectly employed by any of them or for those acts any of them may be liable for, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied and making good any damage to property.
- f. Other overhead or general expense costs of any kind and the costs of any items not specifically and expressly included in paragraph B.1.

C. Contractor's Fee

1. The Contractor's Fee allowed for overhead and profit shall be determined as follows:
 - a. A mutually acceptable fixed fee, or if none can be agreed upon, a fee based on the following percentages of the various portions of the Cost of the Work:
 - (i) For costs incurred under paragraphs B.1.a and B.1.b, the Contractor's Fee shall be fifteen percent (15%).
 - (ii) For costs incurred under paragraph B.1.c, the Contractor's Fee shall be five percent (5%); and if a subcontract is on the basis of Cost of the Work plus a Fee, the maximum allowable fee to Contractor on account of overhead and profit of all subcontractors shall be fifteen percent (15%).
 - (iii) No fee shall be payable on the basis of costs itemized under paragraph B.1.d, B.1.e, and B.2.
 - (iv) The amount of credit to be allowed by Contractor to County for any such change which results in a net decrease in cost will be the amount of the actual net decrease plus a deduction in Contractor's Fee by an amount equal to ten percent (10%) of the net decrease; and,
 - (v) When both additions and credits are involved in any one change, the adjustment in Contractor's Fee shall be computed on the basis of the net change in accordance with paragraphs C.1.b.i through C.1.b.iv, inclusive.
2. Whenever the cost of any Work is to be determined pursuant to paragraph B.1 or B.2, Contractor will submit in a form acceptable to the Engineer an itemized cost breakdown together with supporting data.
3. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the established unit prices for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement. The estimated quantities of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by Contractor will be made by Engineer. Each Unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

Where the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement and there is not a corresponding adjustment with respect to any other item of Work and if Contractor believes that Contractor has incurred additional expense as a result thereof, Contractor may make a claim for an increase in the Contract Price in accordance with ADR if the parties are unable to agree as to the amount of any such increase.

45 Change Procedures

A. Minor Changes:

The Engineer will advise the Contractor, in writing, of minor changes in the Work not involving an adjustment to Contract Price or Contract Time by issuance of a Field Order.

B. Other Changes:

1. The County, through its Engineer may, at any time, without notice to the surety, by written order designated or indicated to be a change order, make any change in the Work within the general scope of the Contract, including but not limited to changes:
 - a. In the Specifications (including drawings and designs);
 - b. In the time, method or manner of performance of the Work;
 - c. In the County furnished facilities, equipment, materials, services, or site; or
 - d. Directing acceleration in the performance of the Work.
2. Any other written order (which terms as used in this paragraph shall include direction, instruction, interpretation, or determination) from the County, which causes any change, shall be treated as a change order under this clause, provided that the Contractor gives the County written notice not later than ten (10) days after the occurrence of the event giving rise to the claim but prior to incurring any expense stating the date, circumstances, and source of the order and that the Contractor regards the order as a Change Order.
3. Except as provided in this Article, no order, statement, or conduct of the County shall be treated as a change under this clause or entitle the Contractor to an equitable adjustment, and this Article shall not allow, nor be construed to allow, a claim otherwise disallowed by the Contract Documents.
4. If any change under this clause causes an increase or decrease in the Contractor's cost of, or the time required for, the performance of any part of the Work under this Contract, whether or not changed by any order, an equitable adjustment shall be made and the Contract modified in writing accordingly; provided however, that no claim for any change under Paragraph 2 above shall be allowed for any costs unless the Contractor gives written notice as herein required.
5. If the Contractor intends to assert a claim for an equitable adjustment under this clause, it must, within thirty (30) days after receipt of a written Change Order under Paragraph 1 above or the furnishing of a written notice under Paragraph 2 above, submit to the County a written statement setting forth the general nature and monetary extent of such claim, unless this period is extended by the County. The statement of claim hereunder may be included in the notice under Paragraph 2 above.
6. No claim by the Contractor for an equitable adjustment hereunder shall be allowed if asserted after final payment under this Contract.

46 Omitted Work

The County may, at any time, by a written order, without notice to the Sureties, require the omission of such Contract Work as it may find necessary or desirable. An order for omission of Work shall be valid only by an executable change order. All Work so ordered must be omitted by the Contractor. The amount by which the Contract Price shall be reduced shall be determined as follows:

- a. By such applicable unit prices, or rates for work of a similar nature or character as set forth in the Contract; or,
- b. By the appropriate lump sum price set forth in the Contract; or,
- c. By the reasonable and fair estimated cost of such omitted Work as determined by the Contractor and the Engineer, and approved by the County.

47 Changes Not to Affect Bonds

It is distinctly agreed and understood that any changes made in the Contract Documents for Work associated with this Project (whether such changes increase or decrease the amount thereof) or any change in the manner or time of payments or time of performance made by the County to the Contractor shall in no way annul, release or affect the liability and surety on the Bonds given by the Contractor.

If notice of any change is required to be given to a Surety by the provisions of any Bond, the giving of any such notice will be the Contractor's responsibility, and the amount of each applicable Bond shall be adjusted accordingly.

48 Continuing the Work

Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with County. If the Contractor and County are unable to agree, all such disputes shall be referred to ADR and litigation. No Work shall be delayed or postponed pending resolution of any disputes or disagreements except as the Contractor and County agree in writing otherwise and County shall continue to make payments in accordance with the Contract Documents.

49 Change of Contract Time

The Contract Time may only be changed by a Change Order. Any claim for an extension of the Contract Time shall be based on written notice delivered by the Contractor to the Engineer promptly (but in no event later than 10 days) after the occurrence of the event giving rise to the claim and stating the general nature of the claim. Notice of the extent of the claim with supporting data shall be delivered within thirty (30) days after such occurrence (unless the Engineer allows, in writing, an additional period of time to ascertain more accurate data in support of the claim) and shall be accompanied by the Contractor's written statement that the adjustment claimed is the entire adjustment to which the Contractor has reason to believe it is entitled as a result of the occurrence of said event. All claims for adjustment in the Contract Time shall be determined by the Engineer in accordance with Article 42 if County and Contractor cannot otherwise agree. No claim for an adjustment in the Contract Time shall be valid if not submitted as previously specified above.

The Contract Time will be extended in an amount equal to time lost due to delays beyond the control of Contractor if a claim is made therefor as provided in this Article. Such delays shall include, but not be limited to, acts or neglect by County or others performing additional Work as contemplated by Article 41, or to fires, floods, labor disputes, epidemics, abnormal weather conditions (Article 50) or acts of God.

Pursuant to the Contract's float-sharing requirements, no time extensions will be granted nor delay damages considered until a delay occurs that impacts the project's critical path, consumes all available float, and extends the work beyond the Contract completion date.

50 Extension of Time on Account of Weather/Inclement Weather

If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be submitted within five (5) days of occurrence and shall be documented by data substantiating that weather conditions where the contractor was unable to perform work, for the period of time required for completion of the Work and could not have been reasonably anticipated and that weather conditions had an adverse effect on the scheduled construction.

The Contractor's construction schedule shall be based upon the inclusion of at least fifteen (15) calendar days per calendar year, of inclement weather delays to be prorated over the length of the contract. Further, the contractor has the responsibility to take reasonable precautions to mitigate the impact of unfavorable weather conditions.

Failure by the contractor to comply with the proper notice or to supply substantial data within the time limit, will result in the contractor waiving its claim for weather delay.

51 Materials, Samples and Inspections

Unless otherwise indicated on the Drawings or specified elsewhere, only new materials and equipment shall be incorporated in the Work. All materials and equipment furnished by the Contractor to be incorporated in the Work shall be subject to inspection by the Engineer. No material shall be processed for, fabricated for, or delivered to the Site without prior acceptance from the Engineer.

If not required by the Proposal, as soon as possible after the formal execution of the Agreement, the Contractor shall submit to the Engineer, the names and addresses of the manufacturers and suppliers of all materials and equipment he proposes to incorporate into the Work. When shop and supplemental drawings are required as specified below, such information shall be submitted prior to the submission of the drawings so that the Engineer may consider the manufacturer, and/or the supplier, to be acceptable or unacceptable, as to his or their ability to furnish a product meeting the Specifications, subject to final acceptance of the particular material or equipment. As requested, the Contractor shall also submit data relating to the material and equipment he proposes to incorporate into the Work, in sufficient detail to enable the Engineer to identify the particular product in question and to form an opinion as to its conformity to the Contract requirements. Such data shall be submitted in a manner similar to that specified for shop drawings.

Facilities and labor for the handling and inspection of all materials and equipment shall be furnished by the Contractor. Defective materials and equipment shall be removed immediately from the site of the Work. The Engineer will make arrangements for, and the County shall pay for soil density tests wherever and whenever the Engineer desires. If the results of a density test indicate that compaction is less than that specified in the Specifications, the Contractor shall reimburse the County for the full cost of the test.

If the Engineer so requires, either prior to beginning or during the progress of the Work, the Contractor shall submit samples of materials for such special tests as may be necessary to demonstrate that they conform to the requirements of the Contract Documents. Such samples, including concrete test cylinders, shall be furnished, taken, stored, packed, and shipped as directed, at the expense of the Contractor. The Contractor shall, at his own expense, furnish acceptable molds for making concrete test cylinders. Except as otherwise specified, the County will make arrangements for, and pay for, the tests.

All samples shall be packed so as to reach their destination in good condition, and shall be labeled to indicate the material represented, the name of the building or Work and location of which the material

is intended, and the name of the Contractor submitting the sample. To ensure consideration of samples, the Contractor shall notify the Engineer by letter that the samples have been shipped and shall properly describe the samples in the letter. In no case shall the original letter of notification be enclosed with the samples.

The Contractor shall submit data and samples, or place his orders, sufficiently early to permit consideration, inspection, testing, and acceptance before the materials and equipment are needed for incorporation in the Work. Delay resulting from his failure to do so shall not be used as the basis of a claim against the County or the Engineer.

When required, the Contractor shall furnish to the Engineer triplicate sworn copies of manufacturer's shop or mill tests (or reports from independent testing laboratories) relative to materials and concrete data.

After the samples, data, etc., are considered acceptable to the Engineer, the materials and equipment used on the Work shall correspond therewith.

If the Work is defective, or the Contractor fails to perform the Work in such a way that the completed Work will conform with the Contract Documents, the County may order the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of the County to stop the Work, or the right of the Engineer to make this recommendation to the County, shall not give rise to any duty on the part of the County or the Engineer to exercise this right for the benefit of the Contractor or any other party.

If required by the Engineer, the Contractor shall promptly either correct all defective Work, whether or not fabricated, installed, or completed, or, if the Work has been rejected by the Engineer, remove it from the site and replace it with non-defective Work. The Contractor shall bear all direct, indirect, and consequential costs of such correction or removal, including but not limited to fees and charges of engineers, architects, attorneys, and other professionals made necessary thereby.

If, instead of requiring correction or removal and replacement of defective Work, County, and, prior to Engineer's recommendation of final payment, also Engineer, prefers to accept the Work, County may do so. Contractor shall bear all direct, indirect and consequential costs attributable to County's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness and to include but not be limited to fees and charges of engineers, architects, attorneys and other professionals). If any such acceptance occurs prior to Engineer's recommendation of Final Payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and County shall be entitled to an appropriate decrease in the Contract Price, and, if the parties are unable to agree as to the amount thereof, County may make claim therefor as provided in Article 44. If the acceptance occurs after such recommendation, an appropriate amount will be paid by the Contractor to the County.

52 Inspection of Work Away From the Site

If Work to be done away from the construction site is to be inspected on behalf of the County during its fabrication, manufacture, or testing, or before shipment, the Contractor shall give notice to the Engineer of the place and time where such fabrication, manufacture, testing or shipping is to be done. Such notice shall be in writing and delivered to the Engineer in ample time so that the necessary arrangements for the inspection can be made.

53 One Year Correction Period

If within one (1) year after the date of Final Acceptance or such longer period of time as may be prescribed by Laws or Regulations or by the terms of any applicable special guarantee required by the Contract Documents, any Work which is found to be defective, the Contractor shall promptly, without cost to the County, and in accordance with the County's written notification, either correct such defective Work, or, if it has been rejected by the County, remove it from the site and replace it with non-defective Work. If the Contractor does not promptly comply with such notification, or in an emergency where delay would cause serious risk of loss or damage, the County may have the defective Work corrected or the rejected Work removed and replaced, and all direct, indirect, and consequential costs of such removal and replacement including but not limited to fees and charges of engineers, architects, attorneys and other professionals will be paid by the Contractor.

If, instead of requiring correction or removal and replacement of defective Work, the County prefers to accept the Work, the County may do so. The Contractor shall bear all direct, indirect, and consequential costs attributable to the County's evaluation of and determination to accept such defective Work. If any such acceptance occurs prior to final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work, and the County shall be entitled to an appropriate decrease in the Contract Price. If the acceptance occurs after final payment, an appropriate amount will be paid by the Contractor to the County, as determined by the Engineer.

54 Application for Progress Payment

Unless otherwise prescribed by law, at the end of each month, the Contractor shall submit to the Engineer for review, an Application for Progress Payment filled out and signed by the Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents.

The Application for Progress Payment and M/WBE Construction Activity Report (sample is attached at the end of this section) shall identify the amount of the Contractor's Total Earnings to Date based upon value of original contract Work performed to date as approved by fully executed change orders. Retainage will be held in the amount of ten percent (10%) of the Total Earning to Date. The sub-total after retainage shall be the Net Amount Earned on the Contract to Date. The amount of previous Pay Estimate payments shall then be subtracted to equal the Balance Due during the Pay Estimate period.

When the Engineer determines the Work to be Substantially Complete, the County may reduce the retainage to five percent (5%) of the dollar value of all Work satisfactorily completed to date, provided that the Contractor is making satisfactory progress toward Final Completion of the Work, that in the opinion of both the Engineer and the County there is no specific cause for a greater retainage, and the Contractor obtains the written consent of the Surety Companies furnishing the required Performance and Payment Bonds on consent forms provided by the County. The County may reinstate the retainage up to ten percent (10%) if the County determines, at his discretion or the Engineer's discretion, that the Contractor is not making satisfactory progress toward final completion of the Work or where there is other specific cause for such withholding.

Partial payment may be made for the delivered cost of stored materials planned for incorporation into the Work, provided such materials meet the requirements of this Contract, the Contract Drawings, and the Specifications, and are delivered and suitably stored at the project site, or at another location acceptable to the County. Such material must be stored in a secure manner acceptable to the County, and in accordance with the manufacturer's recommendations.

The delivered cost of such stored or stockpiled materials may be included in any subsequent application for payment provided the Contractor meets the following conditions:

1. An applicable purchase order or supplier's invoice is provided listing the materials in detail, the cost of each item, and identifies this specific contract by name.
2. The materials are fully insured against loss or damage (from whatever source) or disappearance prior to incorporation into the Work.
3. Stored materials approved for payment by the County shall not be removed from the designated storage area except for incorporation into the Work.
4. Evidence that the Contractor has verified quantity and quality of the materials delivered (verified packing list).

It is further agreed between the parties that the transfer of title and the County's payment for any stored or stockpiled materials pursuant to these General Conditions, and any applicable provisions of the Supplementary General Conditions, shall in no way relieve the Contractor of the responsibility of ensuring the correctness of those materials and for furnishing and placing such materials in accordance with the requirements of this Contract, the Contract Drawings, the Technical Specifications, and any approved changes thereto.

The following monthly Application for Progress Payment shall be accompanied by Bills of Sale, copies of paid invoices, releases of lien, or other documentation warranting that the Contractor has received the stored materials and equipment free and clear of all liens, charges, security interests, and encumbrances (which are hereinafter in these General Conditions referred to as "Liens") and evidence that the stored materials and equipment are covered by appropriate property insurance and other arrangements to protect the County's interest therein, all of which shall be satisfactory to the County.

The Contractor shall warrant and guarantee that title to all Work, materials, and equipment covered by an Application for Progress Payment, whether incorporated in the Work or not, will pass to the County no later than the time of Final Payment free and clear of all liens or other encumbrances.

The Engineer shall, within ten (10) days after receipt of each Application for Progress Payment, either indicate in writing a recommendation of payment and present the Application to the County, or return the Application to the Contractor indicating in writing the Engineer's reasons for refusing to recommend payment. In the later case, the Contractor may make the necessary corrections and resubmit the Application. Twenty (20) business days after presentation of the Application for Progress Payment to the County with the Engineer's recommendation, the amount approved will (subject to the provisions of the following Paragraph) become due and when due will be paid by the County to the Contractor.

The County may refuse to make payment of the full amount recommended by the Engineer because claims have been made against the County on account of the Contractor's performance of the Work, or because Liens have been filed in connection with the Work, or there are other items entitling the County to a credit against the amount recommended, but the County must give the Contractor written notice within twenty (20) business days after the date on which the invoice is stamped as received (with a copy to the Engineer) which specifies the invoice deficiency and any action necessary to make the invoice complete and proper.

55 Partial Utilization

The County shall have the right to utilize or place into service any item of equipment or other usable portion of the Work prior to substantial completion of all of the Work. Whenever the County plans to exercise said right, the Contractor shall be notified in writing by the County, identifying the specific portion or portions of the Work to be so utilized or otherwise placed into service. If the Contractor agrees that such part of the Work is substantially complete and is capable of being partially utilized, The Contractor shall certify to the County and the Engineer that such part of the Work is substantially complete and request the Engineer to issue a Certificate of Substantial Completion for that part of the Work. If the Engineer does not consider that part of the Work to be substantially complete, the Engineer shall notify the County and the Contractor in writing, giving the reasons therefor. If the Engineer considers that part of the Work to be substantially complete, the Engineer shall so recommend in writing to the County.

It shall be understood by the Contractor, that until such written notification of the certification of substantial completion of that part of the Work is issued by the Engineer, all responsibility for care and maintenance of all items or portions of the Work to be partially utilized shall be borne by the Contractor. Upon issuance of said written notice of partial utilization, the County will accept responsibility for the protection and maintenance of all such items or portions of the Work described in the written notice.

The Contractor shall retain full responsibility for satisfactory completion of the Work, regardless of whether a portion thereof has been partially utilized by the County, and the Contractor's one (1) year correction period shall commence only after the date of Final Acceptance of the Work.

56 Substantial Completion

When the Contractor considers the entire Work ready for its intended use, the Contractor shall notify the County and the Engineer in writing that the Work is substantially complete and request that the Engineer prepare a Certificate of Substantial Completion. Within a reasonable time thereafter, the County, the Engineer and the Contractor shall make an inspection of the Work to determine the status of completion. If the Engineer does not consider the Work substantially complete, the Engineer shall notify the Contractor in writing giving the reasons therefor. If the Engineer considers the Work to be substantially complete, the Engineer will prepare and deliver to the County for its execution and recordation the Certificate of Substantial Completion signed by the Engineer and Contractor, which shall fix the Date of Substantial Completion.

57 Final Application for Payment

After the Contractor has completed all correction Work referred to in Article 56 "Substantial Completion", and on the final punch lists, or any other punch lists which have been completed, and the Contractor has delivered all maintenance and operating instructions, schedules, guarantees, Bonds, certificates of inspection, marked-up record documents (as provided in these General Conditions) and other documents, all as required by the Contract Documents, and has given the Engineer written notice that the Work has been completed in conformity with the Drawings and Specifications and any approved changes thereto, the Contractor may make application for final payment following the procedure for progress payments in Article 54 "Applications for Progress Payments. The Final Application for Payment shall be accompanied by all documentation called for in the Contract Documents, including but not limited to the following on forms provided by the County:

1. Contractor's Certification of Final Completion
2. Consent of Surety for Final Payment (Payment Bond)

The Contractor shall also submit complete and legally effective releases or waivers (satisfactory to the County) of all liens and "Notices to Owner" arising out of or filed in connection with the Work.

58 Record Documents

The Contractor shall keep one (1) record copy of all Specifications, Drawings, Addenda, modifications and shop drawings at the site in good order and clearly annotated to show all changes made during the construction process. These shall be available to the Engineer for inspection and reference and shall be delivered to him upon completion of the Project, prior to Application for Final Payment.

59 Final Payment and Acceptance

Upon receipt of written notice from the Contractor that the Work has been completed in conformity with the Drawings and Specifications and any approved changes thereto, and receipt of the Final Application for Payment and accompanying documentation, the County's Engineer shall promptly examine the Work and, making such tests as he may deem proper and using all of the care and judgment normally exercised in the examination of completed Work by a properly qualified and experienced Professional Engineer, shall satisfy himself that the Contractor's statement appears to be correct and the Contractor's other obligations under the Contract Documents have been fulfilled. He shall then inform the County in writing that he has examined the Work and that it appears, to the best of his knowledge and belief, to conform to the Contract Drawings, Specifications and any approved Change Orders, that the Contractor's other obligations under the Contract Documents have been fulfilled, and that he therefore recommends acceptance of the Work for ownership and Final Payment to the Contractor. However, it is agreed by the County and the Contractor that such statement by the County's Engineer does not in any way relieve the Contractor from his responsibility to deliver a fully completed job in a good and workmanlike condition, and does not render the Engineer or the County liable for any faulty Work done or defective materials or equipment used by the Contractor.

The County's Engineer will then make a final estimate of the value of all Work done and will deduct therefrom all previous payments which have been made. The County's Engineer will report such estimate to the County together with his recommendation as to the acceptance of the Work or his findings as to any deficiencies therein. After receipt and acceptance by the County of the properly executed Final Warranty of Title and within sixty (60) days after approval of the Engineer's estimate and recommendation to the County, the County will make final payment to the Contractor of the Amount remaining after deducting all prior payments and all amounts to be kept or retained under the provisions of the Contract Documents, including the following items:

1. Liquidated Damages, as applicable.
2. At the discretion of the County, two times the value of outstanding items of correction Work or "punch list" items indicated on the Certificate of Substantial Completion, "final punch list", or any other "punch list" as being yet uncompleted or uncorrected, as applicable. All such Work shall be completed or corrected to the satisfaction of the County within the time stated on the Certificate of Substantial Completion, or on the "final punch list", or any other "punch list", otherwise the Contractor does hereby waive any and all claims to all monies withheld by the County to cover the value of all such uncompleted or uncorrected items.

All prior estimates are subject to correction in the final estimate.

60 Contractor's Continuing Obligation

The Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. Neither recommendation of any Progress or Final Payment by the Engineer, nor the issuance of a Certificate of Substantial completion nor any payment by the County to the Contractor under the Contract Documents, for any use or occupancy of the Work or any part thereof by the County, nor any act of acceptance by the County, nor any failure to do so, nor any review of a Shop Drawing or sample submittals, will constitute an acceptance of Work not in conformance with the Contract Documents or a release of the Contractor's obligation to perform the Work in accordance with the Contract Documents.

61 Final Payment Terminates Liability of County

Final Payment is defined as the last Progress Payment made to the Contractor for earned funds, less retainage as applicable, less deductions listed in Article 59 "Final Payment and Acceptance". The acceptance of the Final Payment referred to in Article 59, shall be a full release of the County and its agents from any and all claims of liability to the Contractor for anything done or furnished for, or relating to, the Work or for any act or neglect of the County, or of any person relating to or affecting the Work, except demands against the County for the remainder, if any, of the amounts kept or retained under the provisions of Article 59.

62 County's Right to Terminate

(a) If at any time there shall be filed by or against the Contractor in any court, a petition in bankruptcy or insolvency or for reorganization or for the appointment of a receiver or trustee of all or a portion of the Contractor's property, and within thirty (30) days therefrom the Contractor fails to secure a discharge thereof, or if the Contractor makes an assignment for the benefit of creditors or petitions for or enters into an agreement or arrangement with its creditors, or if the Contractor admits in writing an inability to pay its debts generally as they become due, or if the Contractor persistently fails to perform the Work in accordance with the Contract Documents (including, but not limited to failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the progress schedule established under the General Requirements of the Technical Specifications as revised from time to time), or if Contractor disregards Laws or Regulations of any public body having jurisdiction, or if Contractor disregards the authority of the Engineer, or if Contractor otherwise violates in any substantial way any provisions of the Contract Documents, then the County by giving seven (7) days prior written notice of any such default to the Contractor and without prejudice to any other remedy it may have, may terminate the employment of the Contractor, exclude Contractor from the site, and take possession of the Work and all or some of the Contractor's materials, tools, equipment and appliances and use the same to the full extent they could be used by the Contractor (without liability to the Contractor for trespass or conversion), incorporate in the Work all materials and equipment stored at the site or for which County has paid Contractor but which are stored elsewhere and complete the Work by such means as the County deems expedient. In such case, the Contractor shall not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract Sum shall exceed (1) the expense of completing the Work including compensation for additional managerial and administrative services, plus (2) the County's indirect and consequential losses and damages because of the Contractor's default, including but not limited to fees and charges of Engineers, Architects, Attorneys and other professionals and court costs, such excess shall be paid to the Contractor. If such expense, plus the County's losses and damages shall exceed such unpaid balance, the Contractor shall pay the difference to the County promptly on demand. Such costs incurred by the County shall be approved as to reasonableness by the Engineer and incorporated into a Change Order, but when exercising any rights or remedies under this paragraph, County shall not be required to obtain the lowest price for the Work performed.

(b) The County may terminate this Contract without cause by giving seven (7) days prior written notice to the Contractor, and in such event, the County will pay the Contractor for that portion of the

Contract Sum, less the aggregate of previous payments, allocable to the Work completed as of the Date of Termination. The County also will reimburse the Contractor for all costs necessarily incurred for organizing and carrying out the stoppage of the Work and paid directly by the Contractor, not including overhead, general expenses or profit. The County will not be responsible to reimburse the Contractor for any continuing contractual commitments to subcontractors or material suppliers or penalties or damages for canceling such contractual commitments inasmuch as the Contractor shall make all subcontracts and other commitments subject to this provision. County will not be liable for, and Contractor hereby waives, any claim for lost prospective profits, economic losses, or other consequential damages.

(c) In the event of termination by the County, the County may require the Contractor promptly to assign to it all or some subcontracts, construction, plant, materials, tools, equipment, appliances, rental agreements, and any other commitments which the County, in its sole discretion, chooses to take by assignment, and in such event the Contractor shall promptly execute and deliver to the County written assignments of the same.

(d) In the event that any termination under subparagraph (a) above is determined to have been effectuated without proper or sufficient cause, then such termination shall be deemed to have been a termination for convenience under subparagraph (b) above.

63 County Remedies

If the Contractor defaults or neglects to carry out any of his obligations under this Agreement, including but not limited to the provisions of the General Requirements of the Technical Specifications, or should liens be filed, bills of sale, conditional bills of sale, chattel mortgages, assignments of this Agreement, or orders for the payment of money for materials or labor or either, or should the Contractor become insolvent or bankrupt, the County shall have the right, in addition to any other rights and remedies provided herein or by law, to perform and furnish through itself and/or through others any such labor or materials for the Work and to deduct the costs thereof from any money due or to become due to the Contractor for all or any portion of the Work; enter upon the premises and take possession, for the purpose of completing the Work, all equipment, scaffolds, tools, appliances, and any other items thereon, and to employ any person or persons to complete the Work and provide all labor services, materials, equipment, and other items required therefor. In case of such termination of the employment of the Contractor, Contractor shall not be entitled to receive any further payment under this Agreement; however, if the unpaid balance of the amount to be paid under this Agreement shall exceed the cost and expense incurred by the County in completing the Work, such excess shall be paid by the County to the Contractor; but, if such cost and expense shall exceed the unpaid balance, the Contractor shall promptly pay the difference to the County on demand. Said cost and expense shall include not only the cost of completing the Work to the satisfaction of the County and of performing and furnishing all labor, services, materials, equipment, and other items required therefor, but all losses, damages, costs and expenses including attorney's fees sustained, incurred, or suffered by reason of or resulting from the Contractor's default, or by reason of litigation over this Agreement.

64 Contractor's Right to Terminate or Stop Work

If through no act or fault of the Contractor, the Work is suspended for a period of more than ninety (90) days by the County or under an order of court or other public authority, or the Engineer fails to act on any Application for Payment within thirty (30) days after it is submitted or County fails for sixty (60) days to pay the Contractor any sum finally determined to be due, then the Contractor may, upon giving seven (7) days prior written notice to the County and the Engineer, and provided County or Engineer do not remedy such suspension or failure within that time, terminate the Agreement and recover from the County payment on the same terms as provided in Article 62(b). In lieu of terminating

the Agreement and without prejudice to any other right or remedy, if the Engineer has failed to act on an Application for Payment within thirty (30) days after it is submitted, or the County has failed for sixty (60) days to pay the Contractor any sum finally determined to be due, the Contractor may upon seven (7) days prior written notice to the County and the Engineer stop the Work until payment is received of all such amounts due the Contractor.

65 Title to Materials Found on the Work

The County reserves the right to retain title to all suitable soils, stone, sand, gravel, and other materials (as determined suitable by the Engineer) developed and obtained from excavations and other operations connected with the Work. Unless otherwise specified in the Contract Documents, neither the Contractor nor any subcontractor shall have any right, title, or interest in or to any such materials.

The Contractor will be permitted to use any such suitable materials in the Work, without charge, provided that such materials meet the requirements of the Contract Documents.

66 Right to Audit

If the Contractor submits a claim to the County for additional compensation, the County shall have the right, as a condition to considering the claim, and as a basis for evaluation of the claim, and until the claim has been settled, to audit the Contractor's books to the extent they are relevant. This right shall include the right to examine books, records, documents, and other evidence and accounting procedures and practices, sufficient to discover and verify all direct and indirect costs of whatever nature claimed to have been incurred or anticipated to be incurred and for which the claim has been submitted. The right to audit shall include the right to inspect the Contractor's plants, or such parts thereof, as may be or have been engaged in the performance of the Work. The Contractor further agrees that the right to audit encompasses all subcontracts and is binding upon all subcontractors. The rights to examine and inspect herein provided for shall be exercisable through such representatives as the County deems desirable during the Contractor's normal business hours at the office of the Contractor. The Contractor shall make available to the County for auditing, all relevant accounting records and documents, and other financial data, and upon request, shall submit true copies of requested records to the County.

67 Asbestos

If the Contractor during the course of the Work observes, uncovers or otherwise becomes aware of the existence of any asbestos, hazardous waste, or toxic or radioactive material at the site which has not been rendered harmless to which the Contractor or any subcontractor, supplier or other person may be exposed, the Contractor shall immediately stop Work in the affected area and notify the County and the Engineer and thereafter confirm any oral notice in writing. In addition, the Contractor shall take reasonable precautions to prevent or contain the movement, spread or disturbance of such materials and to protect persons and property. The County shall promptly consult with the Engineer concerning such condition and determine the necessity of County's retaining special consultants or qualified experts to deal therewith. The Contractor shall not perform any Work in connection therewith prior to receipt of special written instructions from the County through the Engineer.

A. PROCEDURES FOR DEMOLITION OF STRUCTURES:

1. Notification:

Federal and state asbestos regulations require, prior to demolition of any structure:

- (a) An inspection for asbestos-containing materials (ACM);
- (b) Removal of specific ACM; and,
- (c) An asbestos notification of demolition received at least ten (10) business days prior to demolition.

To meet requirements (a) and (b) above, the County has surveyed the structure(s) in this Contract for the presence of ACM and every effort has been made to remove Regulated Asbestos-Containing Material (RACM) and Category II Non-Friable ACM (e.g. asbestos-cement board and shingles) before releasing this project to the Contractor. Verification of this Work is attached to this Contract. If not attached, it is the Contractor's responsibility to contact the Project Manager of the County Department overseeing this Contract, or the County's Risk Management/Loss Control section to obtain:

- (a) A copy of the pre-demolition asbestos inspection report; and,
- (b) A copy of Risk Management/Loss Control's memo of approval to proceed to the next phase of the project addressed to the County department overseeing this project.

To meet requirement (c) above, the Contractor is responsible for submitting a complete and accurate asbestos notification of demolition form titled "Notice of Asbestos Removal Project" [i.e., NESHAP notification, 40 CFR Part 61.145(b)], for each separate address to be demolished to the below listed agencies at least ten (10) business days prior to demolition. The 4-copy forms are available from the Department of Environmental Protection (FDEP) and Palm Beach County Risk Management/Loss Control.

SEND ORIGINAL TO:
State Asbestos Coordinator
FDEP
2600 Blair Stone Road
Tallahassee, FL 32399-5420

SEND YELLOW COPY TO:
Environmental Specialist
FDEP
P.O. Box 15425
West Palm Beach, FL 33416-5425

SEND PINK COPY OR FAX OF ORIGINAL TO:
P.B.C. Risk Management/Loss Control
Attn.: NESHAP
P.O. Box 21229
West Palm Beach, FL 33416-1229
Fax.: (561) 233-5420

The Contractor must notify Loss Control (561-233-5430) immediately if the demolition start date changes. No demolition may begin before the start date on the NESHAP notification and no demolition may occur without a notice to proceed from the County department. It is the responsibility of the Contractor to call and submit revised NESHAP notifications to the above listed agencies, adhering to required NESHAP time frames.

The Contractor is responsible for physically checking the structure(s) before submitting the NESHAP notification to ensure that all RACM and Category II ACM, as identified in the pre-demolition asbestos inspection report, have been removed. If RACM or Category II ACM is discovered, immediately contact the County's Project Manager or Loss Control.

2. Work Practices:

The Contractor will utilize wet methods to control airborne emissions during the demolition process and during loading onto transport vehicles, regardless whether Category I is present or not. The Contractor is responsible for supplying water meters, hoses, and adequate volume of water to the demolition site.

Recycling of substructure with either presumed or confirmed asbestos-containing Category I (e.g. floor tile, sheet vinyl, and/or roofing materials) is not permitted, unless written authorization is provided to the Contractor by Palm Beach County.

3. OSHA and Florida Statutes Compliance:

In accordance with OSHA (ref. 29 CFR 1926.1101) the Contractor must have a competent person on-site who:

- (a) Is capable of identifying existing asbestos hazards in the work place;
- (b) Is capable of selecting the appropriate control strategy for asbestos exposure;
- (c) Has the authority to take prompt corrective action to eliminate them.

This person must be trained in accordance with Chapter 469 Florida Statutes as an on-site supervisor.

Copies of training certificates of the on-site supervisor shall be made available to the County upon request.

B. REMOVAL OF CONFIRMED OR PRESUMED ASBESTOS-CONTAINING BITUMINOUS ROOFING MATERIALS:

The County will provide all known information as to the roofing material used on the existing roof specified in the Contract Documents. This information will include all existing specifications, drawings, and the results of any recent bulk sampling analysis of the existing roof system determining the presence or absence of asbestos by percentage and the location where each sample was taken. In the absence of bulk sampling for asbestos, the roofing materials will be presumed asbestos containing until proven otherwise.

It is the Contractor's responsibility to determine if the information furnished is adequate to provide a bid.

It is the responsibility of the Contractor awarded the Contract to determine if the roofing materials do not contain asbestos. If the Contractor wishes not to sample and analyze for asbestos, the materials will be presumed to contain asbestos and must be handled accordingly. If the Contractor elects to sample the roof system it must first notify the County of the sampling, including date, location, and number of samples to be collected. The bulk sample analyses must be performed by a NVLAP-accredited laboratory (NVLAP is the National Voluntary Laboratory Accreditation Program). Results, if proven less than one percent (1.0%) asbestos, shall be provided to the County prior to the start of any Work.

The Contractor awarded the Contract will be required to meet all Federal, State, and local regulations pertaining to the handling, removal, and disposal of confirmed or presumed asbestos-containing roofing materials. This includes, but is not limited to:

1. Meeting the requirements listed in Chapter 469.012 (2) and (3) Florida Statutes regarding training of on-site roofing supervisors involved in the removal of asbestos containing bituminous resinous roofing materials; and,

2. Utilizing removal methods that will maintain the roofing material's Category I non-friable status and will not create dust (i.e., employ methods other than sanding, grinding, drilling, abrading, rotary blade, or saw cutting). Suggested methods are slicing, shearing, or punch cutting while using wet methods where feasible.

The Contractor will submit upon award of the Contract the following documentation to the County department coordinating this project:

1. Copies of training certificates of the on-site roofing supervisor in compliance with the current requirements of Chapter 469 Florida Statutes;
2. Resume of the on-site roofing supervisor documenting asbestos-containing roofing removal jobs performed within the last two (2) years;
3. Approval of a landfill to accept confirmed or presumed asbestos containing roofing material and any conditions associated with its acceptance; and,
4. A plan of action, as specified by OSHA 29 CFR 1926.1101, which addresses:
 - a. Method(s) of removal;
 - b. Worker protection;
 - c. Protection of building occupants and ventilation system;
 - d. Method and location of disposal.

C. HANDLING AND DISPOSAL OF ASBESTOS CEMENT PIPE:

1. General:

Federal regulations (40 CFR Part 61, Sub-part M) classify asbestos-cement pipe (AC pipe) as Category II non-friable asbestos-containing material. AC pipe must be handled in a manner which will maintain this classification. Therefore, all cutting and disposal of AC pipe must be performed by a Florida licensed Asbestos Contractor.

The County will make every effort to identify and quantify the location of known AC pipe and material prior to onset of the Work.

If during the course of the Work the Contractor observes, uncovers, or otherwise becomes aware of the existence of any AC pipe, pieces, or material at the site to which the Contractor or any subcontractor, supplier, or other person may be exposed, the Contractor shall immediately notify the County and confirm any verbal notice in writing. The County shall promptly consult with the Project Engineer concerning such conditions and determine the necessity of the County retaining special consultants or qualified experts. The Contractor shall not perform any Work near or in connection with the suspect material until receipt of special written instructions from the County.

The Contractor will ensure that all subcontractors follow these procedures.

2. Pre-Work Submittals:

The Contractor shall submit the name of the Asbestos Contractor and a copy of their Florida Asbestos Contractor license to the Palm Beach County department coordinating this project, prior to start of the Work.

3. Worker Protection:

Licensed asbestos contractors will comply with the requirements of OSHA 29 CFR 1926.1101 concerning worker protection.

4. Execution of Work:

AC pipe will be kept wet during all phases of removal. No visible emissions are permitted. Wet the pipe using an airless sprayer or utilize available water.

Apply drop cloth of 6-mil polyethylene to the area beneath and a minimum of three feet (3') beyond the section of pipe to be cut.

Break, cut or snap pipe into sections suitable in size to the disposal facility. Abrasive disc saws are prohibited.

Apply lockdown encapsulant to exposed edges of pipe. Pick up all pipe debris that may have fallen outside the drop cloth.

Use of compressed air to clean AC pipes is prohibited.

At no time should AC pipe or pieces be mixed in with fill material.

5. Disposal:

Wrap pipe in existing drop cloth. Transfer pipe to a clean drop cloth outside the trench, and wrap and secure in a second layer of 6-mil polyethylene.

Affix the following labels to the exterior of each separately wrapped section of pipe. Labels are to be waterproof, legible, and large enough in size to be readily visible:

First Label: CAUTION
Contains Asbestos Fibers
Avoid Opening or Breaking Container
Breathing Asbestos is Hazardous to Your Health

Second Label: DANGER
Contains Asbestos Fibers
Avoid Breathing Dust
Cancer and Lung Disease Hazard
Breathing Airborne Asbestos, Tremolite,
Anthophyllite or Actinolite Fibers
is Hazardous to Your Health

Third Label: RQ HAZARDOUS SUBSTANCE
Solid, NOS
ORM-E, NA9188
(Asbestos)

Fourth Label: Label each container with the name of the generator (owner) and the location at which the waste was generated.

Properly dispose of all AC pipe generated each day. All wrapped sections may be stored in a secure, locked enclosure pending disposal, if authorized by the County. At no time are sections or pieces of

AC pipe to be left on the project site unwrapped and unsecured at the end of the day.

All vehicles and/or containers used to haul asbestos containing waste material shall be lined with a minimum of 6-mil polyethylene layer.

Label trucks used to transport asbestos-containing waste material during loading and unloading as follows (refer to 29 CFR 1910.145 (d) (4) for sign format):

DANGER
Asbestos Dust Hazard
Cancer and Lung Disease Hazard
Authorized Personnel Only

6. Post Work Submittals

The Contractor, or Asbestos Contractor, as waste generator shall complete a Waste Shipment Record (WSR) for each shipment of asbestos-cement pipe disposed. Refer to 40 CFR Part 61, Revision Final Rule for an example of WSR or contact Palm Beach County Risk Management/Loss Control.

The Contractor or its designated subcontractor will submit the following documents to the Palm Beach County department coordinating this project prior to payment:

- (a) A copy of the WSR prior to shipment; and,
- (b) A copy of the WSR signed by the disposal facility within 35 days of shipment.

7. Regulations:

Environmental Protection Agency: 40 CFR Part 61 National Emission Standards for Hazardous Pollutants; Asbestos NESHAP Revision Final Rule, November 20, 1990.

Occupational Safety and Health Administration: 29 CFR 1926.1100 - Asbestos, Construction Industry Standard.

Department of Business and Professional Regulation, Chapter 469 Florida Statutes, Licensure of Consultants and Contractors.

68 Explosives and Hazardous Materials

Contractor shall obtain all required Federal, State and local permits and licenses and shall be responsible for the safe and proper handling, transporting, storage and use of any explosive or hazardous materials brought onto or encountered within the site, and at its expense, make good any damage caused by its handling, transporting, storage and use. The Contractor will notify the County immediately if explosive or hazardous materials are encountered on the site. Transporting explosive or hazardous materials onto the site will require prior written approval from the County. The Contractor shall maintain and Post as necessary Material Hazard Data Sheets for all applicable Hazardous Materials used in the course of his work.

In the event that hazardous material is improperly handled or stored by the Contractor, its subcontractors, any sub-sub contractors, or any employee or agent of any of the aforementioned which results in contamination of the site, Contractor shall immediately notify the County and the appropriate governmental authority and shall take whatever action is necessary or desirable to remediate the contamination at the Contractor's sole cost and expense. Further, Contractor shall

indemnify and hold harmless from any and all cost, expense, action, or liability whatsoever resulting from such contamination and/or remedial activities.

69 Notice and Service

All notices, demands, requests, instructions, approvals and claims shall be made in writing.

Any notice to or demand upon the Contractor shall be sufficiently given if delivered to such office of the Contractor specified in the Proposal (or to such other office as the Contractor may from time to time designate to the County in writing), or if deposited in the United States Mail in a sealed, postage prepaid envelope, or if delivered with charges prepaid to any telegraph company for transmission, in each case addressed to such office.

All notices or other papers required to be delivered by the Contractor to the County, or to any of its representatives shall, unless otherwise specified in writing to the Contractor, be delivered to the office of the County's Engineer, and any other notice or demand upon the County shall be sufficiently given if delivered to such office, or if deposited in the United States Mail in a sealed, postage prepaid envelope, or if delivered, with the charges prepaid to any telegraph company for transmission, in each case addressed to such office (or to such other representative of the County or to such other address as the County may subsequently specify in writing to the Contractor for such purpose).

Any such notice or demand shall be deemed to have been given or made as of the time of actual delivery, or, in the case of mailing, when the same should have been received in due course of posts, or in the case of telegrams, at the time of actual receipt thereof.

70 Listing of the Duties, Responsibilities and Limitations of Authority of the Resident Project Representative

The Engineer may furnish a Resident Project Representative (RPR), assistants and other field staff to assist the Engineer in observing performance of the Work of the Contractor. The RPR may only be part time on site, and the Contractor shall coordinate with the RPR as required in the Contract Documents.

Through on-site observations of the Work in progress and field checks of materials and equipment by the RPR and assistants, the Engineer shall provide further protection for the County against defects and deficiencies in the Work; but, the furnishing of such services will not make the Engineer responsible for or give the Engineer control over construction means, methods, techniques, sequences or procedures or for the safety precautions or programs, or responsibility for the Contractor's failure to perform the Work in accordance with the Contract Documents.

The duties and responsibilities of the RPR are limited to those of the Engineer in the Engineer's Agreement with the County and in the construction Contract Documents, and are further limited and described as follows:

A. GENERAL:

The RPR is the Engineer's agent at the site, will act as directed by and under the supervision of the Engineer, and will confer with the Engineer regarding the RPR's actions. The RPR's dealings in matters pertaining to the on-site Work shall in general be with the Engineer and the Contractor, keeping the County advised as necessary. RPR's dealings with subcontractors shall only be through or with the full knowledge and approval of the Contractor. RPR shall generally communicate with the County with the knowledge of and under the direction of the Engineer.

B. DUTIES AND RESPONSIBILITIES OF THE RPR:

1. Review the construction progress schedule, schedule of shop drawing submittals, and schedule of values prepared by the contractor and consult with the Engineer concerning their acceptability.
2. Attend various meetings with the Contractor, including pre-construction conferences, construction progress meetings, job site conferences and other project-related meetings, and prepare and circulate written copies of minutes thereof.
3. Serve as the Engineer's liaison with the Contractor, working principally through the Contractor's superintendent or construction manager, and assist in understanding the intent of the Contract Documents; and assist the Engineer in serving as the County's liaison with the Contractor when the Contractor's operations affect the County's on-site operations.
4. Assist in obtaining from the County additional details or information, when required for proper execution of the Work.
5. Record the dates of receipt of shop drawings and samples.
6. Receive samples furnished at the site by the Contractor, and notify the Engineer of availability of samples for examination.
7. Advise the Engineer and the Contractor of the commencement of any Work requiring a shop drawing or sample if the submittal has not been approved by the Engineer.
8. Conduct on-site observations of the Work in progress to assist the Engineer in determining if the Work is in general proceeding in accordance with the Contract Documents.
9. Report to the Engineer whenever the RPR believes that any Work is unsatisfactory, faulty or defective or does not conform to the Contract Documents, or has been damaged, or does not meet the requirements of any inspection, test or approval required to be made; and advise the Engineer of Work that the RPR believes should be corrected or rejected or should be uncovered for observation, or requires special testing, inspection or approval.
10. Verify that tests, equipment and systems start-ups and operating and maintenance training are conducted in the presence of appropriate personnel, and that the Contractor maintains adequate records thereof; and observe, record and report to the Engineer appropriate details relative to the test procedures and start-ups.
11. Accompany visiting inspectors representing public or other agencies having jurisdiction over the Project, record the results of these inspections and report to the Engineer.
12. Report to the Engineer when clarifications and interpretations of the Contract Documents are needed and transmit to the Contractor clarifications and/or interpretations as issued by the Engineer.

13. Consider and evaluate the Contractor's suggestions for modifications in Drawings or Specifications and report with the RPR's recommendations to the Engineer. Transmit to the Contractor decisions as issued by the Engineer.

14. Maintain at the job site and the Engineer's office files for correspondence, reports of job conferences, shop drawings and samples, reproductions of original Contract Documents including all Work Directive Changes, Addenda, Change Orders, Field Orders, Written Amendments, additional drawings issued subsequent to the execution of the Contract, the Engineer's clarifications and interpretations of the Contract Documents, progress reports, and other Project-related documents.

15. Record names, addresses and telephone numbers of all subcontractors and major suppliers of materials, equipment and manufactured articles.

16. Furnish the Engineer periodic reports as required of progress of the Work and of the Contractor's compliance with the progress schedule and schedule of shop drawing and sample submittals.

17. Consult with the Engineer in advance of scheduled major tests, inspections or start of important phases of the Work.

18. Draft proposed Change Orders and Work Directive Changes, obtaining backup material from the Contractor and recommend to the Engineer Change Orders, Work Directive Changes, and Field Orders.

19. Report immediately to the Engineer and the County upon the occurrence of any accident witnessed by the RPR or that was otherwise made known to the RPR.

20. Review applications for payment with the Contractor for compliance with the established procedure for their submission and forward with recommendations to the Engineer, noting particularly the relationship of the payment requested to the schedule of values, Work completed and materials and equipment delivered at the site but not incorporated in the Work.

21. During the course of the Work, verify that certificates, maintenance and operation manuals and other data required to be assembled and furnished by the Contractor are applicable to the items actually installed and in accordance with the Contract Documents, and have this material delivered to the Engineer for review and forwarding to the County prior to final payment for the Work.

22. Before the Engineer issues a Certificate of Substantial Completion, submit to the Contractor a list of observed items requiring completion or correction.

23. Conduct final inspections in the company of the Engineer, the County and the Contractor and prepare a final list of items to be completed or corrected.

24. Observe that all items on the final list have been completed or corrected and make recommendations to the Engineer concerning acceptance.

C. LIMITATIONS OF AUTHORITY:

1. The Resident Project Representative shall not:

- a. Authorize any deviation from the Contract Documents or substitution of materials or equipment, unless authorized in writing by the Engineer.
- b. Exceed limitations of the Engineer's authority as set forth in the Contract Documents.
- c. Undertake any of the responsibilities of the Contractor, subcontractors or the Contractor's superintendent or construction manager.
- d. Advise on, issue directions relative to or assume control over any aspect of the means, methods, techniques, sequences or procedures of construction unless such advice or directions are specifically required by the Contract Documents.
- e. Advise on, issue directions regarding or assume control over safety precautions and programs in connection with the Work.
- f. Accept shop drawings or sample submittals from anyone other than the Contractor.
- g. Authorize the County to occupy the Project in whole or in part.
- h. Participate in specialized field or laboratory tests or inspections conducted by others as specifically authorized by the Engineer.

71 Resolution of Claims and Disputes

A. ADR Procedures:

1. The Contractor and County agree to submit all claims not resolved by mutual agreement using the ADR Procedures listed below, which will be followed by the parties to resolve all disputes, if possible, prior to either the County or Contractor submitting the claim to litigation.

2. ADR Procedures available to the parties include:

- a. Facilitated Negotiation; and,
- b. Non-Binding Arbitration.

B. If a Claim is resolved by an ADR Procedure, the Engineer will prepare or obtain appropriate documentation.

C. Facilitated Negotiations:

1. If a Claim has not been resolved by mutual agreement, the dispute shall be promptly submitted to the individual designated as the Facilitator for this Project.

- a. The Facilitator shall be designated by the Contractor and County at the time of the execution of the Contract. In the event that the parties are unable to agree as to the designation of the Facilitator, the Facilitator shall be designated by the American Arbitration Association, who shall appoint an impartial individual who is skilled at negotiating.
- b. The Engineer shall, at the time of referral to the Facilitator, provide a description of the issues or concerns which relate to the claim to the Facilitator, County and Contractor. Any party may within three (3) days of receipt of the description by the Facilitator forward to the Facilitator and other parties a written notice as to any other issues and concerns which they believe relate to the claim. Unless otherwise agreed, there shall be no ex parte communications with the Facilitator.
- c. The Facilitator shall also promptly determine if all parties are in possession of adequate information necessary to evaluate said issues and concerns. In the

event that they are not, the Facilitator shall utilize his best efforts to obtain the required information in a prompt manner.

- d. The Facilitator shall immediately prepare an agenda consisting of the various issues and concerns which shall be delivered to the County, Contractor and Engineer and schedule a conference among all parties.
- e. The conferences will be attended by the persons most familiar with the issues set forth in the Agenda prepared by the Facilitator as well as a representative of each party who is authorized to act on behalf of such party as to reaching agreement as to such issues. The Engineer shall also be present if requested by either of the parties or the Facilitator during all or part of such conferences.
- f. The Facilitator shall not offer opinions as to the issues and concerns under discussion, but shall lead the negotiations in an impartial manner.
- g. The Facilitator shall endeavor to develop consensus and agreement as to each issue and concern. Agreements as to such issues, if reached, shall be acknowledged by the parties upon preparation of a written summary by the Facilitator.
- h. Upon determination by the Facilitator that such negotiations are unlikely to achieve further meaningful results, the Claim shall be subject to further ADR Procedures in accordance with this Agreement.
- i. The costs of the Facilitator shall be borne equally by the County and Contractor.
- j. These proceedings and the documents prepared exclusively for use in these proceedings shall be deemed to be matters pertaining to settlement negotiations and not subsequently admissible at any further proceeding except for such summaries of agreements prepared by the Facilitator and acknowledged by the parties.

D. Non-Binding Arbitration:

1. Controversies and Claims Subject to Non-Binding Arbitration:

- a. Any controversy or Claim arising out of or related to the Contract, or the breach thereof (except controversies or Claims relating to the aesthetic effect and except those waived by final payment as provided in the General Conditions) shall be referred to non-binding arbitration, which shall be conducted in accordance with this Paragraph 4.D.1, if the Claim remains unresolved following ADR Procedures under Paragraph 3.C.4.
- b. Such controversies or Claims shall be subject to non-binding arbitration upon written demand of either party.
- c. Non-binding arbitration shall be a condition precedent to the litigation of disputes and claims.

2. Rules and Notices for Non-Binding Arbitration:

- a. Claims subject to ADR shall be referred to non-binding, arbitration in accordance with American Arbitration Association Construction Industry, except as modified herein.
- b. Notice of demand for non-binding arbitration shall be filed in writing with the other party to the Agreement between the County and Contractor and a copy shall be filed with the Engineer.

3. Contract Performance During Non-Binding Arbitration:

a. During non-binding arbitration proceedings, the County and Contractor shall comply with the provisions of the General Conditions.

4. When Non-Binding Arbitration May Be Demanded:

a. Demand for non-binding arbitration may not be made until:

- i. Written notice of a claim has been given in accordance with the terms of this Agreement; and,
- ii. The parties have attempted to resolve the claim through Facilitated Negotiation.

b. In no event shall a demand for non-binding arbitration be made after the date when institution of legal or equitable proceedings based on such Claim would be barred by the applicable statute of limitations.

5. Consolidation/Common Arbitrators:

a. To the extent not prohibited by the County's or Contractor's agreements with third parties, disputes or Claims with third parties involving common questions of fact or law shall be heard by the same arbitrators in consolidated, non-binding arbitration proceedings.

6. Document Production, Depositions, and Exchange of Non-Binding Arbitration Exhibits:

a. After a demand for non-binding arbitration, each party shall have the right to immediate production of Project-related documents requested in writing from the other party for inspection and copying, except for those documents which are covered by an unwaived attorney/client privilege or which were prepared in anticipation of arbitration or litigation.

b. Following production, each party to the dispute shall be entitled to take three (3) depositions which in combination shall not exceed three (3) days in length for direct examination.

c. No later than ten (10) days prior to the hearing, the parties shall make available to each other, for inspection and copying, the exhibits, photographs, and other documents which they intend to introduce or refer to during the non-binding arbitration.

7. Award Resulting from Non-binding Arbitration:

a. The award resulting from the non-binding arbitration shall be advisory only. It shall contain specific, detailed findings of fact and conclusions explaining the rationale for the award.

b. Within thirty (30) days from the date of the award, the County and Contractor shall each serve written notice to the other, with a copy to the Engineer, indicating either acceptance or rejection of the award. Failure to specifically accept the award shall be deemed as rejection. If both accept the award, then the dispute or Claim shall be deemed to have been resolved and the Engineer will prepare or obtain appropriate documentation to implement the award. If either the County or Contractor, or both, reject the award, the dispute or Claim shall be considered unresolved and subject to litigation in the appropriate jurisdiction.

c. The award shall not be admissible as evidence in subsequent litigation, but shall be considered for recovery of attorney's fees and costs as provided in Paragraph 4.D.8. For purposes of compliance with the applicable statute of limitations, the running of the statute shall be suspended as of the date of demand for non-binding arbitration, provided that litigation is commenced within sixty (60) days from the date of the arbitration award.

8. Attorneys Fees, Arbitration Costs, and Court Costs:

a. Attorneys fees, arbitration costs, and litigation costs shall be awarded to:

- i. The party who accepts a non-binding arbitration award and subsequently prevails in litigation necessitated by the other party's rejection of the award; and,
- ii. The prevailing party in any litigation necessary to obtain:
 - (a) Enforcement of ADR Procedures; or,
 - (b) Collection of a final, non-appealable judgment obtained subsequent to exhaustion of ADR Procedures.

72 Contractor Furnished Drawings, Data and Samples

Review and permission to proceed by County as stated in this Contract does not constitute acceptance or approval of design details, calculations, analyses, test methods, certificates or materials developed or selected by the Contractor and does not relieve Contractor from full compliance with contractual obligations. Drawings, samples, catalogues, data and certificates required to be submitted to the County for review, shall be submitted attached to forms provided by County.

All correspondence from the Contractor to the County shall be numbered sequentially and the submittal number shall be referenced. Submittal drawings (shop, erection or setting diagrams) and schedules, required for work of various trades, shall be checked before submission by technically qualified employees of Contractor for accuracy, completeness and compliance with contract requirements. These drawings and schedules shall be stamped and signed by Contractor certifying to such check. The certification stamp shall read as follows:

"I certify that I have checked this submittal for accuracy, completeness and compliance with contract requirements, and it has been coordinated with all other submittals and Contract Documents."

Signed

Date

(Company Name)

A. Drawings

Where drawings are required for (a) fabrication of Contractor furnished equipment; (b) installing Contractor furnished material or equipment; or (c) planning and performance of the work under Contract; such drawings shall be submitted by and at the expense of the Contractor before fabrication, installation or performance is commenced. Each submittal shall be made not less than thirty five (35) calendar days prior to the time that the drawings are required in accordance with the schedule. Allow at least 21 calendar days for review by County. County's review will be accomplished

based on the Contractor's submittal schedule portion of the CPM schedule, as approved. Such drawings shall include, but not be limited to, matchmarks, erection diagrams and other details, such as field connections for proper installation, erection of the equipment, and performance of the work.

For drawings greater in size than 11" x 17", one reproducible and four copies shall be submitted to the County by and at the expense of the Contractor. The County will be the sole judge of the adequacy of the quality of the reproducible and prints and may reject reproducibles and/or prints on the basis of quality alone. Such drawings will not be folded, but will be transmitted in mailer rolls manufactured expressly for that purpose. The reproducible with the County's review comments will be returned to the Contractor. A reproducible copy of drawings equal to or less than 11" x 17" is not necessary, but five copies of the unfolded drawings must be transmitted to the County.

If drawings show variations from the contract requirements, the Contractor shall describe such variations in writing, separate from the drawings, at the time of submission. If the County approves any such variation(s), it shall issue an appropriate contract modification, except that, if the variation is minor and does not involve a change in price or in time of performance, a modification need not be issued.

Drawings of a specific piece of equipment shall identify components with the manufacturer's part number or reference drawing clearly indicated. If reference drawing numbers are used, the review date of such drawings shall be included. Drawings shall indicate design dimensions, maximum and minimum allowable operating tolerances on all major wear fits, i.e. rotating, reciprocating or intermittent sliding fits between shafts or stems and seals, guides and pivot pins. The sequence of submission of all drawings shall be such that all information is available for reviewing each drawing when it is received.

All drawings submitted by the Contractor shall be certified and dated by the Contractor on the face of each drawing to be correct, accurate and shall be furnished in accordance with requirements of the specifications. County will conduct a review of Contractor's drawings and a drawing marked with one of the following review comments will be returned to the Contractor.

1. No exceptions taken.
2. Comments attached. Resubmit.
3. Rejected.

The Contractor must incorporate the changes indicated, resubmit and obtain a Code 1 or 2 notation before release for shipment can be granted.

B. Samples

Samples are physical examples which illustrate materials, equipment or workmanship and establish standards by which the work will be judged. Samples of all items of related systems (i.e. adjacent surfaces requiring similar colors but manufactured of different materials) must be submitted in the same time frame before the approval process can begin.

Where samples are required, they shall be submitted by and at the expense of the Contractor. Such submittal shall be made not less than thirty five (35) calendar days prior to the time that the materials represented by such samples need to be ordered for incorporation into any work in accordance with the schedule. Allow at least 21 calendar days for County's review. Materials represented by such samples shall not be manufactured, delivered to the site or incorporated into any work without such review. Each sample shall bear a label showing the Contractor's name, date submitted, project name,

name of the item, manufacturer's name, brand name, model number, supplier's name, and reference to the appropriate drawing, technical specification section and paragraph number, all as applicable.

Samples which have been reviewed may, at County's option, be returned to the Contractor for incorporation into the work.

C. Catalogues, Data and Certificates

Where catalogues, data or certificates are required, five (5) copies of each shall be submitted by and at the expense of the Contractor. Such submittal shall be made not less than thirty five (35) calendar days prior to the time that the materials represented by such catalogues, data or certificates must be ordered for incorporation into any work in accordance with the CPM schedule. Allow at least 21 calendar days for County's review. Material represented by such shall not be fabricated, delivered to the site or incorporated into any work without such review.

Certificates shall clearly identify the material being certified and shall include but not be limited to providing the following information: Contractor's name, project name, name of the item, manufacturer's name, and reference to the appropriate drawing, technical specification section and paragraph number all as applicable. All catalogues, data and certificates submitted by the Contractor shall be certified and dated by the Contractor on the face of each catalogue, data and certificate to be correct and shall be furnished in accordance with these requirements and the requirements of the Technical Specification, on forms provided by the County. County will conduct a review of Contractor's catalogues, data, and certificates and one copy marked with the review comments listed in paragraph A, above, will be returned to the Contractor.

73 Contractor Work-Site Emergency Action Plan

Contractor shall be fully and solely responsible for the safety of all on-site contract personnel, including subcontractors. The contractor shall supply the Plant Superintendent/Chief Operator with names, telephone numbers and/or pager numbers of designated contract/subcontract personnel responsible for implementing contractor emergency action plans in accordance with the Plant emergency action plan requirements.

Briefly, in the event of an emergency or need to evacuate the work-site, Plant personnel will advise designated on-site contract personnel. Should an audible and/or visual alarm be activated, all on-site contract personnel shall prepare to evacuate. Do not evacuate unless notified by Plant personnel. When notified to evacuate, all on-site contract personnel shall evacuate to a safe area as directed by Plant personnel.

The contractor shall review site-specific emergency action plans at a pre-work/construction meeting and shall be fully responsible for communicating the emergency action plans to all contract and subcontract personnel.

74 Cost Savings

After award of the Contract, the County will consider changes to the Contract proposed by the Contractor impacting the intent of the Contract Documents. If the Contractor awarded the project proposes changes to the Contract Documents which reduce project costs, and they are accepted by the County and the Engineer, then the Contractor will be entitled to fifty percent (50%) of the savings resulting from the changes (after engineering fees have been paid).

75 Safety and Health Regulations

A. The Contractor shall be fully and solely responsible for conducting all operations under this Contract at all times in such a manner as to avoid the risk of bodily harm to persons and damage to property. The Contractor shall continually and diligently inspect all work, materials, and equipment to discover any conditions that might involve such risks and shall be solely responsible for discovery and correction of any such conditions.

The Contractor shall comply with the Department of Labor Safety and Health Regulations promulgated under the Occupational Safety and Health Act of 1970 to include General Industry Standards (29 CFE 1910) and (29 CFR 1926/1910) for construction, and under Section 107 of the Contract Work Hours and Safety Standards Act.

B. The Contractor shall comply with the Manual on Uniform Traffic Control Devices when working on or off the site.

C. The Contractor shall allow representatives of the Department of Labor and authorized representatives of the Palm Beach County Water Utilities Department and the Palm Beach County Risk Management Department full access to the project for inspection.

76 Best Management Practices for the Construction Industry

A. The Contractor shall be responsible for assuring that each contractor or subcontractor evaluates the site before construction is initiated to determine if any site conditions may pose particular problems for the use, handling, production or storage of any regulated substances. For instance, handling regulated substances in the proximity of water bodies or wetlands may be improper.

B. If any regulated substances are stored on the construction site during the construction process, they shall be stored in a location and manner which will minimize any possible risk of release to the environment. Any storage container of 55 gallons or 440 pounds or more containing regulated substances shall have constructed below it an impervious containment system constructed of material of sufficient thickness, density and composition that will prevent the discharge to the land, groundwater or surface water of any pollutant which may emanate from said storage container. Each containment system shall be able to contain 150% of the contents of all storage containers above or within the containment system.

C. Each Contractor shall familiarize itself with the manufacturer's safety data sheet supplied with each material containing a regulated substance and shall be thoroughly familiar with procedures required to contain and clean up any releases of the regulated substance. Any tools or equipment necessary to accomplish same shall be available in case of release.

D. Upon completion of construction, all unused and waste regulated substances and containment systems shall be removed from the construction site by the Contractor and shall be disposed of in a proper manner as prescribed by law.

END OF SECTION

SUPPLEMENTAL GENERAL CONDITIONS

1. General
2. Project Sign

1. GENERAL

These Supplemental General Conditions make additions, deletions, or revisions to the General Conditions as indicated herein. All provisions which are not so added, deleted, or revised remain in full force and effect. Terms used in these Supplemental General Conditions which are defined in the General Conditions have the meanings assigned to them in the General Conditions.

2. PROJECT SIGN

Not Required.

END OF SECTION

Appendix A to General Conditions

NOTICE TO PROCEED

Dated _____, 20__

TO: _____
(CONTRACTOR)

ADDRESS: _____

**FOR THE
PALM BEACH COUNTY WATER UTILITIES DEPARTMENT**

**PLANT NO. 9 EASTERN HILLSBORO CANAL
AQUIFER STORAGE AND RECOVERY WELL SYSTEM
Project No.: WUD 98-66**

You are hereby notified that the Contract Time under the above Contract will commence to run on _____, 20__. By that date, you are to start performing your obligations under the Contract Documents. In accordance with the Agreement, the dates of Substantial Completion and Final Completion are 240 days successive calendar days and 270 days successive calendar days, respectively, from this date.

Before you may start any Work you must deliver to the Engineer, the following:

1. List of all subcontractors that will perform work on the project.
2. Construction schedule as required in specification Section 01310.
3. List of all shop drawings to be submitted.

Palm Beach County, Florida

By: _____
(Authorized Signature)
PBC Water Utilities Department

ACCEPTANCE OF NOTICE

Receipt of the above Notice To Proceed is hereby acknowledged by _____ this
_____ day of _____, 20__.

BY: _____

TITLE: _____

Copy to Engineer
(Use Certified Mail
Return Receipt Requested)

WARRANTY OF TITLE AND RELEASE

(For Periodic Progress Payments)

STATE OF _____)
)SS:
COUNTY OF _____)

CUTOFF DATE: _____
CONTRACTOR: _____
PROJECT NO. WUD 98-66
PROJECT NAME: PLANT NO. 9 EASTERN HILLSBORO
CANAL

BEFORE ME, the undersigned authority, personally appeared _____ hereinafter called the "Affiant"), who after being duly sworn, deposes and says that he is the _____ of _____ a _____ corporation (hereinafter called the "Contractor"), pursuant to Palm Beach County Contract No. WUD 98-66, dated the _____ day of _____, 20____ (hereinafter called the "Contract"), with the BOARD OF COUNTY COMMISSIONERS, PALM BEACH COUNTY, FLORIDA (hereinafter called the "County"), for the furnishing of certain labor, materials, equipment, tools, supplies and manufactured articles (hereinafter called the "Work"), to improve certain property located in PALM BEACH COUNTY, FLORIDA (hereinafter called the "Property"), and on behalf of the Contractor named above is authorized to make the following warranties, requests, releases, and indemnifications:

I. The Contractor warrants that it has fully completed in accordance with the Drawings and Specifications therefor, that portion of the Work, pursuant to the Contract (the "Completed Work") and represents that the attached Application for Payment constitutes a full and complete accounting of all monies due the Contractor under the Contract as of the Cutoff Date.

- II. A. ORIGINAL CONTRACT SUM \$ _____
- B. Approved Change Orders \$ _____
- C. Other Adjustments (Explain on attachment) \$ _____

III. The Contractor further warrants and represents that:

1. All Work performed by the Contractor through the Cutoff Date has been incorporated into this request for payment.
2. There are no costs, extras, change orders, or claims of any kind or nature due the Contractor for Work performed through the Cutoff Date other than as set forth herein.
3. Contractor hereby waives its right to payment and to any other claim not indicated herein.
4. All subcontractors, laborers, vendors, materialmen, manufacturers, suppliers and other parties of whatever kind or nature who are entitled to payment from the Contractor for providing labor and materials to the Contractor pursuant to the Contract as of the Cutoff Date in the last previous Periodical Estimate for Partial Payment have been paid in full for performing or furnishing the work, labor, equipment, materials, tools, supplies and manufactured articles upon said Contract and have delivered to the Contractor validly executed Partial Releases of Liens or Claims with respect thereto.
5. Contractor does hereby waive, release, remise, and relinquish Contractor's right to claim, demand, or impose a lien or claims to the extent of the previous payments, and except to the extent of the "Present Unpaid Balance" set forth above, for work done or labor, materials, equipment or supplies furnished and/or any other kind of class of lien or liens on the Property.

6. This shall constitute a full, absolute, and unconditional release and discharge by the Contractor to the County of all claims or liens of the Contractor, of whatever nature, arising out of, in connection with, or resulting from the supply by the Contractor, or any of its subcontractors or suppliers, of labor and/or materials to the Property as of the indicated Cutoff Date, except to the extent of the "Present Unpaid Balance" and any claims listed on the attached statement of unresolved claims.

The Contractor agrees to indemnify and hold the County harmless from and against all costs and expenses, including reasonable attorney's fees and fees on appeal, resulting from any entity or individual who claims to have not been paid for labor, materials, equipment, tools, supplies and manufactured articles furnished in connection with the Completed Work.

This statement is given under oath.

(CORPORATE SEAL)

(Contractor)

(Signature)

(Title)

Sworn to and subscribed before this _____ day of _____, 20____, by _____,

(SEAL)

Notary Public, State of Florida

Personally known__
OR Produced Identification__
Type of Identification Produced _____

**STATEMENT OF UNRESOLVED CLAIMS FOR
CONTRACT NUMBER _____**

PAYMENT APPLICATION NUMBER ____

Contractor shall list, in detail, on this page and any required additional pages all outstanding, unresolved claims which Contractor has on this project.

FINAL WARRANTY OF TITLE

STATE OF FLORIDA _____)

COUNTY OF _____)

Before me, the undersigned authority, personally appeared _____, who was duly sworn and says:

1. Affiant is the _____ of _____ a _____ (hereinafter called the "Contractor").

2. Contractor entered into a Contract dated the _____ day of _____, 20__ (hereinafter called the "Contract") with the **PALM BEACH COUNTY**, a political subdivision of the State of Florida (hereinafter called the "County"), being Contract No. «PROJECT_NUMBER» for the construction of certain improvements and the performance of certain Work more particularly described in the Contract Documents (such construction and performance being hereinafter collectively referred to as the "Work"), on property owned and or controlled by the County, located in Hillsboro Canal approximately 1.5 miles west of State Road 7.

3. Contractor has fully completed the Work and all individuals, firms, and corporations furnishing materials, labor, equipment, tools, supplies, manufactured articles and services incident to the completion of the Work, and all payrolls, bills for materials, equipment, tools, supplies, manufactured articles, and all other indebtedness connected with the Work, have been paid in full, except for the following:

None, unless set forth below:

Name	Address	Amount Due or to Become Due and Unpaid
_____	_____	_____
_____	_____	_____

(Attach additional sheets, if more space is needed)

4. Receipt by Contractor of the Final Payment from County in the amount of \$ _____ shall constitute a full release and discharge by Contractor to said County of all claims and liens of the Contractor against said County arising out of, connected with, or resulting from performance of the Contract or the Work.

5. The undersigned further certifies that all non-exempt taxes imposed by Chapter 212, Florida Statutes (Sales and Use Tax Act), as amended, have been paid and discharged.

6. Contractor agrees to forever indemnify, defend, and hold said County harmless from and against all costs and expenses, including reasonable attorney's fees, including fees on appeal,

resulting from individuals, firms, or corporations who claim to have not been paid for material, labor, equipment, tools, supplies, manufactured articles or services furnished incident to the Work.

7. This Affidavit is made for the purpose of inducing Final Payment from the County to the Contractor under the Contract in compliance with the Contract Documents.

8. Affiant has full authority to execute this Affidavit and to execute a full and final release of all claims and liens on behalf of the Contractor.

Signed and Sealed in the presence of:

(Contractor) (CORPORATE SEAL)

(Witness) (Signature)

(Witness) (Title)

Sworn to and subscribed before this _____ day of _____, 20____, by _____,

(SEAL) _____
Notary Public, State of Florida

Personally known _____
or Produced Identification _____
Type of Identification Produced _____

CERTIFICATE OF SUBSTANTIAL COMPLETION

FOR THE PLANT NO. 9 EASTERN HILLSBORO CANAL AQUIFER STORAGE AND RECOVERY WELL SYSTEM WUD 98-66

Project No. WUD 98-66

CONTRACTOR: _____

CONTRACT DATE: _____, 20__

This Certificate of Substantial Completion applies to all Work under the Contract Documents or to the following specified parts thereof:

TO: _____
(County)

AND
TO: _____
(Contractor)

The Work to which this Certificate applies has been inspected by authorized representatives of the ENGINEER, along with the CONTRACTOR and that Work is hereby declared to be Substantially Complete in accordance with the Contract Documents on:

(Date of Substantial Completion)

A tentative list of items to be completed or corrected is attached hereto. This list may not be all-inclusive, and failure to include an item in the list does not alter the responsibility of the CONTRACTOR to complete all the Work in a good and workmanlike manner in accordance with the Contract Documents. The items in the tentative list shall be completed or corrected by the CONTRACTOR within _____ days of the above date of Substantial Completion.

The responsibilities between the County and the CONTRACTOR for security, operation, safety, maintenance, heat, utilities, insurance and warranties shall be as follows:

County: _____

CONTRACTOR: _____

The following documents are attached to and made a part of this Certificate:

This Certificate does not constitute an acceptance of any Work not in accordance with the Contract Documents nor is it a release of CONTRACTOR'S obligation to complete the Work in a good and workmanlike manner in accordance with the Contract Documents.

Recommended by the ENGINEER on _____, 20__

By: _____

(Signature)

(Print)

(Title)

CONTRACTOR hereby accepts this Certificate of Substantial Completion:

By: _____
(Signature)

(Print)

(Title)

County acknowledges receipt of this Certificate of Substantial Completion:

By: _____
(Signature)

(Print)

(Title)

CONTRACTOR'S CERTIFICATION OF FINAL COMPLETION

TO: _____

Date _____

PROJECT _____

JOB NO. _____

CONTRACT NO. _____

ATTN: _____

County _____

ENGINEER _____

FROM: _____
(Firm or Corporation)

This is to certify that I, _____ am an authorized official of _____ working in the capacity of _____ and have been properly authorized by said firm or corporation to sign the following statements pertaining to the subject Contract:

I know of my own personal knowledge, and do hereby certify, that the work of the Contract described above has been performed, and materials used and installed in every particular, in accordance with, and in conformity to, the Contract Documents and approved changes thereto.

The contract work is now complete in all parts and requirements, and ready for your final inspection.

I understand that neither the determination by the Engineer that the work is complete, nor the acceptance thereof by the County, shall operate as a bar to claim against the Contractor under the terms of the guarantee provisions of the Contract Documents.

BY _____

TITLE _____

FOR _____

Distribution: Project Manager
Field Office
File
County

CONSENT OF SURETY

For Reduction of or Partial Release of Retainage

PROJECT NAME: PLANT NO. 9 EASTERN HILLSBORO CANAL/AQUIFER STORAGE AND RECOVERY WELL SYSTEM

LOCATION: Hillsboro Canal approximately 1.5 miles west of State Road 7

PROJECT NO.: WUD 98-66 CONTRACT NO.: _____ CONTRACT DATE: _____

CONTRACT TYPE: _____

CONTRACT AMOUNT: _____ ENGINEER'S PROJECT NO.: _____

ENGINEER: _____

In accordance with the provisions of the above-named Contract between the County and the Contractor, the following named Surety:

on the PUBLIC CONSTRUCTION BOND of the following named Contractor:

hereby approves a reduction of or a partial release of retainage to the Contractor as set forth below:

The Surety Company hereby agrees that such reduction of or partial release of retainage to the Contractor shall not relieve said Surety Company of any of its obligations to the following named County as set forth in said Surety Company's bond:

IN WITNESS WHEREOF, the Surety Company has hereunto set its hand and seal this _____ day of _____, 20____.

(Attest)

(Name of Surety Company)

(Affix corporate here)

(Signature of Authorized Representative)

TITLE: _____

CONSENT OF SURETY FOR FINAL PAYMENT

PROJECT NAME: PLANT NO. 9 EASTERN HILLSBORO CANAL AQUIFER STORAGE AND RECOVERY WELL SYSTEM

LOCATION: Hillsboro Canal approximately 1.5 miles west of State Road 7

PROJECT NO.: WUD 98-66 CONTRACT NO.: _____ CONTRACT DATE: _____

CONTRACT YPE: _____

CONTRACT AMOUNT: _____ ENGINEER'S PROJECT O.: _____

ENGINEER: _____

In accordance with the provisions of the above named Contract between the County and the Contractor, the following named Surety:

on the PUBLIC CONSTRUCTION BOND of the following named Contractor:

hereby approves of final payment by County to the Contractor, and further agrees that said final payment to the Contractor shall not relieve the Surety Company named herein of any of its obligations to the following named County, as set forth in said Surety Company's bond:

IN WITNESS WHEREOF, the Surety Company has hereunto set its hand and seal this _____ day of _____, 20____.

(Attest)

(Name of Surety Company)

(Affix corporate seal)

(Signature of Authorized Representative)

TITLE: _____

REQUEST FOR ADJUSTMENT OF RETAINAGE

PROJECT NAME: _____ PROJECT NO.: WUD 98-66

County: _____ CONTRACT NO.: _____

ENGINEER: _____ PROJECT MANAGER _____

CONTRACTOR: _____

The Contractor, _____ hereby requests that the percentage of partial payment estimates retained by the County under the provisions of the Contract Documents be REDUCED from ____% to ____%.

By _____ Date _____
Contractor Representative

Title _____

The Surety on the Public Construction Bond for said project:

_____ hereby approves the foregoing request.

By _____ Date _____
Attorney-in-Fact
Power of Attorney must be attached to original copy

Approval IS/IS NOT recommended. The percentage of completed work as of _____, 2000 is _____% and the present percentage of elapsed contract time as of _____, 2000 is _____%

By _____ Date _____
Resident Project Representative

Approval IS/IS NOT recommended:

By _____ Date _____
Project Manager

APPROVED/DISAPPROVED:

By _____ Date _____
County's Representative



Board of County Commissioners

Made Ford Lee, Chairman
Warren H. Newell, Vice Chairman
Karen T. Marcus
Carol A. Roberts
Mary McCarty
Duff Asanman
Tony Marfisi

County Administrator

Robert Welmen

WATER UTILITIES DEPARTMENT

PROJECT NO.: WUD 99-05

PROJECT NAME: PLANT NO. 9 EASTERN HILLSBORO CANAL
AQUIFER STORAGE AND RECOVERY WELL SYSTEM

**INSPECTION OF FACILITIES
CERTIFICATION**

This is to certify that on this date 11/17/00 Mr./MRS. James M. Pellegrino
(Print or Type)

who is an authorized representative of The Haskell Company has
(Print or Type Name of Firm)

visually inspected the facilities where items/services are to be installed/performed.

At this time, the County's representative Vincent Moran was available to answer any
(Print Name)

questions and completely inform Bidder as to the nature and extent of the work required relative to this
invitation for Bid. Failure to submit this executed document with your Bid Response SHALL be cause for
rejection of your Bid.

Vincent Moran
(County Representative's Signature)

11-28-00
(Date)

2005 Prairie Road, Building "K", West Palm Beach, Florida 33408

****DO NOT REMOVE THIS REGISTER****

BIDDER'S REGISTER FOR PRE-BID CONFERENCE

PROJECT #: WUD 98-66

COMPANY: _____ REPRESENTATIVE: _____

ADDRESS: _____ TELEPHONE # _____

_____ ZIP _____ FAX _____

E-MAIL: _____

COMPANY: _____ REPRESENTATIVE: _____

ADDRESS: _____ TELEPHONE # _____

_____ ZIP _____ FAX _____

E-MAIL: _____

COMPANY: _____ REPRESENTATIVE: _____

ADDRESS: _____ TELEPHONE # _____

_____ ZIP _____ FAX _____

E-MAIL: _____

COMPANY: _____ REPRESENTATIVE: _____

ADDRESS: _____ TELEPHONE # _____

_____ ZIP _____ FAX _____

E-MAIL: _____

COMPANY: _____ REPRESENTATIVE: _____

ADDRESS: _____ TELEPHONE # _____

_____ ZIP _____ FAX _____

E-MAIL: _____

COMPLETE MAILING ADDRESS IS REQUIRED

CHANGE ORDER

PROJECT: _____

CHANGE ORDER NO.: ____ **WATER UTIL. DEPT. PROJECT NO. :**WUD 98-66

(Contractor): _____

DOCUMENT NO.
CONTRACT DATE:
NOTICE TO PROCEED:
BUDGET LINE ITEM:

You are directed to make the following changes in this contract:

1.

Total \$

NOT VALID UNTIL SIGNED BY BOTH OWNER AND ENGINEER. SIGNATURE OF THE CONTRACTOR INDICATES HIS AGREEMENT HEREWITH INCLUDING ANY ADJUSTMENT IN THE CONTRACT SUM OR CONTRACT TIME, AND NO ADDITIONAL COST OR TIME INDICATED HEREIN WILL BE RELATED TO THIS CHANGE

The Original Contract Sum was.....	\$ _____
Net Change by previous Change Orders	\$ _____
The Contract Sum prior to this Change Order was	\$ _____
The Contract Sum will be increased/decreased by this Change Order.....	\$ _____
The New Contract Sum indicating this Change Order will be...	\$ _____
The Contract Time will be changed by _____ ()Days	
The Date of Substantial Compl. including this Change Order:	_____
The Date of Final Completion including this Change Order:	_____

Execution of this change order acknowledges final settlement of, and releases, all claims for costs and time associated, directly or indirectly, with the above stated modification(s), including all claims for cumulative delays or disruptions resulting from, caused by, or incident to such modification(s), and including any claim that the above stated modification(s) constitutes, in whole or part, a cardinal change to the contract.

Palm Beach County
ENGINEER
P.O. Box 16097
Address
W. Palm Beach, FL 33416

CONTRACTOR

Address

Palm Beach County
OWNER
P.O. Box 16097
Address
West Palm Beach, FL 33416

BY _____ BY _____

DATE _____ DATE _____

BY _____ BY _____

DATE _____ DATE _____

BY _____

DATE _____

BY _____

DATE _____

Appendix B to General Conditions

POST BID INFORMATION
(If requested by the Owner)

**PLANT NO. 9 EASTERN HILLSBORO CANAL
AQUIFER STORAGE AND RECOVERY WELL SYSTEM
PROJECT NO.: WUD 98-66**

1. POST BID INFORMATION REQUIREMENTS

This form must be completed and returned to the Owner within two (2) working days of the Bid opening by the low Bidder. Each Bidder is responsible for checking the Bid results to determine if they are the low Bidder. Failure to return this form within two (2) working days will result in rejection of the Bid by the Owner. The Owner may, after receiving this Post Bid Information, request additional information of the Bidder concerning his responsibility to perform; and the Bidder may, after submission of this Post Bid Information, provide additional or corrective information concerning this form or his responsibility as a Bidder. If, after review of the Bid and the Bidders qualifications, the Owner deems the low Bidder to be non-responsive/responsible, then the Owner will request the next low Bidder, and possibly subsequent low Bidders, to provide this information within two (2) days of notification. Failure to return this form within two (2) working days will result in rejection of the Bids by the owner.

1. Contractor's Legal Name and Address:

Name: The Haskell Company
Address: 111 Riverside Avenue
City: Jacksonville State FL Zip Code: 32202

2. Check One: Corporation: Partnership:
Individual: Joint Venture:

3. If a Corporation, state:
Date of Incorporation: January 21, 1983
State in which Incorporated: Florida

4. If an out-of-state corporation which is currently authorized to do business in the State of Florida, give the date of such authorization: N/A

5. Names and Titles of Principal Officers Date Elected:
Preston H. Haskell III Chairman (Owner)
Steven T. Halverson President & CEO

See attached listing of Officers.

6. If a Partnership, state:

Date of Partnership: _____

Type of Partnership (General or Limited): _____

Names and Addresses of Partners: _____

N/A

7. If Joint Venture, state:

Date of Joint Ventureship: _____

Names and Addresses of Joint Venturers:

N/A

8. If Sole Proprietorship, state:

Name and Address of Sole Proprietor:

N/A

9. List corporate names or business names under which each of the principals in the present corporation have done business for the last ten (10) years:

N/A

10. List all subsidiaries or holding companies:

Haskell Constructors Ltd.

Jax Utilities Construction

11. Contractor's License: CG-C051098 Primary Classification General Contractor

State License No.: Corporate Charter No. G20498

Supplemental classifications held, if any: _____

Name of Licensee, if different from (1) above:

David Kuntz Scheele

12. What is the maximum bonding capacity of your company?

(A) Capacity (Dollar Amount): \$350,000,000 +

(B) Include the company name, phone number, address and name of the Florida Resident Agent of your current bonding company:

Willis Corroon of Florida, 7650 Courtney Campbell Causeway, Suite 920,
Tampa, Florida 33607

13. Has your organization or any member been involved in any litigation or arbitration within the last ten (10) years as a result of construction contracts, including but not limited to liens, defective performance or workmanship? If yes, provide the following information for each case (attach additional sheets as necessary):

(A) Style or caption of litigation or arbitration: See attached.

(B) All parties to such proceedings:

(C) Names, Addresses, and Telephone Numbers of Attorneys for each party:

(D) Date Litigation Started: _____

(E) Status of Case: _____

(F) Provide an explanation of each claim by and against each party
(Attach additional sheets as necessary).

14. Have you or any principal of your company ever declared bankruptcy?

Yes _____ No x _____

If yes, provide dates and particulars:

<u>Date</u>	<u>Reason</u>
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15. Have you ever failed to complete work awarded to you? If so, where and why?

No

16. List some major subcontractors and suppliers from your completed or ongoing projects:

Eclipse Construction, Unlimited Landscapes, Davco Electric,

McDaniel Grading.

17. State the construction experience of your firm's principal members including, but not limited to, type, size and completion of projects, including project status (attach additional sheets as necessary):

See attached resumes.

18. State the construction experience of your organization including, but not limited to, type, size and completion of projects, including project status (attach additional sheets as necessary):

See attached.

19. State the construction experience of the Superintendent to be assigned to this project including, but not limited to, type, size and completion of projects, including project status (attach additional sheets as necessary):

See attached resume for Eric G. Wichmann.

END OF SECTION



T H E H A S K E L L C O M P A N Y
TOTAL FACILITY SOLUTIONS

Name of Corporation: The Haskell Company
111 Riverside Avenue
Jacksonville, Florida 32202

Chartered Under: State of Florida

Officers:

Preston H. Haskell, III Chairman 111 Riverside Avenue
Jacksonville, Florida 32202

Steven T. Halverson President & CEO 111 Riverside Avenue
Jacksonville, Florida 32202

John R. Cobb Executive Vice President &
Chief Operating Officer 111 Riverside Avenue
Jacksonville, Florida 32202

Hans G. Tanzler III Sr. Vice President &
Chief Financial Officer 111 Riverside Avenue
Jacksonville, Florida 32202

John H. Patton Sr. Vice President &
Corporate Resource Officer 111 Riverside Avenue
Jacksonville, Florida 32202

Robert W. Soulby Senior Vice President 111 Riverside Avenue
Jacksonville, Florida 32202

James A. Gray Senior Vice President 111 Riverside Avenue
Jacksonville, Florida 32202

Gregory Ferrell Senior Vice President 111 Riverside Avenue
Jacksonville, Florida 32202

HASKELL LITIGATION SUMMARY

[disputes with owners over the past ten years, through November 29, 2000]

PARTIES	CASE SUMMARY
<u>Ames Department Stores, Inc. and Zayre New England Corp., a wholly owned subsidiary of Ames Department Stores, Inc. and The Home Insurance Company as subrogee of Ames Department Stores, Inc. v. The Haskell Company and Canam Steel Corporation</u>	<u>Ames Department Stores, Inc., et al. v. The Haskell Company</u> is a suit which names Haskell as defendant in its capacity as general contractor and structural engineer for Plaintiffs' distribution facility located in Pennsylvania. Plaintiffs has alleged damages in excess of \$15,000.00 which its states have resulted from a collapsed roof of the facility following a severe snow storm. On January 30, 1996, Plaintiffs specifically alleged damages in the amount of \$9,700,871.00. Haskell contests this matter vigorously, and it is currently impossible to predict the outcome. Canam Steel Corporation the joist-girder manufacturer and its insurance companies have repaired the premises, which are currently operational. Canam has asserted that weather contributed to the collapse of the warehouses, while Ames has asserted that the collapse was due to defective joist/girder manufactured by Canam Steel. Canam appears to have sufficient insurance coverage. The company has also notified its insurance carrier, Aetna, who is currently defending the action for Haskell. At this point in the litigation, it is impossible to predict the outcome.
<u>C & O Properties, Ltd., a limited partnership, by and through its general partner, Coggin-O'Steen Investment Corporation, a Florida corporation and United States Fire Insurance Co. v. The Haskell Company</u>	<u>C & O Properties, Ltd., et al. v. The Haskell Company</u> was a suit involving damages resulting site drainage allegedly resulting from negligent site design. Haskell contested these allegations. The case was mediated and eventually settled out of court.
<u>Georgia-Pacific vs. The Haskell Company</u>	<u>GEORGIA PACIFIC CORPORATION VS. THE HASKELL COMPANY</u> was a suit brought by GP against The Haskell Company for breach of contract concerning additional drainage built by Haskell in 1991 for Georgia Pacific. The parties have settled the matter out of court.
<u>Georgia-Pacific Corporation and, Georgia Pacific Corporation f/u/b/o Underwriters at Lloyd's and Other Insurers led by Lloyd's Syndicate Sturge Syndicate No.210, and The Commonwealth Insurance Company, v. The Haskell Company</u>	<u>GEORGIA PACIFIC CORPORATION, ET AL. VS. THE HASKELL COMPANY</u> was a suit, which names Haskell as defendant in its capacity as general contractor and structural engineer for Warehouse No. 3 and Warehouse No. 4 of Georgia Pacific's Palatka facility. Plaintiffs alleged damages in excess of \$14 million, which it alleged resulted from collapsed roofs at warehouses following an unprecedented hailstorm. The parties have settled the matter out of court.
<u>Deer Creek Associates, Ltd. V. The Haskell Company, Et Al.</u>	<u>Deer Creek Associates, Ltd. v. The Haskell Company, et al.</u> was an action brought for breach of contract and negligence resulting from the construction of a project known as Villages of Deercreek, Deerfield Beach, Florida, on which Haskell was the Design-Build Contractor. The plaintiff alleged that the stucco facade of the Project was defectively designed and/or constructed without proper expansion joints and/or with the improper use of expansion joints. Haskell denied this claim; however, this matter was settled out of court.
<u>The Haskell Company Vs. Core Development, Inc.</u>	<u>THE HASKELL COMPANY VS. CORE DEVELOPMENT, INC.</u> , was an action filed pursuant to a letter agreement entered into by Haskell and John McDonald/Core Development to assist them in developing assisted-living facilities for their client, Integrated Health Services. Design costs for the project were initially capped at \$20,000. The cap was increased to \$40,000 when two projects were added by a written modification. Haskell started the design portion of the work including architectural designs, etc. Subsequently, three additional projects were added and significant modifications to the original concept were made, which required different criteria. Mr. McDonald was notified that the cap could be exceeded as a result of the added projects and change in scope of the

HASKELL LITIGATION SUMMARY

[disputes with owners over the past ten years, through November 29, 2000]

	<p>projects. All of the projects except one were eventually abandoned and the final project was given to a "lower bidder". The design costs that Mr. McDonald owes Haskell for work completed on all the projects is \$76,500. This matter was settled out of court.</p>
<u>Texas/Frito-Lay Accident</u>	<p><u>Texas/Frito-Lay Accident:</u> On December 9, 1997, a Petition was filed in state court in Texas seeking to recover damages on behalf of the mother, father, wife and daughter of a Haskell employee killed when struck by a backhoe while working in an excavation ditch on August 1, 1997. At this stage of the litigation, it is impossible to predict an outcome.</p>
<u>Tennis Club Villas Vs. Haskell</u>	<p><u>TENNIS CLUB VILLAS VS. HASKELL.</u> is an action filed by Tennis Club Villas ("TCV") alleging damages on a South Carolina project constructed by Haskell over 13 years ago, which exceeds the statute of repose. However, TCV has alleged "gross negligence" in an attempt to circumvent the statute. Haskell vigorously denies this claim. It is too early to predict an outcome in this matter.</p>
<u>Haskell vs. Dade County Public Schools</u>	<p><u>HASKELL VS. DADE COUNTY PUBLIC SCHOOLS.</u> is an action filed by Haskell regarding the contract between Haskell and Dade County for the design and construction of State Schools "F," "H-1," and "U." Haskell has made repeated requests to be compensated for costs associated with changes in the work and project acceleration due to DIC and permitting delays totaling approximately \$2,900,000. Dade County has refused to pay Haskell's claims. It is too early to predict an outcome in this matter.</p>
<u>Haskell v. Medical Pavilion</u>	<p>Medical Pavilion filed suit in state court against Haskell and Carlisle Roofing alleging roofing problems related to work performed in July 1996. The case is scheduled for trial early in 2001.</p>
<u>Haskell v. Adult Care Group</u>	<p>This action involves a dispute surrounding the outstanding contract balance owed to Haskell on the Park Place of Carrollwood project. The owner failed to make final payment, and Haskell filed an action to recover the outstanding contract balance. It is too early to predict an outcome in this matter.</p>
<u>Coca-Cola v. Haskell</u>	<p>Coke has alleged pavement defects on its distribution facility in Columbus, Ohio, which Haskell constructed in 1993-1994. Coke recently filed its complaint against Haskell for the alleged paving defects. It is too early to predict an outcome in this matter.</p>

CREDENTIALS

Mr. Haskell possesses over 35 years of experience in engineering, design and management in the building construction field. He organized The Haskell Company in 1966, and its Engineering Department in 1969, serving as head of engineering activities in the early stages of that unit's formation. Prior to establishing The Haskell Company, he was vice president of a major regional construction and realty development company.

Mr. Haskell is a widely recognized advocate of the design-build delivery system, having been long instrumental in promoting its use among both private sector clients and public agencies. In 1993, this leadership culminated in the founding of the national Design-Build Institute of America (DBIA). Mr. Haskell served as the founding Chairman of DBIA and continues his involvement as a key member of the board of directors. He is a frequent speaker on design-build delivery in the U. S. and abroad, and his articles are widely published in industry publications.

Mr. Haskell is a trustee of Princeton University, and chairman of the Cummer Museum of Art in Jacksonville. He is past chairman of the Jacksonville Chamber of Commerce, Florida Postsecondary Education Commission, Jacksonville Electric Authority, Jacksonville Symphony Orchestra and United Way of Northeast Florida.

RESPONSIBILITIES

As chief executive officer, Mr. Haskell is active in all areas of the Company's operations. His project delivery-related activities include development of design policies and standards, review and critique of major projects, and ongoing involvement in personnel development in all disciplines. At the chief executive level, he guides long-term strategic planning, organizational development, and major marketing initiatives.

EDUCATION

Master of Business Administration, with Distinction
Harvard University

Bachelor of Science in Engineering, with Honors
Princeton University

**REGISTRATIONS/
LICENSES**

Registered Professional Engineer in Florida, Alabama, South Carolina and Virginia

**PROFESSIONAL
AFFILIATIONS**

Member of the National Society of Professional Engineers and Florida Engineering Society
Design-Build Institute of America, Chairman 1993-95, Director 1993
Construction Industry Round Table



STEVEN T. HALVERSON
PRESIDENT & CHIEF EXECUTIVE OFFICER

CREDENTIALS

Mr. Halverson has acquired more than 20 years' experience in design and construction, with direct responsibility for construction of numerous, large-scale projects throughout the U.S. He has co-authored two books, *Federal Grant Law* and *Construction Law Update*, as well as numerous articles for leading industry publications, including *The Future of the Construction Industry*. Mr. Halverson also speaks internationally on topics involving construction, real estate development and environmental issues.

RESPONSIBILITIES

As president and chief executive officer, Mr. Halverson is active in all aspects of the company's business, with particular emphasis on organizational development, major marketing initiatives and client relationships. He also participates in project-delivery activities, including development of design policies and standards; review and critique of major projects; and personnel development in all disciplines. In addition, Mr. Halverson guides long-term strategic planning and organizational development.

EDUCATION

Juris Doctorate
American University

Bachelor of Arts
St. John's University

**REGISTRATIONS/
LICENSES**

Member of the bar, Virginia and Minnesota

**PROFESSIONAL
AFFILIATIONS**

Mr. Halverson is active in many civic and professional organizations. He is a trustee of Regis University, serving as vice chairman; the Lowell Whiteman School, as chairman; and the Center for the New West, a public policy think tank, as secretary. He currently serves as chairman of the Design-Build Institute of America (DBIA) for 2001. Mr. Halverson has also served on advisory boards at the University of Colorado and Purdue University and is past president of Associated General Contractors (AGC) of Colorado, in addition to serving as past national director of AGC.



JOHN R. COBB, PE
EXECUTIVE VICE PRESIDENT, CHIEF OPERATING OFFICER

CREDENTIALS

Cobb joined The Haskell Company in 1974. During his extensive service with Haskell, he has successfully managed and directed a wide range of design and construction projects including food processing facilities, manufacturing plants, low-temperature facilities, warehousing and distribution centers, and commercial facilities, featuring retail and office buildings, resorts and housing. Cobb has worked successfully with governmental agencies, corporate clients and real estate developers.

Since 1965, Cobb has established an excellent reputation in the design-build industry, having managed and directed numerous projects for such clients as Procter & Gamble, Frito-Lay, General Electric, Mazda Motors, Mercedes-Benz and United States Postal Service. These projects have been constructed in 25 states and Canada.

RESPONSIBILITIES

Cobb has held positions as project manager, construction division manager, vice president of construction, chief sector officer and senior vice president of Haskell's industrial sector. In his current position as executive vice president and chief operating officer, Cobb has responsibility for all project delivery business units.

EDUCATION

Master of Science in Civil Engineering
University of Alabama

Bachelor of Science in Civil Engineering
University of Alabama

**REGISTRATIONS/
LICENSES**

Registered Professional Engineer

**PROFESSIONAL
AFFILIATIONS**

National Society of Professional Engineers
Florida Engineering Society
American Society of Civil Engineers
American Concrete Institute
Design-Build Institute of America



HANS G. TANZLER III
*Senior Vice President and
Chief Financial Officer*

CREDENTIALS	Mr. Tanzler joined the Haskell Company in 1998 as its Chief Financial Officer. Mr. Tanzler is an attorney/CPA with an extensive background in tax law and who is also a financial executive. His prior experience includes top level financial and operational management with several companies in diverse industries. His prior positions held include Chief Financial Officer, General Counsel and President.
RESPONSIBILITIES	As Chief Financial Officer, Mr. Tanzler directs corporate financial and lender relations, accounting, budgeting, information technology, taxation and risk management.
RELEVANT EXPERIENCE	<p>Commercial Tax Attorney – Negotiated tax advantaged structures for diverse business acquisitions, dispositions, reorganization and real estate ventures including real estate exchange programs involving "build to suit" construction.</p> <p>Mark III Industries, Inc. – CFO and interim CEO of \$700,000,000 van conversion company in Ocala, Florida.</p> <p>Consolidated International Insurance Group – CFO and Executive Vice President of international insurance group of credit life and disability companies with over one billion dollars in assets.</p> <p>Diamond Carpet Mills, Inc. – Chief Financial Officer and Executive Vice President of \$250,000,000 carpet manufacturer. Managed relations with eight banks and 700 trade creditors to accomplish turnaround and ultimate sale to Mohawk Carpets.</p> <p>Micro Design International, Inc. – Executive Vice President and President of \$25,000,000 computer manufacturer of software and hardware for network data storage management. Refinance debt and default, developed an OEM supply contract with Compaq Computer.</p>
EDUCATION	University of Florida Bachelor of Science in Accounting Juris Doctorate LL.M. (Legal Masters) Taxation
REGISTRATIONS/ LICENSES	Certified Public Accountant – Florida Attorney – Florida Registered Real Estate Broker – Florida
PROFESSIONAL AFFILIATIONS	Tax Section – Florida Bar Association Turnaround Management Association



JOHN H. PATTON
SENIOR VICE PRESIDENT

CREDENTIALS

John Patton joined the Haskell Company in the fall of 1977 as a Field Engineer and progressed to Project Manager. Construction Division Manager. Director of Construction. Projects Officer. and Vice President. During this time, his experience has included a wide variety of institutional, commercial, industrial and civil projects, including schools, office buildings, jails, courthouses, churches, continuing care retirement communities, medical office buildings, and road and bridge work.

He was promoted to Senior Vice President in 1996, and in this role has served as Chief Construction Officer and Chief Corporate Resources Officer. John has been responsible for recruitment, professional development and evaluation of all construction personnel including project managers and superintendents. In addition, other responsibilities have included marketing, advertising, specialty operations, safety, minority business enterprise programs and the development of management training programs. Prior to joining The Haskell Company team, he was Vice President of a South Florida construction company.

RESPONSIBILITIES

John Patton currently serves as head of the Civil/Diversified at The Haskell Company. This new group includes specialty construction work and civil infrastructure. These divisions provide elevated support to the company's major projects. The transportation and water divisions are being expanded by John to promote the benefits of design-build opportunities in the civil arena. As a senior level corporate officer, John has full authority to commit the resources of the company on all aspects of projects.

RELEVANT EXPERIENCE

State of New York DOT – Interstate I-84 Field Engineer for the Construction Manager

Florida Department of Transportation – Several office expansions and buildings, operation centers located throughout Florida.

Dade County Elementary Schools – 3 design-build schools, Dade County, Florida.

Florida Community College at Jacksonville – Urban Resource Center in Jacksonville, Florida.

Flagler County Sheriff's Department – 132 bed jail and sheriffs operations center in Bunnell, Florida.

Volusia County Public Works Department – Justice Center in Daytona Beach, Florida.

Harris County Sheriff's Department – Operations center and 100-bed jail in Hamilton, Georgia.

Falcons Landing – Air Force Retired Officer's Community (753,000 SF) in Sterling, Virginia.

Fleet Landing – Nursing and Assisted Life Care Community (558,000 SF) in Atlantic Beach, Florida.

EDUCATION

Bachelor of Science in Aeronautical Engineering
Rensselaer Polytechnic Institute

**PROFESSIONAL
AFFILIATIONS**

Associated Builders and Contractors – Served on Jacksonville Board
Construction Education Foundation – Member and Former Chairman of the Board
Design Build Institute of America – Member and Speaker



OTHER PROJECTS

Baptist Medical Center – Medical office building in Jacksonville Beach, Florida and eye institute/outpatient clinic in Jacksonville, Florida.

New River Middle School – design-build middle school. Ft. Lauderdale, Florida.

St. Marks Episcopal Church – Sanctuary Expansion and Renovations in Jacksonville, Florida.

The City of Jacksonville – 432 bed jail located in Jacksonville, Florida.



CREDENTIALS	<p>Jim joined The Haskell Company in the spring of 1979 as an Assistant Project Manager. He quickly moved to the position of Project Manager, handling many of the company's largest and most complicated engagements. Since 1976, Jim has compiled a wealth of experience in design/build, construction management and general contractor delivery systems on a variety of building types. This broad experience provides Jim with the knowledge to participate in virtually any engagement The Haskell Company may undertake. Jim is now the Senior Vice President for the Institutional/Commercial Project Delivery Group.</p>
RESPONSIBILITIES	<p>Jim will serve as Chief Construction Officer on this project. This position is responsible for recruitment, professional development and evaluation of all construction personnel including project managers and superintendents. As a senior level corporate officer, Jim has full authority to commit the resources of the company in all aspects of a project.</p>
RELEVANT PROJECT EXAMPLES	<p>Founders Village – 350-Unit Retirement Community located in Virginia Beach, VA Paradise Valley Estates – 327-Unit Retirement Community located in Fairfield, California. Falcon's Landing – 319-Unit Retirement Community located in Sterling, Virginia. Barnett Office Park – 10 Building Campus consisting of 1.5 million s.f of office space plus a 1,500 space parking structure in Jacksonville, Florida. Center for Disease Control and Prevention – 130,000 s.f. Headquarters Building and Data Center in Atlanta, Georgia with a 370-space parking structure. AllTel (Computer Power, Inc.) – 365,000 s.f. Regional Headquarters and Data Center in Jacksonville, Florida with a 450-space parking structure. Blairstone Corporate Center – 200,000 s.f. Corporate Headquarters and 325-space Parking Structure for Department of Corrections in Tallahassee, Florida. Blue Cross/Blue Shield – 650,000 s.f. Multi-Building Office Complex, valued at over \$65 million, in Jacksonville, Florida Cypress Village Retirement Community – \$14,591,000 Retirement Community in Jacksonville, Florida. Baptist Medical Center – \$32,374,000 New Wolfson Children's Hospital in Jacksonville, Florida. AT&T Information Systems, Inc. – \$18 million, Data/Operations Center in Orlando Florida. AT&T Resource Management – 462,000 s.f. American Transtech Operations Center in Jacksonville, Florida.</p>
EDUCATION	<p>Bachelor of Science in Building Construction University of Florida</p>
REGISTRATIONS/ LICENSES	<p>Class "A" General Contractor - State of Florida</p>



GREGORY FERRELL
SENIOR VICE PRESIDENT - INDUSTRIAL

CREDENTIALS

Gregory Ferrell joined The Haskell Company in the summer of 1978 as a project superintendent. He spent three years in the field as a project superintendent learning first hand the design/build delivery system. He has since held the positions of project manager, division manager, Vice President - Project Director and his current position of Senior Vice President. He has been responsible for the design and construction of a broad range of project types, including industrial, commercial and institutional projects. He is directly responsible to the client during preconstruction and construction phases for the project costs, quality and schedule.

RESPONSIBILITIES

Greg will be the Project Director on your project in which capacity he will translate and interpret all the owner needs and criteria and produce a facility of the highest quality, on time, within budget.

**RELEVANT PROJECT
EXAMPLES**

Kraft General Foods - (10 engagements) Distribution Centers for food products located in Florida, Georgia, Illinois, Ohio, Pennsylvania and California.

Consolidated Stores Corporation - (2 engagements) Distribution Centers, totalling over 1.2 million square feet, located in Columbus, Ohio.

Gulfstream Aerospace - (4 engagements) Data Center, Completion Center, Machine Shop and Aircraft Service Center located in Savannah, Georgia.

Coca Cola USA - New Horizons Syrup Branch Expansion located in Columbus, Ohio.

NCR Corporation - (3 engagements) District Offices and Distribution Centers located in Tennessee, Georgia and Florida.

NASA Department of Defense - Processing Control Center located at Cape Kennedy, Florida.

General Electric - Production Facility located in Daytona Beach, Florida.

Sears - Appliance Distribution Center located in Jacksonville, Florida.

Duval County School Board - Two Middle Schools located in Jacksonville, Florida.

**PROFESSIONAL
AFFILIATIONS**

Certified General Contractor - State of Florida

EDUCATION

Florida State University
Bachelor of Arts in Government



REN D. HUFFMAN
VICE PRESIDENT, TRANSPORTATION
CIVIL INFRASTRUCTURE DIVISION

CREDENTIALS

Huffman recently joined The Haskell Company, bringing with him over 25 years of design and construction experience in a wide variety of market sectors: transportation, railroads, water, wastewater, buildings and hazardous waste remediation. His primary focus over the years has been in design-build marketing, sales, and project/operations management projects for municipal water and wastewater districts, state transportation departments, transit agencies, and railroads. Huffman directs Haskell's transportation group within the civil infrastructure division and has total responsibility for client relationships from initial contact through project completion. As project director, he is responsible for cost, quality and schedule of specific projects and is team leader throughout.

RESPONSIBILITIES

As project director, Huffman has full authority to commit the resources of the company to all aspects of each project. He is directly responsible for design performance, cost control, construction quality and scheduling.

**RELEVANT PROJECT
EXAMPLES**

CSX Transportation – Double-track project between Chicago and Cleveland, upgrading 26 bridges, 130 highway grade crossings, and expansion of two rail yards.

CSX Transportation – Design-build rail yard expansion and two locomotive engine house projects in Corbin, Kentucky and Waycross, Georgia.

Kansas Department of Transportation – New interchange in Wichita, Kansas.

Kansas Department of Transportation – Highway safety upgrade project in Topeka, Kansas.

Washington Harbour – Whitehurst Freeway in Washington, D.C.

City of Orlando – Vineland Road Bridge in Orlando, Florida.

C.O.E. – Runway expansion.

City of Seattle – Bridge collapse re-build in Seattle, Washington.

U.S. Navy – Potable water treatment plant in Camp Pendleton, California.

Amoco Corporation – High purity water system in Texas City, Texas.

Nabisco Foods – Industrial wastewater treatment plant in Oxnard, California.

Tennessee Valley Authority – High purity water systems in Tennessee, Alabama, and Kentucky.

Orlando Utilities Commission – Lake Highland waste water treatment plant in Orlando, Florida.

EDUCATION

Bachelor of Science in Civil Engineering
Iowa State University
A.S. Architectural Engineering
Burlington Community College

**REGISTRATIONS/
LICENSES**

Licensed General Contractor – Florida, Tennessee, North Carolina

**PROFESSIONAL
AFFILIATIONS**

American Society of Civil Engineers
Design-Build Institute of America – Board of Directors
Civil Infrastructure Committee of DBIA, Chairman



NORMAN C. ANDERSON
PROJECT DIRECTOR
CIVIL INFRASTRUCTURE DIVISION

CREDENTIALS	Anderson joined The Haskell Company in 1999 with more than 17 years of experience in design-build, program management, project controls and construction management. His areas of expertise include construction, permitting and design of industrial and infrastructure projects.
RESPONSIBILITIES	As project director of Haskell's civil infrastructure division (CID), Anderson develops project opportunities and markets the company's services to prospective clients. He establishes relationships with architecture/engineering (A/E) teams and general contracting partners for CID projects. Anderson is responsible for identifying and hiring staff for performance of CID projects, in addition to oversight of all aspects of each project, including handling daily owner communications, contract administration, scheduling, estimating, purchasing and construction activities.
RELEVANT PROJECT EXAMPLES	<p>Kissimmee Charter School – Sitework and Road Improvements for charter school in Kissimmee, Florida.</p> <p>Osceola Four Corners School – Sitework and Road Improvements for Charter School in Kissimmee, Florida.</p> <p>Pine Island Park Underground Site Improvements – Underground Sitework for Park in Davie, Florida.</p> <p>Waterford Park – Park in Davie, Florida.</p> <p>Bee Ridge Landfill Closure – Largest design-build landfill project in Florida. A \$6.5-million project involving design and construction for closure of an 87-acre landfill in Sarasota County, Florida.</p> <p>City of Memphis – Design-build of a \$12-million wastewater plant expansion, including final and primary clarifiers, aerobic digestors, sludge handling and SCADA improvements, in addition to a \$3.6-million membrane cover and bio-gas collection system at an existing 15-acre lagoon in Memphis, Tennessee.</p> <p>Colorado River Commission – \$200-million, 36-month, "fast-track" design and upgrade of existing water system, including a four-mile tunnel, nine miles of distribution pipelines, 80 MGD plant expansion and a 55 MG reservoir in Las Vegas, Nevada.</p> <p>Orlando Utility Commission (OUC) – \$19-million, design-build project for OUC's Conway water treatment plant improvements in Orlando, Florida.</p> <p>SCADA System – \$7.5-million project for design, permitting and installation of computer controls systems at 500 sewer lift stations and SCADA control at five wastewater treatment plants in Orange County, Florida.</p>
EDUCATION	<p>MBA – Management of Technology Regis University</p> <p>Bachelor of Science in Mechanical Engineering Auburn University</p>
PROFESSIONAL AFFILIATIONS	<p>Design-Build Institute of America (DBIA) Construction Management Association of America (CMAA)</p>



NORMAN C. ANDERSON
PROJECT DIRECTOR
CIVIL INFRASTRUCTURE DIVISION

Association for Advancement of Cost Engineering (AACE)
Asphalt Concrete Institute (ACI)
American Water Works Association (AWWA)
American Public Works Association (APWA)



INDUSTRIAL PROJECT EXPERIENCE
(Five Years)

ABC/PRIME CO.	ABC Channel 25 Jacksonville. FL	Antenna Installation
WCS - JACKSONVILLE DEVELOPMENT CO.	Admiral Truck Lines Concrete Repairs Jacksonville. FL	Concrete Repairs
ALLIANT FOODSERVICE, INC.	Alliant Foodservice Cold Storage Distribution Facility Fishers. IN	235,000 s.f.
ALLIANT FOODSERVICE, INC.	Alliant Foodservice Cold Storage Distribution Facility Swedesboro. NJ	190,000 s.f.
ALLIANT FOODSERVICE, INC.	Alliant Foodservice Distribution Facility Tampa. FL	90,000 s.f.
ALLIANT FOODSERVICE, INC.	Alliant Foodservice Distribution Facility Expansion Rocky Mount. NC	82,000 s.f.
AMERICAN AIRLINES	American Airlines Museum DC-3 Aviation Enclosure Fort Worth. TX	10,000 s.f.
AMERIFREEZE PARTNERS 1, LLC	Amerifreeze Cold Storage Facility Varona. PA	125,000 s.f.
ANHEUSER-BUSCH COMPANIES	Anheuser-Busch Lid Plant Expansion Oklahoma City. OK	30,000 s.f.



ANHEUSER-BUSCH COMPANIES	Anheuser-Busch - New Brewhouse and Mill Towers Columbus. OH	70,000 s.f.
ANHEUSER-BUSCH COMPANIES	Anheuser-Busch Packaging Line Expansion - Phases I & II Jacksonville. FL	58,500 s.f.
ANHEUSER BUSH COMPANIES, INC.	Anheuser Bush Packaging & Warehouse Expansion Williamsburg. VA	90,000,000 s.f.
ARMOUR SWIFT- ECKRICH	Armour Swift-Eckrich Meat Processing Plant Junction City. KS	180,000 s.f.
ATLANTIC DRY DOCK CORP.	Atlantic Dry Dock Precision Machine Shop Building Jacksonville. FL	15,000 s.f.
BF GOODRICH AEROSPACE	B.F. Goodrich Aerospace-Composite Building Jacksonville. FL	1,800 s.f.
BANTA PACKAGING AND FULFILLMENT	Banta Fulfillment and Distribution Center Harrisonburg. VA	261,780 s.f.
CONSOLIDATED STORES CORPORATION	Big Lots Warehouse & Distribution Center Expansion Montgomery. AL	463,750 s.f.
FLORIDA DEPARTMENT OF MANAGEMENT SERVICES	Boeing Horizontal Integrated Facility Cape Canaveral. FL	80,000 s.f.



PETROLEUM HELICOPTERS, INC.	Boothville Heliport Venice. LA	1,070,880 s.f.
CAGLE FOODS, JV, L.L.C.	Cagle Foods Concrete Work Camilla. GA	104,000 s.f.
CAGLE FOODS, JV, L.L.C.	Cagle Foods New Poultry Processing Facility Camilla. GA	796,000 s.f.
CARE FREE ALUMINUM PRODUCTS, INC.	Care Free Aluminum Products Two New Buildings Asheville. NC	51,900 s.f.
CAROLINA TURKEYS	Carolina Turkeys Poultry Plant Renovations and Additions Mount Olive. NC	170,000 s.f.
CLOPAY BUILDING PRODUCTS	Clopay Manufacturing Facility Horn Lake. MS	30,000 s.f.
CONSOLIDATED STORES, INC.	Closeout Distribution, Inc. Tremont. PA	1,200,000 s.f.
CONSOLIDATED STORES CORPORATION	Consolidated Stores Distribution Facility Renovation Montgomery. AL	460,000 s.f.
CONSOLIDATED STORES CORPORATION	Consolidated Mazzanine Renovations Columbus. OH	155,212 s.f.
CUMMER MUSEUM OF ART AND GARDENS	Cummer Museum Garden Lighting Jacksonville. FL	N/A



DOMINEX	Dominex Egg Plant Facilities St. Augustine. FL	5,300 s.f.
ENKEI AMERICA, INC.	Enkei Florida Automotive Parts Plant Jacksonville. FL	120,000 s.f.
ENKEI AMERICA, INC.	Enkei Florida Roofing Jacksonville. FL	32,200 s.f.
ENKEI AMERICA, INC.	Enkei Phase II Jacksonville. FL	28,080 s.f.
FLORIDA DEPARTMENT OF TRANSPORTATION, DISTRICT IV	FDOT District IV Operations Office Center Belle Glade. FL	2,400 s.f.
FIELD PACKING	Field Packing Food Processing Plant Owensboro. KY	98,000 s.f.
FINE DISTRIBUTING, INC.	Fine Distributing Office/Distribution Facility Ft. Lauderdale. FL	200,000 s.f.
FLIGHTSAFETY INTERNATIONAL	FlightSafety Administration Building Renovation Vero Beach. FL	10,000 s.f.
FLIGHTSAFETY INTERNATIONAL	FlightSafety Boeing Pilot Training Facility Miami. FL	115,000 s.f.
FLIGHTSAFETY INTERNATIONAL	FlightSafety High-Bay Assembly Facility Tulso. OK	12,500 s.f.
FLIGHTSAFETY INTERNATIONAL	FlightSafety International Gulfstream Learning Center Savannah. GA	75,000 s.f.



FLIGHTSAFETY INTERNATIONAL	FlightSafety International New Dormitory Facilities Vero Beach. FL	26,000 s.f.
FLIGHTSAFETY INTERNATIONAL	FlightSafety Memphis Memphis. TN	20,000 s.f.
FLIGHTSAFETY INTERNATIONAL	FlightSafety Mexico City Mexico City. Mexico	7,800 s.f.
FLORIDA SCHOOL BOOK DEPOSITORY	Florida School Book Depository - Office Addition Jacksonville. FL	4,400 s.f.
CITY OF JACKSONVILLE	Florida Times Union Center for the Performing Arts -Organ Upgrades Jacksonville. FL	12'x14'x13'
FOSTER'S DAILY DEMOCRAT	Foster's Daily Democrat Printing Facility Dover. NH	45,000 s.f.
FRITO-LAY, INC.	Frito-Lay Dallas Test Kitchen Dallas. TX	40,900 s.f.
FRITO LAY, INC.	Frito-Lay Fayetteville Fayetteville. TN	17,500 s.f.
FRITO-LAY, INC.	Frito-Lay Fayetteville Roofing and Panels Fayetteville. TN	132,495 s.f.
FRITO-LAY, INC.	Frito-Lay Fayetteville Warehouse Addition Fayetteville. TN	130,000 s.f.



FRITO-LAY, INC.	Frito-Lay Jacksonville Distribution Center Jacksonville. FL	24,000 s.f.
FRITO-LAY, INC.	Frito-Lay Jonesboro Snack Food Plant Jonesboro. AR	450,000 s.f.
FRITO-LAY, INC.	Frito-Lay Jonesboro Waste Water Treatment Facility Jonesboro. AR	3,200 s.f.
FRITO LAY, INC.	Frito-Lay Killingly Office Expansion/Renovation Dayville. CT	25,000 s.f. Expansion 20,000 s.f. Renovation
FRITO-LAY, INC.	Frito-Lay Lynchburg Salty Snack Facility Lynchburg. VA	403,000 s.f.
FRITO-LAY, INC.	Frito-Lay Lynchburg Waste Water Treatment Facility Lynchburg. VA	3,200 s.f.
FRITO-LAY, INC.	Frito-Lay Modesto Warehouse Expansion Modesto. CA	90,000 s.f.
FRITO-LAY, INC.	Frito-Lay Ontario Warehouse Expansion Cambridge. Ontario.	86,000 s.f.
FRITO-LAY, INC.	Frito-Lay Orlando Expansion Orlando. FL	1,700 s.f.
FRITO-LAY, INC.	Frito-Lay Perry Salty Snack Facility Kathleen. GA	72,058 s.f.



FRITO-LAY, INC.	Frito-Lay Pompano Beach Distribution Center Pompano Beach. FL	50,000 s.f.
FRITO-LAY, INC.	Frito-Lay Quebec Food Packaging/ Warehouse Facility Levis. Quebec.	115,000 s.f.
FRITO-LAY, INC.	Frito-Lay Rhinelander Research Facility Rhinelander. WI	20,000 s.f.
FRITO-LAY, INC.	Frito-Lay Rosenberg Plant & Waste Water Expansion Rosenberg. TX	100,000 s.f.
FRITO-LAY, INC.	Frito-Lay Rosenberg Plant Expansion Rosenberg. TX	100,000 s.f.
FRITO-LAY, INC.	Frito-Lay Rosenberg Warehouse Expansion Rosenberg. TX	112,335 s.f.
FRITO LAY, INC.	Frito-Lay Topeka Process Facility Expansion Topeka. KS	5,000 s.f.
FRITO-LAY, INC.	Frito-Lay Warehouse Expansion Kathleen. GA	34,000 s.f.
FRITO-LAY, INC.	Frito-Lay Warehouse Expansion Killingly. CT	28,000 s.f.



FRITO-LAY, INC.	Frito-Lay West Valley City Salty Snack Food Plant West Valley City, UT	165,000 s.f.
GALLO SALAME	Gallo Salame Food Processing Facility Renovation San Lorenzo, CA	30,000 s.f.
GREAT LAKES CHEESE, CO., INC.	Great Lakes Cheese Packaging & Distribution Facility Hiram, OH	216,000 s.f.
GULFSTREAM AEROSPACE CORP.	Gulfstream Aerospace Service Center Expansion Savannah, GA	17,500 s.f.
GULFSTREAM AEROSPACE CORP.	Gulfstream Aerospace/Travis Field Service Center Savannah, GA	185,000 s.f.
GULFSTREAM AEROSPACE CORP.	Gulfstream Consolidated Shop/Parking Expansion Savannah, GA	53,000 s.f.
GLYNCO JETPORT	Gulfstream Service Center Brunswick, GA	43,000 s.f.
FLETCHER LAND CORPORATION	Harbour Island Marine Basin at Marsh Landing Ponte Vedra Beach, FL	N/A
HOLSUM BAKERY, INC.	Holsum Bakery Tolleson, AZ	129,370 s.f.



HOUSE OF RAEFORD FARMS, INC.	House of Raeford Poultry Processing Facility Raeford. NC	140,000 s.f.
INDUSTRIAL TRACTOR COMPANY	Industrial Tractor Sales & Maintenance Facility Savannah. GA	34,500 s.f.
INDUSTRIAL COLD STORAGE	Industrial Cold Storage Test Lab Jacksonville. FL	1,500 s.f.
KAY-BEE TOY STORES	Kay-Bee Toys Distribution Center Montgomery. AL	853,000 s.f.
KAY-BEE TOY STORES	Kay-Bee Toys Distribution Center Phoenix. AZ	242,000 s.f.
KRAFT GENERAL FOODS	Kraft Foods Dry Mixing Distribution Center Columbus. OH	400,000 s.f.
THC PENNSYLVANIA	Kraft General Foods Dry Goods Storage Allentown. PA	523,000 s.f.
KRAFT FOODS, INC.	Kraft General Foods Dry Mixing Distribution Center Haslet. TX	400,000 s.f.
U.S.A.A. REAL ESTATE COMPANY	Kraft General Foods Dry Mixing Distribution Center Aurora. IL	530,000 s.f.
KRAFT GENERAL FOODS	Kraft General Foods Locker Room Addition Jonesboro. AR	4,350 s.f.



KRAFT GENERAL FOODS	Kraft General Foods Post-Buffer Warehouse Battle Creek, MI	140,000 s.f.
LEVI-STRAUSS & COMPANY	Levi Strauss Metal Building Valdosta, GA	7,500 s.f.
LEVI-STRAUSS & COMPANY	Levi Strauss Reroof Commercial Laundry Knoxville, TN	53,000 s.f.
LOCKHEED MARTIN INFORMATION SYSTEM	Lockheed Martin Flight Training Academy Orlando, FL	27,843 s.f.
CIRENT SEMICONDUCTOR/ LUCENT TECHNOLOGIES	Lucent Technologies Orlando, FL	120,000 s.f.
MCGEHEE REALTY OF MIAMI, INC.	Mac Papers Distribution & Office Facility Miami, FL	135,000 s.f.
MAC PAPERS, INC.	Mac Papers Distribution Facility Mobile, AL	35,000 s.f.
MAC PAPERS, INC.	Mac Papers Distribution Facility Riviera Beach, FL	40,000 s.f.
MAC PAPERS, INC.	Mac Papers Re-roofing Tampa, FL	5,500 s.f.
MCI	MCI Water Street Building Jacksonville, FL	14th Floor Equipment Area
MERILLAT INDUSTRIES, INC.	Merillat Corporation Ocala, FL	269,000 s.f.



MEYER'S BAKERIES	Meyer's Bakery New Baking Facility Orlando. FL	49,000 s.f.
NEW FEDERAL COLD STORAGE	New Federal Cold Storage Distribution Facility Cranberry Township. PA	117,000 s.f.
ODOM'S TENNESSEE PRIDE	Odom's Tennessee Pride Insulation Upgrades Nashville. TN	2,842 s.f.
ORGILL BROTHERS AND COMPANY	Orgill Brothers Distribution Center Tifton. GA	340,000 s.f.
ORGILL BROTHERS AND COMPANY	Orgill Brothers Facility Roofing Tifton. GA	
GREATER ORLANDO AVIATION AUTHORITY	Orlando Aviation Authority-Baggage Handling Orlando. FL	150,000 s.f.
UNITED STATES POSTAL SERVICE	Owings Mills Post Office Owings Mills. MD	27,000 s.f.
CITY OF PEMBROKE PINES	Pembroke Pines East Campus Addition Pembroke Pines. FL	24,000 s.f.
PEPSI COLA COMPANY	Pepsi Cola Concrete Construction Tampa. FL	130,000 s.f.
PEPSI COLA COMPANY	Pepsi-Cola Distribution Center Tampa. FL	130,000 s.f.
PILOT CORPORATION OF AMERICA	Pilot Pen Manufacturing Facility Jacksonville. FL	90,000 s.f.



PILOT CORPORATION OF AMERICA	Pilot Pen Manufacturing Facility Expansion Jacksonville, FL	52,017 s.f.
PILOT CORPORATION OF AMERICA	Pilot Pen Manufacturing Facility Roofing Jacksonville, FL	89,000
POLO RALPH LAUREN CORPORATION	Polo/Ralph Lauren Parking Area Addition Greensboro, NC	7,750 s.f.
PROCTER & GAMBLE	Procter & Gamble Building 52 Process Addition Brown Summit, NC	19,000 s.f.
PROCTER & GAMBLE COMPANY	Procter & Gamble Cincinnati Building Nos. 2 and Reroofing Cincinnati, OH	N/A
PROCTER & GAMBLE CORPORATION	Procter & Gamble Jackson Warehouse Expansion Jackson, TN	12,500 s.f.
PRUDENTIAL	Prudential Insurance Records Center Renovation Jacksonville, FL	37,000 s.f.
QUAKER OATS	Quaker Oats/Liquid-Dry Warehouse Renovation Louisville, KY	17,500 s.f.
FACILITY DEVELOPMENT CORP/RIVER CITY PLASTICS, INC	River City Plastics PVC Pipe Manufacturing Facility Sanderson, FL	125,000 s.f.



LEWIS W. HOOK, JR.	Robbins Packing Company Statesboro. GA	7750 s.f.
SABRITAS, A.A. DE C.V.	Sabritas Orizaba Snack Food Plant Jacksonville. FL	240,000 s.f.
SEBRING AIRPORT AUTHORITY	Sebring Airport Authority Sebring. FL	49,000 s.f.
CITY OF JACKSONVILLE	St. Andrews Church Renovations Jacksonville. FL	N/A
TARGET STORES	Target Stores Parking Revisions Tifton. GA	N/A
TARGET STORES	Target Stores Wall Renovation Tifton. GA	N/A
TARGET STORES	Target Stores Warehouse Expansion Tifton. GA	450,000 s.f.
CAPITAL CITIES/ABC	Times-Leader Production Facility Wilkes-Barre. PA	53,000 s.f.
FLORIDA DEPARTMENT OF MANAGEMENT SERVICES	Titan IV Off-Site Rail Upgrades Camp Blanding. FL	7 1/2 miles of rail upgrade
FLORIDA DEPARTMENT OF MANAGEMENT SERVICES	Titan IV Rocket Storage Facility Camp Blanding. FL	88,000 s.f.
TRW VEHICLE SAFETY SYSTEMS	TRW Vehicle Safety Systems Manufacturing/ Warehouse Queens Creek. AZ	145,000 s.f.



AMERICAN STANDARD COMPANY	Trane Manufacturing Facility Expansion Lynn Haven, FL	251,774 s.f.
UNION CAMP CORPORATION	Union Camp Equipment Installation Franklin, VA	N/A
UNION CAMP CORPORATION	Union Camp Sheet Converting Facility Franklin, VA	73,840 s.f.
UNITED STATES POSTAL SERVICE	USPS Busse Priority Mail Annex Elk Grove Village, IL	250,909 s.f.
WEYERHAEUSER CORPORATION	Weyerhaeuser Flint River Plant MCC Building Extension Oglethorpe, GA	4,000 s.f.
WINN-DIXIE STORES, INC.	Winn-Dixie Frozen Foods Distribution Facility Charlotte, NC	282,231 s.f.



1960's

- The Haskell Company was founded in 1965 by Preston Haskell, and became a leading construction firm throughout the Southeast.
- We quickly developed a fully-integrated design/build organization.
- Repeat customers became a consistent feature of our workload.

1970's

- Formed a merit shop affiliate in the early 1970's which developed in-house programs for the recruitment and development of construction tradesmen. In 1976, the affiliate was merged into The Haskell Company, and we have since pursued all of our projects on a merit shop basis.
- The inception of our real estate and project finance services opened up valuable front-end development services for our clients. We began to provide long-term financing and leasing structures, site acquisition searches, and turnkey development services.

1980's

- Our signature Project Director management structure was developed to provide our clients with a single point of contact for all project issues. This individual has broad authority and centralized responsibility for design and construction quality of all projects under his supervision.
- Specialty construction units were created to provide in-house expertise in areas such as steel fabrication, utilities construction, equipment leasing, and roofing construction. These units continue to enhance our project delivery today with flexibility, fast response time, and cost control.
- After many years of promoting the cost effectiveness of design-build, we emerged as a leader in public sector construction as a growing number of government agencies accepted the design-build method.
- A new market initiative in health care facilities met with considerable success. We also launched Haskell Community



1990's

- Developers for the marketing, development, and management of continuing care communities.
- With corporate clients such as Proctor & Gamble, Frito Lay, and Kraft, we became a leader in the delivery of design-build food facilities.
 - We moved into large scale construction management projects as an adjunct to our typical design/build operations.
 - We refined our company structure to feature project delivery groups. Each project delivery group is focused on a specific market segment, and is staffed by experienced project development, architecture/engineering and construction professionals.
 - Regional representation has become a key initiative as we open fully functional regional offices in strategic locations across the nation.
 - We have continued to expand our international business for repeat corporate clients with projects located in Canada, Mexico, the Caribbean and Europe.
 - With design-build gaining a widening acceptance for public educational facilities, Haskell has quickly become one of the leading providers.
 - The development of Haskell Educational Services signaled our entrance into the development and management of charter schools.
 - The Pre-Design Services group broadened our ability to provide our clients with *Total Facility Solutions*. We offer an array of up-front services such as master planning, site assessment, facility programming, and permitting investigations.



CREDENTIALS

Wichmann has over 22 years of hands-on field experience as a superintendent. He has supervised a wide range of projects across the United States and has taught seminars on planning and scheduling.

RESPONSIBILITIES

As project superintendent, Wichmann is responsible for recruiting, scheduling and deploying all job personnel; overall organization of subcontractors; and safety and accident control on projects. In addition, he is an on-site point-of-contact between each owner and construction crews.

**RELEVANT
PROJECT
EXAMPLES**

- U.S. Army—Fort Carson, Colorado (\$65,000,000)**
- MCI-Worldcom Node Facility—Burlington, Massachusetts (\$1,000,000)**
- Kaiser Medical Office Building—San Francisco, California (\$56,000,000)**
- Vitesse Semiconductor—Colorado Springs, Colorado (\$21,000,000)**
- Seagate Technologies—Bloomington, Minnesota (\$43,000,000)**
- Squaw Peak Water Treatment Facility—Phoenix, Arizona (\$26,000,000)**
- Sarasota Advanced Waste Treatment Facility—Sarasota, Florida (\$15,000,000)**
- Mulberry Pump Station—Birmingham, Alabama (\$8,000,000)**
- Jordan Valley Water Treatment Plant—Salt Lake City, Utah (\$20,000,000)**
- St. Joseph's Hospital—Phase II hospital expansion, Fort Worth, Texas (\$12,000,000)**
- Doctors Plaza—An 8-story office condominium building, Houston, Texas (\$3,000,000)**
- Farnham Park On The Bayou—Luxury office condominium, Houston, Texas (\$2,500,000)**
- Baytown Water Treatment Plant—Baytown, Texas (\$11,000,000)**
- Starved Rock Lock & Dam—Lock rehabilitation, Utica, Illinois (\$3,000,000)**
- OPPD Power Plant—Fossil Fuel Power Plant, Nebraska City, Nebraska (\$47,000,000)**
- Six Greenspoint Plaza—14-story building, Houston, Texas (\$20,000,000)**
- Hotel Luxeford—7-story luxury hotel, Houston, Texas (\$3,000,000)**

EDUCATION

Associates Degree, Structural/Architectural Engineering Technology, I.T.T. Technical, Ft. Wayne, Indiana





Integrity
Well & Pump Company
Statement of
Qualifications

1.0 INTRODUCTION

Integrity Well & Pump Company is pleased to submit the following (Statement of Qualifications) as requested by Mr. Norman Anderson from the Haskell Company regarding the (Palm Beach County Water Treatment Plant No. 9 ASR Well Project). Integrity, is a professional contracting firm comprised of technical and field personnel specializing in locating, developing, managing and treating ground water supplies for municipal and industrial clients. Our firm has performed a variety of pump installations from deep set oil lubricated vertical turbine pumps to raw water intake applications and high service pump inspections and repairs. Our groundwater development background includes a variety of geologic settings such as; unconsolidated coastal plain installations, fractured bedrock, karst, glacial till and floridian artesian conditions.

Establishing ourselves as a leader within the water supply and pump service industry has been the foundation from which all other aspects of our company have been based. These disciplines; water well drilling; piloting of water treatment equipment and related construction; collector well pump repair, river intake pump repair; drilling and grouting service for soil stabilization and ground water control, enables our firm to offer a broad range of technical and field support as needed by our clientele.

As a Winchester, Virginia based firm Team Integrity is extensively networked throughout the Eastern United states. This "centralized" location enables our firm to successfully incorporate a "turnkey" (full-service) approach/solution to high volume municipal and industrial water consumers.

Products and Service Line

- Drop ship sales of short coupled high service vertical turbine pumps and motors,
- Customized vertical turbine pump design, installation and maintenance specializing in large deep set applications,
- Special application Quarry dewatering pumps (Can Pumps),
- Installation and repair of pumps and motors,
- Test & Production Well: Design, Installation and development,
- Interceptor well field: Design & Installation,
- Hydrogeological Investigations,
- Geophysical surveys specializing in surface and down hole applications,
- Fracture trace analyses tailored to identifying groundwater resources,
- Ground Water mapping,
- Well head protection studies,
- Innovative dual rotary with reverse air and conventional drilling techniques specializing in cavernous bedrock,
- Hollow stem augering and soil identification, sampling and analyses,
- Cable tool and core drilling,
- (R / O & A.S.R.) Well Designs for - (**High Chloride Environments**),
- Water treatment (i.e. pilot membrane technology and two phase vapor extraction),
- Mud Rotary and Reverse Rotary drilling applications,
- Aquifer characterization/well efficiency testing and
- Production well redevelopment/cleaning and preventative maintenance.

For additional information regarding these services or other groundwater related issues please feel free to call. Our toll free number is: 1-888-314-“PUMP” 7867.

Attachment (A)

References

* Should you require any additional information please feel free to call. Note, several of our key personnel who would be scheduled for the completion of this project are recognized as the drillers of record during the installation of numerous Municipal / Industrial production wells within the states of: Virginia, West Virginia, Maryland, North & South - Carolina, Georgia and Florida.

Project Type: * Ground Water Exploration

Client: City of Dayton Virginia
Mr. Rick Chandler - 540-879-9538

Location: Dayton, Virginia

Setting: The site is located in an urban setting at the foot of the Allegheny Mountains. The stratigraphy beneath the study area consists of 10 to 50 feet of unconsolidated material deposited within the flood plain of the South Fork of the Shenandoah River. The underlain bedrock consists of five Cambrian age rock formations. The formations occur in bands trending northeast southwest in direction.

Problem: Previous well locations and construction techniques did not consider well head protection, ground water under the influence and mechanical construction concerns. In turn, existing wells had to be abandoned while additional water sources needed to be secured for future development.

Objective: Provide permit application assistance. Address well head protection concerns evaluating potentials for ground water under the influence of surface water and recommend proper well construction techniques.

Approach: Provide geological site assessment of the study area, perform surface geophysical tasks as required and interpret data to provide three potential test well locations prioritizing each from most to least favorable sites. Upon completion of Phase I geological site assessment, a test drilling and pumping program was performed to evaluate both water quantity and quality of each test site.

Status: The test drilling and pumping tasks have been completed and written recommendations with budgetary estimates have been submitted for the design of one 600 GPM and one 1000 GPM sources addressing: Each well was completed to an approximate depth of 765 and 825 vertical feet. Finished wells have been completed and the pump houses are under construction.

Attachment (A)
Continued

Project Type: * Pump Repair

Client: Capitol Cement Company
Mr. Tom Cluchey - 304-267-8966

Location: Martinsburg, West Virginia

Setting: Industrial rock quarry with high yielding deep aquifers. Deep set oil lubricated vertical turbine pumps are used to provide process water for the facilities operation. Typical pump & motor design: 500 Hp / Three Phase / 2400 Volt / 60 Hertz vertical hollow shaft motors with stacked and water-cooled bearings. Column pipe, oil tubing and shafting (12-inch x 4-inch x 2-7/16-inch) x 565 feet in depth. Bowls cast iron bronze fitted (2100 GPM @ 600 TDH)

Problem: Fluctuating flow rates/Continued motor failures & overheating and severe vibrations.

Objective: Perform flow-testing procedures to evaluate existing well and pump efficiencies as compared to original installation. Provide recommendations for repair of well or pump.

Approach: Previous efforts for repair failed to consider the effects of shaft elongation at start up and during normal operation. Proper lateral adjustment was performed and consideration was given to straightness issues during top-hole alignment.

Status: The pumps are back to original OEM specifications and running smoothly.

Attachment (A)
Continued

Project Type: Well Repair - 7/9/98

Client: Town of Bridgewater
Mr. Ron Shirkey - 540-828-2478

Location: Bridgewater, Virginia

Setting: Municipal water supply with high yielding aquifers and deep set submersible pump. Motor design: 125 Hp / Three Phase / 460 Volt / 60 Hertz submersible motor. Column pipe (5 In. x 290 feet in depth). Bowls cast iron bronze fitted (1040 GPM @ 300 TDH)

Problem: Excessive pumping levels were recorded within the newly constructed well.

Objective: Evaluate well efficiencies with a newly designed pump & motor for comparative purposes. Provide recommendations for repair of well or pump.

Approach: Furnish a temporary pump and motor capable of producing 1.5 MGD with proper consideration given to friction losses past the motor.

Status: The redesigned pump and motor proved unusually high friction losses were occurring as water flowed past the oversized motor resulting in excessive draw down. With this new information we were able to redesign the pump and motor resulting in a smaller horse power requirement while increasing the specific capacity of the well and maintaining the original 1.5 MGD expected yield. By resizing the unit from the original horsepower proposed our client will recognize a yearly electrical cost savings of, \$16,664.00.

Attachment (A)

Continued

- Project Type:** * Ground Water Development for R / O Applications
- Client:** New Port News, Virginia – Phase's (I & II)
Driller – Ted Oliver (Phase I)
Project Superintendent – Robert Counterman (Phase II)
Onsite Geologists – Art Russnow of Russnow Kane & Associates
(757 – 595 – 5561)
- Location:** Tidewater Area of Virginia
- Setting:** The site is located in an urban setting along the Northern Atlantic Coastal Plain known as the Tidewater area of Virginia. The generalized stratigraphy beneath the study area consists of the Columbia, Yorktown, Saint Marys, Ponti-Point, Auquia, Virginia Beach and the Potomac's (Upper / Middle / Lower). Underlying the unconsolidated formations described we encounter bedrock or basement surface.
- Objective:** Determine the aquifer depths, aquifer thickness, formation grain size, transmissivity, communication between formations and water quality of each water bearing zones of the Upper Potomac formation. Upon completion of the testing procedures estimated safe well yields and water quality data was used for the design of the production wells and treatment equipment.
- Approach:** Perform test well and production well installations recording aquifer characteristics as described above through a multiple screen settings in the test wells. Perform subsurface geophysics and interpretations as required.
- Status:** The tests drilling and pumping tasks have been completed and permanent wells installed. Well designs varied however as an example:
(18-inch x 10-inch x 800-foot) Number of well's 9.
-

Attachment (A) **Continued**

Project Type: Well Repair – 6/2/98

Client: City of Bowie
Driller – Mr. Ted Oliver
Point of Contact – Mr. John Ellig
(301 – 805 – 7985)

Location: Bowie, Maryland

Setting: The site is located in an urban setting along the Northern Atlantic Coastal Plain known as the Bay area. The generalized stratigraphy beneath the study area consists of the Magothy, Arundle, Raritan, Patapsco and Patuxent aquifers. Underlying the unconsolidated formations described are the bedrock or basement surface. This well was originally installed in 1965 and had started to pump sand.

Objective: Chemically and mechanically redevelop one (24-inch x 18-inch x 10-inch x 998 Foot) water supply well and re-sleeve with 8-inch screen. Furnish and install repaired 125-Hp Byron Jackson mercury seal submersible pump including flanged 8-inch coated column pipe.

Approach: Perform preliminary flow test, chemically and mechanically redevelop well and install repaired pump.

Status: All work is complete and well pumping 1000 GPM. Expected yield 1000 GPM
Specific capacity 9.9 / GPF.

Attachment (A)
Continued

Project Type: * Ground Water Development

Client: Nu-Core Steel
Driller – Mr. Ted Oliver

Location: Mt. Pleasant, South Carolina

Setting: The site is located in an urban setting along the Mid-Atlantic Coastal Plain. The generalized stratigraphy beneath the study area consists of unconsolidated sand and gravel formations inter-bedded with clays and marrel. Underlying the unconsolidated formations described are the bedrock or the basement surface.

Objective: Develop two Large diameter deep production wells

Approach: Advance 8-inch pilot holes, geophysically logged well and open bore hole up to 30-inch. Finished well's (22-inch x 12-inch x 1500-foot) lap wells.

Status: All work is complete and the well's are in service. Estimated production of each well 1200 GPM.

Attachment (A)
Continued

Project Type: Ground Water Development

Client: City of Marion
Driller – Mr. Ted Oliver

Location: Marion, South Carolina

Setting: The site is located in an urban setting along the Mid-Atlantic Coastal Plain. The generalized stratigraphy beneath the study area consists of unconsolidated sand and gravel formations inter-bedded with clays and marrel. Underlying the unconsolidated formations described are the bedrock or the basement surface.

Objective: Develop municipal water supply well.

Approach: Advance 8-inch pilot holes, geophysically logged well and open bore hole up to 16-inch. Finished well's (16-inch x 10-inch x 4-inch) x 800-feet.

Status: All work is complete and the well is in service.

Attachment (A)
Continued

Project Type: * Ground Water Development

Client: Myrtle Beach Air Force Base
Driller – Mr. Bobby Oliver

Location: Myrtle Beach, South Carolina

Setting: The site is located in an urban setting along the Mid-Atlantic Coastal Plain. The generalized stratigraphy beneath the study area consists of unconsolidated sand and gravel formations inter-bedded with clays and marrel.

Objective: Construct three water supply wells +/- 350 gpm each.

Approach: Advance 7-7/8-inch pilot hole, geophysically logged well, and constructed a (18-inch x 12-inch x 650-foot) well.

Status: All work is complete.

Attachment (A)
Continued

Project Type: Ground Water Development

Client: City of Summerville
Driller – Mr. Bobby Oliver

Location: Summerville, South Carolina

Setting: The site is located in an urban setting along the Mid-Atlantic Coastal Plain. The generalized stratigraphy beneath the study area consists of unconsolidated sand and gravel formations inter-bedded with clays and marrel.

Objective: Construct one water supply wells +/- 550 gpm.

Approach: Advance 7-7/8-inch pilot hole, geophysically logged well, and constructed a (20-inch x 12-inch x 1100-foot) water supply well.

Status: All work is complete.

Attachment (A) **Continued**

Project Type: Two Injection Wells

Client: Sykes Creek Regional Water Treatment
Project Oversight: Mr. Graig Helpling – 407-633-2089
Driller – Mr. Ted Oliver
Driller – Mr. Steve Underwood

Location: Cocoa Beach, Florida
Brevard, County

Setting: The site is located in an urban setting along the Atlantic Coast of Florida. The generalized stratigraphy beneath the study area consists of unconsolidated sand and gravel with inter-bedded Limestone, Dolomite and Marrel.

Objective: Construct two deep injection wells. All work was completed under flowing well conditions of (5000 GPM @ 15 Feet above ground Level)

Approach: Advance 7-7/8-inch pilot hole to 2200-feet, geophysically logged wells, and constructed two (60-inch x 18-inch x 1800-foot) injection wells.

Status: All work is complete.

Attachment (A)
Continued

Project Type: Ground Water Development 12/15/98

Client: Charles County
Driller – Mr. Ted Oliver
Point of Contact – Mrs. Michelle Cutler

Location: La-Plata, Maryland

Setting: The site is located in an urban setting along the Northern Atlantic Coastal Plain known as the Bay area. The generalized stratigraphy beneath the study area consists of the Magothy, Arundle, Raritan, Patapsco and Patuxent aquifers. Underlying the unconsolidated formations described are the bedrock or basement surface.

Objective: Construct one water supply well.

Approach: Advance 7-7/8-inch pilot hole, geophysically logged well and constructed a (16-inch x 12-inch x 6-inch x 4-inch x 785-foot) water supply well.

Status: Desired yield 60-GPM. Development underway estimated well yield 100 to 200 GPM.

Attachment (A) **Continued**

Project Type: Ground Water Development

Client: Warsaw Town of
Driller – Mr. Ted Oliver

Location: Warsaw, North Carolina

Setting: The site is located in an urban setting along the Mid-Atlantic Coastal Plain. The generalized stratigraphy beneath the study area consists of unconsolidated sand and gravel formations inter-bedded with clays lenses and some limestone deposits. Underlying the unconsolidated formations described are the bedrock or basement surface.

Objective: Develop one Large diameter deep production well

Approach: Advance 12-inch pilot holes, geophysically logged well and performed zone pumping tests. Open bore hole up to 36-inch. Finished well's (24-inch x 12-inch x 329-foot) Under-reamed well.

Status: All work is complete and the well is in service. Producing (800 to 1000) GPM.

Attachment (A)
Continued

Project Type: Ground Water Development

Client: General Electric Company
Driller - Mr. Bobby Oliver

Location: Willmington, North Carolina

Setting: The site is located in an urban setting along the Mid-Atlantic Coastal Plain. The generalized stratigraphy beneath the study area consists of unconsolidated sand and gravel formations inter-bedded with clays lenses and some marrel deposits. Underlying the unconsolidated formations described are the bedrock or basement surface.

Objective: Develop two production wells

Approach: Advance 8-inch pilot holes, geophysically logged wells. Open bore holes up to 16-inch. Finished well's (16-inch x 12-inch x 350-foot) wells.

Status: All work is complete and the well is in service. Producing (300 to 400) GPM.

Attachment (A)
Continued

Project Type: * Ground Water Exploration

Client: Giles County, Virginia
Mr. Steve Conner – Schnabel Engineering
(540-953-1239)

Location: Giles County

Setting: The site is located in an urban setting at the foot of the Appalachian / Allegheny Mountains. The stratigraphy beneath the study area consisted of 20 to 60 feet of alluvium deposits at the foot of the valley terrain, which adjoins the flood plain of the New river valley. The underlain bedrock consists Karst geologic subsurface conditions.

Problem: Develop a high yielding ground water supply well not under the influence of surface water with acceptable levels of turbidity.

Objective: Address well head protection concerns evaluating potentials for ground water under the influence of surface water and recommend proper well construction techniques.

Approach: With the use of casing advancement drilling techniques construct a (20-inch x 16-inch x 10-inch) production well. Test drilling and pumping programs were performed to evaluate both water quantity and quality.

Status: The test drilling and pumping tasks have been completed and the well is designed to pump 2300 GPM of good quality water.

Attachment (A)
Continued

Project Type: * Ground Water Development

Client: City of Havelock, NC
Driller – Mr. Ted Oliver
Engineer – Hazen & Sawyer, Mr. Tom Tant – 919-833-7152

Location: Havelock, North Carolina

Setting: The site is located in an urban setting along the Mid-Atlantic Coastal Plain. The generalized stratigraphy beneath the study area consists of unconsolidated sand and gravel formations inter-bedded with clays and marrel. Underlying the unconsolidated formations described are the bedrock or basement surface.

Objective: Develop one large diameter production well.

Approach: Advance 8-inch pilot holes, geophysically logged well and open bore hole up to 24-inch. Finished well (18-inch x 12-inch x 500-foot).

Status: Estimated production from each well 1000 GPM.

Attachment (A)
Continued

Project Type: Ground Water Development - 6/2/98.

Client: Sugar Loaf
Driller - Mr. Ted Oliver
Engineer: Geo Trans, Mr. Brent Waters - 804-346-5433

Location: Staunton, Virginia

Setting: The site is located in an urban setting within the shenandoah valley. The stratigraphy beneath the study area consisted of 10 to 20 feet of alluvium deposits underlain by Karst geologic subsurface conditions.

Objective: Develop a deep production where earlier attempts have failed.

Approach: Advance 12-inch bore hole set 8-inch casing.
Finished well - (12-inch x 8-inch x 600-foot).

Status: Quantity desired 60 - GPM. Estimated safe well yield 100 GPM.

Attachment (A)
Continued

Project Type: Ground Water Development (Test Drilling) - 6/2/98

Client: Frederick County Sanitation Authority
Mr. John Whitacre - 540-868-1061
Engineer: SAIC, Mr. Mike Haufler - 804-346-5433

Location: Frederick County, Virginia

Setting: The site is located in an urban setting within the Shenandoah valley. The stratigraphy beneath the study area consisted of 10 to 20 feet of alluvium deposits underlain by Karst geologic subsurface conditions.

Objective: Develop a deep production well.

Approach: Advance a 12-inch borehole set 8-inch casing.
Finished well - (12-inch x 8-inch x 1100-foot).

Status: Estimated yield 100 to 200 GPM. Well abandoned yield desired 500 to 1000 GPM.

Attachment (A)
Continued

Project Type: Ground Water Development

Client: Town of Wagener, SC
Driller - Mr. Ted Oliver
Engineer - Woolport & Associates
Mr. Bill Orne - 803-731-0261

Location: Wagener, South Carolina

Setting: The site is located in an urban setting along the Mid-Atlantic Coastal Plain. The generalized stratigraphy beneath the study area consists of unconsolidated sand and gravel formations inter-bedded with clays lenses and some rock stringers. Underlying the unconsolidated formations described are the bedrock or basement surface.

Objective: Develop one production well

Approach: Advance 8-inch pilot hole, geophysically log well. Open bore hole up to 24-inch. Finished well (24-inch x 16-inch x 8-inch x 350-foot) well.

Status: Drilling and test pumping is complete and the well is producing (250 to 300) GPM.

Attachment (A)
Continued

Project Type: Ground Water Development

Client: Town of Williston, SC
Driller - Mr. Ted Oliver
Engineer - Wiedeman & Singleton
Mr. Troy Began - 803 - 329 - 2944

Location: Williston, South Carolina

Setting: The site is located in an urban setting along the Mid-Atlantic Coastal Plain. The generalized stratigraphy beneath the study area consists of unconsolidated sand and gravel formations inter-bedded with clays lenses with some rock stringers. Underlying the unconsolidated formations described are the bedrock or basement surface.

Objective: Develop one production well.

Approach: Advance 8-inch pilot-hole, geophysically log well, and perform mini-gravel pack water quality tests of proposed production zones. Open bore holes up to 24-inch. Finished well (24-inch x 16-inch x 10-inch x 850-foot) lap well, capable of producing (700 to 800) GPM.

Status: Test pumping of mini-gravel pack wells is complete.

Attachment (A)
Continued

Project Type: Ground Water Development (Test Drilling)

Client: Frederick County Sanitation Authority
Mr. Wendy Jones / John Whitacre – 540-868-1061
Engineer: SAIC, Mr. Mike Haufler – 804-346-5433

Location: Frederick County, Virginia

Setting: The site is located in an urban setting within the Shenandoah valley. The stratigraphy beneath the study area consisted of 10 to 20 feet of alluvium deposits underlain by Karst geologic subsurface conditions.

Objective: Develop a deep production well.

Approach: Advance a 19-inch bore hole set 12-inch casing.
Finished well - (12-inch x 8-inch x 6-inch x 300-foot).

Status: Estimated yield 1000 to 2000 GPM. Well completion underway.

Attachment (A) **Continued**

Project Type: Ground Water Development

Client: City of Orlando
Driller – Mr. Steve Underwood

Location: Orlando , Florida “ Airport Site “

Setting: The site is located in an urban setting of Central Florida. The generalized stratigraphy beneath the study area consists of unconsolidated sand and gravel formations inter-bedded with clays and marrel. Underlying the unconsolidated material lies the limestone aquifers known as: The Upper & Lower Floridian aquifers.

Objective: Construct water supply wells +/- 5000 gpm.

Approach: Advance 12-inch pilot holes along with each string of casing, geophysically log wells and complete construction and production casing strings as follows:
(36-inch x 24-inch x 18-inch x 1450-foot) - finished water supply well 18-inch.
Well's have been completed as open hole design.

Status: All work has been completed.

Attachment (A)

Continued

Project Type: Ground Water Development

Client: City of Sarasota
Leggette, Brashears & Graham / Mr. David Wiley – 813-968-5882
Driller – Mr. Steve Underwood

Location: Sarasota, Florida

Setting: The site is located in an urban of Central Florida along the eastern gulf shore. The generalized stratigraphy beneath the study area consists of unconsolidated sand and gravel formations inter-bedded with clays and marrel. Underlying the unconsolidated material lies the limestone aquifers known as: The Upper & Lower Floridian aquifers.

Objective: Construct water supply wells +/- 5000 GPM. All work was completed under flowing well conditions of (+/- 1000 GPM @ +/- 10 Feet above ground Level)

Approach: Advance 12-inch pilot holes along with each string of casing, geophysically log wells and complete construction and production casing strings as follows:
(36-inch x 24-inch x 16-inch x 1800-foot) - finished water supply well 16-inch.
Well's have been completed as open hole design.

Status: All work has been completed.

Attachment (A)
Continued

Project Type: Ground Water Development

Client: Everglades City
Driller - Mr. Steve Underwood

Location: Everglades, Florida

Setting: The site is located in an urban of Southern Florida along the gulf shore. The generalized stratigraphy beneath the study area consists of unconsolidated sand and gravel formations inter-bedded with clays and marrel. Underlying the unconsolidated material lies the limestone aquifers known as: The Upper & Lower Floridian aquifers.

Objective: Construct water supply wells +/- 1200 gpm.

Approach: Advance 12-inch pilot holes along with each string of casing, geophysically log wells and complete construction and production casing strings as follows:
(24-inch x 18-inch x 300-foot) - finished water supply well 18-inch.
Well's have been completed as open hole design.

Status: All work has been completed.

Attachment (A) **Continued**

Project Type: Dewatering Well

Client: U.S.S. / PGH
Engineer – Jim Canturbury – 304-949-4762
Project Manager – Robert C. Schumm

Location: Maitland, West Virginia

Setting: The site is located in an rural setting of Southern West Virginia The generalized stratigraphy beneath the study area consists of unconsolidated overburden and sand stone shale formations inter-bedded with clays. Underlying the unconsolidated material lies bedrock and clay conditions.

Objective: Install three deep set vertical turbine pumps and construct one new water supply well +/- 1200 gpm. All work was completed under flowing well conditions of (3000 GPM @ 25 Feet above ground Level)

Approach: Advance 12-inch pilot holes along with each string of casing, geophysically log well and complete construction and production casing strings as follows:
(24-inch x 16-inch x 500-foot) - finished water supply well 16-inch.
Well has been completed and pumps installed.

Status: All work has been completed.

Attachment (A)
Continued

Project Type: Ground Water Development

Client: City of Jacksonville
Engineer - CH2M Hill - Mr. Mike Dykes - 904-607-2763
Driller - Mr. Robert " Michael " McEwen

Location: Jacksonville, Florida

Setting: The site is located within an urban setting of Jacksonville, Florida along the Atlantic coast. The generalized stratigraphy beneath the study area consists of unconsolidated sand and gravel formations inter-bedded with clays and marrel. Underlying the unconsolidated material lies the limestone aquifers known as: The Upper & Lower Floridian aquifers.

Objective: Construct three water supply wells of +/- 2200 gpm.

Approach: Advance 12-inch pilot holes along with each string of casing, geophysically log well and complete construction and production casing strings as follows:
(30-inch x 20-inch) x 520- vertical feet, reverse nominal 19-inch hole from 520 to 1000 vertical feet. Well's were completed as open hole design.

Status: All work has been completed.

Attachment (A) **Continued**

Project Type: Ground Water Development

Client: Tampa Bay Water
Engineer – Terra Environmental, Inc. Mr. Dan Rothenberger
Mr. Jeremy Turner
Driller – Mr. Robert “ Michael “ McEwen

Location: Brandon, Florida

Setting: The site is located within an urban setting East of Tampa, Florida. The generalized stratigraphy beneath the study area consists of unconsolidated sand and gravel formations inter-bedded with clays. Underlying the unconsolidated material lies the limestone aquifers known as: The Upper & Lower Floridian aquifers.

Objective: Construct four water supply wells of +/- 1500 gpm.

Approach: Advance 12-inch pilot holes along with each string of casing, geophysically log well and complete construction and production casing strings as follows:
(24-inch x 16-inch) x 140 - vertical feet, reverse nominal 15-inch hole from 140 to 650 vertical feet. Well's completed as open hole design.

Status: All work has been completed.

Attachment (A)
Continued

Project Type: Ground Water Development
Test Drilling

Client: Manatee County
Engineer – Gee & Jensen Engineering - Mr. Ron Willems
Sandy Nettles
Driller – Mr. Robert “ Michael “ McEwen

Location: Bradenton, Florida

Setting: The site is located within an urban setting South of Tampa, Florida along the Gulf Coast. The generalized stratigraphy beneath the study area consists of unconsolidated sand and gravel formations inter-bedded with clays and marrel. Underlying the unconsolidated material lies the limestone aquifers known as: The Upper & Lower Floridian aquifers.

Objective: Construct one water supply well. Install multiple test borings and monitoring wells.

Approach: Advance 12-inch pilot holes along with each string of casing, geophysically log well and complete construction and production casing strings as follows:
(20-inch x 12-inch) x 80 V.F. gravel packed well. Advance multiple coring from 150 to 250 vertical feet. Construct multiple monitoring wells from 50 to 250 vertical feet.

Status: All work has been completed.

Attachment (A)
Continued

Project Type: Monitoring Well

Client: Tampa Bay Water
Engineer – Terra Enviromental, Inc. Dan Rothenberger
Mr. Jeremy Turner
Driller – Mr. Robert “ Michael “ McEwen

Location: Brandon, Florida

Setting: The site is located within an urban setting East of Tampa, Florida. The generalized stratigraphy beneath the study area consists of unconsolidated sand and gravel formations inter-bedded with clays and marrel. Underlying the unconsolidated material lies the limestone aquifers known as: The Upper & Lower Floridian aquifers.

Objective: Construct one monitoring well.

Approach: Advance 12-inch pilot holes along with each string of casing, geophysically log well and complete construction and production casing strings as follows:
(14-inch x 8-inch) x 140 - vertical feet, reverse nominal 8-inch hole from 140 to 800 vertical feet. Well's completed as open hole design.

Status: All work has been completed.

Mr. Robert C. Schumm
Senior Project Manager
BS (Business) - Edinboro University

Mr. Schumm is Senior Project manager of the Winchester, Virginia office of Integrity Well & Pump Company. His responsibilities include the coordination and design of all projects in the Mid-Atlantic region. He has experience in the installation of monitoring wells in bedrock and overburden formations. He also has extensive knowledge of well and pump designs and installations in a variety of subsurface conditions. Bob, has over 18 years of experience in the drilling industry and has been involved in numerous projects requiring multiple rigs.

EXPERIENCE

1997- Present	Owner and senior project manager of Integrity Well & Pump Company.
1996-1997	Branch Manager of Layne Christensen, Co. Winchester Virginia office.
1987-1995	Branch Manager, Layne Well and Pump Division, Hydro Group, Inc.
1986-1987	Field Coordinator, Layne Well and Pump Division, Hydro Group, Inc.
Pre -1980	Drill Rig Helper, Layne Well and Pump Division, Hydro Group, Inc.

MEMBERSHIP

Technical Instructor – Virginia Tech “ Ground Water Production “
Technical Instructor – Virginia Tech “ Hydrogeology “
Technical Instructor – Virginia Military Institute “ Pump Design & Application “
Virginia Water Works Association
National Ground Water Association
West Virginia Rural Water Association
West Virginia Water Works Association
American Water Works Association

TECHNICAL EXPERIENCE

Drilling Technologies:

- Rotary (Air, Dual, Mud, Direct Water, Reverse Water, Hammer, Roller)
- Coring
- Auger
- Cable-Tool
- Wash/Driven Boring
- Well Design (Consolidated and Unconsolidated)
- Pump Design (Turbine and Submersible)
- Treatment Equipment Design (Potable and Remedial)
- Video / Caliper / Natural Gamma / Electric & Sonic Bond logging Interpretations
- Grouting Technologies
- Well Rehabilitation (Consolidated & Unconsolidated)
- General Troubleshooting (Wells, Pumps, Drilling)
- Packer Testing (Straddle and Single; Pneumatic, Pumping, Slug.)

Keith A. Solomon
Geologist

Education

B.S. Geology, Pennsylvania State University, 1986

Experience Summary

Mr. Solomon is a geologist with experience in the fields of hydrogeology, geologic mapping and geophysical survey/explorations. As a project manager, Mr. Solomon coordinates multiple task activities such as proposal and work plan preparation, engaging drilling contractors, analytical services, and cost and quality control measures while maintaining close communication with clients and appropriate regulatory officials. As a staff geologist/hydrogeologist, he has worked on a variety of projects involving aquifer contamination, confirming mineral reserves and quality, ownership and minability of reserves, and assessing possible environmental or land use constraints. His special technical expertise in geological and geophysical exploration, well construction, sampling, analytical task and data base compilation has given him numerous multi disciplinary responsibilities.

Project Experience

Keystone Landfill, Inc. Performed surface reconnaissance and geologic mappings of anthracite coal seams, glacial deposits, overburden and coal refuse piles, borehole geophysical data interpretation and groundwater monitoring well sampling for regulatory compliance. Also, utilized seismic geophysical techniques to quantify glacial till deposits for potential bio-remediation of on-site effluent waste.

Lackawanna River Basin Sewer Authority. Completed a work plan for a hydrogeologic investigation of two municipal sewage treatment facilities northeast of Scranton, Pennsylvania. Planned tasks involve soil boring/monitoring, well installation and construction, followed by laboratory analysis for EP Toxicity for metals of soils and total and dissolved metals, BOD, and nitrates for surface and groundwater.

Keystone Landfill, Inc. Developed and managed the installation and testing of the groundwater monitoring system for a municipal solid waste disposal facility northeast of Scranton, Pennsylvania. The program was designed to provide groundwater flow and quality data within the uppermost mine pool aquifer and the lower Pottsville Formation aquifer and the lower Pottsville Formation aquifer for the existing "natural renovation" site and to provide background data for a proposed "double lined" site adjacent to the natural renovation site. Testing of the groundwater required development of time series data for purging requirement determination and adherence to strict QA/QC procedures for decontamination between sample points.

**Mr. Steve Underwood
Lead Driller**

Mr. Underwood is a driller for the Winchester, Virginia office of Integrity Well & Pump Company. His responsibilities include the coordination of field activities and installation of wells and pumps within the Mid-Atlantic region. He has experience in the installation of wells in consolidated and unconsolidated formations. He also has extensive knowledge of well design in a variety of subsurface conditions. Steve, has over 26 years of experience in the drilling industry and has been involved in numerous environmental, construction and water supply projects. Steve's, project experience includes: Monitoring Wells (6" x 2" x 300'), Oil & Gas wells to depths of 10,000 feet, Water Supply Wells of (54" x 44" x 36" x 3000') and ASR - Projects consisting of (44" x 36" x 24" x 1500') wells.

EXPERIENCE

Present	Senior driller for Integrity Well & Pump Company
1995-1999	Senior driller for Diversified Drilling, Tampa, FL
1989-1995	Field Operations Manager, Ground Water Technology, Jessup, MD
1987-1989	Driller Abbott Well Drilling, Boonsboro, MD
1983-1987	Driller Layne Atlantic, Orlando, FL
1978-1983	Driller for IPSCO Drilling, Sheffield, PA
1973-1978	Union Drilling , Buckhannon, WV

MEMBERSHIP

Master Maryland Drillers License
South Carolina Drillers License
North Carolina Pump Installer & Drillers License
Florida - Drillers License
Virginia - Drillers License

TECHNICAL EXPERIENCE

Drilling Technologies:

- Rotary (Air, Dual, Mud, Direct Water, Reverse Water, Down Hole Hammer, Roller)
- Artesian - Well Construction
- Coring
- Auger
- Wash/Driven Boring
- Pump Installations (Turbine and Submersible)
- Grouting Technologies
- Well Rehabilitation (Rock, Gravel, Horizontal)
- Packer Testing (Straddle and Single; Pneumatic, Pumping, Slug.)
- General Trouble Shooting (Wells, Pumps, Drilling)
- OSHA / HAZMAT Trained

Mr. Ted Oliver
Lead Driller

Mr. Oliver is a lead driller for the Winchester, Virginia office of Integrity Well & Pump Company. His responsibilities include the construction of test and production wells within the Mid-Atlantic region. He has experience in the installation of monitoring wells in bedrock and overburden formations. He also has extensive knowledge of well design and repair in a variety of subsurface conditions. Ted, has over 20 years of experience in the drilling industry and has been involved in numerous environmental and water supply projects. Ted's project experience includes: Monitoring Wells (6" x 2" x 30'), Production Wells (30" x 22" x 12" x 1800'), Production (24" x 16" x 1200'), Pump Repairs of 500 Horse Power (12" x 4.5" x 1 15/16") Column.

EXPERIENCE

1998- Present	Driller for Integrity Well & Pump Company
1997-1998	Driller Layne Christensen Company, Suffolk, VA
1996-1997	Driller Sydnor Hydrodynamics, Richmond, VA
1995-1996	Driller A.C. Shultes, Annapolis, MD
1987-1995	Driller Sydnor Hydrodynamics, Richmond, VA
1985-1987	Driller Layne Atlantic Orlando, FL & Norfolk, VA
1984-1985	Driller Falcon Drilling Co, West Virginia
1982-1984	Driller Layne Atlantic Orlando, Florida
1879-1982	Driller for IPSCO Drilling Sheffield, PA
1978-1979	Drill Rig Hand of R.H. Whipkey Drilling, PA office

MEMBERSHIP

Maryland Drillers License
South Carolina Drillers License
Delaware Drillers License " Pending "
North Carolina Pump Installer & Drillers License

TECHNICAL EXPERIENCE

Drilling Technologies:

- Rotary (Air, Dual, Mud, Direct Water, Reverse Water, Down Hole Hammer, Roller)
- Coring
- Auger
- Cable-Tool
- Wash/Driven Boring
- Pump Installations (Turbine and Submersible)
- Grouting Technologies
- Well Rehabilitation (Rock, Gravel, Horizontal)
- Packer Testing (Straddle and Single; Pneumatic, Pumping, Slug.)

**Mr. Robert " Michael " McEwen
Lead Driller**

Mr. McEwen is a driller for the Winchester, Virginia office of Integrity Well & Pump Company. His responsibilities include the coordination of field activities and installation of wells and pumps along the Atlantic coast. He has experience in the installation of wells in consolidated and unconsolidated formations. He also has extensive knowledge of well design in a variety of subsurface conditions. Mike, has over 26 years of experience in the drilling industry and has been involved in numerous environmental, construction and water supply projects. Mikes's, project experience includes: Monitoring Wells (6" x 2" x 300'), Oil & Gas wells to depths of 8,000 feet, Water Supply Wells of (54" x 44" x 36" x 2800') and ASR – Projects consisting of (44" x 36" x 24" x 1500') wells.

EXPERIENCE

Present	Senior driller for Integrity Well & Pump Company
1998-2000	Senior driller for Diversified Drilling, Tampa, FL
1997-1998	Senior driller, Rowe Drilling, Tallahassee, FL
1980-1995	Owner, Ground Water Systems, Ft. Pierce, FL
1970-1995	Oil Well Drilling.

MEMBERSHIP

Florida – Drillers License
Georgia – Drillers License

TECHNICAL EXPERIENCE

Drilling Technologies:

- Certified Welder/Fitter
- Rotary (Air, Dual, Mud, Direct Water, Reverse Water, Down Hole Hammer, Roller)
- Artesian – Well Construction
- Coring
- Auger
- Wash/Driven Boring
- Pump Installations (Turbine and Submersible)
- Grouting Technologies
- Well Rehabilitation (Rock, Gravel, Horizontal)
- Packer Testing (Straddle and Single; Pneumatic, Pumping, Slug.)
- General Trouble Shooting (Wells, Pumps,Drilling)
- OSHA / HAZMAT Trained

Mr. Bobby Oliver
Field Superintendent

Mr. Oliver is the field superintendent for the Winchester, Virginia office of Integrity Well & Pump Company. His responsibilities include the coordination of field activities and installation of wells and pumps within the Mid-Atlantic region. He has experience in the installation of monitoring wells in bedrock and overburden formations. He also has extensive knowledge of well design and repair in a variety of subsurface conditions. Bob, has over 20 years of experience in the drilling industry and has been involved in numerous environmental and water supply projects. Bob's, project experience includes: Monitoring Wells (6" x 2" x 30'), Production Wells (30" x 24" x 16" x 1200'), Production (24" x 16" x 1100') and pump repairs.

EXPERIENCE

1998- Present	Field superintendent for Integrity Well & Pump Company
1995-1997	Senior driller for Layne Ohio Columbus office
1992-1995	Driller A.C. Shultes, Annapolis, MD
1988-1992	Driller Sydnor Hydrodynamics, Richmond, VA
1985-1988	Driller Layne Atlantic, Norfolk, VA
1878-1985	Driller for IPSCO Drilling Sheffield, PA

MEMBERSHIP

Maryland Drillers License
South Carolina Drillers License
Delaware Drillers License " Pending "
North Carolina Pump Installer & Drillers License

TECHNICAL EXPERIENCE

Drilling Technologies:

- Rotary (Air, Dual, Mud, Direct Water, Reverse Water, Down Hole Hammer, Roller)
- Coring
- Auger
- Cable-Tool
- Wash/Driven Boring
- Pump Installations (Turbine and Submersible)
- Grouting Technologies
- Well Rehabilitation (Rock, Gravel, Horizontal)
- Packer Testing (Straddle and Single; Pneumatic, Pumping, Slug.)
- General Trouble Shooting (Wells, Pumps, Drilling)

**Mr. Barry Robertson
Pump Technician**

Mr. Robertson is the senior pump installer for the Winchester, Virginia office of Integrity Well & Pump Company. His responsibilities include the service and repair of vertical turbine & submersible pumps, mechanical piping and pump house construction. He has extensive knowledge of cable tool drilling equipment; pump repair and construction related services. Barry, has worked on 5 Hp thru 500 Horse Power pumps in a variety of applications.

EXPERIENCE

1997- Present Pump technician for Integrity Well & Pump Company.

MEMBERSHIP

Virginia Contractors
North Carolina Pump Installer & Driller

TECHNICAL EXPERIENCE

Drilling Technologies:

- Cable-Tool
- Pump Installations (Turbine and Submersible)
- Grouting Technologies
- Well Rehabilitation (Rock, Gravel, Horizontal)
- General Troubleshooting (Wells, Pumps, Drilling)



Available Equipment

Table Drive

- Mud / Reverse Rotary Equipment – Speedstar SS-40 & Layne-Ark 2500.
Including; Support Equipment

Top Head Drive

- Mud / Air Rotary Equipment – Driltech D – 40 K II Deep Hole Package.

Pump Hoists

- 12.5 – Ton Service Crane.
- 28 L – Cable Tool.

Down Hole Equipment

- Test Pumps from (10 thru 5000) GPM.
- Packer Testing Equipment (4 Inch thru 24 Inch)
- Video Logging Equipment

Support Trucks & Handling Tools

ACORD. CERTIFICATE OF LIABILITY INSURANCE

OP ID DM
INTEG-1

DATE WRITTEN
12/06/97

PRODUCER
F&M - J.V. Arthur, Inc.
P.O. Box 2340
Winchester VA 22604
Phone: 540-662-3865 Fax: 540-722-3619

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INSURERS AFFORDING COVERAGE

INSURED
Integrity Well & Pump Co.
159 Windy Hill Lane
Winchester VA 22602

INSURER A: Assurance Company of America
INSURER B:
INSURER C:
INSURER D:
INSURER E:

COVERAGES
THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. AGGREGATE LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSUR LTR	TYPE OF INSURANCE	POLICY NUMBER	POLICY EFFECTIVE DATE (MM/DD/YY)	POLICY EXPIRATION DATE (MM/DD/YY)	LIMITS
A	GENERAL LIABILITY <input checked="" type="checkbox"/> COMMERCIAL GENERAL LIABILITY <input type="checkbox"/> CLAIMS MADE <input checked="" type="checkbox"/> OCCUR GEN'L AGGREGATE LIMIT APPLIES PER: <input type="checkbox"/> POLICY <input type="checkbox"/> PROJECT <input type="checkbox"/> LOC	SCP32108905	09/08/99	09/08/00	EACH OCCURRENCE \$ 1000000 FIRE DAMAGE (Any one fire) \$ 300000 MED EXP (Any one person) \$ 10000 PERSONAL & ADV INJURY \$ 1000000 GENERAL AGGREGATE \$ 2000000 PRODUCTS - COMP/OP AGG \$ 2000000
A	AUTOMOBILE LIABILITY <input checked="" type="checkbox"/> ANY AUTO <input type="checkbox"/> ALL OWNED AUTOS <input type="checkbox"/> SCHEDULED AUTOS <input checked="" type="checkbox"/> HIRED AUTOS <input checked="" type="checkbox"/> NON-OWNED AUTOS	SCP32108905	09/08/99	09/08/00	COMBINED SINGLE LIMIT (Ea accident) \$ 1000000 BODILY INJURY (Per person) \$ BODILY INJURY (Per accident) \$ PROPERTY DAMAGE (Per accident) \$
	GARAGE LIABILITY <input type="checkbox"/> ANY AUTO				AUTO ONLY - EA ACCIDENT \$ OTHER THAN EA ACC \$ AUTO ONLY AGG \$
	EXCESS LIABILITY <input type="checkbox"/> OCCUR <input type="checkbox"/> CLAIMS MADE <input type="checkbox"/> DEDUCTIBLE <input type="checkbox"/> RETENTION \$				EACH OCCURRENCE \$ AGGREGATE \$ \$ \$
A	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY	TC098437842	09/08/99	09/08/00	WS STATE TORY LIMITS: WIP-ER: E.L. EACH ACCIDENT \$ 100000 E.L. DISEASE - EA EMPLOYEE \$ 100000 E.L. DISEASE - POLICY LIMIT \$ 500000
A	OTHER Property Section	SCP32108905	09/08/99	09/08/00	

COPY

DESCRIPTION OF OPERATIONS/LOCATIONS/VEHICLES/EXCLUSIONS ADDED BY ENDORSEMENT/SPECIAL PROVISIONS
 Certificate holder is shown as additional insured and loss payee for the following unit under Hired Auto Physical Damage coverage with a limit of \$70000, comp ded \$100, coll ded \$500: 94 Ford tractor truck VIN 1FDYY9OR3RVA00777. FAX: 803-733-5659

CERTIFICATE HOLDER | N | **ADDITIONAL INSURED: INSURER LETTER:** _____

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING INSURER WILL ENDEAVOR TO MAIL 10 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT, BUT FAILURE TO DO SO SHALL IMPOSE NO OBLIGATION OR LIABILITY OF ANY KIND UPON THE INSURER, ITS AGENTS OR REPRESENTATIVES.

Walter Henry

Integrity

Well & Pump Company

159 Windy Hill Lane, Winchester, VA 22602 Phone: 1-888-314-PUMP (7867) Fax: 540-667-5726



Well & Pump Services

Integrity, Well & Pump Company (Integrity) has expertise in the development, treatment and maintenance of ground water and surface water systems. From preventive maintenance programs to emergency response service we are prepared to handle all of your pumping requirements.

Drop Ship Sales

- Short Coupled " High or Low " Service Booster Pumps
- UL & FM – Fire Pump Products
- River Intake Pumps
- Deep Set Vertical Turbine Well Pumps
- Deep Set Submersible Well Pumps
- U.S. & G.E. Vertical Turbine Hollow Shaft Motors
- Motor Control Panels
- Alternate Metallurgical Pump Designs
(Brackish Water Applications)



Installation & Testing

In the event installation crews are required, (Integrity) has certified pump installers and the proper support equipment to handle any installation application.

Drilling Services

As a drilling concern (Integrity) offers a variety of drilling services from Industrial and Municipal ground water programs to soil stabilization work.

- Municipal & Industrial Water Supply Wells
- De-watering Wells
- Air & Mud Rotary Rigs
- Casing Advancement Equipment for: (Unstable Drilling Conditions)
- Well Cleaning & Repair
- Grouting Services
- Monitoring Well Installations (Haz-Mat Trained)



For sales or service , please call:

1 – 888 - 314 – 7867 “ Pump ”

Appendix C to General Conditions

Contractor's Proposed Substitute or "Or Equal" Products

SECTION 01010 - SUMMARY OF WORK

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The WORK to be performed under this Contract shall consist of furnishing plant, tools, equipment, materials, supplies, and manufactured articles, and furnishing all labor, transportation, and services, including fuel, power, water, and essential communications, and performing all work or other operations required for the fulfillment of the Contract in strict accordance with the Contract Documents. The WORK shall be complete, and all work, materials, and services not expressly indicated or called for in the Contract Documents which may be necessary for the complete and proper construction of the WORK in good faith shall be provided by the CONTRACTOR as though originally so indicated, at no increase in cost to the OWNER.
- B. **Past Performance:** Experienced contractor with a minimum of ten (10) years experience in the well drilling business shall be required. A list of previous projects indicating the contract amounts and contact persons shall be submitted. Special consideration shall be given to contractor's performance and experience with previous projects.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

- A. The WORK of this Contract comprises the construction of a five (5) million gallon per day aquifer storage and recovery (ASR) well, four (4) shallow monitor wells, outfall structure to Hillsboro Canal, below grade vaults, lift station, and all associated piping, mechanical equipment, electrical, instrumentation and control, and associated appurtenances.
- B. The WORK includes control system operation requirements relating to dates on or after January 1, 2000.
- C. The WORK is located along the north right-of-way of the South Florida Water Management District (SFWMD) Hillsboro Canal from State Road 7 approximately 1.5 miles west.

1.3 CONTRACT METHOD

- A. The WORK hereunder will be constructed under a single lump sum contract.

1.4 WORK BY OTHERS

- A. Where 2 or more contracts are being performed at one time on the same Site or adjacent land in such manner that work under one contract may interfere with work under another, the OWNER will determine the sequence and order of the Work in either or both contracts. When the Site of one contract is the necessary or convenient means of access for performance of work under another, the OWNER may grant privilege of access or other reasonable privilege to the contractor so desiring, to the extent, amount, and in manner and at time that the OWNER may determine. No OWNER determination of method or time or sequence or order of the work or access privilege shall be the basis for a claim for delay or damage except under provisions of the General Conditions for temporary suspensions of the work. The CONTRACTOR shall conduct its operations so as to cause a minimum of interference with the work of such other contractors, and shall

cooperate fully with such contractors to allow continued safe access to their respective portions of the Site, as required to perform work under their respective contracts.

- B. **Interference With Work On Utilities:** The CONTRACTOR shall cooperate fully with all utility forces of the OWNER or forces of other public or private agencies engaged in the relocation, altering, or otherwise rearranging of any facilities which interfere with the progress of the WORK, and shall schedule the WORK so as to minimize interference with said relocation, altering, or other rearranging of facilities.

1.5 CONTRACTOR USE OF SITE

- A. The CONTRACTOR's use of the Site shall be limited to its construction operations, including on-Site storage of materials, on-Site fabrication facilities, and field offices.

1.6 OUTAGE PLAN AND REQUESTS

- A. Unless the Contract Documents indicate otherwise, the CONTRACTOR shall not remove from service, de-energize, or modify settings for any existing operating tank pipeline, valve, channel, equipment, structure, road, or any other facility without permission from the ENGINEER.
- B. Where the WORK requires modifications to existing facilities or construction of new facilities and connection of new facilities to existing facilities, the CONTRACTOR shall submit a detailed outage plan and schedule for the ENGINEER'S approval a minimum of 2 weeks in advance of the time that such outage is planned.
- C. A completed System Outage Request form (blank furnished by the ENGINEER) shall accompany each outage plan. The outage plans shall be coordinated with the construction schedule and shall meet the restrictions and conditions of the Contract Documents. The outage plan shall describe the CONTRACTOR's method for preventing bypassing of other treatment units; the length of time required to complete said operation; any necessary temporary power, controls, instrumentation or alarms required to maintain control, monitoring, and alarms for the treatment plant processes; and the manpower, plant, and equipment which the CONTRACTOR will furnish for proper operation of associated treatment units. All costs for preparing and implementing the outage plans shall be at no increase in cost to the OWNER.
- D. The ENGINEER shall be notified in writing at least one week in advance of the required outage if the schedule for performing the work has changed or if revisions to the outage plan are required.
- E. The CONTRACTOR shall provide written confirmation of the shutdown date and time two working days prior to the actual shutdown.

1.7 NOISE ABATEMENT

- A. Noise levels shall not exceed PBC Land Development Code Article 7, Table 7.8-1 (60 dBA above background at property line).

1.8 HOURS OF WORK

- A. Work hours shall be limited to 7:00 A.M. to 7:00 P.M. Monday thru Saturday. No construction is permitted on Sunday in accordance with PBC Land Development Code

Article 7, Section 7.8-A4.

1.9 OWNER USE OF THE SITE

- A. The OWNER may utilize all or part of the existing Site during the entire period of construction for the conduct of the OWNER's normal operations. The CONTRACTOR shall cooperate and coordinate with the ENGINEER to facilitate the OWNER's operations and to minimize interference with the CONTRACTOR's operations at the same time. In any event, the OWNER shall be allowed access to the Site during the period of construction.

1.10 PROJECT MEETINGS

A. **Preconstruction Conference:**

1. Prior to the commencement of WORK at the Site, a preconstruction conference will be held at a mutually agreed time and place. The conference shall be attended by the CONTRACTOR'S Project Manager, its superintendent, and its Subcontractors as the CONTRACTOR deems appropriate. Other attendees will be:
 - a. ENGINEER and the Resident Project Representative.
 - b. Representatives of OWNER.
 - c. Governmental representatives as appropriate.
 - d. Others as requested by CONTRACTOR, OWNER, or ENGINEER.
2. The CONTRACTOR shall bring the preconstruction conference submittals in accordance with Section 01300 - Contractor Submittals.
3. The purpose of the conference is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established. The complete agenda will be furnished to the CONTRACTOR prior to the meeting date. However, the CONTRACTOR should be prepared to discuss all of the items listed below.
 - a. Status of CONTRACTOR's insurance and bonds.
 - b. CONTRACTOR's tentative schedules.
 - c. Transmittal, review, and distribution of CONTRACTOR's submittals.
 - d. Processing applications for payment.
 - e. Maintaining record documents.
 - f. Critical work sequencing.
 - g. Field decisions and Change Orders.
 - h. Use of Site, office and storage areas, security, housekeeping, and OWNER's needs.

- i. Major equipment deliveries and priorities.
 - j. CONTRACTOR's assignments for safety and first aid.
 - k. Daily Report Form which the ENGINEER will furnish.
 - l. Submittal Transmittal Form which the ENGINEER will furnish.
4. The ENGINEER will preside at the preconstruction conference and will arrange for keeping and distributing the minutes to all persons in attendance.
5. The CONTRACTOR and its Subcontractors should plan on the conference taking no less than four (4) hours. It will cover the items listed in paragraphs 2 and 3, and include reviewing the Drawings and Specifications, in extensive detail, with the ENGINEER and the OWNER.

B. Progress Meetings:

6. The CONTRACTOR shall schedule and hold regular on-Site progress meetings at least bi-weekly and at other times as requested by ENGINEER or as required by progress of the WORK. The CONTRACTOR, ENGINEER, and all Subcontractors active on the Site shall attend each meeting. CONTRACTOR may at its discretion request attendance by representatives of its Suppliers, manufacturers, and other Subcontractors.
7. The ENGINEER will preside at the progress meetings and will arrange for keeping and distributing the minutes. The purpose of the meetings is to review the progress of the WORK, maintain coordination of efforts, discuss changes in scheduling, and resolve other problems which may develop. During each meeting, the CONTRACTOR shall present any issues which may impact its progress with a view to resolve these issues expeditiously.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

- END OF SECTION -

SECTION 01025 - MEASUREMENT AND PAYMENT

PART 1 – GENERAL

1.1 SCOPE

- A. Payment for the various items of the Bid Schedule, as further specified herein, shall include all compensation to be received by the CONTRACTOR for furnishing all tools, equipment, supplies, and manufactured articles, and for all labor, operations, and incidentals appurtenant to the items of work being described, as necessary to complete the various items of the WORK all in accordance with the requirements of the Contract Documents, including all appurtenances thereto, and including all costs of permits and cost of compliance with the regulations of public agencies having jurisdiction, including Safety and Health Requirements of the Occupational Safety and Health Administration of the U.S. Department of Labor (OSHA). This includes, but is not limited to, all materials, tools, labor, equipment, supplies, permits, removal and disposal of waste or excess materials, etc. Separate payment will not be made for any item that is not specifically set forth in the Bid Schedule, and all costs therefore shall be included in the prices named in the Bid Schedule for the various appurtenant items of work.

1.2 CONSTRUCTION OF THE ASR WELL ASR-1 - Bid Item No. 1.0

- A. No measurement shall be made for this item.
- B. Payment shall be made at the lump sum price named in the Bid Schedule which shall constitute full compensation for drilling, testing, development, and completion of one (1) Aquifer Storage and Recover well having a 24-inch diameter casing set to 1,080 feet below land surface (bls) and an open hole completion interval to 1,200 feet bls, with all appurtenances and miscellaneous work in accordance with the Contract Documents.

1.3 DRILL MORE OR LESS PILOT HOLE THAN SPECIFIED - Bid Item No. 1.1

- A. Measurement for addition or subtraction to payment for drilling the pilot hole more or less than 1,200 feet from land surface to total depth of 12.25-inch diameter pilot hole will be based upon the number of linear feet of pilot hole drilled, tested, and accepted, all in accordance with the Contract Documents.
- B. Additions or Subtractions to payment for drilling the pilot hole more or less than 1,200 feet from land surface to total depth will be at the unit price per linear foot indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.

1.4 REAM PILOT HOLE TO NOMINAL 44-INCH DIAMETER - Bid Item No. 1.2

- A. Measurement for addition or subtraction to payment for reaming of the pilot hole to a nominal 44-inch diameter will be based upon the number of linear feet more or less than 200 feet of pilot hole reamed, tested, and accepted, all in accordance with the Contract Documents.
- B. Additions or subtractions to payment for reaming the pilot hole to nominal 44-inch diameter shall be at the unit price per linear foot more or less than 200 feet as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.

1.5 FURNISH AND INSTALL 34-INCH DIAMETER CASING - Bid Item No. 1.3

- A. Measurement for addition or subtraction to payment for furnishing and installing 34-inch diameter steel casing will be based on the number of linear feet more or less than 200 feet of casing installed, tested, and accepted, all in accordance with the Contract Documents.
- B. Addition or subtraction to payment for furnishing and installing 34-inch diameter steel casing shall be at the unit price per linear foot more or less than 200 feet as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.

1.6 FURNISH AND INSTALL CEMENT AND ADDITIVES IN THE ANNULAR SPACES - Bid Item No. 1.4

- A. Measurement for addition or subtraction to payment for furnishing and emplacing the cement with up to 2% calcium chloride and 4% bentonite or other approved additives in the casing annuli will be based on the number on cubic feet of cement more or less than 5,000 cubic feet installed, tested, and accepted, all in accordance with the Contract Documents.
- B. Addition or subtraction to payment for furnishing and emplacing the cement shall be at the unit price per cubic foot more or less than 5,000 cubic feet as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents

1.7 REAM PILOT HOLE TO NOMINAL 34-INCH DIAMETER - Bid Item No. 1.5

- A. Measurement for addition or subtraction to payment for reaming of the pilot hole to a nominal 34-inch diameter will be based upon the number of linear feet of pilot hole more or less than 880 feet reamed, tested, and accepted, all in accordance with the Contract Documents.
- B. Addition or subtraction to payment for reaming the pilot hole to nominal 34-inch diameter shall be at the unit price per linear foot more or less than 880 feet as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.

1.8 FURNISH AND INSTALL 24-INCH DIAMETER SURFACE CASING - Bid Item No. 1.6

- A. Measurement for addition or subtraction to payment for furnishing and installing 24-inch diameter steel casing will be based on the number of linear feet more or less than 1,080 feet of casing installed, tested, and accepted, all in accordance with the Contract Documents.
- B. Addition or subtraction to payment for furnishing and installing 24-inch diameter steel casing shall be at the unit price per linear foot more or less than 1,080 feet as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.

1.9 CORE SAMPLES - Bid Item No. 1.7

- A. Measurement for addition or subtraction to payment for collecting core samples shall be based on the number of feet of core more or less than 275 feet completed and accepted, all in accordance with the Contract Documents.
- B. Addition or subtraction to payment for collecting core samples shall be at the unit price per foot more or less than 275 feet as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.

1.10 SINGLE OR STRADDLE PACKER TESTS - Bid Item No. 1.8

- A. Measurement for addition or subtraction to payment for single or straddle packer tests shall be based on the number of tests performed more or less than two (2) all in accordance with the Contract Documents.
- B. Addition or subtraction to payment for performing single or straddle packer tests shall be at the unit price per test more or less than two as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.

1.11 REAM PILOT HOLE TO NOMINAL 24-INCH DIAMETER - Bid Item No. 1.9

- A. Measurement for addition or subtraction to payment for reaming of the pilot hole to a nominal 24-inch diameter will be based upon the number of linear feet more or less than 120 feet of pilot hole reamed, tested, and accepted, all in accordance with the Contract Documents.
- B. Addition or subtraction to payment for reaming the pilot hole to nominal 24-inch diameter shall be at the unit price per linear foot more or less than 120 feet as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.

1.12 WELL DEVELOPMENT - Bid Item No. 1.10

- A. Measurement for addition or subtraction to payment for well development will be based on the number of hours of direct airlifting, pump surging and/or reverse airlifting actually used to develop the well more or less than 120 hours, all in accordance with the Contract Documents.
- B. Addition or subtraction to payment for well development shall be at the unit price per hour more or less than 120 hours as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.

1.13 STANDBY TIME WITH RIG AND CREW WORKING - Bid Item No. 1.11

- A. Measurement for addition or subtraction to payment for standby time will be based on the number of hours actually spent on standby more or less than 40 hours at the direction of the OWNER or ENGINEER in accordance with the Contract Documents.

- B. Addition or subtraction to payment for standby time shall be at the unit price per hour more or less than 40 hours as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.
- 1.14 STANDBY TIME WITH NO RIG AND CREW - Bid Item No. 1.12
- A. Measurement for addition or subtraction to payment for standby time will be based on the number of hours actually spent more or less than 40 hours on standby at the direction of the OWNER or ENGINEER in accordance with the Contract Documents.
 - B. Addition or subtraction to payment for standby time shall be at the unit price per hour more or less than 40 hours as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.
- 1.15 CONSTRUCT FLORIDAN AQUIFER MONITOR WELL FAMW-1 - Bid Item No. 2.0
- A. No measurement shall be made for this item.
 - B. Payment shall be made at the lump sum price named in the Bid Schedule which shall constitute full compensation for drilling, testing, development, and completion of one (1) Floridan Aquifer Monitor Well having a 6-5/8-inch diameter casing set to 1,080 feet below land surface (bls) and an open hole completion interval to 1,200 feet bls, with all appurtenances and miscellaneous work in accordance with the Contract Documents.
- 1.16 DRILL MORE OR LESS PILOT HOLE AS SPECIFIED - Bid Item No. 2.1
- A. Measurement for addition or subtraction to payment for drilling the pilot hole to a nominal diameter of 12.25-inch as specified from land surface to total depth will be based upon the number of linear feet of pilot hole more or less than 1,650 feet drilled, tested, and accepted, all in accordance with the Contract Documents.
 - B. Addition or subtraction to payment for drilling the pilot hole to a nominal diameter of 12.25-inch as specified from land surface to total depth more or less than 1,650 feet will be at the unit price per linear foot indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.
- 1.17 REAM PILOT HOLE TO NOMINAL 34-INCH DIAMETER - Bid Item No. 2.2
- A. Measurement for addition or subtraction to payment for reaming of the pilot hole to a nominal 34-inch diameter will be based upon the number of linear feet more or less than 200 feet of pilot hole reamed, tested, and accepted, all in accordance with the Contract Documents.
 - B. Addition or subtraction to payment for reaming the pilot hole to nominal 34-inch diameter shall be at the unit price per linear foot more or less than 200 feet as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.

- 1.18 FURNISH AND INSTALL 24-INCH DIAMETER CONDUCTOR CASING - Bid Item No. 2.3
- A. Measurement for addition or subtraction to payment for furnishing and installing 24-inch diameter steel casing will be based on the number of linear feet more or less than 200 feet of casing installed, tested, and accepted, all in accordance with the Contract Documents.
 - B. Addition or subtraction to payment for furnishing and installing 24-inch diameter steel casing shall be at the unit price per linear foot more or less than 200 feet as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.
- 1.19 FURNISH AND INSTALL CEMENT ADDITIVES IN THE ANNULAR SPACES OR PILOT HOLE - Bid Item No. 2.4
- A. Measurement for addition or subtraction to payment for furnishing and emplacing the cement with up to 2% calcium chloride and 4% bentonite or other approved additives in the casing annuli or pilot hole will be based on the number on cubic feet of cement more or less than 5,500 cubic feet installed, tested, and accepted, all in accordance with the Contract Documents.
 - B. Addition or subtraction to payment for furnishing and emplacing the cement and additives in the casing annuli or pilot hole shall be at the unit price per cubic foot more or less than 5,500 cubic feet as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.
- 1.20 CORE SAMPLES - Bid Item No. 2.5
- A. Measurement for addition or subtraction to payment for collecting core samples shall be based on the number of feet of core completed and accepted more or less than 435 feet, all in accordance with the Contract Documents.
 - B. Addition or subtraction to payment for collecting core samples shall be at the unit price per foot more or less than 435 feet as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.
- 1.21 REAM PILOT HOLE TO NOMINAL 24-INCH DIAMETER - Bid Item No. 2.6
- A. Measurement for addition or subtraction to payment for reaming of the pilot hole to a nominal 24-inch diameter will be based upon the number of linear feet more or less than 975 feet of pilot hole reamed, tested, and accepted, all in accordance with the Contract Documents.
 - B. Addition or subtraction to payment for reaming the pilot hole to nominal 24-inch diameter shall be at the unit price per linear foot more or less than 975 feet as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.

1.22 FURNISH AND INSTALL 14-INCH DIAMETER CASING - Bid Item No. 2.7

- A. Measurement for addition or subtraction to payment for furnishing and installing 14-inch diameter steel casing will be based on the number of linear feet more or less than 975 feet of casing installed, tested, and accepted, all in accordance with the Contract Documents.
- B. Addition or subtraction to payment for furnishing and installing 14-inch diameter steel casing shall be at the unit price per linear foot more or less than 975 feet as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.

1.23 SINGLE OR STRADDLE PACKER TESTS - Bid Item No. 2.8

- A. Measurement for addition or subtraction to payment for single or straddle packer tests shall be based on the number of tests more or less than six (6) tests performed all in accordance with the Contract Documents.
- B. Addition or subtraction to payment for performing single or straddle packer tests shall be at the unit price per test more or less than six (6) as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.

1.24 FURNISH AND INSTALL 6-5/8-INCH DIAMETER CASING - Bid Item No. 2.9

- A. Measurement for addition or subtraction to payment for furnishing and installing 6-5/8-inch diameter fiberglass casing will be based on the number of linear feet more or less than 1,080 feet of casing installed, tested, and accepted, all in accordance with the Contract Documents.
- B. Addition or subtraction to payment for furnishing and installing 6-5/8-inch diameter fiberglass casing shall be at the unit price per linear foot more or less than 1,080 feet as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.

1.25 WELL DEVELOPMENT - Bid Item No. 2.10

- A. Measurement for addition or subtraction to payment for well development will be based on the number of hours of direct airlifting, pump surging and/or reverse airlifting actually used to develop the well more or less than 80 hours, all in accordance with the Contract Documents.
- B. Addition or subtraction to payment for well development shall be at the unit price per hour more or less than 80 hours as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.

1.26 STANDBY TIME WITH RIG AND CREW WORKING - Bid Item No. 2.11

- A. Measurement for addition or subtraction to payment for standby time will be based on the number of hours actually spent on standby more or less than 40 hours at the direction of the OWNER or ENGINEER in accordance with the Contract Documents.

- B. Payment for standby time shall be at the unit price per hour indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents. For all items, this includes, but is not limited to, all materials, tools, labor, equipment, supplies, permits, removal and disposal of waste or excess materials, etc. necessary to remain on standby in accordance with the Contract Documents.
- 1.27 STANDBY TIME WITH NO RIG AND CREW - Bid Item No. 2.12
- A. Measurement for addition or subtraction to payment for standby time will be based on the number of hours actually spent on standby more or less than 40 hours at the direction of the OWNER or ENGINEER in accordance with the Contract Documents.
 - B. Payment for standby time shall be at the unit price per hour more or less than 40 hours as indicated in the Bid Schedule which price shall constitute full compensation for the completed WORK all in accordance with the Contract Documents.
- 1.28 MOBILIZATION/DEMobilIZATION ALLOWANCE (INSURANCE, BONDS, PERMITS, TEMPORARY PADS, PAD MONITOR WELLS) – Bid Item 3.0
- A. No measurement shall be made for this item.
 - B. Payment for mobilization, demobilization, insurance bonds, permits, temporary containment pad, pad modification, and pad monitor wells will be made at the lump sum price named in the Bid Schedule which shall constitute full compensation for obtaining all required insurance, bonds and permits in accordance with the Contract Documents. This amount will also constitute full compensation for mobilization and demobilization, temporary containment pad, pad modification, and pad monitor wells as outlined in the Contract Documents. No more than 65% percent of the amount set aside for this item may be claimed as mobilization.
- 1.29 UNDERGROUND VAULTS/STRUCTURES – Bid Item 4.0
- A. No measurement shall be made for this item.
 - B. Payment for mobilization, demobilization, insurance bonds, permits, temporary containment pad, pad modification, and pad monitor wells will be made at the lump sum price named in the Bid Schedule which shall constitute full compensation for obtaining all required insurance, bonds and permits in accordance with the Contract Documents. This amount will also constitute full compensation for mobilization and demobilization, temporary containment pad, pad modification, and pad monitor wells as outlined in the Contract Documents. No more than 65% percent of the amount set aside for this item may be claimed as mobilization.
- 1.30 ELECTRICAL/INSTRUMENTATION AND CONTROLS (I&C) – Bid Item 5.0
- A. No measurement shall be made for this item.
 - B. Payment for mobilization, demobilization, insurance bonds, permits, temporary containment pad, pad modification, and pad monitor wells will be made at the lump sum price named in the Bid Schedule which shall constitute full compensation for obtaining all required insurance, bonds and permits in accordance with the Contract Documents. This amount will also constitute full compensation for mobilization and demobilization,

temporary containment pad, pad modification, and pad monitor wells as outlined in the Contract Documents. No more than 65% percent of the amount set aside for this item may be claimed as mobilization.

1.31 PERMIT FEE ALLOWANCE – Bid Item 6.0

- A. Payment for this item will be made for only the amount that can be substantiated with receipts.

1.32 LANDSCAPING ALLOWANCE – Bid Item 7.0

- A. Payment for this item will be made for only the amount that can be substantiated with receipts.

1.33 ELECTRICAL AND INSTRUMENTATION – Bid Item 8.0

- A. Payment for this item will be made for only the amount that can be substantiated with receipts.

1.34 PIPING, STRUCTURES, MECHANICAL – Bid Item 9.0

- A. Payment for this item will be made for only the amount that can be substantiated with receipts.

1.35 INDEMNIFICATION – Bid Item 10.0

- A. No measurement shall be made for this item.
- B. Payment shall be made at the lump sum price identified in the Bid Schedule, which shall constitute full compensation for indemnification of the OWNER and the ENGINEER.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

- END OF SECTION -

SECTION 01070 - ABBREVIATIONS OF INSTITUTIONS

PART 1 -- GENERAL

1.1 GENERAL

- A. Wherever in these Specifications references are made to the standards, specifications, or other published data of the various international, national, regional, or local organizations, such organizations may be referred to by their acronym or abbreviation only. As a guide to the user of these Specifications, the following acronyms or abbreviations which may appear in these Specifications shall have the meanings indicated herein.

1.2 ABBREVIATIONS

AAMA	Architectural Aluminum Manufacturer's Association
AAR	Association of American Railroads
AASHTO	American Association of State Highway and Transportation Officials
AATCC	American Association of Textile Chemists and Colorists
ACI	American Concrete Institute
AFBMA	Anti-Friction Bearing Manufacturer's Association, Inc.
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AI	The Asphalt Institute
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Conditioning Association
ANS	American Nuclear Society
ANSI	American National Standards Institute, Inc.
APA	American Plywood Association or American Parquet Association, Inc.
API	American Petroleum Institute
APWA	American Public Works Association
ARI	Air-Conditioning and Refrigeration Institute
ASA	Acoustical Society of America
ASAE	American Society of Agricultural Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASLE	American Society of Lubricating Engineers
ASME	American Society of Mechanical Engineers
ASQC	American Society for Quality Control
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturer's Association
CABO	Council of American Building Officials
CBM	Certified Ballast Manufacturers
CDA	Copper Development Association
CEMA	Conveyors Equipment Manufacturer's Association
CGA	Compressed Gas Association

CLFMI	Chain Link Fence Manufacturer's Institute
CMA	Concrete Masonry Association
CRSI	Concrete Reinforcing Steel Institute
DCDMA	Diamond Core Drill Manufacturer's Association
DHI	Door and Hardware Institute
DIPRA	Ductile Iron Pipe Research Association
EIA	Electronic Industries Association
ETL	Electrical Test Laboratories
EPA	Environmental Protection Agency
ERM	Environmental Resource Management, Palm Beach County
FCC	Federal Communications Commission
FCI	Fluid Controls Institute
FM	Factory Mutual System
FPL	Florida Power & Light
HI	Hydraulic Institute
HPMA	Hardwood Plywood Manufacturers Association
IAPMO	International Association of Plumbing and Mechanical Officials
ICBO	International Conference of Building Officials
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IME	Institute of Makers of Explosives
IPC	Institute of Printed Circuits
IPCEA	Insulated Power Cable Engineers Association
ISDSI	Insulated Steel Door Systems Institute
ISA	Instrument Society of America
ISEA	Industrial Safety Equipment Association
ISO	International Organization for Standardization
ITE	Institute of Traffic Engineers
MBMA	Metal Building Manufacturer's Association
MPTA	Mechanical Power Transmission Association
MSS	Manufacturers Standardization Society
MTI	Marine Testing Institute
NAAMM	National Association of Architectural Metal Manufacturer's
NACE	National Association of Corrosion Engineers
NB	National Board of Boiler and Pressure Vessel Inspectors (alternate NBBPVI)
NBS	National Bureau of Standards (Now NIST)
NCCLS	National Committee for Clinical Laboratory Standards
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NETA	International Electrical Testing Association
NFPA	National Fire Protection Association or National Fluid Power Association or National Forest Products Association
NISO	National Information Standards Organization
NLGI	National Lubricating Grease Institute
NMA	National Microfilm Association
NRCA	National Roofing Contractors Association
NSF	National Sanitation Foundation
NWMA	National Woodwork Manufacturers Association
NWWDA	National Wood Window and Door Association
OSHA	Occupational Safety and Health Administration
PBCWUD	Palm Beach County Water Utilities Department
PCA	Portland Cement Association

PPI	Plastics Pipe Institute
RCRA	Resource Conservation and Recovery Act
RMA	Rubber Manufacturers Association
RVIA	Recreational Vehicle Industry Association
RWMA	Resistance Welder Manufacturer's Association
SAE	Society of Automotive Engineers
SAMA	Scientific Apparatus Makers Association
SDI	Steel Door Institute
SFBC	South Florida Building Code
SFWMD	South Florida Water Management District
SMA	Screen Manufacturers Association
SMACCNA	Sheet Metal and Air Conditioning Contractors National Association
SPI	Society of the Plastics Industry, Inc.
SPIB	Southern Pine Inspection Bureau
SPR	Simplified Practice Recommendation
SSPC	Society for Protective Coating
SSPWC	Standard Specifications for Public Works Construction
TAPPI	Technical Association of the Pulp and Paper Industry
TFI	The Fertilizer Institute
TIA	Telecommunications Industries Association
TPI	Truss Plate Institute
UBC	Uniform Building Code
UL	Underwriters Laboratories, Inc.
WCLIB	West Coast Lumber Inspection Bureau
WCRSI	Western Concrete Reinforcing Steel Institute
WEF	Water Environment Federation
WRI	Wire Reinforcement Institute, Inc.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

- END OF SECTION -

SECTION 01090 - REFERENCE STANDARDS

PART 1 – GENERAL

1.1 GENERAL

- A. **Titles of Sections and Paragraphs:** Titles and subtitles accompanying specification sections and paragraphs are for convenience and reference only, and do not form a part of the Specifications.
- B. **Applicable Publications:** Whenever in these Specifications references are made to published specifications, codes, standards, or other requirements, it shall be understood that wherever no date is specified, only the latest specifications, standards, or requirements of the respective issuing agencies which have been published as of the date that the Contract is advertised for bids shall apply; except to the extent that said standards or requirements may be in conflict with applicable laws, ordinances, or governing codes. No requirements set forth in the Specifications or shown on the Drawings will be waived because of any provision of, or omission from, said standards or requirements.
- C. **Specialists, Assignments:** In certain instances, specification text requires (or implies) that specific work is to be assigned to specialists or expert entities, who must be engaged for the performance of that work. Such assignments shall be recognized as special requirements over which the CONTRACTOR has no choice or option. These requirements shall not be interpreted so as to conflict with the enforcement of building codes and similar regulations governing the WORK; also they are not intended to interfere with local union jurisdiction settlements and similar conventions. Such assignments are intended to establish which party or entity involved in a specific unit of work is recognized as "expert" for the indicated construction processes or operations. Nevertheless, the final responsibility for fulfillment of the entire set of contract requirements remains with the CONTRACTOR.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. The CONTRACTOR shall construct the WORK in accordance with the Contract Documents and the referenced portions of those referenced codes, standards, and specifications.
- B. References to "Building Code" or "Standard Building Code" shall mean the Standard Building Code of the Southern Building Code Congress International (SBCCI). Similarly, references to "Mechanical Code" or "International Mechanical Code," "Plumbing Code" or "International Plumbing Code," "Fire Code" or "International Fire Code," shall mean International Mechanical Code, International Plumbing Code and International Fire Code of the International Code Council. "Electric Code" or "National Electric Code (NEC)" shall mean the National Electric Code of the National Fire Protection Association (NFPA). The latest edition of the codes as approved by the Municipal Code and used by the local agency as of the date that the WORK is advertised for bids, as adopted by the agency having jurisdiction, shall apply to the WORK herein, including all addenda, modifications, amendments, or other lawful changes thereto.
- C. In case of conflict between codes, reference standards, drawings, and the other Contract Documents, the most stringent requirements shall govern. All conflicts shall be brought to the attention of the ENGINEER for clarification and directions prior to ordering or providing

any materials or furnishing labor. The CONTRACTOR shall bid for the most stringent requirements.

- D. References herein to "OSHA Regulations for Construction" shall mean **Title 29, Part 1926, Construction Safety and Health Regulations**, Code of Federal Regulations (OSHA), including all changes and amendments thereto.
- E. References herein to "OSHA Standards" shall mean **Title 29, Part 1910, Occupational Safety and Health Standards**, Code of Federal Regulations (OSHA), including all changes and amendments thereto.
- F. **Applicable Standard Specifications:** References in the Contract Documents to "Standard Specifications" or SSPWC shall mean the Standard Specifications for Public Works Construction, 1997 Edition.

1.3 REGULATIONS RELATED TO HAZARDOUS MATERIALS

- A. The CONTRACTOR shall be responsible that all work included in the Contract Documents, regardless if shown or not, shall comply with all EPA, OSHA, RCRA, NFPA, and any other Federal, State, and Local Regulations governing the storage and conveyance of hazardous materials, including petroleum products.
- B. Where no specific regulations exist, chemical, hazardous, and petroleum product piping and storage in underground locations shall be installed with double containment piping and tanks, or in separate concrete trenches and vaults, or with an approved lining which cannot be penetrated by the chemicals, unless waived in writing by the OWNER.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

- END OF SECTION -

SECTION 01300 - CONTRACTOR SUBMITTALS

PART 1 -- GENERAL

1.1 GENERAL

- A. Wherever submittals are required in the Contract Documents, submit them to the ENGINEER.
- B. Within 7 days after the date of commencement as stated in the Notice to Proceed, the CONTRACTOR shall submit the following items to the ENGINEER for review:
 - 1. A preliminary schedule of Shop Drawings, Samples, and proposed Substitutes ("Or-Equal") submittals listed in the Bid.
 - 2. A list of all permits and licenses the CONTRACTOR shall obtain indicating the agency required to grant the permit and the expected date of submittal for the permit and required date for receipt of the permit.

1.2 PRECONSTRUCTION CONFERENCE SUBMITTALS

- A. At the preconstruction conference referred to in Section 01010 - Summary of Work, the CONTRACTOR shall submit the following items to the ENGINEER for review:
 - 1. A preliminary schedule of Shop Drawings, Samples, and proposed Substitute ("Or-Equal") submittals listed in the Bid.
 - 2. A list of all permits and licenses the CONTRACTOR shall obtain indicating the agency required to grant the permit, the expected date of submittal for the permit, and required date for receipt of the permit.
 - 3. A preliminary schedule of values in accordance with Section 01301 - Schedule of Values.
 - 4. A 60-day plan of operation in accordance with Section 01311 - Scheduling and Reporting.
 - 5. A project overview bar chart in accordance with Section 01311.

1.3 SHOP DRAWINGS

- A. Wherever called for in the Contract Documents, or where required by the ENGINEER, the CONTRACTOR shall furnish to the ENGINEER for review, 8 copies, plus one reproducible copy, of each Shop Drawing submittal. The term "Shop Drawings" as used herein shall be understood to include detail design calculations, shop-prepared drawings, fabrication, and installation drawings, erection drawings, lists, graphs, catalog sheets, data sheets, and similar items. Whenever the CONTRACTOR is required to submit design calculations as part of a submittal, such calculations shall bear the signature and seal of an engineer registered in the appropriate branch and in the state wherein the project is to be built, unless otherwise indicated.
- B. Shop Drawing submittals shall be accompanied by the ENGINEER's standard submittal

transmittal form, a reproducible copy of which is available from the ENGINEER. Any submittal not accompanied by such a form, or where all applicable items on the form are not completed, will be returned for resubmittal.

C. Organization

1. A single submittal transmittal form shall be used for each technical specification section or item or class of material or equipment for which a submittal is required. A single submittal covering multiple sections will not be acceptable, unless the primary specification references other sections for components. Example: if a pump section references other section for the motor, protective coating, anchor bolts, local control panel, and variable frequency drive, a single submittal would be accepted; a single submittal covering vertical turbine pumps and horizontal split case pumps would not be acceptable.
2. On the transmittal form, index the components of the submittal and insert tabs in the submittal to match the components. Relate the submittal components to Specification paragraph and subparagraph, Drawing number, detail number, schedule title, or room number, or building name, as applicable.
3. Unless indicated otherwise, terminology and equipment names and numbers used in submittals shall match the Contract Documents.

D. Format

1. Minimum sheet size shall be 8.5 inches by 11 inches. Maximum sheet size shall be 24 inches by 36 inches. Every page in a submittal shall be numbered in sequence. Each copy of a submittal shall be collated and stapled or bound, as appropriate. The ENGINEER will not collate copies.
2. Where product data from a manufacturer is submitted, clearly mark which model is proposed, with all pertinent data capacities, dimensions, clearances, diagrams, controls, connections, anchorage, and supports. Sufficient level of detail shall be presented for assessment of compliance with the Contract Documents.
3. Each submittal shall be assigned a unique number. Submittals shall be numbered sequentially. The submittal numbers shall be clearly noted on the transmittal. Original submittals shall be assigned a numeric submittal number. Resubmittals shall bear an alpha-numeric system which consists of the number assigned to the original submittal for that item followed by a letter of the alphabet to represent that it is a subsequent submittal of the original. For example, if submittal 25 requires a resubmittal, the first resubmittal will bear the designation 25-A and the second resubmittal will bear the designation 25-B and so on.

E. Disorganized submittals which do not meet the requirements above will be returned without review.

F. Except as may otherwise be indicated herein, the ENGINEER will return prints of each submittal to the CONTRACTOR with its comments noted thereon, within 30 calendar days following receipt by the ENGINEER. It is considered reasonable that the CONTRACTOR shall make a complete and acceptable submittal to the ENGINEER by the second submission of a submittal item. The OWNER reserves the right to withhold monies due to the CONTRACTOR to cover additional costs of the ENGINEER's review beyond the

second submittal. The ENGINEER'S maximum review period for each submittal, including all resubmittals, will be 30 days per submittal. Thus, for a submittal that requires two resubmittals before it is complete, the maximum review period for that submittal could be 90 days.

- G. If a submittal is returned to the CONTRACTOR marked "NO EXCEPTIONS TAKEN," formal revision and resubmission of said submittal will not be required.
- H. If a submittal is returned marked "MAKE CORRECTIONS NOTED," CONTRACTOR shall make the corrections on the submittal, but formal revision and resubmission of said submittal will not be required.
- I. If a submittal is returned marked "AMEND-RESUBMIT," the CONTRACTOR shall revise said submittal and shall resubmit the required number of copies of said revised submittal to the ENGINEER for review.
- J. If a submittal is returned marked "REJECTED-RESUBMIT," it shall mean that the submitted material or product does not satisfy the specification, the submittal is so incomplete that it cannot be reviewed, or is a substitution request not submitted in accordance with Section 01600 - Products, Materials, Equipment, and Substitutions. The CONTRACTOR shall prepare a new submittal and shall resubmit the required number of copies of said revised submittal to the ENGINEER for review.
- K. Fabrication of an item shall be commenced only after the ENGINEER has reviewed the pertinent submittals and returned copies to the CONTRACTOR marked either "NO EXCEPTIONS TAKEN" or MAKE CORRECTIONS NOTED." Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as changes to the contract requirements.
- L. All submittals shall be carefully reviewed by an authorized representative of the CONTRACTOR, prior to submission to the ENGINEER. Each submittal shall be dated, signed, and certified by the CONTRACTOR, as being correct and in strict conformance with the Contract Documents. In the case of Shop Drawings, each sheet shall be so dated, signed, and certified. The ENGINEER will only review submittals which have been so certified by the CONTRACTOR. All non-certified submittals will be returned to the CONTRACTOR without action taken by the ENGINEER, and any delays caused thereby shall be the total responsibility of the CONTRACTOR.
- M. The ENGINEER's review of submittals shall not relieve the CONTRACTOR of the entire responsibility for the correctness of details and dimensions. The CONTRACTOR shall assume all responsibility and risk for any misfits due to any errors in submittals. The CONTRACTOR shall be responsible for the dimensions and the design of adequate connections and details.

1.4 CONTRACTOR'S SCHEDULE

- A. The CONTRACTOR's construction schedules and reports shall be prepared and submitted to the ENGINEER in accordance with of Section 01311.

1.5 SAMPLES

- A. Whenever in the Specifications samples are required, the CONTRACTOR shall submit not less than 3 samples of each item or material to the ENGINEER for acceptance.

- B. Unless otherwise indicated, samples, shall be submitted a minimum of 21 days prior to ordering such material.
- C. Samples shall be individually and indelibly labeled or tagged, indicating thereon all specified physical characteristics and Manufacturer's name. Upon receiving acceptance of the ENGINEER, one set of the samples will be stamped and dated by the ENGINEER and returned to the CONTRACTOR, and one set of samples will be retained by the ENGINEER, and one set of samples shall remain at the Site until completion of the WORK.
- D. Unless indicated otherwise, all colors and textures of items presented in sample submittals shall be from the manufacturer's standard colors and standard materials, products, or equipment lines. If the samples represent non-standard colors, materials, products, or equipment lines and their selection will require an increase in Contract Times or Price, the CONTRACTOR shall clearly indicate same on the transmittal page of the submittal.
- E. The CONTRACTOR shall schedule sample submittals such that:
 - 1. Samples are submitted in an orderly sequence which allows the ENGINEER 45 Days to assemble color panels and select color and texture dependent products and materials without delay to the construction schedule.
 - 2. The CONTRACTOR has sufficient time after approval or selection of color or texture to provide the products or materials without delay to the construction schedule. The Contract Times will not be extended for the CONTRACTOR's failure to allow enough review and approval or selection time, failure to submit all samples requiring color or texture selection, or failure to submit complete or approvable samples.

1.6 TECHNICAL MANUAL

- A. The CONTRACTOR shall submit technical operation and maintenance information for each item of mechanical, electrical and instrumentation equipment in an organized manner in the Technical Manual. It shall be written so that it can be used and understood by the OWNER'S operation and maintenance staff.
- B. The Technical Manual shall be subdivided first by specification section number; second, by equipment item; and last, by "Category." "Categories" shall conform to the following (as applicable):
 - 1. Category 1 - Equipment Summary:
 - a. Summary: A summary table shall indicate the equipment name, equipment number, and process area in which the equipment is installed.
 - b. Form: The ENGINEER will supply an Equipment Summary Form for each item of mechanical, electrical and instrumentation equipment in the WORK. The CONTRACTOR shall fill in the relevant information on the form and include it in Part 1.
 - 2. Category 2 - Operational Procedures:
 - a. Procedures: Manufacturer-recommended procedures on the following shall be

included in Part 2:

- Installation
- Adjustment
- Startup
- Location of controls, special tools, equipment required, or related instrumentation needed for operation
- Operation procedures
- Load changes
- Calibration
- Shutdown
- Troubleshooting
- Disassembly
- Reassembly
- Realignment
- Testing to determine performance efficiency
- Tabulation of proper settings for all pressure relief valves, low and high pressure switches, and other protection devices
- List of all electrical relay settings including alarm and contact settings

3. Category 3 - Preventive Maintenance Procedures:

- a. Procedures: Preventive maintenance procedures shall include all manufacturer-recommended procedures to be performed on a periodic basis, both by removing and replacing the equipment or component, and by leaving the equipment in place.
- b. Schedules: Recommended frequency of preventive maintenance procedures shall be included. Lubrication schedules, including lubricant SAE grade, type, and temperature ranges, shall be covered.

4. Category 4 - Parts List:

- a. Parts List: A complete parts list shall be furnished, including a generic description and manufacturer's identification number for each part. Addresses and telephone numbers of the nearest supplier and parts warehouse shall be included.
- b. Drawings: Cross-sectional or exploded view drawings shall accompany the parts list.

5. Category 5 - Wiring Diagrams:

- a. Diagrams: Part 5 shall include complete internal and connection wiring diagrams for electrical equipment items.

6. Category 6 - Shop Drawings:

- a. Drawings: This part shall include approved shop or fabrication drawings, complete with dimensions.

7. Category 7 - Safety:

- a. Procedures: This part describes the safety precautions to be taken when operating and maintaining the equipment or working near it.

8. Category 8 - Documentation:

- a. All equipment warranties, affidavits, and certifications required by the Technical Specifications shall be placed in this part.
- C. The CONTRACTOR shall furnish to the ENGINEER 5 (five) identical Technical Manuals. Each set shall consist of one or more volumes, each of which shall be bound in a standard size, 3-ring, looseleaf, vinyl plastic hard cover binder suitable for bookshelf storage. Binder ring size shall not exceed 2.5 inches. A table of contents indicating all equipment in the manuals shall be prepared.
- D. Manuals shall be submitted in final form to the ENGINEER not later than the 75 percent of construction completion date. All discrepancies found by the ENGINEER shall be corrected within 30 days from the date of written notification by the ENGINEER.
- E. Incomplete or unacceptable manuals at the 75 percent construction completion point shall constitute sufficient justification to retain the amount in paragraph "Technical Manual Submittals" of Section 01700 - Project Closeout, from any monies due the CONTRACTOR.

1.7 SPARE PARTS LIST

- A. The CONTRACTOR shall furnish to the ENGINEER 5 identical sets of spare parts information for all mechanical, electrical, and instrumentation equipment. The spare parts list shall include the current list price of each spare part. The spare parts list shall include those spare parts which each manufacturer recommends be maintained by the OWNER in inventory at the plant site. Each manufacturer or supplier shall indicate the name, address, and telephone number of its nearest outlet of spare parts to assist the OWNER in ordering. The CONTRACTOR shall cross-reference all spare parts lists to the equipment numbers designated in the Contract Documents. The spare parts lists shall be bound in standard size, 3-ring, looseleaf, vinyl plastic hard cover binders suitable for bookshelf storage. Binder ring size shall not exceed 2.5 inches.

1.8 RECORD DRAWINGS

- A. The CONTRACTOR shall maintain one record set of Drawings at the Site. On these, it shall mark all project conditions, locations, configurations, and any other changes or deviations which may vary from the information represented on the original Contract Drawings, including buried or concealed construction and utility features which are revealed during the course of construction. Special attention shall be given to recording the horizontal and vertical location of all buried utilities that differ from the locations indicated, or which were not indicated on the Contract Drawings. Said record drawings shall be supplemented by any detailed sketches as necessary or directed to fully indicate the WORK as actually constructed. These master record drawings of the CONTRACTOR's representation of as-built conditions, including all revisions made necessary by addenda and change orders shall be maintained up-to-date during the progress of the WORK. Red ink shall be used for alterations and notes. Notes shall identify relevant Change Orders by number and date.

- B. Copies of the record drawings shall be submitted on the 20th working day of every third month after the month in which the Notice to Proceed is given as well as on completion of WORK. Failure to submit complete record drawings on or before the 20th working day will enact the liquidated damages clause for interim record drawings submittals described in Article 3 of the Agreement.
- C. In the case of those drawings which depict the detail requirement for equipment to be assembled and wired in the factory, such as motor control centers and the like, the record drawings shall be updated by indicating those portions which are superseded by change order drawings or final Shop Drawings, and by including appropriate reference information describing the change orders by number and the Shop Drawings by manufacturer, drawing, and revision numbers.
- D. Record drawings shall be accessible to the ENGINEER at all times during the construction period.
- E. Final payment will not be acted upon until the record drawings have been prepared and delivered to the ENGINEER. Said up-to-date record drawings shall be in the form of a set of prints with carefully plotted information overlaid.
- F. Upon Substantial Completion of the WORK and prior to final acceptance, the CONTRACTOR shall finalize and deliver a complete set of record drawings to the ENGINEER for transmittal to the OWNER, conforming to the construction records of the CONTRACTOR. This set of drawings shall consist of corrected Drawings showing the reported location of the WORK. The information submitted by the CONTRACTOR and incorporated by the ENGINEER into the record drawings will be assumed to be correct, and the CONTRACTOR shall be responsible for the accuracy of such information, and for any errors or omissions which may appear on the record drawings as a result.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

- END OF SECTION -

SECTION 01301 - SCHEDULE OF VALUES

PART 1 – GENERAL

1.1 GENERAL

- A. This Section defines the process whereby the Schedule of Values (lump sum price breakdown) shall be developed and incorporated into the cost loading function of the CPM Schedule as specified in Section 01311 - Scheduling and Reporting. Monthly progress payment amounts shall be determined from the monthly progress updates of the CPM Schedule activities.
- B. The Schedule of Values shall be developed independent but simultaneous with the development of the CPM Schedule activities and logic.

1.2 FORM AND CONTENT OF SCHEDULE OF VALUES

- A. the Contractor shall type Schedule of Values on 8 ½" X 11" or 8 ½" X 14" white paper. The Contractor's standard forms and automated printout shall be considered for approval by the engineer upon the Contractor's request. The contractor shall identify the Schedule of Values with:
 - 1. Title of Project and Location.
 - 2. Engineer and Owner's Project numbers.
 - 3. Date of submission.
- B. The Schedule of Values shall list the installed value of the components of the Work in sufficient detail to serve as a basis for computing values for partial payments during construction.
- C. The Contractor shall identify each line with the numbers and title of the respective major section of the Specifications.
- D. For each major line item, the Contractor shall list sub-values of major products or operations under the item.
- E. For the various portions of the Work:
 - 1. Each item shall include a directly proportional amount of the Contractor's overhead profit.
 - 2. For items on which partial payments will be requested for stored materials, the Schedule of Values shall conform to the requirements of the General Conditions of these Contract documents.
- F. The sum of each item of the lump sum breakdown shall equal the lump sum in the Proposal. All lump sum values listed in the Schedule of Values plus the sum of the unit price items shall equal the total Contract Price.

1.3 PRELIMINARY SCHEDULE OF VALUES

- A. The CONTRACTOR shall submit a preliminary Schedule of Values for the major components of the WORK at the Preconstruction Conference in accordance with Section 01010 - Summary or Work.
- B. The CONTRACTOR and ENGINEER shall meet and jointly review the preliminary Schedule of Values and make any adjustments in value allocations if, in the opinion of the ENGINEER, these are necessary to establish fair and reasonable allocation of values for the major WORK components. Front end loading will not be permitted. The ENGINEER may require reallocation of major WORK components from items in the above listing if in the opinion of the ENGINEER such reallocation is necessary. This review and any necessary revisions shall be completed within 15 days from the date of Notice to Proceed.

1.4 DETAILED SCHEDULE OF VALUES

- A. The CONTRACTOR shall prepare and submit a detailed Schedule of Values to the ENGINEER within 30 days from the date of Notice to Proceed. The detailed Schedule of Values shall be based on the accepted preliminary Schedule of Values for major WORK components. Because the ultimate requirement is to develop a detailed Schedule of Values sufficient to determine appropriate monthly progress payment amounts through cost loading of the CPM Schedule activities, sufficient detailed breakdown shall be provided to meet this requirement. The ENGINEER shall be the sole judge of acceptable numbers, details and description of values established. If, in the opinion of the ENGINEER, a greater number of Schedule of Values items than proposed by the CONTRACTOR is necessary, the CONTRACTOR shall add the additional items so identified by the ENGINEER.
 1. The CONTRACTOR and ENGINEER shall meet and jointly review the detailed Schedule of Values within 35 days from the date of Notice to Proceed. The value allocations and extent of detail shall be reviewed to determine any necessary adjustments to the values and to determine if sufficient detail has been proposed to allow acceptable cost loading of the CPM Schedule activities. Any adjustments deemed necessary to the value allocation or level of detail shall be made by the CONTRACTOR and a revised detailed Schedule of Values shall be submitted within 40 days from the date of Notice to Proceed.
 2. Following acceptance of the detailed Schedule of Values, the CONTRACTOR shall incorporate the values into the cost loading portion of the CPM Schedule. The CPM activities and logic shall have been developed concurrent with development of the detailed Schedule of Values; however, it shall be necessary to adjust the detailed Schedule of Values to correlate to individual Schedule activities. It is anticipated that instances will occur, due to the independent but simultaneous development of the Schedule of Values and the CPM Schedule activities, where interfacing these two documents will require changes to each document. Schedule activities may need to be added to accommodate the detail of the Schedule of Values. Schedule of Value items may need to be added to accommodate the detail of the CPM Schedule activities. Where such instances arise, the CONTRACTOR shall propose changes to the Schedule of Values and to the CPM Schedule activities to satisfy the CPM Schedule cost loading requirements.

SECTION 01311 - CPM CONSTRUCTION SCHEDULE

PART 1 – GENERAL

1.1 GENERAL

- A. Scheduling of the WORK shall be performed by the CONTRACTOR in accordance with the requirements of this Section.
- B. Development of the schedule, the cost loading of the schedule, monthly payment requisitions and project status reporting requirements of the Contract shall employ computerized Critical Path Method (CPM) scheduling. The CPM Schedule shall be cost loaded based on the schedule of values as approved by the ENGINEER in accordance with the requirements of Section 01301 - Schedule of Values. Where submittals are required hereunder, the CONTRACTOR shall submit four copies of each submittal item.

1.2 INITIAL SCHEDULE SUBMITTALS

- A. The CONTRACTOR shall submit two short term schedule documents at the Preconstruction Conference which shall serve as the CONTRACTOR'S Plan of Operation for the initial 60 day period of the Contract Time and to identify the manner in which the CONTRACTOR intends to complete all WORK within the Contract Time.
 - 1. 60 Day Plan of Operation: During the initial 60 days of the Contract Time, the CONTRACTOR shall conduct operations in accordance with a 60 day bar chart type of plan of operation. The bar chart so prepared shall show the accomplishment of the CONTRACTOR'S early activities (mobilization, permits, submittals necessary for early material and equipment procurement, submittals necessary for long lead equipment procurement, CPM submittals, initial Site work and other submittals and activities required in the first 60 days).
 - 2. Project Overview Bar Chart: The overview bar chart shall indicate the major components of the WORK and the sequence relations between major components and subdivisions of major components. The overview bar chart shall indicate the relationships and time frames in which the various components of the WORK will be made substantially complete and placed into service in order to meet the project milestones. Sufficient detail shall be included for the identification of subdivisions of major components into such activities as (1) excavation, (2) foundation subgrade preparation, (3) foundation concrete, (4) completion of all structural concrete, (5) major mechanical work, (6) major electrical work, (7) instrumentation and control work, and (8) other important work for each major facility within the overall project scope. Planned durations and start dates shall be indicated for each work item subdivision. Each major component and subdivision component shall be accurately plotted on time scale sheets not to exceed 36-inch by 60-inch in size. Not more than four sheets shall be employed to represent this overview information.
- B. The ENGINEER and the CONTRACTOR shall meet to review and discuss the 60-day plan of operation and project overview bar chart within 5 days after submittal to the ENGINEER. The ENGINEER'S review and comment on the schedules will be limited to conformance with the sequencing and milestone requirements in the Contract Documents. The CONTRACTOR shall make corrections to the schedules necessary to comply with the requirements and shall adjust the schedules to incorporate any missing information

requested by the ENGINEER.

1.3 CPM SCHEDULE SUBMITTALS

- A. **Original CPM Schedule Submittal:** With 45 days after the commencement date stated in the Notice to Proceed, the CONTRACTOR shall submit for review by the ENGINEER a hard copy of the CPM Schedule and the Computerized Schedule Report tabulations. The CONTRACTOR shall also submit a 3-1/2-inch high density floppy disk or disks that contain all of the schedule submittal information. The disk shall contain data compatible with Microsoft Project to generate network diagrams and schedule reports identical to the hard copies submitted. This submittal shall have already been reviewed and approved by the CONTRACTOR'S Project Manager, Project Superintendent, and the Project Estimator prior to submission. The CPM Schedule shall be a time-scaled network diagram of the "i-j" activity-on-arrow or precedence type. The Network Diagram shall describe the activities to be accomplished and their logical relationships and show the critical path. The CONTRACTOR'S attention is directed to the requirement that the schedule shall contain sufficient detail and information to cost load the CPM schedule in accordance with the approved schedule of values under Section 01301. Each installation and Site work activity shall be cost loaded as indicated.
- B. All float in the schedule shall belong to the project. The Computerized Schedule Report tabulations shall include the following:
1. Report of activities sorted by activity number. Activity numbers, where practical, shall correlate to the area numbers designated in the Contract Drawings and further defined in Section 01010 - Summary of Work.
 2. Report of activities sorted by early start date.
 3. Report of activities sorted by total float.
 4. Report of activities sorted by responsibility code. Responsibility codes shall be established for the CONTRACTOR, ENGINEER, OWNER, subcontractors, suppliers, etc. These codes shall be identified in the Network Diagram.
 5. A successor-predecessor report which shall identify the successor and predecessor activities for each activity and ties between schedule activities.
- C. **Original CPM Schedule Review Meeting:** The CONTRACTOR shall, within 55 days from the commencement date stated in the Notice to Proceed, meet with the ENGINEER to review the original CPM schedule submittal. The CONTRACTOR shall have the Project Manager, Project Superintendent, and the Project Scheduler in attendance. The meeting will take place over a one day period. The ENGINEER'S review will be limited to the conformance to the Contract Documents. However, the review may also include:
1. Clarifications of the design intent, process, and startup requirements.
 2. Directions to include activities and information missing from the submittal.
 3. Requests to the CONTRACTOR to clarify the schedule.
- D. **Revisions to the Original CPM Schedule:** Within 65 days after the commencement date stated in the Notice to Proceed, the CONTRACTOR shall have revised the original

1.5 CROSS REFERENCE LISTING

- A. To assist in the correlation of the Schedule of Values and the CPM Schedule, the CONTRACTOR shall provide a Cross Reference Listing which shall be furnished in two parts. The first part shall list each Scheduled Activity with the breakdown of the respective valued items making up the total cost of the activity. The second part shall list the valued item with the respective Scheduled Activity or Activities that make up the total cost indicated. In the case where a number of schedule items make up the total cost for a valued item (shown in the Schedule of Values) the total cost for each scheduled item should be indicated.
- B. These listings shall be updated and submitted in conjunction with the CPM monthly submittals as stated in Specification Section 01311.
- C. Approved change orders reflected in the CPM Schedule shall be incorporated into the Schedule of Values as a single unit identified by the change order number.

1.6 CHANGES TO SCHEDULE OF VALUES

- A. Changes to the CPM Schedule which add activities not included in the original schedule but included in the original WORK (schedule omissions) shall have values assigned as approved by the ENGINEER. Other activity values shall be reduced to provide equal value adjustment increases for added activities as approved by the ENGINEER.
- B. In the event that the CONTRACTOR and ENGINEER agree to make adjustments to the original Schedule of Values because of inequities discovered in the original accepted detailed Schedule of Values, increases and equal decreases to values for activities may be made.

1.7 LIQUIDATED DAMAGES

- A. The Schedule of Values information is an integral part of the scheduling and reporting under Section 01311 and the progress payment information. As such, it is critical information to evaluating the project's progress and the proper planning of the OWNER's and ENGINEER's work effort as well as their financial obligations associated with this project. Accordingly, if any submittal required by this Section is found to be incomplete or is submitted later than required, the OWNER will suffer financial loss and, accordingly, liquidated damages will be assessed against the CONTRACTOR in accordance with Article 3 of the Agreement.

- END OF SECTION -

CPM schedule submittal to address all review comments from the original CPM schedule review meeting and resubmit the network diagrams and reports for the ENGINEER'S review. The ENGINEER, within 14 days from the date that the CONTRACTOR submitted the revised schedule will either (1) accept the schedule and cost loaded activities as submitted, or (2) advise the CONTRACTOR in writing to review any part or parts of the schedule which either do not meet the Contract requirements or are unsatisfactory for the ENGINEER to monitor the project's progress and status or evaluate monthly payment requests by the CONTRACTOR. The ENGINEER may accept the schedule with conditions that the first monthly CPM schedule update be revised to correct deficiencies identified. When the schedule is accepted, it shall be considered as the "Original CPM Construction Schedule" until an updated schedule has been submitted. The OWNER reserves the right to require that the CONTRACTOR adjust, add to, or clarify any portion of the schedule which may later be discovered to be insufficient for the monitoring of the WORK or approval of partial payment requests. No additional compensation will be provided for such adjustments, additions, or clarifications.

E. Acceptance

1. Acceptance of the CONTRACTOR'S schedule by the ENGINEER and OWNER will be based solely upon compliance with the requirements. By way of the CONTRACTOR assigning activity durations and proposing the sequence of the WORK, the CONTRACTOR agrees to utilize sufficient and necessary management and other resources to perform the work in accordance with the schedule. Upon submittal of a schedule update, the updated schedule shall be considered the "current" project schedule.
2. Submission of the CONTRACTOR'S progress schedule to the OWNER or ENGINEER shall not relieve the CONTRACTOR of total responsibility for scheduling, sequencing, and pursuing the WORK to comply with the requirements of the Contract Documents, including adverse effects such as delays resulting from ill-timed WORK.

F. Monthly Updates and Periodic CPM Schedule Submittals

1. Following the acceptance of the CONTRACTOR'S original CPM Schedule, the CONTRACTOR shall monitor the progress of the WORK and adjust the schedule each month to reflect actual progress and any changes in planned future activities. Each schedule update submitted shall be complete including all information requested in the original schedule submittal and be in the schedule report format indicated below. Each update shall continue to show all work activities including those already completed. Completed activities shall accurately reflect "as built" information by indicating when the work was actually started and completed.
2. Neither the submission nor the updating of the CONTRACTOR'S original schedule submittal nor the submission, updating, change, or revision of any other report, curve, schedule, or narrative submitted to the ENGINEER by the CONTRACTOR under this Contract, nor the ENGINEER'S review or acceptance of any such report, curve, schedule, or narrative shall have the effect of amending or modifying, in any way, the Contract Times or milestone dates or of modifying or limiting, in any way, the CONTRACTOR'S obligations under this Contract. Only a signed, fully executed Change Order can modify contractual obligations.
3. The monthly schedule update submittal will be reviewed with the CONTRACTOR

during a monthly construction progress meeting held on the 20th work day of each month. The goal of these meetings is to enable the CONTRACTOR and the ENGINEER to initiate appropriate remedial action to minimize any known or foreseen delay in completion of the WORK and to determine the amount of WORK completed since the last month's schedule update. The status of the WORK will be determined by the percent complete of each activity in the updated CPM Schedule. These meetings are considered a critical component of the overall monthly schedule update submittal, and the CONTRACTOR shall have appropriate personnel attend. As a minimum, these meetings shall be attended by the CONTRACTOR'S Project Manager and General Superintendent. The CONTRACTOR shall plan on the meeting taking no less than 6 hours. Within 7 working days after the monthly progress meeting, the CONTRACTOR shall submit the revised CPM Schedule, the revised CPM computerized tabulations as noted in this Section, the revised successor/predecessor report, the Project Status Reports as defined below and the CONTRACTOR'S Application for Payment. Within 5 working days of receipt of the revised submittals, the ENGINEER will either accept or reject the monthly schedule update submittal. If accepted, the percent complete in the monthly update shall be the basis for the Application for Payment to be submitted by the CONTRACTOR. If rejected, the update shall be corrected and resubmitted by the CONTRACTOR before the Application for Payment for the update period will be processed.

- G. **Schedule Revisions:** The CONTRACTOR shall highlight or otherwise identify all changes to the schedule logic or activity durations made from the previous schedule. The CONTRACTOR shall modify any portions of the CPM schedule which become infeasible because of activities behind schedule or for any other valid reason.

1.4 CHANGE ORDERS

- A. Upon approval of a Change Order, or upon receipt by the CONTRACTOR of authorization to proceed with additional work, the change shall be reflected in the next submittal of the CPM Schedule. The CONTRACTOR shall utilize a sub-network in the schedule depicting the changed work and its effect on other activities. This sub-network shall be tied to the main network with appropriate logic so that a true analysis of the critical path can be made.

1.5 CPM STANDARDS

- A. **Definitions:** CPM, as required by this Section, shall be interpreted to be generally as outlined in the Association of General Contractors (AGC) publication, "The Use of CPM in Construction." except that either "i-j" arrow diagrams or precedence diagramming format may be utilized. In the case of conflicts between this specification and the AGC document, this specification shall govern.
- B. **Construction Schedules:** Construction schedules shall include a graphic network diagram and computerized construction schedule reports as required below for status reporting.
- C. **Networks:** The CPM network shall be in a form of a time scaled "i-j" activity-on-arrow or precedence type diagram and may be divided into a number of separate sheets with suitable match lines relating the interface points among the sheets. Individual sheets shall not exceed 36 inches by 60 inches.
- D. Construction and procurement activities shall be presented in a time-scaled format with a

calendar time line along the entire sheet length. Each activity arrow or node shall be plotted so that the beginning and completion dates of each activity are accurately represented along the calendar time line. All activities shall use symbols that clearly distinguish between critical path activities, non-critical activities, and free float for each non-critical activity. All activity items shall be identified by their respective activity number, responsibility code, work duration, and their dollar value. All non-critical path activities shall show total float time in scale form by utilizing a dotted line or some other graphical means.

E. **Duration Estimates:** The duration estimate for each activity shall be computed in working days and shall represent the single best estimate considering the scope of the work and resources planned for the activity. Except for certain non-labor activities, such as curing of concrete or delivery of materials, activity duration shall not exceed 10 working days nor be less than one working day unless otherwise accepted by the ENGINEER.

F. **Float Time**

1. **Definition:** Unless otherwise provided herein, float is synonymous with total float. Total float is the period of time measured by the number of working days each non-critical path activity may be delayed before it and its succeeding activities become part of the critical path. If a non-critical path activity is delayed beyond its float period, then that activity becomes part of the critical path and controls the end date of the work. Thus, delay of a non-critical path activity beyond its float period will cause delay to the project itself.
2. **Float Ownership:** Neither the OWNER nor the CONTRACTOR owns the float time. The project owns the float time. As such, liability for delay of the project completion date rests with the party actually causing delay to the project completion date. For example, if Party A uses some, but not all of the float time and Party B later uses the remainder of the float time as well as additional time beyond the float time, Party B shall be liable for the costs associated with the time that represents a delay to the project's completion date. Party A would not be responsible for any costs since it did not consume all of the float time and additional float time remained, therefore, the project's completion date was unaffected.

1.6 **SCHEDULE REPORT FORMAT**

A. **Schedule Reports:** Schedule Reports shall be prepared based on the CPM Schedule, and shall include the following minimum data for each activity:

1. Activity numbers and responsibility codes.
2. Work Order No.
3. CIP No.
4. Estimated activity duration.
5. Activity description.
6. Activity's percent completion.
7. Early start date (calendar dated).

8. Early finish date (calendar dated).
 9. Late start date (calendar dated).
 10. Late finish date (calendar dated).
 11. Status (whether critical).
 12. Total float for each activity.
 13. Free float for each activity.
 14. Cost value for each activity.
- B. **Project Information:** Each Schedule Report shall be prefaced with the following summary data:
1. Project name.
 2. Contractor.
 3. Type of tabulation.
 4. Project duration.
 5. Contract Times (revised to reflect time extensions by Change Order).
 6. The commencement date stated in the Notice to Proceed.
 7. The data date and plot date of the CPM Schedule.
 8. If an update, cite the new schedule completion date.

1.7 PROJECT STATUS REPORTING

- A. The CONTRACTOR shall furnish monthly project status reports (Overview Bar Chart and a written narrative report) in conjunction with the revised CPM Schedules as indicated above. Status reporting shall be in the form below.
- B. The CONTRACTOR shall prepare and submit monthly an Overview Bar Chart schedule of the major project components. The overview bar chart schedule shall be a summary of the current CPM Schedule (original and as updated and adjusted throughout the entire construction period). It shall be limited to not more than four sheets which shall not exceed 36 inches by 60 inches. The major project components shall be represented as time bars which shall be subdivided into various types of work including demolition, excavation and earthwork, yard piping, concrete construction, mechanical, electrical and instrumentation installations. Major components shall include each new structure by area designation, sitework, modifications to existing structures, tie-ins to existing facilities, and plant startups.
- C. Each major component and subdivision shall be accurately plotted consistent with the project overview bar chart above. It shall represent the same status indicated by early

start and finish activity information contained in the latest update of the CPM Schedule. In addition, a percent completion shall be indicated for each major component and subdivision. The initial submittal of the overview bar chart schedule shall be made at the time that the revised original CPM Schedule is submitted to the ENGINEER (65 days from the commencement date stated in the Notice to Proceed). The CONTRACTOR shall amend the overview schedule to include any additional detail required by the ENGINEER. The CONTRACTOR shall include any additional information requested by the ENGINEER at any time during the construction of the WORK.

- D. The CONTRACTOR shall prepare monthly written narrative reports of the status of the project for submission to the ENGINEER. Written status reports shall include:
1. The status of major project components (percent complete, amount of time ahead or behind schedule) and an explanation of how the project will be brought back on schedule if delays have occurred.
 2. The progress made on critical activities indicated on the CPM Schedule.
 3. Explanations for any lack of work on critical path activities planned to be performed during the last month.
 4. Explanations for any schedule changes, including changes to the logic or to activity durations.
 5. A list of the critical activities scheduled to be performed in the next two month period.
 6. The status of major material and equipment procurement.
 7. The value of materials and equipment properly stored at the Site but not yet incorporated into the WORK.
 8. Any delays encountered during the reporting period.
 9. An assessment of inclement weather delays and impacts to the progress of the WORK.
- E. The CONTRACTOR may include any other information pertinent to the status of the project. The CONTRACTOR shall include additional status information requested by the ENGINEER.

1.8 INCLEMENT WEATHER PROVISIONS OF THE SCHEDULE

- A. The CONTRACTOR'S construction schedule shall include at least the number of days of delay due to unusually severe weather as listed in the Supplementary General Conditions.

1.9 LIQUIDATED DAMAGES

- A. If any submittal required by this Section is determined by the ENGINEER to be incomplete or is submitted later than required, the OWNER will suffer financial loss, and accordingly, liquidated damages will be assessed against the CONTRACTOR in accordance with Article 3 of the Agreement.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

- END OF SECTION -

SECTION 01400 - QUALITY CONTROL

PART 1 – GENERAL

1.1 DEFINITION

- A. Specific quality control requirements for the WORK are indicated throughout the Contract Documents. The requirements of this Section are primarily related to performance of the WORK beyond furnishing of manufactured products. The term "Quality Control" includes inspection, sampling and testing, and associated requirements.

1.2 INSPECTION AT PLACE OF MANUFACTURE

- A. Unless otherwise indicated, all products, materials, and equipment shall be subject to inspection by the ENGINEER at the place of manufacture.
- B. The presence of the ENGINEER at the place of manufacturer, however, shall not relieve the CONTRACTOR of the responsibility for providing products, materials, and equipment which comply with all requirements of the Contract Documents. Compliance is a duty of the CONTRACTOR, and said duty shall not be avoided by any act or omission on the part of the ENGINEER.

1.3 SAMPLING AND TESTING

- A. Unless otherwise indicated, all sampling and testing will be in accordance with the methods prescribed in the current standards of the ASTM, as applicable to the class and nature of the article or materials considered; however, the OWNER reserves the right to use any generally-accepted system of sampling and testing which, in the opinion of the ENGINEER will assure the OWNER that the quality of the workmanship is in full accord with the Contract Documents.
- B. Any waiver by the OWNER of any specific testing or other quality assurance measures, whether or not such waiver is accompanied by a guarantee of substantial performance as a relief from the testing or other quality assurance requirements originally indicated, and whether or not such guarantee is accompanied by a performance bond to assure execution of any necessary corrective or remedial WORK, shall not be construed as a waiver of any requirements of the Contract Documents.
- C. Notwithstanding the existence of such waiver, the ENGINEER reserves the right to make independent investigations and tests, and failure of any portion of the WORK to meet any of the requirements of the Contract Documents, shall be reasonable cause for the ENGINEER to require the removal or correction and reconstruction of any such WORK in accordance with the General Conditions.

1.4 INSPECTION AND TESTING SERVICE

- A. Inspection and testing laboratory service shall comply with the following:
 - 1. Unless indicated otherwise by the Technical Specifications, the OWNER will appoint, employ, and pay for services of an independent firm to perform inspection and testing or will perform inspection and testing itself.

2. The OWNER or independent firm will perform inspections, testings, and other services as required by the ENGINEER under Paragraph 1.3C above.
3. Reports of testing, regardless of whether the testing was the OWNERS or the CONTRACTORS responsibility, will be submitted to the ENGINEER in duplicate, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.
4. The CONTRACTOR shall cooperate with the OWNER or independent firm and furnish samples of materials, design mix, equipment, tools, storage, and assistance as requested.
5. The CONTRACTOR shall notify ENGINEER 24 hours prior to the expected time for operations requiring inspection and laboratory testing services.
6. Retesting required because of non-conformance to requirements shall be performed by the same independent firm on instructions by the ENGINEER. The CONTRACTOR shall bear all costs from such retesting.
7. For samples and tests required for CONTRACTOR'S use, the CONTRACTOR shall make arrangements with an independent firm for payment and scheduling of testing. The cost of sampling and testing for the CONTRACTOR'S use shall be the CONTRACTORS responsibility.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. **Inspection:** The CONTRACTOR shall inspect materials or equipment upon the arrival on the job site and immediately prior to installation, and reject damaged and defective items.
- B. **Measurements:** The CONTRACTOR shall verify measurements and dimensions of the WORK, as an integral step of starting each installation.
- C. **Manufacturer's Instructions:** Where installations include manufactured products, the CONTRACTOR shall comply with manufacturer's applicable instructions and recommendations for installation, to whatever extent these are more explicit or more stringent than applicable requirements indicated in Contract Documents.

- END OF SECTION -

SECTION 01505 - MOBILIZATION

PART 1 – GENERAL

1.1 GENERAL

A. Mobilization shall include the obtaining of all permits; moving onto the site of all plant and equipment; furnishing and erecting plants, temporary buildings, and other construction facilities; and implementing security requirements; all as required for the proper performance and completion of the WORK. Mobilization shall include the following principal items:

1. Moving on to the site of all CONTRACTOR's plant and equipment required for first month operations.
2. Installing temporary construction power, wiring, and lighting facilities.
3. Establishing fire protection system.
4. Developing construction water supply.
5. Providing field office trailer for the CONTRACTOR and the ENGINEER, complete with all specified furnishings and utility services including telephones, telephone appurtenances, and copying machine.
6. Providing all on-site communication facilities, including telephones, and radio pagers.
7. Providing on-site sanitary facilities and potable water facilities.
8. Arranging for and erection of CONTRACTOR's work and storage yard.
9. Obtaining all required permits.
10. Having all OSHA required notices and establishment of safety programs.
11. Having the CONTRACTOR's superintendent at the job site full time.
12. Submitting initial submittals.

1.2 PAYMENT FOR MOBILIZATION

A. The CONTRACTOR's attention is directed to the condition that 60% of Bid Item No.1 will be paid upon complete mobilization to the site and the remaining 40% upon demobilization from the site. No drilling will be allowed to commence until the mobilization is complete.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

- END OF SECTION -

SECTION 01510 - TEMPORARY UTILITIES

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

- A. **Types:** The types of utility services required for general temporary use at the Site include the following:

- Water service (potable for certain uses)
- Storm sewer
- Sanitary sewer
- Electric power service
- Telephone service

1.2 JOB CONDITIONS

- A. **Scheduled Uses:** The CONTRACTOR shall, in conjunction with establishment of job progress schedule, establish a schedule for implementation and termination of service for each temporary utility at the earliest feasible time, and when acceptable to OWNER and ENGINEER, change over from use of temporary utility service to permanent service.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. The CONTRACTOR shall provide either new or used materials and equipment, which are in substantially undamaged condition and without significant deterioration and which are recognized in the construction industry, by compliance with appropriate standards, as being suitable for intended use in each case. Where a portion of temporary utility is provided by utility company, the CONTRACTOR shall provide the remaining portion with matching and compatible materials and equipment and shall comply with recommendations of utility company.

PART 3 – EXECUTION

3.1 INSTALLATION OF TEMPORARY UTILITY SERVICES

- A. **General:** Wherever feasible, the CONTRACTOR shall engage the utility company to install temporary service to project, or as a minimum, to make connection to existing utility service; locate services where they will not interfere with total project construction WORK, including installation of permanent utility services; and maintain temporary services as installed for required period of use; and relocate, modify or extend as necessary from time to time during that period as required to accommodate total project construction WORK.
- B. **Approval of Electrical Connections:** Temporary connections for electricity shall be subject to approval of the ENGINEER and the power company representative, and shall be removed in like manner at the CONTRACTOR's expense prior to final acceptance of the WORK.

- C. **Separation of Circuits:** Unless otherwise permitted by the ENGINEER, circuits used for power purposes shall be separate from lighting circuits.
- D. **Construction Wiring:** Wiring for temporary electric light and power shall be properly installed and maintained and shall be securely fastened in place. Electrical facilities shall conform to the requirements of Subpart K of the OSHA Safety and Health Standards for Construction.

3.2 INSTALLATION OF POWER DISTRIBUTION SYSTEM

- A. **Power:** The CONTRACTOR shall provide power required for its operations under the Contract, and shall provide and maintain all temporary power lines required to perform the WORK in a safe and satisfactory manner.
- B. **Temporary Power Distribution:** The CONTRACTOR shall provide a weatherproof, grounded, temporary power distribution system sufficient for performance of entire WORK of project, including temporary electrical heating where indicated, operation of test equipment and test operation of building equipment and systems which cannot be delayed until permanent power connections are operable, temporary operation of other temporary facilities, including permanent equipment and systems which must be placed in operation prior to use of permanent power connections (pumps, HVAC equipment, elevators, and similar equipment), and power for temporary operation of existing facilities (if any) at the Site during change-over to new permanent power system. Provide circuits of adequate size and proper power characteristics for each use; run circuit wiring generally overhead, and rise vertically in locations where it will be least exposed to possible damage from construction operations and will result in minimal interference with performance of the WORK; provide rigid steel conduit or equivalent raceways for wiring which must be exposed on grade, floors, decks, or other exposures to damage or abuse.

3.3 INSTALLATION OF LIGHTING

- A. **Construction Lighting:** WORK conducted at night or under conditions of deficient daylight shall be suitably lighted to insure proper WORK and to afford adequate facilities for inspection and safe working conditions.
- B. **Temporary Lighting:** The CONTRACTOR shall provide a general, weatherproof, grounded temporary lighting system in every area of construction work, as soon as overhead floor/roof deck structure has been installed to provide sufficient illumination for safe work and traffic conditions. Run circuit wiring generally overhead, and rise vertically in locations where it will be least exposed to possible damage from construction operations on grade, floors, decks, or other areas of possible damage or abuse.

3.4 WATER SUPPLY

- A. **General:** The CONTRACTOR shall provide an adequate supply of water of a quality suitable for all domestic and construction purposes.
- B. **Water Connections:** The CONTRACTOR shall not make connection to or draw water from any fire hydrant or pipeline without first obtaining permission of the authority having jurisdiction over the use of said fire hydrant or pipeline and from the agency owning the affected water system. For each such connection made, the CONTRACTOR shall first attach to the fire hydrant or pipeline a valve, backflow preventer, and a meter, if required by the said authority, of a size and type acceptable to said authority and agency. The

CONTRACTOR shall pay all permit and water charges.

3.5 INSTALLATION OF SANITARY FACILITIES

- A. **Toilet Facilities:** Fixed or portable chemical toilets shall be provided wherever needed for the use of CONTRACTOR's employees. Toilets at construction job sites shall conform to the requirements of Subpart D, Section 1926.51 of the OSHA Standards for Construction. Provide separate field office facilities in conformance with Section 01590.
- B. **Sanitary and Other Organic Wastes:** The CONTRACTOR shall establish a regular daily collection of all sanitary and organic wastes. All wastes and refuse from sanitary facilities provided by the CONTRACTOR or organic material wastes from any other source related to the CONTRACTOR's operations shall be disposed of away from the Site in a manner satisfactory to the ENGINEER and in accordance with all laws and regulations pertaining thereto.
- C. **Sewer Connection:** The CONTRACTOR shall coordinate with the Utilities Department for obtaining sewer connection and shall pay all permit and sewer usage charges. The sewer capacity charges will be paid by the OWNER.

3.6 INSTALLATION OF FIRE PROTECTION

- A. **Fire Protection:** The construction plant and all other parts of the WORK shall be connected with the CONTRACTOR's temporary water supply system and shall be adequately protected against damage by fire. Hose connections and hose, water casks, chemical equipment, or other sufficient means shall be provided for fighting fires in the temporary structures and other portions of the WORK, and responsible persons shall be designated and instructed in the operation of such fire apparatus so as to prevent or minimize the hazard of fire. The CONTRACTOR's fire protection program shall conform to the requirements of Subpart F of the OSHA Standards for Construction.

3.7 INSTALLATION OF COMMUNICATIONS

- A. **Telephone Services:** The CONTRACTOR shall provide and maintain at all times during the progress of the WORK not less than one telephone in good working order at its own field construction office at or near the Site. Each such telephone shall be connected to an established exchange for toll service and with all other telephones utilized by the CONTRACTOR.
- B. **OWNER's Telephone:** The CONTRACTOR shall also provide in each office required under Section 01590, a separate telephone for each desk and facsimile machine on a separate trunk line similarly connected to an established exchange.
- C. **Telephone Use:** The CONTRACTOR shall permit the ENGINEER, the OWNER, or their authorized representatives or employees free and unlimited use of said telephone facilities for all calls that do not involve published toll charges. Calls originated by the ENGINEER, the OWNER, their authorized representatives or employees which involve toll or message unit charges shall be billed to the OWNER by the CONTRACTOR at the rates charged by the telephone company.

3.8 OPERATIONS AND TERMINATIONS

- A. **Inspections:** Prior to placing temporary utility services into use, the CONTRACTOR shall inspect and test each service and arrange for governing authorities' required inspection and tests, and obtain required certifications and permits for use thereof.
- B. **Protection:** The CONTRACTOR shall maintain distinct markers for underground lines, and protect from damage during excavating operations.
- C. **Termination and Removal:** When need for a temporary utility service or a substantial portion thereof has ended, or when its service has been replaced by use of permanent services, or not later than time of substantial completion, the CONTRACTOR shall promptly remove installation unless requested by ENGINEER to retain it for a longer period. The CONTRACTOR shall complete and restore WORK which may have been delayed or affected by installation and use of temporary utility, including repairs to construction and grades and restoration and cleaning of exposed surfaces.
- D. **Removal of Water Connections:** Before final acceptance of the WORK on the project, all temporary connections and piping installed by the CONTRACTOR shall be entirely removed, and all affected improvements shall be restored to original condition or better, to the satisfaction of the ENGINEER and to the agency owning the affected utility.

- END OF SECTION -

SECTION 01530 - PROTECTION OF EXISTING FACILITIES

PART 1 – GENERAL

1.1 GENERAL

- A. The CONTRACTOR shall protect all existing utilities and improvements not designated for removal and shall restore damaged or temporarily relocated utilities and improvements to a condition equal to or better than prior to such damage or temporary relocation, all in accordance with the Contract Documents.

1.2 RIGHTS-OF-WAY

- A. The CONTRACTOR shall not do any WORK that would affect any oil, gas, sewer, or water pipeline; any telephone, telegraph, or electric transmission line; any fence; or any other structure, nor shall the CONTRACTOR enter upon the rights-of-way involved until notified that the OWNER has secured authority therefor from the proper party.
- B. After authority has been obtained, the CONTRACTOR shall give said party due notice of its intention to begin work, if required by said party, and shall remove, shore, support, or otherwise protect such pipeline, transmission line, ditch, fence, or structure, or replace the same.

1.3 PROTECTION OF STREET OR ROADWAY MARKERS

- A. The CONTRACTOR shall not destroy, remove, or otherwise disturb any existing survey markers or other existing street or roadway markers without proper authorization. No pavement breaking or excavation shall be started until all survey or other permanent marker points that will be disturbed by the construction operations have been properly referenced. Survey markers or points disturbed by the CONTRACTOR shall be accurately restored after street or roadway resurfacing has been completed.

1.4 RESTORATION OF PAVEMENT

- A. **General:** All paved areas including asphaltic concrete berms cut or damaged during construction shall be replaced with similar materials of equal thickness to match the existing adjacent undisturbed areas, except where specific resurfacing requirements have been called for in the Contract Documents or in the requirements of the agency issuing the permit. The pavement restoration requirement to match existing sections shall apply to all components of existing sections, including sub-base, base, and pavement. Temporary and permanent pavement shall conform to the requirements of the affected pavement owner. Pavements which are subject to partial removal shall be neatly saw cut in straight lines.
- B. **Temporary Resurfacing:** Wherever required by the public authorities having jurisdiction, the CONTRACTOR shall place temporary surfacing promptly after backfilling and shall maintain such surfacing for the period of time fixed by said authorities before proceeding with the final restoration of improvements.
- C. **Permanent Resurfacing:** In order to obtain a satisfactory junction with adjacent surfaces, the CONTRACTOR shall saw cut back and trim the edge so as to provide a clean, sound,

vertical joint before permanent replacement of an excavated or damaged portion of pavement. Damaged edges of pavement along excavations and elsewhere shall be trimmed back by saw cutting in straight lines. All pavement restoration and other facilities restoration shall be constructed to finish grades compatible with adjacent undisturbed pavement.

- D. **Restoration of Sidewalks or Private Driveways:** Wherever sidewalks or private roads have been removed for purposes of construction, the CONTRACTOR shall place suitable temporary sidewalks or roadways promptly after backfilling and shall maintain them in satisfactory condition for the period of time fixed by the authorities having jurisdiction over the affected portions. If no such period of time is so fixed, the CONTRACTOR shall maintain said temporary sidewalks or roadways until the final restoration thereof has been made.

1.5 EXISTING UTILITIES AND IMPROVEMENTS

- A. **General:** The CONTRACTOR shall protect underground Utilities and other improvements which may be impaired during construction operations, regardless of whether or not the Utilities are indicated on the Drawings. The CONTRACTOR shall take all possible precautions for the protection of unforeseen Utility lines to provide for uninterrupted service and to provide such special protection as may be necessary.
- B. Except where the Drawings indicate Utilities have been field located during design or certain Utility locations shall be exposed as part of the WORK, the CONTRACTOR shall be responsible for exploratory excavations as it deems necessary to determine the exact locations and depths of Utilities which may interfere with its work. All such exploratory excavations shall be performed as soon as practicable after Notice to Proceed and, in any event, a sufficient time in advance of construction to avoid possible delays to the CONTRACTOR's progress. When such exploratory excavations show the Utility location as shown on the Drawings to be in error, the CONTRACTOR shall so notify the ENGINEER.
- C. The number of exploratory excavations required shall be that number which is sufficient to determine the alignment and grade of the Utility.
- D. **Utilities to be Moved:** In case it shall be necessary to move the property of any public utility or franchise holder, such utility company or franchise holder will, upon request of the CONTRACTOR, be notified by the OWNER to move such property within a specified reasonable time. When utility lines that are to be removed are encountered within the area of operations, the CONTRACTOR shall notify the ENGINEER a sufficient time in advance for the necessary measures to be taken to prevent interruption of service.
- E. **Utilities to be Removed:** Where the proper completion of the WORK requires the temporary or permanent removal and/or relocation of an existing Utility or other improvement which is indicated, the CONTRACTOR shall remove and, without unnecessary delay, temporarily replace or relocate such Utility or improvement in a manner satisfactory to the ENGINEER and the owner of the facility. In all cases of such temporary removal or relocation, restoration to the former location shall be accomplished by the CONTRACTOR in a manner that will restore or replace the Utility or improvement as nearly as possible to its former locations and to as good or better condition than found prior to removal.

- F. **OWNER's Right of Access:** The right is reserved to the OWNER and to the owners of public utilities and franchises to enter at any time upon any public street, alley, right-of-way, or easement for the purpose of making changes in their property made necessary by the WORK of this Contract.
- G. **Underground Utilities Indicated:** Existing Utility lines that are indicated or the locations of which are made known to the CONTRACTOR prior to excavation and that are to be retained, and all Utility lines that are constructed during excavation operations shall be protected from damage during excavation and backfilling and, if damaged, shall be immediately repaired or replaced by the CONTRACTOR, unless otherwise repaired by the owner of the damaged Utility. If the owner of the damaged facility performs its own repairs, the CONTRACTOR shall reimburse said owner for the costs of repair.
- H. **Underground Utilities Not Indicated:** In the event that the CONTRACTOR damages existing Utility lines that are not indicated or the locations of which are not made known to the CONTRACTOR prior to excavation, a verbal report of such damage shall be made immediately to the ENGINEER and a written report thereof shall be made promptly thereafter. The ENGINEER will immediately notify the owner of the damaged Utility. If the ENGINEER is not immediately available, the CONTRACTOR shall notify the Utility owner of the damage. If directed by the ENGINEER, repairs shall be made by the CONTRACTOR under the provisions for changes and extra work contained in Articles 10, 11, and 12 of the General Conditions.
- I. Costs of locating and repairing damage not due to failure of the CONTRACTOR to exercise reasonable care, and removing or relocating such Utility facilities not indicated in the Contract Documents with reasonable accuracy, and for equipment on the project which was actually working on that portion of the WORK which was interrupted or idled by removal or relocation of such Utility facilities, and which was necessarily idled during such work will be paid for as extra work in accordance with the provisions of Articles 10, 11, and 12 of the General Conditions.
- J. **Approval of Repairs:** All repairs to a damaged Utility or improvement are subject to inspection and approval by an authorized representative of the Utility or improvement owner before being concealed by backfill or other work.
- K. **Maintaining in Service:** Unless indicated otherwise, oil and gasoline pipelines, power, and telephone or the communication cable ducts, gas and water mains, irrigation lines, sewer lines, storm drain lines, poles, and overhead power and communication wires and cables encountered along the line of the WORK shall remain continuously in service during all the operations under the Contract, unless other arrangements satisfactory to the ENGINEER are made with the owner of said pipelines, duct, main, irrigation line, sewer, storm drain, pole, or wire or cable. The CONTRACTOR shall be responsible for and shall repair all damage due to its operations, and the provisions of this Section shall not be abated even in the event such damage occurs after backfilling or is not discovered until after completion of the backfilling.
- 1.6 **TREES OR SHRUBS WITHIN STREET RIGHTS-OF-WAY AND PROJECT LIMITS**
- A. **General:** Except where trees or shrubs are indicated to be removed, the CONTRACTOR shall exercise all necessary precautions so as not to damage or destroy any trees or shrubs, including those lying within street rights-of-way and project limits, and shall not trim or remove any trees unless such trees have been approved for trimming or removal by the jurisdictional agency or OWNER. Existing trees and shrubs which are damaged during

construction shall be trimmed or replaced by the CONTRACTOR or a certified tree company under permit from the jurisdictional agency and/or the OWNER. Tree trimming and replacement shall be accomplished in accordance with the following paragraphs.

- B. **Trimming:** Symmetry of the tree shall be preserved; no stubs or splits or torn branches left; clean cuts shall be made close to the trunk or large branch. Spikes shall not be used for climbing live trees. Cuts over 1-1/2 inches in diameter shall be coated with a tree paint product that is waterproof, adhesive, and elastic, and free from kerosenes, coal tar, creosote, or other material injurious to the life of the tree.
- C. **Replacement:** The CONTRACTOR shall immediately notify the jurisdictional agency and/or the OWNER if any tree or shrub is damaged by the CONTRACTOR's operations. If, in the opinion of said agency or the OWNER, the damage is such that replacement is necessary, the CONTRACTOR shall replace the tree or shrub at its own expense. The tree or shrub shall be of a like size and variety as the one damaged, or, if of a smaller size, the CONTRACTOR shall pay to the owner of said tree a compensatory payment acceptable to the tree or shrub owner, subject to the approval of the jurisdictional agency or OWNER. The size of the tree or shrub shall be not less than 1-inch diameter nor less than 6 feet in height. Unless otherwise indicated, the CONTRACTOR shall water and maintain the replacement trees and shrubs for 6 months after planting.

1.7 LAWN AREAS

- A. Lawn or landscaped areas damaged during construction shall be repaired to match the pre-construction condition to the satisfaction of the land owner and the OWNER.

1.8 NOTIFICATION BY THE CONTRACTOR

- A. Prior to any excavation in the vicinity of any existing underground facilities, including all water, sewer, storm drain, gas, petroleum products, or other pipelines; all buried electric power, communications, or television cables; all traffic signal and street lighting facilities; and all roadway and state highway rights-of-way, the CONTRACTOR shall notify the respective authorities representing the owners or agencies responsible for such facilities not less than 3 days nor more than 7 days prior to excavation so that a representative of said owners or agencies can be present during such work if they so desire.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

- END OF SECTION -

SECTION 01550 - SITE ACCESS AND STORAGE

PART 1 – GENERAL

1.1 HIGHWAY LIMITATIONS

- A. The CONTRACTOR shall make its own investigation of the condition of available public and private roads and of clearances, restrictions, bridge load limits, and other limitations affecting transportation and ingress and egress to the site of the WORK. It shall be the CONTRACTOR's responsibility to construct and maintain any haul roads required for its construction operations.

1.2 TEMPORARY CROSSINGS

- A. **General:** Continuous, unobstructed, safe, and adequate pedestrian and vehicular access shall be provided to fire hydrants, commercial and industrial establishments, churches, schools, parking lots, service stations, motels, fire and police stations, and hospitals. Safe and adequate public transportation stops and pedestrian crossings at intervals not exceeding 300 feet shall be provided. The CONTRACTOR shall cooperate with parties involved in the delivery of mail and removal of trash and garbage so as to maintain existing schedules for such services. Vehicular access to residential driveways shall be maintained to the property line except when necessary construction precludes such access for reasonable periods of time.
- B. **Temporary Bridges:** Wherever necessary, the CONTRACTOR shall provide suitable temporary bridges or steel plates over unfilled excavations, except in such cases as the CONTRACTOR shall secure the written consent of the responsible individuals or authorities to omit such temporary bridges or steel plates, which written consent shall be delivered to the ENGINEER prior to excavation. All such bridges or steel plates shall be maintained in service until access is provided across the backfilled excavation. Temporary bridges or steel plates for street and highway crossing shall conform to the requirements of the authority having jurisdiction in each case, and the CONTRACTOR shall adopt designs furnished by said authority for such bridges or steel plates, or shall submit designs to said authority for approval, as may be required.
- C. **Street Use:** Nothing herein shall be construed to entitle the CONTRACTOR to the exclusive use of any public street, alleyway, or parking area during the performance of the WORK hereunder, and it shall so conduct its operations as not to interfere unnecessarily with the authorized work of utility companies or other agencies in such streets, alleyways, or parking areas. No street shall be closed to the public without first obtaining permission of the ENGINEER and proper governmental authority. Where excavation is being performed in primary streets or highways, one lane in each direction shall be kept open to traffic at all times unless otherwise indicated. Toe boards shall be provided to retain excavated material if required by the ENGINEER or the agency having jurisdiction over the street or highway. Fire hydrants on or adjacent to the WORK shall be kept accessible to fire-fighting equipment at all times. Temporary provisions shall be made by the CONTRACTOR to assure the use of sidewalks and the proper functioning of all gutters, storm drain inlets, and other drainage facilities.

1.3 CONTRACTOR'S WORK AND STORAGE AREA

- A. The OWNER will designate and arrange for the CONTRACTOR's use, a portion of the property at one or more of the plant sites for its exclusive use during the term of the Contract as a storage and shop area for its construction operations relative to this Contract. At completion of WORK, the CONTRACTOR shall return this area to its original condition, including grading and landscaping.
- B. The CONTRACTOR shall make its own arrangements for any necessary off-Site storage or shop areas necessary for the proper execution of the WORK.
- C. The CONTRACTOR shall construct and use a separate storage area for hazardous materials used in constructing the WORK.
 - 1. For the purpose of this paragraph, hazardous materials to be stored in the separate area are all products labeled with any of the following terms: Warning, Caution, Poisonous, Toxic, Flammable, Corrosive, Reactive, or Explosive. In addition, whether or not so labeled, the following materials shall be stored in the separate area: diesel fuel, gasoline, new and used motor oil, hydraulic fluid, cement, paints and paint thinners, two-part epoxy coatings, sealants, asphaltic products, glues, solvents, wood preservatives, sand blast materials, and spill absorbent.
 - 2. Hazardous materials shall be stored in groupings according to the Material Safety Data Sheets.
 - 3. The CONTRACTOR shall develop and submit to the ENGINEER a plan for storing and disposing of the materials above.
 - 4. The CONTRACTOR shall obtain and submit to the ENGINEER a single EPA number for wastes generated at the Site.
 - 5. All hazardous materials which are delivered in containers shall be stored in the original containers until use. Hazardous materials which are delivered in bulk shall be stored in containers which meet the requirements of authorities having jurisdiction.
- D. The CONTRACTOR shall construct and use a separate area for maintenance of vehicles and equipment used in constructing the WORK. This site may be located on property or easements designated by the OWNER for a CONTRACTORs work and storage area, or this site may be located on land obtained by the CONTRACTOR. The designated site should include a site for receiving concrete truck washdown water if concrete will be placed as part of the WORK. If a concrete truck washdown area is not provided, concrete truck drivers and workers shall be notified that concrete equipment must be washed in an approved manner at an offsite location. Enclosures or flow barriers shall be erected around these designated areas. The enclosures of flow barriers also will minimize stormwater flows from leaving the designated area. If water enters the maintenance areas and contacts pollutants associated with the construction vehicles and equipment, the CONTRACTOR shall notify the ENGINEER to determine if the surface water has become contaminated or may be allowed to be discharged to the storm drains or stream channels. If the surface water flows have become contaminated due to contact with pollutants associated with the construction vehicles and equipment, the CONTRACTOR, shall immediately notify the ENGINEER and contain and cleanup the spill to prevent spilled material from entering storm drains, stream channels, or groundwater or from being

absorbed by the underlying pavement or soil.

1.4 PARKING

- A. The CONTRACTOR shall direct its employees to park in areas as directed by the OWNER.
- B. Traffic and parking areas shall be maintained in a sound condition, free of excavated material, construction equipment, mud, and construction materials. The CONTRACTOR shall repair breaks, potholes, low areas which collect standing water, and other deficiencies.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

- END OF SECTION -

SECTION 01560 - TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 – GENERAL

1.1 EXPLOSIVES AND BLASTING

- A. The use of explosives on the WORK will not be permitted.

1.2 DUST ABATEMENT

- A. The CONTRACTOR shall prevent its operation from producing dust in amounts damaging to property, cultivated vegetation, or domestic animals, or causing a nuisance to persons living in or occupying buildings in the vicinity. The CONTRACTOR shall be responsible for any damage resulting from dust originating from its operations. The dust abatement measures shall be continued until the CONTRACTOR is relieved of further responsibility by the ENGINEER.

1.3 RUBBISH CONTROL

- A. During the progress of the WORK, the CONTRACTOR shall keep the Site and other areas used by it in a neat and clean condition, and free from any accumulation of rubbish. The CONTRACTOR shall dispose of all rubbish and waste materials of any nature occurring at the Site, and shall establish regular intervals of collection and disposal of such materials and waste. The CONTRACTOR shall also keep its haul roads free from dirt, rubbish, and unnecessary obstructions resulting from its operations. Disposal of all rubbish and surplus materials shall be off the Site in accordance with local codes and ordinances governing locations and methods of disposal, and in conformance with all applicable safety laws, and to the particular requirements of Part 1926 of the OSHA Safety and Health Standards for Construction.

1.4 SANITATION

- A. **Toilet Facilities:** Fixed or portable chemical toilets shall be provided wherever needed for the use of employees. Toilets at construction job sites shall conform to the requirements of Part 1926 of the OSHA Standards for Construction.
- B. **Sanitary and Other Organic Wastes:** The CONTRACTOR shall establish a regular daily collection of all sanitary and organic wastes. All wastes and refuse from sanitary facilities provided by the CONTRACTOR or organic material wastes from any other source related to the CONTRACTOR's operations shall be disposed of away from the Site in a manner satisfactory to the ENGINEER and in accordance with all laws and regulations pertaining thereto.

1.5 CHEMICALS

- A. All chemicals used during project construction or furnished for project operation, whether defoliant, soil sterilant, herbicide, pesticide, disinfectant, polymer, reactant or of other classification, shall show approval of either the U.S. Environmental Protection Agency or the U.S. Department of Agriculture. Use of all such chemicals and disposal of residues shall be in strict accordance with the printed instructions of the manufacturer. In addition, see the requirements set forth in paragraph 6.11 of the General Conditions.

1.6 CULTURAL RESOURCES

- A. The CONTRACTOR's attention is directed to the National Historic Preservation Act of 1966 (16 U.S.C. 470) and 36 CFR 800 which provides for the preservation of potential historical architectural, archaeological, or cultural resources (hereinafter called "cultural resources").
- B. The CONTRACTOR shall conform to the applicable requirements of the National Historic Preservation Act of 1966 as it relates to the preservation of cultural resources.
- C. In the event potential cultural resources are discovered during subsurface excavations at the site of construction, the following procedures shall be instituted:
 - 1. The ENGINEER will issue a field order directing the CONTRACTOR to cease all construction operations at the location of such potential cultural resources find.
 - 2. Such field order shall be effective until such time as a qualified archaeologist can be called to assess the value of these potential cultural resources and make recommendations to the OWNER.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

- END OF SECTION -

SECTION 01590 - FIELD OFFICE, EQUIPMENT, AND SERVICES

PART 1 – GENERAL

1.1 GENERAL

- A. The CONTRACTOR shall provide a field office and equipment and furnish related services at the Site, to be shared by CONTRACTOR and OWNER (site to be at Hillsboro ASR).

1.2 FIELD OFFICE SCHEDULE

- A. Field offices, equipped as indicated herein, shall be provided at the site(s) indicated, ready for exclusive use by the ENGINEER and the OWNER's representative and staff within 14 days after the commencement date stated in the Notice to Proceed. The CONTRACTOR's attention is directed to the condition that no payment for mobilization, or any part thereof, will be approved for payment under the Contract until the field office facilities indicated herein have been provided. The provisions for such payment are included in Section 01505 - Mobilization.
- B. Unless released earlier by the ENGINEER in writing, field office(s) shall be maintained in full operation at the Site with all utilities connected and operable until the Notice of Completion has been executed or recorded. Upon execution or recordation of the Notice of Completion, or upon early release of the field office(s) by the ENGINEER, the CONTRACTOR shall remove the field office(s) within 14 days from said date, and shall restore the Site occupied by the field office(s) to the condition indicated.

PART 2 – PRODUCTS

2.1 OFFICE FACILITIES

- A. **General:** The CONTRACTOR shall provide all necessary electrical wiring; plumbing, toilet and lavatory fixtures, air conditioning and heating equipment, and shelving, and shall furnish all necessary light, heat, water, telephone services (local and long distance) and weekly janitorial services in connection with the field offices for the duration of the WORK.
- B. **Field Office:** The office shall be one separate, well lighted, air conditioned, electrically heated field office with a toilet room containing a water closet and lavatory partitioned off from the working area. The water closet may be of the chemical type; provided, that it is a flush type with an approved holding tank. The toilet room door shall be provided with a latch set. The office shall have an outside door lock. The area of said field office shall not be less than 400 square feet, exclusive of toilet room area. Said office shall be of the portable trailer type unless otherwise specifically authorized by the ENGINEER in writing and shall be a separate unit, not attached or connected to any other structures. The office shall have as minimum 2 private offices, one common area that can accommodate at least 2 desks, 4 filing cabinets, 1 plan table, and 2 bookcases.

2.2 FIELD OFFICE FURNISHINGS

- A. The CONTRACTOR shall furnish the following items in good condition in the primary field office:

- 4 each - Standard 30 x 60-inch desk(s) with not less than 3 drawers.
- 1 each - Plan table 36 x 72-inch top; 36 inches high.
- 1 each - Plan rack (all metal plan-hold type) capable of holding 6 sets of plans, complete with 6 standard all metal plan-hold clamps.
- 6 each - File cabinet, legal size, 4-5 drawer with lock and 3 keys, double suspension, complete with Pendaflex suspension racks for each drawer.
- 4 each - Office chair(s), standard armrest type, adjustable, swivel, tilt-back with casters.
- 10 each - Office chair(s), stiff-leg type, no armrest.
- 4 each - Waste basket(s).
- 4 each - Tack board 36 x 42 inches.
- 100 lin ft - Bookshelves
- 1 each - White Board (dry-erasable ink type, 36" x 60")
- 1 each - Bottled water dispenser unit (supplying both hot and cold water) and bottled water service and continuous supply of paper cups.

2.3 FIELD OFFICE SERVICES

- A. Each field office required hereunder shall be provided with sufficient lighting to provide not less than 50 foot-candles at desktop height at each desk location. Exterior lighting shall be provided over the entrance door.
- B. A minimum of four 110-VAC duplex electric convenience outlets shall be provided in each office and in the conference room and common area. At least one such outlet shall be located on each wall. The electric distribution panel shall service not less than two 110-VAC circuits.
- C. Where inside toilet facilities are not connected to outside plumbing, a flush-type chemical toilet with a holding tank shall be provided. All such sanitary waste material shall be regularly pumped out and the chemicals recharged. Toilet paper and paper towels shall be furnished for each toilet facility.
- D. Regular weekly janitorial services shall be furnished during working hours each day. Offices shall be swept, dusted, and waste receptacles emptied. Toilet facilities shall be sanitized and cleaned daily, and paper supplies shall be replenished.

2.4 TELEPHONE SERVICE

- A. Within 14 days after the commencement date stated in the Notice to Proceed, the CONTRACTOR shall provide in each of the field offices one telephone, in good order, at each desk for the use of the OWNER's or ENGINEER's employees in connection with the

WORK.

2.5 OFFICE COPY MACHINE

- A. The CONTRACTOR shall provide one new office copy machine for the exclusive use of the ENGINEER. The copy machine shall be designed for 50,000 copies per month duty and be dust resistant.
- B. Copy machine shall employ a dry, electrostatic process and be capable of automatically feeding 8-1/2 x 11, 8-1/2 x 14, and 11 x 17 originals and copying onto wither 8-1/2 x 11 or 8-1/2 x 14 plain bond paper sheets at variable magnification from 50 percent to 200 percent. The machine shall have an automatic copy sorter and automatic stapler. The paper tray shall hold 1000 sheets.
- C. The CONTRACTOR shall obtain and pay for a service and repair contract with a local representative of the copy machine dealer or manufacturer for daily on-site service. The CONTRACTOR shall furnish all necessary powders, chemicals, or other materials required for proper operation of the copy machine, exclusive of bond paper. The CONTRACTOR will supply all bond reproduction paper required.
- D. **Manufacturers, or Equal:** The copy machine shall be the latest model from:
 - 1. Sharp
 - 2. Xerox

2.6 COMPUTER AND PRINTER

- A. **General:** The CONTRACTOR shall provide, for the exclusive use of the ENGINEER, one computer and printer in the ENGINEER's [primary] field office.
- B. **Computer:** Computer shall be a shock-mounted unit with all component parts contained in a single, portable case. The computer shall include:
 - 1. 64 MB of RAM.
 - 2. One 3-1/2-inch DS HD diskette drive.
 - 3. One CD-Rom Drive.
 - 4. One 8 GB hard disc drive.
 - 5. Processor speed of 300 MHz, minimum
 - 6. Windows NT 4.0 operating system, with latest revision
 - 7. Operate on 110/220 VAC
 - 8. One parallel communications port.
 - 9. Internal modem, 56 K baud speed, with communications software
- C. **Printer:** The printer shall be a Laser Jet automatic feed type, compatible with the computer and shall be complete with connecting cable to the computer. The printer shall operate off the parallel port, and shall be capable of printing both 8 1/2 by 11 inch, 8-1/2 x 14, and 11 by 17 inch sheets.
- D. **Service Contract:** The CONTRACTOR shall obtain and pay for a service and repair contract with a local representative of the dealer or manufacturer for daily, on-site service. The service contract shall cover both the computer and the printer.

2.7 FACSIMILE MACHINE

- A. **General:** The CONTRACTOR shall provide, for the exclusive use of the ENGINEER, one facsimile machine **Xerox model 7074, or equal**, with a service contract, in the ENGINEER'S field office.
- B. **Facsimile Machine:** The facsimile machine shall conform to CCITT Group 2 and Group 3 standard and shall be capable of receiving and sending documents to other machines compatible with the same standards. The facsimile machine shall be equipped with the following features:
1. Automatic document feeder
 2. 16-digit dot matrix display
 3. Uses standard 8 1/2 by 11 inch paper
 4. Alphabetical dialing
 5. Delayed transmission
 6. Automatic redial
- C. **Service Contract:** The CONTRACTOR shall obtain and pay for a service and repair contract with local representative of the dealer or manufacturer for daily, on-site service.

PART 3 – EXECUTION (Not Used)

- END OF SECTION -

SECTION 01600 - PRODUCTS, MATERIALS, EQUIPMENT AND SUBSTITUTIONS

PART 1 – GENERAL

1.1 DEFINITIONS

- A. The word "Products," as used in the Contract Documents, is defined to include purchased items for incorporation into the WORK, regardless of whether specifically purchased for the project or taken from CONTRACTOR's stock of previously purchased products. The word "Materials," is defined as products which must be substantially cut, shaped, worked, mixed, finished, refined, or otherwise fabricated, processed, installed, or applied to form WORK. The word "Equipment" is defined as products with operational parts, regardless of whether motorized or manually operated, and particularly including products with service connections (wiring, piping, and other like items). Definitions in this paragraph are not intended to negate the meaning of other terms used in the Contract Documents, including "specialties," "systems," "structure," "finishes," "accessories," "furnishings," "special construction," and similar terms, which are self-explanatory and have recognized meanings in the construction industry.
- B. Neither "Products" nor "Materials" nor "Equipment" includes machinery and equipment used for preparation, fabrication, conveying, and erection of the WORK.

1.2 QUALITY ASSURANCE

- A. **Source Limitations:** To the greatest extent possible for each unit of WORK, the CONTRACTOR shall provide products, materials, and equipment of a singular generic kind from a single source.
- B. **Compatibility of Options:** Where more than one choice is available as options for CONTRACTOR's selection of a product, material, or equipment, the CONTRACTOR shall select an option which is compatible with other products, materials, or equipment. Compatibility is a basic general requirement of product, material and equipment selections.

1.3 PRODUCT DELIVERY AND STORAGE

- A. The CONTRACTOR shall deliver and store the WORK in accordance with manufacturer's written recommendations and by methods and means which will prevent damage, deterioration, and loss including theft. Delivery schedules shall be controlled to minimize long-term storage of products at the Site and overcrowding of construction spaces. In particular, the CONTRACTOR shall ensure coordination to ensure minimum holding or storage times for flammable, hazardous, easily damaged, or sensitive materials to deterioration, theft, and other sources of loss.

1.4 TRANSPORTATION AND HANDLING

- A. Products shall be transported by methods to avoid damage and shall be delivered in undamaged condition in manufacturer's unopened containers and packaging.
- B. The CONTRACTOR shall provide equipment and personnel to handle products, materials,

and equipment including those furnished by OWNER, by methods to prevent soiling and damage.

- C. The CONTRACTOR shall provide additional protection during handling to prevent marring and otherwise damaging products, packaging, and surrounding surfaces.

1.5 STORAGE AND PROTECTION

- A. Products shall be stored in accordance with manufacturer's written instructions and with seals and labels intact and legible. Sensitive products shall be stored in weather-tight climate controlled enclosures and temperature and humidity ranges shall be maintained within tolerances required by manufacturer's recommendations.
- B. For exterior storage of fabricated products, products shall be placed on sloped supports above ground. Products subject to deterioration shall be covered with impervious sheet covering and ventilation shall be provided to avoid condensation.
- C. Loose granular materials shall be stored on solid flat surfaces in a well-drained area and shall be prevented from mixing with foreign matter.
- D. Storage shall be arranged to provide access for inspection. The CONTRACTOR shall periodically inspect to assure products are undamaged and are maintained under required conditions.
- E. Storage shall be arranged in a manner to provide access for maintenance of stored items and for inspection.

1.6 MAINTENANCE OF PRODUCTS IN STORAGE

- A. Stored products shall be periodically inspected on a scheduled basis. The CONTRACTOR shall maintain a log of inspections and shall make the log available on request.
- B. The CONTRACTOR shall comply with manufacturer's product storage requirements and recommendations.
- C. The CONTRACTOR shall maintain manufacturer-required environmental conditions continuously.
- D. The CONTRACTOR shall ensure that surfaces of products exposed to the elements are not adversely affected and that weathering of finishes does not occur.
- E. For mechanical and electrical equipment, the CONTRACTOR shall provide a copy of the manufacturer's service instructions with each item and the exterior of the package shall contain notice that instructions are included.
- F. Products shall be serviced on a regularly scheduled basis, and a log of services shall be maintained and submitted as a record document prior to final acceptance by the OWNER in accordance with the Contract Documents.

1.7 PROPOSED SUBSTITUTIONS OR "OR-EQUAL" ITEM

- A. Whenever materials or equipment are indicated in the Contract Documents by using the

name of a proprietary item or the name of a particular manufacturer, the naming of the item is intended to establish the type, function, and quality required. If the name is followed by the words "or equal" indicating that a substitution is permitted, materials or equipment of other manufacturers may be accepted if sufficient information is submitted by the CONTRACTOR to allow the ENGINEER to determine that the material or equipment proposed is equivalent or equal to that named, subject to the following requirements:

1. The burden of proof as to the type, function, and quality of any such substitution product, material or equipment shall be upon the CONTRACTOR.
2. The ENGINEER will be the sole judge as to the type, function, and quality of any such substitution and the ENGINEER's decision shall be final.
3. The ENGINEER may require the CONTRACTOR to furnish additional data about the proposed substitution.
4. The OWNER may require the CONTRACTOR to furnish a special performance guarantee or other surety with respect to any substitution.
5. Acceptance by the ENGINEER of a substitution item proposed by the CONTRACTOR shall not relieve the CONTRACTOR of the responsibility for full compliance with the Contract Documents and for adequacy of the substitution.
6. The CONTRACTOR shall pay all costs of implementing accepted substitutions, including redesign and changes to WORK necessary to accommodate the substitution.

B. The procedure for review by the ENGINEER will include the following:

1. If the CONTRACTOR wishes to provide a substitution item, the CONTRACTOR shall make written application to the ENGINEER on the "Substitution Request Form."
2. Unless otherwise provided by law or authorized in writing by the ENGINEER, the "Substitution Request Form(s)" shall be submitted within the 35-day period after award of the Contract.
3. Wherever a proposed substitution item has not been submitted within said 35-day period, or wherever the submission of a proposed substitution material or equipment has been judged to be unacceptable by the ENGINEER, the CONTRACTOR shall provide the material or equipment indicated in the Contract Documents.
4. The CONTRACTOR shall certify by signing the form that the list of paragraphs on the form are correct for the proposed substitution.
5. The ENGINEER will evaluate each proposed substitution within a reasonable period of time.
6. As applicable, no shop drawing submittals shall be made for a substitution item nor shall any substitution item be ordered, installed, or utilized without the ENGINEER'S prior written acceptance of the CONTRACTOR'S "Substitution Request Form."

7. The ENGINEER will record the time required by the ENGINEER in evaluating substitutions proposed by the CONTRACTOR and in making changes by the CONTRACTOR in the Contract Documents occasioned thereby.
- C. The CONTRACTOR's application shall address the following factors which will be considered by the ENGINEER in evaluating the proposed substitution:
1. Whether the evaluation and acceptance of the proposed substitution will prejudice the CONTRACTOR's achievement of Substantial Completion on time.
 2. Whether acceptance of the substitution for use in the WORK will require a change in any of the Contract Documents to adapt the design to the proposed substitution.
 3. Whether incorporation or use of the substitution in connection with the WORK is subject to payment of any license fee or royalty.
 4. Whether all variations of the proposed substitution from the items originally specified are identified.
 5. Whether available maintenance, repair, and replacement service are indicated. The manufacturer shall have a local service agency (within 50 miles of the site) which maintains properly trained personnel and adequate spare parts and is able to respond and complete repairs within 24 hours.
 6. Whether an itemized estimate is included of all costs that will result directly or indirectly from acceptance of such substitution, including cost of redesign and claims of other contractors affected by the resulting change.
 7. Whether the proposed substitute item meets or exceeds the experience and/or equivalency requirements listed in the appropriate technical specifications.
- D. Without any increase in cost to the OWNER, the CONTRACTOR shall be responsible for and pay all costs in connection with proposed substitutions and of inspections and testing of equipment or materials submitted for review prior to the CONTRACTOR's purchase thereof for incorporation in the WORK, whether or not the ENGINEER accepts the proposed substitution or proposed equipment or material. The CONTRACTOR shall reimburse the OWNER for the charges of the ENGINEER for evaluating each proposed substitution.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

- END OF SECTION -

SECTION 01660 - TESTING AND PLANT STARTUP

PART 1 -- GENERAL

1.1 GENERAL

- A. Equipment testing startup are prerequisites to satisfactory completion of the contract requirements and shall be completed within the Contract Times.
- B. The startup of an ASR Well System is a highly complex operation requiring the combined expertise of the CONTRACTOR, manufacturers' representatives, subcontractors, the ENGINEER, and the OWNER. The CONTRACTOR shall be responsible for coordinating all parties for a successful startup: the ENGINEER and OWNER will be available for technical and operational advice prior to and during startup.
- C. Testing and startup activities shall be scheduled according to Section 01311 - CPM Construction Schedule. The 7-day test and the 8-day test shall start prior to midday on a Monday, Tuesday, or Wednesday. Testing periods shall not include holidays, based on the OWNER's calendar.
- D. During system testing and startup, product water shall be wasted.

1.2 SUBMITTALS

- A. **Schedule:** The schedule for testing and startup shall be submitted under Section 01311.
- B. **Testing and Startup Plan:** Not less than 60-days prior to startup, submit for review a detailed Testing and Startup Plan. The Plan shall include schedules for manufacturers' equipment certifications, schedules for submitting final Owner's Manuals, schedule for training the OWNER's personnel, list of OWNER and CONTRACTOR-furnished supplies, electrical testing, and detailed schedule of operations to achieve successful system testing, startup, and performance and acceptance testing. The Plan shall include test checklists and data forms for each item of equipment and shall address coordination with the OWNER's staff. The CONTRACTOR shall revise the Plan as necessary based on review comments.
- C. **System Outage Requests:** Request for shutdown of existing systems as necessary to test or start up new facilities.
- D. **Records and Documentation:**
 - 1. **Equipment Installation Certification:** Where required by the specifications, submit documentation from manufacturer's representative that the equipment has been properly installed and lubricated, is in accurate alignment, is free from undue stresses from connecting piping and anchoring, and has operated satisfactorily under full load conditions.
 - 2. Records of testing and startup as indicated below.

PART 2 -- PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 EXECUTION

A. Prerequisites: The following shall be completed before testing and startup begins.

1. Furnish all Owner's Manual information required by the Contract Documents.
2. Provide all safety equipment, emergency shower and eyewash units, fire extinguishers, gas detectors, protective guards and shields, emergency repair kits, safety chains, handrails, gratings, safety signs, and valve and piping identification required by the Contract Documents. Devices and equipment shall be fully functional, adjusted, and tested.
3. Manufacturer's certifications of proper installation have been accepted.
4. Leakage tests, electrical tests, and adjustments have been completed.
5. The ENGINEER has approved the CONTRACTOR's Testing and Startup Plan.
6. Functional verification of the individual instrumentation loops (analog, status, alarm, and control.)
7. Adjustment of the pressure switches, flow switches, timing relays, level switches, vibration switches, temperature switches, RTD monitors, pressure regulating valves, and all other control devices to the settings determined by the ENGINEER or the equipment manufacturer.
8. Functional verification of the individual interlocks between the field-mounted control devices and the motor control circuits, control circuits of variable-speed controllers, and packaged system controls.

B. Supplies:

1. The CONTRACTOR shall furnish:
 - a. Chemicals
 - b. Fuel
 - c. Oil and grease
 - d. Other necessary materials not listed for the OWNER to furnish
2. The OWNER will furnish:
 - a. Water
 - b. Power
3. The cost of water and power shall be paid by the CONTRACTOR.

- C. Records of Testing and Startup:** The CONTRACTOR shall maintain the following during testing and startup and submit originals to ENGINEER prior to acceptance:
1. Lubrication and service records for each mechanical and electrical equipment item
 2. Hours of daily operation for each mechanical and electrical equipment item
 3. Equipment alignment and vibration measurement records
 4. Logs of electrical measurements and tests
 5. Instrumentation calibration and testing logs
 6. Testing and validation of SCADA inputs, outputs, logic functions, status indications, and alarms
 7. Factory and field equipment settings
 8. Log of problems encountered and adjustments made
 9. Other records, logs, and checklists as required by the Contract Documents

3.2 SYSTEM TESTING

- A. After individual equipment items have been tested and certified as required by the Technical Specifications, tests of systems comprised of single or multiple equipment items with appurtenant equipment and instruments and controls shall be conducted. All items of equipment shall be tested as part of a system to the maximum extent possible.
- B. The CONTRACTOR shall demonstrate the manual and automatic modes of operation to verify proper control sequences, software interlocks, proper operation of software logic and controllers, etc. System testing shall include the use of water or other process media, as applicable, to simulate the actual conditions of operation.
- C. All systems testing activities shall follow the detailed test procedures and checklists in the Testing and Startup Plan. Completion of systems testing shall be documented by a report.
- D. The CONTRACTOR shall system test the utility, chemical feed, safety equipment, and other support systems before testing the process system.
- E. Furnish the ENGINEER at least 10 days written notice confirming the start of system testing.
- F. The CONTRACTOR shall arrange for manufacturer's representative to revisit the Site as often as necessary to correct malfunctions to the ENGINEER's satisfaction.
- G. Each system shall be tested for a continuous, 7-day, 24-hour/day period. If any system malfunctions during the test, the item or equipment shall be repaired and the test restarted at time zero with no credit given for the elapsed time before the malfunction.

3.3 STARTUP AND ACCEPTANCE TESTING

- A. The CONTRACTOR shall start up the plant and operate it at rates directed by the ENGINEER without malfunction for a continuous 8-day, 24 hour/day acceptance test period. If any equipment item, sub system, or system malfunctions during the test period, the item shall be repaired and the test restarted at time zero with no credit given for the elapsed time before the malfunction.
- B. Defects in material or workmanship which appear shall be promptly corrected. Time lost for wiring corrections, control point settings, or other reasons which interrupt the test may, at the judgement of the ENGINEER, be cause for extending the test period an equal amount of time.
- C. Acceptance testing shall not begin until all leakage tests, instrumentation tests and adjustments, electrical tests and adjustments, equipment field tests, [disinfection,] and system tests have been completed to the satisfaction of the ENGINEER.
- D. The CONTRACTOR shall furnish the services of manufacturer's representatives, if necessary, to correct equipment malfunctions.
- E. During acceptance testing, the CONTRACTOR shall:
 - 1. Lubricate and maintain all equipment in accordance with the manufacturers' recommendations.
 - 2. Clean or replace strainers, screens, and filter elements.

- END OF SECTION -

SECTION 01700 - PROJECT CLOSEOUT

PART 1 -- GENERAL

1.1 FINAL CLEANUP

- A. The CONTRACTOR shall promptly remove from the vicinity of the completed WORK, all rubbish, unused materials, concrete forms, construction equipment, and temporary structures and facilities used during construction. Final acceptance of the WORK by the OWNER will be withheld until the CONTRACTOR has satisfactorily performed the final cleanup of the Site.

1.2 CLOSEOUT TIMETABLE

- A. The CONTRACTOR shall establish dates for equipment testing, acceptance periods, and on-site instructional periods (as required under the Contract). Such dates shall be established not less than one week prior to beginning any of the foregoing items, to allow the OWNER, the ENGINEER, and their authorized representatives sufficient time to schedule attendance at such activities.

1.3 TECHNICAL MANUAL SUBMITTAL

- A. The CONTRACTOR's attention is directed to the condition that one percent of the Contract Price will be retained from any monies due the CONTRACTOR as progress payments, if at the 75 percent construction completion point, the approved Technical Manual complying with Section 01300 has not been submitted. The aforementioned amount will be retained by the OWNER as the agreed, estimated value of the approved Technical Manual. Any such retention of money for failure to submit the approved Technical Manual on or before the 75 percent construction completion point shall be in addition to the retention of any payments due to the CONTRACTOR under Article 14 of the General Conditions.

1.4 FINAL SUBMITTALS

- A. The CONTRACTOR, prior to requesting final payment, shall obtain and submit the following items to the ENGINEER for transmittal to the OWNER:
 - 1. Written guarantees, where required.
 - 2. Technical Manuals and instructions.
 - 3. New permanent cylinders and key blanks for all locks.
 - 4. Maintenance stock items; spare parts; special tools.
 - 5. Completed record drawings.
 - 6. Bonds for roofing, maintenance, etc., as required.
 - 7. Certificates of inspection and acceptance by local governing agencies having jurisdiction.

8. Releases from all parties who are entitled to claims against the subject project, property, or improvement pursuant to the provisions of law.

1.5 MAINTENANCE AND GUARANTEE

- A. The CONTRACTOR shall comply with the maintenance and guarantee requirements contained in Article 13 of the General Conditions.
- B. Replacement of earth fill or backfill, where it has settled below the required finish elevations, shall be considered as a part of such required repair work, and any repair or resurfacing constructed by the CONTRACTOR which becomes necessary by reason of such settlement shall likewise be considered as a part of such required repair work unless the CONTRACTOR shall have obtained a statement in writing from the affected private owner or public agency releasing the OWNER from further responsibility in connection with such repair or resurfacing.
- C. The CONTRACTOR shall make all repairs and replacements promptly upon receipt of written order from the OWNER. If the CONTRACTOR fails to make such repairs or replacements promptly, the OWNER reserves the right to do the WORK and the CONTRACTOR and its surety shall be liable to the OWNER for the cost thereof.

1.6 BOND

- A. The CONTRACTOR shall provide a bond to guarantee performance of the provisions contained in Paragraph "Maintenance and Guarantee" above, and Article 13 of the General Conditions.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

- END OF SECTION -

SECTION 02100 - SITE PREPARATION

PART 1 – GENERAL

1.1 THE REQUIREMENT

- A. The WORK of this Section includes measures required during the CONTRACTOR's initial move onto the Site to protect existing fences, houses and associated improvements, streets, and utilities downslope of construction areas from damage due to boulders, trees or other objects dislodged during the construction process; clearing, grubbing and stripping; and regrading of certain areas to receive embankment fill.

1.2 SITE INSPECTION

- A. Prior to moving onto the Site, the CONTRACTOR shall inspect the Site conditions and review maps of the existing site and facilities delineating the OWNER's property and right-of-way lines.

PART 2 – PRODUCTS - NOT USED

PART 3 – EXECUTION

3.1 PRIMARY PLANT SITE ACCESS

- A. The CONTRACTOR shall develop any necessary access to the Site, including access barriers to prohibit entry of unauthorized persons.
- B. **Utility Interference:** Where existing utilities interfere with the WORK, notify the utility owner and the ENGINEER before proceeding in accordance with the General Conditions.

3.2 CLEARING, GRUBBING, AND STRIPPING

- A. Construction areas shall be cleared of grass and weeds to at least a depth of six inches and cleared of structures, pavement, sidewalks, concrete or masonry debris, trees, logs, upturned stumps, loose boulders, and any other objectionable material of any kind which would interfere with the performance or completion of the WORK, create a hazard to safety, or impair the subsequent usefulness of the WORK, or obstruct its operation. Loose boulders within 10 feet of the top of cut lines shall be incorporated in landscaping or removed from the Site. Trees and other natural vegetation outside the actual lines of construction shall be protected from damage during construction, as directed by the ENGINEER.
- B. Within the limits of clearing, the areas below the natural ground surface shall be grubbed to a depth necessary to remove all stumps, roots, buried logs, and all other objectionable material. Septic tanks, drain fields, and connection lines and any other underground structures, debris or waste shall be removed if found on the Site. All objectionable material from the clearing and grubbing process shall be removed from the Site and wasted in approved safe locations.
- C. The entire area to be affected by construction shall be stripped to a depth of 2.5 feet below

the existing ground contours. The stripped materials shall be stockpiled and incorporated into landscaped areas or other non-structural embankments.

- D. Unless otherwise indicated, native trees larger than three inches in diameter at the base shall not be removed without the ENGINEER's approval. The removal of any trees, shrubs, fences, or other improvements outside of rights-of-way, if necessary for the CONTRACTOR's choice of means and methods, shall be arranged with the owner of the property, and shall be removed and replaced, at no additional cost to the OWNER.

3.3 OVEREXCAVATION, REGRADING, AND BACKFILL UNDER FILL AREAS

- A. After the fill areas have been cleared, grubbed, and excavated, the areas to receive fill will require overexcavation, regrading, and backfill, consisting of the removal and/or stockpiling of undesirable soils. The ground surface shall be recontoured for keying the fill and removing severe or abrupt changes in the topography of the Site. The overexcavated volumes to a level 2.5 feet below the existing ground contours shall be backfilled.

- END OF SECTION -

SECTION 02140 - DEWATERING

PART 1 – GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall dewater trench and structure excavations, in accordance with the Contract Documents. The CONTRACTOR shall secure all necessary permits to complete the requirements of this Section of the Specifications.

1.2 CONTRACTOR SUBMITTALS

- A. Prior to commencement of excavation, the CONTRACTOR shall submit a detailed plan and operation schedule for dewatering of excavations. The CONTRACTOR may be required to demonstrate the system proposed and to verify that adequate equipment, personnel, and materials are provided to dewater the excavations at all locations and times. The CONTRACTOR's dewatering plan is subject to review by the ENGINEER.

1.3 QUALITY CONTROL

- A. It shall be the sole responsibility of the CONTRACTOR to control the rate and effect of the dewatering in such a manner as to avoid all objectionable settlement and subsidence.
- B. All dewatering operations shall be adequate to assure the integrity of the finished project and shall be the responsibility of the CONTRACTOR.
- C. Where critical structures or facilities exist immediately adjacent to areas of proposed dewatering, reference points shall be established and observed at frequent intervals to detect any settlement which may develop. The responsibility for conducting the dewatering operation in a manner which will protect adjacent structures and facilities rests solely with the CONTRACTOR. The cost of repairing any damage to adjacent structures and restoration of facilities shall be the responsibility of the CONTRACTOR.

PART 2 – PRODUCTS

2.1 EQUIPMENT

- A. Dewatering, where required, may include the use of well points, sump pumps, temporary pipelines for water disposal, rock or gravel placement, and other means. Standby pumping equipment shall be maintained on the jobsite.

PART 3 – EXECUTION

3.1 GENERAL REQUIREMENTS

- A. The CONTRACTOR shall provide all equipment necessary for dewatering. It shall have on hand, at all times, sufficient pumping equipment and machinery in good working condition and shall have available, at all times, competent workmen for the operation of the pumping equipment. Adequate standby equipment shall be kept available at all times to insure efficient dewatering and maintenance of dewatering operation during power

failure.

- B. Dewatering for structures and pipelines shall commence when groundwater is first encountered, and shall be continuous until such times as water can be allowed to rise in accordance with the provisions of this Section or other requirements.
- C. At all times, site grading shall promote drainage. Surface runoff shall be diverted from excavations. Water entering the excavation from surface runoff shall be collected in shallow ditches around the perimeter of the excavation, drained to sumps, and be pumped or drained by gravity from the excavation to maintain a bottom free from standing water.
- D. Dewatering shall at all times be conducted in such a manner as to preserve the undisturbed bearing capacity of the subgrade soils at proposed bottom of excavation.
- E. If foundation soils are disturbed or loosened by the upward seepage of water or an uncontrolled flow of water, the affected areas shall be excavated and replaced with drain rock.
- F. The CONTRACTOR shall maintain the water level below the bottom of excavation in all work areas where groundwater occurs during excavation construction, backfilling, and up to acceptance.
- G. Flotation shall be prevented by the CONTRACTOR by maintaining a positive and continuous removal of water. The CONTRACTOR shall be fully responsible and liable for all damages which may result from failure to adequately keep excavations dewatered.
- H. If well points or wells are used, they shall be adequately spaced to provide the necessary dewatering and shall be sandpacked and/or other means used to prevent pumping of fine sands or silts from the subsurface. A continual check by the CONTRACTOR shall be maintained to ensure that the subsurface soil is not being removed by the dewatering operation.
- I. The CONTRACTOR shall dispose of water from the WORK in a suitable manner without damage to adjacent property. CONTRACTOR shall be responsible for obtaining any permits that may be necessary to dispose of water. No water shall be drained into work built or under construction without prior consent of the ENGINEER. Water shall be filtered using an approved method to remove sand and fine-sized soil particles before disposal into any drainage system.
- J. The release of groundwater to its static level shall be performed in such a manner as to maintain the undisturbed state of the natural foundation soils, prevent disturbance of compacted backfill and prevent flotation or movement of structures, pipelines, and sewers.
- K. Dewatering of trenches and other excavations shall be considered as incidental to the construction of the WORK and all costs thereof shall be included in the various contract prices in the Bid Forms, unless a separate bid item has been established for dewatering.

- END OF SECTION -

SECTION 02200 - EARTHWORK

PART 1 – GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall perform all earthwork indicated and required for construction of the WORK, complete and in place, in accordance with the Contract Documents.
- B. The CONTRACTOR shall submit samples of all materials proposed to be used in the work in accordance with the requirements in Section 01300 - Contractor Submittals. Sample sizes shall be as determined by the testing laboratory.

PART 2 – PRODUCTS

2.1 SUITABLE FILL AND BACKFILL MATERIAL REQUIREMENTS

- A. **General:** Fill, backfill, and embankment materials shall be suitable selected or processed clean, fine earth, rock, or sand, free from grass, roots, brush, or other vegetation.
- B. Fill and backfill materials to be placed within 6 inches of any structure or pipe shall be free of rocks or unbroken masses of earth materials having a maximum dimension larger than 3 inches.
- C. **Suitable Materials:** Materials not defined as unsuitable below are defined as suitable materials and may be used in fills, backfilling, and embankment construction subject to the indicated limitations. In addition, when acceptable to the ENGINEER, some of the material listed as unsuitable may be used when thoroughly mixed with suitable material to form a stable composite.
- D. Suitable materials may be obtained from on-site excavations, may be processed on-site materials, or may be imported. If imported materials are required by this Section or to meet the quantity requirements of the project the CONTRACTOR shall provide the imported materials at no additional expense to the OWNER, unless a unit price item is included for imported materials in the bidding schedule.
- E. The following types of suitable materials are defined:
 - 1. **Type A (three-quarters inch minus granular backfill):** Crushed rock or gravel, and sand with the gradation requirements below. The material shall have a minimum sand equivalent value of 28 and a minimum R-value of 78. If the sand equivalent value exceeds 35 the R-value requirement is waived.

<u>Sieve Size</u>	<u>Percentage Passing</u>
3/4-inch	100
No. 4	30 - 50
No. 200	0 - 12

- 2. **Type B (Class I crushed stone):** Manufactured angular, crushed stone, crushed rock, or crushed slag with the following gradation requirements. The material shall have a minimum sand equivalent value of 75.

<u>Sieve Size</u>	<u>Percentage Passing</u>
3/4-inch	100
No. 4	30 - 50
No. 200	0 - 5

3. Type C (sand backfill): Sand with 100 percent passing a 3/8-inch sieve, at least 90 percent passing a Number 4 sieve, and a sand equivalent value not less than 30.
4. Type D: Not used
5. Type E (pea gravel backfill): Crushed rock or gravel with 100 percent passing a 1/2-inch sieve and not more than 10 percent passing a Number 4 sieve.
6. Type F (coarse drainrock): Crushed rock or gravel meeting the following gradation requirements:

<u>Sieve Size</u>	<u>Percentage Passing</u>
2-inch	100
1-1/2-inch	90 - 100
1-inch	20 - 55
3/4-inch	0 - 15
No. 200	0 - 3

7. Type G (aggregate base): Crushed rock aggregate base material of such nature that it can be compacted readily by watering and rolling to form a firm, stable base for pavements. At the option of the CONTRACTOR, the grading for either the 1-1/2-inch maximum size or 3/4-inch maximum size gradation shall be used. The sand equivalent value shall be not less than 22, and the material shall meet the following gradation requirements:

<u>Sieve Size</u>	<u>Percentage Passing</u>	
	<u>1-1/2-inch Max.</u>	<u>3/4-inch Max.</u>
2-inch	100	-
1-1/2-inch	90 - 100	-
1-inch	-	100
3/4-inch	50 - 85	90 - 100
No. 4	25 - 45	35 - 55
No. 30	10 - 25	10 - 30
No. 200	2 - 9	2 - 9

8. Type H (graded drainrock): Drainrock shall be crushed rock or gravel, durable and free from slaking or decomposition under the action of alternate wetting or drying. The material shall be uniformly graded and shall meet the following gradation requirements:

<u>Sieve Size</u>	<u>Percentage Passing</u>
1-inch	100
3/4-inch	90 - 100

3/8-inch	40 – 100
No. 4	25 – 40
No. 8	18 – 33
No. 30	5 – 15
No. 50	0 – 7
No. 200	0 – 3

The drainrock shall have a sand equivalent value not less than 75. The finish graded surface of the drainrock immediately beneath hydraulic structures shall be stabilized to provide a firm, smooth surface upon which to construct reinforced concrete floor slabs. The CONTRACTOR shall use, at its option, one of the asphalt types listed below:

	<u>Type 1</u>	<u>Type 2</u>	<u>Type 3</u>
Designation	SC-800	SC-250	RS-1
Spray Temperature (°F)	175-255	165-200	70-120
Coverage (gal/sq yd)	0.50	0.50	0.50

If the surface remains tacky, sufficient sand shall be applied to absorb the excess asphalt.

9. Type I: Any other suitable material as defined herein.
10. Type J (cement-treated backfill): Material which consists of Type H material, or any mixture of Types B, C, G, and H materials which has been cement-treated so that the cement content of the material is not less than 5 percent by weight when tested in accordance with ASTM D 2901 - Standard Test Method for Cement Content of Freshly Mixed Soil Cement. The ultimate compressive strength at 28 days shall be not less than 400 psi when tested in accordance with ASTM D 1633 - Standard Test Method for Compressive Strength of Molded Soil - Cement Cylinders.
11. Type K (topsoil): Stockpiled topsoil material which has been obtained at the site by removing soil to a depth not exceeding 2 feet. Removal of the topsoil shall be done after the area has been stripped of vegetation and debris.
12. Type L (controlled low strength material): Controlled low strength material shall be in accordance with Section 02210 - Controlled Low Strength Material.
13. Type M (aggregate subbase): Crushed rock aggregate subbase material that can be compacted readily by watering and rolling to form a firm stable base. The sand equivalent value shall be not less than 18 and the material shall meet the following gradation requirements:

<u>Sieve Size</u>	<u>Percentage Passing</u>
3-inch	100
2-1/2 inch	87 – 100
No. 4	35 – 95
No. 200	0 – 29

14. Type N (trench plug): Low permeable fill material, a non-dispersible clay material having a minimum plasticity index of 10.

2.2 UNSUITABLE MATERIAL

F. Unsuitable materials include the materials listed below.

1. Soils which, when classified under ASTM D 2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System), fall in the classifications of Pt, OH, CH, MH, or OL.
2. Soils which cannot be compacted sufficiently to achieve the density specified for the intended use.
3. Materials that contain hazardous or designated waste materials including petroleum hydrocarbons, pesticides, heavy metals, and any material which may be classified as hazardous or toxic according to applicable regulations.
4. Soils that contain greater concentrations of chloride or sulfate ions, or have a soil resistivity or pH less than the existing on-site soils.
5. Topsoil, except as allowed below.

2.3 USE OF FILL, BACKFILL, AND EMBANKMENT MATERIAL TYPES

- A. The CONTRACTOR shall use the types of materials as designated herein for all required fill, backfill, and embankment construction hereunder.
- B. Where these Specifications conflict with the requirements of any local agency having jurisdiction or with the requirements of a pipe material manufacturer, the ENGINEER shall be immediately notified. In case of conflict between types of pipe embedment backfills, the CONTRACTOR shall use the agency-specified backfill material if that material provides a greater degree of structural support to the pipe, as determined by the ENGINEER. In case of conflict between types of trench or final backfill types, the CONTRACTOR shall use the agency-specified backfill material if that material provides the greater in-place density after compaction.
- C. Fill and backfill types shall be used in accordance with the following provisions:
1. Embankment fills shall be constructed of Type I material, as defined herein, or any mixture of Type I and Type A through Type H materials.
 2. Pipe zone backfill, as defined under "Pipe and Utility Trench Backfill" below, shall consist of the following materials for each pipe material listed below.
 - a. Mortar coated pipe, concrete pipe, and un-coated ductile iron pipe shall be provided Type A or B pipe bedding and embedment backfill material.
 - b. Coal tar enamel coated pipe, polyethylene encased pipe, tape wrapped pipe, and other non-mortar coated pipe shall be backfilled with Type C bedding and embedment zone backfill material.
 - c. Plastic pipe and vitrified clay pipe shall be backfilled with Type B bedding and embedment zone backfill material. Vitrified clay pipe shall be backfilled with Type B material to the top of the pipe zone.
 - d. Where pipelines are installed on grades exceeding 4 percent, and where backfill materials are graded such that there is less than 10 percent passing a

Number 4 sieve, trench plugs of Type J, L, or N material shall be provided at maximum intervals of 200 feet unless indicated otherwise.

3. Trench zone backfill for pipelines as defined under "Pipe and Utility Trench Backfill" shall be Type I backfill material or any of Types A through H backfill materials or any mixture thereof, except:
 - a. Type K material may be used for trench zone backfill in agricultural areas unless otherwise shown or specified.
4. Final backfill material for pipelines under paved areas, as defined under "Pipe and Utility Trench Backfill" shall be Type G backfill material. Final backfill under areas not paved shall be the same material as that used for trench backfill, except that Type K material shall be used for final backfill in agricultural areas unless otherwise indicated.
5. Trench backfill and final backfill for pipelines under structures shall be the same material as used in the pipe zone, except where concrete encasement is required by the Contract Documents.
6. Aggregate base materials under pavements shall be Type G material constructed to the thicknesses indicated. Aggregate subbase shall be Type M material.
7. Backfill around structures shall be Type I material, or Types A through Type H materials, or any mixture thereof, except as shown.
8. Backfill materials beneath structures shall be as follows:
 - a. Drainrock materials under hydraulic structures or other water retaining structures with underdrain systems shall be Type H material.
 - b. Under concrete hydraulic structures or other water retaining structures without underdrain systems, Types G or H materials shall be used.
 - c. Under structures where groundwater must be removed to allow placement of concrete, Type F material shall be used. Before the Type F material is placed, filter fabric shall be placed over the exposed foundation.
 - d. Under all other structures, Type G or H material shall be used.
9. Backfill used to replace pipeline trench over-excavation shall be a layer of Type F material with a 6-inch top filter layer of Type E material or filter fabric to prevent migration of fines for wet trench conditions or the same material as used for the pipe zone backfill if the trench conditions are not wet.
10. The top 6 inches of fill on reservoir roofs, embankment fills around hydraulic structures, and all other embankment fills shall consist of Type K material, topsoil.
11. Filter fabric shall be **Mirafi 140 N, Mirafi 700X**, or equal.

2.4 MATERIALS TESTING

- A. All soils testing of samples submitted by the CONTRACTOR will be done by a testing laboratory of the OWNER'S choice and at the OWNER'S expense. At its discretion, the

ENGINEER may request that the CONTRACTOR supply samples for testing of any material used in the work.

- B. Particle size analysis of soils and aggregates will be performed using ASTM D 422 - Standard Test Method for Particle-Size Analysis of Soils.
- C. Determination of sand equivalent value will be performed using ASTM D 2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
- D. **Unified Soil Classification System:** References in this Section to soil classification types and standards shall have the meanings and definitions indicated in ASTM D 2487. The CONTRACTOR shall be bound by all applicable provisions of said ASTM D 2487 in the interpretation of soil classifications.

PART 3 – EXECUTION

3.1 EXCAVATION - GENERAL

- A. **General:** Except when specifically provided to the contrary, excavation shall include the removal of all materials of whatever nature encountered, including all obstructions of any nature that would interfere with the proper execution and completion of the WORK. The removal of said materials shall conform to the lines and grades indicated or ordered. Unless otherwise indicated, the entire construction site shall be stripped of all vegetation and debris, and such material shall be removed from the site prior to performing any excavation or placing any fill. The CONTRACTOR shall furnish, place, and maintain all supports and shoring that may be required for the sides of the excavations. Excavations shall be sloped or otherwise supported in a safe manner in accordance with applicable State safety requirements and the requirements of OSHA Safety and Health Standards for Construction (29CFR1926).
- B. **Removal and Exclusion of Water:** The CONTRACTOR shall remove and exclude water, including stormwater, groundwater, irrigation water, and wastewater, from all excavations. Dewatering wells, wellpoints, sump pumps, or other means shall be used to remove water and continuously maintain groundwater at a level at least two feet below the bottom of excavations before the excavation work begins at each location. Water shall be removed and excluded until backfilling is complete and all field soils testing has been completed.

3.2 STRUCTURE, ROADWAY, AND EMBANKMENT EXCAVATION

- A. **Excavation Beneath Structures and Embankments:** Except where otherwise indicated for a particular structure or ordered by the ENGINEER, excavation shall be carried to the grade of the bottom of the footing or slab. Where indicated or ordered, areas beneath structures or fills shall be over-excavated. The subgrade areas beneath embankments shall be excavated to remove not less than the top [6 inches] of native material and where such subgrade is sloped, the native material shall be benched. When such over-excavation is indicated, both over-excavation and subsequent backfill to the required grade shall be performed by the CONTRACTOR. When such over-excavation is not indicated but is ordered by the ENGINEER, such over-excavation and any resulting backfill will be paid for under a separate unit price bid item if such bid item has been established; otherwise payment will be made in accordance with a negotiated price. After the required excavation or over-excavation has been completed, the exposed surface shall be scarified to a depth of 6 inches, brought to optimum moisture

content, and rolled with heavy compaction equipment to obtain 95 percent of maximum density.

- B. **Excavation Beneath Concrete Reservoirs:** Excavation under reservoirs shall extend to the bottom of the drainrock layer. After such excavation has been completed, the exposed surface shall be rolled with heavy compaction equipment to 95 percent of maximum density and then graded to provide a reasonably smooth surface for placement of the drainrock. Areas under the reservoir upon which fill is to be placed shall be scarified to a depth of 6 inches, brought to optimum moisture content, and compacted to obtain 95 percent of maximum density.
- C. **Excavation Beneath Paved Areas:** Excavation under areas to be paved shall extend to the bottom of the aggregate base or subbase, if such base is called for; otherwise it shall extend to the paving thickness. After the required excavation has been completed, the top 12 inches of exposed surface shall be scarified, brought to optimum moisture content, and rolled with heavy compaction equipment to obtain 95 percent of maximum density. The finished subgrade shall be even, self-draining, and in conformance with the slope of the finished pavement. Areas that could accumulate standing water shall be regraded to provide a self-draining subgrade.
- D. **Notification of ENGINEER:** The CONTRACTOR shall notify the ENGINEER at least 3 days in advance of completion of any structure excavation and shall allow the ENGINEER a review period of at least one day before the exposed foundation is scarified and compacted or is covered with backfill or with any construction materials.

3.3 PIPELINE AND UTILITY TRENCH EXCAVATION

- A. **Exploratory Excavation**
 - 1. The CONTRACTOR shall excavate and expose buried points of connection to existing utilities where indicated on the Drawings. Excavation shall be performed prior to preparation of Shop Drawings for connections and before fabrication of pipe, and the data obtained shall be used in preparing Shop Drawings.
 - 2. Data, including dates, locations excavated, and sketches, shall be submitted to the ENGINEER within one week of excavation.
 - 3. Damage to utilities from excavation activities shall be repaired by the CONTRACTOR.
- B. **General:** Unless otherwise indicated or ordered, excavation for pipelines and utilities shall be open-cut trenches with widths as indicated.
- C. **Trench Bottom:** Except when pipe bedding is required, the bottom of the trench shall be excavated uniformly to the grade of the bottom of the pipe bedding. Excavations for pipe bells and welding shall be made as required.
- D. **Open Trench:** The maximum amount of open trench permitted in any one location shall be 500 feet, or the length necessary to accommodate the amount of pipe installed in a single day, whichever is greater. All trenches shall be fully backfilled at the end of each day or, in lieu thereof, shall be covered by heavy steel plates adequately braced and capable of supporting vehicular traffic in those locations where it is impractical to backfill at the end of each day. The above requirements for backfilling or use of steel plate will be waived in cases where the trench is located further than 100 feet from any traveled

roadway or occupied structure. In such cases, however, barricades and warning lights meeting safety requirements shall be provided and maintained.

- E. **Trench Over-Excavation:** Where trenches are indicated to be over-excavated, excavation shall be to the depth indicated, and backfill shall be installed to the grade of the bottom of the pipe bedding.
- F. **Over-Excavation:** When ordered by the ENGINEER, whether indicated on the Drawings or not, trenches shall be over-excavated beyond the depth and/or width shown. Such over-excavation shall be to the dimensions ordered. The trench shall then be backfilled to the grade of the bottom of the pipe bedding. Over-excavation less than 6 inches below the limits on the Drawings shall be done at no increase in cost to the OWNER. When the over-excavation ordered by the ENGINEER is 6 inches or greater below the limits shown, or wider, additional payment will be made to the CONTRACTOR. Said additional payment will be made under separate unit price bid items for over-excavation if such bid items have been established; otherwise payment will be made in accordance with a negotiated price.
- G. Where pipelines are to be installed in embankments, fills, or structure backfills, the fill shall be constructed to a level at least one foot above the top of the pipe before the trench is excavated.
- H. If a moveable trench shield is used during excavation operations, the trench width shall be wider than the shield so that the shield is free to be lifted and then moved horizontally without binding against the trench sidewalls. If the trench walls cave in or slough, the trench shall be excavated as an open excavation with sloped sidewalls or with trench shoring, as indicated and as required by the pipe structural design.

3.4 OVER-EXCAVATION NOT ORDERED OR INDICATED

- A. Any over-excavation carried below the grade ordered or indicated, shall be backfilled and compacted to the required grade with the indicated material.

3.5 EXCAVATION IN LAWN AREAS

- A. Where excavation occurs in lawn areas, the sod shall be carefully removed, dampened, and stockpiled to preserve it for replacement. Excavated material may be placed on the lawn; provided, that a drop cloth or other suitable method is employed to protect the lawn from damage. The lawn shall not remain covered for more than 72 hours. Immediately after completion of backfilling and testing of the pipeline, the sod shall be replaced and lightly rolled in a manner so as to restore the lawn as near as possible to its original condition. CONTRACTOR shall provide new sod if stockpiled sod has not been replaced within 72 hours.

3.6 EXCAVATION IN VICINITY OF TREES

- A. Except where trees are indicated to be removed, trees shall be protected from injury during construction operations. No tree roots over 2 inches in diameter shall be cut without express permission of the ENGINEER. Trees shall be supported during excavation by any means previously reviewed by the ENGINEER.

3.7 ROCK EXCAVATION

- A. Rock excavation shall include removal and disposal of the following: (1) all boulders measuring 1/3 of a cubic yard or more in volume; (2) all rock material in ledges, bedding

deposits, and un-stratified masses which cannot be removed without systematic drilling and blasting; (3) concrete or masonry structures which have been abandoned; and (4) conglomerate deposits which are so firmly cemented that they possess the characteristics of solid rock and which cannot be removed without systematic drilling and blasting.

B. Rock excavation shall be performed by the CONTRACTOR; provided, that should the quantity of rock excavation be affected by any change in the scope of the work, an appropriate adjustment of the contract price will be made under a separate bid item if such bid item has been established; otherwise payment will be made in accordance with a negotiated price.

C. Explosives and Blasting

1. Blasting will not be permitted.

3.8 BACKFILL - GENERAL

A. Backfill shall not be dropped directly upon any structure or pipe. Backfill shall not be placed around or upon any structure until the concrete has attained sufficient strength to withstand the loads imposed. Backfill around water retaining structures shall not be placed until the structures have been tested, and the structures shall be full of water while backfill is being placed.

B. Except for drainrock materials being placed in over-excavated areas or trenches, backfill shall be placed after all water is removed from the excavation, and the trench sidewalls and bottom have been dried to a moisture content suitable for compaction.

C. If a moveable trench shield is used during excavation, pipe installation, and backfill operations, the shield shall be moved by lifting the shield free of the trench bottom or backfill and then moving the shield horizontally, The CONTRACTOR shall not drag trench shields along the trench causing damage or displacement to the trench sidewalls, the pipe, or the bedding and backfill.

D. Immediately prior to placement of backfill materials, the bottoms and sidewalls of trenches and structure excavations shall have all loose sloughing, or caving soil and rock materials removed. Trench sidewalls shall consist of excavated surfaces that are in a relatively undisturbed condition before placement of backfill materials.

3.9 PLACING AND SPREADING OF BACKFILL MATERIALS

A. Backfill materials shall be placed and spread evenly in layers. When compaction is achieved using mechanical equipment, the layers shall be evenly spread so that when compacted each layer shall not exceed 6 inches in thickness.

B. During spreading, each layer shall be thoroughly mixed as necessary to promote uniformity of material in each layer. Pipe zone backfill materials shall be manually spread around the pipe so that when compacted the pipe zone backfill will provide uniform bearing and side support.

C. Where the backfill material moisture content is below the optimum moisture content, water shall be added before or during spreading until the proper moisture content is achieved.

- D. Where the backfill material moisture content is too high to permit the specified degree of compaction the material shall be dried until the moisture content is satisfactory.

3.10 COMPACTION OF FILL, BACKFILL, AND EMBANKMENT MATERIALS

- A. Each layer of Types A, B, C, G, H, I, and K backfill materials as defined herein, where the material is graded such that at least 10 percent passes a No. 4 sieve, shall be mechanically compacted to the indicated percentage of density. Equipment that is consistently capable of achieving the required degree of compaction shall be used and each layer shall be compacted over its entire area while the material is at the required moisture content.
- B. Each layer of Type E, F, and J backfill materials shall be compacted by means of at least 2 passes from a flat plate vibratory compactor. When such materials are used for pipe zone backfill, vibratory compaction shall be used at the top of the pipe zone or at vertical intervals of 24 inches, whichever is the least distance from the subgrade.
- C. Fill on reservoir and structure roofs shall be deposited at least 30 days after the concrete roof slab has been placed. Equipment weighing more than 10,000 pounds when loaded shall not be used on a roof. A roller weighing not more than 8,000 pounds shall be used to compact fill on a roof.
- D. Flooding, ponding, or jetting shall not be used for fill on roofs, backfill around structures, backfill around reservoir walls, for final backfill materials, or aggregate base materials.
- E. Equipment weighing more than 10,000 pounds shall not be used closer to walls than a horizontal distance equal to the depth of the fill at that time. Hand operated power compaction equipment shall be used where use of heavier equipment is impractical or restricted due to weight limitations.
- F. Backfill around and over pipelines that is mechanically compacted shall be compacted using light, hand operated, vibratory compactors and rollers. After completion of at least two feet of compacted backfill over the top of pipeline, compaction equipment weighing no more than 8,000 pounds may be used to complete the trench backfill.
- G. **Compaction Requirements:** The following compaction test requirements shall be in accordance with ASTM D 1557 - Test Method for Laboratory Compaction Characteristics of Soils Using Modified Effort (56,000 ft - lbf/ft³) (2,700 kN-m/m³) for Type A, B, C, G, H, I, K, M, and N materials and in accordance with ASTM D 4253 - Standard Test Method for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table, and D 4254 - Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density, for Type B, E, F, and J materials. Where agency or utility company requirements govern, the highest compaction standards shall apply.

<u>Location or Use of Fill</u>	<u>Percentage of Percentage of Maximum Density</u>	<u>Relative Density</u>
Pipe embedment backfill for flexible pipe.	95	70
Pipe bedding and over-excavated zones under bedding for flexible pipe, including trench plugs.	95	70
Pipe embedment backfill for Steel Yard Piping	---	70

Pipe embedment backfill for rigid pipe	90	55
Pipe zone backfill portion above embedment for rigid pipe.	90	70
Pipe bedding and over-excavated zones under bedding for rigid pipe.	95	70
Final backfill, beneath paved areas or structures.	95	70
Final backfill, not beneath paved areas or structures.	90	55
Trench zone backfill, beneath paved areas and structures, including trench plugs.	95	70
Trench zone backfill, not beneath paved areas or structures, including trench plugs.	90	70
Embankments and fills.	90	55
Embankments and fills beneath paved areas or structures.	95	70
Backfill beneath structures and hydraulic structures.	95	70
Backfill and fill around structures on reservoir or structure roof.	90	55
Topsoil (Type K material)	80	N.A.
Aggregate base or subbase (Type G or M material)	95	N.A.

3.11 PIPE AND UTILITY TRENCH BACKFILL

A. Pipe Zone Backfill

1. The pipe zone is defined as that portion of the vertical trench cross-section lying between a plane below the bottom surface of the pipe and a plane at a point above the top surface of the pipe as indicated. The bedding is defined as that portion of pipe zone backfill material between the trench subgrade and the bottom of the pipe. The embedment is defined as that portion of the pipe zone backfill material between the bedding and a level line as indicated.
2. After compacting the bedding the CONTRACTOR shall perform a final trim using a stringline for establishing grade, such that each pipe section when first laid will be

continually in contact with the bedding along the extreme bottom of the pipe. Excavation for pipe bells and welding shall be made as required.

3. The pipe zone shall be backfilled with the indicated backfill material. The CONTRACTOR shall exercise care to prevent damage to the pipeline coating, cathodic bonds, and the pipe itself during the installation and backfill operations.
4. If a moveable trench shield is used during backfill operations the shield shall be lifted to a location above each layer of backfill material prior to compaction of the layer. The CONTRACTOR shall not displace the pipe or backfill while the shield is being moved.

B. **Trench Zone Backfill:** After the pipe zone backfills have been placed, backfilling of the trench zone may proceed. The trench zone is defined as that portion of the vertical trench cross-section lying as indicated between a plane above the top surface of the pipe and a plane at a point 18 inches below the finished surface grade, or if the trench is under pavement, 18 inches below the roadway subgrade.

C. **Final Backfill:** Final backfill is all backfill in the trench cross-sectional area within 18 inches of finished grade, or if the trench is under pavement, all backfill within 18 inches of the roadway subgrade.

3.12 FILL AND EMBANKMENT CONSTRUCTION

A. The area where a fill or embankment is to be constructed shall be cleared of all vegetation, roots and foreign material. Following this, the surface shall be moistened, scarified to a depth of 6 inches, and rolled or otherwise mechanically compacted. Embankment and fill material shall be placed and spread evenly in approximately horizontal layers. Each layer shall be moistened or aerated, as necessary. Unless otherwise approved by the ENGINEER, each layer shall not exceed 6 inches of compacted thickness. The embankment, fill, and the scarified layer of underlying ground shall be compacted to 95 percent of maximum density under structures and paved areas, and 90 percent of maximum density elsewhere.

B. When an embankment or fill is to be made and compacted against hillsides or fill slopes steeper than 4:1, the slopes of hillsides or fills shall be horizontally benched to key the embankment or fill to the underlying ground. A minimum of 12 inches normal to the slope of the hillside or fill shall be removed and re-compacted as the embankment or fill is brought up in layers. Material thus cut shall be re-compacted along with the new material. Hillside or fill slopes 4:1 or flatter shall be prepared in accordance with Paragraph A, above.

C. Where embankment or structure fills are constructed over pipelines, the first 4 feet of fill over the pipe shall be constructed using light placement and compaction equipment that does not damage the pipe. Heavy construction equipment shall maintain a minimum distance from the edge of the trench equal to the depth of the trench until at least 4 feet of fill over the pipe has been completed.

3.13 FIELD TESTING

A. **General:** All field soils testing will be done by a testing laboratory of the OWNER's choice at the OWNER's expense except as indicated below.

B. Where soil material is required to be compacted to a percentage of maximum density, the maximum density at optimum moisture content will be determined in accordance with

Method C of ASTM D 1557. Where cohesionless, free draining soil material is required to be compacted to a percentage of relative density, the calculation of relative density will be determined in accordance with ASTM D 4253 and D 4254. Field density in-place tests will be performed in accordance with ASTM D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method, ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place By Nuclear Methods (Shallow Depth), or by such other means acceptable to the ENGINEER.

- C. In case the test of the fill or backfill show non-compliance with the required density, the CONTRACTOR shall accomplish such remedy as may be required to insure compliance. Subsequent testing to show compliance shall be by a testing laboratory selected by the OWNER and paid by the CONTRACTOR.
- D. The CONTRACTOR shall provide test trenches and excavations including excavation, trench support, and groundwater removal for the OWNER'S field soils testing operations. The trenches and excavations shall be provided at the locations and to the depths required by the OWNER.

- END OF SECTION -

SECTION 02268 - EROSION CONTROL BARRIER

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide erosion control barriers, complete and in place, in accordance with the Contract Documents

1.2 CONTRACTOR SUBMITTALS

- A. Submittals shall be in accordance with Section 01300 - Contractor Submittals:
- B. **Product Data:** Manufacturer's catalog sheets on geotextile fabrics.

PART 2 -- PRODUCTS

2.1 FABRIC

- A. Fabric may be woven or non-woven, made from polypropylene, polyethylene, or polyamid, and shall contain sufficient UV inhibitors so that it will last for 2 years in outdoor exposure.
- B. Fabric shall have the following properties:

Parameter	Standard Method	Value
Grab tensile strength	ASTM D 4632	100 lb
Burst strength	ASTM D 3786	200 psi
Apparent opening size	ASTM D 4751	Between 200 and 70 sieve size

- C. Fabric Manufacturer, or equal:

Mirafi

2.2 POSTS

- A. Posts shall be wood, at least 2 inches by 2 inches, at least 6 feet long.
- B. Posts shall be steel, 1½-inch, T-shaped, at least 6 feet long with protective coating.

2.3 FENCING

- A. Woven wire fabric fencing shall be galvanized, mesh spacing of 6 inches, maximum 14-gauge, at least 30 inches tall.

2.4 FASTENERS

- A. Fasteners to wood posts shall be steel, at least 1½ inches long.

PART 3 -- EXECUTION

3.1 PREPARATION

- A. Provide erosion control barriers as required to prevent erosion and silt loss from the Site.
- B. CONTRACTOR shall not commence clearing, grubbing, earthwork, or other activities which may cause erosion until barriers are in place.

3.2 INSTALLATION

- A. Barrier systems shall be installed in such a manner that surface runoff will percolate through the system in sheet flow fashion and allow sediment to be retained and accumulated.
- B. Attach the woven wire fencing to the posts that are spaced a maximum of 6 feet apart and embedded a minimum of 12 inches. Install posts at a slight angle toward the source of the anticipated runoff.
- C. Trench in the toe of the filter fabric barrier with a spade or mechanical trencher so that the downward face of the trench is flat and perpendicular to the direction of flow. Lay fabric along the edges of the trench. Backfill and compact.
- D. Securely fasten the fabric materials to the woven wire fencing with tie wires.
- E. Reinforced fabric barrier shall have a height of 18 inches.
- F. Provide the filter fabric in continuous rolls and cut to the length of the fence to minimize the use of joints. When joints are necessary, splice the fabric together only at a support post with a minimum 6-inch overlap and seal securely.

3.3 MAINTENANCE

- A. Regularly inspect and repair or replace damaged components of the barrier. Unless otherwise directed, maintain the erosion control system until final acceptance; then remove erosion and sediment control systems promptly.
- B. Remove sediment deposits when silt reaches a depth of 6 inches or ½ the height of the barrier, whichever is less. Dispose of sediments on the Site, if a location is indicated on the Drawings, or at a site arranged by the CONTRACTOR which is not in or adjacent to a stream or floodplain.

- END OF SECTION -

SECTION 02347 - HORIZONTAL DIRECTIONAL DRILLING

PART 1 – SCOPE

1.1 THE REQUIREMENT

- A. This Specification covers the installation of pipe or conduit by horizontal directional drilling. Horizontal directional drilling is a trenchless excavation method which is accomplished in two phases. The first phase consists of drilling a small diameter pilot hole along a designed directional path. The second phase consists of enlarging the pilot hole to a diameter suitable for installation of the pipe or conduit, and pulling the pipe or conduit into the enlarged hole. Horizontal directional drilling is accomplished using a specialized horizontal drilling rig with ancillary tools and equipment.

1.2 EXISTING FACILITIES AND UTILITIES

- A. CONTRACTOR shall undertake the following steps prior to commencing drilling operations in this project location which contains existing underground facilities.
 - 1. Contact the utility location/notification service, for the construction area.
 - 2. Positively locate and stake all existing lines, cables, or other underground facilities including exposing any facilities which are located within 10 feet of the designed drilled path.
 - 3. Modify drilling practices and downhole assemblies to prevent damage to existing facilities.
- B. CONTRACTOR shall be responsible for locating any and all underground facilities regardless of any previous efforts in this regard. CONTRACTOR shall be responsible for all losses and repairs occasioned by damage to underground facilities resulting from drilling operations.

1.3 INSTRUMENTATION

- A. CONTRACTOR shall at all times provide and maintain instrumentation which will accurately locate the pilot hole, measure drill string axial and torsional loads, and measure drilling fluid discharge rate and pressure. The ENGINEER will have access to these instruments and their readings at all times.

1.4 CONTRACTOR SUBMITTALS

- A. All procedure or material descriptions requiring the ENGINEER'S approval shall be submitted not less than three weeks prior to commencing any horizontal directional drilling activities at the crossing location.

PART 2 – PRODUCTS

2.1 POLYVINYL CHLORIDE, C900

- A. The installed pull section shall be as described in Section 02597 - PVC PRESSURE PIPE.

2.2 PILOT HOLE DIRECTIONAL TOLERANCE

- A. **Description:** The pilot hole shall be drilled along the path shown on the plan and profile drawings to the tolerances listed. However, in all cases, right-of-way restrictions shall take precedence over the listed tolerances. Regardless of the tolerance achieved, no pilot hole will be accepted if it will result in any or all of the pipeline being installed in violation of right-of-way restrictions. In all cases, concern for adjacent utilities and/or structures shall take precedence over the listed tolerances. Listing of tolerances does not relieve CONTRACTOR from responsibility for safe operations or damage to adjacent utilities and structures.
- B. **Curve Radius:** Curves shall be drilled at radii which fall within the tolerances listed. The drilled radius will be calculated over any three joint (range 2 drill pipe) segment using the following formula:

$$R_{\text{drilled}} = (L_{\text{drilled}} / A_{\text{avg}}) * 57.32$$

Where:

R_{drilled} = drilled radius over L_{drilled}

L_{drilled} = length drilled, no less than 75 feet and no greater than 100 feet

A_{avg} = total change in angle over L_{drilled}

- C. **As-Built Survey:** At the completion of pilot hole drilling, CONTRACTOR shall provide a tabulation and sealed drawings(s) of coordinates, referenced to the drilled entry point, which accurately describe the location of the pilot hole.

2.3 REAM AND PULL BACK

- A. **Hydrostatic Pretest:** The entire pull section shall be subjected to a four hour hydrostatic test prior to being installed in the hole. The test pressure shall be equal to or exceed that required for final certification. The hydrostatic pretest shall be conducted and documented in accordance with the applicable Specification.
- B. **Pre-Reaming:** Pre-reaming operations shall be conducted at the discretion of CONTRACTOR. All provisions of this Specification relating to simultaneous reaming and pulling back operations shall also pertain to pre-reaming operations.
- C. **Pulling Loads:** The maximum allowable tensile load imposed on the pull section shall be equal to 80% of the product of the specified minimum yield strength of the pipe and the area of the pipe section. If more than one value is involved for a given pull section, the lesser shall govern.
- D. **Torsional Stress:** A swivel shall be used to connect the pull section to the reaming assembly to minimize torsional stress imposed on the section.
- E. **Pull Section Support:** The pull section shall be supported as it proceeds during pull back so that it moves freely and the pipe and corrosion coating are not damaged.
- F. **External Collapse Pressure:** The pull section shall be installed in the reamed hole in such a manner that external pressures are minimized. Any damage to the pipe resulting from external pressure during installation shall be the responsibility of CONTRACTOR.
- G. **Buoyancy Modification:** Buoyancy modification shall be used at the discretion of CONTRACTOR. Any buoyancy modification procedure proposed for use shall be

submitted to ENGINEER for approval. No procedure shall be used which has not been approved. CONTRACTOR is responsible for any damage to the pull section resulting from buoyancy modification.

- H. CONTRACTOR shall provide a sufficient number of rollers, cradles and motorized equipment to support the pipe and prevent over-stressing due to sags or bends during the pull back Procedure.

2.4 DRILLING FLUIDS

- A. **Composition:** The composition of all drilling fluids proposed for use shall be submitted to the ENGINEER for approval. No fluid will be approved or utilized that does not comply with permit requirements and environmental regulations.
- B. **Water:** CONTRACTOR is responsible for obtaining, transporting, and storing any water required for drilling fluids.
- C. **Recirculation:** CONTRACTOR shall maximize recirculation of drilling fluid surface returns. CONTRACTOR shall provide solids control and fluid cleaning equipment of a configuration and capacity that can process surface returns and produce drilling fluid suitable for reuse. The CONTRACTOR will be solely responsible for solids control and cleansing equipment performance or for treatment of excess drilling fluid and drilled spoil.
- D. **Disposal:** Disposal of excess drilling fluids and cuttings is the responsibility of CONTRACTOR and shall be conducted in compliance with all environmental regulations, right-of-way and workspace agreements, and permit requirements.
- E. **Inadvertent Returns:** CONTRACTOR shall employ his best efforts to maintain full annular circulation of drilling fluids. Drilling fluid returns at locations other than the entry and exit points shall be minimized. In the event that annular circulation is lost, CONTRACTOR shall take steps to restore circulation. If inadvertent surface returns of drilling fluids occur, they shall be immediately contained with hand placed barriers (i.e. hay bales, sand bags, silt fences, etc.) and collected using pumps as practical. If the amount of the surface return is not great enough to allow practical collection, the affected area shall be diluted with fresh water and the fluid will be allowed to dry and dissipate naturally. If the amount of the surface return exceeds that which can be contained with hand placed barriers, small collection sumps (less than 5 cubic yards) may be used. If the amount of the surface return exceeds that which can be contained and collected using small sumps, drilling operations shall be suspended until surface return volumes can be brought under control.

PART 3 -- EXECUTION

3.1 TRENCH SAFETY ACT

- A. The CONTRACTOR shall comply with Florida's "Safe Trench Act" in the performance of all work. The CONTRACTOR shall be responsible for the design, installation, maintenance and removal of any sheeting and shoring necessary for the drilling operation, including fluid containment and permitted disposal practices.

3.2 NOISE ABATEMENT

- A. The CONTRACTOR is required to furnish, install and maintain noise control barriers at the site and shall remove them upon the completion of the WORK. These barriers shall include fire retardant sound blankets specifically designed for drilling operations. The blankets shall be at least 20 feet in height from ground level and of a quality to effectively reduce noise from the drilling operation throughout the duration of the WORK. Sound blankets shall be mounted on scaffolding, as required, around the entire work site. Blanketed access gates shall be installed around the rig mast up to and including the monkey board; the work platform; pumps; compressors; and other noisy equipment, as required. Drawwounds and rig engine shall be enclosed with insulated noise barriers. The CONTRACTOR shall equip all machinery and equipment used for construction with noise devices such as mufflers, muffling sleeves, and spark arrestors or other suitable noise suppressor. Electric power shall be used in lieu of internal combustion engine power wherever possible. Air compressors shall be of a quiet type such as a "whisperized" compressor. Metal parts of the rig that come in contact with casing or drill pipe shall be protected by use of wood, rubber or other sound absorbent material, wherever possible.
- B. Noise produced by construction operations shall be kept to a minimum. Noisy operations shall be conducted wherever possible during daylight hours and scheduled to minimize duration. the CONTRACTOR shall comply with all applicable Federal, State, and local noise pollution control regulations. Unless specified otherwise noise levels in connection with the WORK shall not exceed 60 dab at a distance of twenty-five (25) feet for continuous exposure and they shall not exceed 85 dBA at a distance of fifty (50) feet for relatively infrequent intermittent exposure.
- C. Noisy equipment shall be kept as far as possible from noise sensitive site boundaries. Equipment shall be properly maintained to reduce noise from excessive vibration, faulty mufflers, or other sources. No equipment shall be left idling unnecessarily. Noisy operations shall be limited to daylight hours and scheduled to minimize their duration.
- D. To determine whether the noise limits are being met, the CONTRACTOR shall use a portable sound level meter meeting the requirements of the American National Standards Institute Specification S1.2 for Type 2 sound level meters. Sound levels shall be recorded at a minimum of four (4) times daily in the presence of the ENGINEER. If non-complying noise levels are found, the CONTRACTOR shall be responsible for monitoring and correction of excessive noise levels. The CONTRACTOR is required to respond immediately and positively to provide corrective action required to meet the sound attenuation specification.

- END OF SECTION -

SECTION 02556 - REINFORCED CONCRETE PIPE (ASTM C 76, MODIFIED)

PART 1 – GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall construct all reinforced concrete culvert, complete, including connection to existing and new structures, all in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Commercial Standards:

ASTM C76 Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

ASTM C596 Test Method for Drying Shrinkage of Mortar Containing Portland Cement.

1.3 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish certificates to the ENGINEER guaranteeing that the pipe furnished hereunder is in compliance with the requirements of these Specifications.

PART 2 – PRODUCTS

2.1 PIPE MATERIALS

- A. **Reinforced Concrete Pipe:** Reinforced concrete pipe shall conform to the requirements of ASTM Designation C 76 for Class IV, Wall B, and Type II cement; provided, that pipe shall have tongue and groove joint designed to be self-centering and to leave a recess on the inside of the pipe for pointing with mortar after jointing. Pipe shall be designed for an internal pressure of 100 feet of water, and a minimum external load of 2000 – D (D-load to produce a 0.01-inch crack).
- B. **Cement Mortar:** Cement mortar shall consist of a mixture of portland cement, sand, and water. Cement and sand shall first be combined in the proper proportions, and then thoroughly mixed with the required amount of water.
- C. Cement mortar shall be designated by class and proportioned by loose volume in the proportion of 1 part cement to 2 parts sand. The quantity of water to be used in the preparation of mortar shall be only that required to produce a mixture sufficiently workable for the purpose intended.
- D. Mortar shall be used as soon as possible after mixing and shall show no visible signs of setting prior to use. Retempering of mortar will not be permitted.
- E. Cement, sand, and water for cement mortar shall conform to the requirements of Section 03310 - Cast-in-Place Concrete.
- F. **Admixtures:** No admixture shall be used in mortar unless otherwise specified or accepted by the ENGINEER.

- G. **Quick Setting Grout:** Quick setting grout shall be a high strength, non-staining grout approved by the ENGINEER prior to use. It shall reach an initial set within 90 minutes at 70 degrees F (21 degrees C) and shall reach minimum compressive strength of 2,500 psi (17mPa) within 24 hours. Shrinkage shall be less than 0.1 percent when tested, using the test procedures of ASTM C 596. The grout shall be mixed, handled, and placed in accordance with the manufacturer's written instructions.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. The pipe shall be placed with the minor axis of the reinforcement in a vertical position. Mortar for jointing pipe shall be composed of 1 part of cement and 2 parts of clean, well-graded sand of such size that all will pass a No. 8 sieve. The consistency of laying mortar shall be such that it will adhere to the ends of the pipe while being laid and be easily squeezed out of the joint when the pipe sections are pressed together. Pointing and bonding mortar shall be plastic and of such consistency that it will readily adhere to the pipe.
- B. In advance of jointing sections of concrete pipe, the ends of each section shall be washed clean with a wet brush and, immediately prior to placing mortar and jointing the sections, the ends shall be thoroughly wetted. After laying, the joints on the inside shall be swabbed smooth, and all excess mortar shall be removed from the pipe, after which backfilling shall be performed.
- C. Backfill over the pipe shall not be commenced within 16 hours of jointing pipe sections. Care shall be used to make sure that the bottom of the pipe is in contact with the bottom of the trench for the full length of each section.

- END OF SECTION -

SECTION 02565 - DUCTILE IRON PIPE (AWWA C151, MODIFIED)

PART 1 – GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide ductile iron pipe and all appurtenant work, complete in place, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Commercial Standards:**

ANSI/AWWA C104/A21.4	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
ANSI/AWWA C110/A21.10	Ductile-Iron and Gray-Iron Fittings, 3 in Through 48 in for Water and Other Liquids
ANSI/AWWA C111/A21.11	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
ANSI/AWWA C115/A21.15	Flanged Ductile-Iron and Gray-Iron Pipe with Threaded Flanges
ANSI/AWWA C150/A21.50	Thickness Design of Ductile-Iron Pipe
ANSI/AWWA C151/A21.51	Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
ANSI/AWWA C153/A21.53	Ductile-Iron Compact Fittings, 3 in. Through 12 in. for Water and Other Liquids
AWWA C209	Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
AWWA C214	Tape Coating Systems for the Exterior of Steel Water Pipelines
AWWA C600	Installation of Ductile Iron Water Mains and Their Appurtenances
ASTM C 150	Specification for Portland Cement

1.3 CONTRACTOR SUBMITTALS

- A. **Shop Drawings:** The CONTRACTOR shall submit shop drawings of pipe and fittings in accordance with the requirements in Section 01300 - Contractor Submittals, the requirements of the referenced standards and the following supplemental requirements as applicable:

1. Certified dimensional drawings of all valves, fittings, and appurtenances.
2. For pipe 24 inches in diameter and larger, line layout and marking diagrams which indicate the specific number of each fitting and the location and the direction of each fitting in the completed line. In addition, the line layouts shall include: the pipe station and invert elevation at all changes in grade or horizontal alignment; all elements of curves and bends, both in horizontal and vertical alignment; and the limits of each reach of restrained joints, or of concrete encasement.

B. Certifications: The CONTRACTOR shall furnish a certified affidavit of compliance for all pipe and other products or materials furnished under this Section of the Specifications, as specified in the referenced standards and the following supplemental requirements:

1. Physical and chemical properties.
2. Hydrostatic test reports.

C. The CONTRACTOR shall be responsible for performing and paying for sampling and testing as necessary for the certifications.

1.4 QUALITY ASSURANCE

A. Inspection: All pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of the referenced standards, as supplemented by the requirements herein. The CONTRACTOR shall notify the ENGINEER in writing of the manufacturing starting date not less than 14 calendar days prior to the start of any phase of the pipe manufacture.

B. During the manufacture of the pipe, the ENGINEER shall be given access to all areas where manufacturing is in process and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.

C. Tests: Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of the referenced standards as applicable.

D. The CONTRACTOR shall perform said material tests at no additional cost to the OWNER. The ENGINEER shall have the right to witness all testing conducted by the CONTRACTOR; provided, that the CONTRACTOR's schedule is not delayed for the convenience of the ENGINEER.

E. In addition to those tests specifically required, the ENGINEER may request additional samples of any material including lining and coating samples for testing by the OWNER. The additional samples shall be furnished as a part of the WORK.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Mortar-lined ductile iron pipe shall conform to ANSI/AWWA C151, C104, and C105, subject to the following supplemental requirements. The pipe shall be of the diameter and class shown, shall be furnished complete with rubber gaskets as indicated in the Contract Documents, and all specials and fittings shall be provided as required under the Contract

Documents.

- B. **Markings:** The CONTRACTOR shall legibly mark specials 24 inches in diameter and larger in accordance with the laying schedule and marking diagram. All fittings shall be marked at each end with top field centerline.
- C. **Handling and Storage:** The pipe shall be handled by devices acceptable to the ENGINEER, designed and constructed to prevent damage to the pipe coating/exterior. The use of equipment which might injure the pipe coating/exterior will not be permitted. Stockpiled pipe shall be suitably supported and shall be secured to prevent accidental rolling. All other pipe handling equipment and methods shall be acceptable to the ENGINEER.
- D. **Laying Lengths:** Maximum pipe laying lengths shall be 20 ft with shorter lengths provided as required by the Drawings.
- E. **Finish:** The pipe shall have smooth dense interior surfaces and shall be free from fractures, excessive interior surface crazing and roughness.
- F. **Closures and Correction Pieces:** Closures and correction pieces shall be provided as required so that closures may be made due to different headings in the pipe laying operation and so that correction may be made to adjust the pipe laying to conform to pipe stationing shown on the Drawings. The locations of correction pieces and closure assemblies are shown on the Drawings. Any change in location or number of said items shall be acceptable to the ENGINEER.

2.2 PIPE DESIGN CRITERIA

- A. **General:** Ductile iron pipe shall be designed in accordance with the requirements of ANSI/AWWA C150 as applicable and as modified in this Section.
- B. **Pipe Wall Thickness for Internal Pressure:** The pipe shall be designed with a net thickness to withstand the design pressure in accordance with the hoop stress formula.
- C. **Pipe Wall Thickness for External Load:** The pipe shall also be designed with a net thickness to withstand external loads using ANSI/AWWA C150 Design Equation (2) with the appropriate bending moment and deflection coefficients for Laying Condition Types 4 and 5 as applicable.
- D. The pipe deflection shall be checked using ANSI/AWWA C150 Design Equation (3) and the coefficients stated above. The allowable deflection shall not exceed 0.0225 times the nominal diameter.
- E. In lieu of ANSI/AWWA C150 Design Equation (4), the earth loads will be computed using the following 2 equations for trench or embankment loading as applicable:

1. Trench Condition:

$$W_d = C_d W B_d^2$$

Where:

- W_d = Earth Load in pounds per linear foot
- C_d = Calculation Coefficient
- Ku' = 0.13

w = 120 lb/ft³
B_d = Trench width at top of pipe, feet

2. Positive Projecting Embankment Condition:

$$W_c = C_c w B_c^2$$

Where: W_c = Earth Load in pounds per linear foot
C_c = Calculation Coefficient (based on r_{sd}P of 0.25)
K_u = 0.19
w = 120 lb/ft³
B_c = Outside diameter of pipe, feet

- F. The above 2 formulas are based on a depth of cover of 10 feet or greater. For depths of cover of less than 10 feet, HS-20 live load shall be included. For depths of cover of 3 feet or less, HS-20 live load plus impact shall be included. The determination of live load and impact factors shall be as recommended by AASHTO in "Standard Specifications for Highway Bridges."
- G. If the calculated deflection, Defl_x, exceeds 0.0225 times the nominal diameter, the pipe class shall be increased.
- H. **Minimum Pipe Wall Thickness:** In addition to the requirements of this Section, the minimum wall thickness shall be in accordance with Table 50.5 of ANSI/AWWA C150.

2.3 MATERIALS

- A. **Ductile Iron Pipe:** Pipe materials shall conform to the requirements of ANSI/AWWA C151.
- B. **Cement:** Cement for mortar lining shall conform to the requirements of ANSI/AWWA C104; provided, that cement for mortar lining, shall be Type II or V. Cement shall not originate from kilns which burn metal-rich hazardous waste fuel, nor shall a fly ash or pozzolan be used as a cement replacement.

2.4 SPECIALS AND FITTINGS

- A. Fittings for ductile iron pipe shall conform to the requirements of ANSI/AWWA C153/A21.53 or ANSI/AWWA C110/A21.10 for diameters 3-inch through 48-inch and shall have a minimum pressure rating of 250 psi. Ductile iron fittings larger than 48-inch shall conform to the above referenced standard with the necessary modifications for the larger size.

2.5 DESIGN OF PIPE

- A. **General:** The pipe furnished shall be ductile iron pipe, mortar-lined, with rubber-gasketed joints as shown.
- B. The pipe shall be designed, manufactured, tested, inspected, and marked according to applicable requirements previously stated and except as hereinafter modified, shall conform to ANSI/AWWA C151.
- C. **Pipe Dimensions:** The pipe shall be of the diameter and class shown. The minimum wall

thickness for each pipe size shall be as specified or shown.

- D. **Fitting Dimensions:** The fittings shall be of the diameter and class shown.
- E. **Joint Design:** Ductile iron pipe and fittings shall be furnished with mechanical joints, push-on joints, flanged joints, and restrained joints as required.
 - 1. Mechanical and push-on joints shall conform to ANSI/AWWA C111/A21.11.
 - 2. Flanged joints shall conform to ANSI/AWWA C115/A21.15.
 - 3. Restrained joints shall be "Flex-Ring" or "Lok-Ring" Restrained Joint by American Ductile Iron Pipe, "TR FLEX" Restrained Joint by U.S. Pipe, Super-Lock by McWayne, SnapLok, BoltLok by Griffen.
- F. For bell-and-spigot ends with rubber gaskets, the clearance between the bells and spigots shall be such that when combined with the gasket groove configuration and the gasket itself, will provide watertight joints under all operating conditions when properly installed. The CONTRACTOR shall require the pipe manufacturer to submit details complete with significant dimensions and tolerances and also to submit performance data indicating that the proposed joint has performed satisfactorily under similar conditions. In the absence of a history of field performance, the results of a test program shall be submitted.
- G. Shop-applied interior linings and exterior coatings shall be held back from the ends of the pipe as shown or as otherwise acceptable to the ENGINEER.

2.6 CEMENT-MORTAR LINING

- A. **Cement-Mortar Lining for Shop Application:** Except as otherwise provided herein, interior surfaces of all ductile iron pipe, fittings, and specials shall be cleaned and lined in the shop with cement-mortar lining applied centrifugally in conformity with ANSI/AWWA C104. During the lining operation and thereafter, the pipe shall be maintained in a round condition by suitable bracing or strutting. The lining machines shall be of a type that has been used successfully for similar work. Every precaution shall be taken to prevent damage to the lining. If lining is damaged or found faulty at delivery site, the damaged or unsatisfactory portions shall be replaced with lining conforming to these Specifications.
- B. The minimum lining thickness shall be as follows:

<u>Nominal Pipe Diameter (in)</u>	<u>Minimum Lining Thickness (in)</u>
3-12	1/8
14-24	3/16
30-54	1/4

- C. **Protection of Pipe Lining/Interior:** All shop-applied cement mortar lining shall be given a seal coat of asphaltic material in conformance with ANSI/AWWA C104.

2.7 EXTERIOR COATING OF PIPE

- A. **Exterior Coating of Exposed Piping:** The exterior surfaces of pipe which will be exposed to the atmosphere inside structures or above ground shall be thoroughly cleaned

and then given a shop coat of rust-inhibitive primer conforming to the requirements of Section 09800, "Protective Coating."

- B. **Exterior Coating of Buried Piping:** The exterior coating shall be an asphaltic coating approximately 1 mil thick.

PART 3 – EXECUTION

3.1 INSTALLATION OF PIPE

- A. **Handling and Storage:** All pipe, fittings, etc., shall be carefully handled and protected against damage, impact shocks, and free fall. All pipe handling equipment shall be acceptable to the ENGINEER. Pipe shall not be placed directly on rough ground but shall be supported in a manner which will protect the pipe against injury whenever stored at the trench site or elsewhere. No pipe shall be installed where the lining or coating show defects that may be harmful as determined by the ENGINEER. Such damaged lining or coating shall be repaired, or a new undamaged pipe shall be furnished and installed.
- B. All pipe damaged prior to Substantial Completion shall be repaired or replaced by the CONTRACTOR.
- C. The CONTRACTOR shall inspect each pipe and fitting prior to installation to insure that there are no damaged portions of the pipe.
- D. Before placement of pipe in the trench, each pipe or fitting shall be thoroughly cleaned of any foreign substance, which may have collected thereon and shall be kept clean at all times thereafter. For this purpose, the openings of all pipes and fittings in the trench shall be closed during any interruption to the WORK.
- E. **Pipe Laying:** The pipe shall be installed in accordance with ANSI/AWWA C600.
- F. Pipe shall be laid directly on the [imported] bedding material. No blocking will be permitted, and the bedding shall be such that it forms a continuous, solid bearing for the full length of the pipe. Excavations shall be made as needed to facilitate removal of handling devices after the pipe is laid. Bell holes shall be formed at the ends of the pipe to prevent point loading at the bells or couplings. Excavation shall be made as needed outside the normal trench section at field joints to permit adequate access to the joints for field connection operations and for application of coating on field joints.
- G. Each section of pipe 24 inches in diameter and larger shall be laid in the order and position shown on the laying schedule. In laying pipe, it shall be laid to the set line and grade, within approximately one inch plus or minus. On grades of zero slope, the intent is to lay to grade.
- H. Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the ENGINEER may change the alignment and/or the grades. Such change shall be made by the deflection of joints, by the use of bevel adapters, or by the use of additional fittings. However, in no case shall the deflection in the joint exceed the maximum deflection recommended by the pipe manufacturer. No joint shall be misfit any amount which will be detrimental to the strength and water tightness of the finished joint.
- I. Except for short runs which may be permitted by the ENGINEER, pipes shall be laid uphill

on grades exceeding 10 percent. Pipe which is laid on a downhill grade shall be blocked and held in place until sufficient support is furnished by the following pipe to prevent movement. All bends shall be properly installed as shown.

- J. **Pipe and Specials Protection:** The openings of all pipe and specials shall be protected with suitable bulkheads to prevent unauthorized access by persons, animals, water or any undesirable substance. At all times, means shall be provided to prevent the pipe from floating.
- K. **Pipe Cleanup:** As pipe laying progresses, the CONTRACTOR shall keep the pipe interior free of all debris. The CONTRACTOR shall completely clean the interior of the pipe of all sand, dirt, mortar splatter and any other debris following completion of pipe laying, pointing of joints and any necessary interior repairs prior to testing and disinfecting the completed pipeline.

3.2 RUBBER GASKETED JOINTS

- A. **Rubber Gasketed Joints:** Immediately before jointing pipe, the bell end of the pipe shall be thoroughly cleaned, and a clean rubber gasket lubricated with an approved vegetable-based lubricant shall be placed in the bell groove. The spigot end of the pipe shall be carefully cleaned and lubricated with a vegetable-based lubricant. The spigot end of the pipe section shall then be inserted into the bell of the previously laid joint and telescoped into its proper position. Tilting of the pipe to insert the spigot into the bell will not be permitted.

3.3 INSTALLATION OF PIPE APPURTENANCES

- A. **Installation of Valves:** All valves shall be handled in a manner to prevent any injury or damage to any part of the valve. All joints shall be thoroughly cleaned and prepared prior to installation. The CONTRACTOR shall adjust all stem packing and operate each valve prior to installation to insure proper operation.
- B. All valves shall be installed so that the valve stems are plumb and in the location shown.

- END OF SECTION -

SECTION 02597 - PVC PRESSURE PIPE, RUBBER JOINTS (AWWA C900, MODIFIED)

PART 1 – GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide polyvinyl chloride (PVC) pressure pipe, complete in place, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards:

ANSI/AWWA C104/A21.5	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
ANSI/AWWA C110/A21.10	Ductile-Iron and Gray-Iron Fittings 3-in Through 48-in for Water and Other Liquids
ANSI/AWWA C111/A21.11	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
ANSI/AWWA C600	Installation of Ductile-Iron Water Mains and Appurtenances
ANSI/AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe 4-in Through 12-in for Water Distribution
ASTM D 2584	Test Method for Ignition Loss of Cured Reinforced Resins
PPI Technical Report TR 3/4	Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials
AWWA Manual M23	PVC Pipe - Design and Installation

1.3 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 01300 - Contractor Submittals.
- B. **Shop Drawings:** Drawings of pipe, fittings, and appurtenances. Design calculations to demonstrate compliance of pipe and fittings with this Section. MANUFACTURER'S literature for metallic locating tape.
- C. **Certifications:** A certified affidavit of compliance for pipe and other products or materials under this Section and the following supplemental requirements:
1. Hydrostatic proof test reports.
 2. Sustained pressure test reports.

3. Burst strength test reports.

- D. The CONTRACTOR shall be responsible for performing and paying for sampling and testing as necessary for the certifications.

1.4 QUALITY ASSURANCE

- A. **Inspection:** Pipe shall be subject to inspection at the place of manufacture. The CONTRACTOR shall notify the ENGINEER in writing of the manufacturing starting date not less than 14 calendar days prior to the start of any phase of the pipe manufacture.
- B. During manufacture of the pipe, the ENGINEER shall be given access to all areas where manufacturing is in process and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.
- C. **Tests:** Materials used in manufacture of the pipe shall be tested in accordance with the requirements of this Section and the referenced standards, as applicable.
- D. The CONTRACTOR shall perform said material tests. The ENGINEER shall have the right to witness testing; provided, that the CONTRACTOR'S schedule is not delayed for the convenience of the ENGINEER.
- E. In addition to those tests specifically required, the ENGINEER may request additional samples of any material for testing by the OWNER. The additional samples shall be furnished as a part of the WORK.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. PVC pressure pipe (4-inch through 12-inch) shall conform to the applicable requirements of ANSI/AWWA C900 subject to additional requirements herein.

2.2 PIPE DESIGN CRITERIA

- A. **General:** PVC pressure pipe shall be designed in accordance with the requirements of Appendix A of ANSI/AWWA C900, as applicable, and the supplemental requirements in this Section.
- B. **Pipe Wall Thickness for Internal Pressure:** The pipe shall be designed with a minimum thickness (t) or dimension ratio (DR) in accordance with paragraph A.3 of the above referenced Appendix A.
- C. **Determination of External Loads:** Instead of the equations in paragraph A.4 of the above referenced Appendix A, the dead (earth) loads shall be computed using the following 2 equations for trench or embankment conditions as applicable:

1. Trench Condition:

$$W_d = C_d W B_d^2$$

Where: W_d = Earth load in pounds per linear foot
 C_d = Calculation coefficient

K_u' = 0.13
 w = 130 lb/ft³
 B_d = Trench width at top of pipe, feet

2. Positive Projecting Embankment Condition:

$$W_c = C_c w B_c^2$$

Where: W_c = Earth load in pounds per linear foot
 C_c = Calculation coefficient (based on $r_{sd}P$ of 0.75)
 K_u = 0.19
 w = 130 lb/ft³
 B_c = Outside diameter of pipe, feet

- D. Instead of the equations in paragraph A.4, the truck live loads shall be determined using the method recommended by AASHTO in "Standard Specifications for Highway Bridges." For depths of cover less than 10 feet HS-20 live loads shall be added to the earth loads to determine the total load. For depths of cover 3 feet or less, HS-20 live load plus impact shall be included.
- E. **Deflection Control:** With reference to paragraph A.5, the deflection of the pipe after installation shall not exceed 0.03 times the outside diameter. If the calculated deflection exceeds 0.03 times the outside diameter the pipe class shall be increased or the quality of the pipe zone backfill shall be improved to achieve a higher modulus of soil reaction, E' . For purposes of calculation, values of E' shall be 1100 psi at 90 percent Standard Proctor; 1500 psi at 95 percent Standard Proctor; and 2500 psi at 100 percent Standard Proctor. Similarly, the deflection lag factor shall be 1.5.

2.3 PIPE

- A. The pipe shall be of the diameter and pressure class specified or shown, shall be furnished complete with rubber gaskets, and all specials and fittings shall be provided as required in the Contract Documents. The dimensions and pressure classes for Dimension Ratios for large PVC pressure pipe with Cast-Iron Pipe Equivalent O.D.'s shall conform to the requirements of AWWA C900.
- B. **Additives and Fillers:** Unless otherwise allowed in alternate qualification procedures of PPI-TR3, compounds which have a Hydrostatic Design Basis (HDB) of 4000 psi at 73.4 degrees F and for water shall not contain additives and fillers that exceed the recommended values in Table 1, Part Y of PPI-TR3 (e.g., allowable content range for calcium carbonate is 0.0-5.0 parts per hundred of resin). If requested by the ENGINEER, the additive and filler content shall be determined using the pyrolysis method as specified in ASTM D 2584.
- C. **Joints:** Joints for the buried PVC pipe shall be either an integral bell manufactured on the pipe or a separate coupling both employing a rubber ring joint. The bell and coupling shall be the same thickness as of the pipe barrel, or greater thickness. The sealing ring groove in the coupling shall be of the same design as the groove in cast iron fittings and valves available from local water works supply distributors. Where indicated, restrained joint pipe shall be ductile iron pipe. No restrained joint PVC pipe will be allowed.

- D. **Joint Deflection:** Deflection at the joint shall not exceed 1.5 degrees or the maximum deflection recommended by the MANUFACTURER. No deflection of the joint shall be allowed for joints which are over-belled or not belled to the stop mark.

2.4 SPLINE-COUPLED PVC PIPE

- A. **Materials:** Pipe-couplings shall be made from unplasticized PVC compounds having a minimum cell classification of 12454-B, as defined in ASTM D 1784. The compound shall qualify for a hydrostatic design basis of 4000 psi for water at 73.4° F, in accordance with the requirements of ASTM D2837.
- B. **Joints:** Pipe shall be joined using non-metallic couplings which, together, have been designed as an integral system. High-strength flexible thermoplastic splines shall be inserted into mating precision-machined grooves in the pipe and coupling to provide full 360° restraint with evenly distributed loading.

2.5 PIPE DESIGN SCHEDULE

<u>Pipe Designation or Pipe Class</u>	<u>Nom. Diam. (in)</u>	<u>Maximum Sustained Pressure, P_w (psi)</u>	<u>Cover Range (feet)</u>	<u>Trench Condition Outside Diam+(ft)</u>	<u>Minimum Compaction (percent)</u>
100-5	4	100	5	OD+2	90

2.6 FITTINGS

- A. Fittings shall be ductile iron and shall conform to the requirements of AWWA C110, Class 250. PVC pipe fittings shall be mechanical joint.
- B. All fittings shall be lined and coated in accordance with the requirements of Section 09800 - Protective Coating.
- C. Each fitting shall be clearly labeled to identify its size and pressure class.

PART 3 – EXECUTION

3.1 GENERAL

- A. Laying, jointing, testing for defects and for leakage shall be performed in the presence of the ENGINEER, and shall be subject to approval before acceptance. Material found to have defects will be rejected and the CONTRACTOR shall promptly remove such defective materials from the Site.
- B. Installation shall conform to the requirements of AWWA M23, instructions furnished by the pipe MANUFACTURER, and to the supplementary requirements herein. Wherever the provisions of this Section and the aforementioned requirements are in conflict, the more stringent provision shall apply.

3.2 HANDLING AND STORAGE

- A. **Handling:** Pipe, fittings and accessories shall be carefully inspected before and after installation and those found defective shall be rejected. Pipe and fittings shall be free

from fins and burrs. Before being placed in position, pipe, fittings, and accessories shall be cleaned, and shall be maintained in a clean condition. Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall pipe, fittings or any other material be dropped or dumped into trenches.

- B. **Storage:** Pipe should be stored, if possible, at the Site in unit packages provided by the MANUFACTURER. Caution should be exercised to avoid compression damage or deformation to bell ends of the pipe. Pipe should be stored in such a way as to prevent sagging or bending and be protected from exposure to direct sunlight by covering with an opaque material while permitting adequate air circulation above and around the pipe. Gaskets should be stored in a cool, dark place out of the direct rays of the sun, preferably in original cartons.

3.3 TRENCHING AND BACKFILL

- A. Trench excavation and backfill shall conform to the requirements of Section 02200 - Earthwork.

3.4 INSTALLATION

- A. Bell-and-spigot pipe shall be laid with the bell end pointing in the direction of laying. Pipe shall be graded in straight lines, taking care to avoid the formation of any dips or low points. Pipe shall not be laid when the conditions of trench or weather are unsuitable. At the end of each days work, open ends of pipe shall be closed temporarily with wood blocks or bulkheads.
- B. Pipe shall be supported at its proper elevation and grade, care being taken to secure firm and uniform support. Wood support blocking will not be permitted. The full length of each section of pipe and fittings shall rest solidly on the pipe bed, with recessed excavation to accommodate bells, joints, and couplings. Anchors and supports shall be provided where indicated and where necessary for fastening work into place. Fittings shall be independently supported.
- C. Short lengths of pipe shall be used in and out of each rigid joint or rigid structure. Piping that does not allow sufficient space for proper installation of jointing material shall be replaced by one of proper dimensions. Blocking or wedging between bells and spigots will not be permitted.
- D. Joints shall be installed according to MANUFACTURER'S recommendations. Trenches shall be kept free of water until joints have been properly made. The maximum combined deflection at any coupling shall be in accordance with the MANUFACTURER'S recommendations.
- E. Pipe shall be cut by means of saws, power driven abrasive wheels, or pipe cutters, which will produce a square cut. No wedge-type roller cutters will be permitted. After cutting, the end of the pipe shall be beveled using a beveling tool, portable type sander, or abrasive disc.

3.5 INSTALLATION OF SPLINE-COUPLED PVC PIPE

- A. The pipeline shall not be bent to a radius less than that shown below:

<u>Pipe Diameter</u>	<u>Minimum Radius of Curvature</u>	<u>Offset per 20' Length</u>	<u>Deflection per 20' Length</u>
4"	100'	23"	11.5 degrees

3.6 INSTALLATION OF COPPER WIRE

- A. Polyvinyl chloride pipelines shall be provided with No. 10 A.W.G. bare copper wire laid along the top of the pipe and held in place with ties or hitches of the same kind of wire spaced not more than 13 feet apart, or metallic locating tape laid along the centerline of the pipe trench at a depth of 18 inches below finish grade. In such case, the CONTRACTOR shall furnish MANUFACTURER'S literature, completely describing the tape proposed to be furnished. No tape shall be used prior to receipt of written approval of the ENGINEER.

3.7 SERVICE CONNECTIONS

- A. **Service Connections:** Direct tapping will not be permitted. Double strap bronze service clamps shall be used for all service connections. Service clamps shall have a bearing area of sufficient width along the axis of the pipe, so that the pipe will not be distorted when the saddle is made tight. An internal shell cutter shall be used to drill through the corporation stop to minimize PVC shavings, retain the coupon, and reduce stress. Single fluted shell cutters or twist drills are not acceptable. Lubricate the cutting and tapping edges of the tool with cutting lubricant. Make the cuts slowly and use the follower very lightly - do not force cutter through pipe wall. Shell cutter shall have sufficient throat depth to handle the heavy wall PVC pipe. Maximum outlet size permitted with service clamps or saddle is 2 inches.
- B. Tapping sleeves and valves shall be used for all outlet sizes greater than 2 inches in diameter. Tapping sleeves shall be assembled and installed in accordance with the MANUFACTURER'S recommendations.

3.8 CONNECTIONS TO EXISTING WATERLINES

- A. The CONTRACTOR shall locate all underground improvements and install the pipelines to the depths indicated. Where the new work is to be connected to existing pipelines, the CONTRACTOR shall make its arrangements with the serving utility well in advance of the connections, to allow adequate time for dewatering of the existing line, if necessary, and shall expedite the work to minimize water outages to the users. Where sections of existing distribution mains are taken permanently out of service and abandoned in place, the cut ends shall be plugged solid with concrete to a depth of not less than one pipe diameter.

3.9 FIELD TESTING AND DISINFECTION

- A. Field testing and disinfection and water mains shall conform to the requirements of Section 02643 - Water Pipeline Testing and Disinfection.

- END OF SECTION -

SECTION 02633 - CLASS V AQUIFER STORAGE AND RECOVERY WELL AND FLORIDAN AQUIFER MONITOR WELL

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall construct, test, and disinfect, one Class V Aquifer Storage and Recovery (ASR) well, one Floridan Aquifer monitor well (FAMW), four water table monitoring wells, a temporary containment structure and ancillary piping and appurtenances in accordance with the requirements of the Contract Documents. The WORK shall be in accordance with the Technical Specifications and Contract Documents at all times. The work shall be completed according to the following outline:

B. Preparation and Mobilization (ASR well and FAMW)

1. Site clearing, excavation and placement of structural fill.
2. Set pit casing for ASR well and FAMW.
3. Construction of temporary containment structure for both ASR well and FAMW, foundation, and containment walls
4. Installation of water table monitor wells around temporary containment structure(s).
5. Equipment set-up.
6. Installation of temporary services.

C. FAMW Well Drilling and Testing

1. The CONTRACTOR is hereby advised that this listing is representative of the WORK, but the sequence of testing such as coring, straddle packer testing and geophysical logging may be changed by the ENGINEER relative to order of occurrence, or deleted, or additional testing may be added. No drilling or testing on the ASR well shall take place until Part 1.1 B. is complete to the satisfaction of the ENGINEER.
 - a. Complete 12.25-inch pilot hole using mud rotary method to approximately 220 ft
 - b. Complete Long and Short Normal Resistivity (LSN) or similar, Spontaneous Potential (SP), Gamma Ray (GR) and Caliper geophysical Logs
 - c. Ream 34-inch hole using mud rotary method to approximately 200 ft
 - d. Complete Caliper log in reamed borehole
 - e. Install and cement 24-inch steel conductor casing to approximately 200 ft
 - f. Complete cement top logs, if necessary
 - g. Complete 12.25-inch diameter pilot hole using mud rotary method to approximately 1,020 ft
 - h. During Completion of 12.25-inch diameter pilot hole, collect continuous cores from approximately 925 ft to 1,020 ft

- i. Upon completion of pilot hole to 1020 feet bls, perform Dual-Induction (DI), SP, GR, Bonehole Compensated Sonic (BHC), and caliper, geophysical logs
 - j. Ream nominal 24-inch hole using mud rotary method to approximately 975 ft
 - k. Complete caliper geophysical log
 - l. Install and cement 14-inch diameter steel casing to approximately 975 ft
 - m. Complete cement top logs if necessary
 - n. Complete 12.25-inch diameter pilot hole to approximately 1,650 ft using reverse air method
 - o. During completion of 12.25-inch pilot hole to 1,650 ft, collect continuous cores from 1,020 ft to 1,210 ft. Between 1,210 and 1,650 ft, collect 10-ft core samples every 30-ft.
 - p. During completion of 12.25-inch pilot hole to 1,650 ft, collected water samples and measure flow rate every 30 ft during drilling
 - q. Complete DI, SP, GR, caliper, Borehole Compensated (BHC) Sonic with Variable Density Log (VDL), digital borehole televiewer (BHTV), video survey; conduct static and dynamic fluid resistivity, temperature, and flow meter geophysical logs in the 12.25-inch diameter borehole below 975 feet.
 - r. Conduct Packer tests in the 12.25-inch diameter borehole
 - s. Backfill borehole with cement to approximately 1,200 ft, or to a depth selected by the ENGINEER
 - t. Install and cement 6.625-inch diameter fiberglass casing to approximately 1,080 ft, using cement basket or external casing packer or equivalent
 - u. Complete cement top logs, if necessary.
 - v. Set temporary bridge plug or packer
 - w. Pressure test casing
 - x. Remove temporary bridge plug or packer
 - y. Develop Well
 - z. Conduct caliper log; also perform Static and Dynamic Fluid Resistivity, Temperature, and Flow Meter geophysical logs in the open borehole under free flowing conditions.
1. Complete Video log
 2. Conduct pumping test
 3. Collect background water samples
 4. Disinfect well

D. ASR Well Drilling and Testing

Preparation and mobilization (pit casing, pad, and water table monitoring wells) were previously performed as part of preparations outlined in 1.1.B, above). No drilling shall commence on the construction of the ASR well until after approval to proceed from the ENGINEER, and a minimum of 24 hour notification to the water plant superintendent.

1. Complete 12.25-inch pilot hole using mud rotary method to 220 feet bls
2. Complete LSN, SP, GR, and Caliper geophysical Logs
3. Ream nominal 44-inch borehole using mud rotary method to 200 ft bls
4. Complete caliper log in reamed borehole
5. Install and cement 34-inch diameter steel conductor casing to 200 ft bls
6. Complete cement top logs, if necessary
7. Complete 12.25-inch diameter pilot hole using mud rotary method to 1,080 ft bls (or depth determined during drilling of FAMW)

8. During drilling of 12.25-inch diameter pilot hole, collect continuous cores from 925 ft to 1,080 ft
9. Upon completion of pilot hole, perform DI, SP, GR, BHC sonic and caliper geophysical logs
10. Ream nominal 34-inch hole using mud rotary method to 1,080 ft bls
11. Complete caliper geophysical log in reamed borehole
13. Install and cement 24-inch casing to 1,080 ft bls
14. Complete cement top logs (if needed) and cement bond log
15. Pressure test casing
16. Complete 12.25-inch diameter pilot hole to 1,200 ft bls (or depth determined by FAMW) using reverse air method
17. During completion of 12.25-inch pilot hole to 1,200 ft bls , collect continuous in the interval between 1080 ft and 1200 ft bls
18. Collect water samples and measure flow rate every 30 ft during drilling of 12.25-inch pilot hole from 1,080 ft to 1,200 ft
19. Upon completion of pilot hole, perform DI, SP, GR, Caliper, BHC Sonic, BHTV, Video Survey, Static and Dynamic Fluid Resistivity, Temperature, and Flow Meter geophysical logs in the open borehole.
20. Conduct Packer tests as directed by the ENGINEER
21. Ream nominal 24-inch borehole to 1,200 ft bls (or depth determined by FAMW drilling)
22. Develop Well
23. Conduct caliper log; also perform Static and Dynamic Fluid Resistivity, Temperature, and Flow Meter Geophysical logs in the open borehole under free flowing conditions.
24. Complete Video log
25. Conduct pumping tests
26. Collect background water samples
27. Disinfect well

1.2 CONTRACTOR SUBMITTALS

- A. **General:** All CONTRACTOR submittals shall conform to the applicable requirements of Section 01300, "Contractor Submittals," and the supplementary requirements specified.
- B. **Equipment List:** The CONTRACTOR shall submit a list of the equipment it proposes to utilize on the project which shall include manufacturer's load capacities, horsepower, and year of manufacture and year of purchase by the present owner.
- C. **Material and Supplier's List.** The CONTRACTOR shall submit a complete list of all proposed vendors and material specifications to be used in the work.
- D. **Subcontractor's List.** The CONTRACTOR shall submit a complete list of all proposed subcontractors to be used in the work. Each subcontractor shall be approved by the ENGINEER. The CONTRACTOR may be required to submit additional information or a resume of qualifications for any of the subcontractors proposed. The ENGINEER reserves the right to disapprove the use of any subcontractor proposed.
- E. **Survey Measuring Point:** The CONTRACTOR shall establish a survey measuring point relative to the National Geodetic Vertical Datum (NGVD) of 1929. The surveyed elevation shall be reported to the ENGINEER before drilling commences. A qualified

surveying subcontractor shall be used to establish this datum. All depths shall be referenced to this measuring point.

- F. **Samples and Test Specimens:** Where required in the specifications, and as determined necessary by the ENGINEER, test specimens or samples of materials or fluid, equipment and fittings to be used in connection with the work shall be submitted to the ENGINEER at the CONTRACTOR'S expense, with information as to their sources, with all transportation fees paid, and in such quantities and sizes as may be required for proper examination and tests to establish the quality or equality thereof. In addition, the following will be applicable:
1. All samples and specimens shall be submitted in ample time to enable the ENGINEER to make any tests and examinations necessary, without delay to the work.
 2. The CONTRACTOR will be held responsible for any loss of time due to his negligence or failure to deliver the required samples to the ENGINEER, as specified.
 3. Laboratory tests and examinations that the OWNER elects to make for his own purposes, at his own laboratory or expense, will be performed at no cost to the CONTRACTOR, except that if a sample of any material or equipment fails to meet the specifications, the cost of testing subsequent samples shall be borne by the CONTRACTOR.
- G. **Daily Log:** The CONTRACTOR shall maintain a detailed daily events log of his activities at each rig on the site, during well construction and testing. The information shall be recorded on IADC-API Official Daily Drilling Report forms.
1. The report forms shall be completed fully, providing information on bit assembly and drill string, drilling mud and additives, drilling mud properties using a mudscale, fluid losses, water and fluid level changes, footage drilled and formations encountered, and cementing operations. In addition, information relative to maintenance and repair time along with details of repair, and presence of CONTRACTOR'S personnel and sub-contractors, and other pertinent data as may be required by the ENGINEER.
 2. One legible form suitable for photocopying shall be submitted to the ENGINEER on a daily basis.
- H. **Mill Certificates:** The submittal of all casing mill certificates to the ENGINEER is required for all casings. Mill certificates shall be made available to the ENGINEER for review at least 72 hours prior to the installation of casing in the ground.
- I. **Welding Procedures:** Furnish procedure specifications and qualification records of welding procedures for all pipe welding to be performed under this section, in accordance with Section IX, Article II of the ASME Boiler and Pressure Vessel Code, to the ENGINEER at least 72 hours prior to welding the first string of casing.
- J. **Geophysical Logging:** Twenty (20) field copies of all geophysical logs will be provided to the ENGINEER within 24 hours of performance and 20 final copies will be provided

within 10 days of completion. For each geophysical log suite performed, the ENGINEER may request the CONTRACTOR to obtain a brief descriptive report from the service company interpreting the results of the log or logs. These completed reports must be submitted to the ENGINEER within 72 hours of completion of logging. Electronic data files of geophysical logs shall be provided to the ENGINEER in ASCII format within 72 hours of completion of logging. A summary follows:

Summary Table of Geophysical Logs:

FAMW WELL		
Depth (Feet bls)	Hole Type	Proposed Logs
0-220	12.25-inch Pilot	Caliper, Gamma Ray, Long, Short Normal Resistivity, Spontaneous potential
0-200	34-inch Reamed	Caliper
0-200	24-inch Casing	Cement top logs, if necessary
240-1020	12.25-inch Pilot	Caliper, Gamma Ray, Dual Induction, Spontaneous potential, Borehole Compensated Sonic
200-975	24-inch Reamed	Caliper
0-975	14-inch Casing	Cement top logs, if necessary
975-1,650	12.25-inch Pilot	Caliper, Gamma Ray, Dual Induction, Spontaneous potential, Borehole Compensated Sonic with VDL display, BHTV, video survey, Dynamic and Static Fluid Resistivity, Flowmeter, Temperature.
0-1,080	6-inch casing	Cement top logs, if necessary
1080-1200	Completed Well	Caliper, Dynamic and Static Fluid Resistivity, Flowmeter, Temperature.
0-1,200	Completed Well	Video Survey

* Cement top log = gamma ray/temperature logs

ASR WELL		
Depth (Feet bls)	Hole Type	Proposed Logs
0-220	12.25-inch Pilot	Caliper, Gamma Ray, Long, Short Normal Resistivity, Spontaneous potential
0-200	44-inch Reamed	Caliper
0-200	34-inch Casing	Cement top logs, if necessary
200-1,080	12.25-inch Pilot	Caliper, Gamma Ray, Dual Induction, Spontaneous potential, Borehole Compensated Sonic
200-1,080	34-inch Reamed	Caliper
0 -1,080	24-inch casing	Cement top logs, if necessary Cement bond log
1,080-1,200	12.25-inch Pilot	Caliper, Gamma Ray , Dual Induction, Spontaneous potential, Borehole Compensated Sonic with VDL display, BHTV, Video Survey, Dynamic and Static Fluid Resistivity, Flowmeter, Temperature.
1,080-1,200	24-inch Reamed	Caliper
1080-1,200	Completed Well	Caliper, Dynamic and Static Fluid Resistivity, Flowmeter, Temperature.
0-1,200	Completed Well	Video Survey

* Cement top log = gamma ray/temperature logs

K. **Cores:** Cores will be obtained in accordance with the following schedule:

Coring Schedule

Well/ Phase	Depth Interval (ft,bls)	Coring Interval	Core Barrel Length (ft)	Number of Cores
FAMW				
12.25-inch Pilot Hole	925-1,020	continuous	Minimum 10 ft	Dependent on core barrel length
12.25-inch Pilot Hole	1,020-1,210	continuous	Minimum 10 ft	Dependent on core barrel length
12.25-inch Pilot Hole	1,210-1,650	30 ft	10 ft	15
ASR Well				
12.25-inch Pilot Hole	925-1,080	continuous	Minimum 10 ft	Dependent on core barrel length
12.25-inch Pilot Hole	1,080-1,200	continuous	Minimum 10 ft	Dependent on core barrel length

After collection, boxing and labeling, the cores shall be furnished to the ENGINEER. The ENGINEER will then select a maximum of 35 representative samples from the cores on which the CONTRACTOR will have laboratory analyses performed to determine vertical and horizontal permeability, porosity, specific gravity, dry density, moisture content, porosity, loading rate, unconfined compressive strength, young modulus, average isotropic effective confining stress, and back pressure. The CONTRACTOR shall submit the name of the laboratory to the ENGINEER for review before analyses. The report of analytical results shall be submitted to the ENGINEER within 45 days of CONTRACTOR's receipt of core samples from the ENGINEER. The CONTRACTOR will also supply wood boxes with lids, a maximum of 6 feet in length, for the storage of the cores.

L. **Television Survey:** The CONTRACTOR shall perform television surveys at the following stages of construction:

1. After drilling of the 12.25-inch diameter pilot hole through the interval between approximately 975 feet-1650 feet in FAMW.
2. After drilling of the 12.25-inch diameter pilot hole through the interval between approximately 1,080 ft and 1,200 feet in the ASR well.
3. After setting the final tubing in FAMW, and completion of the open borehole.
4. After setting the final ASR casing, and completion of the open borehole.

The CONTRACTOR will make provisions for the well to be pumped during television logging in order to obtain a clear picture.

Fifteen (15) copies of each completed survey shall be provided by the CONTRACTOR to the ENGINEER for distribution within 30 days of completion of the television survey.

M. **Packer Tests:** Open-hole straddle packer and single-packer tests shall be conducted in a manner determined by the ENGINEER. A representative water sample shall be collected for analysis prior to completion of the test. The ENGINEER will select the depth intervals to be tested in conjunction with the service company representative, based upon evaluation of the geophysical logs and other available data. Preliminary laboratory data should be available within 5 days of sampling. Two (2) copies of the report of analyses from each test will be submitted to the ENGINEER within 14 days of acceptance of the samples by the laboratory.

N. **Calibration Data:** Calibration records for each measuring instrument used in the construction of the well shall be submitted to the ENGINEER for review prior to the installation or use of the instruments. The calibration records shall contain the following information:

1. Flow meter calibration sheet:

Serial number, model number, gears, test apparatus size, meter reading and flow rate for at least three (3) steps, percent error for each step, tester's name and title.

2. Pressure gauge calibration sheet:

Serial number, model number, scale range, meter reading and inches of mercury for at least three (3) steps covering the entire range of the gauge, percent error for each step, tester's name and title.

3. Inclination tools and geophysical logs:

Each downhole instrument used in testing the wells during construction shall demonstrate acceptable calibration before use. Where possible, this calibration record shall be included on the output of the test or on the log.

4. Pressure Transducers

Pressure transducers used for monitoring pressure shall be calibrated in the ASR well and FAMW on the day that it is installed for monitoring constant rate and step rate tests. The transducer pressure measurement shall be compared to the theoretical static water pressure, and the transducer error shall be plotted against temperature or depth and a correction formula determined, if deemed necessary by the ENGINEER.

O. **Plans:** The CONTRACTOR shall submit for the ENGINEER'S review plans for cementing operations, casing installation, and ASR test pipeline construction at least 72 hours prior to commencing work on those operations. These plans shall include the following information:

1. Cementing program:

Top and bottom of each interval to be cemented, pre-flush and spacer, composition of cement to be used in each interval and volume to be pumped, method of emplacement of cement, expected fill-up, expected pressures, and any additives to be used.

2. Casing installation:

Tabulation of casing on site and the length of each section, weight of each joint, cumulative string weight, order of installation of casing sections, locations of centralizers and casing tabs.

3. Hurricane Preparedness Plan:

Prior to the commencement of drilling, a Hurricane Preparedness Plan shall be submitted to the ENGINEER. The plan shall detail activities to be undertaken at the issuance of a Hurricane Watch by the National Weather Service, and shall include but are not limited to the following:

- a. Securing of all on-site chemicals and additives for the prevention of surface and/or groundwater contamination.
- b. Securing drilling equipment and rig(s) to prevent damage to well(s) and on-site treatment process equipment as well as public property.

- c. The CONTRACTOR shall coordinate his hurricane preparedness activities with the OWNER'S construction coordinator.

- P. **Development and Test Records:** Development and test records shall be recorded on an hourly basis, showing production rates, static water level, pumping level, drawdown, production of sand, and all other pertinent information concerning the method of development. Pumping test drawdown records shall be kept for each step of the test.

- Q. **Permits:** The CONTRACTOR shall obtain all necessary permits with local and state regulatory agencies for the drilling and testing of the ASR well, and disposal of waste materials associated with the CONTRACTOR's activities, as described in these Technical Specifications. The required Underground Injection Control permits shall be obtained by the OWNER.

- R. **Final Description:** The final well descriptions shall show the following: diameter, wall thickness, depths, and lengths of casings installed; borehole diameters; cemented casings; depths and thickness of annular seals; quantity of material removed during development operations; and all other pertinent details.

- S. **Records Required by Law:** The CONTRACTOR shall maintain all records required by governmental agencies having jurisdiction, and shall submit such records to them as may be required. Two (2) copies of all such material shall be furnished to the ENGINEER.

- T. **Resumes:** Resumes of key personnel, including welders and drilling superintendents will be submitted to the ENGINEER.

- U. **Costs:** All costs for meeting the provisions of the regulatory agencies having jurisdiction in this project shall be included in the bid. Should any action by the CONTRACTOR be necessary to meet these requirements during construction and testing, the entire cost of compliance shall be borne by the CONTRACTOR.

1.3 QUALITY ASSURANCE

- A. **Mechanical Integrity Tests:** The CONTRACTOR shall perform mechanical integrity tests (MITs) to demonstrate well soundness prior to acceptance. MIT's will be conducted upon final completion of the ASR well and the FAMW, as specified in Part 3-Execution. All tests shall be performed in coordination with FDEP.

- B. **Rejection and Remedy:** A well failing MIT's may be unacceptable and subject to immediate repair in an acceptable manner or subject to abandonment, and a new well constructed at the CONTRACTOR's expense. If good bonding between the casing, cement and formation is not obtained, as demonstrated by the cement bond log in the ASR well, remedial work shall be performed to the satisfaction of the ENGINEER. In addition, the ENGINEER may request additional temperature, gamma or cement bond logs to evaluate the effectiveness of any remedial grout work performed. These operations shall be conducted at the CONTRACTOR's expense.

- C. **Instrumentation:** The CONTRACTOR shall provide calibration records of all instruments used during testing to the ENGINEER prior to installation.

- D. **Inclination Tools:** In order to insure the drilling of the wells to alignment specifications, the CONTRACTOR shall furnish and employ a self-checking mechanical drift indicator to measure hole deflection. Drift indications shall be taken at intervals of not more than 60 feet during the drilling of all pilot holes and reamed holes. The mechanical drift indicator shall be an **Eastman mechanical drift indicator available from the Eastman Oil Well Survey Company, or equal.** A 1.5-degree unit shall be used with the indicator. The drift from vertical shall be not more than 0.5 of one degree between any two consecutive surveys, and not more than one degree over the entire well length. Any deviation shall be corrected by the CONTRACTOR.
- E. **Television Survey:** The video camera to be used for the television survey will be centralized and of a type that is capable of focusing on the diameter of open borehole or casing upon which the survey is being performed having sharp contrast and good resolution. The video camera should be capable of viewing using a sideview capability.
- F. **Pressure Test:** Pressure tests shall be performed in the final casing of the ASR well and the FAMW to test the integrity of the well casings. Details for the performance of these tests is contained in Part 3 - Execution. Any variation in pressure during these tests may be cause for rejection of the wells. A maximum variation of ± 5 percent of the test pressure may be acceptable if the cause of the variation is obvious and demonstrable.
- G. **Geophysical Logs:** All geophysical logs shall be run by a qualified service company experienced in the type of logs they are to perform. The logs will be run using accurate instruments of resolution sufficient to allow detailed interpretation of the logs. The correct calibration of each instrument shall be demonstrated at the time of logging and record of the calibration shall be included on the logs, where possible. The logs shall be run at no more than 30 feet per minute and shall be output at a scale that permits detailed interpretation of the logs. A repeat section shall be included on each log to demonstrate the sensitivity of the instrument to variations in the properties of the intervals being logged and to demonstrate repeatability of the logs.
1. The caliper tool shall include a minimum of 3 arms. Borehole volume shall be indicated on the reamed borehole caliper log, or an ASCII file of the caliper log shall be provided to the ENGINEER for cementing calculations.
 2. The BHTV tool shall make a preliminary pass in the casing for comparison of a known diameter with the measured and calculated casing diameter as produced by the BHTV log.
 3. The CBL tool shall have dual receivers and be calibrated on site in the presence of the ENGINEER.
- The VDL tool shall be configured with 5-foot spacing between the transmitter and receiver; the spacing for the amplitude shall be 3-feet.
- H. **Remedial Work:** If it becomes necessary to perform remedial work on the ASR well or the FAMW prior to final acceptance, in order for it to meet either regulatory requirements or the Technical Specifications and Contract Documents, or both, due to defective materials, accident, loss of equipment or equipment malfunction, or for any other cause directly attributable to the CONTRACTOR's actions, the CONTRACTOR

shall bear the entire cost of the remediation, including any necessary Engineering costs to meet regulatory requirements. In the event of a problem, the ENGINEER shall be notified immediately, and the following shall apply:

1. The CONTRACTOR shall propose a method of correcting the problem, in writing to the OWNER. The ENGINEER and OWNER shall review the method of corrective action, and accept the plan in writing before work can proceed.
 2. At all times all work on the well must be in accordance with all applicable local, state and federal regulations.
- I. **Abandonment of Well by Contractor:** If, at any time the CONTRACTOR voluntarily stops work, and/or fails to complete a hole in a satisfactory manner in accordance with governing regulations or the Contract Documents, the hole will be considered abandoned. The CONTRACTOR shall not be paid for all or part of a hole declared as abandoned by the OWNER.

The cost of properly plugging and sealing a well or hole, in accordance with applicable local, state or federal regulations, shall be borne by the CONTRACTOR. In addition, if a well or part thereof, does not have mechanical integrity as defined by the appropriate regulatory authorities, it must be restored prior to abandonment of the well.

1. Under conditions where post-abandonment monitoring requirements are imposed by regulation as a direct result of the CONTRACTOR's abandonment of the well, or hole, the cost of this monitoring also must be borne by the CONTRACTOR.
 2. All salvageable material furnished by the CONTRACTOR may be removed and remain his property.
 3. The CONTRACTOR shall propose his method of abandonment of the well or hole in writing to the OWNER. The ENGINEER and OWNER shall review the method of abandonment, and accept the plan in writing before work can proceed. At all times all work on the well must be in accordance with all applicable local, state and federal regulations.
- J. **Guarantee:** The CONTRACTOR guarantees that the work performed under this section of the Contract, and the workmanship, materials and equipment supplied or used in the execution of the work, are free from defects or flaws and are furnished in strict accordance with the Contract Documents in every respect. The CONTRACTOR further guarantees that the performance test requirements of the Contract Documents shall be fulfilled. The CONTRACTOR shall repair, correct, or replace all damage to the work by failures covered by the guarantee. The guarantee shall remain in effect for a period of 5 years from the date of final acceptance by the OWNER.
- K. **Sand Production:** Sand production during well development shall be recorded on pump development and testing records. Sand production, shall be measured by a centrifugal sand separating meter as described in the Journal of the American Water Works Association, Vol. 46, No. 2, February 1954, and should not exceed 5 parts per million during the 20-minute period after the pump starts pumping at a rate of approximately 50 gpm, or as determined appropriate by the ENGINEER.

1.4 MATERIALS DELIVERY, STORAGE, AND PROTECTION OF MATERIALS

CLASS V AQUIFER STORAGE AND RECOVERY
WELL FLORIDAN AQUIFER MONITOR WELLS

- A. All materials shall be delivered in an undamaged condition and stored to provide protection against damage. All defective or damaged materials shall be replaced with new materials.
- B. The CONTRACTOR shall prepare an area, within the limits of the location delineated on the Drawings, for the storage of materials required for this work.

1.5 CONTRACTOR'S EQUIPMENT

- A. **General.** The CONTRACTOR'S equipment shall be clean, well maintained, and in good operating condition when delivered to the site, and during the entire operation.
 - 1. The equipment shall be of adequate size, strength, horsepower, and capacity for the project and shall be of the type successfully utilized by the CONTRACTOR for the construction of similar or larger wells within the last 2 years.
 - 2. All equipment shall be provided with safety devices as required by governmental authorities having jurisdiction.
- B. **Equipment Use:** Reaming and setting of casing shall be performed with the same equipment and no re-setting of equipment will be allowed after the hole is reamed. The equipment shall be provided with all reasonably possible noise deadening devices. The rig engines and all other power plant equipment shall have mufflers, and metal parts of the rig that may encounter casing or drill pipe shall be protected through the use of wood, or other sound absorbent material, where possible, in conformance with Section 01560, "Temporary Environmental Controls."
- C. **Equipment Requirements:** The CONTRACTOR'S drilling rigs shall have a lift capacity exceeding the greatest load required during construction of the well. The rigs shall be equipped with drill string weight and drilling speed recorders such as that manufactured by Swaco Geolograph, or equivalent. Equipment equivalent to the SG-SMART Level 2 System is preferred. At minimum, the recorders shall produce a graphical output accurately displaying drill string weight in pounds and the time required to drill each foot. The device also shall have a mechanical depth recorder showing depth drilled in increments of one foot. If a solid state electronic system is provided, an additional satellite recording box shall be placed in the ENGINEER's trailer. ASCII files of the data also shall be provided to the ENGINEER.

1.6 MOBILIZATION, PERSONNEL AND OPERATING REQUIREMENTS

- A. **Mobilization:** The CONTRACTOR shall mobilize equipment and personnel to effectively commence drilling operations within the time limit specified.
- B. **Personnel Requirements:** The CONTRACTOR shall furnish capable personnel, experienced in the work required by these specifications. In addition, the following shall apply:

1. The personnel shall be subject to the ENGINEER'S approval.
2. For key personnel involved in this project including, but not necessarily limited to persons in key positions in the project, such as the drilling superintendent, tool pusher and drilling shift supervisors (or drillers), principal welders, and safety officer, a resume will be required for submittal to the ENGINEER for review and approval prior to assignment of personnel to the project.
3. The CONTRACTOR, in addition to providing the services of skilled and experienced drillers in the type of formations expected, shall also provide an adequate number of competent helpers.
 - a. The drillers shall be capable of keeping accurate and clean well logs, and reports of the drilling, developing and pump testing operations as instructed by the ENGINEER.
 - b. The drillers also shall be capable of recognizing and making lithologic classifications of the formations to be encountered during the work.
 - c. Drillers and helpers should know how to collect and handle representative formation and water samples required by the ENGINEER, as described in these Technical Specifications.
 - d. Prior to the start of the work, the CONTRACTOR shall submit a list of the welders he proposes using and the type of welding for which each has been qualified.
 1. All welders and welding operators shall be qualified at the CONTRACTOR's sole expense by a qualified testing laboratory before performing any welding under this section. Qualification tests shall be in accordance with Section IX, Article III of the ASME Boiler and Pressure Vessel Code. Welders and operators shall be qualified for making groove welds in carbon steel pipe in position 6G for each welding process to be used.
 - e. The name and the background of service companies and the individuals providing the services shall be submitted to the ENGINEER for approval prior to beginning work. The ENGINEER reserves the right to reject any service company. At a minimum, service companies shall be employed for the following:
 1. Logging Company. The CONTRACTOR shall employ the services of one or more qualified geophysical logging service companies approved by the ENGINEER to obtain geophysical logs of the wells.
 2. Coring. The collection of the cores required as a part of this contract shall be observed by technicians from the manufacturer of the coring tool unless the CONTRACTOR can demonstrate previous experience of coring.

3. **Television Survey.** The television survey required as a part of this contract shall be performed using the services of a company approved by the ENGINEER.
 4. **Straddle Packer Tests.** The straddle packer tests required as a part of this contract shall be performed using the services of a company approved by the ENGINEER.
 5. **Cementing.** All cementing operations required as part of this contract shall be performed by an approved company experienced in well cementing such as Halliburton Services.
- C. **Equipment Operation:** All equipment shall be carefully maintained during the CONTRACTOR'S operations period and any damage to the well or surrounding property and/or facilities of any nature due to the CONTRACTOR'S operations shall be repaired or replaced.
- D. **Noise Control Barriers:** The CONTRACTOR is required to furnish, install and maintain noise control barriers at the site and shall remove them upon the completion of the work, in accordance with Section 01560 - Temporary Environmental Controls.
- E. **Work Area:** The CONTRACTOR shall prepare an area, within the limits of the location delineated on the Drawings, for the work described in these Technical Specifications.
- F. **Cuttings and Fluid Disposal:** It shall be the CONTRACTOR'S responsibility to arrange for an approved disposal site for both drill cuttings and fluid from drilling that complies with all applicable regulations. No drilling operations can commence without an approved disposal site. The CONTRACTOR shall be responsible for providing and maintaining all necessary tank trucks, dump trucks, pipe, pumps and equipment necessary to pump and haul excess pad drainage, drilling fluid, drill cuttings and pumped water to a pre-determined disposal site in accordance with federal, state and local regulations, or sub-contract with firm capable of providing these services when necessary.
- G. **Discharge and Development of Testing Water.** An NPDES permit will be acquired by the OWNER for the purposes of discharging testing and development water to the Hillsboro Canal through a structure to be built concurrently with the ASR well. The CONTRACTOR may elect to use this NPDES permit and associated structure to dispose of fluids during construction and testing. However, if the CONTRACTOR chooses to use this disposal mechanism, he will be responsible for meeting all water quality requirements for discharge incorporated into the NPDES permit.
- H. **Temporary Raw Water Piping.** In order to meet the NPDES permit requirements, the CONTRACTOR may elect to blend formation testing water with raw surficial aquifer water prior to discharge into the Hillsboro Canal. If the CONTRACTOR chooses to use raw water from adjacent production wells, a temporary piping and blending plan must be submitted to the ENGINEER and OWNER (water plant superintendent) for review and approval prior to implementation.
- I. **Protection of Water Quality:** The CONTRACTOR and his sub-contractors shall take all necessary precautions to prevent contaminated water, gasoline, or other hazardous substances from entering the wells, either through the wells themselves or through

seepage from land surface. All fuel and chemical storage tanks shall be properly contained in case of spillage. All precautions shall be maintained during and after well construction, and until acceptance of the wells by the OWNER. If the CONTRACTOR fails to prevent contaminants from entering the groundwater, any remedial action required by the governing regulatory agencies shall be performed by the CONTRACTOR at his sole expense.

- J. **Flow Control.** The CONTRACTOR shall be required to use a commercially available blow-out preventer during all drilling operations subsequent to the setting of surface casings to approximately 240 feet, unless the CONTRACTOR proposes use of a rotating head or other sealed circulation system.
1. If a rotating head is used, an emergency flow control system will be required. The system, comprising a blow-out preventer as specified herein, shall be placed on the well in periods when drilling is not being conducted or when the rotating head is not in operation.
 2. Manufacturers specifications for the type of blow-out preventer proposed shall be submitted to the ENGINEER for review and approval before the drilling of each well commences.
 - a. The type of blow-out preventer to be used will be a hydraulically operated, single annular blow-out preventer, which shall be commercially available.
 - b. The operation of the blow-out preventer shall be demonstrated to the ENGINEER by each crew on a weekly basis to ensure that the emergency device will operate as designed when needed.
- L. **Use of Salt:** The use of salt or brine as a method of increasing the mud weight during drilling will not be permitted during the construction of the wells. Barite will be used in place of salt solution. Any materials other than barite proposed for controlling the flow must be reviewed and approved by the ENGINEER, prior to use.
- M. **Start of Drilling:** Drilling activities at the site will not be permitted to proceed prior to the establishment of all temporary utilities as defined in Section 01510, Temporary Utilities, and the project field office as defined in Section 01590 Field Office, Equipment and Services.
- N. **Field Relocation:** During construction, it is expected that minor relocation of proposed facilities may be necessary. Such relocations will only be made at the direction of the ENGINEER. If existing structures are encountered that prevent construction as shown, the ENGINEER shall be notified prior to continuing work, so the necessary field revisions can be made.
- O. **Standby Time:** The ENGINEER may ask the CONTRACTOR to stop his operations so that extra work not included in the specifications may be performed. The ENGINEER will advise the CONTRACTOR when he proposes to do this and will schedule his request so it causes the minimum of delay. The CONTRACTOR will be reimbursed for all approved standby time at hourly rates which will be listed in the Bid Proposal form. All extra work must be approved in advance by the ENGINEER, in writing.

- P. **Construction Safety Program:** The CONTRACTOR shall comply with the OSHA regulations contained in 29CFR Section 1910 for General Industry Regulations and 29CFR Section 1926 for Construction Regulations.
- Q. **Safety Equipment:** At all times the CONTRACTOR must provide safety equipment, as required by all applicable federal and State regulations.
- R. **Accident Reports:** One copy of the CONTRACTOR's accident report form should be submitted to the ENGINEER within 24 hours of the occurrence of any accident in connection with the work.
- S. **Record Drawings:** Record Drawings shall be submitted in accordance with relevant sections of the Technical Specifications and Drawings.

1.7 SITE CLEANUP, PRESERVATION AND RESTORATION

- A. **Unused Materials and Equipment.** During construction, the CONTRACTOR shall regularly remove from the site all accumulated debris and surplus materials of any kind which results from his operations. Unused tools or equipment shall be stored at the CONTRACTOR'S yard or base of operations for the project.
- B. **Periodic Cleaning.** The CONTRACTOR shall perform clean-up work on a regular basis and as frequently as requested by the ENGINEER at a minimum of once per week. Basic site restoration in an area shall be accomplished immediately following installation or substantial completion of the required facilities in that area. Also, such work shall be performed, when requested by the ENGINEER, if partially completed facilities must remain incomplete for some time period.
- C. **Work Completion.** Upon completion of work at the site, the CONTRACTOR shall promptly remove all his equipment and unused materials. He shall dismantle any temporary structures erected for his purposes that are not part of the final product. He shall promptly effect minor repairs to the pad and retaining wall, fill the "rat" and "mouse" holes and leave the site in a manner acceptable to the ENGINEER, within one month after the completion of drilling and testing.
- D. **Failure to Keep Clean Site.** If the CONTRACTOR fails to perform periodic clean-up and basic restoration of the site to the ENGINEER'S satisfaction, he may, upon five days written notice to the CONTRACTOR, employ such labor and equipment as he deems necessary for the purpose.
- E. **Cost of Cleanup.** All costs resulting from the clean-up or restoration activity shall be charged to the CONTRACTOR, and may be deducted from monies owed to him by the OWNER.
- F. **References Elsewhere.** In addition, the CONTRACTOR shall effect clean-up in accordance with Section 01510, "Temporary Utilities," and Section 01700, "Project Closeout."

1.8 RELATED WORK SPECIFIED ELSEWHERE

- A. **Site Preparation.** As specified in Section 02100 SITE PREPARATION and Section 02200 EARTHWORK.
- B. **Water Supply.** As specified in Section 01510 TEMPORARY UTILITIES.
- C. **Electricity.** As specified in Section 01510 TEMPORARY UTILITIES.
- D. **Sanitary Facilities.** As specified in Section 01510 TEMPORARY UTILITIES, Section 01560 TEMPORARY ENVIRONMENTAL CONTROLS and Section 01590 FIELD OFFICE, EQUIPMENT AND SERVICES.
- E. **Field Office.** As specified in Section 01590 FIELD OFFICE, EQUIPMENT AND SERVICES.
- F. **Submittals.** In accordance with Section 01300 CONTRACTOR SUBMITTALS.
- G. **Quality Control.** In accordance with Section 01400 QUALITY CONTROL.
- H. **Mobilization.** In accordance with Section 01505 MOBILIZATION.
- I. **Site Access.** In accordance with Section 01550 SITE ACCESS AND STORAGE.
- J. **Pad Construction.** In accordance with Section 03200 REINFORCEMENT STEEL, Section 03290 JOINTS IN CONTAINMENT, and Section 03300 CAST-IN-PLACE CONCRETE.
- K. **Wellhead Gauges and Valves.** In accordance with Section 15183 GAUGES, and Section 15200 VALVES, GENERAL, Section 15202 BUTTERFLY VALVES, Section 15204 BALL VALVES, and Section 15206 GATE VALVES.
- L. **Noise Control.** In accordance with Section 01560 TEMPORARY ENVIRONMENTAL CONTROLS.

PART 2-- PRODUCTS

2.1 DRILLING EQUIPMENT AND FLUIDS CONTAINMENT STRUCTURE(S)

- A. **General.** During construction of the ASR well and FAMW, at the location described in the Drawings, the CONTRACTOR shall devise and construct a means to contain all drilling equipment, fluid and drill cuttings to prevent spillage of brackish water or other potential contaminants from affecting the surficial aquifer. The method shall be capable of serving to support the weight of the greatest load necessary during the construction of the wells, of retaining all necessary quantities of fluids and cuttings from the well during construction and testing without leakage or spillage, and serving as a work floor for all drilling activities. It will be necessary to store all fuel or chemical tanks used during the well construction on this pad. Any sumps or drains in the pads shall be sealed below, not to allow leakage beneath the pad (including "rat" or "mouse" holes utilized during drilling). Any sumps shall have 6-inch water stop material in all joints.

The CONTRACTOR may design and construct a temporary concrete pad or other containment structure to meet the objectives outlined above, for review and approval by the ENGINEER. The CONTRACTOR shall design and construct the foundation to protect all existing underground structures. The designs shall be signed and sealed by a professional engineer registered in the State of Florida and submitted in accordance with Section 01300. The CONTRACTOR's containment structure(s) design must be submitted to and approved by the ENGINEER prior to implementation and must meet all applicable federal and State regulations.

- B. **After Completion of Construction.** The containment structure and all specified accessories shall be removed upon completion of construction and replaced with permanent concrete vaults, as shown in the Drawings. All fluid pumped from pad drainage shall be disposed of in accordance with Part 3 Execution.
- C. **Water Table Monitor Wells.** Around the outside of the containment structure, water table monitor wells shall be installed. A total of three wells shall be installed, around each containment structure, as shown in the Drawings.

2.2 WATER TABLE MONITOR WELLS

- A. **Requirements.** The CONTRACTOR shall install six shallow, small diameter (2-inch) monitor wells to permanently monitor the shallow groundwater table around the containment structure(s) as shown in the Drawings.
- B. **General.** Each well shall be located in close proximity to the edge of containment structure(s); they shall be protected from damage during construction and maintained in good order throughout the Contract Time. The purpose of these wells is to monitor the shallow groundwater table around the containment structure(s) for increases in chloride concentration, which may be attributable to brackish or saltwater spills from drilling. If a spill occurs, the CONTRACTOR shall be financially responsible for the cost of all clean-up activities attributable to his work at the site.
- C. **Construction.** The wells shall be constructed as shown in the Drawings, as described in this section of the Technical Specifications, Subsection 3.3, Water Table Monitoring Well Construction, and in accordance with all applicable local, state and federal laws.
- D. **Start of Drilling.** All the water table monitor wells shall be installed, developed, surveyed to NGVD, background sampling conducted, and the results reported to the ENGINEER all prior to the start of drilling operations at the site.
- E. **Additional Wells.** If a spill occurs in the vicinity of the ASR or FAMW, resulting from the drilling operation related to either well, the CONTRACTOR may be required to construct additional water table monitor wells or fluid recovery wells. The cost of any necessary additional wells, or sampling needed to evaluate or clean-up any spill will be borne by the CONTRACTOR.
- F. **Gravel.** The annular space between the casing or screen and the borehole walls shall be filled with a gravel pack composed of 6/20 silica sand. The gravel shall fill from the bottom of the hole to a depth of at least 3 ft above the top of the well screen. This sand shall be clean, well sorted, rounded to subrounded.

- G. **Sampling.** Each well shall be sampled immediately after construction, as described in Technical Specifications Subsection 3.3, Water Table Monitoring Well Construction.

2.3 CASING AND APPURTENANCES

- A. **Centralizers:** The CONTRACTOR shall supply and install steel strap type centralizers for all casings that center the casing within the specified borehole.

1. The CONTRACTOR may pre-fabricate strap-type centralizers where the straps are individually welded across casing joints or may utilize Halliburton-type centralizers that meet or exceed API Specification 10D.

- B. **Welding Materials:** The CONTRACTOR shall utilize welding materials that are properly handled and stored in accordance with the manufacture's recommendations so as to preclude moisture or other contamination. All welding rods shall be new, and appropriately stored and maintained prior to use.

- C. **Threaded Connections:** To achieve a structurally sound, leak tight connection, fiberglass tubing will utilize an integral joint. It shall be properly made-up to a controlled torque level using the MANUFACTURER'S recommended thread compound and procedures.

D. Casings- FAMW

1. **Pit Casing:** Pit casing with an inside diameter large enough to accommodate a thirty four (34)-inch diameter drill bit shall be installed to a depth sufficient to prevent unconsolidated material from caving into successive boreholes, and to prevent undermining of the pad. The length and method of installation shall be at the CONTRACTOR's option, subject to the acceptance of the ENGINEER. Casing shall be steel, have a minimum wall thickness of 0.375-inches, conform to the standards of ASTM A139 or spiralweld, or equivalent. Casing joints shall be welded.
2. **Conductor Casing:** Twenty-four (24)-inch diameter, 0.375-inch wall thickness steel casing, conforming to the standards of API 5L Grade B, or ASTM A 53 Grade B, ASTM A139 Grade B, or spiral weld shall be set and cemented to a depth of approximately 200 feet. Casing shall be beveled, with a straight edge for welding.
3. **Intermediate Casing:** Fourteen (14)-inch outside diameter, 0.375-inch wall thickness steel casing, conforming to the standards of API 5L Grade B, or ASTM A 53 Grade B, ASTM A139 Grade B, or spiral-weld shall be set to a depth of approximately 975 feet. Casing shall be beveled, with a straight edge for welding.
4. **Final Casing:** Six (6)-inch diameter, 6.625-inch outside diameter 0.71-inch wall thickness, fiberglass casing conforming to the standards of ASTM D2996B shall be set and cemented to a depth of approximately 1,080 feet. Tubing shall be threaded utilizing an integral joint API 8Rd long threaded connection.

5. Summary of FAMW Well Casing Information

Casing	Casing Material	Casing Length (ft)	Casing OD (in)	Casing Wall thickness (in)
Pit	Steel ASTM A139 Grade B or spiralweld	To be proposed By CONTRACTOR	34	0.375
Conductor	Steel ASTM A139 Grade B or spiralweld	200	24	0.375
Intermediate	Steel API 5L Grade B or equivalent	975	14	0.375
Final	Fiberglass ASTM 2996B	1,080	6.625	0.71

E. Casings-ASR Well

1. **Pit Casing:** Pit casing, with an inside diameter large enough to accommodate a nominal 44-inch diameter drill bit, shall be installed to a depth sufficient to prevent unconsolidated material from caving into successive boreholes, and to prevent undermining of the pad. The length and method of installation shall be at the CONTRACTOR's option, subject to the acceptance of the ENGINEER. Casing shall be steel, have a minimum wall thickness of 0.375-inches, conform to the standards of ASTM A139 or spiralweld, or equivalent. Casing joints shall be welded.
2. **Conductor Casing:** Thirty-four-(34) inch outside diameter, 0.375-inch wall thickness, steel casing conforming to the standards of API 5L Grade B, or ASTM A 53 Grade B, ASTM A139 Grade B, or spiral-weld shall be set and cemented to a depth of approximately 200 feet. Casing shall be beveled, with a straight edge for welding.
3. **Final Casing:** Twenty-four (24) inch outside diameter, 0.500-inch wall thickness seamless steel casing, conforming to the standards of API 5L Grade B, or ASTM A 53 Grade B, shall be set and cemented to a depth of approximately 1,080 feet. Casing joints shall be welded. Casing shall be beveled, with a straight edge for welding.

a. **Summary of ASR Well Casing Information**

Casing	Casing Material	Casing Length (ft)	Casing OD (in)	Casing Wall thickness (in)
Pit	Steel ASTM A139 Grade B or spiralweld	To be proposed by CONTRACTOR	Min. 44-inch	0.375
Conductor	Steel ASTM A139 Grade B or spiralweld	200	34	0.375
Final	Steel API 5L Grade B or equivalent	1,080	24	0.500

2.5 CEMENT

- A. **General:** Material used for sealing the casing shall consist of a neat cement grout using Type II Portland cement conforming to ASTM C 150. Neat-cement grout shall contain not more than 5.2 gallons of water per 94 pound sack of cement.
- B. **Additives:** Additives and lost circulation materials may be mixed with the sealing material to speed setting time or to expand the material. They shall not exceed the following:
1. Not more than 4 percent, by weight, calcium chloride.
 2. Not more than 12 percent, by weight, bentonite.
 3. Other additives as approved by the ENGINEER.
- C. **Casing Seat:** The lowermost 250 feet of the intermediate casing and final tubing of the FAMW and final casing of the ASR well must be cemented using neat cement only; lost circulation materials may, however, be used if necessary.

2.6 WELLHEAD CAPPING AND VALVES

- A. **Wellhead Capping and Valves.** Shall be in accordance with the Specifications and Drawings.

2.7 DRILLING FLUID

- A. **Rotary Method:** Drilling fluid material for well construction by the rotary method shall be high-grade clays in common drilling usage. The drilling fluid shall possess such characteristics as are required to adequately condition the walls of the hole to prevent caving of the walls as drilling progresses, and to permit recovery of representative samples of cuttings.
1. Only fresh water from the designated source (see Water Supply specified in Section 01510 Temporary Utilities), shall be used in drilling fluids whether employed alone or in combination with drilling additives. Any other drilling additives to be used will require acceptance by the ENGINEER.

2. The CONTRACTOR shall maintain complete control over drilling fluid characteristics during the entire well construction.
 3. The CONTRACTOR shall provide holding tanks for handling the drilling fluid. The CONTRACTOR shall provide adequate protection for the public at all times. Upon completion of the drilling, drilling mud and cuttings from the well shall be removed from the site and disposed by the CONTRACTOR. The ground surface shall be restored to its original condition.
- B. **Reverse Air Circulation Method:** Drilling fluid for well construction by the reverse air circulation method shall be compressed air and water. Bentonite or other materials shall not be utilized without acceptance by the ENGINEER. If utilization of these materials is necessary due to lost circulation or other drilling problems that may arise, the CONTRACTOR shall submit the procedure to the ENGINEER for review. Adequate fluid tanks shall be employed by the CONTRACTOR to settle out drill cuttings and to ensure that a minimum of silt and clay is returned to the drill hole.
- C. **Drilling Fluid Additives:** Some drilling mud and barite will be permitted during the drilling in the upper Floridan aquifer, but no salt will be used in order to preserve the natural water quality in the aquifer as much as possible.

PART 3 -- EXECUTION

3.1 GENERAL

- A. **Drilling Methods:** The wells shall be drilled using the reverse or direct rotary process in which the walls of the drill hole are held in place at all times with a circulating fluid. The drilling techniques proposed for these wells will be methods customarily used in the South Florida area for the drilling of ASR wells. The work shall be performed by a competent crew with equipment which is adequate to complete all phases of well construction.
1. **Mud Rotary Method.** For all drilling through the surficial aquifer and through the confining clays of the Hawthorn Group, the conventional mud rotary method will be required.
 2. **Reverse Air Circulation Method.** After the setting of the casing through the Hawthorn Group, in the potentially lost circulation zones of the Floridan Aquifer, the reverse air circulation drilling method will be used.
- B. **Repeat Work:** All work required to be repeated, resulting from the CONTRACTOR's performance, including all additional materials, labor and equipment required, shall be furnished at the expense of the CONTRACTOR and no claim for additional compensation shall be made or be allowed therefore, except as specifically provided herein.
- C. **Noise:** The CONTRACTOR shall install soundproofing barriers, provide mufflers on equipment suitable for use in close proximity to residential areas and take whatever other steps are necessary during drilling, pumping, testing and all other work incidental

thereto, to ensure that noise levels conform to the local noise standard as required by the OWNER, and in accordance with Specifications Section 01560, Temporary Environmental Controls. Equipment storage and staging areas will be planned to be in areas away from homes, and traffic will be restricted to essential services during quiet hours, to preserve the rights of local homeowners.

- D. **Water Samples:** The CONTRACTOR will be required to collect water samples for analysis by a State of Florida certified laboratory, from the FAMW after development, and from the ASR well after completion of the open borehole and development. The CONTRACTOR shall be responsible for the cost of collection and analysis of each set of samples, as listed above. Additional information and the list of parameters for are discussed subsequently. Water samples will be collected by the CONTRACTOR during the completion of the 12.25-inch pilot hole of the FAMW from 1,020 ft to 1,650 feet, at 30 foot intervals. Water samples will also be collected by the CONTRACTOR during drilling of the pilot hole from 1,080 ft to 1,200 ft in the ASR well. The CONTRACTOR will not be responsible for analysis of the water samples collected during drilling of the pilot holes but will be responsible for providing proper sample jars and follow FDEP approved protocol for sampling.
1. **Receptacles:** Samples for which laboratory analysis is required, shall be collected in specially designated and approved sample containers to be provided by the CONTRACTOR from a State of Florida certified laboratory approved by the ENGINEER for the specific type of parameters for which the water samples will be analyzed.
 2. **Labeling:** The sample containers shall be clearly labeled with the well identification, and the depth interval below ground surface from which the sample was collected and the time and date of sample collection.
 3. **Delivery:** The CONTRACTOR shall collect the samples, store them in the appropriate manner as instructed by the laboratory, and deliver them to the laboratory in accordance with the laboratory's instructions.
 4. **Chain of Custody:** Chain of Custody forms shall be completed for all water samples. Copies of the Chain of Custody forms shall be submitted to the ENGINEER within ten days of final delivery of the samples to the laboratory. All persons handling the samples shall be required to sign the chain of custody form.
 5. **Sample Collection:** For the background samples to be collected from the FAMW, and the ASR will be upon completion, the CONTRACTOR shall use the approved laboratory field sampling services to collect the water samples and transmit them to their laboratory. Samples will be collected under FDEP Comprehensive Quality Assurance Plan (ComQAP)
 6. **Holding Times:** The CONTRACTOR shall be apprised of applicable water sampling holding times for the samples for which he is responsible and assure that the samples are transmitted to the laboratory within these time periods. For samples collected by the laboratory the CONTRACTOR shall be responsible to the ENGINEER for the performance of the sub-contractor's service performance in analyzing the samples within established holding times.

- E. **Formation Samples:** At 10-foot intervals and at changes of formations, the CONTRACTOR shall collect representative formation samples in order to provide an indication and classification of geological formations penetrated. The CONTRACTOR shall take a large representative sample of the cuttings from the interval or new formation, and shall label and preserve each sample in a sturdy container. All sample containers shall be labeled to indicate well number, date, time, and the exact depth from which the sample was taken and stored in a manner to prevent damage or loss. Three sets of samples from each borehole shall be collected and transmitted to the ENGINEER.
- F. **Exploratory Pilot Borehole and Coring:** A 12.25 inch diameter exploratory pilot hole will be drilled prior to each stage of reaming operations of the ASR well and FAMW. Cores will be collected consistent with the coring schedule in 1.2.K. Four-inch diameter cores shall be taken at points designated by the ENGINEER. During continuous coring, a core barrel at least 10 feet long is to be used, as manufactured by the **Christensen Diamond Products Company or approved equivalent**. A 10 ft core barrel will be used when coring the 12.25-inch pilot hole in the FAMW from 1,210-1,650 ft. The core barrel will be of a "split" design, which will allow for the recovery of the rock core as an entire piece. The collection and distribution of the cores shall take place as described in Part 1 General.
- G. **Gauges:** The CONTRACTOR shall provide and install pressure gauges for use during testing of the wells. The gauges shall be calibrated before use and calibration records shall be submitted to the ENGINEER prior to use, as described in the section SUBMITTALS. The pressure gauges used in pressure tests shall have a minimum diameter of 6 inches, and have a 0 to 300 psi range with major gradations of 50 psi and minor gradations of 1 psi. Pressure gauges for use during aquifer performance tests, if required, shall have scales from 0 to 50 psi with 1 psi gradations. Gauge accuracy shall be 1/4 of 1 percent of full scale.
- H. **Meters:** The CONTRACTOR shall supply flowmeters and other meters for use in testing the wells. The flow meter for use in the ASR test shall have a scale from 0 to 5,000 gpm with major gradations of 1,000 gpm and minor gradations of 50 gpm. All flow meters shall be calibrated before use and calibration records shall be submitted to the ENGINEER prior to use, as described in the section SUBMITTALS. Flow meter accuracy shall be 1/4 of 1 percent of full scale.
- I. **Pumps:** Two separate pumps will be required for the execution of tests during construction of the ASR well.
1. **Straddle Packer Tests:** The CONTRACTOR shall furnish and operate a 4-inch diameter submersible pump for each packer test of the pilot hole. The submersible pump shall have the capability of pumping at rates between 5 and 100 gpm at 250 ft.
 2. **Pumping Tests in ASR Well:** The CONTRACTOR shall furnish and operate a test pump assembly for the step and constant rate pump tests on the ASR well. This pump shall be capable of pumping 5,000 gpm. The pump assembly shall also include a 20-turn gate valve to regulate the flow rate during the test. The pump shall connect to a flange for connection to the temporary pipeline.

3. Pumping Test in FAMW: The CONTRACTOR shall furnish and operate a test pump assembly for the pumping test on the FAMW. This pump shall be capable of pumping 1,000 gpm. The pump assembly shall also include a 20-turn gate valve to regulate the flow rate during the test. The pump shall connect to a flange for connection to the temporary pipeline.

J. **Reaming Operations:** A pilot bit or stinger will be required during all reaming operations.

K. **Owner's Instructions to Proceed:**

1. If information indicates that the completion of a well at the test well site is not warranted, after any stage of pilot hole drilling, the OWNER reserves the right to terminate all further work at the site. In such an event, the CONTRACTOR will be paid the value of its work completed to that time based on unit prices indicated in the Bidding Schedule.
 - a. The CONTRACTOR shall be required to abandon the well as directed by the OWNER in accordance with regulations formulated by governmental agencies having such jurisdiction.
2. If information indicates that completion of a well at the test well site is warranted, the OWNER will instruct the CONTRACTOR to proceed with reaming the pilot hole and completion of the well.
3. The OWNER reserves the right to wait 48 hours after each stage of pilot hole drilling and geophysical surveys are completed before instructing the CONTRACTOR to proceed with the work. No standby time will be paid for the 48-hour period after the geophysical surveys are run while the ENGINEER interprets the information. Standby time will be paid thereafter until instructions are given to the CONTRACTOR.

L. **Welding:**

1. The standards of the American Welding Society, Structural Welding Code (AWS D1.1) shall apply for all welded joint casing and accessories. All welds shall conform to the latest revision of ANSI B31.1.
2. All welded casing joints shall be made by welders certified in the State of Florida.

3.2 DRILLING EQUIPMENT AND FLUIDS CONTAINMENT STRUCTURE

- A. **General.** The containment structure shall be constructed in accordance with the Drawings and Technical Specifications Sections 03200 - Reinforcement Steel, 03290 - Joints in Concrete, and 03300 - Cast-In-Place Concrete. Upon completion of the ASR well and FAMW, the containment structure will be removed and replaced with vaults, as shown in the Drawings.

3.3 WATER TABLE MONITORING WELL CONSTRUCTION

- A. **General:** The CONTRACTOR shall install small diameter water table monitor wells in the area around the ASR and FAMW containment structure(s) in the locations shown on the Drawings. A total of 6 wells shall be installed.
- B. **Construction Method:** The water table wells shall be constructed as shown in the Drawings using the hollow stem auger drilling method. If the CONTRACTOR proposes using another method, it should be approved by the ENGINEER prior to implementation.
- C. **Materials:** Each water table monitor well shall be drilled to an approximate depth of 25 feet and cased with PVC casing to a depth of at least 10 feet below the water table. The annular space around the casing shall be filled with a filter pack material to a level 3 feet above the top of the slotted well casing. The filter pack shall be protected by 1 foot of fine silica sand and the open annular space above the filter pack to the surface shall be filled with neat cement grout. All materials to be used in construction of the water table monitor wells shall be approved in advance by the ENGINEER. The wells will be constructed in accordance with SFWMD and State of Florida regulations concerning the construction of monitor wells. The monitor wells will be left in place after construction.
- D. **Installation of Gravel Envelope:** Gravel, as specified, shall be installed in the annular space between the borehole wall and the casing by a method selected by the CONTRACTOR and approved by the ENGINEER. Filter pack gravel shall be carefully installed to insure complete filling of the annular space from the bottom of the hole to a depth corresponds to 3 ft above the top of the well screen or as specified by the ENGINEER.
- E. **Sand Pack:** When the gravel packing operation is completed, the fine sand pack shall be placed in the annular space on top of the gravel pack. The depth to the top of the gravel shall be measured prior to placement of the sand pack and the depth to the top of the sand pack at the designated interval shall be verified following sand pack emplacement.
- F. **Sanitary Seal:** Upon completion of gravel and sand packing operations, and subsequent to well development, a cement grout seal shall be placed in the annulus between the borehole and the PVC well casing from approximately a depth of 7 feet in the well, filling to the surface or as determined by the ENGINEER. The specific grouting method to be employed by the CONTRACTOR shall be acceptable to the ENGINEER. A protective lid and containment structure pad will be finished around each wellhead, as per the Drawings.
- G. **Development and Sampling:** After completion, the water table monitor wells shall be developed by pumping, swabbing or airlifting until the discharge water is clear, in accordance with development procedures outlined in the Specifications. Each well shall be sampled immediately after development for background concentrations, then weekly for chloride, specific conductance, and temperature. The cost of the initial background sample analysis, to be completed by a state certified laboratory having a current approved ComQAP on file with FDEP, shall be

borne by the CONTRACTOR. Subsequent weekly sampling shall be performed by the OWNER or ENGINEER.

- H. **Cleanup:** The CONTRACTOR shall be financially responsible for the cost of all cleanup activities attributable to his drilling activities at the site, including the installation and operation of more monitoring/recovery wells, if deemed necessary by the ENGINEER or needed to comply with regulatory requirements.

3.4 ASR AND FAMW CONSTRUCTION

- A. **Pilot Hole Drilling:** The 12.25-inch diameter pilot holes shall be drilled in accordance with the Technical Specifications at all times. Geophysical logs shall be performed upon completion of drilling each section of the pilot hole. The exact depth of each pilot hole shall be determined by the ENGINEER. Collection of drill stem water samples may be requested by the ENGINEER at intervals during pilot hole drilling. The CONTRACTOR should be prepared to collect these samples upon direction by the ENGINEER, and include the cost of collection of up to 30 samples in the lump sum price of his bid. No cost of analysis will be incurred by the CONTRACTOR for drill stem samples .
- B. **Pilot Hole Cementing:** Subsequent to the installation of the intermediate casing in the ASR well, the pilot hole shall be cemented following the completion of logging and testing and prior to reaming.
- C. **Reaming:** Upon completion of the required geophysical logs and with the concurrence of the ENGINEER, the CONTRACTOR shall proceed with reaming. The final reamed borehole diameter shall be in accordance with the Drawings and Specifications. The exact depth of reaming will be determined by the ENGINEER.
- D. **Open Borehole.** After the setting and cementing of the 24-inch diameter final casing in the ASR well, a nominal 24-inch diameter borehole shall be drilled to the total depth of the well, as determined by the ENGINEER. Geophysical logs and water samples shall be performed upon completion of drilling.
- E. **Caliper Survey:** Upon completion of each stage of reaming operations, the CONTRACTOR shall arrange for the reamed hole to be surveyed for hole diameter. The cost of this survey shall be borne by the CONTRACTOR. If a caliper survey shows the hole to be less than the specified diameter at any point, the hole shall be re-reamed and re-surveyed. After the caliper survey has been made and accepted by the ENGINEER, installation of the well casing shall commence.
- F. **Installation of Well Casing:** When the reaming operation has been completed, the casing shall be installed. The lengths and intervals of each casing type will be determined by the ENGINEER.
 - 1. **General:** The CONTRACTOR shall submit a casing installation plan, as described in the section "SUBMITTALS" a minimum of 72-hours prior to the installation of each casing string. All casing shall be handled using drilling rig tools that are equipped with a weight indicator. Each casing joint shall be

able to support the weight of the casing below. The following also shall apply:

- a. The casings shall be lowered into the borehole open-ended and the weight of the casing shall be supported by the drilling rig.
 - b. The hook load of the drilling rig must exceed the maximum casing weight to be encountered during the construction of the well (approximately 385,000 pounds).
 - c. Other casing equipment, such as casing guides shall be attached to the casing as described in this section, and in Sections 2.3 and 2.4, during assembly.
 - d. Alternative methods of casing installation may be proposed by the CONTRACTOR by submitting the proposed method to the ENGINEER for approval.
2. Centralizers: All casings in the ASR well and FAMW shall be centralized in the borehole using strap-type centralizers welded at intervals along the pipe at 0, 90, 180 and 270 degrees around the casing at each position.
- a. Conductor Casing: Centralizers will be placed as follows:
 1. One at 20 feet above the bottom end of the casing.
 2. One at 20 feet above the bottom centralizer or across the first welded joint.
 3. One at regular intervals across each welded joint thereafter.
 4. One within 20 feet of land surface.
 - b. Other Casings: Centralizers in all other casings will be placed as follows:
 1. One at 20 feet above the bottom end of the casing.
 2. One at 20 feet above the bottom centralizer or across the first welded joint.
 3. Three at intervals across each welded joint above the uppermost centralizer and at approximate intervals of 200 feet thereafter.
 4. The topmost centralizer to be at a depth of 20 feet beneath the land surface.
 - c. Alignment: All centralizers shall be in perfect vertical alignment, one above the other in order to permit the passage of at least one tremmie pipe alongside the casing to the bottom of the borehole.
3. Casing Connection: The casing shall be connected by welding. All welded casing joints shall be made by welders certified in the State of Florida and in accordance with the requirements of AWWA C206. The casing joints shall be made with the casing properly aligned and using casing tabs to ensure

alignment and sufficient strength at the joint. Each weld shall be made with sufficient tensile strength to support the weight of the casing below and with sufficient burst strength to contain water at a pressure of 300 psi without leaking.

4. Tension: The casing shall be suspended in tension from the surface by means of a landing clamp. The bottom of the casing shall be at a sufficient distance above the bottom of the reamed hole so that none of the casing is supported from the bottom of the hole.
5. Weld Reinforcement: Weld reinforcement shall be as specified by the AWS code. Upon completion of welding, all weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance, with uniform weld contours and dimensions. All sharp corners of material which is to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.
6. Failure to Complete: If the casing cannot be landed in the correct position or at a depth acceptable to the ENGINEER, the CONTRACTOR shall construct another well immediately adjacent to the original location and complete this well in accordance with the Contract Documents at no additional cost to the OWNER. The abandoned hole shall be sealed in accordance with all State of Florida regulations.
7. Collapsed Casing. If the casing should collapse prior to well completion, it shall be withdrawn and replaced at the CONTRACTOR'S expense.
8. Casings-ASR Well: All casings shall be installed as shown in the Drawings and in accordance with the Technical Specifications. In addition:
 - a. Pit Casing shall be installed utilizing a method and set to a depth, selected by the CONTRACTOR.
 - b. Conductor Casing shall be installed in a pre-drilled, nominal 44-inch diameter borehole, to a depth selected by the ENGINEER
 - c. Final Casing shall be installed in a pre-drilled, nominal 34-inch diameter borehole, to a depth selected by the ENGINEER.
9. Casing FAMW:
 - a. Pit Casing shall be installed utilizing a method, and to a depth selected by the CONTRACTOR.
 - b. Conductor Casing shall be installed in a pre-drilled, nominal 34-inch diameter
 - c. Intermediate Casing shall be installed in a pre-drilled, nominal 24-inch diameter borehole, to a depth selected by the ENGINEER.
 - d. Final Casing shall be installed in a pre-drilled, nominal 14-inch diameter borehole to a depth selected by the ENGINEER.

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G. **Wellhead Capping and Valves:** The wellhead and valves for both the ASR well and FAMW shall be installed in accordance with the Drawings and requirements of the Specifications.

H. **Water Quality Analysis:** All water quality analysis will be performed by a State of Florida certified laboratory with a current ComQAP on file with FDEP in accordance with methods approved by FDEP.

1. Analyses requested for the ASR Zone and FAMW Zone are as follows:

A. Primary Drinking Water Standards

Alachlor
Aldicarb
Aldicarb sulfoxide
Aldicarb sulfone
Aroclors (Polychlorinated Biphenyls or PCBs)
Alpha, Gross
Antimony
Arsenic
Atrazine
Barium
Benzene
Benzo(a)pyrene
Beryllium
Cadmium
Carbofuran
Chlordane
Chlorobenzene (Monochlorobenzene)
Chromium
Coliforms, Total
Cyanide
2,4-D (2,4-Dichlorophenoxyacetic acid)
Dalapon (2,2-Dichloropropionic acid)
Dibromochloropropane (DBCP)
1,2-Dibromoethane (EDB, Ethylene Dibromide)
1,2-Dichlorobenzene (o-Dichlorobenzene)
1,4-Dichlorobenzene (p-dichlorobenzene or Para Dichlorobenzene)
1,2-Dichloroethane (Ethylene dichloride)
cis-1,2- Dichloroethene (1,2-Dichloroethene)
trans-1,2-Dichloroethene (1,2-Dichloroethene)
Dichloromethane (Methylene chloride)
1,2-Dichloropropane
Di(2-ethylhexyl) adipate (Bis(2-ethylhexyl) adipate)
Di(2-ethylhexyl) phthalate (Bis(2-ethylhexyl) phthalate)
Dinoseb
Diquat
Endothall
Endrin
Ethylbenzene
Fluoride

Glyphosate (Roundup)
Heptachlor
Heptachlor Epoxide
Hexachlorobenzene (HCB)
gamma-Hexachlorocyclohexane (Lindane)
Hexachlorocyclopentadiene
Lead
Mercury
Methoxychlor
Nickel
Nitrate (as N)
Nitrite (as N)
Total Nitrate + Nitrite (as N)
Oxamyl
Pentachlorophenol
Pichloram
Radium
Selenium
Silver
Silvex (2,4,5-TP)
Simazine
Sodium
Styrene (Vinyl Benzene)
Tetrachloroethene (Perchloroethene)
Tetrachloromethane (Carbon Tetrachloride)
Thallium
Toluene
Toxaphene
1,2,4-Trichlorobenzene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethene (TCE)
Trihalomethanes, Total
Vinyl Chloride (Chloroethylene)
Xylenes (total)

B. Secondary Drinking Water Standards

Aluminum
Chloride
Color
Copper
Corrosivity
Ethylbenzene
Fluoride
Foaming Agents (MBAS)
Iron
Manganese
Odor
pH
Silver
Sulfate

Toluene
Total Dissolved Solids (TDS)
Zinc

C. Inorganics

Ammonia
Total Organic Nitrogen
Orthophosphate (soluble)
Phosphorus, Total
Total Kjeldahl Nitrogen
Nitrate, as N
Nitrite as N

D. Volatile Organics

Chloroethane
Chloroform
1, 4 Dichlorobenzene
cis 1, 2 Dichloroethylene

E. Base/Neutral Organics

Anthracene
Butylbenzylphthalate
Dimethylphthalate
Naphthalene
Phenanthrene

F. Pesticides and PCB's

Aldrin
Dieldrin
Dioxin

G. Acid Extractables

2-chlorophenol
Phenol
2,4,6-trichlorophenol

H. Other

Conductivity
Biological Oxygen Demand
Chemical Oxygen Demand
Temperature
Potassium
Turbidity
Total Hardness
Hydroxide
Hydrogne Sulfide

Magnesium Hardness
Bicarbonate
Calcium Hardness
Carbon Dioxide
Gross Alpha
Radium 226
Radium 228

3.5 CEMENT

A. **General:** Before each cementing operation, the CONTRACTOR shall submit a cementing program to the ENGINEER for approval, as described in **Section 1 General, 1.4 Submittals, Cementing Program.**

1. **Operations:** The CONTRACTOR'S cementing program should be designed to provide an effective seal around the casings.
 - a. It is the CONTRACTOR'S responsibility to conduct the cementing operations in such a manner that the burst strengths of the casing (with safety factor) are not exceeded and the casing is not caused to fail.
 - b. The cement shall be pumped as a slurry of thoroughly mixed components in stages that are designed to fill the annular space without exceeding the collapse pressure of the casing pipe to which the cement is applied.
 - c. Cement will be pumped or placed so that the pressure of the slurry and the pressure applied inside the casing pipe do not affect the bond.
2. **Communications, Access and Work Summary:** Before each cementing operation, the CONTRACTOR shall submit a cementing program to the ENGINEER for approval, as described in **Section 1 General, 1.4 Submittals, Cementing Program.**
 - a. Full access to all cementing equipment and gauges shall be provided to the ENGINEER by the cementing contractor before, during and after pumping operations.
 - b. The cementing contractor will utilize portable radios to communicate during cement pumping operations and shall provide a portable radio to the ENGINEER to enable full communication with the cementing contractor during pumping.
 - c. Cement pumping summary sheets from the cementing specialty contractor shall be provided to the ENGINEER immediately following cement pumping. Should the cement pumping sheets not be submitted to the ENGINEER prior to the cement contractor leaving the site after pumping, the CONTRACTOR shall not be paid for the individual cementing job.
 - d. The CONTRACTOR shall begin cementing operations immediately after casing installation.

- e. The CONTRACTOR will collect cement samples (both dry and mixed) at the request of the ENGINEER. The CONTRACTOR will be responsible for analysis of up to 10 cement samples.
 - f. Measurements of cement weight shall be provided to the ENGINEER at frequent intervals prior to and during cementing operations using either a Densometer or mud scale.
- B. **Casing Seat:** The first stage of cement pumped into the annulus around the base of each casing shall consist of neat cement slurry. Each casing shall have a minimum 250 foot casing seat that will consist of neat cement.
- C. **Specialty Contractor:** In all cementing operations, the CONTRACTOR must be assisted by a specialty contractor familiar with cementing the type of formations expected to be encountered and experienced in using the type of cements and methods typically utilized for the work as specified in these Contract Documents and Specifications.
- D. **Cementing Procedures:** The cement will be placed in the annular space in stages using a collarless tremie pipe. After each stage of cementing and before the next stage, the CONTRACTOR shall conduct a temperature log and shall tag the top of cement with the tremmie pipe. If the temperature log and the tag do not indicate the same depth to the top of cement, a gamma log shall be run to confirm the top of cement. Cementing shall be continuous for each stage after cementing begins. If there is a loss of circulation or there are no returns at the surface, the ENGINEER shall be informed immediately of remedial procedures that will be used to re-establish circulation and complete the cementing program according to the well design and Specifications.
- E. **Cement Samples:** The CONTRACTOR shall collect dry and mixed samples of cement being used during the cementing of all stages. Mill test certificates documenting chemical and physical properties for all dry cement shall be provided to the ENGINEER for each batch of dry cement used in the well. Mixed cement samples shall include at least three 2-inch cubes suitable for tests of compressive strength. These samples shall be provided to the ENGINEER prior to the cement contractor leaving the site after pumping each stage. Slurry density shall be measured and documented by the CONTRACTOR on the cement stage pumping logs.
- F. **Preflush.** During all stages of cementing, the CONTRACTOR shall use a pre-flush or spacer. The CONTRACTOR shall submit the technical specifications of the pre-flush to the ENGINEER as part of the cementing plan submittal.
- G. **Cement Bond Log.** The top 150 feet of the annulus of the final casing shall not be cemented until after the completion of the cement bond log in the ASR well for the purposes of calibrating the cement bond log tool.
- H. **Pilot Hole Cementing:** Upon completion of the drilling and testing of the pilot hole in the FAMW to 1,650 ft, the CONTRACTOR will fill the open-hole portion of the hole (from approximately 1,200 feet to 1,650 feet) with neat cement. The cement will be emplaced from bottom to top, through a tremmie pipe

- I. **Access:** Full access to all cementing equipment and gauges shall be provided to the ENGINEER by the cementing contractor before, during and after pumping operations.

3.6 TESTS

A. **General:** Tests shall be performed as described below, and in accordance with these Specifications.

B. **Packer Testing:** Upon completion of the geophysical logs in the final 12.25-inch diameter pilot holes of the ASR well and FAMW, the CONTRACTOR shall perform up to a total of six straddle packer tests in the wells as directed by the ENGINEER.

1. **General:** All packer tests shall be conducted in such a way to obtain accurate hydrologic properties of the formation and a representative formation water sample.
2. **Straddle Packers:** The tests shall be performed using two inflatable packers with a section of perforated pipe between them installed in the borehole on drill pipe. The lower packer shall be equipped with a pressure measuring device that shall display the downhole pressure during the test (real time display). The pressure data shall also be recorded in an electronic format for downloading as an ASCII file to the ENGINEER.
3. **Single Packer:** A single inflatable packer will be set on open-ended drill pipe at a depth to be specified by the ENGINEER for the single packer test in the FAMW.
4. **Equipment:** The CONTRACTOR will be responsible for providing all necessary pumps, prime movers, pipelines, meters, and gauges necessary for testing and will provide access for water-level measurements using an M-scope, tape, or electronic probe.
5. **Pump Installation:** The upper 250 feet of the casing or pipe being used to set the straddle packers or single packer shall have an inside diameter to facilitate the installation of a 4-inch diameter submersible pump. The submersible pump shall have the capability of pumping at rates between 5 and 100 gpm at 250 ft.
6. **Flowmeter:** An in-line propeller-type flowmeter capable of recording total flow and discharge will be used to measure the flow from the tested zone.
7. **Drill String:** The internal surfaces of drill pipe, casings, and other fittings used for the packer tests shall be free of rust, scale, and other material that could be dislodged and interfere with a test.
8. **Test Failure:** Should a test fail because of the presence of any of rust or scale, or other foreign material in the tools or pipe, the CONTRACTOR will not be reimbursed for the test and he will be required to clean the pipe, reset it and the packer, and rerun the test successfully as part of the Contract requirements at his own cost.

9. **Development:** After successfully inflating and setting the packer and before the CONTRACTOR conducts a 4-hour pumping test and a 3-hour recovery test for each straddle packer test, he shall develop each zone so that it is free of any drilling mud/fluids (and producing representative formation water) and allow the water level in the pipes to return to static. It is anticipated that rates of between 20 and 100 gpm will be obtained during the pumping test. The water produced during development and during the pumping test shall be confined to the closed-circulation system.
10. **Samples:** Just prior to completion of each pumping test, the CONTRACTOR shall collect a water sample from the discharge and have the following analyses performed by a State-certified laboratory acceptable to the ENGINEER: chlorides, specific conductance, sulfate, TDS, pH, temperature, bicarbonate, calcium, potassium, sodium, magnesium, nitrate, ammonia nitrogen, total kjeldahl nitrogen and total phosphorus. The laboratory shall be certified by FDEP and have a current, approved COMQAPP on file with FDEP.

C. **Flow Tests:** Flow tests shall be conducted in the pilot hole after reaming and setting the final casing in the ASR well. The CONTRACTOR shall provide for access to the borehole for the geophysical logging equipment while temperature, fluid resistivity and fluid velocity logs are conducted by the CONTRACTOR (or their subcontractor) under static and flowing conditions.

1. Upon completion of the intermediate and final phases of pilot hole drilling, the open pilot hole shall be developed by pumping until the discharge water is free from silt and sand, as determined by the ENGINEER.
2. The shut-in pressure of the well will be measured before conducting the flow test, either by using a pressure gauge or by measuring the equilibrium height of the water column in a stand pipe above ground surface.
3. The well will then be allowed to flow freely into the circulation tanks through the normal circulation piping of the drilling rig. The flow into the tanks will be measured by a flow meter inserted into the pipeline.

D. **Pilot Hole Video Surveys:** Upon completion of the pilot holes below 1,020 feet (after geophysical logging and straddle packer tests have been completed) the CONTRACTOR shall perform downhole video surveys of the open borehole.

1. The surveys will be run using equipment that is capable of providing a clear image of a 12.25-inch and 24-inch diameter borehole and with sufficient resolution to identify the targets of the survey. Sideview capability should be provided.
2. The CONTRACTOR shall install a standpipe, tee and valve on the wellhead to permit access to the well by the video camera.
3. The CONTRACTOR shall pump potable water from a source approved by the ENGINEER into the well through the tee until the casing can be clearly recorded using the video equipment.

4. The CONTRACTOR shall continue to pump during the survey until a clear record of the well has been made.
5. A video record of the entire well will be made from land surface to the total depth of the well.

E. Well Development and Pumping: After each well has been completely constructed in accordance with the requirements of the Contract Documents, the CONTRACTOR shall notify the ENGINEER and shall make the necessary arrangements for conducting the well development, and the production tests.

1. **Development by Pumping:** Within 24 hours after completion of each well, the CONTRACTOR shall commence well development of the ASR well open borehole, and the FAMW open borehole.
 - a. The CONTRACTOR shall furnish, install, operate and remove all equipment necessary for developing the wells.
 - b. The CONTRACTOR shall furnish, install, operate and remove a submersible pump for developing the ASR well. The pump and driving unit shall have a capacity to pump from 500 to 5,000 gpm with a pump suction inlet setting at a depth of approximately 150 feet bls.
 - c. A submersible pump will be used for development of the FAMW and shall have a capacity to pump from 10 to 200 gpm against a total head of 80 feet with a pump suction inlet setting at the depth of approximately 100 feet.
 - d. The CONTRACTOR shall furnish and install discharge piping of sufficient size and length to conduct water to a location at the outfall structure designated by the OWNER. The discharge line shall contain an in-line meter with 6-digit, straight reading totalizer, registering in units of 100 gallons, together with a rate of flow indicator dial, which reads in units of gallons per minute and is suitable for the expected flow range.
 - e. The initial development pumping rates shall be restricted and as the water clears shall be gradually increased until the maximum rate is reached. The maximum rate will be determined by the ENGINEER after consideration of the drawdown and discharge characteristics of the respective zone. At frequent intervals the pump shall be stopped and the water in the well shall be allowed to surge back through the pump bowls or drill pipe and through the open area beneath the casing.
 - f. The cycle of pumping and surging shall be repeated until the discharge water is clear of sand, silt and mud and until there is no increase in specific capacity (discharge per foot of drawdown) in either the ASR or FAMW.
 - g. The wells shall be thoroughly developed so that it will produce a reasonable maximum capacity based on the consideration of depth and nature of the water-bearing formations, and so that it will not produce a composite amount of fine sands in excess of 1 parts per million. Sand

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production during well discharge shall be recorded on pump development and testing records. Sand production concentration is to be less than 1 ppm at the post-rehabilitation design rate, shall be measured using a centrifugal sand-separating device, as described in the Journal of the American Water Works Association, Vol. 46, No. 2, February 1954.

- h. Development and test records shall be maintained on an hourly basis, showing production rates, static water level, pumping level, drawdown, production of sand, and all other pertinent information concerning the method of development. Pumping test records shall show drawdown versus production to the approximate range of 1,000 gpm, at 5-minute intervals, for the step drawdown tests. Also included with this submittal shall be records of all volumes and amounts of materials used in rehabilitation operations, such as chlorine, acid and potable water.
 - i. Upon completion of the development operations, the CONTRACTOR shall demonstrate that the bottom of both wells are clear of all sand, mud and other foreign material, as applicable.
 - j. It is anticipated that development pumping of the FAMW shall continue for a cumulative period of approximately 20 hours. The development of the ASR zone shall continue for a cumulative period of approximately 20 hours.
 - k. The CONTRACTOR will provide clean water at the required flow rate for well development purposes. [The nearest fire hydrant is 130 feet to the north; however, it requires at least 360 feet of hose to traverse fence between well location and hydrant.]
2. Disinfection: The CONTRACTOR shall provide for disinfection of the ASR well and FAMW immediately after sampling and test pumping of the well has been completed. The CONTRACTOR shall carry out adequate cleaning procedures immediately preceding disinfection where evidence indicates that normal well construction and development work have not adequately cleaned the well. All oil, soil, and other materials, shall be removed from the well.
- a. Disinfection of the well shall be performed in accordance with the requirements of ANSI/AWWA C654, except as modified herein. The method of chlorination to be used shall consist of (1) treating the water in the well casing to provide a chlorine residual of approximately 500 mg/L; (2) circulating the chlorinated water within the well casing and pump column; and (3) pumping the well to waste to remove chlorinated water.
3. The disinfected ASR well and FAMW shall be tested for the presence of coliform in accordance with ANSI/AWWA C654. The results shall be submitted to the ENGINEER. If bacterial evaluation fails, Part 3 Execution, Section 3.4(H) alone, and testing shall be repeated until the results indicate a pass.
4. ASR Well Pumping Tests.
- a. General

1. The CONTRACTOR will furnish calibrated and maintained data logger and pressure transducer capable of measuring water levels to within 0.1 ft. The CONTRACTOR shall furnish an electrical depth gauge, capable of indicating depths to water to the nearest one-tenth foot, with sounding tube placed to the maximum depth to water anticipated and shall also furnish an air source and air line having a direct reading gauge calibrated in feet.
 2. Pumping tests conducted on the ASR well shall include: (1) a step-drawdown test with increasing discharge rate, and (2) a continuous, constant rate, time-drawdown test. A period of time is required for pump shut down and water level recovery between the well development and the tests and between the step-drawdown and constant rate pumping tests. There will be no additional payment for rig time or standby time during these periods of well recovery.
- b. Step-Drawdown Test:
1. Following the completion of the ASR well development with the test pump the water level shall be allowed to recover for a period of at least 2 hours or until the water level has recovered fully to the original static water level. Following this recovery period, a 4-hour step-drawdown test shall commence.
 2. The pump shall be operated initially at a rate of approximately 1000 gpm. The pumping rate shall then be increased by increments determined by the ENGINEER at 1-hour intervals until the well has been tested at maximum capacity. The test duration and pumping rates will be determined by the ENGINEER. The estimated rates at this time are 1,000 gpm, 2,500 gpm, 3,500 gpm, and 4,000 gpm. During the test, the CONTRACTOR shall record the time, pumping level, and discharge at 5-minute intervals. When the test is completed, the pump shall be stopped and the water level in the well allowed to recover.
- c. Upon completion of the step drawdown test, background will be monitored for a 24 hour period by the CONTRACTOR. This will consist of monitoring water levels in the ASR well and recording them at 30 minute intervals for 24 hours prior to the continuous rate test.
- d. Constant-Rate Pumping Test:
1. A continuous, constant rate, time-drawdown test shall commence after the water level in the well has recovered from the step-drawdown test for at least 24 hours. The rate of pumping will be determined by the ENGINEER. The CONTRACTOR shall assure that the pumping rate selected remains constant throughout the test. The test duration shall be 24 hours. When the test is completed and the pump stopped, the CONTRACTOR shall not remove the test pump from the well for a period of approximately 24 hours.

2. The CONTRACTOR shall record the discharge rate each time the pumping water level is measured. In addition to these measurements, the ENGINEER may require the CONTRACTOR to periodically record the temperature of the discharge water or collect water samples. During the test, the CONTRACTOR shall measure the pumping water level according to the following schedule:
3. Startup to 5 minutes - every 30 seconds; 5 minutes to 15 minutes - every 1 minute; 15 minutes to 60 minutes - every 5 minutes; 60 minutes to 120 minutes - every 10 minutes; 2 hours to 5 hours - every 30 minutes, thereafter - every hour.
4. If the measurements are not be made exactly at the times specified, the actual time of each measurement shall be recorded. On completion of pumping, recovery measurements shall be made according to the above drawdown schedule.
5. Supervision by the CONTRACTOR of constant rate pumping test shall be maintained on a continuous basis by qualified personnel.
6. If either test is aborted or interrupted for any reason, the test shall be stopped; the water level allowed to recover; and the test restarted. No payment will be made to the CONTRACTOR for interrupted pumping tests.
7. After the test pump has been removed, the CONTRACTOR shall remove any accumulated sediment from the well.
8. All test data will be provided in spreadsheet form to the ENGINEER by electronic file using ASCII.

F. Mechanical Integrity Tests (MIT): The following tests will be performed:

1. Pressure Test (Final Casing of ASR and FAMW): After setting and cementing the 24-inch and 6-inch diameter final casings and before drilling below the casing, the CONTRACTOR shall conduct a pressure test of the final casing. The casing or tubing shall be filled with water and placed under a minimum of 150 pounds per square inch (psi) and a maximum of 225 psi for a period of 60 minutes. The criterion for acceptance of the well is no greater than ± 5 percent of test pressure for the period of the test. If the pressure changes or if there is some other indication of leakage in the equipment, the CONTRACTOR shall take steps to locate the leak and make repairs in a manner satisfactory to the ENGINEER.
 - a. Pressure test apparatus will consist of a wellhead assembly equipped with a pressure gauge that can seal the wellhead without leaking to a pressure of 225 psi, a water line with valve that can be used to shut in the well when the pressure reaches maximum available pressure, and a potable water source and pump that can be used to increase the pressure in the well to the desired level. The pressure gauge shall have a range from 0 to 300 psi with 50 psi major increments and minor

increments of 1 psi, according to Technical Specification Section 3.1 (G) - Gauges.

- b. The test shall consist of increasing the pressure in the casing to at least 150 psi, shutting in the well, and monitoring the pressure for 1 hour. The pressure measured at the wellhead shall be recorded every minute for the entire period of the test. The CONTRACTOR shall notify the ENGINEER at least 72 hours before the start of the test.
 - c. The CONTRACTOR will conduct a preliminary test to determine if the test apparatus leaks. All apparatus shall be leak free before the pressure test commences.
 - d. The CONTRACTOR shall notify the ENGINEER at least 12 hours before starting the preliminary test.
 - e. If the well fails the pressure tests described above, the CONTRACTOR must re-run the test until the well passes within the range of acceptance stated in Part 1, Section 1.3 Quality Assurance. If the well does not pass the above described test, the CONTRACTOR shall be required to perform the test according to the procedure outlined below, utilizing a packer to seal the bottom of the casing.
 - (1) The CONTRACTOR shall seat a packer at a depth within 50 feet of the bottom of the casing. The packer will be inflated and a pressure gauge will be installed on the packer assembly at the surface to monitor the pressure in the packer.
 - (2) In the event that the pressure in the well cannot be maintained, the CONTRACTOR will set the packer at another depth and repeat the test. This procedure will be repeated until the leak is located.
2. Downhole Video Survey (ASR Well and FAMW): The purpose of the survey is to evaluate the condition of the casing and of the formation in the open holes.
- a. The survey will be run using equipment that is capable of providing a clear image of 24-inch and 6-inch diameter pipes and with sufficient resolution to identify the targets of the survey.
 - b. The CONTRACTOR shall install a standpipe, tee and valve on the wellhead to permit access to the well by the video camera.
 - c. The CONTRACTOR shall pump potable water from a source approved by the ENGINEER into the ASR and FAMW wells through the tee until a volume of at least three times the borehole volume has been pumped into the well. The CONTRACTOR will continue to pump during the survey until a clear record of the well has been made.
 - d. A video record of the entire well shall be made from land surface to the total depth of the wells. Views of all casing welds or joints and the base of the casing should be provided using a sideward tooling camera.

3.7 GEOPHYSICAL LOGS

- A. Geophysical logs will be performed in accordance to the summary schedule in Section 1.2.J.A and 1.2.J.B.

3.8 WELL ACIDIFICATION

- A. **General:** The following explicit operations may potentially be recommended by the ENGINEER during the course of WORK. The CONTRACTOR will obtain a specialty CONTRACTOR experienced in performing well acidization to conduct this work.
- B. **Health and Safety:** The CONTRACTOR will prepare and submit a health and safety plan for well acidization for review and approval prior to initiating well acidization.
- C. **Disposal Plan:** Prior to commencement of WORK, the CONTRACTOR shall submit a plan for disposal of rehabilitation waste products, including neutralization of acidization wastes, and disposal of wastes from acidization, chlorination, casing cleaning, drilling, and development. The plan shall meet the requirements of the NPDES permit for discharge.
- D. **Procedure:** If, after development operations are completed, the well does not produce a sufficient quantity of water or produces greater than 1 ppm sand or silt, as determined by the ENGINEER, acidization of the well may be required as an additional development technique. Tubing, hoses and pumps used during acidization of a well shall be chemically inert and shall be capable of withstanding 300 pounds per square inch of pressure. The acidization equipment shall have the ability to inject chemical constituents at various depths through out the length of the well.
 - 1. The acid, in the form of a liquid, shall be introduced into the well directly from the CONTRACTOR's pumping equipment, through a tremie pipe set in the open hole portion of the well, at a predetermined depth designated by the OWNER. The wellhead assembly used for acidizing shall be sealed except for the entry point for the tremie pipe, a threaded nipple for a pressure gauge, and a pressure release valve. An approved means of sealing the area around the tremie pipe shall be employed.
 - 2. The tremie pipe shall be moved up and down the entire length of the ASR zone to introduce acid directly to all parts of the zone. Water shall be pumped into the well head through another opening to force acid into each depth.
 - 3. A pressure gauge for the purpose of monitoring increases in pressure from the addition of the acid must be used. If significant pressure increases are observed after addition of the acid, the pressure may be relieved using the pressure release valve.
 - 4. Approximately 8,500 gallons of 18 Baume muriatic acid (28 percent hydrochloric acid) shall be used to acidize the well. Additives such as

chelating agents may be added to the acid prior to pumping, if approved by the OWNER. After the acid is placed in the open hole, the well shall be closed and sealed for approximately one hour. Afterwards a volume of water equal to the volume of acid used shall be pumped to force the acid solution into the formation. The well shall then be closed and sealed for a period of at least 24 hours prior to removal of the acid residuals.

5. All mixing tanks, chemical pumps and piping shall be constructed of materials compatible with the acid used. All personnel involved in the acidization process shall observe adequate safety procedures at all times including appropriate safety equipment and clothing.
6. The removal of the acid residuals shall be judged complete when the water pumped from the well after acidization has a pH equal to the background pH measured in the well prior to acidization. These waters shall be contained so as not to cause an environmental hazard, and disposed of in a manner consistent with Local, State, and Federal regulations. A disposal plan will be submitted to the ENGINEER by the CONTRACTOR for review and approval prior to implementation.

-END OF SECTION-

SECTION 02643 - WATER PIPELINE TESTING AND DISINFECTION

PART 1 – GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall perform flushing and testing of all pipelines and appurtenant piping and disinfection of all pipelines and appurtenant piping for potable water, complete, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards:

ANSI/AWWA B300	Hypochlorites.
ANSI/AWWA C651	Disinfecting Water Mains.

1.3 CONTRACTOR SUBMITTALS

- A. A proposed plan and schedule for water conveyance, cleaning, pressure testing, disinfection, and water disposal shall be submitted in writing for approval a minimum of 48 hours before testing is to start. The plan shall demonstrate that personnel are experienced and prepared to resolve problems which may arise.

PART 2 – PRODUCTS

2.1 MATERIALS REQUIREMENTS

- A. All test equipment, chemicals for chlorination, temporary valves, bulkheads, or other water control equipment and materials shall be selected and furnished by the CONTRACTOR subject to the ENGINEER's review. No materials shall be used which would be injurious to the construction or its future function.
- B. Chlorine for disinfection may be in the form of liquid chlorine, sodium hypochlorite solution, or calcium hypochlorite granules or tablets.
- C. Sodium hypochlorite and calcium hypochlorite shall be in accordance with the requirements of ANSI/AWWA B300.

PART 3 – EXECUTION

3.1 GENERAL

- A. Unless otherwise indicated, water for testing and disinfecting water pipelines will be furnished by the OWNER; however, the CONTRACTOR shall make all necessary provisions for conveying the water from the OWNER-designated source to the points of use.

- B. All pressure pipelines shall be tested.
- C. Disinfection shall be accomplished by chlorination. All chlorinating and testing operations shall be performed in the presence of the ENGINEER.
- D. Disinfection operations shall be scheduled by the CONTRACTOR as late as possible during the contract time period so as to assure the maximum degree of sterility of the facilities at the time the WORK is accepted by the OWNER. Bacteriological testing shall be performed by a certified testing laboratory approved by the OWNER and at the expense of the CONTRACTOR. Results of the bacteriological testing shall be satisfactory to the State Department of Health or other appropriate regulatory agency.

3.2 PIGGING

- A. The CONTRACTOR shall clean the system thoroughly by pigging to remove sand, grit, gravel, stones, fluids, construction waste, and all material which would not be found in a properly cleaned pipeline. Pigging shall obtain a smooth interior pipe surface free from any material or fluid not used in cleaning.
- B. Pigging shall be defined as passage of a sufficient number of pigs through the pipeline to achieve the clean conditions above. Flushing will not be acceptable as a substitute for pigging.
- C. Provision for pig access and egress points and disposal of water and materials shall be the CONTRACTOR's responsibility.
- D. Pigs shall be individually marked and their location shall be controlled and monitored so that no pigs remain in the system after cleaning.
- E. Pigging may be done in conjunction with initial filling for the hydrostatic test.

3.3 HYDROSTATIC TESTING OF PIPELINES

- A. Prior to hydrostatic testing, pipelines shall be flushed or blown out as appropriate. The CONTRACTOR shall test all pipelines either in sections or as a unit. No section of the pipeline shall be tested until all field-placed concrete or mortar has attained an age of 14 days. The test shall be made by closing valves when available, or by placing temporary bulkheads in the pipe and filling the line slowly with water. The CONTRACTOR shall be responsible for ascertaining that all test bulkheads are suitably restrained to resist the thrust of the test pressure without damage to, or movement of, the adjacent pipe. Any unharnessed sleeve-type couplings, expansion joints, or other sliding joints shall be restrained or suitably anchored prior to the test, to avoid movement and damage to piping and equipment. The CONTRACTOR shall provide sufficient temporary air tappings in the pipelines to allow for evacuation of all entrapped air in each pipe segment to be tested. After completion of the tests, such taps shall be permanently plugged. Care shall be taken to see that all air vents are open during filling.
- B. The pipeline shall be filled at a rate which will not cause any surges or exceed the rate at which the air can be released through the air valves at a reasonable velocity and all the air within the pipeline shall be properly purged. After the pipeline or section thereof has been filled, it shall be allowed to stand under a slight pressure for at least 24 hours to allow the concrete or mortar lining, as applicable, to absorb what water it will and to allow the

escape of air from any air pockets. During this period, bulkheads, valves, and connections shall be examined for leaks. If leaks are found, corrective measures satisfactory to the ENGINEER shall be taken.

- C. The hydrostatic test shall consist of holding the test pressure on the pipeline for a period of 2 hours. The test pressure for distribution and transmission pipelines shall be 150 psi. A test procedures shall be in accordance with the requirements of the Palm Beach County Health Department.
- D. The maximum allowable leakage for distribution and transmission pipelines shall be according to the requirements of the Palm Beach County Health Department.
- E. The maximum leakage for yard piping shall be as shown on the Piping Schedule. Pipe with welded joints shall have no leakage.
- F. Pipelines that fail to pass the prescribed leakage test will be considered defective WORK, and the CONTRACTOR shall determine the cause of the leakage, shall take corrective measures necessary to repair the leaks, and shall retest the pipelines.

3.4 DISINFECTING PIPELINES

- A. **General:** All potable water pipelines except those appurtenant to hydraulic structures shall be disinfected in accordance with the requirements of ANSI/AWWA C651 using the Continuous-Feed Method as modified herein.
- B. **Chlorination:** A chlorine-water solution shall be uniformly introduced into the pipeline by means of a solution-feed chlorinating device. The chlorine solution shall be introduced at one end of the pipeline through a tap in such a manner that as the pipeline is filled with water, the concentration in the water entering the pipe is approximately 50 mg/l. Care shall be taken to prevent the strong chlorine solution in the pipeline being disinfected from flowing back into the line supplying the water.
- C. **Retention Period:** Chlorinated water shall be retained in the pipeline long enough to destroy all non-spore-forming bacteria. This period shall be at least 24 hours. After the chlorine-treated water has been retained for the required time, the free chlorine residual at the pipeline extremities and at other representative points shall be at least 25 mg/l.
- D. **Chlorinating Valves:** During the process of chlorinating the pipelines, all valves and other appurtenances shall be operated while the pipeline is filled with the heavily-chlorinated water.
- E. **Sampling Ports:** The CONTRACTOR shall provide sampling ports along the pipeline as defined on AWWA C651. Taps may be made at manways and air valves to help facilitate the spacing requirement.
- F. **Final Flushing:** After the applicable retention period, the heavily chlorinated water shall be flushed from the pipeline until chlorine measurements show that the concentration in the water leaving the pipeline is no higher than that generally prevailing in the system or is acceptable for domestic use. If there is any question that the chlorinated discharge will cause damage to the environment, a reducing agent shall be applied to the water to neutralize thoroughly the chlorine residual remaining in the water.

- G. **Bacteriological Testing:** After final flushing and before the pipeline is placed in service, a sample, or samples shall be collected from the end of the line, and shall be tested for bacteriological quality in accordance with the requirements of the State Department of Health or other appropriate regulatory agency. For this purpose the pipe shall be re-filled with fresh potable water and left for a period of 24 hours before any sample is collected. Should the initial disinfection treatment fail to produce satisfactory bacteriological test results, the disinfection procedure shall be repeated until acceptable results are obtained.

3.5 CONNECTIONS TO EXISTING SYSTEM

- A. Where connections are to be made to an existing potable water system, the interior surfaces of all pipe and fittings used in making the connections shall be swabbed or sprayed with a one percent hypochlorite solution before they are installed. Thorough flushing shall be started as soon as the connection is completed and shall be continued until discolored water is eliminated.

- END OF SECTION -

SECTION 02831 – CHAIN LINK FENCING AND GATES

PART 1 – GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide chain link fencing and gates and appurtenant WORK, complete and operable, in accordance with the Contract Documents.
- B. **Single Manufacturer:** Chain link fencing, gates, accessories, fittings, and fastenings shall be products of a single manufacturer.

1.2 CONTRACTOR SUBMITTALS

- A. General: Furnish submittals in accordance with Section 01300 - Contractor Submittals.
- B. Shop Drawings
 - 1. Manufacturer's technical data, product specifications, standard details, certified product test results, installation instructions and general recommendations.
 - 2. Scale layout of fencing, gates, and accessories. Drawings shall show fence height, post layout, including sizes and sections; post setting and bracing configuration, details of gates and corner construction, and other accessories which may be necessary.
- C. Samples: Samples of proposed fence components, at least 12 inches long, to illustrate the selected color and finish.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Dimensions indicated herein for roll-formed pipe and H-sections are outside dimensions, excluding coatings.
- B. Fence fabric height shall be 8 feet unless otherwise indicated.
- C. Fencing materials shall be hot-dip galvanized after fabrication.
- D. Fence fabric and posts shall be black PVC coated. PVC coatings shall be made from virgin PVC resin with plasticizer, stabilizers, and ultraviolet inhibitor. Coatings shall have a tensile strength of 2500 psi, maximum elongation of 200 percent, and a shore durometer hardness of 40 to 46.

2.2 STEEL FABRIC

- A. Fence fabric shall be No. 9 gauge steel wire, 2-inch mesh, with top selvages knuckled and bottom selvages twisted and barbed.

B. **Fabric Finish:** Fabric shall be galvanized according to ASTM A 392 - Zinc-Coated Steel Chain Link Fence Fabric, Class I, with not less than 1.2 ounces zinc per square foot of coated surface, followed by a thermally bonded poly vinyl chloride coating at least 7 mils thick.

1. PVC coating shall comply with ASTM F 668 - Poly (Vinyl Chloride)(PVC) - Coated Steel Chain Link Fence Fabric, Class 2, except that the wire core shall measure 9 gauge prior to application of coating.

2.3 FRAMING AND ACCESSORIES

A. **Steel Framework, General:** Unless otherwise indicated, framework components shall be fabricated of galvanized steel conforming to ASTM A 53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless, or ASTM A 123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products, with not less than 1.8 ounces zinc per square feet of coated surface.

1. Fittings and accessories shall be galvanized in accordance with ASTM A 153 _ Zinc Coating (Hot-Dip) on Iron and Steel Hardware, with zinc weights per Table I of that standard, except that no coating shall be less than 1.8 ounce zinc per square foot of coated surface.
2. After galvanizing, framework, fittings, and accessories shall be finished with manufacturer's standard thermally bonded PVC finish, not less than 10 mils thick.

B. **End, Corner and Pull Posts:** Posts shall be one-piece without circumferential welds, 3 inch schedule 40 pipe, 5.79 pounds per linear foot.

C. **Line Posts:** Line posts shall be spaced no more than 10 feet on center and shall be 2-1/4 inch "H" column section, 4.1 pounds per linear foot, or schedule 40, 2-1/2 inch pipe, 3.65 pounds per linear foot.

D. **Gate Posts:** Gate posts shall be 4 inch schedule 40 pipe, 9.1 pounds per linear foot.

E. **Top Rail:** Top railing shall be provided in manufacturer's longest lengths, with expansion type couplings, approximately 6 inches long, for each joint. Fence design shall provide positive, secure attachment of top rail to each gate post, corner post, pull post and end post. Top rail and braces shall be 1-5/8 inch schedule 40 pipe, 2.27 pounds per linear foot, or 1-1/2 inch "H" column section, 2.00 pounds per linear foot.

F. **Tension Wire:** Tension wire shall be located at the bottom of the fabric and shall consist of No. 7 gauge coated coil spring wire of metal and finish to match fabric. Tension wire shall be interlaced with the fabric or attached to the fabric along the extreme bottom of the fence. Tension wire attachment shall be with fabric tie wires at a spacing of no more than 24 inches apart.

G. **Fabric Tie Wires:** Fabric tie wires shall be No. 9 gauge galvanized steel wire of the same finish as the fabric. Aluminum ties shall not be used. Ties shall be spaced 14 inches apart on posts and 24 inches apart on rails.

H. **Post Brace Assembly:** Post brace assembly shall be manufacturer's standard adjustable brace assembly provided at each end post, gate post and at both sides of each corner post and intermediate brace post. Material used for brace shall be same as top rail. Truss bracing between line posts shall be achieved with 0.375-inch diameter rod and adjustable tensioner.

- I. **Post Tops:** Post tops shall be weather-tight closure caps, designed for containment of top rail and positive permanent attachment to post. One cap shall be provided for each post.
- J. **Stretcher Bars:** Stretcher bars shall be one-piece lengths equal to the full height of the fabric, with minimum cross-section of 3/16 inch by 3-1/2 inch. One stretcher bar shall be provided for each gate and end post, and two for each corner and intermediate brace post.
- K. **Stretcher Bar Bands:** Stretcher bar bands shall be one-piece fabrications designed to secure stretcher bars to end, corner, intermediate brace, and gate posts. Bands shall have a minimum cross-section of 1/8 inch by 3/4 inch. Stretcher bar bands shall be spaced no more than 15 inches on center.

2.4 GATES

- A. **Fabrication:** Perimeter frames of gates shall be fabricated from same metal and finish as fence framework. Gate frames shall be assembled by welding or with fittings and rivets for rigid, secure connections. Welds shall be ground smooth. Gate frames and any ungalvanized hardware, shall be hot-dip galvanized after fabrication. Horizontal and vertical members shall be provided to ensure proper gate operation and attachment of fabric, hardware and shall be hot-dip galvanized after fabrication.
 - 1. Fabric for gates shall match fence fabric, unless otherwise indicated. Fabric shall be installed with stretcher bars at all perimeter edges. Stretcher bars shall be attached to gate frame with stretcher bar bands spaced no more than 15 inches on center.
 - 2. Each gate shall be diagonally cross-braced with a 3/8-inch diameter adjustable length truss rod to ensure frame rigidity without sag or twist.
 - 3. Where barbed wire is indicated above gates, vertical members shall be extended and fabricated as required to receive barbed wire supporting arms.
- B. **Swing Gates:** Perimeter frames of swing gates shall be constructed of the same pipe or "H" column members as the top rails and shall be fabricated by welding. Welds shall be ground smooth prior to hot-dip galvanizing.
 - 1. Hardware and accessories shall be provided for each gate, galvanized in conformance with ASTM A 153, and in accordance with the following:
 - a. Hinges: Hinges shall be of size and material to suit gate size, non-lift-off type, offset to permit 180-degree gate opening. Three hinges shall be provided for each leaf 6 feet or more in height.
 - b. Latch: Latch shall be forked type or plunger-bar type, permitting operation from either side of the gate, with padlock eye as an integral part of the latch.
 - c. Keeper: Keeper shall be provided which automatically engages the gate leaf and holds it in the open position until it is manually released.

2.5 RELATED ITEMS

- A. **Concrete:** Concrete shall be provided according to Section 03300 - Cast-In-Place Concrete.

- B. Nuts, bolts and screws shall be steel, minimum size 3/8-inch diameter, hot-dip galvanized after fabrication.

2.6 MANUFACTURERS

- A. **Manufacturer's Qualifications:** Chain link fencing and gates shall be products of a single manufacturer which has been successfully engaged in the production of such items for a period of at least 5 years.
- B. Manufacturers, or equal
 - 1. **American Fence Corp.**
 - 2. **Anchor Fence, Inc.**
 - 3. **United States Steel**

PART 3 -- EXECUTION

3.1 INSPECTION

- A. Prior to commencing installation, require Installer to inspect all areas and conditions within which Work of this Section will be performed. Dimensions and clearances shall be verified. Final grading shall be completed and all earth, brush, or other obstructions which interfere with the proper alignment and construction of fencing shall be removed.

3.2 INSTALLATION

- A. **General:** Unless otherwise indicated, all posts shall be set in concrete. Gate and related posts, corner posts, and other critical elements shall be provided with concrete foundations which are designed by an engineer to safely accommodate the loads to which they will be subjected.
- B. **Excavation:** Holes for posts shall be drilled or hand excavated to the diameters and spacings indicated, in firm, undisturbed or compacted soil. Post foundations which are not designed by an engineer shall comply with the following:
 - 1. Holes shall be excavated to a diameter not less than 12 inches or not less than five times the largest dimension of the item being anchored, whichever is larger.
 - 2. Depth for holes shall be not less than 40 inches; excavated approximately 4 inches lower than the post bottom, with bottom of posts set not less than 36 inches below finish grade surface.
- C. **Setting Posts:** Line posts shall be spaced at not more than 10-foot intervals, measured from center to center of the posts, parallel to the ground slope. Posts shall be set plumb and shall be centered in holes, 4 inches above the bottom of the excavation, with posts extending not less than 36 inches below finish grade surface.
 - 1. Corner posts shall be installed where changes in the fence lines equal or exceed 15 degrees, measured horizontally.

2. Each post shall be properly aligned vertically and its top aligned parallel to the ground slope. Posts shall be maintained in proper position during placement and finishing operations.

D. Concrete

1. Concrete for footings may be placed without forms, providing the ground is firm enough to permit excavation to neat line dimensions. Prior to placing concrete, the earth around the hole shall be thoroughly moistened.
2. Encasement concrete for footings shall be placed immediately after mixing in a manner such that there will be no concentration of the large aggregates. The concrete shall be consolidated by tamping or vibrating.
3. Concrete footings shall have a neat appearance and shall be extended 2 inches above grade and troweled to a crown to shed water.
4. A minimum of 7 days shall elapse after placing the concrete footings before the fence fabric or barbed wire is fastened to the posts.

E. **Bracing:** Bracing shall be provided at all ends, corners, gates, and intermediate brace posts. Corner posts and intermediate brace posts shall be braced in both directions. Horizontal brace rails shall be set midway between the top rail and the ground, running from the corner, end, intermediate brace or gate post to the first line post. Diagonal tension members shall connect tautly between posts below horizontal braces.

1. Braces shall be so installed that posts remain plumb when diagonal rod is under proper tension.

F. **Intermediate Brace Posts:** Where straight runs of fencing exceed 500 feet, intermediate brace posts shall be installed, spaced equally between ends or corners; with additional posts provided as required, such that the spacing between intermediate brace posts does not exceed 500 feet. Intermediate brace posts shall be equivalent in size to corner posts and shall be braced with horizontal brace rails and diagonal tension members in both directions.

G. **Top Rails:** Top rails shall be run continuously through post caps, bending to radius for curved runs. Expansion couplings shall be provided as recommended by the fencing manufacturer.

H. **Tension Wire:** Continuous bottom tension wire shall be stretched tight with turnbuckles at end, gate, intermediate, and corner posts. Tension wire shall be installed on a straight grade between posts, with approximately 2 inches of space between finish grade and bottom selvage, unless otherwise indicated. Tension wire shall be tied to each post with not less than 6_gauge galvanized wire.

I. Fabric:

1. Chain-link fabric shall be fastened on the secured side of the posts.
2. Fabric shall be stretched and securely fastened to posts. Between posts, top and bottom edges of the fabric shall be fastened to the top rail and bottom tension wire, respectively.

3. Fabric shall be stretched and anchored in such a manner that it remains in tension after the pulling force is released.
- J. **Tie Wires:** Tie wire shall be bent to conform to the diameter of the pipe to which it is attached, clasping pipe and fabric firmly with ends twisted at least two full turns. Ends of wire shall be bent back to minimize hazard to persons or clothing.
1. Fabric shall be tied to line posts with tie wires spaced at 12 inches on center.
 2. Fabric shall be tied to rails and braces with tie wires spaced at 24 inches on center.
 3. Fabric shall be tied to tension wires, with hog rings spaced 24 inches on center.
- K. **Stretcher Bars:** Fabric shall be fastened to end, corner, intermediate brace, and gate posts with stretcher bars. Bars shall be threaded through or clamped to fabric at 4-inches on center and secured to posts with stretcher bar bands spaced no more than 14 inches on center.
- L. **Fasteners:** Nuts for tension bands and hardware bolts shall be installed on the side of fence opposite the fabric side. Ends of bolts shall be peened or the threads scored to prevent removal of nuts.
- M. Galvanized coating damaged during construction of the fencing shall be repaired by application of **Galvo-Weld; Galvinox;** or equal.
- N. Damage to PVC coating shall be repaired with material equivalent in color and thickness to the original coating.

3.3 GROUNDING

- A. Fences crossed by powerlines of 600 volts or more shall be grounded at or near the point of crossing and at distances not exceeding 150 feet on each side of the crossing.
- B. Fences, gates and appurtenances enclosing electrical equipment areas, gas yards, or other hazardous areas shall be electrically continuous and grounded.
- C. Ground conductor shall consist of No. 8 AWG solid copper wire. Grounding electrodes shall be 3/4-inch by 10-foot long copper-clad steel rod. Electrodes shall be driven into the earth so that the top of the electrode is at least 6 inches below grade.
 1. Where driving is impracticable, electrodes shall be buried a minimum of 12 inches deep and radically from the fence. Top of electrode shall be not less than 2 feet or more than 8 feet from the fence.
- D. Ground conductor shall be clamped to the fence and electrodes with bronze grounding clamps so as to create electrical continuity between fence posts, fence fabric, and ground rods. After installation, the total resistance of fence to ground shall not be greater than 25 ohms.

- END OF SECTION -

SECTION 03290 - JOINTS IN CONCRETE

PART 1 – GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall construct all joints in concrete at the locations shown. Joints required in concrete structures are of various types and will be permitted only where shown, unless specifically accepted by the ENGINEER.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Federal Specifications:

TT-S-0227E(3) Sealing Compound, elastomeric type, Multi-component for Caulking, Sealing, and Glazing Buildings and Other Structures).

B. U.S. Army Corps of Engineers Specifications:

CRD-C572 PVC Waterstop.

C. Commercial Standards:

ASTM A 775 Specification for Epoxy-Coated Reinforcing Steel Bars

ASTM C 920 Specification for Elastomeric Joint Sealants

ASTM D 412 Test Methods for Rubber Properties in Tension

ASTM D 624 Test Method for Rubber Property -- Tear Resistance

ASTM D 638 Test Method for Tensile Properties of Plastics

ASTM D 746 Test Method for Brittleness Temperature of Plastics and Elastomers by Impact

ASTM D 747 Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam

ASTM D 1056 Specification for Flexible Cellular Materials -- Sponge or Expanded Rubber

ASTM D 1752 Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

ASTM D 2240 Test Method for Rubber Property -- Durometer Hardness

ASTM D 2241 Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR-Series)

1.3 TYPES OF JOINTS

- A. **Construction Joints:** When fresh concrete is placed against a hardened concrete surface, the joint between the two pours is called a construction joint. Unless otherwise specified, all joints in water bearing members shall be provided with a waterstop and/or sealant groove of the shape specified and shown. The surface of the first pour may also be required to receive a coating of bond breaker as shown.
- B. **Contraction Joints:** Contraction joints are similar to construction joints except that the fresh concrete shall not bond to the hardened surface of the first pour, which shall be coated with a bond breaker. The slab reinforcement shall be stopped 4-1/2 inches from the joint; which is provided with a sleeve-type dowel, to allow shrinkage of the concrete of the second pour. Waterstop and/or sealant groove shall also be provided when specified or shown.
- C. **Expansion Joints:** To allow the concrete to expand freely, a space is provided between the two pours, the joint shall be formed as shown. This space is obtained by placing a filler joint material against the first pour, which acts as a form for the second pour. Unless otherwise specified, all expansion joints in water bearing members shall be provided with a center-bulb type waterstop as shown.
- D. Premolded expansion joint material shall be installed with the edge at the indicated distance below or back from finished concrete surface, and shall have a slightly tapered, dressed, and oiled wood strip secured to or placed at the edge thereof during concrete placement, which shall later be removed to form space for sealing material.
- E. The space so formed shall be filled with a joint sealant material as specified in the Paragraph in Part 2 entitled "Joint Sealant." In order to keep the two wall or slab elements in line the joint shall also be provided with a sleeve-type dowel as shown.
- F. **Control Joints:** The function of the control joint is to provide a weaker plane in the concrete, where shrinkage cracks will probably occur. A groove, of the shape and dimensions shown, is formed or saw-cut in the concrete. This groove is afterward filled with a joint sealant material as specified in the Paragraph in Part 2 entitled "Joint Sealant."

1.4 CONTRACTOR SUBMITTALS

- A. **Waterstops:** Prior to production of the material required under this contract, qualification samples shall be submitted. Such samples shall consist of extruded or molded sections of each size or shape to be used, and shall be accomplished so that the material and workmanship represents in all respects the material to be furnished under this contract. The balance of the material to be used under this contract shall not be produced until after the ENGINEER has reviewed the qualification samples.
- B. **Joint Sealant:** Prior to ordering the sealant material, the CONTRACTOR shall submit to the ENGINEER for the ENGINEER's review, sufficient data to show general compliance with the requirements of the Contract Documents.
- C. Certified test reports from the sealant manufacturer on the actual batch of material being supplied indicating compliance with the above requirements shall be furnished the ENGINEER before the sealant is used on the job.

- D. **Shipping Certification:** The CONTRACTOR shall provide written certification from the manufacturer as an integral part of the shipping form, to show that all of the material shipped to this project meets or exceeds the physical property requirements of the Contract Documents. Supplier certificates are not acceptable.
- E. **Joint Location:** The CONTRACTOR shall submit placement shop drawings showing the location and type of all joints for each structure.

1.5 QUALITY ASSURANCE

- A. **Waterstop Inspection:** It is required that all waterstop field joints shall be subject to rigid inspection, and no such work shall be scheduled or started without having made prior arrangements with the ENGINEER to provide for the required inspections. Not less than 24 hours' notice shall be provided to the ENGINEER for scheduling such inspections.
- B. All field joints in waterstops shall be subject to rigid inspection for misalignment, bubbles, inadequate bond, porosity, cracks, offsets, and other defects which would reduce the potential resistance of the material to water pressure at any point. All defective joints shall be replaced with material which shall pass said inspection, and all faulty material shall be removed from the site and disposed of by the CONTRACTOR at its own expense.
- C. The following waterstop defects represent a partial list of defects which shall be grounds for rejection:
 - 1. Offsets at joints greater than 1/16-inch or 15 percent of material thickness, at any point, whichever is less.
 - 2. Exterior crack at joint, due to incomplete bond, which is deeper than 1/16-inch or 15 percent of material thickness, at any point, whichever is less.
 - 3. Any combination of offset or exterior crack which will result in a net reduction in the cross section of the waterstop in excess of 1/16-inch or 15 percent of material thickness at any point, whichever is less.
 - 4. Misalignment of joint which result in misalignment of the waterstop in excess of 1/2-inch in 10 feet.
 - 5. Porosity in the welded joint as evidenced by visual inspection.
 - 6. Bubbles or inadequate bonding which can be detected with a penknife test. (If, while prodding the entire joint with the point of a pen knife, the knife breaks through the outer portion of the weld into a bubble, the joint shall be considered defective.)
- D. **Waterstop Samples:** Prior to use of the waterstop material in the field, a sample of a fabricated mitered cross and a tee constructed of each size or shape of material to be used shall be submitted to the ENGINEER for review. These samples shall be fabricated so that the material and workmanship represent in all respects the fittings to be furnished under this contract. Field samples of fabricated fittings (crosses, tees, etc.) will be selected at random by the ENGINEER for testing by a laboratory at the OWNER's expense. When tested, they shall have a tensile strength across the joints equal to at least 600 psi.
- E. **Construction Joint Sealant:** The CONTRACTOR shall prepare adhesion and cohesion test specimens as specified herein, at intervals of 5 working days while sealants are being

installed.

- F. The sealant material shall show no signs of adhesive or cohesive failure when tested in accordance with the following procedure in laboratory and field tests:
1. Sealant specimen shall be prepared between 2 concrete blocks (1-inch by 2-inch by 3-inch). Spacing between the blocks shall be 1-inch. Coated spacers (2-inch by 1-1/2-inch by 1/2-inch) shall be used to insure sealant cross-sections of 1/2-inch by 2 inches with a width of 1-inch.
 2. Sealant shall be cast and cured according to manufacturer's recommendations except that curing period shall be not less than 24 hours.
 3. Following curing period, the gap between blocks shall be widened to 1-1/2-inch. Spacers shall be used to maintain this gap for 24 hours prior to inspection for failure.

1.6 GUARANTEE

- A. The CONTRACTOR shall provide a 5-year written guarantee of the entire sealant installation against faulty and/or incompatible materials and workmanship, together with a statement that it agrees to repair or replace, to the satisfaction of the OWNER, at no additional cost to the OWNER, any such defective areas which become evident within said 5-year guarantee period.

PART 2 – PRODUCTS

2.1 GENERAL

- A. All joint materials specified herein shall be classified as acceptable for potable water use, by the Environmental Protection Agency, within 30 days of application.

2.2 PVC WATERSTOPS

- A. **General:** Waterstops shall be extruded from an elastomeric polyvinyl chloride compound containing the plasticizers, resins, stabilizers, and other materials necessary to meet the requirements of these Specifications. No reclaimed or scrap material shall be used. The CONTRACTOR shall obtain from the waterstop manufacturer and shall furnish to the ENGINEER for review, current test reports and a written certification of the manufacturer that the material to be shipped to the job meets the physical requirements as outlined in the U.S. Army Corps of Engineers Specification CRD-C572 and those listed herein.
- B. **Flatstrip and Center-Bulb Waterstops:** Flatstrip and center-bulb waterstops shall be as detailed and as manufactured by: **Kirkhill Rubber Co., Brea, California; Water Seals, Inc., Chicago, Illinois; Progress Unlimited, Inc., New York, New York; Greenstreak Plastic Products Co., St. Louis, Missouri; or equal;** provided, that at no place shall the thickness of flat strip waterstops, including the center bulb type, be less than 3/8-inch.
- C. **Multi-Rib Waterstops:** Multi-rib waterstops, where required, shall be as detailed and as manufactured by **Water Seals, Inc., Chicago, Illinois; Progress Unlimited, Inc., New York, New York; Greenstreak Plastic Products Co., St. Louis, Missouri; or equal.** Prefabricated joint fittings shall be used at all intersections of the ribbed-type waterstops.

D. **Other Types of Waterstops:** When other types of waterstops, not listed above are required and shown, they shall be subjected to the same requirements as those listed herein.

E. **Waterstop Testing Requirements:** When tested in accordance with the specified test standards, the waterstop material shall meet or exceed the following requirements:

<u>Physical Property, Sheet Material</u>	<u>Value</u>	<u>ASTM Std.</u>
Tensile Strength-min (psi)	1750	D 638, Type IV
Ultimate Elongation-min (percent)	350	D 638, Type IV
Low Temp Brittleness-max (degrees F)	-35	D 746
Stiffness in Flexure-min (psi)	400	D 747
Accelerated Extraction (CRD-C572)		
Tensile Strength-min (psi)	1500	D 638, Type IV
Ultimate Elongation-min (percent)	300	D 638, Type IV
Effect of Alkalies (CRD-C572)		
Change in Weight (percent)	+0.25/-0.10	-----
Change in Durometer, Shore A	+5	D 2240
Finish Waterstop		
Tensile Strength-min (psi)	1400	D 638, Type IV
Ultimate Elongation-min (percent)	280	D 638, Type IV

2.3 JOINT SEALANT

A. Joint sealant shall be polyurethane polymer designed for bonding to concrete which is continuously submerged in water. No material will be acceptable which has an unsatisfactory history as to bond or durability when used in the joints of water retaining structures.

B. Joint sealant material shall meet the following requirements (73 degrees F and 50 percent R.H.):

Work Life	45 - 180 minutes
Time to Reach 20 Shore "A" Hardness (at 77 degrees F, 200 gr quantity)	24 hours, maximum
Ultimate Hardness (ASTM D 2240)	20 - 45 Shore "A"
Tensile Strength (ASTM D 412)	175 psi, minimum
Ultimate Elongation (ASTM D 412)	400 percent, minimum
Tear Resistance (Die C ASTM D 624)	75 pounds per inch of thickness, minimum

Color

Light Gray

- C. All polyurethane sealants for waterstop joints in concrete shall conform to the following requirements:
1. Sealant shall be 2-part polyurethane with the physical properties of the cured sealant conforming to or exceeding the requirements of ANSI/ASTM C 920 or Federal Specification TT-S-0227 E(3) for 2-part material, as applicable.
 2. For vertical joints and overhead horizontal joints, only "non-sag" compounds shall be used; all such compounds shall conform to the requirements of ANSI/ASTM C 920 Class 25, Grade NS, or Federal Specification TT-S-0227 E(3), Type II, Class A.
 3. For plane horizontal joints, the self-leveling compounds which meet the requirements of ANSI/ASTM C 920 Class 25, Grade P, or Federal Specification TT-S-0227 E(3), Type I shall be used. For joints subject to either pedestrian or vehicular traffic, a compound providing non-tracking characteristics, and having a Shore "A" hardness range of 35 to 45, shall be used.
 4. Primer materials, if recommended by the sealant manufacturer, shall conform to the printed recommendations of the sealant manufacturer.
- D. All sealants, wherever shown, or required hereunder shall be **PSI-270 as manufactured by Polymeric Systems Inc.; Elastothane 227R as manufactured by Pacific Polymers; Sikaflex 2C, as manufactured by Sika Corporation;** or equal.
- E. Sealants for non-waterstop joints in concrete shall conform to the requirements of Section 07920, "Sealants and Caulking."

2.4 JOINT MATERIALS

- A. **Bearing Pad:** Bearing pad to be neoprene conforming to ASTM D 2000 BC 420, 40 durometer hardness unless otherwise noted.
- B. **Neoprene Sponge:** Sponge to be neoprene, closed-cell, expanded, conforming to ASTM D 1056, type 2C3-E1.
- C. **Joint Filler:**
1. Joint filler for expansion joints in waterholding structures shall be neoprene conforming to ASTM D1056, type 2C5-E1.
 2. Joint filler material in other locations shall be of the preformed non-extruding type joint filler constructed of cellular neoprene sponge rubber or polyurethane of firm texture. Bituminous fiber type will not be permitted. All non-extruding and resilient-type preformed expansion joint fillers shall conform to the requirements and tests set forth in ASTM D 1752 for Type I, except as otherwise specified herein.

2.5 BACKING ROD

- A. Backing rod shall be an extruded closed-cell, polyethylene foam rod. The material shall be compatible with the joint sealant material used and shall have a tensile strength of not less than 40 psi and a compression deflection of approximately 25 percent at 8 psi. The rod

shall be 1/8-inch larger in diameter than the joint width except that a one-inch diameter rod shall be used for a 3/4-inch wide joint.

2.6 BOND BREAKER

- A. Bond breaker shall be **Super Bond Breaker as manufactured by Burke Company, San Mateo, California; Select Cure CRB as manufactured by Select Products Co., Upland, California;** or equal. It shall contain a fugitive dye so that areas of application will be readily distinguishable.

2.7 BENTONITE WATERSTOP

- A. Where called for in the Contract Documents, bentonite type waterstop, which shall expand in the presence of water to form a watertight joint seal without damaging the concrete in which it is cast, shall be provided.
- B. The bentonite waterstop shall be composed of 75 percent bentonite. The balance of the material shall be butyl rubber-hydrocarbon with less than 1.0 percent volatile matter. The waterstop shall contain no asbestos fibers or asphaltics.
- C. The manufacturer's rated application temperature range shall be from 5 to 125 degrees F. The service temperature range shall be from -40 to 212 degrees F.
- D. The cross sectional dimensions of the unexpanded waterstop shall be one inch by 3/4-inch.
- E. The waterstop shall be provided with an adhesive backing which will provide excellent adhesion to concrete surfaces.

2.8 SLIP DOWELS

- A. Slip dowels in joints shall be A36 smooth epoxy-coated bars, conforming to ASTM A 775.

2.9 PVC TUBING

- A. PVC tubing in joints shall be Sch. SDR 13.5, conforming to ASTM D 2241.

PART 3 – EXECUTION

3.1 GENERAL

- A. Waterstops of the type specified herein shall be embedded in the concrete across joints as shown. All waterstops shall be fully continuous for the extent of the joint. Splices necessary to provide such continuity shall be accomplished in conformance to printed instructions of manufacturer of the waterstops. The CONTRACTOR shall take suitable precautions and means to support and protect the waterstops during the progress of the work and shall repair or replace at its own expense any waterstops damaged during the progress of the work. All waterstops shall be stored so as to permit free circulation of air around the waterstop material.
- B. When any waterstop is installed in the concrete on one side of a joint, while the other half or portion of the waterstop remains exposed to the atmosphere for more than 2 days,

suitable precautions shall be taken to shade and protect the exposed waterstop from direct rays of the sun during the entire exposure and until the exposed portion of the waterstop is embedded in concrete.

3.2 SPLICES IN WATERSTOPS

- A. Splices in waterstops shall be performed by heat sealing the adjacent waterstop sections in accordance with the manufacturer's printed recommendations. It is essential that:
 - 1. The material not be damaged by heat sealing.
 - 2. The splices have a tensile strength of not less than 60 percent of the unspliced materials tensile strength.
 - 3. The continuity of the waterstop ribs and of its tubular center axis be maintained.
- B. Butt joints of the ends of 2 identical waterstop sections may be made while the material is in the forms.
- C. All joints with waterstops involving more than 2 ends to be jointed together, and all joints which involve an angle cut, alignment change, or the joining of 2 dissimilar waterstop sections shall be prefabricated by the CONTRACTOR prior to placement in the forms, allowing not less than 24-inch long strips of waterstop material beyond the joint. Upon being inspected and approved, such prefabricated waterstop joint assemblies shall be installed in the forms and the ends of the 24-inch strips shall be butt welded to the straight run portions of waterstop in place in the forms.
- D. Where a centerbulb waterstop intersects and is jointed with a non-centerbulb waterstop, care shall be taken to seal the end of the centerbulb, using additional PVC material if needed.

3.3 JOINT CONSTRUCTION

- A. **Setting Waterstops:** In order to eliminate faulty installation that may result in joint leakage, particular care shall be taken of the correct positioning of the waterstops during installation. Adequate provisions must be made to support and anchor the waterstops during the progress of the WORK and to insure the proper embedment in the concrete. The symmetrical halves of the waterstops shall be equally divided between the concrete pours at the joints. The center axis of the waterstops shall be coincident with the joint openings. Maximum density and imperviousness of the concrete shall be insured by thoroughly working it in the vicinity of all joints.
- B. In placing flat-strip waterstops in the forms, means shall be provided to prevent them from being folded over by the concrete as it is placed. Unless otherwise shown, all waterstops shall be held in place with light wire ties on 12-inch centers which shall be passed through the edge of the waterstop and tied to the curtain of reinforcing steel. Horizontal waterstops, with their flat face in a vertical plane, shall be held in place with continuous supports to which the top edge of the waterstop shall be tacked. In placing concrete around horizontal waterstops, with their flat face in a horizontal plane, concrete shall be worked under the waterstops by hand so as to avoid the formation of air and rock pockets.
- C. In placing centerbulb waterstops in expansion joints, the centerbulb shall be centered on the joint filler material.

- D. Waterstop in vertical wall joints shall stop 6 inches from the top of the wall where such waterstop does not connect with any other waterstop and is not to be connected to for a future concrete placement.
- E. **Joint Location:** Construction joints, and other types of joints, shall be provided where shown. When not shown, construction joints shall be provided at 25-foot maximum spacing for all concrete construction, unless noted otherwise. Where joints are shown spaced greater than 40 feet apart, additional joints shall be provided to maintain the 25-foot maximum spacing. The location of all joints, of any type, shall be submitted for acceptance by the ENGINEER.
- F. **Joint Preparation:** Special care shall be used in preparing concrete surfaces at joints where bonding between 2 sections of concrete is required. Unless otherwise shown, such bonding will be required at all horizontal joints in walls. Surfaces shall be prepared in accordance with the requirements of Section 03310, "Cast-in-Place Concrete." Except on horizontal wall construction joints, wall to slab joints or where otherwise shown or specified, at all joints where waterstops are required, the joint face of the first pour shall be coated with a bond breaker as specified herein.
- G. **Construction Joint Sealant:** Construction joints in water-bearing floor slabs, and elsewhere as shown, shall be provided with tapered grooves which shall be filled with a construction joint sealant. The material used for forming the tapered grooves shall be left in the grooves until just before the grooves are cleaned and filled with joint sealant. After removing the forms from the grooves, all laitance and fins shall be removed, and the grooves shall be sand-blasted. The grooves shall be allowed to become thoroughly dry, after which they shall be blown out; immediately thereafter, they shall be primed, bond breaker tape placed in the bottom of the groove, and filled with the construction joint sealant. The primer used shall be supplied by the same manufacturer supplying the sealant. No sealant will be permitted to be used without a primer. Care shall be used to completely fill the sealant grooves. Areas designated to receive a sealant fillet shall be thoroughly cleaned, as outlined for the tapered grooves, prior to application of the sealant.
- H. The primer and sealant shall be placed strictly in accordance with the printed recommendations of the manufacturer, taking special care to properly mix the sealant prior to application. The sides of the sealant groove shall not be coated with bond breaker, curing compound, or any other substance which would interfere with proper bonding of the sealant. All sealant shall achieve final cure at least 7 days before the structure is filled with water.
- I. All sealant shall be installed by a competent waterproofing specialty contractor who has a successful record of performance in similar installations. Before work is commenced, the crew doing the WORK shall be instructed as to the proper method of application by a representative of the sealant manufacturer.
- J. Thorough, uniform mixing of 2-part, catalyst-cured materials is essential; special care shall be taken to properly mix the sealer before its application. Before any sealer is placed, the CONTRACTOR shall arrange to have the crew doing the WORK carefully instructed as to the proper method of mixing and application by a representative of the sealant manufacturer.
- K. Any joint sealant which, after the manufacturer's recommended curing time for the job conditions of the WORK hereunder, fails to fully and properly cure shall be completely

removed; the groove shall be thoroughly sandblasted to remove all traces of the uncured or partially cured sealant and primer, and shall be re-sealed with the specified joint sealant. All costs of such removal, joint treatment, re-sealing, and appurtenant work shall be at the expense of the CONTRACTOR.

L. Bentonite Waterstop:

1. Where a bentonite waterstop is called for in the Contract Documents, it shall be installed with the manufacturer's instructions and recommendations; except, as modified herein.
2. When requested by the ENGINEER, the manufacturer shall provide technical assistance in the field.
3. Bentonite waterstop shall only be used where complete confinement by concrete is provided. Bentonite waterstop shall not be used in expansion or contraction joints nor in the first 6 inches of any intersecting joint.
4. The bentonite waterstop shall be located as near as possible to the center of the joint and it shall be continuous around the entire joint. The minimum distance from the edge of the waterstop to the face of the member shall be 5 inches.
5. Where the thickness of the concrete member to be placed on the bentonite waterstop is less than 12 inches, the waterstop shall be placed in grooves formed or ground into the concrete. The groove shall be at least 3/4 inch deep and 1-1/4 inches wide. When placed in the groove, the minimum distance from the edge of the waterstop to the face of the member shall be 2.5 inches.
6. Where a bentonite waterstop is used in combination with PVC waterstop, the bentonite waterstop shall overlap the PVC waterstop for a minimum of 6 inches and shall be placed in contact with the PVC waterstop.
7. The bentonite waterstop shall not be placed when the temperature of the waterstop material is below 40 degrees F. The waterstop material may be warmed so that it shall remain above 40 degrees F during placement; however, means used to warm the material shall in no way harm the material or its properties. The waterstop shall not be installed where the air temperature falls outside the manufacturer's recommended range.
8. The concrete surface under the bentonite waterstop shall be smooth and uniform. The concrete shall be ground smooth if needed. Alternately, the bentonite waterstop shall be bonded to the surface using an epoxy grout which completely fills all voids and irregularities beneath the waterstop material. Prior to installation, the concrete surface shall be wire brushed to remove any laitance or other materials that may interfere with the bonding of epoxy.
9. The bentonite waterstop shall be secured in place with concrete nails and washers at 12-inch maximum spacing. This shall be in addition to the adhesive backing provided with the waterstop.

- END OF SECTION -

SECTION 03310 - CAST-IN-PLACE CONCRETE

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide cast-in-place concrete, complete and in place, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Federal Specifications and Standards

UU-B-790A (1) (2) Building Paper, Vegetable Fiber (Kraft, Waterproofed, Water Repellant and Fire Resistant)

PS 1 Construction and Industrial Plywood

PS 20 American Softwood Lumber Standard

B. Commercial Standards

ACI 214 Recommended Practice for Evaluation of Strength Test Results of Concrete

ACI 301 Structural Concrete for Buildings

ACI 315 Details and Detailing of Concrete Reinforcement

ACI 318 Building Code Requirements for Reinforced Concrete

ACI 347 Guide to Formwork for Concrete

ASTM A 82 Steel Wire, Plain, for Concrete Reinforcement

ASTM A 185 Steel Welded Wire Fabric, Plain, for Concrete Reinforcement

ASTM A 615 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

ASTM C 31 Standard Practice for Making and Curing Concrete Test Specimens in the Field

ASTM C 33 Concrete Aggregates

ASTM C 39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

ASTM C 94 Ready-Mixed Concrete

ASTM C 114	Test Methods for Chemical Analysis of Hydraulic Cement
ASTM C 136	Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 143	Standard Test Method for Slump of Hydraulic Cement Concrete
ASTM C 150	Portland Cement
ASTM C 156	Standard Test Method for Water Retention by Concrete Curing Materials
ASTM C 192	Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 260	Air-Entraining Admixtures for Concrete
ASTM C 309	Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 494	Chemical Admixtures for Concrete
ASTM C 1077	Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM D 1752	Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM E 119	Standard Test Methods for Fire Tests of Building Construction and Materials
AWS D 1.4	Structural Welding Code - Reinforcing Steel
WRI	Manual of Standard Practice for Welded Wire Fabric

1.3 CONTRACTOR SUBMITTALS

A. **General:** Furnish submittals in accordance with Section 01300 - Contractor Submittals.

B. Shop Drawings

1. Detailed plans of the false work proposed to be used. Such plans shall be in sufficient detail to indicate the general layout, sizes of members, anticipated stresses, grade of materials to be used in the false work, and typical soil conditions.
2. Shop bending diagrams, placing lists, and drawings of all reinforcing steel prior to fabrication.
3. Details of the concrete reinforcing steel and concrete inserts shall be submitted at the earliest possible date after receipt of the Notice to Proceed. Details of

reinforcing steel for fabrication and erection shall conform to ACI 315 and the requirements indicated. The shop bending diagrams shall show the actual lengths of bars, to the nearest inch measured to the intersection of the extensions (tangents for bars of circular cross section) of the outside surface. The Shop Drawings shall include bar placement diagrams which clearly indicate the dimensions of each bar splice.

4. Where mechanical couplers are required or permitted to be used to splice reinforcing steel, submit manufacturer's literature which contains instructions and recommendations for installation for each type of coupler used; certified test reports which verify the load capacity of each type and size of coupler used; and Shop Drawings which show the location of each coupler with details of how they are to be installed in the formwork.
5. Submit a written welding procedure for each type of weld for each size of bar which is to be spliced by welding; merely a statement that AWS procedures will be followed is not acceptable. Certify procedure qualifications for each welding procedure used and welder qualifications, for each welding procedure, and for each welder performing the work. Such qualifications shall be as specified in AWS D1.4.

C. **Mix Designs:** Prior to beginning the WORK, submit preliminary concrete mix designs which shall show the proportions and gradations of all materials proposed for each class and type of concrete herein. The mix designs shall be checked by an independent testing laboratory acceptable to the ENGINEER. All costs related to such checking shall be borne by the CONTRACTOR. When a water reducing admixture is to be used, the CONTRACTOR shall furnish mix designs for concrete both with and without the admixture.

D. **Delivery Tickets:** Where ready-mix concrete is used, furnish certified delivery tickets at the time of delivery of each load of concrete. Each ticket shall show the state certified equipment used for measuring, and the total quantities, by weight, of cement, sand, each class of aggregate, admixtures, and the amounts of water in the aggregate, added at the batching plant, and the amount allowed to be added at the site for the specific design mix. In addition, each certificate shall state the mix number, total yield in cubic yards, and the time of day, to the nearest minute, corresponding to the time when the batch was dispatched, when it left the plant, when it arrived at the Site, when unloading began, and when unloading was finished.

1.4 QUALITY ASSURANCE

A. Testing of Reinforcing Steel

1. If requested by the ENGINEER, the CONTRACTOR shall furnish samples from each heat of reinforcing steel in a quantity adequate for testing. Costs of initial tests will be paid by the OWNER. Costs of additional tests of non-compliant steel shall be paid by the CONTRACTOR.
2. If requested by the ENGINEER, the CONTRACTOR shall provide samples of each type of welded splice used in the work in a quantity and of dimensions adequate for testing. At the discretion of the ENGINEER, radiographic testing of direct butt welded splices will be performed. The CONTRACTOR shall provide assistance necessary to facilitate testing. The CONTRACTOR shall repair any weld which fails to meet the requirements of AWS D1.4. The costs of testing will be paid by the OWNER; except,

the costs of all tests which fail to meet specified requirements shall be paid by the CONTRACTOR.

B. Testing of Materials

1. Tests on component materials and for compressive strength of concrete will be performed as indicated herein. Test for determining slump will be in accordance with the requirements of ASTM C 143.
2. The cost of laboratory tests on cement, aggregates, and concrete, will be paid by the OWNER. However, the CONTRACTOR will be charged for the cost of any additional tests and investigations on WORK which does not meet the Specifications. The laboratory will meet or exceed the requirements of ASTM C 1077.
3. Concrete for testing shall be supplied by the CONTRACTOR at no cost to the OWNER, and the CONTRACTOR shall assist the ENGINEER in obtaining samples and disposal and cleanup of excess material.

C. Field Compression Tests

1. Compression test specimens will be taken from the first placement of each class of concrete herein and at intervals thereafter as selected by the ENGINEER to insure continued compliance. Each set of test specimens will be a minimum of 4 cylinders.
2. Compression test specimens for concrete will be made in accordance with section 9.2 of ASTM C 31. Specimens will be 6-inch diameter by 12-inch high cylinders.
3. Compression tests will be performed in accordance with ASTM C 39. One test cylinder will be tested at 7 days and 2 at 28 days. The remaining cylinder will be held to verify test results, if needed.

D. Evaluation and Acceptance of Concrete

1. Evaluation and acceptance of the compressive strength of concrete will be according to the requirements of ACI 318, Chapter 5 "Concrete Quality", and as indicated herein.
2. If any concrete fails to meet these requirements, immediate corrective action shall be taken to increase the compressive strength for all subsequent batches of the type of concrete affected.
3. All concrete which fails to meet the ACI requirements and these Specifications, is subject to removal and replacement at no additional cost to the OWNER.

- E. Construction Tolerances:** The CONTRACTOR shall set and maintain concrete forms and perform finishing operations so as to ensure that the concrete is within the tolerances herein. Surface defects and irregularities are defined as finishes and are to be distinguished from tolerances. Tolerance is the permissible variation from lines, grades, or dimensions indicated. Where tolerances are not stated in the Specifications, permissible deviations will be in accordance with ACI 117.

PART 2 – PRODUCTS

2.1 FORM AND FALSE WORK MATERIALS

- A. Except as otherwise specifically accepted by the ENGINEER, all lumber brought on the Site for use as forms, shoring, or bracing shall be new material.
- B. Materials for concrete forms, formwork, and false work shall conform to the following requirements:
 - 1. Lumber shall be Douglas Fir or Southern Yellow Pine, construction grade or better, in conformance with U.S. Product Standard PS 20.
 - 2. Plywood for concrete formwork shall be new, waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern Yellow Pine plywood manufactured especially for concrete formwork and shall conform to the requirements of PS 1 for Concrete Forms, Class I, and shall be edge sealed.
 - 3. Form materials shall be metal, wood, plywood, or other material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line, and grade required. Metal forms shall be an approved type that will accomplish such results. Wood forms for surfaces to be painted shall be Medium Density Overlaid plywood, MDO Ext. Grade.
- C. Unless otherwise indicated, exterior corners in concrete members shall be provided with 3/4-inch chamfers or tooled to a 1/2-inch radius. Re-entrant corners in concrete members shall not have fillets unless otherwise indicated.
- D. Forms and false work to support the roof and floor slabs shall be designed for the total dead load, plus a live load of 30 psf (minimum).

2.2 FORM TIES

- A. Form ties shall be provided with a plastic cone or other suitable means for forming a conical hole to insure that the form tie may be broken off back of the face of the concrete. The maximum diameter of removable cones for rod ties or other removable form-tie fasteners having a circular cross-section shall not exceed 1-1/2 inches; and all such fasteners shall be such as to leave holes of regular shape for reaming. Form ties shall be **Burke Penta-Tie System by The Burke Company**, or equal.
- B. Removable taper ties may be used when approved by the ENGINEER. Taper Ties shall be **Taper-Tie System by The Burke Company**, or equal.

2.3 REINFORCEMENT STEEL

- A. **General:** Reinforcement steel for cast-in-place reinforced concrete construction shall conform to the following requirements:
 - 1. Bar reinforcement shall conform to the requirements of ASTM A 615 for Grade 60 Billet Steel Reinforcement unless otherwise indicated.
 - 2. Welded wire fabric reinforcement shall conform to the requirements of ASTM A 185 and the details indicated; provided, that welded wire fabric with longitudinal wire of W9.5 size wire shall be either furnished in flat sheets or in rolls with a core diameter

of not less than 10 inches; and provided further, that welded wire fabric with longitudinal wires larger than W9.5 size shall be furnished in flat sheets only.

3. Spiral reinforcement shall be cold-drawn steel wire conforming to the requirements of ASTM A 82.

B. Accessories

1. Accessories shall include all necessary chairs, slab bolsters, concrete blocks, tie wires, dips, supports, spacers, and other devices to position reinforcement during concrete placement. Slab bolsters shall have gray plastic-coated legs.
2. Concrete blocks (dobies), used to support and position reinforcement steel, shall have the same or higher compressive strength than required for the concrete in which they are located. Where concrete blocks are used on concrete surfaces exposed to view, the color and texture of the concrete blocks shall match that required for the finished surface. Wire ties shall be embedded in concrete block bar supports.

2.4 MECHANICAL COUPLERS

- A. Mechanical couplers shall be provided where indicated and where approved by the ENGINEER. Couplers shall develop a tensile strength which exceeds 125 percent of the yield strength of the reinforcing bars being spliced at each splice.

2.5 WELDED SPLICES

- A. Welded splices shall be provided where indicated and where approved by the ENGINEER. All welded splices of reinforcement steel shall develop a tensile strength which exceeds 125 percent of the yield strength of the reinforcing bars which are connected.
- B. All materials required to perform the welded splices to the requirements of AWS D1.4 shall be provided.

2.6 CONCRETE MATERIALS

- A. Materials shall be delivered, stored, and handled so as to prevent damage by water or breakage. Only one brand of cement shall be used. Cement reclaimed from cleaning bags or leaking containers shall not be used. All cement shall be used in the sequence of receipt of shipments.
- B. All materials furnished for the work shall comply with the requirements of Sections 201, 203, and 204 of ACI 301, as applicable.
- C. Storage of materials shall conform to the requirements of Section 205 of ACI 301.
- D. Materials for concrete shall conform to the following requirements:
 1. Cement shall be standard brand portland cement conforming to ASTM C 150 for Type II or Type V.
 2. Water shall be potable, clean, and free from objectionable quantities of silty organic matter, alkali, salts and other impurities. The water shall be considered potable, for the purposes of this Section only, if it meets the requirements of the local

governmental agencies. Agricultural water with high total dissolved solids (over 1000 mg/l TDS) shall not be used.

3. Aggregates shall be obtained from pits acceptable to the ENGINEER, shall be non-reactive, and shall conform to ASTM C 33. Maximum size of coarse aggregate shall be as indicated herein. Lightweight sand for fine aggregate will not be permitted.
4. Ready-mix concrete shall conform to the requirements of ASTM C 94.
5. Air-entraining agent meeting the requirements of ASTM C 260 shall be used. Sufficient air-entraining agent shall be used to provide a total air content of 3 to 5 percent; provided that, when the mean daily temperature in the vicinity of the Site falls below 40 degrees F for more than one day, the total air content provided shall be 5 to 7 percent. The OWNER reserves the right, at any time, to sample and test the air-entraining agent received on the job by the CONTRACTOR. The air-entraining agent shall be added to the batch in a portion of the mixing water. The solution shall be batched by means of a mechanical batcher capable of accurate measurement.
6. Admixtures: Admixtures may be added at the CONTRACTOR's option to control the set, affect water reduction, and increase workability. In either case, the addition of an admixture shall be at the CONTRACTOR's expense. The use of an admixture shall be subject to acceptance by the ENGINEER. Concrete containing an admixture shall be first placed at a location determined by the ENGINEER. If the use of an admixture is producing an inferior end result, the CONTRACTOR shall discontinue use of the admixture. Admixtures shall conform to the requirements of ASTM C 494. The required quantity of cement shall be used in the mix regardless of whether or not an admixture is used. Admixtures shall contain no free chloride ions, shall be non-toxic after 30 days, and shall be compatible with and made by the same manufacturer as the air entraining admixture.
 - a. Concrete shall not contain more than one water reducing admixture. Concrete containing an admixture shall be first placed at a location determined by the ENGINEER.
 - b. Set controlling admixture may be either with or without water-reducing properties. Where the air temperature at the time of placement is expected to be consistently over 80 degrees F, a set retarding admixture such as **Sika Corporation's Plastiment; Master Builder's Pozzolith 440-N**, or equal shall be used. Where the air temperature at the time of placement is expected to be consistently under 40 degrees, a set accelerating admixture such as **Sika Corporation's Plastocrete 161FL; Master Builder's Pozzutec 20**; or equal shall be used.
 - c. Low range water reducer shall conform to ASTM C 494, Type A. It shall be **WRDA by Grace Concrete Products; Pozzolith 322-n by Master Builders**; or equal. The quantity of admixture used and the method of mixing shall be in accordance with the manufacturer's instructions and recommendations.
7. Calcium Chloride: Calcium chloride will not be permitted in concrete.

2.7 CURING MATERIALS

- A. Materials for curing concrete shall conform to the following requirements and ASTM C 309:

1. Concrete curing compound shall be Select Cure CRB as manufactured by Select Products Co., Upland, CA; Burke Spartan Cote Cure-Seal Hardener (with red fugitive dye) as manufactured by The Burke Company, San Mateo, CA; MB-429 as manufactured by Master Builders; or equal. The curing compound shall contain a fugitive dye so that areas of application will be readily distinguishable.
2. Polyethylene sheet for use as concrete curing blanket shall be white, and shall have a nominal thickness of 6 mils. The loss of moisture when determined in accordance with the requirements of ASTM C 156 shall not exceed 0.055 grams per square centimeter of surface.
3. Evaporation retardant shall be a material such as **Confilm** as manufactured by **Master Builders**; **Eucobar** as manufactured by **Euclid Chemical Company**; or equal.

2.8 JOINT MATERIALS

A. Materials for joints in concrete shall conform to the following requirements:

1. Joint filler material shall be of the preformed non-extruding type joint filler constructed of cellular neoprene sponge rubber or polyurethane of firm texture. Bituminous fiber type will not be permitted. All non-extruding and resilient-type preformed expansion joint fillers shall conform to the requirements and tests set forth in ASTM D 1752 for Type I, except as otherwise indicated.
2. Elastomeric joint sealer shall conform to the requirements of Section 07920 - Sealants and Caulking.
3. Mastic joint sealer shall be a material that does not contain evaporating solvents; that will tenaciously adhere to concrete surfaces; that will remain permanently resilient and pliable; that will not be affected by continuous presence of water and will not in any way contaminate potable water; and that will effectively seal the joints against moisture infiltration even when the joints are subject to movement due to expansion and contraction. The sealer shall be composed of special asphalts or similar materials blended with lubricating and plasticizing agents to form a tough, durable mastic substance containing no volatile oils or lubricants and shall be capable of meeting the test requirements set forth hereinafter, if testing is required by the ENGINEER.

2.9 MISCELLANEOUS MATERIALS

A. Epoxy adhesives shall be the following products.

1. For bonding freshly-mixed, plastic concrete to hardened concrete, **Sikadur 32 Hi-Mod Epoxy Adhesive**, as manufactured by **Sika Corporation**; **Concresive Liquid (LPL)**, as manufactured by **Master Builders**; **BurkEpoxy MV** as manufactured by **The Burke Company**; or equal.
2. For bonding hardened concrete or masonry to steel, **Sikadur 31 Hi-Mod Gel** as manufactured by **Sika Corporation**; **BurkEpoxy NS** as manufactured by **The Burke Company**; **Concresive Paste (LPL)** as manufactured by **Master Builders**; or equal.

2.10 CONCRETE DESIGN REQUIREMENTS

A. General

1. Concrete shall be composed of cement, admixtures, aggregates and water, all of the qualities indicated. In general, the mix shall be designed to produce a concrete capable of being deposited so as to obtain maximum density and minimum shrinkage and, where deposited in forms, to have good consolidation properties and maximum smoothness of surface. The proportions shall be changed whenever necessary or desirable to meet the required results at no additional cost to the OWNER. All changes shall be subject to review by the ENGINEER.
2. The CONTRACTOR is cautioned that the limiting parameters specified below are **NOT** a mix design. Additional cement or water reducing agent may be required to achieve workability demanded by the CONTRACTOR's construction methods. The CONTRACTOR is responsible for any costs associated with furnishing concrete with the required workability.

B. **Water-Cement Ratio and Compressive Strength:** The minimum compressive strength and cement content of concrete shall be not less than the following tabulation.

<u>Class of Concrete</u> <u>Min 28-Day Compressive</u> <u>Strength (psi)</u>	<u>Type of Work</u>	<u>Max Size</u> <u>Aggregate</u> <u>(in)</u>	<u>Min</u> <u>Cement</u> <u>Per cu yd</u> <u>(sacks)</u>	<u>Max W/C</u> <u>Ratio</u> <u>(by weight)</u>
4,000	All concrete	1	6.0	0.45

Note: One sack of cement equals 94 lb.

2.11 CONSISTENCY

A. The consistency of the concrete in successive batches shall be determined by slump tests in accordance with ASTM C 143. The slumps shall be as follows:

<u>Part of Work</u>	<u>Slump (in)</u>
Footings and slabs	3 inches plus 1/2 inch, minus 1 inch
Mortar or grout for construction joints	8 inches plus or minus 1-1/2 inch
Other work	3 inches plus 1 inch

2.12 MEASUREMENT OF CEMENT AND AGGREGATE

A. The amount of cement and of each separate size of aggregate entering into each batch of concrete shall be determined by direct weighing equipment furnished by the CONTRACTOR and acceptable to the ENGINEER; provided that, where batches are so proportioned as to contain an integral number of conventional sacks of cement, and the cement is delivered at the mixer in the original unbroken sacks, the weight of the cement contained in each sack may be taken without weighing as 94 pounds.

2.13 MEASUREMENT OF WATER

- A. The quantity of water entering the mixer shall be measured by a suitable water meter or other measuring device of a type acceptable to the ENGINEER and capable of measuring the water in variable amounts within a tolerance of one percent.

2.14 READY-MIXED CONCRETE

- A. At the CONTRACTOR'S option, ready-mixed concrete may be used meeting the requirements as to materials, batching, mixing, transporting, placing and the supplementary requirements as required herein and in accordance with ASTM C 94.
- B. Ready-mixed concrete shall be delivered to the Site, and discharge shall be completed within one hour after the addition of the cement to the aggregates or before the drum has been revolved 250 revolutions, whichever is first. In hot weather, or under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 85 degrees F or above, the time between the introduction of the cement to the aggregates and discharge shall not exceed 45 minutes.
- C. Truck mixers shall be equipped with electrically-actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be of the resettable, recording type, and shall be mounted in the driver's cab. The counters shall be actuated at the time of starting mixers at mixing speeds.
- D. Each batch of concrete shall be mixed in a truck mixer for not less than 70 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolution of mixing.
- E. Each batch of ready-mixed concrete delivered to the Site shall be accompanied by a certified delivery ticket in accordance with the Paragraph in Part 1 entitled "Delivery Tickets."
- F. The use of non-agitating equipment for transporting ready-mixed concrete will not be permitted. Combination truck and trailer equipment for transporting ready-mixed concrete will not be permitted. The quality and quantity of materials used in ready-mixed concrete and in batch aggregates shall be subject to continuous inspection at the batching plant by the ENGINEER.

PART 3 – EXECUTION

3.1 GENERAL FORMWORK REQUIREMENTS

- A. Forms to confine the concrete and shape it to the required lines shall be used wherever necessary. The CONTRACTOR shall assume full responsibility for the adequate design of all forms, and any forms which are unsafe or inadequate in any respect shall promptly be removed from the WORK and replaced at the CONTRACTOR's expense. A sufficient number of forms of each kind shall be provided to permit the required rate of progress to be maintained. The design and inspection of concrete forms, false work, and shoring shall comply with applicable local, state and federal regulations. All design, construction, maintenance, preparation, and removal of forms shall be in accordance with ACI 347 and the requirements herein.

- B. All forms shall be true in every respect to the required shape and size, shall conform to the established alignment and grade, and shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete.

3.2 CONSTRUCTION

- A. **Vertical Surfaces:** All vertical surfaces of concrete members shall be formed, except where placement of the concrete against the ground is called for on the Drawings. Not less than 1-inch of concrete shall be added to the thickness of the concrete member as shown where concrete is permitted to be placed against trimmed ground in lieu of forms. Such permission will be granted only for members of comparatively limited height and where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed.

- B. **Construction Joints:** Concrete construction joints will not be permitted at locations other than those indicated, except as may be acceptable to the ENGINEER. When a second lift is placed on hardened concrete, special precautions shall be taken in the way of the number, location, and tightening of ties at the top of the old lift and bottom of the new to prevent any unsatisfactory effect whatsoever on the concrete. Pipe stubs and anchor bolts shall be set in the forms where required.

- C. **Form Ties**

1. **Embedded Ties:** Wire ties for holding forms will not be permitted. No form-tying device or part thereof, other than metal, shall be left embedded in the concrete. Ties shall not be removed in such manner as to leave a hole extending through the interior of the concrete members. The use of snap-ties which cause spalling of the concrete upon form stripping or tie removal will not be permitted. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste. Where metal rods extending through the concrete are used to support or to strengthen forms, the rods shall remain embedded and shall terminate not less than 1-inch back from the formed face or faces of the concrete.
2. **Removable Ties:** Where taper ties are approved for use, after the taper tie is removed, the hole shall be thoroughly cleaned and roughened for bond. A precast neoprene or polyurethane tapered plug shall be located at the wall centerline. The hole shall be completely filled with non-shrink or regular cement grout. Exposed faces of walls shall have at least the outer 2 inches of the exposed face filled with a cement grout which shall match the color and texture of the surrounding wall surface.

3.3 REUSE OF FORMS

- A. Forms may be reused only if in good condition and only if acceptable to the ENGINEER. Light sanding between uses will be required wherever necessary to obtain uniform surface texture on all exposed concrete surfaces. Exposed concrete surfaces are defined as surfaces which are permanently exposed to view.

3.4 REMOVAL OF FORMS

- A. Careful procedures for the removal of forms shall be strictly followed, and this work shall be done with care so as to avoid injury to the concrete. No heavy loading on green concrete will be permitted. Members which must support their own weight shall not have

their forms removed until they have attained at least 75 percent of the 28-day strength of the concrete. Forms for all vertical walls and columns shall remain in place at least 2 days after the concrete has been placed. Forms for all parts of the WORK not specifically mentioned herein shall remain in place for periods of time as determined by the ENGINEER.

3.5 GENERAL REINFORCEMENT REQUIREMENTS

- A. All reinforcement steel, welded wire fabric, couplers, and other appurtenances shall be fabricated, and placed in accordance with the requirements of the Building Code and the supplementary requirements indicated herein.

3.6 FABRICATION

A. General

1. Reinforcement steel shall be accurately formed to the dimensions and shapes required, and the fabricating details shall be prepared in accordance with ACI 315 and ACI 318, except as modified by the Drawings.
2. The CONTRACTOR shall fabricate reinforcement bars for structures in accordance with bending diagrams, placing lists, and placing drawings. Said drawings, diagrams, and lists shall be prepared by the CONTRACTOR.
3. Unless otherwise indicated, dowels shall match the size and spacing of the spliced bar.

- B. **Bending or Straightening:** Reinforcement shall not be straightened or rebent in a manner which will injure the material. No bars with kinks or bends not required shall be used. All bars shall be bent cold, unless otherwise permitted by the ENGINEER. No bars partially embedded in concrete shall be field-bent except as shown or specifically permitted by the ENGINEER.

3.7 PLACING

- A. Reinforcement steel shall be accurately positioned and shall be supported and wired together to prevent displacement, using annealed iron wire ties or suitable clips at intersections. All reinforcement steel shall be supported by concrete, plastic or metal supports, spacers or metal hangers which are strong and rigid enough to prevent any displacement of the reinforcement steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used, in sufficient numbers to support the bars without settlement, but in no case shall such support be continuous. All concrete blocks used to support reinforcement steel shall be tied to the steel with wire ties which are embedded in the blocks. For concrete over formwork, the CONTRACTOR shall provide concrete, metal, plastic, or other acceptable bar chairs and spacers.
- B. The portions of all accessories in contact with the formwork shall be made of concrete, plastic, or steel coated with a 1/8-inch minimum thickness of plastic which extends at least 1/2-inch from the concrete surface. Plastic shall be gray in color.
- C. Tie wires shall be bent away from the forms in order to provide the required concrete coverage.

- D. Bars additional to those indicated which may be found necessary or desirable by the CONTRACTOR for the purpose of securing reinforcement in position shall be provided by the CONTRACTOR at its own expense.
- E. Unless otherwise specified, reinforcement placing tolerances shall be within the limits specified in Section 7.5 of ACI 318 except where in conflict with the requirements of the Building Code.
- F. The minimum spacing requirements of ACI 318 shall be followed for all reinforcing steel.
- G. Welded wire fabric reinforcement placed over horizontal forms shall be supported on slab bolsters having gray, plastic-coated standard type legs. Slab bolsters shall be spaced not less than 30 inches on centers, shall extend continuously across the entire width of the reinforcing mat, and shall support the reinforcing mat in the plane indicated.
- H. Welded wire fabric placed over the ground shall be supported on wired concrete blocks (dobies) spaced not more than 3 feet on centers in any direction. The construction practice of placing welded wire fabric on the ground and hooking into place in the freshly placed concrete shall not be used.

3.8 SPLICING

- A. **General:** Reinforcement bar splices shall only be used at locations indicated. When it is necessary to splice reinforcement at points other than where indicated, the character of the splice shall be as acceptable to the ENGINEER.
- B. Splices of Reinforcement
 1. The length of lap for reinforcement bars, unless otherwise indicated, shall be in accordance with ACI 318, Section 12.15.1 for a Class C splice.
 2. Welded splices shall be performed in accordance with AWS D 1.4.
 3. Laps of welded wire fabric shall be in accordance with the ACI 318. Adjoining sheets shall be securely tied together with No. 14 tie wire, one tie for each 2 running feet. Wires shall be staggered and tied in such a manner that they cannot slip.

3.9 CLEANING AND PROTECTION

- A. Reinforcement steel shall at all times be protected from corrosive conditions until concrete is placed around it.
- B. The surfaces of all reinforcement steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed. Where there is delay in depositing concrete, reinforcing shall be reinspected and, if necessary recleaned.

3.10 PROPORTIONING AND MIXING

- A. **Proportioning:** Proportioning of the concrete mix shall conform to the requirements of Chapter 3 "Proportioning" of ACI 301.

- B. **Mixing:** Mixing of concrete shall conform to the requirements of Chapter 7 ACI 301.
- C. **Slump:** Maximum slumps shall be as indicated.
- D. **Retempering:** Retempering of concrete or mortar which has partially hardened will not be permitted.

3.11 PREPARATION OF SURFACES FOR CONCRETING

- A. **General:** Earth surfaces shall be thoroughly wetted by sprinkling, prior to the placing of any concrete, and these surfaces shall be kept moist by frequent sprinkling up to the time of placing concrete thereon. The surface shall be free from standing water, mud, and debris at the time of placing concrete.
- B. **Joints in Concrete:** Concrete surfaces upon or against which concrete is to be placed, where the placement of the old concrete has been stopped or interrupted so that, as determined by the ENGINEER, the new concrete cannot be incorporated integrally with that previously placed, are defined as construction joints. The surfaces of horizontal joints shall be given a compacted, roughened surface for good bond. Except where the Drawings call for joint surfaces to be coated, the joint surfaces shall be cleaned of all laitance, loose or defective concrete, and foreign material. Such cleaning shall be accomplished by hydroblasting. All pools of water shall be removed from the surface of construction joints before the new concrete is placed.
- C. **Placing Interruptions:** When placing of concrete is to be interrupted long enough for the concrete to take a set, the working face shall be given a shape by the use of forms or other means, that will secure proper union with subsequent WORK; provided that construction joints shall be made only where acceptable to the ENGINEER.
- D. **Embedded Items**
 - 1. No concrete shall be placed until all formwork, installation of parts to be embedded, reinforcement steel, and preparation of surfaces involved in the placing have been completed and accepted by the ENGINEER at least 4 hours before placement of concrete. All surfaces of forms and embedded items that have become encrusted with dried grout from concrete previously placed shall be cleaned of all such grout before the surrounding or adjacent concrete is placed.
 - 2. All reinforcement, anchor bolts, sleeves, inserts, and similar items shall be set and secured in the forms where shown on the Drawings or by Shop Drawings and shall be accepted by the ENGINEER before any concrete is placed. Accuracy of placement is the responsibility of the CONTRACTOR.
- E. **Casting New Concrete Against Old:** Where concrete is to be cast against old concrete (any concrete which is greater than 60 days of age), the surface of the old concrete shall be thoroughly cleaned and roughened by hydro-blasting (exposing aggregate) prior to the application of an epoxy bonding agent. Application shall be according to the bonding agent manufacturer's instructions and recommendations.
- F. No concrete shall be placed in any structure until all water entering the space to be filled with concrete has been properly cut off or has been diverted by pipes, or other means, and carried out of the forms, clear of the work. No concrete shall be deposited underwater nor shall the CONTRACTOR allow still water to rise on any concrete until the concrete has attained its initial set. Water shall not be permitted to flow over the surface of any concrete in such manner and at such velocity as will injure the surface finish of

the concrete. Pumping or other necessary dewatering operations for removing ground water, if required, will be subject to the review of the ENGINEER.

- G. **Corrosion Protection:** Pipe, conduit, dowels, and other ferrous items required to be embedded in concrete construction shall be so positioned and supported prior to placement of concrete that there will be a minimum of 2 inches clearance between said items and any part of the concrete reinforcement. Securing such items in position by wiring or welding them to the reinforcement will not be permitted.
- H. Openings for pipes, inserts for pipe hangers and brackets, and the setting of anchors shall, where practicable, be provided for during the placing of concrete.
- I. Anchor bolts shall be accurately set, and shall be maintained in position by templates while being embedded in concrete.
- J. **Cleaning:** The surfaces of all metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed.

3.12 HANDLING, TRANSPORTING, AND PLACING

- A. **General:** Placing of concrete shall conform to the applicable requirements of Chapter 8 of ACI 301 and the requirements of this Section. No aluminum materials shall be used in conveying any concrete.
- B. **Non-Conforming WORK or Materials:** Concrete which upon or before placing is found not to conform to the requirements herein shall be rejected and immediately removed from the WORK. Concrete which is not placed in accordance with these Specifications, or which is of inferior quality, shall be removed and replaced.
- C. **Unauthorized Placement:** No concrete shall be placed except in the presence of a duly authorized representative of the ENGINEER. The CONTRACTOR shall notify the ENGINEER in writing at least 24 hours in advance of placement of any concrete.
- D. **Placement in Wall and Column Forms**
 - 1. Concrete shall not be dropped through reinforcement steel or into any deep form, whether reinforcement is present or not, causing separation of the coarse aggregate from the mortar on account of repeatedly hitting rods or the sides of the form as it falls, nor shall concrete be placed in any form in such a manner as to leave accumulation of mortar on the form surfaces above the placed concrete. In such cases, some means such as the use of hoppers and, if necessary, vertical ducts of canvas, rubber, or metal shall be used for placing concrete in the forms in a manner that it may reach the place of final deposit without separation. In no case shall the free fall of concrete exceed 4 feet in walls and 8 feet in columns below the ends of ducts, chutes, or buggies. Concrete shall be uniformly distributed during the process of depositing and in no case after depositing shall any portion be displaced in the forms more than 6 feet in horizontal direction. Concrete in forms shall be deposited in uniform horizontal layers not deeper than 2 feet; and care shall be taken to avoid inclined layers or inclined construction joints except where such are required for sloping members. Each layer shall be placed while the previous layer is still soft. The rate of placing concrete in wall forms shall not exceed 5 feet of vertical rise per hour.

2. The surface of the concrete shall be level whenever a run of concrete is stopped. To insure a level, straight joint on the exposed surface of walls, a wood strip at least 3/4-inch thick shall be tacked to the forms on these surfaces. The concrete shall be carried about 1/2-inch above the underside of the strip. About one hour after the concrete is placed, the strip shall be removed and any irregularities in the edge formed by the strip shall be leveled with a trowel and all laitance shall be removed.
- E. **Conveyor Belts and Chutes:** Ends of chutes, hopper gates, and all other points of concrete discharge throughout the CONTRACTOR'S conveying, hoisting and placing system shall be so designed and arranged that concrete passing from them will not fall separated into whatever receptacle immediately receives it. Conveyor belts, if used, shall be of a type acceptable to the ENGINEER. Chutes longer than 50 feet will not be permitted. Minimum slopes of chutes shall be such that concrete of the required consistency will readily flow in them. If a conveyor belt is used, it shall be wiped clean by a device operated in such a manner that none of the mortar adhering to the belt will be wasted. All conveyor belts and chutes shall be covered. Sufficient illumination shall be provided in the interior of all forms so that the concrete at the places of deposit is visible from the deck or runway.
- F. **Temperature of Concrete:** The temperature of concrete when it is being placed shall be not more than 90 degrees F nor less than 40 degrees F in moderate weather, and not less than 50 degrees F in weather during which the mean daily temperature drops below 40 degrees F. Concrete ingredients shall not be heated to a temperature higher than that necessary to keep the temperature of the mixed concrete, as placed, from falling below the required minimum temperature. If concrete is placed when the weather is such that the temperature of the concrete would exceed 90 degrees F, the CONTRACTOR shall employ effective means, such as precooling of aggregates and mixing water, using ice, or placing at night, as necessary to maintain the temperature of the concrete, as it is placed, below 90 degrees F. The CONTRACTOR shall be entitled to no additional compensation on account of the foregoing requirements.

3.13 PUMPING OF CONCRETE

- A. **General:** If the pumped concrete does not produce satisfactory end results, the CONTRACTOR shall discontinue the pumping operation and proceed with the placing of concrete using conventional methods.
- B. **Pumping Equipment**
1. The pumping equipment shall have 2 cylinders and be designed to operate with one cylinder only in case the other one is not functioning. In lieu of this requirement, the CONTRACTOR may have a standby pump on the site during pumping.
 2. The minimum diameter of the hose (conduits) shall be 4 inches.
 3. Pumping equipment and hoses (conduits) that are not functioning properly, shall be replaced.
 4. Aluminum conduits for conveying the concrete shall not be permitted.
- C. **Proportioning**
1. Minimum compressive strength, cement content, and maximum size of aggregates shall be as required in this Section.

2. Gradation of coarse aggregates shall conform to ASTM C 33 and shall be as close to the middle range as possible.
3. Gradation of fine aggregate shall conform to ASTM C 33, with 15 to 30 percent passing the number 50 screen and 5 to 10 percent passing the number 100 screen. The fineness modulus of sand used shall not be over 3.00.

3.14 TAMPING AND VIBRATING

- A. As concrete is placed in the forms or in excavations, it shall be thoroughly settled and compacted, throughout the entire depth of the layer which is being consolidated, into a dense, homogeneous mass, filling all corners and angles, thoroughly embedding the reinforcement, eliminating rock pockets, and bringing only a slight excess of water to the exposed surface of concrete during placement. Vibrators shall be high speed power vibrators (8000 to 10,000 rpm) of an immersion type in sufficient number and with (at least one) standby units as required.
- B. Concrete in walls shall be internally vibrated and at the same time rammed, stirred, or worked with suitable appliances, tamping bars, shovels, or forked tools until it completely fills the forms or excavations and closes snugly against all surfaces. Subsequent layers of concrete shall not be placed until the layers previously placed have been worked thoroughly. Vibrators shall be provided in sufficient numbers, with standby units as required, to accomplish the required results within 15 minutes after concrete of the prescribed consistency is placed in the forms. The vibrating head shall be kept from contact with the surfaces of the forms. Care shall be taken not to vibrate concrete excessively or to work it in any manner that causes segregation of its constituents.

3.15 FINISHING CONCRETE SURFACES

- A. **General:** Surfaces shall be free from fins, bulges, ridges, offsets, honeycombing, or roughness of any kind, and shall present a finished, smooth, continuous hard surface. Allowable deviations from plumb or level and from the alignment, profiles, and dimensions indicated are defined as tolerances and are indicated in Part 1 above. These tolerances are to be distinguished from irregularities in finish as described herein. Aluminum finishing tools shall not be used.
- B. **Formed Surfaces:** No treatment is required after form removal except for curing, repair of defective concrete, and treatment of surface defects.
 1. Surface holes larger than 1/2-inch in diameter or deeper than 1/4-inch are defined as surface defects in basins and exposed walls.
- C. **Unformed Surfaces:** After proper and adequate vibration and tamping, all unformed top surfaces of slabs, floors, walls, and curbs shall be brought to a uniform surface with suitable tools. The classes of finish specified for unformed concrete surfaces are designated and defined as follows:
 1. Finish U1 - Sufficient leveling and screeding to produce an even, uniform surface with surface irregularities not to exceed 3/8-inch. No further special finish is required.
 2. Finish U2 - After sufficient stiffening of the screeded concrete, surfaces shall be float finished with wood or metal floats or with a finishing machine using float blades. Excessive floating of surfaces while the concrete is plastic and dusting of dry cement and sand on the concrete surface to absorb excess moisture will not be

permitted. Floating shall be the minimum necessary to produce a surface that is free from screed marks and is uniform in texture. Surface irregularities shall not exceed 1/4-inch. Joints and edges shall be tooled where indicated or as determined by the ENGINEER.

3. Finish U3 - After the Finish U2 surface has hardened sufficiently to prevent excess of fine material from being drawn to the surface, steel troweling shall be performed with firm pressure such as will flatten the sandy texture of the floated surface and produce a dense, uniform surface free from blemishes, ripples, and trowel marks. The finish shall be smooth and free of all irregularities.
4. Finish U4 - Trowel the Finish U3 surface to remove local depressions or high points. In addition, the surface shall be given a light hairbroom finish with brooming perpendicular to drainage unless otherwise indicated. The resulting surface shall be rough enough to provide a nonskid finish.

D. Unformed surfaces shall be finished according to the following schedule:

UNFORMED SURFACE FINISH SCHEDULE

Area	Finish
Grade slabs and foundations to be covered with concrete or fill material	U1
Floors to be covered with grouted tile or topping grout	U2
Slabs to be covered with built-up roofing	U2
Slabs and floors to receive architectural finish	U3
Slabs	U4

3.16 CURING AND DAMPPROOFING

- A. **General:** Concrete shall be cured for not less than 14 days after placing, in accordance with the methods indicated below for the different parts of the WORK.

Surface to be Cured or Dampproofed	Method
Unstripped forms	1
Construction joints between footings and walls, and between floor slab and columns	2
Encasement concrete and thrust blocks	3
All concrete surfaces not specifically provided for elsewhere in this Paragraph	4

- B. **Method 1:** Wooden forms shall be wetted immediately after concrete has been placed and shall be kept wet with water until removed. If steel forms are used the exposed concrete surfaces shall be kept continuously wet until the forms are removed. If forms

are removed within 14 days of placing the concrete, curing shall be continued in accordance with Method 4.

- C. **Method 2:** The surface shall be covered with burlap mats which shall be kept wet with water for the duration of the curing period, until the concrete in the walls has been placed. No curing compound shall be applied to surfaces cured under Method 2.
- D. **Method 3:** The surface shall be covered with moist earth not less than 4 hours, nor more than 24 hours, after the concrete is placed. Earthwork operations that may damage the concrete shall not begin until at least 7 days after placement of concrete.
- E. **Method 4:** The surface shall be sprayed with a liquid curing compound.
 - 1. It shall be applied in accordance with the manufacturer's printed instructions at a maximum coverage rate of 200 square feet per gallon and in such a manner as to cover the surface with a uniform film which will seal thoroughly.
 - 2. Where the curing compound method is used, care shall be exercised to avoid damage to the seal during the curing period. Should the seal be damaged or broken before the expiration of the curing period, the break shall be repaired immediately by the application of additional curing compound over the damaged portion.
 - 3. Wherever curing compound may have been applied by mistake to surfaces against which concrete subsequently is to be placed and to which it is to adhere, curing compound shall be entirely removed by wet sandblasting just prior to the placing of new concrete.
 - 4. Where curing compound is required, it shall be applied as soon as the concrete has hardened enough to prevent marring on unformed surfaces, and within 2 hours after removal of forms from contact with formed surfaces. Repairs required to be made to formed surfaces shall be made within the said 2-hour period; provided, however, that any such repairs which cannot be made within the said 2-hour period shall be delayed until after the curing compound has been applied. When repairs are to be made to an area on which curing compound has been applied, the area involved shall first be wet-sandblasted to remove the curing compound.
 - 5. Whenever the air temperature exceeds 85 degrees F or the wind speed exceeds 25 mph at the time of placement, the concrete shall be treated as follows. Immediately after the concrete has been screeded, it shall be treated with a liquid evaporation retardant. The retardant shall be used again after each work operation as necessary to prevent drying shrinkage cracks.
 - 6. During the curing period, no traffic of any nature and no depositing of any materials, temporary or otherwise, shall be permitted on surfaces coated with curing compound. Foot traffic and the depositing of materials may be allowed after three days if the surface is covered with 5/8-inch plywood placed over polyethylene sheets.
- F. The CONTRACTOR may submit alternate methods of curing which maintain the concrete in a continuously wet condition for acceptance by the ENGINEER.

3.17 PROTECTION

- A. The CONTRACTOR shall protect all concrete against injury until final acceptance by the OWNER. Fresh concrete shall be protected from damage due to rain, hail, sleet, or snow. The CONTRACTOR shall provide such protection while the concrete is still plastic and whenever such precipitation is imminent or occurring. Immediately following the first frost in the fall, the CONTRACTOR shall be prepared to protect all concrete against freezing. After the first frost, and until the mean daily temperature in the vicinity of the Site falls below 40 degrees F for more than one day, the concrete shall be maintained at a temperature not lower than 50 degrees F for at least 72 hours after it is placed.

3.18 TREATMENT OF SURFACE DEFECTS

- A. As soon as forms are removed, exposed concrete surfaces shall be carefully examined and any irregularities shall be immediately rubbed or ground in a satisfactory manner in order to secure a smooth, uniform, and continuous surface. Plastering or coating of surfaces to be smoothed will not be permitted. No repairs shall be made until after inspection by the ENGINEER. In no case will extensive patching of honeycombed concrete be permitted. Concrete containing minor voids, holes, honeycombing, or similar depression defects shall be repaired as required herein. Concrete containing extensive voids, holes, honeycombing, or similar depression defects, shall be completely removed and replaced. Repairs and replacements shall be promptly executed.
- B. Defective surfaces to be repaired shall be cut back from true line a minimum depth of $\frac{1}{4}$ -inch over the entire area. Feathered edges will not be permitted. Where chipping or cutting tools are not required in order to deepen the area properly, the surface shall be prepared for bonding by the removal of all laitance or soft material, and not less than $\frac{1}{32}$ -inch depth of the surface film from all hard portions, by means of an efficient sandblast. After cutting and sandblasting, the surface shall be wetted sufficiently in advance of shooting with shotcrete or with cement mortar so that while the repair material is being applied, the surfaces under repair will remain moist, but not so wet as to overcome the suction upon which a good bond depends. The material used for repair shall consist of a mixture of one sack of cement to 3 cubic feet of sand. For exposed walls, the cement shall contain such a proportion of Atlas white portland cement as is required to make the color of the patch match the color of the surrounding concrete.
- C. Holes left by tie-rod cones shall be reamed with suitable toothed reamers so as to leave the surfaces of the holes clean and rough. These holes then shall be repaired in an approved manner with dry-packed cement grout. Holes left by form-tying devices having a rectangular cross-section, and other imperfections having a depth greater than their least surface dimension, shall not be reamed but shall be repaired in an approved manner with dry-packed cement grout.
- D. All repairs shall be built up and shaped in such a manner that the completed work will conform to the requirements of this Section, using methods which will not disturb the bond, cause sagging, or cause horizontal fractures. Surfaces of said repairs shall receive the same kind and amount of curing treatment as required for the concrete in the repaired section.

3.19 CARE AND REPAIR OF CONCRETE

- A. The CONTRACTOR shall protect all concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until final acceptance by the OWNER. Particular care shall be taken to prevent the drying of concrete and to avoid

roughening or otherwise damaging the surface. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time prior to the final acceptance of the completed work, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete.

- END OF SECTION -

SECTION 03315 - GROUT

PART 1 – GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide grout, complete and in place, in accordance with the Contract Documents.
- B. The following types of grout are covered in this Section:
 - 1. Non-Shrink Grout: This type of grout is to be used wherever grout is indicated, unless another type is specifically referenced.
 - 2. Cement Grout
 - 3. Epoxy Grout
 - 4. Topping Grout and Concrete Fill

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Specifications, codes, and standards shall be as listed in Section 03300 - Cast-in-Place Concrete, and as indicated herein.

1.3 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 01300 - Contractor Submittals
- B. **Shop Drawings:** Include certified test results verifying compliance with the compressive strength, shrinkage, and expansion requirements herein; and manufacturer's literature containing instructions and recommendations on the mixing, handling, placement, and appropriate uses for each type of non-shrink and epoxy grout proposed for the WORK.

1.4 QUALITY ASSURANCE

- A. **Field Tests:**
 - 1. Compression test specimens will be taken during construction from the first placement of each type of grout, and at intervals thereafter selected by the ENGINEER to insure continued compliance with these specifications. The specimens will be made by the ENGINEER or its representative.
 - 2. Compression tests and fabrication of specimens for cement grout and non-shrink grout will be performed in accordance with ASTM C 109 - Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in or 50-mm Cube Specimens) at intervals during construction selected by the ENGINEER. A set of three specimens will be made for testing at 7 days, 28 days, and each additional time period as appropriate.
 - 3. Compression tests and fabrication of specimens for epoxy grout will be performed in accordance with ASTM C 579 - Test Methods for Compressive Strength of Chemical-Resistant Mortars and Monolithic Surfacing, Method B, at intervals during

construction selected by the ENGINEER. A set of three speci will be made for testing at 7 days, and each earlier time period as appropriate.

4. All grout which fails to meet requirements is subject to removal and replacement at no increased cost to the OWNER.
5. The cost of all laboratory tests on grout will be borne by the OWNER, but the CONTRACTOR shall assist the ENGINEER in obtaining specimens for testing. The CONTRACTOR shall be responsible for the cost of testing and inspection of Defective Work which has been replaced. The CONTRACTOR shall furnish all materials necessary for fabricating the test specimens.

B. **Construction Tolerances:** Construction tolerances shall be in accordance with Section 03300, unless indicated otherwise.

PART 2 -- PRODUCTS

2.1 CEMENT GROUT

- A. **Cement Grout:** Cement grout shall be composed of one part cement, three parts sand, and the minimum amount of water necessary to obtain the desired consistency. Where needed to match the color of adjacent concrete, white portland cement shall be blended with regular cement as needed. The minimum compressive strength at 28 days shall be 4000 psi.
- B. Cement grout materials shall be as indicated in Section 03300, except that no cement from kilns burning metal-rich hazardous waste fuel shall be used.

2.2 PREPACKAGED GROUTS

A. Non-Shrink Grout:

1. Non-shrink grout shall be a prepackaged, inorganic, non-gas-liberating, non-metallic, cement-based grout requiring only the addition of water. Cement from kilns burning metal-rich hazardous waste fuel shall not be used. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each class of non-shrink grout herein shall be that recommended by the manufacturer for the particular application.
2. Class A non-shrink grouts shall have a minimum 28 day compressive strength of 5000 psi; shall have no shrinkage (0.0 percent) and a maximum 4.0 percent expansion in the plastic state when tested in accordance with ASTM C 827 - Test Method for Early Volume Change of Cementitious Mixtures; and shall have no shrinkage (0.0 percent) and a maximum of 0.2 percent expansion in the hardened state when tested in accordance with CRD C 621 - Corps of Engineers Specification for Non-shrink Grout.
3. Class B non-shrink grouts shall have a minimum 28 day compressive strength of 5000 psi and shall meet the requirements of CRD C 621.

4. Application:

- a. Class A non-shrink grout shall be used for the repair of all holes and defects in concrete members which are water bearing or in contact with soil or other fill material, grouting under all equipment base plates, and at all locations where grout is required by the Contract Documents except where Class B non-shrink grout and epoxy grout are specifically required. Class A non-shrink grout may be used in place of Class B non-shrink grout for all applications.
- b. Class B non-shrink grout shall be used for the repair of all holes and defects in concrete members which are not water-bearing and not in contact with soil or other fill material, grouting under all base plates for structural steel members, and grouting railing posts in place.

B. Epoxy Grout:

1. Epoxy grout shall be a pourable, non-shrink, 100 percent solids system. The epoxy grout system shall have three components: resin, hardener, and specially blended aggregate, all premeasured and prepackaged. The resin component shall not contain any non-reactive diluents. Resins containing butyl glycidyl ether (BGE) or other highly volatile and hazardous reactive diluents are not acceptable. Variation of component ratios is not permitted unless specifically recommended by the manufacturer. Manufacturer's instructions shall be printed on each container in which the materials are packaged. Epoxy grout shall be **BurkEpoxy Anchoring Grout by The Burke Company**.
2. The chemical formulation of the epoxy grout shall be that recommended by the manufacturer for the particular application.
3. The mixed epoxy grout system shall have a minimum working life of 45 minutes at 75 degrees F.
4. The epoxy grout shall develop a compressive strength of 5000 psi in 24 hours and 10,000 psi in seven days when tested in accordance with ASTM C 579, Method B. There shall be no shrinkage (0.0 percent) and a maximum 4.0 percent expansion when tested in accordance with ASTM C 827.
5. The epoxy grout shall exhibit a minimum effective bearing area of 95 percent. This shall be determined by a test consisting of filling a 2-inch diameter by 4-inch high metal cylinder mold covered with a glass plate coated with a release agent. A weight shall be placed on the glass plate. At 24 hours after casting, the weight and plate shall be removed and the area in plan of all voids measured. The surface of the grout shall be probed with a sharp instrument to locate all voids.
6. The peak exotherm of a 2-inch diameter by 4-inch high cylinder shall not exceed 95 degrees F when tested with 75 degree F material at laboratory temperature. The epoxy grout shall exhibit a maximum thermal coefficient of 30×10^{-6} inches/inch/degree F when tested according to ASTM C 531 - Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical- Resistant Mortars, Grouts, and Monolithic Surfacing or ASTM D 696 - Test Method for Coefficient of Linear Thermal Expansion of Plastics.

7. Application: Epoxy grout shall be used to embed all anchor bolts and reinforcing steel required to be set in grout, and for other applications specifically required in the Contract Documents.

2.3 TOPPING GROUT AND CONCRETE FILL

- A. Grout for topping of slabs and concrete fill for built-up surfaces of tank, channel, and basin bottoms shall be composed of cement, fine aggregate, coarse aggregate, water, and admixtures. All materials and procedures for concrete in Section 03300-Cast-in-Place Concrete shall apply except as noted otherwise herein.
- B. Topping grout and concrete fill shall contain a minimum of 564 pound of cement per cubic yard with a maximum water cement ratio of 0.45. Where concrete fill is thicker than 3 inches, sitework concrete in accordance with Section 03300 Cast-in-Place Concrete may be used if accepted by the ENGINEER.
- C. Coarse aggregate shall be graded as follows:

<u>U.S. STANDARD SIEVE SIZE</u>	<u>PERCENT BY WEIGHT PASSING</u>
1/2"	100
3/8"	90-100
No. 4	20-55
No. 8	5-30
No. 16	0-10
No. 30	0

- D. Final mix design shall be determined by trial mix design under supervision of the approved testing laboratory.
- E. **Strength:** Minimum compressive strength of topping grout and concrete fill at the end of 28 days shall be 3000 psi.

2.4 CURING MATERIALS

- A. Curing materials shall be in accordance with Section 03300 - Cast-in-Place Concrete for cement grout and be as recommended by the manufacturer of prepackaged grouts.

2.5 CONSISTENCY

- A. The consistency of grout shall be as necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is such that the grout is plastic and moldable but will not flow. Where "dry pack" is required by the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as indicated herein for the particular application.
- B. The slump for topping grout and concrete fill shall be adjusted to match placement and finishing conditions but shall not exceed 4 inches.

2.6 MEASUREMENT OF INGREDIENTS

- A. Measurements for cement grout shall be made accurately by volume using containers.

Shovel measurement shall not be allowed.

- B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

PART 3 – EXECUTION

3.1 GENERAL

- A. All surface preparation, curing, and protection of cement grout shall be in accordance with Section 03300 - Cast-in-Place Concrete. The finish of the grout surface shall match that of the adjacent concrete.
- B. The manufacturer of Class A non-shrink grout and epoxy grout shall provide on-Site technical assistance upon request.
- C. Base concrete or masonry must have attained its design strength before grout is placed, unless authorized by the ENGINEER.

3.2 GROUTING PROCEDURES

- A. **Prepackage Grouts:** All mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.

- B. **Base Plate Grouting:**

1. For base plates, the original concrete shall be blocked out or finished off a sufficient distance below the plate to provide for a one-inch thickness of grout or a thickness as indicated on the Drawings.
2. After the base plate has been set in position at the proper elevation by steel wedges or double nuts on the anchor bolts, the space between the bottom of the plate and the original pour of concrete shall be filled with non-shrink-type grout. The mixture shall be of a trowelable consistency and be tamped or rodded solidly into the space between the plate and the base concrete. A backing board or stop shall be provided at the back side of the space to be filled with grout. Where this method of placement is not practical or where required by the ENGINEER, alternate grouting methods shall be submitted for acceptance.

- C. **Topping Grout**

1. All mechanical, electrical, and finish work shall be completed prior to placement of topping or concrete fill. The base slab shall be given a roughened textured surface by sandblasting or hydroblasting, exposing the aggregates to ensure bonding to the base slab.
2. The minimum thickness of grout topping and concrete fill shall be one inch. Where the finished surface of concrete fill is to form an intersecting angle of less than 45 degrees with the concrete surface it is to be placed against, a key shall be formed in the concrete surface at the intersection point. The key shall be a minimum of 3-1/2-inches wide by 1-1/2-inches deep.

3. The base slab shall be thoroughly cleaned and wetted prior to placing topping and fill. No topping concrete shall be placed until the slab is completely free from standing pools or ponds of water. A thin coat of neat cement grout shall be broomed into the surface of the slab just before topping of fill placement. The topping and fill shall be compacted by rolling or tamping, brought to established grade, and floated. Grouted fill for tank and basin bottoms where scraping mechanisms are to be installed shall be screeded by blades attached to the revolving mechanism of the equipment in accordance with the procedures outlined by the equipment manufacturer after the grout is brought to the established grade.
4. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement.
5. The surface shall be tested with a straight edge to detect high and low spots which shall be immediately eliminated. When the topping and fill has hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. An approved type of mechanical trowel may be used as an assist in this operation, but the last pass over the surface shall be by hand-troweling. During finishing, no water, dry cement, or mixture of dry cement and sand shall be applied to the surface.

3.3 CONSOLIDATION

- A. Grout shall be placed in such a manner, for the consistency necessary for each application, so as to assure that the space to be grouted is completely filled.

- END OF SECTION -

SECTION 03400 - STRUCTURAL PRECAST CONCRETE

PART 1 – GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall furnish all tools, equipment, materials, and supplies and shall perform all labor required to complete the precast concrete work in accordance with the Contract Documents.
- B. This Section covers the design, fabrication, delivery and installation of all precast concrete units, including connections, complete, in place, as shown and specified.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards:

ANSI/ACI 315	Concrete Reinforcement
ANSI/ACI 318	Concrete Construction
ANSI/AWS A5.4	Welding Rods and Electrodes
AWS B2.1	
ANSI/AWS D1.1	Welding and Cutting
ANSI/AWS D1.4	Welding and Cutting
ASTM A 184	Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A 185	Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement
ASTM A 193	Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194	Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
ASTM A 351	Steel Castings, Austenitic, for High-Temperature Service
ASTM A 497	Welded Deformed Steel Wire Fabric for Concrete Reinforcement
ASTM A 580	Stainless and Heat-Resisting Steel Wire
ASTM A 615	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

ASTM A 666	Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar for Structural Applications
ASTM A 775	Epoxy-Coated Reinforcing Steel Bars
ASTM C 33	Concrete Aggregates
ASTM C 67	Method for Sampling and Testing Brick and Structural Clay Tile
ASTM C 127	Test Method for Specific Gravity and Absorption of Coarse Aggregate
ASTM C 128	Test Method for Specific Gravity and Absorption of Fine Aggregate
ASTM C 150	Portland Cement
ASTM C 173	Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 204	Test Method for Fineness of Portland Cement by Air Permeability Apparatus
ASTM C 231	Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	Air-Entraining Admixtures for Concrete
ASTM C 311	Method for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete
ASTM C 494	Test Method for Shear Fatigue of Sandwich Core Materials
ASTM D 2240	Test Method for Rubber Property -- Durometer Hardness
AWS D12.1	
PCI MNL-116	
PCI MNL-117	
PCI MNL-121	

1.3 CONTRACTOR SUBMITTALS

- A. Submittals shall be made in accordance with Section 01300 - Contractor Submittals.
- B. Shop Drawings:

1. Shop drawings shall show details in accordance with ACI 315 and ACI 318 including installation details and design computations.
2. Shop drawings, including design computations, shall be stamped and signed by a structural engineer registered in the State of Florida and shall be approved by the ENGINEER.
3. Shop drawings shall indicate precast unit identification marks, location of units in the WORK, elevations, fabrication details, welding details, reinforcement, connections, dimensions, interface with adjacent members, and special handling instructions in sufficient detail to cover manufacture, handling, and erection. Shop drawings shall include erection drawings.
4. Shop drawings shall be divided into complete separate submittals for each structure. Each complete submittal shall consist of a panel schedule and shop drawings.
 - a. Panel Schedule: Showing all exterior elevations of the building, including all precast concrete enclosure faces exposed to view, in its associated shop drawing submittal. Elevations at a minimum scale of $1/8" = 1'0"$ shall be drawn, identifying the type and location of each panel by a number which corresponds to the panel number appearing on an associated shop drawing; this same number shall be permanently marked on the back of each panel as they are fabricated.
 - b. Shop Drawings: Showing all elevations, dimensions, horizontal and vertical sections, openings, inserts, reinforcing, anchorage devices, details, design computations, and other requirements for each different type of panel to be incorporated into the portion of the project covered by the submittal. Drawings shall be 24 inches x 36 inches maximum.

C. Small Samples:

1. Two 24-inch by 24-inch samples of precast concrete unit finish shall be submitted, as required for the project. Each sample shall show matrix color, surface color, surface texture, and panel back finish.
2. The face of each sample shall contain at least two areas of approved size and shape which have been chipped out and then patched and repaired and one form joint; the color, texture and appearance of patched areas and form joint shall match that of adjacent surface.
3. Samples will be inspected for color and texture match to the samples selected by the ENGINEER, uniformity of color and texture throughout the panel and acceptability of patching and joint treatment. Exposed face of samples shall be tested for efflorescence in accordance with ASTM C 67; rating shall not be more than "slightly effloresced."
4. If the ENGINEER rules a sample, or samples, to be unacceptable, the CONTRACTOR shall fabricate and resubmit additional samples.
5. When approved, one sample will be kept at the ENGINEER's field office and the other shall be picked up by the CONTRACTOR and returned to the manufacturing plant. These sample panels will be used as a comparison to judge acceptability of the full-size panel samples and, where necessary, the production precast units.

- D. **Mix Proportions:** Prior to commencing operations, including fabrications of the precast for any mock-up, a statement shall be submitted giving the nominal maximum aggregate size and proportions of all ingredients that will be used in the manufacture of concrete. The statement shall include test results from an approved testing laboratory, certifying that the proportions selected will produce concrete of the properties required. No substitutions shall be made in materials used in the concrete mix without approval and additional tests to verify that the concrete properties are satisfactory. A copy shall be submitted of concrete mix with each set of samples.
- E. **Test Reports:** Tests for compressive strength of concrete shall be performed by an independent commercial testing laboratory. Copies of test reports including all test data and all test results shall be submitted.
- F. **Certificates of Compliance:** Certificates of compliance shall be submitted attesting that materials and products meet or exceed specified requirements.
- G. **Manufacturer's Qualifications:** Prior to commencing operations, a statement shall be submitted giving the qualifications of the precast concrete Manufacturer, and evidence that the Manufacturer and plant are PCI certified.

1.4 QUALITY ASSURANCE

- A. **General Requirements:** Design members under direct supervision of a professional structural engineer experienced in design of precast concrete units, registered in the State and conforming to requirements of PCI MNL-121 and to ACI 318.
 - 1. Precast Manufacturer and erectors shall be qualified in accordance with PCI MNL-117 and MNL-116.
 - 2. Welding shall be in accordance with AWS D1.1, AWS D12.1, AWS B2.1, and AWS A5.4.
 - 3. **Manufacture, Transportation and Installation:** The Manufacturer shall specialize in providing architectural precast products and services normally associated with precast concrete construction with high quality architectural finishes similar to that indicated on drawings, using procedures complying with PCI MNL-116 and MNL-117, and PCI plant certified for at least 2 years.

1.5 DESIGN REQUIREMENTS

- A. **General:** The precast concrete panel and connection designs shown represent minimum precast construction requirements. The Manufacturer shall verify the panel and connection designs for all handling, erection, and service conditions, and shall provide any additional materials necessary to meet the design conditions.
- B. **Standards and Loads:** The precast panel and connection design and construction shall conform to all applicable codes and AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings. The precast or prefabricated, nonbearing, nonshear wall panels and connections which are attached to or enclose the exterior, shall resist, in addition to initial handling and erection loads and dead loads, the following forces:
 - 1. Wind pressure and load combinations relative to panel design in accordance with SCBBI.

For design of inserts, welds, and bolts, use $F_p=1.20W_p$. Add proportionate gravity loads to connections assigned to carry gravity loads.

2. The design shall be based on a differential temperature of 50 degrees F between interior and exterior faces of the units and an 80 degrees (± 40 degrees from erected temperature) average panel temperature differential.
 3. Stresses due to restrained volume changes caused by shrinkage and temperature differentials shall be accounted for.
- C. **Connections:** Prior to submitting shop drawings, the CONTRACTOR shall verify the precast connection designs shown against the aforementioned and following design criteria and provide any additional materials necessary to meet the design conditions.
1. The panel joints shall be designed to accommodate an in-plane movement between stories of 0.005 times the story height in inches but not less than 3/4-inch.
 2. Panel connections shall accommodate building movement and permit panels to move freely so as not to resist in plane deformation of the main frame structural system. Adjustment shall be provided to accommodate misalignment of structure without permanent distortion, damage to components, racking of joint connection, breakage of seals, or moisture penetration.
- D. **Concrete Mix:** The concrete mix shall be designed by the Manufacturer and approved by the ENGINEER, using the materials and quantities specified to meet all of the requirements of this specification.
1. **Proportioning of Concrete Mixes:** Mixes shall be proportioned by weight except water and admixtures may be batched by volume if desired. Trial mixes and testing to meet requirements of the strengths of concrete specified is the CONTRACTOR's responsibility. Design mix shall contain similar materials as those proposed for use in the WORK.
 2. **Admixtures:** Concrete shall contain an air entraining admixture in proportion so as to provide 4 percent plus or minus 1 percent total air in the concrete as determined by ASTM C 173 or C 231. Set retarding admixtures may be used provided cement content is not reduced. Water reducing admixtures may be used provided they are used in the mix design studies. High-range water reducers (superplasticizers) shall be used only where specifically called for in this Section, otherwise superplasticizers shall not be used without written approval from the ENGINEER. No admixture may contain chlorides, bromides, or fluorides.
 3. **Water:** Clean, potable water. The CONTRACTOR shall provide tests to assure that no more than 200 parts per million total aggregated content of chlorides, bromides, and fluorides are present.
- E. **Formwork:** Formwork shall be designed to withstand high-frequency vibration and to ensure finished units.
- F. **Pickup Points and Boxouts:** Pickup points, boxouts, and inserts on panel faces and surfaces to be exposed are prohibited except as approved.

1.6 DELIVERY, STORAGE AND HANDLING

- A. **General:** Precast members shall be handled to position consistent with their shape and design; they shall be lifted and supported from design incorporated support points and provided with strong backs and other devices as required. Lifting or handling equipment shall be capable of maintaining units during manufacture, storage, transportation, erection, and in position for fastening.
- B. Blocking and supports, lateral restraints and protective materials during transport and storage shall be clean, nonstaining, without causing harm to exposed surfaces, including temporary support to prevent bowing and warping. Lateral restraints shall be provided to prevent undesirable horizontal movement. Edges and exposed faces of members shall be protected to prevent straining, chipping, or spalling of concrete.
- C. Units shall be marked with date of production and final position in structure in location not visible after erection.
- D. Precast units shall be stored off the ground in a manner to prevent warpage and they shall be protected from weather, marring, and overload.
- E. **Stainless Steel Hardware:** Stainless steel hardware shall be transported, handled, stored, and protected in wood crates.

PART 2 -- PRODUCTS

2.1 CONCRETE MATERIALS

- A. Cement ASTM C 150, Type II, "low alkali," white color. "Low alkali" requirement may be waived if not reactive as defined in Appendix to ASTM C 33. Submit laboratory test reports.
- B. Aggregate ASTM C 33, 1/2-inch max coarse aggregate size fine aggregate ratio to total aggregate volume = 0.35 min, 0.55 max.
 - 1. Water Absorption, Coarse ASTM C 127.
 - 2. Water Absorption, Fine ASTM C 128.
- C. Reinforcing Steel ASTM A 615, Grade 60, deformed epoxy coated in accordance with ASTM A 775.
- D. Welded Wire Fabric:
 - 1. Plain ASTM A 185, epoxy coated.
 - 2. Deformed Steel ASTM A 497, epoxy coated.
 - 3. Fabricated Steel Bar or Rod Mats. ASTM A 184, epoxy coated.

- E. Tie Wire ASTM A 580, Type 316L, cold finished annealed, **Huntington Alloy Co. "Monel" or "Inconel."**
- F. Air Entrainment Admixture ASTM C 260.
- G. Water Reducing or Retarding Admixtures ASTM C 494, Type C, D, or F/G, with no chloride, bromide, and fluoride ingredients.
- H. Silica Fume Slurry Admixture 45 to 50 percent silica fume, water, and superplasticizer as dispersant. Silica Fume: 85 percent amorphous silicon dioxide in accordance with ASTM C 311; loss on ignition shall not exceed 6 percent and moisture shall not exceed 3 percent in accordance with ASTM C 311. Surface area not less than 10,000 square meters per kilogram at bed porosity of 0.50 in accordance with ASTM C 204.

Reduce water in mix by 5.6 to 9.5 lbs for each gallon of slurry added to mix, as recommended by slurry Manufacturer used.

- I. Pigment Pure mineral type, color-resistant to alkalis, nonfading. Color as required to produce finished concrete matching color and appearance of prebid sample and the 72-inch by 72-inch sample at the ENGINEER's field office.

2.2 SUPPORT DEVICES

- A. Connecting and Support Devices ASTM A 666, Type 316L stainless steel.
- B. Bolts ASTM A 193, Grade B8M (Type 316).
- C. Nuts and Washers ASTM A 194, Grade 8M (Type 316).
- D. Weld Filler Metal for Stainless Steel Stainless steel to stainless steel; AWS A5.4, Grade 316L filler metal; stainless steel to carbon steel, AWS A5.4, Grade 309 filler metal, 3/32-inch diameter.
- E. Primer Zinc-dust, zinc oxide primer in a phenolic resin spar varnish vehicle, TT-P-641 Type III (for galvanized surfaces).

2.3 ACCESSORIES

- A. Plates, Angles, Anchors, and Studs ASTM A 666, Type 316L stainless steel.
- B. Austenitic Steel Castings for ASTM A 351, Type CF3M, with Type 316

Embedments and Anchorage Assemblies stainless steel bolts, nuts, and washers.

C. Reglets Plastic, shaped and flanged to remain in place once cast; tape closed to prevent concrete intrusion.

D. Bearing Pads Neoprene, molded to size or cut from molded sheet, 70-80 Type A durometer, ASTM D 2240.

E. Sealant Specified in Section 07920 - Sealants and Caulking.

2.4 FORMS

A. Forms Manufacturer's standard with smooth, hard, dense, and rigid casting surface; without bow, warpage, oil canning, or other imperfections.

B. Form Release Agent Manufacturer's standard, nonstaining, nonpetroleum based; compatible with concrete surface sealer.

C. Surface Sealer Clear, flat, penetrating, nonyellowing, nonclouding solution; high concentration of organosilane in an aqueous alcoholic vehicle which is designed to provide water repellent concrete surfaces from which graffiti can be easily removed. Oil-type silicones, paraffins, waxes, vinyls, modified urethanes, or acrylics shall not be used. Sealant shall be tested by Manufacturer and proved compatible with surface sealer.

2.5 MIX

A. Silica Fume Concrete Minimum 5,000 psi, 28-day compressive strength; aggregate 3/8-inch max; water - 305 lbs per cu yd; cement - 763 lbs per cu yd; w/c ratio 0.40 max; slump range 3 inches to 5 inches with silica fume slurry; air entrainment 4 percent plus or minus 1 percent; 7.5 percent dry silica fume by weight of cement, provided through specified silica fume slurry; add superplasticizer to achieve desired working slump for precast concrete as may be required by silica fume slurry Manufacturer. Add colorant as required to achieve match with ENGINEER's sample. Moist cure by spray mist.

2.6 FABRICATION

A. General:

1. Precast concrete units shall be fabricated by a licensed shop in accordance with ACI 318, PCI MNL-116 (structural features), PCI MNL-117 (nonstructural features, surface treatments, patching, and tolerances). Plant records and quality control program shall be maintained during production of precast units. Records and access to plant shall be available to the ENGINEER upon request.
2. Rigid molds shall be used, constructed to maintain precast unit uniform in shape, size, and finish, free from castings and dents, gouges, oil canning, or other irregularities that will adversely affect appearance or strength of units. Consistent quality shall be maintained during manufacture.
3. Equipment for handling epoxy-coated reinforcing bars shall have protected contact areas. Bundles of coated bars shall be lifted at multiple pickup points to prevent bar-to-bar abrasion from sags in the bundles. Coated bars or bundles of coated bars shall not be dropped or dragged. Coated bars shall be stored on protective cribbing. The maximum amount of damage shall not exceed 2 percent of the surface area of each bar.
4. Reinforcing steel, anchors, inserts, plates, angles, and other cast-in-place items shall be embedded as indicated on shop drawings. Reinforcement shall be fabricated and placed in conformance with ACI 318. No tack welding of or to reinforcement permitted. Welding when allowed shall conform to AWS D1.4 requirements. No carbon steel chairs, spacers, nails or tie wire shall be used in positioning reinforcing and embedments.
5. Adequate reinforcing steel shall be provided to control cracking. Maximum permissible crack width:
 - a. Surfaces exposed to weather: 0.005 inch
 - b. Surfaces exposed to view but not weather: 0.01 inch
6. Connecting devices, plates, angles, items fit to steel framing members, inserts, bolts, and accessories shall be fabricated to permit initial placement and final attachment.
7. Anchors, inserts, lifting devices, and other accessories shall be placed and embedded in accordance with approved shop drawings, accurately positioned in their designed location and anchored to prevent dislocation during panel construction. Flashing reglets shall be placed and embedded continuous and straight, with lifting devices to permit removal after erection.
8. Units shall be moist cured with water mist to develop concrete quality and to minimize surface drying and appearance blemishes such as nonuniformity, staining, or surface cracking.
9. Precast units shall be removed from formwork using procedures conforming to PCI MNL-117. Minor patching in plant acceptable, providing structural adequacy and appearance of units are not impaired. Each precast unit shall be identified with corresponding code on erection drawings; in location not visible to finished work.

10. Repair of damaged epoxy coating, when required, shall be made with patching material conforming to ASTM A 775. Repair shall be in accordance with the material Manufacturer's recommendations.

B. Fabrication and Tooling of Stainless Steel Connections and Embedments:

1. All tools used during fabrication shall be made of stainless steel. Use of carbon steel tools is prohibited.
2. Welding of stainless steel shall conform to AWS A5.4, AWS B2.1 and AWS D1.1, using tungsten inert gas procedures and 316L filler metal for stainless steel to stainless steel and 309 filler metal for stainless steel to carbon steel. Surfaces shall be sanded smooth (do not grind), and oxidized discoloration removed (blue heat tint). Threaded parts of stainless steel bolts shall be lubricated with graphite suspended in alcohol (Neo-Lube) every time that nut is run on or off the threads. No other lubricant is acceptable.
3. Erection slings, cables, blocking, hardware and restraints shall be nonmetallic or stainless steel. Cribbing or crating shall be wood.

2.7 FINISH OF PRECAST UNITS

- A. Backs and Sides (Unexposed Edges):** Smooth, dense, uniform surface free from blemishes. Defects in backs and sides (unexposed edges) shall be repaired as approved.

B. Faces:

1. Appearance, color, and texture finish of all panels shall match appearance, color and texture of the approved sample panels constructed by the CONTRACTOR. Panels that do not match will be rejected. Repairs will be acceptable only if structural adequacy and appearance of product are not impaired and the repair and surrounding area match the approved sample panels at the ENGINEER's field office.
2. Mechanical finishing of panels at precast plant shall be at essentially the same age (or strength) of concrete to assure finished appearance is uniform from panel to panel.
3. To reduce possibility of stains occurring during transportation and erection, sealer shall be applied at the plant as recommended by Manufacturer and the precaster and shall be guaranteed in writing that sealer will not alter or yellow the original precast concrete color in any way and that it is compatible with the joint sealants to be used on the project. Seal finish surfaces of precast units to be exposed in completed work as follows: apply a uniform coat of surface sealer in accordance with Manufacturer's written instructions. Apply sealer by method and in quantity required to provide coverage specified by sealer Manufacturer. Forty-eight hours after application of sealer, apply water to face of each panel in sufficient quantity to determine if full sealer coverage was achieved. Panels not fully sealed shall be resealed and retested. A second coat shall be applied at the jobsite after erection and cleanup in accordance with the Manufacturer's instructions.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. **Examination:** The CONTRACTOR shall verify that building structure, anchors, devices, and openings are ready to receive work of this Section. Beginning of installation means acceptance of existing condition.
- B. **Preparation:** The CONTRACTOR shall provide for erection procedures and induced loads, during erection, maintain temporary bracing in place until final support is provided, provide necessary hoisting equipment and safety and protective devices.
- C. **Erection:**
1. The units shall be erected in accordance with approved shop/erection drawings without damage to shape or finish or adjacent work. Damaged panels shall be replaced or repaired. Unless otherwise shown, members shall be erected level and plumb within allowable tolerances.
 2. The CONTRACTOR shall align and maintain uniform horizontal and vertical joints as erection progresses, provide approved shims and wedges as required, and when members required adjustment beyond design or tolerance criteria, discontinue affected work. Units shall be secured in place and field welds, scratches and otherwise damaged steel surfaces shall be touched up.
 3. Field fabrication and erection of stainless steel shall conform to the procedures outlined in the paragraph entitled "Fabrication and Tooling of Stainless Steel Connectors and Embedments."
 4. The vertical units shall be set dry, without grout, attaining joint dimension with lead or plastic shims and spacers.
 5. Pickup points, boxouts, inserts and bearing surfaces shown shall be grouted with non-shrink grout in accordance with Section 03315 - Grout. The color and texture of concrete surfaces of adjacent areas shall be finished to match in the same plane.
- D. **Tolerances:** In accordance with requirements of PCI MNL-117 unless otherwise indicated.
1. Variation from Plane of Location: 1/4-inch in 10 feet and 3/8-inch in 100 feet maximum, compensating not cumulative.
 2. Offset from True Alignment between Two Connecting Members: 1/4-inch maximum.
 3. Out of Square: 1/8-inch in 10 feet maximum, noncumulative.
 4. Variation in Dimensions Indicated in Shop Drawings: Plus or minus 1/8-inch.
 5. Misalignment of Anchors, Inserts, Openings: 1/8-inch, maximum.
 6. Bowing or Warpage of Units: 1/700 of panel dimension.
 7. Exposed Joint Dimension: 3/4-inch plus or minus 1/8-inch.
 8. Location of Reglets: 1/4-inch from true position.

E. **Joint Sealing:** Specified in Section 07920 - Sealants and Caulking.

3.2 CLEANING

- A. Not sooner than 72 hours after joints are sealed, faces and other exposed surfaces of precast units shall be cleaned using a cleaning detergent recommended by the sealer manufacturer and water applied with a soft bristle brush, and thoroughly rinsed using clean water or other approved procedures.
- B. Units shall be cleaned when temperature and humidity conditions are such that surfaces dry rapidly (e.g., 70 degrees F and rising, 50 percent RH or less).
- C. Discolorations which cannot be removed by these procedures shall be considered defective work, and repaired or replaced as directed by ENGINEER.

3.3 PROTECTION

- A. Adjacent surfaces shall be protected from damage during sealing and cleaning operations and against damage, disfiguration or discoloration from subsequent operations. Noncombustible shielding shall be used during welding operations.

- END OF SECTION -

SECTION 05500 - MISCELLANEOUS METALWORK

PART 1 – GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide miscellaneous metalwork and appurtenances, complete and in place, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Federal Specifications

MIL-G-18015 A (3)	(Ships) Aluminum Planks. (6063-T6)
MIL-A-907E	Antiseize Thread Compound, High Temperature

B. Commercial Standards

AA-M32C22A41	Aluminum Association.
AASHTO HS-20	Truck Loading
AISC	Manual of Steel Construction
AISI	Design of Light Gauge, Cold-Formed Steel Structural Members
ASTM A 36	Carbon Structural Steel
ASTM A 48	Gray Iron Castings
ASTM A 53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 193	Alloy Steel and Stainless Steel Bolting Materials for High Temperature Service
ASTM A 194	Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service
ASTM A 307	Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A 325	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

ASTM A 500	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ANSI/AWS D1.1	Structural Welding Code - Steel
ANSI/AWS D1.2	Structural Welding Code - Aluminum
ANSI/AWS QC1	Qualification and Certification of Welding Inspectors

1.3 CONTRACTOR SUBMITTALS

- A. **Shop Drawings:** Shop Drawings of all miscellaneous metalwork shall be submitted in accordance with Section 01300 - Contractor Submittals.
- B. Layout drawings for grating shall be submitted showing the direction of span, type and depth of grating, size and shape of grating panels, seat angle details, and details of grating hold down fasteners. Load and deflection tables shall be submitted for each style and depth of grating used.
- C. An ICBO report listing the ultimate load capacity in tension and shear for each size and type of concrete anchor shall be submitted. CONTRACTOR shall submit manufacturer's recommended installation instructions and procedures for adhesive anchors. Upon review, by ENGINEER, these instructions shall be followed specifically.
- D. No substitution for the indicated adhesive anchors will be considered unless accompanied with ICBO report verifying strength and material equivalency, including temperature at which load capacity is reduced to 90 percent of that determined at 75 degrees F.

1.4 QUALITY ASSURANCE

- A. All weld procedures and welder qualifications shall be available in the CONTRACTOR's field office for review.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Steel
 - 1. Shapes, Plates, Bars ASTM A 36
 - 2. Pipe, Pipe Columns, Bollards ASTM A 53, Type E or S, Grade B standard weight unless noted otherwise
 - 3. Tubes ASTM A 500 Grade B
- B. **Corrosion Protection:** Unless otherwise indicated, fabricated steel metalwork which will be used in a corrosive environment and/or will be submerged in water/wastewater shall be coated in accordance with Section 09800 -Protective Coating and shall not be galvanized prior to coating. All other miscellaneous steel metalwork shall be hot-dip galvanized after fabrication.

- C. **Stainless Steel:** Unless otherwise indicated, stainless steel metalwork and bolts shall be of Type 316 stainless steel. Where anaerobic conditions are noted, Type 304 stainless steel shall be used.
- D. **Aluminum:** Unless otherwise indicated, aluminum metalwork shall be of Alloy 6061-T6. Aluminum in contact with concrete, masonry, wood, porous materials, or dissimilar metals shall have contact surfaces coated in accordance with Section 09800.
- E. **Cast Iron:** Unless otherwise indicated, iron castings shall conform to the requirements of ASTM A 48, Class 50B or better.

2.2 ALUMINUM RAILINGS

- A. **General:** Aluminum handrails and railings shall be component systems complete with all anchors, attachments, balusters, brackets, caps, fasteners, gates (swing with self-latching hardware or removable), posts, sleeves, trim, and any other related items required or necessary for a complete installation. All gates and removable rail sections shall be complete with all hardware such as self-closing hinges, self-latching latches, hasps, etc. Railings shall conform to the Building Code and OSHA General Industry Occupational Safety and Health Standards (29CFR1910).
- B. **Materials:** Materials shall conform to the following:
 - 1. **Aluminum:** Aluminum shall be U.S. Alloy 6063 T-5 or T-6. Aluminum pipe rail shall not be less than 1-1/2-inch diameter Schedule 40 pipe.
 - 2. **Electrolysis Protection:** Electrolysis protective material shall be alkali-resistant asphaltum base paint, **Koppers "Bitumastic 50," Texaco "Cement 1401,"** or equal.
 - 3. **Sleeves:** Sleeves shall be of galvanized steel or PVC.
 - 4. **Grout:** Grout for hand rail posts shall consist of an inorganic, non-shrink, non-metallic premixed grout in accordance with Section 03315 - Grout with a minimum 28-day compressive strength of 4,000 psi.
 - 5. **Fasteners:** Fasteners, screws, and bolts shall be concealed and shall be of stainless steel or aluminum.
 - 6. **Welding Rods:** Aluminum welding rods shall be of a type recommended by the aluminum manufacturer for anodized finished products.
- C. **Finishes:** Pipe railing system including handrails, railings, tube caps, and other miscellaneous parts of rails shall be provided with a clear anodized finish, AA-M32 C22A41.
- D. **Manufacturers or Equal:**
 - 1. **C-V Pipe Rail, by Crane Veyor Corp.;**
 - 2. **Connectorail, by Julius Blum and Co.**

2.3 METAL STAIRS

- A. **Metal Stairs:** Metal stairs shall be composed of steel or aluminum stringers and supports, be fabricated in accordance with standard practice of the National Association of Ornamental Metal Manufacturers, and be as indicated. Steel stair members shall be hot-dip galvanized after fabrication.

2.4 GRATING STAIR TREADS

- A. Grating stair treads shall be designed to support a live load of 100 psf or a concentrated load at mid-span of 1000 pounds, whichever creates the higher stress. The maximum deflection due to the uniform live load shall be as required for metal grating below. All grating stair treads shall have an integral non-slip nosing.

2.5 SAFETY STAIR NOSINGS

- A. Safety stair nosing shall be provided on all concrete stairs and other locations as indicated. The nosing shall be 3-inch wide, extruded aluminum with cast-in abrasive strips and integral extruded anchors. The color of the cast abrasive shall be as selected by the ENGINEER from the manufacturer's standard colors. The nosing shall be **American Abrasive Metals Company, Style "231-A"; American Mason Safety Tread Company, Figure "31A"** or equal.

2.6 LADDERS

- A. Ladders which may be partially or wholly submerged, or which are located inside a hydraulic structure, shall be entirely of Type 316 stainless steel. All other ladders shall be of aluminum.
- B. Every ladder that does not have an exterior handhold shall be equipped with a pop-up extension. Pop-up extension device shall be manufactured of the same material and finish as the ladder with telescoping tubular section that locks automatically when fully extended. Upward and downward improvement shall be controlled by stainless steel spring balancing mechanisms. Units shall be completely assembled with fasteners for securing to the ladder rungs in accordance with the manufacturer's instructions.

2.7 METAL GRATING

- A. **General:** Metal grating shall be of the design, sizes, and types indicated. Grating shall be completely banded at all edges and cutouts using material and cross section equivalent to the bearing bars. Such banding shall be welded to each cut bearing bar. Grating shall be supported on all sides of an opening by support members. Where grating is supported on concrete, embedded support angles matching grating material shall be used on all sides, unless indicated otherwise. Such angles shall be mitered and welded at corners.
 1. All pieces of grating shall be fastened in two locations to each support.
 2. Where grating forms the landing at the top of a stairway, the edge of the grating, which forms the top riser, shall have an integral non-slip nosing, width equal to that of the stairway.

3. Where grating depth is not given, grating shall be provided which will be within allowable stress levels, and which shall not exceed a deflection of 1/4 inch or the span divided by 180, whichever is less. For standard duty plank, and safety grating, the loading to be used for determining stresses and deflections shall be the uniform live load of the adjacent floor or 100 psf, whichever is greater or a concentrated load of 1000 pounds. For heavy duty grating, the loading used for determining stresses and deflections shall be AASHTO HS-20.

B. Material

1. Except where indicated otherwise, bar grating shall be fabricated entirely of aluminum as follows: Bearing and banding bars, alloy 6061-T6; cross bars, alloy 6063-T5.
2. Safety grating shall be fabricated of aluminum alloy 5052-H32.
3. Grating which may be partially or wholly submerged shall be fabricated entirely of stainless steel, Type 316.

C. Standard-Duty Grating

1. No single piece of grating shall weigh more than 80 pounds, unless indicated otherwise. Standard duty grating shall be serrated bar grating.
2. Cross bars shall be welded or mechanically locked tightly into position so that there is no movement allowed between bearing and cross bars.

2.8 CHECKERED PLATE

- A. Checkered plate shall have a pattern of raised lugs on one face and shall be smooth on the opposite face. Lugs shall be a minimum of one inch in length and raised a minimum of 0.050 inch above the surface. The lugs shall be located in a pattern in which the lugs are oriented at 90 degrees from the adjacent lugs in two orthogonal directions. The rows of lugs shall be oriented at 45 degrees from the edges of the plates.
- B. Where no plate material is indicated on the Drawings, aluminum shall be provided. Unless indicated otherwise, the minimum plate thickness shall be as required to limit deflection resulting from a live load of 100 psf to 1/4-inch or the span divided by 240, whichever is less.

2.9 FLOOR HATCHES

- A. Where access hatches are mounted on a floor slab (including top slabs which are not covered with a roofing membrane) or on a concrete curb, the hatch shall be a flush type as indicated herein.
- B. Hatches shall be fabricated from Aluminum 6061 T6, unless otherwise indicated. Hatch hardware shall be Type 316 stainless steel. Hatches shall be gutter-type; **Bilco Type "J"** or **"JD"** **Babcock-Davis type "FT"** or **"AM"** or equal.
- C. The design live load shall be 300 psf, unless indicated otherwise.

- D. Hatch opening sizes, number and swing direction of door leaves, and locations, shall be as indicated. Sizes are for the clear opening. Where the number of leaves is not given, openings larger than 42 inches in either direction shall have double-leaf doors. Unless indicated otherwise, hinges shall be located on the longer dimension side. Unless indicated otherwise, ladder hatches shall be a minimum of 30 inches wide by 36 inches long, with the ladder centered on the shorter dimension, and the door hinge opposite the ladder.
- E. Door leaves shall be a minimum of 1/4-inch thick checkered pattern plate. Channel frames shall be a minimum of 1/4-inch material with an anchor flange around the perimeter. Hatches shall be provided with an automatic hold-open arm with release handle. Hatches shall be designed for easy opening from both inside and outside.
- F. Hatches shall be designed to be watertight and shall be equipped with a joint gutter and moat-type edge drain. A minimum 1-1/2-inch diameter drain connection shall be provided, located by the manufacturer.
- G. Hatches shall include a recessed hasp for a padlock that is covered by a hinged lid flushed with the surface.
- H. Hatches shall include a single pole normally open switch, rated 10 amps, hinge mounted.

2.10 IRON CASTINGS

- A. Iron castings shall be of uniform quality, free from blowholes, porosity, hard spots, shrinkage, distortion, or other defects. They shall be smooth and well cleaned by shotblasting.
- B. Covers and grates shall fit together evenly, so that the cover fits flush with the surrounding finished surface and so that the cover does not rock or rattle when loading is applied. Round covers and frames shall have machined bearing surfaces.
- C. Covers and grates with matching frames shall be designed to support the following loadings:
 - 1. Where located within a structure, the design loading shall match that required for the adjacent floor area, or, if no floor loading is given, a minimum of 300 pounds per square foot.
 - 2. Exterior covers and grates shall be designed for AASHTO HS-20 loading unless indicated otherwise.

2.11 CAST-IN-PLACE THRESHOLD

- A. The cast-in-place threshold at overhead roll-up doors shall be a steel threshold embedded in the concrete floor slab. The threshold shall be the product of **Eastern Metal Products Co., Elizabeth City, NC (telephone: 919-335-5451)**; or equal.

2.12 BOLTS AND ANCHORS

- A. **Standard Service (Non-Corrosive Application):** Unless otherwise indicated, bolts, anchor bolts, washers, and nuts shall be steel as indicated herein. Threads on galvanized bolts and nuts shall be formed with suitable taps and dies such that they retain their normal clearance after hot-dip galvanizing. Except as otherwise indicated, steel for bolts, anchor bolts and cap screws shall be in accordance with the following:
1. Structural connections: ASTM A 307, Grade A or B, hot-dip galvanized.
 2. Anchor Bolts: ASTM A 307, Grade A or B, or ASTM A 36.
 3. High strength bolts where indicated: ASTM A 325
 4. Pipe and equipment flanges: ASTM A 193, Grade B-7
- B. **Corrosive Service:** All bolts, nuts, and washers in the locations listed below shall be stainless steel as indicated below.
1. All buried locations.
 2. All submerged locations.
 3. All locations subject to seasonal or occasional flooding.
 4. Inside hydraulic structures below the top of the structure.
 5. Inside buried vaults, manholes, and structures which do not drain through a gravity sewer or to a sump with a pump.
 6. All chemical handling areas.
 7. Inside trenches, containment walls, and curbed areas.
 8. All locations subject to continuous or intermittent wetting or spraying other than weather.
 9. Locations indicated by the Contract Documents or designated by the ENGINEER to be provided with stainless steel bolts.
- C. Unless otherwise indicated, stainless steel bolts, anchor bolts, nuts, and washers shall be Type 316 stainless steel, class 2, conforming to ASTM A 193 for bolts and to ASTM A 194 for nuts. All threads on stainless steel bolts shall be protected with an antiseize lubricant suitable for submerged stainless steel bolts, to meet government specification MIL-A-907E. Buried bolts in poorly drained soil shall be coated the same as the buried pipe.
1. Antiseize lubricant shall be classified as acceptable for potable water use by the NSF.
 2. Antiseize lubricant shall be "PURE WHITE" by **Anti-Seize Technology**, Franklin Park, IL, 60131, AS-470 by **Dixon Ticonderoga Company**, Lakehurst, NJ, 08733, or equal.

D. Bolt Requirements

1. The bolt and nut material shall be free-cutting steel.
2. The nuts shall be capable of developing the full strength of the bolts. Threads shall be Coarse Thread Series conforming to the requirements of the American Standard for Screw Threads. All bolts and cap screws shall have hexagon heads and nuts shall be Heavy Hexagon Series.
3. Bolts and nuts shall be installed with washers fabricated of material matching the base material of bolts, except that hardened washers for high strength bolts shall conform to the requirements of the AISC Specification. Lock washers fabricated of material matching the bolts shall be installed with washers where indicated.
4. The length of each bolt shall be such that after the joint is made up, the bolt extends through the entire nut, but in no case more than 1/2-inch beyond the nut.

E. **Adhesive Anchors:** Unless otherwise indicated, all drilled, concrete or masonry anchors shall be adhesive anchors. No substitutions will be considered unless accompanied with ICBO report verifying strength and material equivalency.

1. Epoxy adhesive anchors are required for drilled anchors where exposed to weather, in submerged, wet, splash, overhead, and corrosive conditions, and for anchoring handrails, pumps, mechanical equipment, and reinforcing bars. Epoxy anchor grout shall comply with Section 03315 - Grout. Threaded rod shall be stainless steel Type 316.
2. Unless otherwise indicated, glass capsule, polyester resin adhesive anchors will be permitted in locations not included above and shall be **Hilti HVA** or **Cobra Anchors**. Threaded rod shall be galvanized steel.

F. **Expanding-Type Anchors:** Expanding-type anchors if indicated or permitted, shall be steel expansion type **ITW Ramset/Redhead "Trubolt" anchors; McCulloch Industries "Kwick-Bolt;"** or equal. Lead caulking anchors will not be permitted. Size shall be as indicated. Expansion type anchors which are to be embedded in grout may be steel. Non-embedded buried or submerged anchors shall be stainless steel.

2.13 POWDER-DRIVEN PINS

- A. **Materials:** Powder-driven pins for installation in concrete or steel shall be heat-treated steel alloy. If the pins are not inherently sufficiently corrosion-resistant for the conditions to which they are to be exposed, they shall be protected in an acceptable manner. Pins shall have capped or threaded heads capable of transmitting the loads the shanks are required to support. Pins that are connected to steel shall have longitudinal serrations around the circumference of the shank.

2.14 IMPACT ANCHOR

- A. Impact anchors shall be an expansion type anchor in which a nail type pin is driven to produce the expansive force. The pin shall have a zinc sleeve with a mushroom style head and stainless steel nail pin. Anchors shall be **Metal Hit Anchors, manufactured by Hilti, Inc., Rawl Zamac Nailin, manufactured by the Rawlplug Company;** or equal.

PART 3 – EXECUTION

3.1 FABRICATION AND INSTALLATION REQUIREMENTS

- A. **Fabrication and Erection:** Except as otherwise indicated, the fabrication and erection of structural steel shall conform to the requirements of the American Institute of Steel Construction "Manual of Steel Construction."
- B. **Aluminum Railings:** Aluminum railing fabrication and installation shall be performed by craftsmen experienced in the fabrication of architectural metalwork. Exposed surfaces shall be free from defects or other surface blemishes. Dimensions and conditions shall be verified in the field. All joints, junctions, miters and butting sections shall be precision fitted with no gaps occurring between sections, and with all surfaces flush and aligned. Electrolysis protection of materials shall be provided.
- C. **Floor Hatches:** Unless otherwise indicated, the CONTRACTOR shall provide a 1/2-inch drain line to the nearest floor drain for all floor hatches.
- D. **Powder-Driven Pins:** Powder-driven pins shall be installed by a craftsman certified by the manufacturer as being qualified to install the manufacturer's pins. Pins shall be driven in one initial movement by an instantaneous force that has been carefully selected to attain the required penetration. Driven pins shall conform to the following requirements where "D" = pin's shank diameter:

<u>Material Penetrated by Pin</u>	<u>Material Minimum Thickness</u>	<u>Pin Shank Penetration in Supporting Material</u>	<u>Minimum Space From Pin's CL to Edge of Penetrated Material</u>	<u>Minimum Pin Spacing</u>
Concrete	16D	6D minimum	14D	20D
Steel	1/4-inch	Steel thickness	4D	7D

3.2 WELDING

- A. **Method:** Welding shall be by the metal-arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" as supplemented by other pertinent standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards governing same.
- B. **Quality:** In assembly and during welding, the component parts shall be adequately clamped, supported and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall be as indicated by the AWS Code. Upon completion of welding, weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance, with uniform weld contours and dimensions. All sharp corners of material which is to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.

3.3 GALVANIZING

- A. Structural steel plates shapes, bars, and fabricated assemblies required to be galvanized shall, after the steel has been thoroughly cleaned of rust and scale, be galvanized in accordance with the requirements of ASTM A 123. Any galvanized part that becomes warped

during the galvanizing operation shall be straightened. Bolts, anchor bolts, nuts and similar threaded fasteners, after being properly cleaned, shall be galvanized in accordance with the requirements of ASTM A 153. Field repairs to galvanizing shall be made using "Galvinox," "Galvo-Weld," or equal.

3.4 DRILLED ANCHORS

- A. Drilled anchors and reinforcing bars shall be installed in strict accordance with the manufacturer's instructions. Holes shall be roughened with a brush on a power drill, cleaned and dry. Drilled anchors shall not be installed until the concrete has reached the required 28-day compressive strength. Adhesive anchors shall not be loaded until the adhesive has reached its indicated strength in accordance with the manufacturer's instructions.

- END OF SECTION -

SECTION 07150 - DAMPPROOFING

PART 1 – GENERAL

1.1 THE REQUIREMENT

- A. The GENERAL CONTRACTOR shall furnish all the materials for and shall properly erect and install all dampproofing at the locations shown and as indicated on the Contract Drawings and as specified herein.
- B. This shall include all surface-applied bituminous and cementitious coatings, on concrete and masonry surfaces, and all labor, materials, tools, and appurtenances required to complete the work of this Contract.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. **Codes:** All codes, as referenced herein, are specified in Section 01090, "Reference Standards."

- B. **Commercial Standards:**

ASTM D 412 Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension

ASTM E 96 Test Methods for Water Vapor Transmission of Materials

1.3 CONTRACTOR SUBMITTALS

- A. **Shop Drawings:** Detailed, dimensioned shop drawings and data conforming to the requirements of Section 01300 of the General Requirements shall be submitted to the Engineer and approved before fabrication, shipment or work specified under this Section begins.
- B. **Certificates of Compliance:** Submit Certificates of Compliance for all materials in accordance with the provisions of Section 01300 of the General Requirements.

PART 2 – PRODUCTS

2.1 SURFACE-APPLIED CEMENTITIOUS COATINGS

- A. Cementitious coatings shall be Thoroseal by Thoro System Products. Color shall be as selected by the Engineer from manufacturer's standard colors.
- B. For finishing concrete use an additive to improve bonding such as acryl 60 Thoroseal.

2.2 SURFACE-APPLIED BITUMINOUS WATERPROOFING

- A. Bituminous waterproofing material shall be Karnak Corporation "KARNAK #920," or equal.

2.3 SURFACE-APPLIED CLEAR SEALER

- A. All exposed C.M.U. shall receive spray-applied, clear penetrating sealer, sealer shall be "OKON W-2" as manufactured by OKON, Inc., "SILOXANE" by Prosoco, or equal.

PART 3 – EXECUTION

3.1 SURFACE-APPLIED CEMENTITIOUS COATINGS

- A. A cement base, aggregate type, heavy duty, waterproof coating shall be furnished and installed for all exterior concrete walls located above ground at all buildings erected under this Contract. Coating shall extend from 12" below furnished grade to top of concrete walls.
- B. Surface to be coated shall be structurally sound, clean and free of dirt, loose mortar particles, paint, films, protective coatings, etc. Concrete to receive coating shall be carefully formed to provide a smooth surface, free of form marks and in condition to receive a coating of approximately 1/8" thickness. Do not use form treatments that will stain or otherwise injure the concrete or prevent a good bond for cement-base coatings. Cut rods, steel separators back to depth of 2 inches and patch all holes, cracked and spalled concrete, and honeycombed areas with patching cement as recommended by manufacturer of finish coating.
- C. For finishing concrete, mix cement coat according to manufacturer's instructions, including an additive to improve bonding. Mix and apply first coat at 2 lbs. per sq. yd. Apply second brush coat at same rate after first coat has set. When finish coat has set, float it to uniform texture with a sponge float.

3.2 SURFACE-APPLIED BITUMINOUS WATERPROOFING

- A. Before beginning to lay any veneer masonry work, the GENERAL CONTRACTOR shall paint the exterior part of the vertical concrete or C.M.U. walls, with bituminous waterproofing material. Extreme care shall be taken to keep all exposed concrete surfaces free from bituminous waterproofing and/or splatters. Apply only to clean, firm and dry surfaces, follow manufacturer's instructions. This material shall be compatible with, and act as an adhesive for any insulation.

3.3 SURFACE-APPLIED CLEAR SEALER

- A. All surfaces should be thoroughly cleaned. Caulking and other sealants should be in place before sealer application. Air and substrate temperature should be 50 degrees F. and rising. The surface to be treated can be slightly damp but no obvious signs of wetness should exist. In hot, dry weather, surfaces to be treated should receive a light spray of water prior to sealer application. Application and coverage shall be according to manufacturer's recommendations. Protect adjacent areas which would be adversely affected from overspray.

- END OF SECTION -

SECTION 07190 – VAPOR RETARDERS

PART 1 – GENERAL

1.1 THE REQUIREMENT

- A. The GENERAL CONTRACTOR shall furnish all the materials for and shall properly erect and install all vapor retarders at the locations shown and as indicated on the Contract Drawings, and as specified herein. This shall include all plastic sheet moisture vapor retarders, and all labor, materials, tools, and appurtenances required to complete the work of this Contract.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. **Codes:** All codes, as referenced herein, are specified in Section 01090, "Reference Standards."

1.3 WORKMANSHIP AND MATERIALS

- A. All equipment and materials furnished under this Contract shall be new, suitable for the conditions on service to which they will be subject, and equal to the best of their respective classes. Grade and quality shall meet the applicable cited specifications and standards.
- B. Workmanship shall be of the highest quality and shall be carried out by competent and experienced workmen.

1.4 CONTRACTOR SUBMITTALS

- A. **Shop Drawings:** Detailed, dimensioned shop drawings and data conforming to the requirements of Section 01300 of the General Requirements shall be submitted to the Engineer and approved before fabrication, shipment or work specified under this Section begins.

PART 2 — PRODUCTS

2.1 PLASTIC SHEET

- A. The plastic vapor retarder shall be a 0.010 inch thick polyethylene film with 2 inch wide, **3M**, ("Scotch") glass filament tape.

PART 3 — EXECUTION

- 3.1 A plastic vapor retarder shall be placed over the backfill and under the concrete floor slab. The plastic sheets shall be lapped 6 inches at joints and sealed with tape and the sheets shall be turned up the wall at the edges of the slab. Tears caused by sharp stones or placement of reinforcement steel shall be repaired with additional sheets of film taped in place with tape.

- END OF SECTION -

SECTION 07920 - SEALANTS AND CAULKING

PART 1 – GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide caulking, sealing, and appurtenant work, complete and in place, in accordance with the Contract Documents.

1.2 REFERENCE STANDARDS

- A. **General:** Portions of the following standards are incorporated into this Section by references below. The standards are listed here for convenience.

B. Federal Specifications:

TT-S-001543A Sealing Compound, Silicone Rubber Base, (For Caulking, Sealing and Glazing in Buildings and Other Structures)

SS-S-200D Sealants, Joint, Two Compound, Jet Blast Resistant, Cold Applied for Portland Cement Concrete Pavement.

TT-S-00227E Sealing Compound, Elastomeric Type, Multi-Component, (For Caulking, Sealing and Glazing in Buildings and Other Structures)

TT-S-00230C Sealing Compound, Elastomeric Type, Single Component, (For Caulking, Sealing, and Glazing in Buildings and Other Structures)

C. Commercial Standards:

ASTM C 557 Adhesives for Fastening Gypsum Wallboard to Wood Framing

ASTM C 834 Latex Sealing Compounds

ASTM C 919 Practice for Use of Sealants in Acoustical Applications

ASTM C 920 Elastomeric Joint Sealants

ASTM C 1056 Flexible Cellular Material-Sponge or Expanded Rubber

ASTM D 1752 Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

ASTM E 84 Surface Burning Characteristics of Building Materials

ASTM E 814

Methods for Fire Tests of Through Penetrations:
Firestops

UL 1479

Underwriter's Laboratory Standard for Safety Fire
Tests of Through Penetrations Firestops.

1.3 CONTRACTOR SUBMITTALS

- A. **General:** Submittals shall be in accordance with Section 01300 - Contractor Submittals.
- B. **Technical Data:** A complete materials list along with the manufacturer's technical data and literature, specifications, joint width and depth tables, and installation instructions.
- C. **Samples:** Samples (including color samples) of all the caulking and sealant materials and other materials proposed for use on the WORK. The samples shall be clearly marked with the manufacturer's name and product identification.
- D. **Certificates:** If requested by the ENGINEER, certificates from an independent testing laboratory approved by the ENGINEER, certifying that the submitted materials meet all the requirements of the ASTM and Federal Specifications cited.
- E. **Warranty:** A copy of the manufacturer's warranty covering all sealants, caulking materials, and other materials against defects in materials.

PART 2 – PRODUCTS

2.1 SEALANTS AND CAULKING MATERIALS

A. General:

- 1. **Manufacturer's Standards:** In addition to the standards listed below, the sealants and caulking products and application shall be in accordance with the manufacturer's published recommendations and specifications.
- 2. Wherever manufacturer's names and products are listed in this Section, "or equal" products will be considered in accordance with Section 01300 - Contractor Submittals.

B. Materials shall conform to the following requirements:

- 1. **Significant Movement Sealants (plus or minus 25% movement capability)**
 - a. For expansion wall joints; masonry and metal curtainwall joints; precast concrete joints and concrete panels; perimeter sealing (windows, doors, and panels); control joints; interior and non-traffic horizontal joints.
 - 1) Two component, non-sag, polyurethane or polysulfide sealant conforming to Federal Specification TT-S-227E, Class A, Type II, and ASTM C 920, Type M, Class 25, Grade NS.

Products Research & Chemical Corp. "RC-2"
Progress Unlimited "Iso-Flex 2000"

- 2) One component, non-sag, low modulus, polyurethane or polysulfide sealant conforming to Federal Specification TT-S230C, Class A, Type II, and ASTM C 920, Type S, Class 25, Grade NS.

Products Research & Chemical Corp. "RC-1"
Tremco "Dymonic"

- 3) One component, non-sag, medium modulus, neutral cure, silicone sealant conforming to Federal Specification TT-S-1543A, Class A, and ASTM C 920, Type S, Class 25, Grade NS.

Products Research & Chemical Corp. "PRC-4000"
Dow Corning "795"

b. [For horizontal joints exposed to fuel spillage.

- 1) Two component, self-leveling, fuel resistant, polyurethane or polysulfide sealant conforming to Federal Specification SS-S-200D, Type H, and ASTM C 920, Type M, Class 25, Grade P.

Products Research & Chemical Corp. "3105-S"
Pacific Polymere Inc. "ElastoThane 200"

c. For horizontal joints not exposed to fuel spillage.

- 1) Two component, self-leveling, polyurethane or polysulfide sealant conforming to Federal Specification TT-S-227E, Class A, Type I, and ASTM C 920, Type M, Class 25, Grade P.

Products Research & Chemical Corp. "RC-2SL"
Bostic "Chem-Calk 550"

- 2) One component, self-leveling, polyurethane or polysulfide sealant conforming to Federal Specification TT-S-230C, Class A, Type I, and ASTM C 920, Type S, Class 25, Grade P.

Products Research & Chemical Corp. "6006"
Mameco "Vulkem 45"]

2. Glazing Sealants

a. For non-structural applications

- 1) One component non-sag, medium modulus, neutral cure, silicone sealant conforming to Federal Specification TT-S-1543A, Class A, and ASTM C 920, Type S, Class 25, Grade NS.

Products Research & Chemical Corp. "4000"
Dow Corning "795"

- 2) One component, non-sag, high modulus, acetoxycure, silicone sealant conforming to Federal Specification TT-S-1543A, Class A, and ASTM C 920, Type S, Class 25, Grade NS.

3. Interior Sealant and Caulking

- a. For general applications
 - 1) One component, acrylic latex caulking conforming to ASTM C 834
Pecora Corp. "AC-20"
Bostic "Chem-Calk 600"
- b. For non-exposed acoustical applications
 - 1) One component, non-drying, non-hardening, non-shrinking, acoustical caulking conforming to ASTM C 557 and ASTM C 919.
Inmont Company "Prestite 579.64"
Tremco, "Acoustical Sealant"
United States Gypsum, "Acoustical Sealant"
W.W. Henry, "Type 313, Acoustical Sealant"
4. Acoustic Sheet Caulking: For use on all outlet boxes including intercoms, telephone or other services that require penetrations in the walls, acoustic sheet caulking shall be resilient synthetic polymer, self-adhesive, 1/8-inch thick, 6-inch x 8-inch, sheet acoustic sealer. Pads shall be **Lowry's Electrical Box Pads** as manufactured by **Harry A. Lowry & Associates, Inc., 11176 Penrose Street, Sun Valley, CA 91352, (818) 768-4661, (213) 875-0225**; or equal.
5. Firestop Sealant: Where piping, conduit, wire, or other materials pass through fire rated walls, floors, ceilings or roofs, provide a [1] [3]-hour fire rated sealant in accordance with ASTM E 814 and UL 1479. Fire-resistant penetration sealant shall be a medium density fire-resistant foam that retains form and stability at high temperature. Fire-resistant sealant shall be **Dow-Corning Corporation "3-6548 Silicone RTV" foam**; **3M Corporation "Fire Barrier Caulk CP25N, No-sag "**or **"CP25 S/L, Self-Leveling"**, as appropriate for the use intended. Equivalent products of **General Electric** and **Metalines, Inc.** will also be considered.
6. Preformed Sealants: Preformed sealant shall be polybutylene or isoprene-butylene based pressure sensitive weather resistant tape or bead sealant capable of sealing out moisture, air, and dust when installed as recommended by the manufacturer. At temperatures from minus 30 to plus 160 degrees F, the sealant shall be non-bleeding and shall have no loss of adhesion.
7. Tape Sealant: Dimensions shall be as required for application conditions. Tape sealants shall be type recommended by tape manufacturer for connecting and bonding to surfaces.
8. Filler material shall be resilient, closed-cell polyethylene foam conforming to ASTM D 1752, Type II or III, and/or bond breakers of proper size for joint widths. Filler shall be compatible with sealant manufacturer's product and shall not stain the sealant nor the materials to which applied.
9. Primer: Primers shall be as recommended in the manufacturer's printed instructions for caulking and sealants, and shall not stain the sealant nor the materials to which applied. Manufacturer shall be consulted for all surfaces not specifically covered in submittal application instructions. Primer shall be used in accordance with manufacturer's instructions with all primers being applied prior to the installation of any backer rod or bond breaker tape.

10. Cleaning and cleanup solvents, agents, and accessory materials shall be as recommended in the manufacturer's printed instructions for cleaning up.

2.2 COLOR OF SEALANTS

- A. Color of sealants that are visible after installation shall match adjacent building finish. If in doubt of color match, obtain color approval from ENGINEER.

PART 3 – EXECUTION

3.1 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. **Delivery of Materials:** Manufactured materials shall be delivered in original, unbroken packages or containers bearing the manufacturer's label. Packages or containers shall be delivered to the site with seals unbroken.
- B. **Shelf Life:** Materials whose shelf life dates have expired shall not be used in the WORK. Such materials shall be promptly removed from the project site.
- C. **Storage:** All materials shall be carefully stored in accordance with the manufacturer's instructions, in an area that is protected from deleterious elements, and in a manner that will prevent damage to the product. Materials shall be stored at temperatures between 40 and 90 degrees unless otherwise specified by the manufacturer.

3.2 INSTALLATION

- A. **Manufacturer's Recommendations:** All work under this Section and all testing, where applicable, shall be performed in accordance with manufacturer's printed recommendations, specifications, and installation instructions except where more stringent requirements are indicated herein; and, except where project conditions require extra precautions or provisions to assure performance of the waterproofing system.
- B. **Authorized Installers:** Caulking and sealants shall be complete systems and be installed only by installers authorized and approved by the respective manufacturers.
- C. **Surface Preparation**
 1. **General:** The surfaces of joints to be sealed shall be dry. Oil, grease, dirt, chalk, particles of mortar, dust, loose rust, loose mill scale, and other foreign substances shall be removed from surfaces of joints which will be in contact with the sealant. Ferrous metal surfaces shall be cleaned of all rust, mill scale, and other coatings by wire brush, grinding, or sandblasting. Oil and grease shall be removed by cleaning in accordance with sealant manufacturer's printed recommendations. Protective coatings shall be removed from all aluminum surfaces against which caulking or sealing compound is to be placed. Bituminous or resinous materials shall be removed from surfaces to receive caulking or sealants.
 2. **Concrete and Masonry Surfaces:** Where surfaces have been treated with curing compounds, oil, or other such materials, the materials shall be removed by sandblasting or wire brushing. Laitance, efflorescence, and loose mortar shall be removed from the joint cavity.
 3. **Steel Surfaces:** Steel surfaces to be in contact with sealant shall be sandblasted or, if sandblasting would not be practical or would damage adjacent finish work, the

metal shall be scraped and wire brushed to remove loose mill scale. Protective coatings on steel surfaces shall be removed by sandblasting or by a solvent that leaves no residue.

4. **Aluminum Surfaces:** Aluminum surfaces to be in contact with sealants shall be cleaned of temporary protective coatings. When masking tape is used for a protective cover, the tape and any residual adhesive shall be removed just prior to applying the sealant. Solvents used to remove protective coating shall be as recommended by the manufacturer of the aluminum work and shall be non-staining.
5. **Wood Surfaces:** Wood surfaces to be in contact with sealants shall be free of splinters and sawdust or other loose particles.

D. **Joint Types and Sizes:** Joint shapes and sizes shall be as indicated or as necessary for job conditions where not indicated. Joints to be caulked or sealed include through-bolt holes, door frames, louver and ventilator frames, joints between openings where items pass through exterior walls, concrete masonry, or combination of these surfaces, and as otherwise indicated or required for watertightness, weatherproofing, or airtightness. Use sealing compound at both exterior and interior surfaces of exterior wall penetrations.

3.3 SEALANT FILLED JOINTS

- A. **Manufacturer's Representative:** The CONTRACTOR shall furnish the on-site services of the sealant manufacturer's representative prior to sealant work for inspection of the joints to be sealed and for instructing the installer in the proper use of the materials.
- B. **Sealant:** Sealant shall be used before expiration of shelf life. Multi-component sealants shall be mixed according to manufacturer's printed instructions. Sealant in guns shall be applied with a nozzle of proper size to fit the width of joint. Sealant shall be installed to the required depth without displacing the backing. Unless otherwise indicated or recommended by the manufacturer, the installed sealant shall be tooled so that the surface is uniformly smooth and free of wrinkles and to assure full adhesion to the sides of the joint. Sealants shall be installed free of air pockets, foreign embedded matter, ridges, and sags. Sealer shall be applied over the sealant if recommended by the sealant manufacturer.
- C. **Sealant Depth:** Sealant depth in joints shall be 1/2 the width of joint, but not less than 1/8-inch deep and 1/4-inch wide nor more than 1/2-inch deep and 1-inch wide. All joints shall have a rigid filler material installed to proper depth prior to application of sealant.
- D. **Masking Tape:** Masking tape shall be placed on the finish surface on one or both sides of a joint cavity to protect adjacent finish surfaces from primer or sealant smears. Masking tape shall be removed within 10 minutes after joint has been filled and tooled.
- E. **Backing:** Backing shall be installed to provide the indicated sealant depth. The installation tool shall be shaped to avoid puncturing the backing.
- F. **Bond-Breaker:** Bond-breaker shall be applied to fully cover the bottom of the joint without contaminating the sides where sealant adhesion is required.
- G. **Primer:** Primer shall be used on concrete masonry units, wood, or other porous surfaces in accordance with instructions furnished with the sealant. Primer shall be applied to the joint surfaces to be sealed. Surfaces adjacent to joints shall not be primed.

- H. **Applications:** A full bead of sealant shall be applied into the joint under sufficient pressure, with the nozzle drawn across sealant, to completely fill the void space and to ensure complete wetting of contact area to obtain uniform adhesion. During application, the tip of the nozzle shall be kept at the bottom of the joint thereby forcing the sealant to fill from the bottom to the top. Sealants shall be tooled immediately after exposure with a caulking tool or soft bristled brush moistened with solvent. The finished sealant-filled joint shall be slightly concave unless otherwise indicated.
- I. **Acoustic Partition Joints:** Acoustic partition joints shall be made air and sound-tight with acoustic caulking material.
 - 1. Partitions shall be sealed where indicated on the Drawings. Gypsum panels may have joint treatment applied in the normal manner over sealed joints, or panels may be finished with base or trim as required.
 - 2. A 1/4-inch minimum round bead of sealant shall be applied around all cut-outs, such as at electrical boxes and air conditioning ducts, sufficient to seal the openings.

3.4 ACOUSTIC CAULKING

- A. **Preparation:** Joints and surfaces to be sealed shall be clean, dry, and free of loose materials.
- B. **Concealed Joints:** Concealed joints in acoustic partitions including perimeters and intersections of walls and penetrations through finish work and at conduit ends with boxes shall be sealed with acoustic caulking compound. Backs of electrical boxes shall be sealed with acoustic sheet caulking, covering all holes and knock-outs.

3.5 CLEANING

- A. After application of sealant and caulking materials, adjacent materials which have been soiled shall be cleaned and left in a neat, clean, undamaged, or unstained condition. On porous surfaces, excess sealant shall be removed per sealant or caulking manufacturer's printed instructions.

- END OF SECTION -

SECTION 09800 - PROTECTIVE COATING

PART 1 – GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide protective coatings, complete and in place, in accordance with the Contract Documents.
- B. Definitions
 - 1. The term "paint," "coatings," or "finishes" as used herein, shall include surface treatments, emulsions, enamels, paints, epoxy resins, and all other protective coatings, excepting galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat.
 - 2. The term "DFT" means minimum dry film thickness, without any negative tolerance.
- C. The following surfaces shall not be protective coated:
 - 1. Concrete, unless required by items on the concrete coating schedule below or the Drawings.
 - 2. Stainless steel
 - 3. Machined surfaces
 - 4. Grease fittings
 - 5. Glass
 - 6. Equipment nameplates
 - 7. Platform gratings, stair treads, door thresholds, and other walk surfaces, unless specifically indicated to be coated.
- D. The coating system schedules summarize the surfaces to be coated, the required surface preparation, and the coating systems to be applied. Coating notes on the Drawings are used to show or extend the limits of coating schedules, to show exceptions to the schedules, or to clarify or show details for application of the coating systems.

1.2 CONTRACTOR SUBMITTALS

- A. **General:** Submittals shall be furnished in accordance with Section 01300 - Contractor Submittals, unless indicated otherwise below.
- B. Submittals shall include the following information and be submitted at least 30 days prior to protective coating work:
 - 1. Coating Materials List: Eight copies of a coating materials list showing the Manufacturer and the coating number, keyed to the coating systems herein. The list shall be submitted prior to or at the time of submittal of samples.

2. **Paint Manufacturer's Information:** For each coating system to be used, the following data:
 - a. Paint Manufacturer's data sheet for each product proposed, including statements on the suitability of the material for the intended use.
 - b. Technical and performance information that demonstrates compliance with the system performance and material requirements.
 - c. Paint Manufacturer's instructions and recommendations on surface preparation and application.
 - d. Colors available for each product (where applicable).
 - e. Compatibility of shop and field applied coatings (where applicable).
 - f. Material Safety Data Sheet for each product used.

C. Samples

1. Samples of all paint, finishes, and other coating materials shall be submitted on 8-1/2-inch by 11-inch sheet metal. Each sheet shall be completely coated over its entire surface with one protective coating material, type, and color.
2. Two sets of color samples to match each color selected by the ENGINEER from the Manufacturer's standard color sheets. If custom mixed colors are indicated, the color samples shall be made using color formulations prepared to match the color samples furnished by the ENGINEER. The color formula shall be shown on the back of each color sample.
3. One fifteen pound sample of each abrasive proposed to be used for surface preparation for submerged and severe service coating systems.

1.3 SPECIAL CORRECTION OF DEFECTS REQUIREMENTS

- A. Warranty Inspection:** A warranty inspection may be conducted during the eleventh month following completion of all coating and painting work. The CONTRACTOR and a representative of the coating material Manufacturer shall attend this inspection. All defective work shall be repaired in accordance with these specifications and to the satisfaction of the OWNER. The OWNER may, by written notice to the CONTRACTOR, reschedule the warranty inspection to another date within the one-year correction period, or may cancel the warranty inspection altogether. If a warranty inspection is not held, the CONTRACTOR is not relieved of its responsibilities under the Contract Documents.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Suitability:** The CONTRACTOR shall use suitable coating materials as recommended by the Manufacturer.

- B. Compatibility:** In any coating system only compatible materials from a single Manufacturer shall be used in the work. Particular attention shall be directed to compatibility of primers and finish coats. If necessary, a barrier coat shall be applied between existing prime coat and subsequent field coats to ensure compatibility.
- C. Containers:** Coating materials shall be sealed in containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, and name of manufacturer, all of which shall be plainly legible at the time of use.
- D. Colors:** All colors and shades of colors of all coats of paint shall be as indicated or selected by the ENGINEER. Each coat shall be of a slightly different shade, to facilitate inspection of surface coverage of each coat. Finish colors shall be as selected from the manufacturer's standard color samples by the ENGINEER.
- E. Substitute or "Or-Equal" Products.**
1. To establish equality under Section 01600 - Products, Materials, Equipment and Substitutions, the CONTRACTOR shall furnish satisfactory documentation from the manufacturer of the proposed substitute or "or-equal" product that the material meets the indicated requirements and is equivalent or better in the following properties:
 - a. Quality
 - b. Durability
 - c. Resistance to abrasion and physical damage
 - d. Life expectancy
 - e. Ability to recoat in future
 - f. Solids content by volume
 - g. Dry film thickness per coat
 - h. Compatibility with other coatings
 - i. Suitability for the intended service
 - j. Resistance to chemical attack
 - k. Temperature limitations in service and during application
 - l. Type and quality of recommended undercoats and topcoats
 - m. Ease of application
 - n. Ease of repairing damaged areas
 - o. Stability of colors

2. Protective Coating Materials shall be standard products produced by recognized manufacturers who are regularly engaged in production of such materials for essentially identical service conditions. Where requested, the CONTRACTOR shall provide the ENGINEER with the names of not less than 10 successful applications of the proposed manufacturer's products which comply with these requirements.
3. If a proposed substitution requires changes in the WORK, the CONTRACTOR shall bear all such costs involved.

2.2 INDUSTRIAL COATING SYSTEMS

A. **Material Sources:** Each of the following manufacturers is capable of supplying many of the industrial coating materials indicated herein. Where manufacturers and paint numbers are listed, it is to show the type and quality of coatings that are required. Proposed substitute materials will be considered as indicated above. All industrial coating materials shall be materials that have a record of satisfactory performance in industrial plants, manufacturing facilities, and water and wastewater treatment plants.

1. **Ameron**
2. **Carboline Coatings Company**
3. **Inorganic Coatings, Inc.**
4. **International (Courtaulds)**
5. **Tnemec Company**

B. **System 1 - Alkyd Enamel:** High quality, gloss or semi-gloss, medium long oil alkyd finish shall have a minimum solids content of 49 percent by volume. Primer shall be as recommended by manufacturer.

1. Prime coat DFT = 3 mils **Ameron 5105, Tnemec 4-55, or equal.**
2. Finish coats (two or more, DFT = 3 mils), **Ameron 5401 HSA or 5405, Tnemec 2H, or equal.**
3. Total system DFT = 6 mils.

C. **System 2 - Not Used**

D. **System 3 - Aluminum Silicone Resin:** Aluminum silicone resin material shall be suitable for a service temperature of up to 1,000 degrees F, and shall comply with Federal Specification TT-P-28 - Paint, Aluminum, Heat Resisting (1200 degrees F)

1. Prime coat and finish coat (2 or more, DFT = 3 mils), **Tnemec Series 39-1061, Ameron 878, or equal.**
2. Total system DFT = 3 mils.

E. **System 4 - Aliphatic Polyurethane:** Two component aliphatic acrylic polyurethane coating material shall provide superior color and gloss retention, resistance to splash from acid and alkaline chemicals, resistance to chemical fumes and severe weathering and with a minimum solids content of 58 percent by volume. Primer shall be a rust inhibitive two component epoxy coating with a minimum solids content of 68 percent by volume.

1. Prime coat DFT = 4 mils, **Ameron 385, Carboline 893, Tnemec 69, or equal.**
2. Finish coat (one or more, DFT = 3 mils), **Ameron Amershield, Carboline 134 HS, Tnemec 74, or equal.**
3. Total system DFT = 7 mils.
4. More than one finish coat shall be applied as necessary to produce a finish with uniform color and texture.

F. **System 5 - Inorganic Zinc/Polyurethane:** The inorganic zinc primer shall be a water or solvent based, self-curing, zinc silicate two-component inorganic coating which contains at least 85 percent of metallic zinc by weight in the dried film, and is recommended by the coating manufacturer as a primer for this system. The intermediate coat shall be a high-build two component epoxy with a solids content of at least 70 percent by volume. Finish coats shall be a 2-component aliphatic acrylic or polyester polyurethane coating material that provides superior color and gloss retention, resistance to chemical fumes and severe weathering, and a minimum solids content of 58 percent by volume.

1. Prime coat DFT = 3 mils, **Ameron Dimetcote 21-5 or 21-9, Inorganic Coatings 531, or equal.**
2. Intermediate coat DFT = 4 mils, **Ameron 385, Inorganic Coatings P24, or equal.**
3. Finish coats (one or more, DFT = 3 mils), **Ameron Amershield, Inorganic Coatings 64, or equal.**
4. Total system DFT = 10 mils.
5. Intermediate coat shall be applied in excess of 4 mils DFT or in more than one coat as necessary to completely cover the inorganic zinc primer and prevent application bubbling of the polyurethane finish coat.
6. More than one finish coat shall be applied as necessary to produce a finish with uniform color and texture.
7. If the inorganic zinc primer is used as a pre-construction or shop applied primer, all damaged and uncoated areas shall be spot abrasive blasted and coated after construction using the indicated material.

G. **System 6 - Inorganic Zinc, Water Based:** Water based, self curing, zinc silicate coating material shall be a two component inorganic coating material that contains at least 85 percent of metallic zinc by weight in the dried film.

1. Prime coat and finish coat (One, DFT = 3 mils), **Ameron Dimetcote 21-5, Inorganic Coatings 531, or equal.**
 2. Total system DFT = 3 mils.
- H. **System 7 - Acrylic Latex:** Single component, water based acrylic latex with a fungicide additive shall have a minimum solids content of 35 percent by volume. Prime coat shall be as recommended by manufacturer. The coating material shall be available in the ANSI safety colors.
1. Prime coat DFT = 2 mils, as recommended by manufacturer.
 2. Finish coats (2 or more, DFT = 6 mils), **Ameron Amercoat 220, Carboline 3359, Tnemec 6, or equal.**
 3. Total system DFT = 8 mils.
- I. **System 8 - Epoxy, Equipment:** Two component, rust inhibitive polyamide cured epoxy coating material shall provide a recoatable finish that is available in a wide selection of colors. The coating material shall have a minimum solids content of 66 percent by volume and be resistant to service conditions of condensing moisture, splash and spillage of lubricating oils, and frequent washdown and cleaning.
1. Prime coat DFT = 3 mils, **Ameron 385, Tnemec 69, or equal.**
 2. Prime coat, where shop applied. (DFT = 3 mils), universal primer, **Ameron 185 HS, Tnemec 50-330 or 161, or equal.**
 3. Finish coats (2 or more, DFT = 6 mils), **Ameron 385, Tnemec 69, or equal.**
 4. Total system DFT = 9 mils.
- J. **System 9 - Inorganic Zinc/Epoxy, Equipment:** The inorganic zinc primer shall be a water or solvent based, self curing, zinc silicate, two-component inorganic coating that contains at least 85 percent of metallic zinc by weight in the dried film, and is recommended by the coating manufacturer as a primer for this system. The finish coats shall be a polyamide cured epoxy material with a minimum solids content of at least 80 percent by volume, and available in a large selection of colors.
1. Prime coat DFT = 3 mils **Ameron Dimetcote 21-5 or 21-9, Carboline Carbozinc 7 WB, or equal.**
 2. Finish coats (2 or more, DFT = 9 mils) **Ameron 400, Carboline 890, or equal.**
 3. Total system DFT = 12 mils.
- K. **System 10 - Acrylic, Concrete:** The acrylic coating material shall be a single component, industrial grade, high molecular weight, waterborne acrylic material with a solids content of at least 35 percent by volume. The filler-sealer shall be a two component epoxy masonry sealer for wet and exterior exposure, with a solids content of at least 64 percent by volume. A 100 percent solids epoxy surfacer shall be used to fill holes and patch the concrete surface after abrasive blasting.

1. Prime coat (filler-sealer), applied in two coats to the entire surface and worked into the surface with a squeegee to achieve a smooth, void-free surface, **Tnemec 54-660, Ameron Nu-Klad 105A followed by Nu-Klad 114A (2 coats) or equal.**
2. Finish coats (2 or more, DFT = 6 mils), **Tnemec 6, Ameron Amercoat 220, or equal.**

L. **System 11 - Aliphatic Polyurethane, Concrete:** Two component aliphatic polyurethane coating material shall provide superior color and gloss retention, resistance to splash from acid and alkaline chemicals, resistance to chemical fumes and severe weathering, and contain a minimum solids content of 65 percent by volume. Filler-sealer compound shall be a two component epoxy material used to provide a smooth surface for the epoxy intermediate coat. The filler-sealer is applied to the entire concrete surface and worked into the concrete surface with a wide blade putty knife or squeegee. The intermediate coat shall be a high-build epoxy coating with a minimum solids content of 70 percent by volume.

1. Prime coat (Filler-sealer), **Ameron Nu-Klad 105A followed by Nu-Klad 114, Tnemec 54-660, or equal.**
2. Intermediate coat DFT = 4 mils, **Ameron Amerlock 400, Tnemec 104 HS, or equal.**
3. Finish coats (2 or more, DFT = 3 mils), **Ameron Amershield, Tnemec 74, or equal.**

M. **System 12 - Aliphatic Polyurethane, Fiber Glass:** Two-component aliphatic polyurethane coating material shall provide superior color and gloss retention, resistance to splash from acid and alkaline chemicals, and resistance to chemical fumes and severe weathering. A primer, tie coat, or mist coat shall be used as recommended by the manufacturer.

1. Prime coat (Tie coat), **Ameron 385, Tnemec 66, or equal.**
2. Finish coats (2 or more, DFT = 3 mils), **Ameron Amershield, Tnemec 74, or equal.**

2.3 SUBMERGED AND SEVERE SERVICE COATING SYSTEMS

A. **Materials Sources:** The manufacturers' products listed in this paragraph are materials which satisfy the material descriptions of this paragraph and have a documented successful record for long term submerged or severe service conditions. Proposed substitute products will be considered as indicated above.

B. **System 100 - Amine Cured Epoxy:** High build, amine cured, epoxy resin shall have a solids content of at least 80 percent by volume, and shall be suitable for long-term immersion service in potable water and municipal wastewater. For potable water service, the coating material shall be listed by the NSF International as in compliance with NSF Standard 61 - Drinking Water System Components - Health Effects.

1. Prime coat and finish coats (3 or more, DFT = 16 mils), **Ameron 395, Tnemec 139, or equal.**
2. For coating of valves and non-submerged equipment, DFT = 12 mils.

C. **System 101 – Not Used**

D. **System 102 - Polyamide Cured Epoxy:** High build, polyamide epoxy resin shall have a solids content of at least 56 percent by volume, and shall be suitable for long-term immersion in potable water and municipal wastewater. For potable water service, the coating material shall be listed by the NSF International as in compliance with NSF Standard 61.

1. Prime coat and finish coats (3 or more, DFT = 12 mils), **Tnemec 20, or equal.**

E. **System 103 - Not Used**

F. **System 104 - Not Used**

G. **System 105 – Not Used**

H. **System 106 - Fusion Bonded Epoxy:** The coating material shall be a 100 percent powder epoxy, certified as compliant with NSF Standard 61, applied in accordance with the ANSI/AWWA C213 - Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines, except that the surface preparation shall be as specified in the coating system schedule of this Section. The coating shall be applied using the fluidized bed or electrostatic spray process.

1. Coating DFT = 16 mils, **Scotchkote 134 or 206N, or equal.**
2. For coating of valves, DFT - 12 mils.
3. Liquid Epoxy: For field repairs, the use of a liquid epoxy will be permitted, applied in not less than 3 coats to provide a DFT of 15 mils. The liquid epoxy shall be a 100 percent solids epoxy recommended by the powder epoxy manufacturer.

I. **System 107 – Not Used**

J. **System 108 - Epoxy, Concrete:** The coating material shall be an amino cured epoxy material suitable for long-term immersion in water and wastewater and for service where subjected to occasional splash and spillage of water and wastewater treatment chemicals. The finish coating material shall have a minimum solids content of 80 percent by volume. If used for potable water service the finish coating material shall be listed by the NSF International as in compliance with NSF Standard 61, and shall conform with state and local health regulations and policies for service in potable water. The filler-sealer shall be a 100 percent solids amine-cured epoxy material with silica and inert fillers. A 100 percent solids epoxy surfacer shall be used to fill holes and patch the concrete surface after abrasive blasting.

1. Filler-sealer: **Plasite 9029** (applied by squeegee); **Tnemec 69-1211** (6-8 mils) followed by **Tnemec 63-1500**; **Ameron Nu-Klad 105A** followed by **Nu-Klad 114A (two coats)** or equal.
2. Finish coats (2 or more, DFT = 12 mils): **Plasite 9133**; **Tnemec 69**; **Ameron Amercoat 395, or equal.** On walking surfaces use a non-skid additive such as **Ameron 886** in the final coat.

- K. **System 109 - Not Used**
- L. **System 110 - Not Used**
- M. **System 111 - Not Used**
- N. **System 112 - Not Used**

2.4 SPECIAL COATING SYSTEMS

- A. **System 200 - PVC Tape:** Prior to wrapping the pipe with PVC tape, the pipe and fittings first shall be primed using a primer recommended by the PVC tape manufacturer. After being primed, the pipe shall be wrapped with a 20-mil adhesive PVC tape, half-lapped, to a total thickness of 40 mils.
- B. **System 201 - Rich Portland Cement Mortar:** Rich portland cement mortar coating shall have a minimum thickness of 1/8-inch, followed by enclosure in an 8-mil thick polyethylene sheet with all joints and edges lapped and sealed with tape.
- C. **System 203 - Epoxy Surfacing:** Two-component epoxy floor surfacing shall be formulated to resist many acids, alkalis, and solvents. Material shall be resistant to liquid alum, sodium hydroxide, and 50 percent sulfuric acid. Products shall be as follows, or equal:
 - 1. Prime coat **Nu-Klad 105**; finish coat **Nu-Klad 110** (1/4-inch thick), or equal.
- D. **System 204 - Water-Retardant:**
 - 1. Two coats (or single coat if manufacturer recommends in writing) of a clear, non-staining, silane-modified-siloxane masonry water-retardant material. The water-retardant system after application shall be provided with not less than a five-year warranty on the performance of the product.
 - 2. Surfaces shall be cleaned with a chemical cleaner approved by the manufacturer and power wash. Surfaces shall be clean and dry before application of the material. Method and rate of application shall be in accordance with manufacturer's published instructions. A manufacturer's representative shall be present during applications if necessary for warranty.
 - 3. **TAMMS Barricade Series, Rainguard "Blok-Lok"; or equal.**
- E. **System 205 - Polyethylene Encasement:** Application of polyethylene encasement shall be in accordance with ANSI/AWWA C105 using Method C.
- F. **System 206 - Cement Mortar Coating:** A 1-1/2-inch minimum thickness mortar coating reinforced with 3/4-inch galvanized welded wire fabric shall be provided. The cement mortar shall contain no less than one part Type V cement to 3 parts sand. The cement mortar shall be cured by a curing compound meeting the requirements of "Liquid Membrane Forming Compounds for Curing Concrete," ASTM C 309, Type II, white pigmented, or by enclosure in an 8-mil thick polyethylene sheet with all edges and joints lapped by at least 6 inches.

G. **System 207 - Not Used**

H. **System 208 - Aluminum Metal Isolation:** Two coats of a high build polyamide epoxy paint, such as **Tnemec 66**, or **equal** (8 mils). Total thickness of system DFT = 8.0 mils.

I. **System 209 – Not Used**

J. **System 210 – Not Used**

K. **System 211 – Not Used**

PART 3 – EXECUTION

3.1 MANUFACTURER'S SERVICES

A. The CONTRACTOR shall require the protective coating manufacturer to furnish a qualified technical representative to visit the project site for technical support as may be necessary to resolve field problems attributable or associated with the manufacturer's products.

3.2 WORKMANSHIP

A. Skilled craftsmen and experienced supervision shall be used on all WORK.

B. Coating shall be done in a workmanlike manner so as to produce an even film of uniform thickness. Edges, corners, crevices, and joints shall receive special attention to insure thorough cleaning and an adequate thickness of coating material. The finished surfaces shall be free from runs, drops, ridges, waves, laps, brush marks, and variations in color, texture, and finish. The hiding shall be so complete that the addition of another coat would not increase the hiding. Special attention shall be given to insure that edges, corners, crevices, welds, and similar areas receive a film thickness equivalent to adjacent areas, and installations shall be protected by the use of drop cloths or other precautionary measures.

C. All damage to surfaces resulting from the WORK shall be cleaned, repaired, and refinished to original condition.

3.3 STORAGE, MIXING, AND THINNING OF MATERIALS

A. **Manufacturer's Recommendations:** Unless otherwise indicated, the coating manufacturer's printed recommendations and instructions for thinning, mixing, handling, applying, and protecting its coating materials, for preparation of surfaces for coating, and for all other procedures relative to coating shall be strictly observed.

B. All protective coating materials shall be used within the manufacturer's recommended shelf life.

C. **Storage and Mixing:** Coating materials shall be stored under the conditions recommended by the Material Safety Data Sheets, and shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings of different manufacturers shall not be mixed together.

3.4 PREPARATION FOR COATING

- A. **General:** All surfaces to receive protective coatings shall be cleaned as indicated prior to application of coatings. The CONTRACTOR shall examine all surfaces to be coated, and shall correct all surface defects before application of any coating material. All marred or abraded spots on shop-primed and on factory-finished surfaces shall receive touch-up restoration prior to any coating application. Surfaces to be coated shall be dry and free of visible dust.
- B. **Protection of Surfaces Not to be Coated:** Surfaces which are not to receive protective coatings shall be protected during surface preparation, cleaning, and coating operations.
- C. All hardware, lighting fixtures, switchplates, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not to be painted shall be removed, masked or otherwise protected. Drop cloths shall be provided to prevent coating materials from falling on or marring adjacent surfaces. The working parts of all mechanical and electrical equipment shall be protected from damage during surface preparation and coating operations. Openings in motors shall be masked to prevent entry of coating or other materials.
- D. Care shall be exercised not to damage adjacent work during blast cleaning operations. Spray painting shall be conducted under carefully controlled conditions. The CONTRACTOR shall be fully responsible for and shall promptly repair any and all damage to adjacent work or adjoining property occurring from blast cleaning or coating operations.
- E. **Protection of Painted Surfaces:** Cleaning and coating shall be coordinated so that dust and other contaminants from the cleaning process will not fall on wet, newly-coated surfaces.

3.5 SURFACE PREPARATION STANDARDS

- A. The following referenced surface preparation specifications of the Steel Structures Painting Council shall form a part of this specification:
 - 1. Solvent Cleaning (SSPC-SP1): Removal of oil, grease, soil, salts, and other soluble contaminants by cleaning with solvent, vapor, alkali, emulsion, or steam.
 - 2. Hand Tool Cleaning (SSPC-SP2): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by hand chipping, scraping, sanding, and wire brushing.
 - 3. Power Tool Cleaning (SSPC-SP3): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by power tool chipping, descaling, sanding, wire brushing, and grinding.
 - 4. White Metal Blast Cleaning (SSPC-SP5): Removal of all visible rust, oil, grease, soil, dust, mill scale, paint, oxides, corrosion products and foreign matter by blast cleaning.
 - 5. Commercial Blast Cleaning (SSPC-SP6): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 33 percent of each square inch of surface area.

6. Brush-Off Blast Cleaning (SSPC-SP7): Removal of all visible oil, grease, soil, dust, loose mill scale, loose rust, and loose paint.
7. Near-White Blast Cleaning (SSPC-SP10): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 5 percent of each square inch of surface area.

3.6 METAL SURFACE PREPARATION (UN GALVANIZED)

- A. The minimum abrasive blasting surface preparation shall be as indicated in the coating system schedules included at the end of this Section. Where there is a conflict between these specifications and the coating manufacturer's printed recommendations for the intended service, the higher degree of cleaning shall apply.
- B. Workmanship for metal surface preparation shall be in conformance with the current SSPC Standards and this Section. Blast cleaned surfaces shall match the standard samples available from the National Association of Corrosion Engineers, NACE Standard TM-01-70 - Visual Standard for Surfaces of New Steel Airblast Cleaned with Sand Abrasive and TM-01-75 - Visual Standard for Surfaces of New Steel Centrifugally Blast Cleaned with Steel Grit.
- C. All oil, grease, welding fluxes, and other surface contaminants shall be removed by solvent cleaning per SSPC-SP1 - Solvent Cleaning prior to blast cleaning.
- D. All sharp edges shall be rounded or chamfered and all burrs, and surface defects and weld splatter shall be ground smooth prior to blast cleaning.
- E. The type and size of abrasive shall be selected to produce a surface profile that meets the coating manufacturer's recommendation for the particular coating and service conditions. Abrasives for submerged and severe service coating systems shall be clean, hard, sharp cutting crushed slag. Automated blasting systems shall not be used for surfaces that will be in submerged service. Metal shot or grit shall not be used for surfaces that will be in submerged service, even if subsequent abrasive blasting is planned to be one with hard, sharp cutting crushed slag.
- F. The abrasive shall not be reused unless an automated blasting system is used for surfaces that will be in non-submerged service. For automated blasting systems, clean oil-free abrasives shall be maintained. The abrasive mix shall include at least 50 percent grit.
- G. The CONTRACTOR shall comply with the applicable federal, state, and local air pollution control regulations for blast cleaning.
- H. Compressed air for air blast cleaning shall be supplied at adequate pressure from well maintained compressors equipped with oil and moisture separators which remove at least 95 percent of the contaminants.
- I. Surfaces shall be cleaned of all dust and residual particles of the cleaning operation by dry air blast cleaning, vacuuming, or another approved method prior to painting.
- J. Enclosed areas and other areas where dust settling is a problem shall be vacuum cleaned and wiped with a tack cloth.

- K. Damaged or defective coating shall be removed by the specified blast cleaning to meet the clean surface requirements before recoating.
- L. If the specified abrasive blast cleaning will damage adjacent work, the area to be cleaned is less than 100 square feet, and the coated surface will not be submerged in service, then SSPC-SP2 or SSPC-SP3 be used.
- M. Shop applied coatings of unknown composition shall be completely removed before the indicated coatings are applied. Valves, castings, ductile or cast iron pipe, and fabricated pipe or equipment shall be examined for the presence of shop-applied temporary coatings. Temporary coatings shall be completely removed by solvent cleaning per SSPC-SP1 before the abrasive blast cleaning work has been started.
- N. Shop primed equipment shall be solvent cleaned in the field before finish coats are applied.

3.7 SURFACE PREPARATION FOR GALVANIZED FERROUS METAL

- A. Galvanized ferrous metal shall be alkaline cleaned per SSPC-SP1 to remove oil, grease, and other contaminants detrimental to adhesion of the protective coating system to be used, followed by brush off blast cleaning per SSPC-SP7.
- B. Pretreatment coatings of surfaces shall be in accordance with the printed recommendations of the coating manufacturer.

3.8 SURFACE PREPARATION OF FERROUS SURFACES WITH EXISTING COATINGS, EXCLUDING STEEL RESERVOIR INTERIORS

- A. **General:** All grease, oil, heavy chalk, dirt, or other contaminants shall be removed by solvent or detergent cleaning prior to abrasive blast cleaning. The generic type of the existing coatings shall be determined by laboratory testing.
- B. **Abrasive Blast Cleaning:** The CONTRACTOR shall provide the degree of cleaning specified in the coating system schedule for the entire surface to be coated. If the degree of cleaning is not indicated in the schedule, deteriorated coatings shall be removed by abrasive blast cleaning to SSPC-SP6. Areas of tightly adhering coatings shall be cleaned to SSPC-SP7, with the remaining thickness of existing coating not to exceed 3 mils.
- C. **Incompatible Coatings:** If coatings to be applied are not compatible with existing coatings the CONTRACTOR shall apply intermediate coatings per the paint manufacturer's recommendation for the indicated coating system or shall completely remove the existing coating prior to abrasive blast cleaning. A small trial application shall be conducted for compatibility prior to painting large areas.
- D. **Unknown Coatings:** Coatings of unknown composition shall be completely removed prior to application of new coatings.
- E. **Water Abrasive or Wet Abrasive Blast Cleaning:** Where specified or where job site conditions do not permit dry abrasive blasting for industrial coating systems due to dust or air pollution considerations, water abrasive blasting or wet abrasive blasting may be used. In both methods, paint-compatible corrosion inhibitors shall be used, and coating application shall begin as soon as the surfaces are dry. Water abrasive blasting shall be done using high pressure water with sand injection. In both methods, the equipment used

shall be commercially produced equipment with a successful service record. Wet blasting methods shall not be used for submerged and severe service coating systems unless indicated.

3.9 CONCRETE AND CONCRETE BLOCK MASONRY SURFACE PREPARATION

- A. Surface preparation shall not begin until at least 30 days after the concrete or masonry has been placed.
- B. All oil, grease, and form release and curing compounds shall be removed by detergent cleaning per SSPC-SP1 before abrasive blast cleaning.
- C. Concrete, concrete block masonry surfaces and deteriorated concrete surfaces to be coated shall be abrasive blast cleaned to remove existing coatings, laitance, deteriorated concrete, and to roughen the surface equivalent to the surface of the No. 80 grit flint sandpaper.
- D. If acid etching is required by the coating application instructions, the treatment shall be made after abrasive blasting. After etching, rinse surfaces with water and test the pH. The pH shall be between neutral and 8.
- E. Surfaces shall be clean and as recommended by the coating manufacturer before coating is started.
- F. Unless required for proper adhesion, surfaces shall be dry prior to coating. The presence of moisture shall be determined with a moisture detection device such as **Delmhorst Model DB, or equal**.

3.10 PLASTIC, FIBER GLASS AND NONFERROUS METALS SURFACE PREPARATION

- A. Plastic and fiber glass surfaces shall be sanded or brush off blast cleaned prior to solvent cleaning with a chemical compatible with the coating system primer.
- B. Non-ferrous metal surfaces shall be solvent-cleaned SSPC-SP1 followed by sanding or brush-off blast cleaning SSPC-SP7.
- C. All surfaces shall be clean and dry prior to coating application.

3.11 SHOP COATING REQUIREMENTS

- A. Unless otherwise indicated, all items of equipment, or parts of equipment which are not submerged in service, shall be shop primed and then finish coated in the field after installation with the indicated or selected color. The methods, materials, application equipment and all other details of shop painting shall comply with this section. If the shop primer requires topcoating within a specified period of time, the equipment shall be finish coated in the shop and then touch-up painted after installation.
- B. All items of equipment, or parts and surfaces of equipment which are submerged or inside an enclosed hydraulic structure when in service, with the exception of pumps and valves, shall have all surface preparation and coating work performed in the field.
- C. The interior surfaces of steel water reservoirs, except for Part A surfaces, shall have all surface preparation and coating work performed in the field.

- D. For certain pieces of equipment it may be undesirable or impractical to apply finish coatings in the field. Such equipment may include engine generator sets, equipment such as electrical control panels, switchgear or main control boards, submerged parts of pumps, ferrous metal passages in valves, or other items where it is not possible to obtain the indicated quality in the field. Such equipment shall be primed and finish coated in the shop and touched up in the field with the identical material after installation. The CONTRACTOR shall require the manufacturer of each such piece of equipment to certify as part of its shop drawings that the surface preparation is in accordance with these specifications. The coating material data sheet shall be submitted with the shop drawings for the equipment.
- E. For certain small pieces of equipment the manufacturer may have a standard coating system which is suitable for the intended service conditions. In such cases, the final determination of suitability will be made during review of the shop drawing submittals. Equipment of this type generally includes only indoor equipment such as instruments, small compressors, and chemical metering pumps.
- F. Shop painted surfaces shall be protected during shipment and handling by suitable provisions including padding, blocking, and the use of canvas or nylon slings. Primed surfaces shall not be exposed to the weather for more than 2 months before being topcoated, or less time if recommended by the coating manufacturer.
- G. Damage to shop-applied coatings shall be repaired in accordance with this Section and the coating manufacturer's printed instructions.
- H. The CONTRACTOR shall make certain that the shop primers and field topcoats are compatible and meet the requirements of this Section. Copies of applicable coating manufacturer's data sheets shall be submitted with equipment shop drawings.

3.12 APPLICATION OF COATINGS

- A. The application of protective coatings to steel substrates shall be in accordance with SSPC-PA1 - Paint Application Specification No. 1.
- B. Cleaned surfaces and all coats shall be inspected prior to each succeeding coat. The CONTRACTOR shall schedule such inspection with the ENGINEER in advance.
- C. Blast cleaned ferrous metal surfaces shall be painted before any rusting or other deterioration of the surface occurs. Blast cleaning shall be limited to only those surfaces that can be coated in the same working day.
- D. Coatings shall be applied in accordance with the manufacturer's instructions and recommendations, and this Section, whichever has the most stringent requirements.
- E. Special attention shall be given to edges, angles, weld seams, flanges, nuts and bolts, and other places where insufficient film thicknesses are likely to be present. Use stripe painting for these areas.
- F. Special attention shall be given to materials which will be joined so closely that proper surface preparation and application are not possible. Such contact surfaces shall be coated prior to assembly or installation.

- G. Finish coats, including touch-up and damage repair coats shall be applied in a manner which will present a uniform texture and color matched appearance.
- H. Coatings shall not be applied under the following conditions:
 - 1. Temperature exceeding the manufacturer's recommended maximum and minimum allowable.
 - 2. Dust or smoke laden atmosphere.
 - 3. Damp or humid weather.
 - 4. When the substrate or air temperature is less than 5 degrees F above dewpoint.
 - 5. When air temperature is expected to drop below 40 degrees F or less than 5 degrees F above the dewpoint within 8 hours after application of coating.
 - 6. When wind conditions are not calm.
- I. Dewpoint shall be determined by use of a sling psychrometer in conjunction with U.S. Dept. of Commerce, Weather Bureau psychrometric tables.
- J. Unburied steel piping shall be abrasive blast cleaned and primed before installation.
- K. The finish coat on all work shall be applied after all concrete, masonry, and equipment installation is complete and the work areas are clean and dust free.
- L. No smoking or eating shall be permitted during the coating application.

3.13 CURING OF COATINGS

- A. The CONTRACTOR shall maintain curing conditions in accordance with the conditions recommended by the coating material manufacturer or by this Section, whichever is the most stringent, prior to placing the completed coating system into service.
- B. In the case of enclosed areas, forced air ventilation, using heated air if necessary, may be required until the coatings have fully cured.
- C. **Forced Air Ventilation of Steel Reservoirs and Enclosed Hydraulic Structures:** Forced air ventilation is required for the application and curing of coatings on the interior surfaces of steel reservoirs and enclosed hydraulic structures. During application and curing periods, continuously exhaust air from a manhole in the lowest shell ring, or in the case of an enclosed hydraulic structure, from the lowest level of the structure using portable ducting. After all interior coating operations have been completed, provide a final curing period for a minimum of 10 days, during which the forced ventilation system shall operate continuously. For additional requirements, refer to the specific coating system requirements in Part 2 above.

3.14 IDENTIFICATION OF PIPING

- A. Identification of piping shall be in accordance with Section 15005 - Piping Identification Systems.

3.15 SHOP AND FIELD INSPECTION AND TESTING

- A. General: The CONTRACTOR shall give the ENGINEER a minimum of 3 days advance notice of the start of any field surface preparation work or coating application work, and a minimum of 7 days advance notice of the start of any shop surface preparation work.
- B. All such work shall be performed only in the presence of the ENGINEER, unless the ENGINEER has granted prior approval to perform such work in its absence.
- C. Inspection by the ENGINEER, or the waiver of inspection of any particular portion of the WORK, shall not relieve the CONTRACTOR of its responsibility to perform the work in accordance with these Specifications.
- D. Scaffolding shall be erected and moved to locations where requested by the ENGINEER to facilitate inspection. Additional illumination shall be furnished to cover all areas to be inspected.
- E. **Inspection Devices:** The CONTRACTOR shall furnish, until final acceptance of such coatings, inspection devices in good working condition for the detection of holidays and measurement of dry-film thicknesses of protective coatings. Dry-film thickness gages shall be made available for the ENGINEER'S use at all times while coating is being done, until final acceptance of such coatings. The CONTRACTOR shall furnish the services of a trained operator of the holiday detection devices until the final acceptance of such coatings. Holiday detection devices shall be operated only in the presence of the ENGINEER.
- F. **Holiday Testing:** The CONTRACTOR shall holiday test all coated ferrous surfaces inside a steel reservoir, other surfaces which will be submerged in water or other liquids, or surfaces which are enclosed in a vapor space in such structures and surfaces coated with any of the submerged and severe service coating systems. Areas which contain holidays shall be marked and repaired or recoated in accordance with the coating manufacturer's printed instructions and then retested.
 - 1. Coatings With Thickness Exceeding 20 Mils: For surfaces having a total dry film coating thickness exceeding 20 mils: pulse-type holiday detector such as **Tinker & Razor Model AP-W, D.E. Stearns Co. Model 14/20, or equal** shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the specified coating thickness.
 - 2. Coatings With Thickness of 20 Mils or Less: For surfaces having a total dry film coating thickness of 20 mils or less: **Tinker & Razor Model M1 non-destructive type holiday detector, K-D Bird Dog, or equal** shall be used. The unit shall operate at less than 75-volts. For thicknesses between 10 and 20 mils, a non-sudsing type wetting agent, such as **Kodak Photo-Flo, or equal**, shall be added to the water prior to wetting the detector sponge.
- G. **Film Thickness Testing:** On ferrous metals, the dry film coating thickness shall be measured in accordance with the SSPC "Paint Application Specification No. 2" using a magnetic-type dry film thickness gage such as **Mikrotest model FM, Elcometer model 111/1EZ, or equal**. Each coat shall be tested for the correct thickness. No measurements shall be made until at least 8 hours after application of the coating. On non-ferrous metals and other substrates, the coating thicknesses shall be measured at the time of application using a wet film gage.

H. **Surface Preparation:** Evaluation of blast cleaned surface preparation work will be based upon comparison of the blasted surfaces with the standard samples available from the NACE, using NACE standards TM-01-70 and TM-01-75.

3.16 COATING SYSTEM SCHEDULES - FERROUS METALS

A. Coating System Schedule, Ferrous Metal - Not Galvanized:

	Item	Surface Prep.	System No.
FM-1	All surfaces indoors and outdoors, exposed or covered, except those included below.	Commercial blast cleaning SSPC-SP6	(4) aliphatic polyurethane
FM-2	Surfaces of equipment and ferrous surfaces submerged or intermittently submerged in potable water, utility water, and wastewater including all surfaces lower than 2 feet above high water level in hydraulic structures, and all surfaces inside enclosed hydraulic structures and vents (excluding shop-coated valves, couplings, pumps).	White metal blast cleaning SSPC-SP5	(100) amine-cured epoxy
FM-3	Buried small steel pipe.	Removal of dirt, grease, oil	(200) PVC tape
FM-4	Where indicated, ferrous surfaces in water passages of all valves 4-inch size and larger, exterior surfaces of submerged valves.	White metal blast cleaning SSPC-SP5	(102) polyamide-cured epoxy
FM-5	Where indicated, ferrous surfaces in water passages and submerged surfaces of all pumps which have discharge size of 4 inches or larger.	White metal blast cleaning SSPC-SP5	(100) amine-cured epoxy
FM-6	Ferrous surfaces of sleeve-couplings.	Solvent cleaning SSPC-SP1, followed by white metal blast cleaning SSPC-SP10	(106) fusion-bonded epoxy

FM-7	Buried surfaces that are not indicated to be coated elsewhere.	Near white metal blast cleaning SSPC-SP10	(100) amine-cured epoxy
FM-8	Surfaces of indoor equipment, not submerged	Commercial blast cleaning SSPC-SP6	(8) epoxy, equipment
FM-10	Buried pipe couplings, valves, and flanged joints (where piping is mortar-coated steel or reinforced concrete), including epoxy-coated surfaces.	Removal of dirt, grease, oil	(206) cement-mortar coating

B. **Coating System Schedule, Ferrous Metal - Galvanized:** Pretreatment coatings, barrier coatings, or washes shall be applied as recommended by the coating manufacturer. All galvanized surfaces shall be coated except for the following items which shall be coated only if required by other Sections: (1) Floor gratings and frames, (2) Handrails, (3) Stair treads, (4) Chain link fencing and appurtenances.

	Item	Surface Prep.	System No.
FMG-1	All exposed surfaces indoors and outdoors, except those included below.	Solvent cleaning SSPC-SP1	(4) aliphatic polyurethane
FMG-2	Buried small steel pipe.	Removal of dirt, grease, oil	(200) PVC tape
FMG-3	Surfaces buried or submerged in water or wastewater, including all surfaces lower than two feet above high water level and all surfaces inside enclosed hydraulic structures and vents.	Solvent cleaning SSPC-SP1 followed by brush-off grade blast cleaning SSPC-SP7	(100) amine-cured epoxy

3.17 COATING SYSTEM SCHEDULE, NON-FERROUS METAL, PLASTIC, FIBER GLASS

A. Where isolated non-ferrous parts are associated with equipment or piping, the CONTRACTOR shall use the coating system for the adjacent connected surfaces. Do not coat handrails, gratings, frames or hatches. Only primers recommended by the coating manufacturer shall be used.

	Item	Surface Prep.	System No.
NFM-1	All exposed surfaces, indoors and outdoors, except those included below.	Solvent cleaned SSPC-SP1	(4) aliphatic polyurethane
NFM-2	Aluminum surfaces in contact with concrete, or with any other metal except galvanized ferrous metal.	Solvent cleaned SSPC-SP1	(208) aluminum metal isolation
NFM-3	Polyvinyl chloride plastic piping, indoors and outdoors, or in structures, not submerged.	Solvent cleaned SSPC-SP1	(7) acrylic latex
NFM-4	Buried non-ferrous metal pipe.	Removal of dirt, grease, oil	(200) PVC tape

3.11 COATING SYSTEM SCHEDULE-CONCRETE

	Item	Surface Prep.	System No.
C-1	All surfaces indoors and outdoors, where indicated.	Per paragraph 3.9	(11) aliphatic polyurethane, concrete
C-2	Submerged in water or wastewater including surfaces up to 2 feet above high water line and down to 2 feet below low water line and all surfaces in an enclosed structure.	Per paragraph 3.9	(108) epoxy, concrete

- END OF SECTION -

SECTION 11000 - EQUIPMENT GENERAL PROVISIONS

PART 1 – GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all equipment and appurtenant work, complete and operable, in accordance with the Contract Documents.
- B. The provisions of this Section shall apply to all equipment except where otherwise indicated.
- C. **Equipment Arrangement:** Unless specifically indicated otherwise, the arrangement of equipment shown on the Drawings is based upon information available at the time of design and is not intended to show exact dimensions particular to a specific manufacturer in all cases. Some aspects of the Drawings are diagrammatic and some features of the illustrated equipment arrangement may require revision to meet the actual equipment requirements. Structural supports, foundations, piping and valve connections, and electrical and instrumentation connections indicated may have to be altered to accommodate the equipment provided. No additional payment will be made for such revisions and alterations. Substantiating calculations and drawings shall be submitted prior to beginning the installation of equipment.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Equipment shall be in accordance with the following standards, as applicable and as indicated in each equipment specification:
 - 1. American Society for Testing and Materials (ASTM).
 - 2. American National Standards Institute (ANSI)
 - 3. American Society of Mechanical Engineers (ASME).
 - 4. American Water Works Association (AWWA).
 - 5. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE).
 - 6. American Welding Society (AWS).
 - 7. National Fire Protection Association (NFPA).
 - 8. Federal Specifications (FS).
 - 9. National Electrical Manufacturers Association (NEMA).
 - 10. Manufacturer's published recommendations and specifications.
 - 11. General Industry Safety Orders (OSHA).

B. The following standards are referenced in this Section:

ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800
ANSI B16.5	Pipe Flanges and Flanged Fittings, Steel, Nickel Alloy and other Special Alloys
ANSI B46.1	Surface Texture
ANSI S12.6	Method for the Measurement of the Real-Ear Attenuation of Hearing Protectors
ASME B1.20.1	General Purpose Pipe Threads (Inch)
ASME B31.1	Power Piping
AWWA C206	Field Welding of Steel Water Pipe
AWWA C207	Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In. (100 mm through 3,600 mm)
AWWA D100	Welded Steel Tanks for Water Storage
ASTM A 48	Gray Iron Castings
ASTM A 108	Steel Bars, Carbon, Cold-Finished, Standard Quality

1.3 CONTRACTOR SUBMITTALS

- A. **General:** Furnish submittals in accordance with Section 01300 - Contractor Submittals.
- B. **Shop Drawings:** Furnish complete drawings and technical information for equipment, piping, valves, and controls. Where indicated or required by the ENGINEER, Shop Drawings shall include clear, concise calculations showing equipment anchorage forces and the capacities of the anchorage elements proposed by the CONTRACTOR.
- C. **Spare Parts List:** The CONTRACTOR shall obtain from the manufacturer and submit at the same time as Shop Drawings a list of suggested spare parts for each piece of equipment. CONTRACTOR shall also furnish the name, address, and telephone number of the nearest distributor for each piece of equipment.
- D. **Torsion and Vibration Analyses:**
1. The CONTRACTOR shall arrange for and submit torsional and lateral vibration analyses for the following equipment types:
 - a. Engine drives except engine generators
 - b. Pumps, blowers, and compressors with variable speed drives of 500 horsepower and greater.
 - c. Pumps, blowers and compressors with variable speed drives of 100

horsepower and greater.

- d. Vertical pumps with universal joints and extended shafts.
 - e. Other equipment as indicated.
2. An experienced specialist from the equipment manufacturer shall perform a complete torsional and lateral vibration analysis of each distinct equipment, motor, and variable speed drive. These analyses shall identify the dry and wet lateral critical speeds plus the torsional critical speeds of the system. Appropriate lateral and critical speed maps shall be produced and submitted.
 3. No active critical speed shall be allowed within 25 percent of the operating speed range. No fabrication of the equipment shall be started until the analyses have been approved by the ENGINEER.

1.4 QUALITY ASSURANCE

- A. **Costs:** Responsibility shall be the CONTRACTOR's for performing and paying the costs of inspection, startup, testing, adjustment, and instruction services performed by factory representatives. The CONTRACTOR shall pay for costs of power and water. If available, the OWNER'S operating personnel will provide assistance in the field testing.
- B. **Inspection:** The CONTRACTOR shall inform the local authorities, such as building and plumbing inspectors, fire marshall, OSHA inspectors, and others, to witness all required tests for piping, plumbing, fire protection systems, pressure vessels, safety systems, and related items to obtain all required permits and certificates, and shall pay all inspection fees.
- C. **Quality and Tolerances:** Tolerances and clearances shall be as shown on the Shop Drawings and shall be closely adhered to.
 1. Machine work shall in all cases be of high-grade workmanship and finish, with due consideration to the special nature or function of the parts. Members without milled ends and which are to be framed to other steel parts of the structure may have a variation in the detailed length of not greater than 1/16-inch for members 30 feet or less in length, and not greater than 1/8-inch for members over 30 feet in length.
 2. Castings shall be homogeneous and free from non-metallic inclusions and defects. Surfaces of castings which are not machined shall be cleaned to remove foundry irregularities. Casting defects not exceeding 12.5 percent of the total thickness and where defects will not affect the strength and serviceability of the casting may be repaired by approved welding procedures. The ENGINEER shall be notified of larger defects. No repair welding of such defects shall be carried out without the ENGINEER'S written approval. If the removal of metal for repair reduces the stress resisting cross-section of the casting by more than 25 percent or to such an extent that the computed stress in the remaining metal exceeds the allowable stress by more than 25 percent, then the casting may be rejected. Costs of casting new material shall be the CONTRACTOR'S responsibility.
 3. All materials shall meet the physical and mechanical properties in accordance with the reference standards.

- D. **Machine Finish:** The type of finish shall be the most suitable for the application and shall be shown in micro-inches in accordance with ANSI B46.1. The following finishes shall be used:
1. Surface roughness not greater than 63 micro-inches shall be required for all surfaces in sliding contact.
 2. Surface roughness not greater than 250 micro-inches shall be required for surfaces in contact where a tight joint is not required.
 3. Rough finish not greater than 500 micro-inches shall be required for other machined surfaces.
 4. Contact surfaces of shafts and stems which pass through stuffing boxes and contact surfaces of bearings shall be finished to not greater than 32 micro-inches.
- E. **Manufacturer's Experience:** Equipment manufacturer shall have a record of at least 5 years of successful, troublefree operation in similar applications and size equal or larger than the equipment in this contract.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. **Noise Level:** When in operation, no single piece of equipment shall exceed the OSHA noise level requirement of 105 dBA for one hour exposure per day.
- B. **High Noise Level Location:** The CONTRACTOR shall provide one personal hearing protection station at each high noise level location. Locations are defined as follows:
1. **Outdoor Location:** Any single equipment item or any group of equipment items that produce noise exceeding OSHA noise level requirements for a 2-hour exposure. Where such equipment is separated by a distance of more than 20 feet, measured between edges of footings, each group of equipment shall be provided with a separate hearing protection station.
 2. **Indoor Location**
 - a. Any single equipment item or any group of equipment items located within a single room not normally occupied, that produces noise exceeding OSHA noise level requirements for a 2-hour exposure.
 - b. Any single equipment item or any group of equipment items located within a single room normally occupied by workers, that produces noise exceeding OSHA noise level requirements for an 8-hour exposure.
- C. **Personal Hearing Protection:** The CONTRACTOR shall furnish three pairs of high attenuation hearing protectors in the original unopened packaging. The ear protectors shall be capable of meeting the requirements of ANSI S12.6 and shall produce a noise level reduction of 25 dBA at a frequency of 500 Hz. The hearing protectors shall have fluid filled ear cushions and an adjustable, padded headband. The protectors shall be stored in a weatherproof, labeled, steel cabinet, provided at an approved location near the noise

reinforcement shall be as specified by the AWS code. Upon completion of welding, weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance, with uniform weld contours and dimensions. Sharp corners of material that is to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.

- I. **Protective Coating:** Equipment shall be painted or coated in accordance with Section 09800 - Protective Coating, unless otherwise indicated. Non-ferrous metal and corrosion-resisting steel surfaces shall be coated with grease or lubricating oil. Coated surfaces shall be protected from abrasion or other damage during handling, testing, storing, assembly, and shipping.
- J. **Protection of Equipment:** Equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage. Equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry at all times. Pumps, motors, drives, electrical equipment, and other equipment having anti-friction or sleeve bearings shall be stored in weathertight storage facilities prior to installation. For extended storage periods, plastic equipment wrappers should be avoided, to prevent accumulation of condensate in gears and bearings. In addition, motor space heaters shall be energized and shafts shall be rotated. Equipment delivered to the Site with rust or corroded parts shall be rejected. If equipment develops defects during storage, it shall be disassembled, cleaned, and recoated to restore it to original condition.
- K. **Identification of Equipment Items:** Each item of equipment shipped shall have a legible identifying mark corresponding to the equipment number for the particular item.
- L. **Vibration Isolators:** Air compressors, blowers, engines, inline fans shall be provided with restrained spring-type vibration isolators or pads per manufacturer's written recommendations. Vibration isolations shall be provided with seismic restraint.
- M. **Shop Fabrication:** Shop fabrication shall be performed in accordance with the Contract Documents and the Shop Drawings.
- N. **Controls:** Equipment and system controls shall be in accordance with Division 17 - Instrumentation.

2.2 EQUIPMENT SUPPORTS AND FOUNDATIONS

- A. **Equipment Supports:** Unless otherwise indicated, equipment supports, anchors, and restrainers shall be adequately designed for static, dynamic, wind, and seismic loads. The design horizontal seismic force shall be the greater of: that noted in the general structural notes or as required by the governing building code, or 10 percent of gravity. Submitted design calculations for equipment supports shall bear the signature and seal of an engineer registered in the State wherein the project is to be built, unless otherwise indicated.
- B. **Equipment Foundations:** Mechanical equipment, tanks, control cabinets, enclosures, and related equipment shall be mounted on minimum 3.5-inch high concrete bases, unless otherwise indicated. Equipment foundations are indicated on Drawings. The CONTRACTOR through the equipment manufacturer shall verify the size and weight of equipment foundation to insure compatibility with equipment.

2.3 COUPLINGS

- A. Mechanical couplings shall be provided between the driver and the driven equipment. Flexible couplings shall be provided between the driver and the driven equipment to accommodate slight angular misalignment, parallel misalignment, end float, and to cushion shock loads. Unless otherwise indicated or recommended by the equipment manufacturer, coupling type shall be furnished with the respective equipment as follows:

Equipment Type	Coupling Type
Horizontal and end suction pumps	Gear or flexible spring
Vertical turbine pumps	3 piece spacer for solid shaft or double nut for hollow shaft
Vertical nonclog pumps, close coupled	Flexible disc pack
Screw pumps	Flexible spring, gear coupling, fluid coupling
Vertical nonclog pumps with extended shaft	Flexible disc pack or Universal joint with carbon fiber composite shaft and steady bearing support(s)

- B. Each coupling size shall be determined based on the rated horsepower of the motor, speed of the shaft, and the load classification service factor. The CONTRACTOR shall have the equipment manufacturer select or recommend the size and type of coupling required to suit each specific application.
- C. **Differential Settlement:** Where differential settlement between the driver and the driven equipment may occur, 2 sets of universal type couplings shall be provided.
- D. **Taper-Lock** or equal bushings may be used to provide for easy installation and removal of shafts of various diameters.

2.4 SHAFTING

- A. **General:** Shafting shall be continuous between bearings and shall be sized to transmit the power required. Keyways shall be accurately cut in line. Shafting shall not be turned down at the ends to accommodate bearings or sprockets whose bore is less than the diameter of the shaft. Shafts shall rotate in the end bearings and shall be turned and polished, straight, and true.
- B. **Design Criteria:** All shafts shall be designed to carry the steady state and transient loads suitable for unlimited number of load applications, in accordance with ASME B106.1M, - Design of Transmission Shafting. Where shafts are subjected to fatigue stresses, such as frequent start and stop cycles, the mean stress shall be determined by using the modified Goodman Diagram. The maximum torsional stress shall not exceed the endurance limit of the shaft after application of the factor of safety of 2 in the endurance limit and the stress concentration factor of the fillets in the shaft and keyway. Stress concentration factor shall be in accordance with ASME Standard B17.1 - Keys and Keyseats.
- C. **Materials:** Shafting materials shall be appropriate for the type of service and torque transmitted. Environmental elements such as corrosive gases, moisture, and fluids shall be taken into consideration. Materials shall be as indicated unless furnished as part of an equipment assembly.

1. Low carbon cold-rolled steel shafting shall conform to ASTM A 108, Grade 1018.
2. Medium carbon cold-rolled shafting shall conform to ASTM A 108, Grade 1045.
3. Other grades of carbon steel alloys shall be suitable for service and load.
4. Corrosion-resistant shafting shall be stainless steel or Monel, whichever is most suitable for the intended service.

- B. **Differential Settlement:** Where differential settlement between the driver and the driven equipment may occur, a shaft of sufficient length with 2 sets of universal type couplings shall be provided.

2.5 GEARS AND GEAR DRIVES

- A. Unless otherwise indicated, gears shall be of the spur, helical, or spiral-bevel type, designed and manufactured in accordance with AGMA Standards, with a service factor suitable for load class, mechanical service and thermal rating adjustment, a minimum L-10 bearing life of 60,000 hours, and a minimum efficiency of 94 percent. Peak torque, starting torque, and shaft overhung load shall be checked when selecting the gear reducer. Worm gears shall not be used unless specifically approved by the ENGINEER.
- B. Gear speed reducers or increasers shall be of the enclosed type, oil- or grease-lubricated and fully sealed, with a breather to allow air to escape but keep dust and dirt out. The casing shall be of cast iron or heavy-duty steel construction with lifting lugs and an inspection cover for each gear train. An oil level sight glass and an oil flow indicator shall be provided, located for easy reading.
- C. Gears and gear drives that are part of an equipment assembly shall be shipped fully assembled for field installation.
- D. Material selections shall be left to the discretion of the manufacturer, provided the above AGMA values are met. Input and output shafts shall be adequately designed for the service and load requirements. Gears shall be computer-matched for minimum tolerance variation. The output shaft shall have 2 positive seals to prevent oil leakage.
- E. Oil level and drain locations shall be easily accessible. Oil coolers or heat exchangers with all required appurtenances shall be provided when necessary.
- F. Where gear drive input or output shafts from one manufacturer connect to couplings or sprockets from a different manufacturer, the CONTRACTOR shall have the gear drive manufacturer furnish a matching key taped to the shaft for shipment.

2.6 DRIVE CHAINS

- A. Power drive chains shall be commercial type roller chains meeting ANSI Standards.
- B. A chain take-up or tightener shall be provided in every chain drive arrangement to provide easy adjustment.
- C. A minimum of one connecting or coupler link shall be provided in each length of roller chain.

- D. Chain and attachments shall be of the manufacturer's best standard material and be suitable for the process fluid.

2.7 SPROCKETS

- A. **General:** Sprockets shall be used in conjunction with chain drives and chain-type material handling equipment.
- B. **Materials:** Unless otherwise indicated, materials shall be as follows:
 1. Sprockets with 25 teeth or less, normally used as a driver, shall be made of medium carbon steel in the 0.40 to 0.45 percent carbon range.
 2. Type A and B sprockets with 26 teeth or more, normally used as driven sprockets, shall be made of minimum 0.20 percent carbon steel.
 3. Large diameter sprockets with Type C hub shall be made of cast iron conforming to ASTM A 48, Class 30.
- C. Sprockets shall be accurately machined to ANSI Standards. Sprockets shall have deep hardness penetration in tooth sections.
- D. Finish bored sprockets shall be furnished complete with keyseat and set screws.
- E. To facilitate installation and disassembly, sprockets shall be of the split type or shall be furnished with **Taper-Lock** bushings as required.
- F. Idler sprockets shall be provided with brass or Babbitt bushings, complete with oil hole and axial or circumferential grooving with stainless steel tubing and grease fitting extended to an accessible location. Steel collars with set screws may be provided in both sides of the hub.

2.8 V-BELT DRIVES

- A. V-belts and sheaves shall be of the best commercial grade and shall conform to ANSI, MPTA, and RMA Standards.
- B. Unless otherwise indicated, sheaves shall be machined from the finest quality gray cast iron.
- C. Sheaves shall be statically balanced. In some applications where vibration is a problem, sheaves shall be dynamically balanced. Sheaves operating at belt speeds exceeding 6,500 fpm may be required to be of special materials and construction.
- D. To facilitate installation and disassembly, sheaves shall be provided complete with **Taper-Lock** or **QD** bushings as required.
- E. Finish bored sheaves shall be complete with keyseat and set screws.
- F. Sliding motor bases shall be provided to adjust the tension of V-belts.

2.9 DRIVE GUARDS

- A. Power transmission trains, prime movers, machines, shaft extensions, and moving machine parts shall be guarded to conform with the OSHA Safety and Health Standards (29CFR1910). The guards shall be constructed of minimum 10 gage expanded, flattened steel with smooth edges and corners, galvanized after fabrication, and securely fastened. Where required for lubrication or maintenance, guards shall have hinged and latched access doors.

2.10 BEARINGS

- A. **General:** Bearings shall conform to the standards of the Anti-Friction Bearing Manufacturers Association, Inc. (AFBMA).
- B. To assure satisfactory bearing application, fitting practice, mounting, lubrication, sealing, static rating, housing strength, and lubrication shall be considered in bearing selection.
- C. Re-lubricatable type bearings shall be equipped with a hydraulic grease fitting in an accessible location and shall have sufficient grease capacity in the bearing chamber.
- D. Lubricated-for-life bearings shall be factory-lubricated with the manufacturer's recommended grease to insure maximum bearing life and best performance.
- E. **Anti-Friction Type Bearing Life:** Except where otherwise indicated, bearings shall have a minimum L-10 life expectancy of 5 years or 20,000 hours, whichever occurs first. Where so indicated, bearings shall have a minimum rated L-10 life expectancy corresponding to the type of service, as follows:

Type of Service	Design Life (years) (whichever	L-10 Design Life (hours) comes first)
8-hour shift	10	20,000
16-hour shift	10	40,000
Continuous	10	60,000

- F. Bearing housings shall be of cast iron or steel and bearing mounting arrangement shall be as indicated or as recommended in the published standards of the manufacturer. Split-type housings may be used to facilitate installation, inspection, and disassembly.
- G. **Sleeve Type Bearings:** Sleeve-type bearings shall have a cast iron or ductile iron housing and Babbitt or bronze liner. Bearing housing shall be bolted and doweled to the lower casing half. These housings shall be provided with cast iron caps bolted in place and the bearing end caps shall be bored to receive the bearing shells. Sleeve bearings shall be designed on the basis of the maximum allowable load permitted by the bearing manufacturer. If the sleeve bearing is connected to an equipment shaft with a coupling, the coupling transmitted thrust will be assumed to be the maximum motor or equipment thrust. Lubricant, lubrication system, and cooling system shall be as recommended by the bearing manufacturer.
- H. **Plate Thrust Bearings:** Thrust bearings shall be the Kingsbury Type, designed and manufactured to maintain the shaft in the fixed axial position without undue heating or the necessity of adjustment or attention. Bearings shall be oil lubricated to suit the manufacturer's standard method of lubrication for the specific bearing. If bearing cooling

is required, manufacturer shall provide necessary piping, filters, and valves.

2.11 PIPING CONNECTIONS

- A. **Pipe Hangers, Supports, and Guides:** Pipe connections to equipment shall be supported, anchored, and guided to avoid stresses and loads on equipment flanges and equipment. Supports and hangers shall be in accordance with Section 15006 - Pipe Supports.
- B. **Flanges and Pipe Threads:** Flanges on equipment and appurtenances shall conform to ANSI B16.1, Class 125, or B16.5, Class 150, unless otherwise indicated. Pipe threads shall be in accordance with ANSI/ASME B1.20.1 and Section 15000 - Piping, General.
- C. **Flexible Connectors:** Flexible connectors shall be installed in all piping connections to engines, blowers, compressors, and other vibrating equipment and in piping systems in accordance with the requirements of Section 15000. Flexible connectors shall be harnessed or otherwise anchored to prevent separation of the pipe where required by the installation.
- D. **Insulating Connections:** Insulating bushings, unions, couplings, or flanges, as appropriate, shall be used in accordance with the requirements of the Section 15000.

2.12 GASKETS AND PACKINGS

- A. Gaskets shall be in accordance with Section 15000.
- B. Packing around valve stems and reciprocating shafts shall be of compressible material, compatible with the fluid being used. Chevron-type "V" packing shall be **Garlock No. 432**, **John Crane "Everseal,"** or equal.
- C. Packing around rotating shafts (other than valve stems) shall be "O"-rings, stuffing boxes, or mechanical seals, as recommended by the manufacturer and approved by the ENGINEER, in accordance with Section 11100 - Pumps, General.

2.13 NAMEPLATES

- A. Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in an accessible location with No. 4 or larger oval head stainless steel screws or drive pins. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the machine performance ratings.

2.14 TOOLS AND SPARE PARTS

- A. **Tools:** The CONTRACTOR shall furnish one complete set of special wrenches and other special tools necessary for the assembly, adjustment, and dismantling of the equipment. Tools shall be of best quality hardened steel forgings with bright finish. Wrench heads shall have work faces dressed to fit nuts. Tools shall be suitable for professional work and manufactured by **Snap On, Crescent, Stanley,** or equal. The set of tools shall be neatly mounted in a labeled tool box of suitable design provided with a hinged cover.

- B. Spare parts shall be furnished as indicated in the individual equipment sections. All spare parts shall be suitably packaged in a metal box and labeled with equipment numbers by means of stainless steel or solid plastic name tags attached to the box.

2.15 EQUIPMENT LUBRICANTS

- A. The CONTRACTOR shall install lubricants for all equipment during storage and prior to initial testing of the equipment. After successful initial testing, final testing, and satisfactory completion startup testing as specified in Section 01660 - Equipment Testing and Plant Startup, the CONTRACTOR shall conduct one complete lubricant change on all equipment. In addition, the CONTRACTOR shall be responsible for the proper disposal of all used lubricants. The OWNER will then be responsible for subsequent lubricant changes

PART 3 -- EXECUTION

3.1 SERVICES OF MANUFACTURER

- A. **Inspection, Startup, and Field Adjustment:** Where required by individual sections, an authorized, experienced, and competent service representative of the manufacturer shall visit the Site for the number of days indicated in those sections to witness or perform the following and to certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation.

1. Installation of equipment
2. Inspection, checking, and adjusting the equipment and approving its installation
3. Startup and field testing for proper operation, efficiency, and capacity
4. Performing field adjustments during the test period to ensure that the equipment installation and operation comply with requirements

- B. Instruction of the Owner's Personnel

1. Where required by the individual equipment sections, an authorized training representative of the manufacturer shall visit the Site for a number of days indicated in those sections to instruct the OWNER's personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment. Instruction shall be specific to the models of equipment provided.
2. The representative shall have at least 2 years experience in training. A resume of the representative shall be submitted.
3. Training shall be scheduled 3 week in advance of the scheduled session.
4. Proposed training material and a detailed outline of each lesson shall be submitted for review. Review comments from the ENGINEER shall be incorporated into the material.
5. The training materials shall remain with the trainees after the session.
6. The OWNER may videotape the training for later use by the OWNER's personnel.

- C. **Vibration Monitoring:** For the equipment types listed in paragraph 1.3D, the CONTRACTOR shall arrange for at least two Site visits by the manufacturer's specialist during testing of the equipment covered by torsional and vibration analysis submittals to measure the amount of vibration and prepare written recommendations for keeping the vibration within acceptance limits. If vibration readings exceed the specified or the applicable referenced standard vibration limits for the type of equipment, the CONTRACTOR shall make necessary corrections for the equipment to meet the acceptance criteria.

3.2 INSTALLATION

- A. **General:** Equipment shall be installed in accordance with the manufacturer's written recommendations.
- B. **Alignment:** Equipment shall be field tested to verify proper alignment.

3.3 PACKAGED EQUIPMENT

- A. When any system is furnished as pre-packaged equipment, the CONTRACTOR shall coordinate all necessary space and structural requirements, clearances, utility connections, signals, and outputs with subcontractors to avoid later change orders.
- B. If the packaged system has any additional features (as safety interlocks, etc.) other than required by the Contract Documents, the CONTRACTOR shall coordinate such features with the ENGINEER and provide all material and labor necessary for a complete installation as required by the manufacturer.

3.4 FIELD ASSEMBLY

- A. Studs, cap screws, bolt and nuts used in field assembly shall be coated with "**Never Seize**" compound or equal.

3.5 WELDING

- A. Welds shall be cleaned of weld-slag, splatter, etc. to provide a smooth surface.

3.6 FIELD TESTS

- A. Where indicated by the individual equipment sections, equipment shall be field tested after installation to demonstrate satisfactory operation without excessive noise, vibration, or no overheating of bearings or motor.
- B. The following field testing shall be conducted:
 - 1. Start equipment, check, and operate the equipment over its entire operating range. Vibration level shall be within the amplitude limits as indicated or as recommended by the reference applicable Standards. A written report on vibration monitoring shall be submitted to OWNER as required after all testing and adjustments are completed.
 - 2. Obtain concurrent readings of motor voltage, amperage, capacity, vibration and bearing temperatures.

- 3. Operate equipment indicated in Section 01660.
- C. Field testing shall be witnessed by the ENGINEER. The CONTRACTOR shall notify the ENGINEER of the test schedule three days in advance.
- D. In the event that any equipment fails to meet the test requirements, the equipment shall be modified and retested until it satisfies the requirement.

- END OF SECTION -

producing equipment.

- D. **Drive Trains and Service Factors:** Service factors shall be applied in the selection or design of mechanical power transmission components. All components of drive train assemblies between the prime mover and the driven equipment shall be designed and rated to deliver the maximum peak or starting torque, speed, and horsepower. All of the applicable service factors shall be considered, such as mechanical (type of prime mover), load class, start frequency, ventilation, ambient temperature, and fan factors. Drive train components include couplings, shafts, gears and gear drives, drive chains, sprockets, and V-belt drives. Unless otherwise indicated, the following load classifications shall apply in determining service factors:

Type of Equipment	Service Factor	Load Classification
Pumps:		
Centrifugal or Rotary	1.0	Uniform
Reciprocating	1.8	Moderate Shock
Progressing Cavity	1.0	Uniform

- E. Mechanical Service Factors

	Mechanical Service Factors	
	Electric Motor	Internal Combustion Engine
Uniform	1.25	1.50
Moderate Shock	1.50	1.75
Heavy Shock	2.00	2.25

- F. For thermal rating adjustments such as start frequency, ambient temperature, and hourly duty cycle factor, ventilation factor, and fan factor, refer to gear manufacturer sizing information.
- G. Where load classifications are not indicated, service factors based on AGMA 514.02 shall be used for standard load classifications and service factors for flexible couplings,
- H. **Welding:** Unless otherwise indicated, welding shall conform to the following:
1. Latest revision of AWWA D100.
 2. Latest revision of AWWA C206.
 3. Composite fabricated steel assemblies that are to be erected or installed inside a hydraulic structure, including any fixed or movable structural components of mechanical equipment, shall have continuous seal welds to prevent entrance of air or moisture.
 4. Welding shall be by the metal-arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" as supplemented by other pertinent standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards.
 5. In assembly and during welding, the component parts shall be adequately clamped, supported, and restrained to minimize distortion and for control of dimensions. Weld

SECTION 11100 - PUMPS, GENERAL

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all pumps and pumping appurtenances, complete and operable, in accordance with the Contract Documents.
- B. The provisions of this Section shall apply to all pumps and pumping equipment except where otherwise indicated in the Contract Documents.
- C. The requirements of Section 11000 – Equipment General Provisions apply to this Section.
- D. **Unit Responsibility:** The pump manufacturer shall be made responsible for furnishing the WORK and for coordination of design, assembly, testing, and installation of the WORK of each pump Section; however, the CONTRACTOR shall be responsible to the OWNER for compliance with the requirements of each pump Section.
- E. **Single Manufacturer:** Where two or more pump systems of the same type or size are required, the pumps shall all be produced by the same manufacturer.

1.2 CONTRACTOR SUBMITTALS

- A. **General:** Submittals shall be furnished in accordance with Section 01300 - Contractor Submittals.
- B. **Shop Drawings:** Shop Drawings shall contain the following information:
 - 1. Pump name, identification number, and specification Section number.
 - 2. Performance data curves showing head, capacity, horsepower demand, NPSH required, and pump efficiency over the entire operating range of the pump. The equipment manufacturer shall indicate separately the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at the design flow conditions and the maximum and minimum flow conditions. Performance curves at intervals of 100 rpm from minimum speed to maximum speed shall be furnished for each centrifugal pump equipped with a variable speed drive.
 - 3. The CONTRACTOR shall require the manufacturer to indicate the limits on the performance curves recommended for stable operation without surge, cavitation, or excessive vibration. The stable operating range shall be as wide as possible based on actual hydraulic and mechanical tests.
 - 4. Assembly and installation drawings including shaft size, seal, coupling, bearings, anchor bolt plan, part nomenclature, material list, outline dimensions, and shipping weights.
 - 5. Data, in accordance with Division 16, for the electric motor proposed for each pump.
 - 6. Elevation of proposed Local Control Panel showing panel-mounted devices, details of enclosure type, single line diagram of power distribution, and current draw of

panel, and list of all terminals required to receive inputs or to transmit outputs from the Local Control Panel.

7. Wiring diagram of field connections with identification of terminations between Local Control Panels, junction terminal boxes, and equipment items.
 8. Complete electrical schematic diagram.
- C. **Technical Manual:** The Technical Manual shall contain the required information for each pump Section.
- D. **Spare Parts List:** A Spare Parts List shall contain the required information for each pump Section.
- E. **Factory Test Data:** Signed, dated, and certified factory test data for each pump system which requires factory testing, submitted before shipment of equipment.
- F. **Certifications:**
1. Manufacturer's certification of proper installation.
 2. CONTRACTOR'S certification of satisfactory field testing.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Compliance with the requirements of the individual pump Sections may necessitate modifications to the Manufacturer's standard equipment.
- B. **Performance Curves:** All centrifugal pumps shall have a continuously rising curve or the system operating range shall not cross the pump curve at two different capacities or "dip region." Unless indicated otherwise, the required pump shaft horsepower at any point on the performance curve shall not exceed the rated horsepower of the motor or engine or encroach on the service factor.
- C. All components of each pump system provided under the pump Sections shall be entirely compatible. Each unit of pumping equipment shall incorporate all basic mechanisms, couplings, electric motors or engine drives, variable speed controls, necessary mountings, and appurtenances.

2.2 MATERIALS

- A. All materials shall be suitable for the intended application; materials not indicated shall be high-grade, standard commercial quality, free from all defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended, and shall conform to the following requirements:
 1. Cast iron pump casings and bowls shall be of close-grained gray cast iron, conforming to ASTM A 48 - Gray Iron Castings, Class 30, or equal.
 2. Bronze pump impellers shall conform to ASTM B 62 - Composition Bronze or Ounce

Metal Castings, or B 584 - Copper Alloy Sand Castings for General Applications, where dezincification does not exist.

3. Stainless steel pump shafts shall be Type 416 or 316. Miscellaneous stainless steel parts shall be of Type 316, except in a septic environment.
4. Anchor bolts, washers, and nuts in Standard Service (Non-Corrosive Application) shall be galvanized steel in accordance with the requirements of Section 05500 - Miscellaneous Metalwork. Anchor bolts, washers, and nuts in Corrosive Service as defined in Section 05500 shall be stainless steel in accordance with that Section.

2.3 PUMP COMPONENTS - GENERAL

- A. **Flanges and Bolts:** Suction and discharge flanges shall conform to ANSI/ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800 or B16.5 - Pipe Flanges and Flanged Fittings dimensions. Bolts shall be in accordance with Section 05500.
- B. **Lubrication:** Vertical pump shafts of clean water pumps shall be product water-lubricated, unless otherwise indicated. Deep-well pumps and pumps with dry barrels shall have water- or oil-lubricated bearings and seals and enclosed line shafts. Pumps for sewage, sludge, and other process fluids shall be lubricated as indicated. All lubricates shall be compatible with potable water use as required by applicable regulations.
- C. **Handholes:** Handholes on pump casings shall be shaped to follow the contours of the casing to avoid any obstructions in the water passage.
- D. **Drains:** All gland seals, air valves, cooling water drains, and drains from variable speed drive equipment shall be piped to the nearest floor sink, or drain, with copper tube, properly supported with brackets.
- E. **Grease Lubrication:** For all vertical propeller, mixed-flow, and turbine pumps, other than deep well pumps, of bowl sizes 10-inches and larger, the CONTRACTOR shall provide a stainless steel tube attached to the column for grease lubrication of the bottom bearing.
- F. **Stuffing Boxes:** Where stuffing boxes are specified for the pump seal, they shall be of the best quality, using the manufacturer's suggested materials best suited for the specific application. For sewage, sludge, drainage, and liquids containing sediments, the seals shall be fresh-water flushed, using lantern rings.
 1. Unless otherwise indicated, the packing material shall be interlaced Teflon braiding, containing 50 percent ultrafine graphite impregnation to satisfy the following:
 - a. Shaft speeds - up to 2500 rpm
 - b. Temperature - up to 500 degrees F
 - c. pH range - 0-14
 2. If fresh water is not available, the seal shall be flushed with product water cleaned by a solids separator as manufactured by **John Crane Co., Lakos (Claude Laval Corp.), or equal.**
- G. **Mechanical Seals:** Mechanical seals shall be fresh water-flushed unless indicated otherwise; in which case product water cleaned by a solids separator as above shall be

otherwise; in which case product water cleaned by a solids separator as above shall be used. Mechanical seals shall be as manufactured by the following, or equal:

- | | |
|----------------|--------------------------------|
| 1. Water Pumps | Single seals: |
| Hot and Cold | John Crane, Type I, 21; |
| | Borg-Warner Type L |

- H. Where indicated, a buffer fluid must be circulated a minimum 20 psi above discharge pressure, or as required by the manufacturer, in order to maintain reliable seal performance.
- I. Mechanical seals for all services other than chemicals and corrosives shall be equipped with nonclogging, single coil springs and nonsliding, internal, secondary elastomers. Metal parts shall be Type 316 stainless steel, Alloy 20, or Hastelloy B or C.
- J. Fresh water shall be delivered to the seals through appropriate size piping with plug valves, strainers, pressure regulators, electrically operated solenoid valves, and rotameters. Wiring shall comply with Division 16 and solenoid control shall comply with Division 17.

2.4 PUMP APPURTENANCES

- A. **Nameplates:** Each pump shall be equipped with a stainless steel nameplate indicating serial numbers, rated head and flow, impeller size, pump speed, and manufacturer's name and model number.
- B. **Solenoid Valves:** The pump manufacturer shall provide solenoid valves on the water or oil lubrication lines and on all cooling water lines. Solenoid valve electrical ratings shall be compatible with the motor control voltage.
- C. **Gauges:**
 - 1. All pumps (except sample pumps, sump pumps, and hot water circulating pumps) shall be equipped with pressure gauges installed at pump discharge lines. Pump suction lines shall be provided with compound gauges. Gauges shall be located in a representative location, where not subject to shock or vibrations, in order to achieve true and accurate readings.
 - 2. Where subject to shock or vibrations, the gauges shall be wall-mounted or attached to stainless steel floor stands and connected by means of flexible connectors.
 - 3. Pressure and compound gauges shall be provided in accordance with Division 17.

2.5 FACTORY TESTING

- A. The following tests shall be conducted on each indicated pump system:
 - 1. **Motors:** motors rated 100 HP and larger shall be factory tested in conformance with ANSI/IEEE 112, IEEE 43 – Recommended Practice for Testing Resistance of Rotating Machinery, and NEMA MG-2. Except where specific testing or witnessed shop tests are required by the specifications for driven equipment, factory test reports may be copies of routine test reports of electrically duplicate motors. Test

- data. Test report shall be certified by the motor manufacturer's test personnel and be submitted to the ENGINEER.
2. **Pump Systems:** All centrifugal pump systems with drives 10 hp up to and including 125 hp shall be tested at the pump factory in accordance with the American National Standard for Centrifugal Pump Tests (ANSI/HI 1.6) acceptance Level "A" or the American National Standard for Vertical Pump Tests (ANSI/HI 2.6) as approved by ANSI and published by the Hydraulic Institute. Tests shall be performed using the complete pump system to be furnished, including the project motor and variable speed drive if equipped with variable speed drive. For pumps with motors smaller than 100 hp, the manufacturer's certified test motor shall be acceptable. Testing of prototype models will not be acceptable. The following minimum test results shall be submitted:
 - a. Hydrostatic test results
 - b. At maximum speed, a minimum of five hydraulic test readings between shutoff head and 25 percent beyond the maximum indicated capacity, recorded on data sheets as defined by the Hydraulic Institute. For variable speed driven pumps, each pump shall be tested between maximum and minimum speed at 100 rpm increments.
 - c. Pump curves showing head, flow, bhp, and efficiency requirements.
 - d. NPSH required test curve if required by the pump specification. Otherwise, a calculated NPSH required curve may be submitted.
 - e. Certification that the pump shaft horsepower demand did not exceed the rated motor horsepower of 1.0 service rating at any point on the curve.
 3. **Factory Witnessed Tests:** All pumps, variable speed drives, and motors, 150 hp and larger shall be factory-tested as complete assembled systems and may be witnessed by the OWNER and ENGINEER. The CONTRACTOR shall give the ENGINEER a minimum of 2 weeks notification prior to the test. All costs for OWNER and ENGINEER shall be borne by the CONTRACTOR and shall be included in the bid price. Such costs shall include travel and subsistence for two people excluding salaries. Test results shall be submitted to the ENGINEER. No equipment shall be shipped until the test data have been approved by the ENGINEER.
 4. **Acceptance:** In the event of failure of any pump to meet any of the requirements, the CONTRACTOR shall make all necessary modifications, repairs, or replacements to conform to the requirements of the Contract Documents and the pump shall be re-tested until found satisfactory.

PART 3 – EXECUTION

3.1 SERVICES OF MANUFACTURER

- A. **Inspection, Startup, and Field Adjustment:** Where required by the individual pump Sections, an authorized service representative of the manufacturer shall visit the Site for the number of days indicated in those sections to witness the following and to certify in writing that the equipment and controls have been properly installed, aligned, lubricated,

adjusted, and readied for operation.

1. Installation of the equipment
2. Inspection, checking, and adjusting the equipment
3. Startup and field testing for proper operation
4. Performing field adjustments to ensure that the equipment installation and operation comply with requirements

B. Instruction of the Owner's Personnel:

1. Where required by the individual pump Sections, an authorized training representative of the manufacturer shall visit the Site for the number of days indicated in those Sections to instruct the OWNER'S personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment. Instruction shall be specific to the models of equipment provided.
2. The representative shall have at least two year's experience in training. A resume for the representative shall be submitted.
3. Training shall be scheduled a minimum of three weeks in advance of the first session.
4. Proposed training material and a detailed outline of each lesson shall be submitted for review. Comments shall be incorporated into the material.
5. The training materials shall remain with the trainees.
6. The OWNER may videotape the training for later use with the OWNER'S personnel.

3.2 INSTALLATION

- A. **General:** Pumping equipment shall be installed in accordance with the manufacturer's written recommendations.
- B. **Alignment:** All equipment shall be field tested to verify proper alignment and freedom from binding, scraping, shaft runout, or other defects. Pump drive shafts shall be measured just prior to assembly to ensure correct alignment without forcing. Equipment shall be secure in position and neat in appearance. Alignment reports shall be submitted by CONTRACTOR for all necessary alignment tests.
- C. **Lubricants:** The CONTRACTOR shall provide the necessary oil and grease for initial operation.

3.3 PROTECTIVE COATING

- A. Materials and equipment shall be coated as required in Section 09800 - Protective Coating.

3.4 FIELD TESTS

- A. Each pump system shall be field tested after installation to demonstrate:
1. Satisfactory operation without excessive noise and vibration.
 2. No material loss caused by cavitation.
 3. No overheating of bearings.
 4. Indicated head, flow, and efficiency at design point.
- B. The following field testing shall be conducted:
1. Startup, check, and operate the pump system over its entire speed range. If the pump is driven by a variable speed drive, the pump and motor shall be tested at 100 RPM increments. If the pump is driven at constant speed, the pump and motor shall be tested at max RPM. Unless otherwise indicated, vibration shall be within the amplitude limits recommended by the Hydraulic Institute Standards at a minimum of four pumping conditions defined by the ENGINEER.
 2. Obtain concurrent readings of motor voltage, amperage, pump suction head, and pump discharge head for at least four pumping conditions at each pump rotational speed if variable speed at 100 RPM increment or at max RPM if constant speed. Check each power lead to the motor for proper current balance.
 3. Determine bearing temperatures by contact type thermometer. A run time until bearing temperatures have stabilized shall precede this test, unless insufficient liquid volume is available.
 4. Electrical and instrumentation tests shall conform to the requirements of the sections under which that equipment is specified.
- C. Field testing will be witnessed by the ENGINEER. The CONTRACTOR shall furnish three days advance notice of field testing.
- D. In the event any pumping system fails to meet the indicated requirements, the pump shall be modified or replaced and retested as above until it satisfies the requirements.
- E. After each pumping system has satisfied the requirements, the CONTRACTOR shall certify in writing that it has been satisfactorily tested and that all final adjustments have been made. Certification shall include the date of the field tests, a listing of all persons present during the tests, and the test data.
- F. The CONTRACTOR shall be responsible for all costs of field tests, including related services of the manufacturer's representative, except for power and water, which the OWNER will bear. If available, the OWNER'S operating personnel will provide assistance in field testing.

- END OF SECTION -

SECTION 11107 – HOSE PUMPS

PART 1 – GENERAL

1.1 THE REQUIREMENT

The CONTRACTOR shall furnish and install hose pumps with horizontal electric motor, and all appurtenant work, complete and operable, all in accordance with the requirements of the Contract Documents.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section 11100, "Pumps, General."

PART 2 – PRODUCTS

2.1 The hose pumps shall be peristaltic-type pumps and shall be of corrosion-resistant construction with no moving parts contacting the pumped liquid. The pumps shall be capable of running dry without damage. Each pumping unit shall be mounted on a common base with its driver. Each pump shall have one rotating member with two sliding shoes mounted 180 degrees opposite each other. Pumps incorporating rollers will not be acceptable. The hose shall be contained in a cast iron housing and lubricated by compounded glycerin. Piping for filling and changing the lubricant shall be provided on the front of the housing, and shall include a sapped end capable of withstanding 50 ft of pressure. Each pump shall be complete with pump base, drive, gear reducer, coupling guard, electric motor, and local control panel with AC variable speed drive per Section 11259. Pumps shall be suitable in all parts and materials for the type of service and they shall conform to the following requirements:

A. General:

Numer of pumps	-	1
Equipment number	-	P-2
Service	-	ASR Well Recharge
Operation (hours per day)	-	Intermittent

B. Operating Conditions:

Capacity (gpm)	-	0.5
Pump Head (TDH-ft)	-	13
Liquid to be pumped	-	Water
Specific gravity of liquid	-	1.0
Liquid temperature (degrees F)	-	77 to 86

Max pump speed (rpm)	-	1,800
Min motor size (hp)	-	0.25
Max motor speed	-	1,800

C. Pump Dimensions:

Min hose diameter (in)	-	0.985
Min size of suction flange (in)	-	1
Min size of discharge flange (in)	-	1
Flange rating (psi)	-	150

1.3 PUMP REQUIREMENTS

A. Construction: Construction of hose pumps shall conform to the following requirements:

Casing	-	Cast-iron
Shaft	-	Steel, with Type 316 SST hardware
Hose	-	Natural rubber with PVC hose nipples and pulsation suppressor at pump inlet
Rotor	-	Alloy steel, SAE 1045, with replaceable aluminum shoes
Bearings	-	Anti-fiction, grease lubricated ball bearings, rated for B10 life of 60,000 hours at maximum speed and pressure.
Pump base	-	Cast iron or fabricated steel

B. Drive: the hose pump shall have a horizontal, heavy-duty, TEFC AC electric motor. The motors shall be coupled to helical gear reducer rated for minimum AGMA Class II service at full load motor output and suitable for use with an AC variable speed drive.

C. MANUFACTURER OR EQUAL:

1. **Watson-Marlow, Inc.**
2. **Masterflex**

PART 2 – EXECUTION

2.1 INSTALLATION

- A. Pumping equipment shall be installed in accordance with approved procedures submitted with the shop drawings and as shown, unless otherwise approved.**

- END OF SECTION -

SECTION 11149 - SUBMERSIBLE SUMP PUMPS

PART 1 – GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide submersible sump pumps and appurtenant work, complete and operable, in accordance with the Contract Documents.
- B. The requirements of Section 11000 - Equipment General Provisions apply to the WORK of this Section.
- C. The Supplier shall examine the Site conditions, intended application, and operation of the pump system and recommend the pump which will satisfy the indicated requirements.

PART 2 – PRODUCTS

2.1 PUMPS

A. Identification:

Quantity	Location	Pump No.
2	ASR Well IVault	P-200, P-201
2	Control Valve Vault	P-300, P-301
2	FAM Well Vault	P-400, P-401
2	Lift Station	P-500, P-501

- B. **Operating Conditions:** All pumps named in this Section shall be suitable for long term operation under the following conditions:

- 1. Duty - Intermittent
- 2. Drive - Constant speed
- 3. Ambient environment - Outdoors
- 4. Ambient temperature, (degrees F) - 32 to 104
- 5. Ambient relative humidity (percent) - 20 to 100
- 6. Fluid service - storm/groundwater
- 7. Fluid temperature, (degrees F) - 77 to 86
- 8. Fluid pH range - 6 to 9

- 9. Fluid specific gravity - 1.0
- 10. Minimum available NPSH (ft) - Flooded
- 11. Maximum size of spheres to pass (in. dia) - ½

C. Performance Requirements:

**Table 1
Performance Requirements**

Location	Pump Discharge Size (in) NTP	Min. Hp	Max. Shutoff Head (ft)	Design Flow Capacity (gpm)	Design Flow Pump Head (ft)	Min. Efficiency	Max. Pump Speed (rpm)
ASR Well	1 ½	1/3	25	25	20	50	1800
Control Valve Vault	3	1.0	60	50	40	50	3600
FAM Well Vault	2	1/2	50	50	30	50	3600
Lift Station	3	1.0	30	75	35	50	3600

D. Pump Dimensions:

- 1. Sump dimensions (in) - 24 x 42
- 2. Sump depth (in) - 24
- 3. Sump top - Aluminum grating with frame

2.2 PUMP REQUIREMENTS

A. Construction: Construction of submersible sump pumps shall conform to the following requirements:

- 1. Pump casing - Cast iron
- 2. Impeller - Semi-open, non-clog cast iron
- 3. Bearings - Permanently lubricated ball and sleeve type
- 4. Shaft - Stainless steel, series 400
- 5. Seal - Mechanical seal
- 6. Mounting Method - free standing with/lifting handle

7. Pump Connection - union with neoprene pressure hose

- B. **Drive:** Enclosed, submerged, electric 1800 or 3600 rpm motor, suitable for 240-volt, 1-phase, 60-Hz ac power supply, with armored cable. Motors shall have integral thermal overload protection or shall be inherently current limited. Motors shall be provided with lubricated-for-life ball bearings.
- C. **Control:** Pumps shall be controlled in accordance with Section 17100 - Process Control and Instrumentation Systems. Sump pumps shall have integral floats for starting and stopping operation.

2.3 PROTECTIVE COATING

- A. Pumps shall be coated in accordance with Section 09800 - Protective Coating.

2.4 MANUFACTURERS OR EQUAL

- A. **Aurora Pumps**
- B. **Flygt Corporation**
- C. **Goulds Pumps Inc.**

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Pumping equipment shall be installed in accordance with approved procedures submitted with the Shop Drawings and as indicated.
- B. General installation requirements shall be in accordance with Section 11100 - Pumps, General.

- END OF SECTION -

SECTION 11189 - SUBMERSIBLE TURBINE PUMPS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall furnish, install and test motor-driven submersible turbine pumps and all appurtenant work, complete and operable, in accordance with the requirements of the Contract Documents.
- B. The requirements of Section 11100 – Pumps, General apply to this section.
- C. The Supplier shall examine the site conditions, intended application, and operation of the pump system and recommend the pump, which will satisfy the indicated requirements.

PART 2 -- PRODUCTS

2.1 WELL PUMPS

A. Identification:

- 1. Pump Name: ASR Recovery Pump
- 2. Pump Number: P – 01
- 3. Quantity: 1
- 4. Location: ASR Well Vault

B. Operating Conditions:

- 1. Duty - Continuous
- 2. Drive - Constant Speed
- 3. Ambient Environment - Submerged
- 4. Ambient Temperature (degrees F) - 32 to 104
- 5. Ambient relative humidity (percent) - 40 to 100
- 6. Fluid Service - Raw Water
- 7. Fluid Temperature (degrees F) - 70 to 85
- 8. Fluid pH range - 6 to 9
- 9. Fluid specific gravity - 1.0
- 10. Fluid viscosity (absolute) (centipoises at 60 deg. F) - 1.2
- 10. Project site elevation (ft. above m.s.l.) - 15
- 12. Minimum available NPSH (Feet) 50

C. Performance Requirements:

- | | | | |
|-----|--|---|------|
| 1. | Maximum shut-off head (ft) | - | 420 |
| 2. | Design flow capacity (gpm) | - | 3500 |
| 3. | Design flow pump head TDH (ft) | - | 225 |
| 4. | Design flow minimum pump/motor wire-to-water efficiency, (percent) | - | 66 |
| 5. | Maximum flow capacity, (gpm) | - | 4000 |
| 6. | Maximum flow pump head TDH, (ft) ± 10 feet | - | 175 |
| 7. | Minimum flow capacity, (gpm) | - | 1400 |
| 8. | Minimum flow pump head TDH, (FT) ± 10ft | - | 350 |
| 9. | Maximum pump speed, (rpm) | - | 1770 |
| 10. | Motor size, (hp) | - | 250 |

D. Pump Dimensions:

- | | | | |
|----|--|---|------|
| 1. | Nominal setting depth below well head flange, (ft) | - | 100 |
| 2. | Maximum outside diameter of bowls, (in) | - | 17.0 |
| 3. | Minimum Discharge Diameter (in) | - | 12 |
| 4. | Discharge Flange Rating ANSI (psi) | - | 150 |
| 5. | Inside Diameter of well casing, (in) | - | 23 |

2.2 PUMP REQUIREMENTS

A. Pump Construction: Construction of submersible turbine pumps shall conform to the following requirements:

- | | | | |
|----|-------------------|---|---|
| 1. | Bowl | - | Stainless steel type CF8M. The exterior surfaces of the bowl units shall be coated in accordance with Section 09800, "Protective Coatings." Bowl shall be flanged, bolted type. |
| 2. | Impeller | - | Stainless steel type CF8M, enclosed type, secured to bowl shaft with stainless steel tapered sleeve collet. Impeller shall be statically and dynamically balanced. |
| 3. | Casing wear rings | - | Nitronic 50 or CD4M-Cu stainless steel |
| 4. | Bowl shaft | - | Type 316 stainless steel |

- 5. Bowl bearings discharge case and suction case
 - Rubber cutlass bearing with Type 316 SS shell.
 - 6. Suction Case
 - Stainless steel type CF8M
 - 7. Discharge Case
 - Stainless steel type CF8M, an up-thrust plug or washer shall be provided to limit up-thrust.
 - 8. Pump-Motor Coupling
 - Stainless steel with keyway
 - 9. Cable Guard
 - Stainless steel
 - 10. Fasteners
 - Stainless Steel, ASTM A193 grade B8M
- B. **Column Pipe:** Column pipe shall be 12 inch diameter schedule 10S type 316L stainless steel with ANSI 150 lb. flanges. Each 20 foot section shall be fitted with a stainless steel centralizer.
- C. **Discharge Head:** Well discharge head shall be fabricated of type 316L stainless steel, schedule 10S as shown. The flange column pipe shall be fastened to the flange well head. The column pipe shall be attached to the top of the well casing as indicated on the drawings. A well casing adapter flange will be required as shown.

2.3 WELL PUMP MOTOR

- A. The pump manufacturer shall supply the pump-motor assembly and shall accept unit responsibility for this assembly. The pump manufacturer shall mate pumps and motors and adjust the pump thrust plug.
- B. The motor shall be of the 'squirrel cage' induction type, suitable for reduced voltage starting. The motor shall be liquid filled and be rated at 460-volt, 3-phase, 60 Hertz for continuous operation. Mercury-seal motors are not acceptable. The motor horsepower rating shall not be exceeded at pump design flow. It shall have a service factor of 1.15 which shall not be exceeded over the full range of pump operation specified from shut-off to maximum flow. The 1.15 service factor shall be achieved at a minimum cooling flow velocity of 0.5 fps. with 77°F water.
- C. The motor shall be equipped with fill liquid lubricated radial and Kingsbury type thrust bearings. The motor thrust bearing shall be sized to carry the weight of all rotating parts plus the unbalanced thrust of the pump, regardless of the direction of rotation. A mechanical shaft seal shall be provided in the motor housing to prevent loss of fill liquid. Motor shall be equipped with a pressure relief valve, drain plug and filling device.
- D. Motor materials of construction shall be as follows:
 - 1. Outer housing – Stainless steel with cast iron end bells, epoxy coated
 - 2. Shaft - stainless steel
 - 3. Coupling - stainless steel
 - 4. Fasteners - stainless steel

- E. The motor power factor shall not be less than 0.75 at pump design flow. Motor starter overload relays shall be sized for motor full load current for +/- 10 percent voltage range.
- F. The submersible motor cable shall be a flat cable, with factory splices only allowed in the well. The cable shall be sized to limit voltage drop to no more than 2.5 percent at full load current. The outer jacket of the cable shall be watertight over its entire length and be suitably supported from the column pipe.
- G. Motor winding insulation shall be rated for continuous duty at not less than 130 °C.

2.4 WATER LEVEL INDICATOR

- A. The CONTRACTOR shall supply a submersible pressure transducer with a cord of sufficient length to reach from the setting depth shown to the control panel. Transducer and transmitter shall be as specified in Division 17.

2.5 SPARE PARTS: Furnish the following spare parts for each pump:

- A. One set of all bowl discharge case, and suction case bearings
- B. One set of all wear rings
- C. Two sets of all gaskets and o-rings

2.6 SUPPLIERS

- A. Pumps shall be manufactured by:
 - 1. **Byron Jackson Pumps (Flowserve)**
 - 2. **Floway Pumps**
 - 3. **Goulds Pumps (ITT)**
 - 4. **Ingersoll Dresser Pump Co. (Flowserve)**
 - 5. **Johnston Pump Co.**
 - 6. **Peerless (Sterling)**
- B. Motors shall be manufactured by:
 - 1. **Hitachi, or equal.**

PART 3 — EXECUTION

3.1 INSTALLATION

- A. Pumping equipment shall be installed in accordance with approved procedures submitted with the shop drawings. In all cases manufacturers' requirements shall be met.
- B. General installation requirements shall be as specified for "Execution" in Section 11100, "Pumps, General."

3.2 MANUFACTURER'S SERVICE REPRESENTATIVE

A. **Erection and Startup Assistance:** Service and instruction assistance by the manufacturer's engineering representative for each pump shall be provided by the CONTRACTOR during the following periods:

1. One day during erection
2. As required but not less than one day of service assistance during startup.

- END OF SECTION -

SECTION 15000 - PIPING, GENERAL

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all piping systems indicated, complete and operable, in accordance with the Contract Documents.
- B. The provisions of this Section shall apply to all piping sections in Divisions 2 and 15.
- C. The mechanical drawings define the general layout, configuration, routing, method of support, pipe size, and pipe type. The mechanical drawings are **not** pipe construction or fabrication drawings. It is the CONTRACTOR's responsibility to develop the details necessary to construct all mechanical piping systems, to accommodate the specific equipment provided, and to provide all spools, spacers, adapters, and connectors for a complete and functional system.

1.2 CONTRACTOR SUBMITTAL

- A. **General:** Submittals shall be furnished in accordance with Section 01300 - Contractor Submittals.
- B. **Shop Drawings:** Shop Drawings shall contain the following information:
 - 1. **Drawings:** Layout drawings including all necessary dimensions, details, pipe joints, fittings, specials, bolts and nuts, gaskets, valves, appurtenances, anchors, guides, and material lists. Fabrication drawings shall indicate all spool pieces, spacers, adapters, connectors, fittings, and supports to accommodate the equipment and valves in a complete and functional system.
- C. **Samples:** Performing and paying for sampling and testing as necessary for certifications are the CONTRACTOR'S responsibility.
- D. **Certifications**
 - 1. All necessary certificates, test reports, and affidavits of compliance shall be obtained by the CONTRACTOR.
 - 2. A certification from the pipe fabricator that all pipes will be manufactured subject to the fabricator's or a recognized Quality Control Program. An outline of the program shall be submitted to the ENGINEER for review prior to the manufacture of any pipe.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. **Extent of Work:** Pipes, fittings, and appurtenances shall be provided in accordance with the requirements of the applicable Sections of Divisions 2 and 15 and as indicated.
- B. **Pipe Supports:** Pipes shall be adequately supported, restrained, and anchored in accordance with Section 15006 - Pipe Supports, and as indicated.

- C. **Lining:** Application, thickness, and curing of pipe lining shall be in accordance with the applicable Sections of Division 2, unless otherwise indicated.
- D. **Coating:** Application, thickness, and curing of pipe coating shall be in accordance with the applicable Sections of Division 2, unless otherwise indicated. Pipes above ground or in structures shall be field-coated in accordance with Section 09800 - Protective Coating.
- E. **Pressure Rating:** Piping systems shall be designed for the maximum expected pressure as defined in Section 02643 - Water Pipeline Testing and Disinfection, or as indicated on the Piping Schedule.
- F. **Inspection:** Pipe shall be subject to inspection at the place of manufacture. During the manufacture of the pipe, the ENGINEER shall be given access to all areas where manufacturing is in progress and shall be permitted to make all inspections necessary to confirm compliance with requirements.
- G. **Tests:** Except where otherwise indicated, materials used in the manufacture of the pipe shall be tested in accordance with the applicable specifications and standards. Welds shall be tested as indicated. The CONTRACTOR shall be responsible for performing material tests.
- H. **Welding Requirements:** Welding procedures used to fabricate pipe shall be prequalified under the provisions of ANSI/AWS D1.1 - Structural Welding Code. Welding procedures shall be submitted for the ENGINEER'S review for longitudinal and girth or spiral welds for pipe cylinders, spigot and bell ring attachments, reinforcing plates and ring flange welds, and plates for lug connections.
- I. **Welder Qualifications:** Welding shall be done by skilled welders and welding operators who have had adequate experience in the methods and materials to be used. Welders shall be qualified under the provisions of ANSI/AWS D1.1 by an independent local, approved testing agency not more than 6 months prior to commencing work on the pipeline. Machines and electrodes similar to those used in the WORK shall be used in qualification tests. Qualification testing of welders and materials used during testing are part of the WORK.

2.2 PIPE FLANGES

- A. **General:** Flanges shall have flat faces and shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise indicated. Attachment of the flanges to the pipe shall conform to the applicable requirements of ANSI/AWWA C207. Flange faces shall be perpendicular to the axis of the adjoining pipe. Flanges for miscellaneous small pipes shall be in accordance with the standards indicated for these pipes.
- B. **Pressure Ratings**
 - 1. 150 psi or less: Flanges shall conform to either ANSI/AWWA C207 - Steel Pipe Flanges for Waterworks Service--Sizes 4 In. Through 144 In., Class D, or ANSI/ASME B16.5 - Pipe Flanges and Flanged Fittings, 150-lb class.
 - 2. 150 psi to 275 psi: Flanges shall conform to either ANSI/AWWA C207 Class E or Class F, or ANSI/ASME B16.5 150-lb class.
 - 3. 275 psi to 700 psi: Flanges shall conform to ANSI/ASME B16.5, 300-lb class.

4. Selection based on test pressure: AWWA flanges shall not be exposed to test pressures greater than 125 percent of rated capacity. For higher test pressures, the next higher rated AWWA flange or an ANSI-rated flange shall be selected.
- C. **Blind Flanges:** Blind flanges shall be in accordance with ANSI/AWWA C207, or as indicated for miscellaneous small pipes. Blind flanges for pipe sizes 12 inches and greater shall be provided with lifting eyes in form of welded or screwed eye bolts.
- D. **Flange Coating:** Machined faces of metal blind flanges and pipe flanges shall be coated with a temporary rust-inhibitive coating to protect the metal until the installation is completed.
- E. **Flange Bolts:** Bolts and nuts shall conform to Section 05500 - Miscellaneous Metalwork. Studs and bolts shall extend through the nuts a minimum of 1/4-inch. All-thread studs shall be used on all valve flange connections, where space restrictions preclude the use of regular bolts.
- F. **Insulating Flanges:** Insulated flanges shall have bolt holes 1/4-inch diameter greater than the bolt diameter.
- G. **Insulating Flange Sets:** Insulating flange sets shall be provided where indicated. Each insulating flange set shall consist of an insulating gasket, insulating sleeves and washers and a steel washer. Insulating sleeves and washers shall be one piece when flange bolt diameter is 1-1/2-inch or smaller and shall be made of acetal resin. For bolt diameters larger than 1-1/2-inch, insulating sleeves and washers shall be 2-piece and shall be made of polyethylene or phenolic material. Steel washers shall be in accordance with ASTM A 325 - Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength. Insulating gaskets shall be full-face.
- H. Insulating Flange Manufacturers, or equal;
1. **JM Red Devil, Type E**
 2. **Maloney Pipeline Products Co., Houston**
 3. **PSI Products, Inc., (Frost Engineering Service Co., Costa Mesa, California.)**
- I. Flange Gaskets
1. Gaskets for flanged joints used in general water and wastewater service shall be full-faced type, with material and thickness in accordance with ANSI/AWWA C207, suitable for temperatures to 700 degrees F, a pH of one to eleven, and pressures to 1000 psig. Blind flanges shall have gaskets covering the entire inside face of the blind flange and shall be cemented to the blind flange. Ring gaskets shall not be permitted, unless otherwise indicated. Flange gaskets shall be as manufactured by **John Crane, Style 2160, Garlock, Style 3000**, or equal.

2.3 THREADED INSULATING CONNECTIONS

- A. **General:** Threaded insulating bushings, unions, or couplings, as appropriate, shall be used for joining threaded pipes of dissimilar metals and for piping systems where corrosion control and cathodic protection are involved.

- B. **Materials:** Threaded insulating connections shall be of nylon, Teflon, polycarbonate, polyethylene, or other non-conductive materials, and shall have ratings and properties to suit the service and loading conditions.

2.4 MECHANICAL-TYPE COUPLINGS (GROOVED OR BANDED PIPE)

- A. **General:** Cast mechanical-type couplings shall be provided where indicated. The couplings shall conform to the requirements of ANSI/AWWA C606 - Grooved and Shouldered Joints. Bolts and nuts shall conform to the requirements of Section 05500 - Miscellaneous Metalwork. Gaskets for mechanical-type couplings shall be compatible with the piping service and fluid utilized, in accordance with the coupling manufacturer's recommendations. The wall thickness of grooved piping shall conform with the coupling manufacturer's recommendations to suit the highest expected pressure. To avoid stress on equipment, equipment connections with mechanical-type couplings shall have rigid-grooved couplings or flexible type coupling with harness in sizes where rigid couplings are not available, unless thrust restraint is provided by other means. Mechanical-type couplings shall be bonded. The CONTRACTOR shall have the coupling manufacturer's service representative verify the correct choice and application of couplings and gaskets, and the workmanship, to assure a correct installation. To assure uniform and compatible piping components, all grooved fittings, couplings, and valves shall be from the same manufacturer.

- B. Manufacturers of Couplings for Steel Pipe, or equal

1. **Gustin-Bacon (Aeroquip Corp.)** (banded or grooved)
2. **Victaulic Style 41 or 44** (banded, flexible)
3. **Victaulic Style 77** (grooved, flexible)
4. **Victaulic Style 07 or HP-70** (grooved, rigid)

- C. Manufacturers of Ductile Iron Pipe Couplings, or equal

1. **Gustin-Bacon, (Aeroquip Corp.)**
2. **Victaulic Style 31** (flexible or rigid grooving)

Note: Ductile iron pipe couplings shall be furnished with flush seal gaskets.

- D. Manufacturers of Couplings for PVC Pipe, or equal

1. **Gustin-Bacon, (Aeroquip Corp)**
2. **Victaulic Style 775**

Note: Couplings for PVC pipe shall be furnished with radius cut or standard roll grooved pipe ends.

2.5 SLEEVE-TYPE COUPLINGS

- A. **Construction:** Sleeve-type couplings shall be provided where indicated, in accordance with ANSI/AWWA C219 - Standard for Bolted Sleeve-Type Couplings for Plain-End Pipe. Couplings shall be steel with steel bolts, without pipe stop. Couplings shall be of sizes to fit the pipe and fittings indicated. The middle ring shall be not less than 1/4-inch thick or at least the same wall thickness as the pipe to which the coupling is connected. If the strength of the middle ring material is less than the strength of the pipe material, the thickness of the middle ring shall be increased to have the same strength as the pipe. The coupling shall be either 5 or 7 inches long for sizes up to and including 30 inches and 10 inches long for sizes greater than 30 inches, for standard steel couplings, and 16 inches long for long-sleeve couplings. The followers shall be single-piece contoured mill sections welded and cold-expanded as required for the middle rings, and of sufficient strength to accommodate the number of bolts necessary to obtain adequate gasket pressures without excessive rolling. The shape of the follower shall be of such design as to provide positive confinement of the gasket. Bolts and nuts shall conform to the requirements of Section 05500. Buried sleeve-type couplings shall be epoxy-coated at the factory as indicated.
- B. **Pipe Preparation:** Where indicated, the ends of the pipe shall be prepared for flexible steel couplings. Plain ends for use with couplings shall be smooth and round for a distance of 12 inches from the ends of the pipe, with outside diameter not more than 1/64-inch smaller than the nominal outside diameter of the pipe. The middle ring shall be tested by cold-expanding a minimum of one percent beyond the yield point, to proof-test the weld to the strength of the parent metal. The weld of the middle ring shall be subjected to air test for porosity.
- C. **Gaskets**
1. Gaskets for sleeve-type couplings shall be rubber-compound material that will not deteriorate from age or exposure to air under normal storage or use conditions. Gaskets for wastewater and sewerage applications shall be Buna "N," Grade 60, or equivalent suitable elastomer. The rubber in the gasket shall meet the following specifications:
 - a. Color - Jet Black
 - b. Surface - Non-blooming
 - c. Durometer Hardness - 74 +/- 5
 - d. Tensile Strength - 1000 psi Minimum
 - e. Elongation - 175 percent Minimum
 2. The gaskets shall be immune to attack by impurities normally found in water or wastewater. All gaskets shall meet the requirements of ASTM D 2000 - Classification System for Rubber Products in Automotive Applications, AA709Z, meeting Suffix B13 Grade 3, except as noted above. Where sleeve couplings are used in water containing chloramine or other fluids which attack rubber materials, gasket material shall be compatible with the piping service and fluid utilized.

- D. **Insulating Couplings:** Where insulating couplings are required, both ends of the coupling shall have a wedge-shaped gasket which assembles over a rubber sleeve of an insulating compound in order to obtain insulation of all coupling metal parts from the pipe.
- E. **Restrained Joints:** Sleeve-type couplings on pressure lines shall be harnessed unless thrust restraint is provided by other means. Harnesses shall be designed by the pipe manufacturer in accordance with Manual M11, or as indicated. Harness sets shall be designed for the maximum test pressure of the pipe in which they are installed. Where harness sets are installed near the suction and discharge of the pump, harness bolts shall have zero elongation to prevent misalignment of the pump imparted by the thrust within the piping system.
- F. **Manufacturers, or equal**
 - 1. **Dresser, Style 38**
 - 2. **Ford Meter Box Co., Inc., Style FC1 or FC3**
 - 3. **Smith-Blair, Style 411**

2.6 FLEXIBLE CONNECTORS

- A. Flexible connectors shall be installed in all piping connections to engines, blowers, compressors, and other vibrating equipment, and where indicated. Flexible connectors for service temperatures up to 180 degrees F shall be flanged, reinforced Neoprene or Butyl spools, rated for a working pressure of 40 to 150 psi, or reinforced, flanged duck and rubber, as best suited for the application. Flexible connectors for service temperatures above 180 degrees F shall be flanged, braided stainless steel spools with inner, annular, corrugated stainless steel hose, rated for minimum 150 psi working pressure, unless otherwise indicated. The connectors shall be a minimum of 9 inches long, face-to-face flanges, unless otherwise indicated. The final material selection shall be approved by the manufacturer. The CONTRACTOR shall submit manufacturer's shop drawings and calculations.

2.7 EXPANSION JOINTS

- A. Piping subject to expansion and contraction shall be provided with sufficient means to compensate for such movement without exertion of undue forces to equipment or structures. This may be accomplished with expansion loops, bellow-type expansion joints, or sliding-type expansion joints. Expansion joints shall be of stainless steel, Monel, rubber, or other materials best suited for each individual service. The CONTRACTOR shall submit detailed calculations and manufacturer's Shop Drawings of all proposed expansion joints, piping layouts, and anchors and guides, including information on materials, temperature and pressure ratings.

2.8 PIPE THREADS

- A. Pipe threads shall be in accordance with ANSI/ASME B1.20.1 - Pipe Threads, General Purpose (inch), and be made up with Teflon tape unless otherwise indicated.

PART 3 -- EXECUTION

3.1 MATERIAL DELIVERY, STORAGE, AND PROTECTION

- A. Piping materials, fittings, valves, and accessories shall be delivered in a clean and undamaged condition and stored off the ground for protection against oxidation caused by ground contact. Defective or damaged materials shall be replaced with new materials.

3.2 GENERAL

- A. Pipes, fittings, and appurtenances shall be installed in accordance with the requirements of the applicable Sections of Divisions 2 and 15.
- B. **Lined Piping Systems:** The lining manufacturer shall take full responsibility for the complete, final product and its application. Pipe ends and joints of lined pipes at screwed flanges shall be epoxy-coated to assure continuous protection.
- C. **Core Drilling:** Where core drilling is required for pipes passing through existing concrete, core drilling locations shall be determined by radiograph of concrete construction to avoid damage to embedded raceways and reinforcing bars.
- D. **Cleanup:** After completion of the WORK, cuttings, joining and wrapping materials, and other scattered debris shall be removed from the Site. The entire piping system shall be handed over in a clean and functional condition.

- END OF SECTION -

SECTION 15005 - PIPING IDENTIFICATION SYSTEMS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide identification devices for all exposed piping and valves using color bands, lettering, flow direction arrows, and related permanent identification devices, and all appurtenant works, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards:

ANSI A13.1 Scheme for the Identification of Piping Systems

1.3 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall submit samples of all types of identification devices to be used in the work.
- B. The CONTRACTOR shall submit to the ENGINEER, for approval, a list of suggested wording for all valve tags prior to fabrication.
- C. All submittals shall be in strict accordance with the requirements of Section 01300 - Contractor Submittals.

PART 2 -- PRODUCTS

2.1 IDENTIFICATION OF PIPING

- A. Identification of all exposed pipe shall be accomplished by color-coding with bands and by lettering as specified in Part 3, herein, and in Section 09800 - Protective Coating. Color bands shall either be painted directly upon the pipe or shall be pressure-sensitive adhesive-backed vinyl cloth or plastic tape.
- B. Each pipe identification shall consist of 2 color-coded bands, a printed label identifying the name of the pipe, and a flow arrow to indicate direction of flow in the pipe. All labels shall be preprinted on pressure-sensitive adhesive-backed vinyl cloth or plastic tape. Arrows shall be die-cut of the same type of material as the labels.
- C. Letter sizes and colors for lettering, arrows, and background shall conform to ANSI A13.1.
- D. Preprinted identification devices shall be as manufactured by **W.H. Brady Co.; Seton Nameplate Corp.; or equal.**

2.2 EXISTING IDENTIFICATION SYSTEMS

- A. In installations where existing piping identification systems have been established, the CONTRACTOR shall continue to use the existing system. Where existing identification systems are incomplete, utilize the existing system as far as practical and supplement with

the specified system. The objective is to fully identify all new piping, valves, and appurtenances to the level specified herein.

2.3 IDENTIFICATION OF VALVES AND SHORT PIPE LENGTHS

- A. Identifying devices for valves and the sections of pipe that are too short to be identified with color bands, lettered labels, and arrows shall be identified with metal or plastic tags as specified herein.
- B. Metal tags shall be of stainless steel with embossed lettering. Plastic tags shall be of solid black plastic laminate with white embossed letters. All tags shall be designed to be firmly attached to the valves or short pipes or to the structure immediately adjacent to such valves or short pipes.

PART 3 – EXECUTION

3.1 GENERAL

- A. All labels and identification tags shall be installed in accordance with the manufacturer's printed instructions, and shall be neat and uniform in appearance. All such tags or labels shall be readily visible from all normal working locations.

3.2 VALVE TAGS

- A. Valve tags shall be permanently attached to the valve or structure by means of 2 stainless steel bolts or screws.
- B. The wording on the valve tags shall describe the exact function of each valve, e.g., "HWR-BALANCING," "CLS THROTTLING", "RAS-PUMP SHUT-OFF," etc.

3.3 PIPE IDENTIFICATION

- A. Each pipe shall be identified at intervals of 20 feet, and at least one time in each room. Piping shall also be identified at a point approximately within 2 feet of all turns, ells, valves, and on the upstream side of all distribution fittings or branches. Sections of pipe that are too short to be identified with color bands, lettered labels, and directional arrows shall be tagged and identified similar to valves.
- B. Pipe identification shall consist of 4 elements, i.e., 2 color bands, a lettered label, and a directional label. The bands shall be arranged so that the lettered label and the directional arrow is placed between the 2 bands.

3.4 IDENTIFICATION SCHEDULE

- A. Application of identifying devices shall conform to the fluid abbreviations color codes determined by ENGINEER.

- END OF SECTION -

SECTION 15006 - PIPE SUPPORTS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide pipe supports, hangers, guides, and anchors, complete, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

- A. **General:** Submittals shall be in accordance with Section 01300 - Contractor Submittals.
- B. **Shop Drawings:** Shop Drawings shall include the following information:
 - 1. Drawings of pipe supports, hangers, anchors, and guides
 - 2. Calculations for special supports and anchors.

PART 2 -- PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. **Code Compliance:** All piping systems and pipe connections to equipment shall be properly anchored and supported to prevent undue deflection, vibration, dislocation due to seismic events and line pressures, and stresses on piping, equipment, and structures. All supports and parts thereof shall conform to the requirements of ANSI/ASME B31.1 - Power Piping, except as supplemented or modified below. Supports for plumbing piping shall be in accordance with the latest edition of the applicable plumbing code or local administration requirements.
- B. **Structural Members:** Wherever possible, pipes shall be supported from structural members. Where it is necessary to frame structural members between existing members, such supplementary members shall be provided by the CONTRACTOR. All supplementary members shall be in accordance with the requirements of the building code and the American Institute of Steel Construction and shall be acceptable to the ENGINEER.
- C. **Pipe Hangers:** Pipe hangers shall be capable of supporting the pipe in all conditions of operation, allowing free expansion and contraction of the piping, and preventing excessive stress on equipment. All hangers shall have a means of vertical adjustment after erection. Hangers shall be designed to prevent becoming disengaged by any movement of the supported pipe. Hangers subject to shock, seismic disturbances, or thrust imposed by the actuation of safety valves, shall include hydraulic shock suppressors. All hanger rods shall be subject to tensile loading only.
- D. **Hangers Subject to Horizontal Movements:** At hanger locations where lateral or axial movement is anticipated, suitable linkage shall be provided to permit such movement. Where horizontal pipe movement is greater than 1/2-inch, or where the hanger rod deflection from the vertical is greater than 4 degrees from the cold to the hot position of the pipe, the hanger rod and structural attachment shall be offset in such a manner that the rod is vertical in the hot position.

- E. **Spring-Type Hangers:** Spring-type pipe hangers shall be provided for piping subject to vibration or vertical expansion and contraction, such as engine exhausts and similar piping. All spring-type hangers shall be sized to the manufacturer's printed recommendations and the loading conditions encountered. Variable spring supports shall be provided with means to limit misalignment, buckling, eccentric loading, or to prevent overstressing of the spring, and with means to indicate at all times the compression of the spring. Supports shall be capable of accommodating at least 4 times the maximum travel due to thermal expansion.
- F. **Thermal Expansion:** Wherever expansion and contraction of piping is expected, a sufficient number of expansion loops or joints shall be provided, together with the necessary rolling or sliding supports, anchors, guides, pivots, and restraints permitting the piping to expand and contract freely in directions away from the anchored points. All components shall be structurally suitable to withstand all loads imposed.
- G. **Heat Transmission:** Supports, hangers, anchors, and guides shall be so designed and insulated, that excessive heat will not be transmitted to the structure or to other equipment.
- H. **Riser Supports:** Where practical, risers shall be supported on each floor with riser clamps and lugs, independent of the connected horizontal piping.
- I. **Freestanding Piping:** Free-standing pipe connections to equipment such as chemical feeders and pumps shall be firmly attached to steel frames fabricated from angles, channels, or I-beams anchored to the structure. Exterior, free-standing overhead piping shall be supported on fabricated pipe stands consisting of pipe columns anchored to concrete footings, with horizontal, welded steel angles and U-bolts or clamps securing the pipes.
- J. **Materials of Construction:**
1. **General:** All pipe support assemblies, including framing, hardware, and anchors, shall be of stainless steel construction, unless otherwise indicated.
 2. **Submerged Supports:** All submerged piping, as well as piping, conduits, and equipment in hydraulic structures within 24 inches of the water level, shall be supported with support assemblies, including framing, hardware, and anchors, constructed of Type 316 stainless steel, unless otherwise indicated.
 3. **Corrosive:** All piping in chemical and corrosive areas shall be supported with support assemblies, including framing, hardware, and anchors, constructed of Type 316 stainless steel or FRP, unless otherwise indicated.
- K. **Point Loads:** Any meters, valves, heavy equipment, and other point loads on PVC, FRP, and other plastic pipes, shall be supported on both sides, according to manufacturer's recommendations to avoid undue pipe stresses and failures. To avoid point loads, all supports on PVC, FRP, and other plastic piping shall be equipped with extra wide pipe saddles or galvanized steel shields.
- L. **Noise Reduction:** To reduce transmission of noise in piping systems, all copper tubes in buildings and structures shall be wrapped with a 2-inch wide strip of rubber fabric or similar, suitable material at each pipe support, bracket, clip, or hanger.

2.2 SUPPORT SPACING

63	--	41	45	49	52	55	60	64	67	71
66	--	41	45	49	52	55	60	64	68	71
72	--	41	45	49	52	55	61	65	69	72
78	--	41	46	49	53	56	61	66	69	73
84	--	41	46	50	53	56	62	66	70	74
90	--	41	46	50	53	56	62	67	71	74
96	--	42	46	50	54	57	62	67	71	75

For steel pipe sizes not presented in this table, the support spacing shall be designed so that the stress on the pipe does not exceed 5,000 psi. Maximum deflection of pipe shall be limited to 1/360th of the span and shall be calculated by using the formula:

$$L = (7500tD/(32t+D))^{1/2}$$

where: t = Thickness (inches)
 D = Diameter (inches)
 L = Maximum span (feet)

3. Support Spacing for Ductile-Iron Pipe:

Nominal Pipe Diameter (inches)	Maximum Span (feet)
All Diameters	Two supports per pipe length or 10 feet (one of the 2 supports located at joint)

4. Support Spacing for Copper Tubing:

Nominal Pipe Diameter (inches)	Maximum Span (feet)
1/2 to 1-1/2	6
2 to 4	10
6 and greater	12

5. Support Spacing for Schedule 80 PVC Pipe:

Nominal Pipe Diameter (inches)	Maximum Span (at 100 degrees F) (feet)
1/2	4
3/4	4.5
1	5
1-1/4	5.5
1-1/2	5.75
2	6.25
3	7.5
4	8.25
6	10
8	11
10	12.25
12	13.25

A. Supports for piping with the longitudinal axis in approximately a horizontal position shall be spaced to prevent excessive sag, bending, and shear stresses in the piping, with special consideration given where components such as flanges and valves impose concentrated loads. Pipe support spacing shall not exceed the maximum spans in the tables below. For temperatures other than ambient temperatures, or those listed, and for other piping materials or wall thicknesses, the pipe support spacings shall be modified in accordance with the pipe manufacturer's recommendations. Vertical supports shall be provided to prevent the pipe from being overstressed from the combination of all loading effects.

1. Support Spacing for Schedule 40 and Schedule 80 Steel Pipe:

Nominal Pipe Diameter (inches)	Maximum Span (feet)
1/2	6
3/4 and 1	8
1-1/4 to 2	10
3	12
4	14
6	17
8 and 10	19
12 and 14	23
16 and 18	25
20 and greater	30

2. Support Spacing for Welded Fabricated Steel Pipe:

Maximum Spans for Pipe Supported in Minimum
120 degree Contact Saddles (feet)

Nominal Pipe Diameter (inches)	Wall Thickness (inches)									
	3/16	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1
24	33	37	41	43	45	47				
26	34	38	41	44	46	48				
28	34	38	41	44	47	49				
30	34	38	42	45	48	49				
32	34	39	42	45	48	50				
34	35	39	43	46	48	50				
36	35	39	43	46	49	51	55			
38	35	39	43	46	49	51	55			
40	35	40	43	47	49	52	56			
42	35	40	44	47	50	52	56			
45	--	40	44	47	50	53	57			
48	--	40	44	47	50	53	58	61		
51	--	40	44	48	51	53	58	62		
54	--	40	44	48	51	54	58	62		
57	--	41	45	48	51	54	59	63		
60	--	41	45	48	52	54	59	63	67	70

2.3 MANUFACTURED SUPPORTS

- A. **Stock Parts:** Where not specifically indicated, designs which are generally accepted as exemplifying good engineering practice and use stock or production parts, shall be utilized wherever possible. Such parts shall be locally available, new, of best commercial quality, designed and rated for the intended purpose.
- B. **Manufacturers, or Equal:**
1. **Basic Engineers Inc.,** Pittsburgh, PA;
 2. **Bergen-Paterson Pipesupport Corp.,** Woburn, MA;
 3. **Grinnell Corp. (Supply Sales Company),** Cranston, RI;
 4. **NPS Products, Inc.,** Westborough, MA;
 5. **Power Piping Company,** Pittsburgh, PA.

2.4 COATING

- A. **Galvanizing:** Unless otherwise indicated, all fabricated pipe supports other than stainless steel or non-ferrous supports shall be blast-cleaned after fabrication and hot-dip galvanized in accordance with ASTM A 123 - Specifications for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- B. **Other Coatings:** Other than stainless steel or non-ferrous supports, all supports shall receive protective coatings in accordance with the requirements of Section 09800 - Protective Coating.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. **General:** All pipe supports, hangers, brackets, anchors, guides, and inserts shall be fabricated and installed in accordance with the manufacturer's printed instructions and ANSI/ASME B31.1 - Power Piping. All concrete inserts for pipe hangers and supports shall be coordinated with the formwork.
- B. **Appearance:** Pipe supports and hangers shall be positioned to produce an orderly, neat piping system. All hanger rods shall be vertical, without offsets. Hangers shall be adjusted to line up groups of pipes at the proper grade for drainage and venting, as close to ceilings or roofs as possible, without interference with other work.

3.2 FABRICATION

- A. **Quality Control:** Pipe hangers and supports shall be fabricated and installed by experienced welders and fitters, using the best welding procedures available. Fabricated supports shall be neat in appearance without sharp corners, burrs, and edges.

- END OF SECTION -

SECTION 15030 - STAINLESS STEEL PIPE

PART 1 — GENERAL

1.1 SCOPE OF WORK

- A. The CONTRACTOR shall furnish all materials, tools, equipment, labor, and appurtenances required to supply, store, install, clean, and test the shop fabricated stainless steel pipe and fittings where shown on the Drawings and as specified herein.

1.2 QUALIFICATIONS

- A. All shop fabricated stainless steel pipe and fittings shall be furnished by a single manufacturer who is experienced, and qualified in the manufacture and fabrication of the items to be furnished. The pipe and fittings shall be shop fabricated and field installed in accordance with common industry wide practices and methods, and shall comply with these specifications.
- B. **Welder Qualifications:** All welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used. All field welding shall be per pipe manufacturer's written instructions.

1.3 SUBMITTALS

- A. **Shop Drawings:** The CONTRACTOR shall submit shop drawings of pipe and fittings in accordance with the requirements in Section 01300, "Contractor Submittals," and the following supplemental requirements as applicable:
 1. Certified dimensional drawings of all valves, fittings, and appurtenances.
 2. Joint and pipe/fitting wall construction details which indicate the type and thickness of pipe, manufacturing tolerances, and all other pertinent information required for the manufacture of the product.
 3. Fittings and specials details such as elbows, wyes, tees, outlets, connections, test bulkheads, and nozzles or other specials where shown on the Drawings which indicate amount and position of all reinforcement. All fittings and specials shall be properly reinforced to withstand the internal pressure, both circumferential and longitudinal.
 4. Line layout and marking diagrams which indicate the specific number of each pipe and fitting and the location of each pipe and the direction of each fitting in the completed line. In addition, the line layouts shall include: the pipe station and invert elevation at all changes in grade or horizontal alignment, the station and invert elevation to which the bell end of each pipe will be laid, all elements of curves and bends, both in horizontal and vertical alignment, and the limits of each reach of restrained and/or welded joints, or of concrete encasement.
 5. Full and complete information regarding location, type, size, and extent of all welds shall be shown on the shop drawings. The shop drawings shall distinguish between shop and field welds. Shop drawings shall indicate by welding symbols or sketches the details of the welded joints, and the preparation of parent metal required to make

them. Joints or groups of joints in which welding sequence or technique are especially important shall be carefully controlled to minimize shrinkage stresses and distortion.

PART 2 — PRODUCTS

2.1 PIPE AND FITTINGS

- A. Pipe shall be manufactured in accordance with ASTM A778 of hot rolled annealed and pickled sheets. Pipe shall be manufactured to nominal pipe sizes as listed in ANSI B36.19, Table 2.
- B. Actual Schedule/Gauge/Plate and Wall Thickness to be verified by manufacturer's shop drawings. Unless otherwise noted in the Contract Documents all stainless steel pipe shall be Schedule 10S.
- C. Fittings shall be butt weld type manufactured in accordance with ASTM 774 of the same raw material and in the same thicknesses as the pipe. Long radius elbows up to 24-inch diameter shall be smoothflow; i.e., centerline to end of elbow equals 1.5 times the nominal pipe size. All short radius, special radius, and reducing elbows and long radius elbows greater than 24-inch diameter shall be of mitered construction with at least (5) miter sections for 90 degree bends, (3) mitered sections for 45 and 60 degree bends, and (2) mitered sections for 30 degree and smaller bends. Reducers shall be straight tapered, cone type. Tees, crosses, laterals and wyes shall be shop fabricated from pipe.
- D. Pipe and fittings shall be acid pickled after manufacture in accordance with paragraph 3.1.A to achieve a uniform No. 1 or better finish.

2.2 FLANGES

- A. Flange pipe ends shall be made up of type 316L stainless steel slip-on type rolled angle face rings and 300 series stainless steel back-up flanges drilled to ANSI 16.5 class 150 standard. The angle face ring thickness shall be equal to or greater than the wall of the pipe or fitting to which it is welded and it shall be continuously welded on both sides to the pipe or fitting. The angle log shall not interfere with the flange bolt holes. The back-up flanges shall be supplied with nominal thicknesses in accordance with the requirements of ANSI/AWWA C207 Class D ring flanges. Alternatively, back-up flanges may be designed in accordance with Section VIII Division 1 of the ASME Boiler and Pressure Vessel Code for a working pressure of not less than 150 psi at 1000F.

2.3 COUPLINGS

- A. The piping will be shop prepared for pipe couplings where shown on the drawings or specified herein.
- B. Mechanical couplings at equipment connections shall be in accordance with the requirements of Section 15000, "Piping, General" as modified by this Section. Gaskets shall be suitable for the service conditions. The pipe ends shall be roll grooved to the coupling manufacturer's specifications for piping size 12-inches and under. Where roll grooving is impractical, the pipe shall have heavy wall machine grooved pipe nipples or machined ring collars fully welded to the pipe or fitting. Nipples shall be taper bored to

the I.D. of the adjoining pipe to allow full weld penetration. Collars shall be welded on both sides to the piping. Nipples and collars shall be of the same alloy as the piping.

- C. For piping sizes 8-inches and over, shouldered couplings may be used. Shoulder rings shall be the same alloy as the pipe material and shall be welded to the pipe ends to coupling manufacturer's requirements for the required pressure rating. Shouldered couplings shall be **Depend-O-Lok, Fluid Master by Brico Industries, Inc., or equal.**
- D. Couplings for roll grooved or shouldered pipe shall be steel with fusion bonded epoxy coating in accordance with Section 09800, "Protective Coatings."

2.4 JOINTS

- A. Flanges shall be provided where shown in the Drawings and at other locations where necessary for proper installation. Flanges shall be provided as a minimum at all flanged valves, meters, couplings, and other equipment. Couplings will be provided as shown on the drawings.
- B. Pipe and fitting spools shall be shop fabricated to the fullest extent possible in 40-foot maximum lengths with 7-foot 6-inch maximum widths. Spools with fittings may exceed 40 feet. Smaller pipe spools shall be provided with joints as shown on the Drawings for special handling, installation, and/or disassembly requirements.
- C. All other joints required for shipping, handling, and installation of the piping spools shall be field welds, unless otherwise shown or specified.
- D. **Markings:** The CONTRACTOR shall legibly mark all pipes and specials in accordance with the laying schedule and marking diagram. Each pipe shall be numbered in sequence and said number shall appear on the laying schedule and marking diagram in its proper location for installation. All special pipe sections and fittings shall be marked at each end with top field centerline. The word "top" shall be painted or marked on the outside top spigot end of each pipe section.
- E. Tees, crosses, laterals and wyes shall be shop fabricated from pipe; however stainless steel reinforcement pads shall be fully welded to the branch and run of pipe to maintain the specified test pressure of the system. The thickness and width of the reinforcing pad shall be determined in accordance with ANSI B31.1.

PART 3 — EXECUTION

3.1 GENERAL

- A. After the manufacture of individual stainless steel fittings and pipe lengths, they shall be pickled by immersion in a tank containing an ambient nitric-hydrofluoric acid solution made up from **Oakite Deoxidizer SS, or equal**, and monitored to generally maintain a 25 percent or higher solution by volume of water. The duration of immersion shall be 15 to 20 minutes and may be supplemented by manually scrubbing or brushing with non metallic pads or stainless steel wire brushes. The acid treatment shall be followed by immersion in a rinse water tank, followed, if necessary, by a spray rinse. The stainless steel products shall be allowed to air dry to achieve passivation. Stainless steel pipe

located above the slab on the membrane skids shall be in accordance with Section 11276.

- B. Welding of pipe spools shall be performed using welders and procedures qualified in accordance with ASME Section IX. Piping with wall thicknesses up to an including 11 gauge (0.125 inches) shall be welded with TIG (GTAW) process. Heavier walls shall be beveled according to procedure, root pass welded with the TIG (GTAW), and have subsequent weld passes performed using the TIG (GTAW), MIT (GMAW), or Metallic Arc (SMAW) process. Filler metal of equal or superior ELC grades only shall be added to all welds to provide a cross section at the weld equal to or greater than the parent metal. Weld deposit shall be smooth and evenly distributed; weld reinforcement shall be as follows:

	<u>Wall Thickness (inches)</u>	<u>Weld Reinforcement (maximum) (inches)</u>
	<u>I.D.</u>	<u>O.D.</u>
Up to 12 Ga. (0.109)	1/16	3/32
11 Ga. (0.125) to 3/16 Pl.	3/32	1/8
1/4 Plate and Larger	1/8	3/16

- C. Concavity, undercut, cracks, or crevices shall not be allowed. Butt welds shall have full penetration to the interior surface, and inert argon gas shielding shall be provided to the interior and exterior of the joint. Angle face rings shall be continuously welded on both sides to pipe or fitting. Exterior welds, such as the back side of face rings or flanges and structural attachments, may be welded by the MIG (GMAW) or Metallic Arc (SMAW) process; interior surface on very light walls. Excessive weld deposits, slag, spatter, and projections shall be removed by grinding. Welds on gasket surfaces shall be ground smooth.
- D. Spools shall be fabricated to the "Pipe Fabrication Institute" fabricating tolerances ES-3 (1981).
- E. After shop fabrication into pipe spools or field welding, exterior welds and heat affected areas shall be pickled with **Oakite Deoxidizer SS or equal**, rinsed with clean water and allowed to air dry."
- F. **Handling and Storage:** Extreme care shall be used to avoid the contact of any ferrous materials with the stainless steel piping. All saws, drills, files, wire brushes, etc. shall be used for stainless steel piping only. Pipe storage and fabrication racks shall be non ferrous or stainless steel or rubber lined. Nylon slings or straps shall be used for handling stainless steel piping. Contact with ferrous items may cause rusting of iron particles embedded in the piping walls. After installation, the CONTRACTOR shall wash and rinse all foreign matter from the piping surface. If rusting of embedded iron occurs, the CONTRACTOR shall pickle the affected surface with **Oakite Deoxidizer SS or equal**, scrub with stainless steel brushes and rinse clean.
- G. The use of chains, hooks, or other equipment which might injure the pipe will not be permitted. All other pipe handling equipment and methods shall be acceptable to the ENGINEER.
- H. All fabricated piping shall have openings plugged and flanges screened for storage and/or transport after fabrication.

- I. The CONTRACTOR shall be fully liable for the cost of replacement or repair of pipe which is damaged.
- J. Stockpiled pipe shall be supported on sand or earth berms free of rock exceeding 3 inches in diameter. The pipe shall not be rolled and shall be secured to prevent accidental rolling.
- K. **Strutting:** Adequate strutting shall be provided on all specials, fittings, and straight pipe so as to avoid damage to the pipe and fittings during handling, storage, hauling, and installation. For stainless steel pipe, the following requirements shall apply:
- L. The strutting materials, size and spacing shall be adequate to support the earth backfill plus any greater loads which may be imposed by the backfilling and compaction equipment.
- M. Any pipe damaged during handling, hauling, storage, or installation due to improper strutting shall be repaired or replaced.
- N. The details of the strutting assembly shall be submitted for review by the ENGINEER prior to the start of pipe manufacture.
- O. Painting of the stainless steel pipe is not required unless otherwise noted. However, the CONTRACTOR shall be responsible for supplying and installing the stainless steel piping with a consistently clean and smooth surface. Identifying spool pierce marks shall be removed with paint thinner or solvents and the entire stainless steel surface shall be washed with detergent and hot water and rinsed clean. Final marking of the pipeline will be in accordance with Section 15005, "Piping Identification Systems."

- END OF SECTION -

**SECTION 15060 - PVC PRESSURE PIPE, SOLVENT-WELDED
(ASTM D 1785, MODIFIED)**

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide Polyvinyl Chloride (PVC) pressure pipe, complete and in place, in accordance with the Contract Documents.
- B. The requirements of Section 15000 - Piping, General, apply to the WORK of this Section.

PART 2 -- PRODUCTS

2.1 PIPE MATERIAL

- A. PVC pipe shall be made from all new rigid unplasticized polyvinyl chloride and shall be normal impact Type 1, Grade 1, class 12454, Schedule 80, listed as compliant with NSF Standard 61, unless otherwise indicated, in accordance with ASTM D 1785 Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120, as called out in the Piping Schedule.

2.2 PIPE JOINTS

- A. Pipe joints shall be solvent-welded with solvent cement in accordance with ASTM D 2564 - Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems, and with primer in accordance with ASTM F 656 - Primers for use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings. Screwed joints that are necessary to match up to threaded valves or fittings shall be made up with appropriate thread sealant, either paste or tape. Flanged joints shall be made with solvent-welded PVC flanges, drilled to ANSI/ASME B 16.5 - Pipe Flanges and Flanged Fittings, Class 150, unless otherwise indicated. Gaskets shall be ANSI 150 lb. full face, 1/8-inch thick Neoprene.

2.3 FITTINGS

- A. **Solvent Welded and Threaded Fittings:** Solvent-welded and threaded fittings shall be Schedule 80 PVC fittings in accordance with ASTM D 2467 - Socket-Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- B. **Flanged Fittings:** Flanged fittings shall be Schedule 80 fabricated PVC fittings with 150 lb. flanges to ANSI/ASME B 16.5.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. **General:** PVC pipes shall be installed in a neat and workmanlike manner, properly aligned, and cut from measurements taken at the site to avoid interferences with structural members, architectural features, openings, and equipment. Exposed pipes shall afford maximum headroom and access to equipment, and where necessary piping shall be installed with sufficient slopes for venting or drainage of liquids and condensate to low

accessories which are to be connected to the lines and which would be damaged if subjected to the test pressure shall be disconnected and ends of the branch lines be plugged or capped as required during the testing procedures.

2. Leaks shall be repaired to the satisfaction of the ENGINEER, and the system shall be re-tested until no leaks are found.

- END OF SECTION -

points. The entire installation shall be acceptable to the ENGINEER. It is recommended that the CONTRACTOR obtain the assistance of the pipe manufacturer's field representative to instruct the pipe fitters in the correct installation and support of PVC piping.

- B. **Supports and Anchors:** Piping shall be firmly supported with fabricated or commercial hangers or supports in accordance with Section 15006 - Pipe Supports. Where necessary to avoid stress on equipment or structural members, the pipes shall be anchored or harnessed. Expansion joints and guides shall compensate for pipe expansion due to temperature differences.
- C. **Valves and Unions:** Unless otherwise indicated, connections to fixtures, groups of fixtures, and equipment shall be provided with a shutoff valve and union, unless the valve has flanged ends. Unions shall be provided at threaded valves, equipment, and other devices requiring occasional removal or disconnection. Valves and flanges attached to PVC pipe shall be provided with adequate supports.

3.2 PIPE PREPARATION

- A. Prior to installation, each pipe length shall be carefully inspected, flushed clean of any debris or dust, and be straightened, if not true. Ends of threaded pipes shall be reamed and filed smooth. Pipe fittings shall be equally cleaned before assembly.

3.3 PIPE JOINTS

- A. **Threaded Joints:** Pipe threads shall conform to ASTM F 1498 - Taper Pipe Threads 60° for Thermoplastic Pipe and Fittings, and shall be full and cleanly cut with sharp dies or molded. Joints shall be made with Teflon tape or thread sealant.
- B. **Solvent-Welded Joints:** Solvent-welded joints shall be made with fresh primer and solvent cement on clean, dry pipe ends. The primer and cement cans shall be kept closed at all times and the joints shall be made up at the recommended ambient temperatures, to the pipe or cement manufacturer's written recommendations. Pipe ends shall be inserted to the full depth of the socket.
- C. **Flange Joints:** Flanged joints shall be made with gaskets and Type 316 stainless steel bolts and nuts. Care shall be taken not to over-torque the bolts, in accordance with the manufacturer's written recommendations.

3.4 INSPECTION AND FIELD TESTING

- A. **Inspection:** Finished installations shall be carefully inspected for proper joints and sufficient supports, anchoring, interferences, and damage to pipe, fittings, and coating. Damage shall be repaired to the satisfaction of the ENGINEER.
- B. **Field Testing:** Prior to enclosure or burying, piping systems shall be pressure tested as required in the Piping Schedule, for a period of not less than one hour, without exceeding the tolerances listed in the Piping Schedule. Caution - Do not use air or gas for testing PVC pipe. Where no pressures are indicated, the pipes shall be subject to 1-1/2 times the maximum working pressure. The CONTRACTOR shall furnish all test equipment, labor, materials, and devices.

- 1. Leakage shall be determined by loss of pressure. Fixtures, devices, or other

SECTION 15075 - METERS, GENERAL

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall furnish and install all meters and flow measurement devices with associated instrumentation and controls as shown and specified herein, complete and operable, for functions including flow measurement, density determination, and batch metering of fluids including water, chemicals, and gases in accordance with the requirements of the Contract Documents.

B. REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

1. **Codes:** All codes, as referenced herein, are specified in Section 01090, "Reference Standards."

Commercial Standards:

ISA - S 5.1	Instrumentation Symbols and Identification
ANSI - B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800
ANSI/AWWA C207	Steel Pipe Flanges for Waterworks Service - Sizes 4 In Through 144 In.
ANSI/AWWA C701	Cold-Water Meters - Turbine Type for Customer Service
ANSI/AWWA C702	Cold-Water Meters - Compound Type
AWWA C704	Cold-Water Meters - Propeller Type for Main Line Applications
ASME REPORT	Fluid Meters, Sixth Edition, 1971

1.2 CONTRACTOR SUBMITTALS

A. **Shop Drawings:** The CONTRACTOR shall submit complete shop drawings of all meters for review in accordance with the Section 01300, "Contractor Submittals." Each meter shall be identified with its equipment number, as shown or specified.

B. **Manufacturer's Data:** With the shop drawings, the CONTRACTOR shall also furnish certified curves indicating flow versus differential pressure and any other information called for in the individual meter specifications.

C. **O & M Manuals:** The CONTRACTOR shall furnish to the ENGINEER 5 identical copies of complete operation and maintenance instructions of all the metering systems including instrumentation and controls, as specified under paragraph "Technical Manuals" of the Section 01300, "Contractor Submittals."

- D. **Spare Parts:** The CONTRACTOR shall provide a list of manufacturer's recommended spare parts and after the ENGINEER'S approval, shall furnish all spare parts suitably packaged and labeled for each meter device.
- E. **Special Tools:** A list of special tools required shall be submitted to the ENGINEER for approval. After approval the CONTRACTOR shall supply these tools suitably wrapped and identified for application. Special tools shall include substitute steel spools for each meter for maintenance purposes. Each spool shall be labeled to identify the meter for which temporary replacement is required. The label shall include the meter identification number, size and service.

1.3 QUALITY ASSURANCE

- A. **Inspection and Testing Requirements:** After installation, the CONTRACTOR shall obtain the services of an experienced factory service representative to inspect and test all meters for proper performance and installation.
- B. **Accuracy Requirements:** Unless otherwise specified herein, the flow meters shall be guaranteed to register flow to an accuracy of ± 2 percent of actual flow throughout the range specified. (All density measuring equipment shall have a degree of accuracy within ± 2 percent of actual solids content over the range specified for each density measurement system.)

1.4 MANUFACTURER'S SERVICE REPRESENTATIVE

- A. **Erection and Startup Assistance:** During erection and startup of the plant the CONTRACTOR shall obtain all necessary assistance from an experienced factory service representative to ensure a correct and first class installation, in accordance with the manufacturer's instructions.
- B. **Instruction of OWNER's Personnel:** After completion of the installation and during startup of the plant, the CONTRACTOR shall instruct the OWNER's personnel in the proper operation, maintenance and repair of all metering equipment. For this purpose, the CONTRACTOR shall obtain the services of an experienced factory service representative, who shall spend sufficient time on the site to fully instruct the OWNER's operating personnel on all phases of its equipment.

1.5 CLEANUP

- A. After completion and testing of its work, the CONTRACTOR shall remove all debris from the site, clean all meters, controls, cabinets, and other metering appurtenances, to hand over each system in perfect operating condition.

1.6 GUARANTEES, WARRANTIES

- A. After completion the CONTRACTOR shall furnish to the OWNER the manufacturer's written guarantees, that the metering systems will operate within the published accuracies and flow ranges and meet these Specifications. The CONTRACTOR shall also furnish the manufacturer's warranties as published in its literature and as specified.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. The CONTRACTOR shall assemble and install all equipment specified herein, in strict accordance with the manufacturer's published instructions, under the supervision of the manufacturer's representative, under the general review of the ENGINEER. All installations shall be accomplished by competent craftsmen in a workmanlike manner.
- B. The meters shall be installed in easily accessible locations for ease of reading and maintenance, and, where shown, for balancing of flow in several lines, in conjunction with throttling and shut-off valves. Wherever possible, all meters shall be installed in such a way to provide the manufacturer's recommended straight approach and straight piping downstream. All meters, shut-off and balancing valves shall be firmly supported from the structure or from the floor with approved supports. In-line meters shall be installed to provide full-line flow and not less than the manufacturer's recommended head at all times.

3.2 TESTING

- A. Equipment shall be prepared for operational use in accordance with manufacturer's instructions, including bench test and calibration, where required.
- B. Each item shall be subjected to an operating test over the total range of capability of the equipment. Where applicable, tests shall be conducted in accordance with the Test Code of the Standards of the Hydraulic Institute. The CONTRACTOR shall obtain copies of factory test certifications and shall notify the ENGINEER one week in advance of all tests to be conducted on site.

3.3 ACCEPTANCE BY OWNER

- A. Final acceptance of the equipment is contingent on satisfactory operation after installation.

- END OF SECTION -

SECTION 15082 - VENTURI METERS

PART 1 — GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all differential-producing metering equipment and all appurtenant work, complete and operable, in accordance with the requirements of the Contract Documents. The equipment shall be compatible with differential sensing flow rate transmitters specified in Division 17.

1.2 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall submit complete shop drawings of all metering tubes. The flow tube for FE-1,2 shall be a fabricated primary flow element type bi-directional Venturi meter. FE-3 shall be a short body modified type Venturi meter with throat liner. The Venturi-type flow tubes shall be designed for working under conditions shown. The CONTRACTOR shall furnish a certified curve from the manufacturer that shall show flow versus differential pressure for each tube. The CONTRACTOR shall also furnish certified data which shall substantiate tube proportions and performance. These data shall include:

1. Coefficient values and tolerances.
2. Effects of upstream configuration (for each meter).
3. Headloss as a function of the velocity head expended.
4. Permanent headloss shall not exceed 40" water column.
5. Test results from recognized hydraulic laboratory for each meter furnished. Tests shall show that the discharge coefficient is within 0.75 percent of standard.
6. This tolerance shall not exceed twice the standard deviation by this procedure described in ASME "Fluid Meters" Sixth Edition. Documentation tabulating at least 30 different venturi tubes of the same type which have been tested at a recognized hydraulic laboratory and conforming to the twice standard deviation procedure will be acceptable in lieu of hydro testing.

- B. The differential pressure shall indicate flow change only as a Herschel Standard Venturi tube without use of devices which employ entire or partial pilot effects, or which amplify differential, or which introduce unwanted noise. Maximum headloss at maximum flow shall not exceed 40" water column. Minimum discharge coefficient shall be 0.97. The accuracy shall be ± 0.7 percent of actual rate of flow corresponding to the differential produced over the ranges indicated. The total overall error of each flow measurement loop including flow tube, transmitting, receiving, and totalizing equipment shall not exceed 2 percent of actual rates of flow between the specified flow ranges.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. **Compatibility:** To assure the highest possible accuracy and complete compatibility, the CONTRACTOR shall provide all similar flow metering equipment from a single manufacturer.
- B. **Characteristics of Flow Tubes:** The meter shall be of the pressure differential-producing type utilizing pure static pressures sensed at the inlet and at the throat, without the use of devices which amplify differential through change in direction of flow at the cross-sections where inlet and/or throat static pressure is sensed.
- C. **Tube Design:** The inlet section which incorporates the high pressure tap shall be a cylindrical section of the same diameter as the pipe. The throat section shall be cylindrical for a minimum length of 1/2 of the throat diameter; the low pressure tap shall be installed in this section. The metering element shall be free of debris-collecting cavities or annular chambers and shall have a single pressure connection at the inlet and one at the throat.
- D. **Schedule of Venturi Meters:** The CONTRACTOR shall furnish the following flow tubes:

I.D. No.	Service	Size (in)	Flow Range (gpm)	Differential (in w/c)	Ends	Beta Ratio	Material of Tube
FE-1,2	Raw Water	12"	4000 max 1400 min	100	Flange d 150#	0.67	316 SS
FE-3	Raw Water	10"	4000 max 1400 min	100	Flange d 150#	0.73	316 SS

2.2 BASIC MATERIALS

- A. **Meter Body:** The venturi body shall be fabricated of Type 316 stainless steel, including the throat and inlet sections. All internal, ferrous surfaces shall be coated in accordance with the requirements of Section 09800- Protective Coating. The tubes shall have flanged ends. Flanges shall be ANSI rated 150 lbs. and constructed of Type 304 or 316 stainless steel.
- B. **Instrumentation:** A flow transmitter shall be furnished and installed as specified in Division 17. The flow transmitter shall be installed in accordance with the installation details. The transmitter shall be connected to the flow tube with stainless steel tubing, complete with 3 way valve manifold, flush and vent connections, as recommended by the manufacturer.
- C. **Nameplate:** Contractor shall provide a nameplate stating the following information: manufacturer, size, name, serial number, and flow at 100 inches w.c.
- D. **Manufacturers:**
1. BIF,
 2. Primary Flow Signal.

PART 3 — EXECUTION

3.1 INSTALLATION

- A. All venturi meters and appurtenant work shall be installed in strict accordance with the manufacturer's printed instructions.**

END OF SECTION -

SECTION 15183 - GAUGES

PART 1 – GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide pressure and vacuum gauges and appurtenances, complete and operable, in accordance with the Contract Documents.

PART 2 – PRODUCTS

2.1 PRESSURE AND VACUUM GAUGES

- A. **General:** Pressure gauges shall be provided on suction and discharge connections to pumps as indicated in the pump specifications; on discharge connections from blowers and compressors; each side of pressure reducing valves; and wherever indicated. Vacuum gauges shall be provided for vacuum pumps and wherever indicated. In all locations (such as certain pump suction connections) where pressures may vary from below to above atmospheric head, compound gauges shall be installed.
- B. **Gauge Construction:** Gauges shall be industrial quality type with Type 316 stainless steel movement and stainless steel or alloy case. Unless otherwise indicated, gauges shall have a 3-1/2-inch dial, 1/4-inch threaded connection, a Type 316 stainless steel snubber adapter, and a shut-off valve. Gauges shall be calibrated to read in applicable units, with an accuracy of plus and minus 1 percent, to 150 percent of the working pressure or vacuum of the pipe or vessel to which they are connected. All gauges shall be vibration and shock resistant.
- C. **Diaphragm Seal:** Gauges attached to systems involving chemical solutions, corrosive fluids, sludge, sewage, or other liquids containing solids at less than 1 percent dry solids shall be equipped with diaphragm seals, or equal protective pressure or vacuum sensing devices, as follows:

1. For: sewage, sludge, liquids containing solids, pulsating flow

Seals of all Type 316 stainless steel, with stainless steel diaphragm for pressures over 15 psi, and elastomer diaphragm for pressures of 15 psi and below, Type 316 stainless steel nuts and bolts, fill connection and valved flush port size 1/4-inch NPT, capable of disassembly without loss of filler fluid.

Manufacturers, or Equal:
Ashcroft, model 101;
U.S. Gauge (Ametek), SG;
Marshalltown, Series 225-01.

2. For: chlorine and sulfur dioxide under pressure

Seals of carbon steel with silver diaphragm of 800 psi rating.

Manufacturers, or Equal:
Pennwalt (W&T);
Fischer and Porter.

3. For: chemical solutions, sewage, sludge, etc., where breakage does not create a major shutdown

Seals with PVC body for removable mounting rated at 200 psi, with Type 316 stainless steel bolts and nuts, 1/2-inch inlet, 1/4-inch outlet, liquid-filled with Teflon diaphragm for pressure, and suitable elastomer diaphragm for vacuum service.

Manufacturers, or Equal:
Plast-O-Matic Valves, Inc.;
Harrington Ind. Plastics, Inc.; **Utilities Supply.**

D. Gauge Manufacturers, or Equal

1. **Marsh Instrument Company;**
2. **Ashcroft Industrial Instruments (Dresser);**
3. **Foxboro/Jordan, Inc.;**
4. **Marshalltown Instruments, Inc.;**
5. **U.S. Gauge Div. of Ametek.**

E. Snubber Manufacturers, or Equal

1. **Cajon Company;**
2. **Weksler Instruments, Corp.**

2.2 ANNULAR SEAL PRESSURE GAUGES

A. **General:** Annular pressure gauges shall be provided where shown.

B. **Construction:** Pressure shall be sensed by a flexible sleeve contained in a flanged cast iron or steel spool or wafer body, and transmitted to the gauge through a captive fluid. The sleeve shall be of Buna N and fabricated so as to isolate the body from the process liquid. Gauges shall be calibrated to read in applicable units, with an accuracy of plus and minus 1 percent, to 150 percent of the working pressure of the system to which they are connected.

C. Manufacturers, or Equal

1. **Red Valve Company, Inc.**
2. **Ronningen-Petter.**

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Gauges shall be installed with the face in the vertical position, at the locations indicated and in strict accordance with the manufacturer's printed instructions. Care shall be taken to minimize the effect of water hammer or vibrations on the gauges. In extreme cases, the gauges may have to be mounted independently, with flexible connectors.**

- END OF SECTION -

SECTION 15200 - VALVES, GENERAL

PART 1 – GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all valves, actuators, and appurtenances, complete and operable, in accordance with the Contract Documents.
- B. The requirements of Section 11000 - Equipment General Provisions, apply to the WORK of this Section.
- C. The provisions of this Section shall apply to all valves and valve actuators except where otherwise indicated. Valves and actuators in particular locations may require a combination of units, sensors, limit switches, and controls indicated in Division 16 and 17.
- D. Where a valve is to be supported by means other than the piping to which it is attached, the CONTRACTOR shall obtain from the valve manufacturer a design for support and foundation that satisfies the criteria in Section 11000. The design, including drawings and calculations sealed by an engineer, shall be submitted with the Shop Drawings. When the design is approved, the support shall be provided.
- E. **Unit Responsibility:** A single manufacturer shall be made responsible for coordination of design, assembly, testing, and furnishing of each valve; however, the CONTRACTOR shall be responsible to the OWNER for compliance with the requirements of each valve section. Unless indicated otherwise, the responsible manufacturer shall be the manufacturer of the valve.
- F. **Single Manufacturer:** Where two or more valves of the same type and size are required, the valves shall be furnished by the same manufacturer.

1.2 CONTRACTOR SUBMITTALS

- A. **General:** Submittals shall be furnished in accordance with Section 01300 - Contractor Submittals.
- B. **Shop Drawings:** Shop Drawings shall contain the following information:
 - 1. Valve name, size, Cv factor, pressure rating, identification number (if any), and specification section number.
 - 2. Complete information on valve actuator, including size, Manufacturer, model number, limit switches, and mounting.
 - 3. Cavitation limits for all control valves.
 - 4. Assembly drawings showing part nomenclature, materials, dimensions, weights, and relationships of valve handles, handwheels, position indicators, limit switches, integral control systems, needle valves, and control systems.
 - 5. Complete wiring diagrams and control system schematics.

6. **Valve Labeling:** A schedule of valves to be furnished with stainless steel tags, indicating in each case the valve location and the proposed wording for the label.
- C. **Technical Manual:** The Technical Manual shall contain the required information for each valve.
- D. **Spare Parts List:** A Spare Parts List shall contain the required information for each valve assembly, where indicated.
- E. **Factory Test Data:** Where indicated, signed, dated, and certified factory test data for each valve requiring certification shall be submitted before shipment of the valve. The data shall also include certification of quality and test results for factory-applied coatings.

PART 2 -- PRODUCTS

2.1 PRODUCTS

- A. **General:** Valves and gates shall be new and of current manufacture. Shut-off valves 6-inches and larger shall have actuators with position indicators. Buried valves shall be provided with valve boxes and covers containing position indicators and valve extensions. Manual shut-off valves mounted higher than 7-feet above working level shall be provided with chain actuators.
- B. **Valve Actuators:** Unless otherwise indicated, valve actuators shall be in accordance with Section 15201 - Valve and Gate Actuators.
- C. **Protective Coating:** The exterior surfaces of all valves and the wet interior surfaces of ferrous valves of sizes 4 inches and larger shall be coated in accordance with Section 09800 - Protective Coating. The valve Manufacturer shall certify in writing that the required coating has been applied and tested in the manufacturing plant prior to shipment, in accordance with these Specifications. Flange faces of valves shall not be epoxy coated.
- D. **Valve Labeling:** Except when such requirement is waived by the ENGINEER in writing, a label shall be provided on all shut-off valves and control valves except for hose bibs and chlorine cylinder valves. The label shall be of 1/16-inch plastic or stainless steel, minimum 2 inches by 4 inches in size, as indicated in Section 15005 - Piping Identification Systems, and shall be permanently attached to the valve or on the wall adjacent to the valve as directed by the ENGINEER.
- E. **Valve Testing:** As a minimum, unless otherwise indicated or recommended by the reference Standards, valves 3 inches in diameter and smaller shall be tested in accordance with manufacturer's standard and 4 inches in diameter and larger shall be factory tested as follows:
 1. **Hydrostatic Testing:** Valve bodies shall be subjected to internal hydrostatic pressure equivalent to twice the water rated pressure of the valve. Metallic valves rating pressures shall be at 100 degrees F and plastic valves shall be 73 degrees, or at higher temperature according to type of material. During the hydrostatic test, there shall be no leakage through the valve body, end joints, or shaft seals, nor shall any part of the valve be permanently deformed. The duration shall be sufficient time to allow visual examination for leakage. Test duration shall be at least 10 minutes.
 2. **Seat Testing:** Valves shall be tested for leaks in the closed position with the

pressure differential across the seat equal to the water rated pressure of the valve. The duration of test shall be sufficient time to allow visual examination for leakage. Test duration shall be at least 10 minutes. Leakage past the closed valve shall not exceed 1 fluid ounce per hour per inch diameter for metal seated valves and drop-tight for resilient seated valves.

3. **Performance Testing:** All valves shall be shop operated from fully closed to fully open position and reverse under no-flow conditions in order to demonstrate the valve assembly operates properly.
- F. **Certification:** Prior to shipment, the CONTRACTOR shall submit for valves over 12 inches in size, certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, ANSI, or ASTM.
- G. **Valve Marking:** Valve bodies shall be permanently marked in accordance with MSS SP25 - Standard Marking Systems for Valves, Fittings, Flanges, and Unions.

2.2 MATERIALS

- A. **General:** Materials shall be suitable for the intended application. Materials not indicated shall be high-grade standard commercial quality, free from defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended. Unless otherwise indicated, valve and actuator bodies shall conform to the following requirements:
 1. **Cast Iron:** Close-grained gray cast iron, conforming to ASTM A 48 - Gray Iron Castings, Class 30, or to ASTM A 126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 2. **Ductile Iron:** ASTM A 536 - Ductile Iron Castings, or to ASTM A 395 - Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
 3. **Steel:** ASTM A 216 - Steel Castings, Carbon Suitable for Fusion Welding for High-Temperature Service, or to ASTM A 515 - Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service.
 4. **Bronze:** ASTM B 62 - Composition Bronze or Ounce Metal Castings, and valve stems not subject to dezincification shall conform to ASTM B 584 - Copper Alloy Sand Castings for General Applications.
 5. **Stainless Steel:** Stainless steel valve and operator bodies and trim shall conform to ASTM A 351 - Steel Castings, Austenitic, for High-Temperature Service, Grade CF8M, or shall be Type 316 stainless steel.
 6. **PVC:** Poly Vinyl Chloride materials for valve body, flanges, and cover shall conform to Cell Classification 12454.
 7. **CPVC:** Chlorinated Poly Vinyl Chloride materials for valve body, flanges, and cover shall conform to Cell Classification 23447.
 8. **NSF Standard 14:** All materials shall be listed for use in contact with potable water.

2.3 VALVE CONSTRUCTION

- A. **Bodies:** Valve bodies shall be cast, molded (in the case of plastic valves), forged, or welded of the materials indicated, with smooth interior passages. Wall thicknesses shall be uniform in agreement with the applicable standards for each type of valve, without casting defects, pinholes, or other defects that could weaken the body. Welds on welded bodies shall be done by certified welders and shall be ground smooth. Valve ends shall be as indicated, and be rated for the maximum temperature and pressure to which the valve will be subjected.
- B. **Bonnets:** Valve bonnets shall be clamped, screwed, or flanged to the body and shall be of the same material, temperature, and pressure rating as the body. The bonnets shall have provision for the stem seal with the necessary glands, packing nuts, or yokes.
- C. **Stems:** Valve stems shall be of the materials indicated, or, if not indicated, of the best commercial material for the specific service, with adjustable stem packing, O-rings, Chevron V-type packing, or other suitable seal. Where subject to dezincification, bronze valve stems shall conform to ASTM B 62, containing not more than 5 percent of zinc or more than 2 percent of aluminum, with a minimum tensile strength of 30,000 psi, a minimum yield strength of 14,000 psi, and an elongation of at least 10 percent in 2 inches. Where dezincification is not a problem, bronze conforming to ASTM B 584 may be used, except that zinc content shall not exceed 16 percent.
- D. **Stem Guides:** Stem guides shall be provided, spaced 10-feet on centers unless the manufacturer can demonstrate by calculation that a different spacing is acceptable. Submerged stem guides shall be 304 stainless steel.
- E. **Internal Parts:** Internal parts and valve trim shall be as indicated for each individual valve. Where not indicated, valve trim shall be of Type 316 stainless steel or other best suited material.
- F. **Nuts and Bolts:** Nuts and bolts on valve flanges and supports shall be in accordance with Section 05500 - Miscellaneous Metalwork.

2.4 VALVE ACCESSORIES

- A. Valves shall be furnished complete with the accessories required to provide a functional system.

2.5 SPARE PARTS

- A. The CONTRACTOR shall furnish the required spare parts suitably packaged and labeled with the valve name, location, and identification number. The CONTRACTOR shall also furnish the name, address, and telephone number of the nearest distributor for the spare parts of each valve. Spare parts are intended for use by the OWNER, after expiration of the correction of defects period.

2.6 MANUFACTURERS

- A. **Manufacturer's Qualifications:** Valve manufacturers shall have a successful record of not less than 5 years in the manufacture of the valves indicated.

PART 3 -- EXECUTION

3.1 VALVE INSTALLATION

- A. **General:** Valves, actuating units, stem extensions, valve boxes, and accessories shall be installed in accordance with the Manufacturer's written instructions and as indicated. Gates shall be adequately braced to prevent warpage and bending under the intended use. Valves shall be firmly supported to avoid undue stresses on the pipe.
- B. **Access:** Valves shall be installed with easy access for actuation, removal, and maintenance and to avoid interference between valve actuators and structural members, handrails, or other equipment.
- C. **Valve Accessories:** Where combinations of valves, sensors, switches, and controls are indicated, the CONTRACTOR shall properly assemble and install such items so that systems are compatible and operating properly. The relationship between interrelated items shall be clearly noted on Shop Drawing submittals.

- END OF SECTION -

SECTION 15201 - VALVE AND GATE ACTUATORS

PART 1 — GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all valve and gate actuators and appurtenances, complete and operable, in accordance with the Contract Documents.
- B. The provisions of this Section shall apply to all valves and gates, except where otherwise indicated in the Contract Documents.
- C. **Unit Responsibility:** A single manufacturer shall be made responsible for furnishing the WORK and for coordination of design, assembly, testing, and installation of the WORK of each type of valve and gate; however, the CONTRACTOR shall be responsible to the OWNER for compliance with the requirements of each valve and gate section. Unless otherwise indicated, the single manufacturer shall be the Manufacturer of the valve or gate.
- D. **Single Manufacturer:** Where two or more valve or gate actuators of the same type or size are required, the actuators shall all be produced by the same Manufacturer.

1.2 CONTRACTOR SUBMITTALS

- A. **General:** Submittals shall be furnished in accordance with Section 01300 - Contractor Submittals and Section 15200 - Valves, General.
- B. **Shop Drawings:** Shop Drawings of all actuators shall be submitted together with the valve and gate submittals as a complete package.

PART 2 — PRODUCTS

2.1 GENERAL

- A. **General:** Unless otherwise indicated, all shut-off and throttling valves, and externally-actuated valves and gates, shall be provided with manual or power actuators. The CONTRACTOR shall furnish all actuators complete and operable with mounting hardware, motors, gears, controls, wiring, solenoids, handwheels, levers, chains, and extensions, as applicable. All actuators shall be capable of holding the valve in any intermediate position between fully-open and fully-closed without creeping or fluttering. All wires of motor-driven actuators shall be identified by unique numbers.
- B. **Manufacturers:** Where indicated, certain valves and gates may be provided with actuators manufactured by the valve or gate Manufacturer. Where actuators are furnished by different manufacturers, the CONTRACTOR shall coordinate selection to have the fewest number of manufacturers possible.
- C. **Materials:** All actuators shall be current models of the best commercial quality materials and liberally-sized for the maximum expected torque. All materials shall be suitable for the environment in which the valve or gate is to be installed.

- D. **Mounting:** All actuators shall be securely mounted by means of brackets or hardware specially designed and sized for this purpose and of ample strength. The word "open" shall be cast on each valve or actuator with an arrow indicating the direction to open in the counter-clockwise direction. All gear and power actuators shall be equipped with position indicators. Where possible, manual actuators shall be located between 48 and 60 inches above the floor or the permanent working platform.
- E. **Standard:** Unless otherwise indicated and where applicable, all actuators shall be in accordance with ANSI/AWWA C 540 - AWWA Standard for Power-Actuating Devices for Valves and Sluice Gates.
- F. **Functionality:** Electric, pneumatic, and hydraulic actuators shall be coordinated with power and instrumentation equipment indicated elsewhere in the Contract Documents.

2.2 MANUAL ACTUATORS

- A. **General:** Unless otherwise indicated, all valves and gates shall be furnished with manual actuators. Valves in sizes up to and including 4 inches shall have direct acting lever or handwheel actuators of the Manufacturer's best standard design. Larger valves and gates shall have gear-assisted manual actuators, with an operating pull of maximum 60 pounds on the rim of the handwheel. All buried and submerged gear-assisted valves, all gates, all gear-assisted valves for pressures higher than 250 psi, all valves 30 inches in diameter and larger, and where so indicated, shall have worm-gear actuators, hermetically-sealed and grease-packed, where buried or submerged. All other valves 6 inches to 24 inches in diameter may have traveling-nut actuators, worm-gear actuators, spur- or bevel-gear actuators, as appropriate for each valve.
- B. **Buried Valves:** Unless otherwise indicated, all buried valves shall have extension stems to grade, with square nuts or floor stands, position indicators, and cast-iron or steel pipe extensions with valve boxes, covers, and operating keys. Where so indicated, buried valves shall be in cast-iron, concrete, or similar valve boxes with covers of ample size to allow operation of the valve actuators. Covers of valve boxes shall be permanently labeled as requested by the local Utility Company or the ENGINEER. Wrench-nuts shall comply with AWWA C 500 -Metal - Seated Gate Valves for Water Supply Service, and a minimum of 2 operating keys, or one key per 10 valves, whichever is greater, shall be furnished.
- C. **Chain Actuator:** Manually-activated valves with the stem located more than 7 feet above the floor or operating level shall be furnished with chain drives consisting of sprocket-rim chain wheels, chain guides, and operating chains, and be provided by the valve Manufacturer. The wheel and guide shall be of ductile-iron, cast-iron, or steel, and the chain shall be hot-dip galvanized steel or stainless steel, extending to 5 feet 6 inches above the operating floor level. The valve stem of chain-actuated valves shall be extra strong to allow for the extra weight and chain pull. Hooks shall be provided for chain storage where chains interfere with pedestrian traffic.
- D. **Floor Boxes:** Hot-dip galvanized cast-iron or steel floor boxes and covers to fit the slab thickness shall be provided for all operating nuts in or below concrete slabs. For nuts in the concrete slab, the cover shall be bronze-bushed.
- E. **Manual Worm-Gear Actuator:** The actuator shall consist of a single or double reduction gear unit contained in a weather-proof cast-iron or steel body with cover and

minimum 12-inch diameter handwheel. The actuator shall be capable of 90-degree rotation and shall be equipped with travel stops capable of limiting the valve opening and closing. The actuator shall consist of spur or helical gears and worm-gearing. The spur or helical gears shall be of hardened alloy steel and the worm-gear shall be alloy bronze. The worm-gear shaft and the handwheel shaft shall be of 17-4 PH or similar stainless steel. All gearing shall be accurately cut with hobbing machines. Ball or roller bearings shall be used throughout. Actuator output gear changes shall be mechanically possible by simply changing the exposed or helical gearset ratio without further disassembly of the actuator. All gearing shall be designed for a 100 percent overload.

2.3 ELECTRIC MOTOR ACTUATORS

A. General

1. **Equipment Requirements:** Where electric motor actuators are indicated, an electric motor-actuated valve control unit shall be attached to the actuating mechanism housing by means of a flanged motor adaptor piece.
2. **Gearing:** The motor actuator shall include the motor, reduction gearing, reversing starter, torque switches, and limit switches in a weather-proof NEMA 4 assembly. The actuator shall be a single or double reduction unit consisting of spur or helical gears and worm-gearing. The spur or helical gears shall be of hardened alloy steel and the worm-gear shall be alloy bronze. All gearing shall be accurately cut with hobbing machines. All power gearing shall be grease- or oil-lubricated in a sealed housing. Ball or roller bearings shall be used throughout. Actuator output speed changes shall be mechanically possible by simply removing the motor and changing the exposed or helical gearset ratio without further disassembly of the electric actuator.
3. **Starting Device:** Except for modulating valves, the unit shall be so designed that a hammer blow is imparted to the stem nut when opening a closed valve or closing an open valve. The device should allow free movement at the stem nut before imparting the hammer blow. The actuator motor must attain full speed before stem load is encountered.
4. **Switches and Wiring:** Travel in the opening and closing directions shall be governed by a switch responsive to mechanical torque developed in seating the valve, or by an obstruction met in opening or closing the valve, or by an on-board microprocessor. The torque switch shall be adjustable and shall function without auxiliary relays or devices, or it shall be adjustable in one-percent increments, sensed by a pulse-counter which receives 15 pulses per rotation of the unit. The geared limit switches shall be of the open type and shall be actuated by a rotor cam with 4 contacts to each cam or gear train. The actuator shall have a number of gear trains as required to produce the operation indicated. The actuator shall be wired in accordance with the schematic diagram. All wiring for external connections shall be connected to marked terminals. One 1-inch and one 1-1/4-inch conduit connection shall be provided in the enclosing case. A calibration tag shall be mounted near each switch correlating the dial setting to the unit output torque. Position limit switches and associated gearing shall be an integral part of the valve actuator. To provide the best possible accuracy and repeatability, limit-switch gearing shall be of the "counting" intermittent type, made of stainless steel, grease-lubricated, and enclosed in its own gearcase to prevent dirt and foreign

matter from entering the gear train. Switches shall not be subject to breakage or slippage due to over-travel. Traveling-nuts, cams, or microswitch tripping mechanisms shall not be used. Limit-switches shall be of the heavy-duty open contact type with rotary wiping action. Provide a open status contact, closed status contact and hand switch in remote status contact for all valves.

5. **Handwheel Operation:** A permanently-attached handwheel shall be provided for emergency manual operation. The handwheel shall not rotate during electrical operation. The maximum torque required on the handwheel under the most adverse conditions shall not exceed 60 lb-ft, and the maximum force required on the rim of the handwheel shall not exceed 60 lb. An arrow and either the word "open" or "close" shall be cast or permanently affixed on the handwheel to indicate the appropriate direction to turn the handwheel.
6. **Motor:** The motor shall be of the totally-enclosed, non-ventilated, high-starting torque, low-starting current type for full voltage starting. It shall be suitable for operation on 480-volt, 3-phase, 60-Hz current, and have Class F insulation and a motor frame with all dimensions in accordance with the latest revised NEMA MG Standards. The observed temperature rise by thermometer shall not exceed 55 degrees C above an ambient temperature of 40 degrees C when operating continuously for 15 minutes under full rated load. With a line voltage ranging between 10 percent above to 10 percent below the rated voltage, the motor shall develop full rated torque continuously for 15 minutes without causing the thermal contact protective devices imbedded in the motor windings to trip or the starter overloads to drop-out. All bearings shall be of the ball type and thrust bearings shall be provided where necessary. All bearings shall be provided with suitable seals to confine the lubricant and prevent the entrance of dirt and dust. Motor conduit connections shall be watertight. Motor construction shall incorporate the use of stator and rotor as independent components from the valve operation such that the failure of either item shall not require actuator disassembly or gearing replacement. The motor shall be furnished with a space heater suitable for operation on 120-volt, single-phase, 60-Hz circuit unless the entire actuator is an hermetically-sealed, non-breathing design with a separately sealed terminal compartment which prevents moisture intrusion.

B. Electric Motor Actuators (AC Reversing Control Type)

1. **General:** Where indicated, electric motor actuators shall be the AC reversing type complete with local control station with open/close and local/remote selector switches.
2. **Actuator Appurtenances:** The actuator for each valve shall be supplied with open and close status lights; open, close and stop push-buttons, and all other devices indicated.
3. **Starter:** The starter shall be a suitably sized amperage rated reversing starter with its coils rated for operation on 480-volt, 3-phase, 60-Hz current. A control power transformer shall be included to provide a 120-volt source, unless otherwise indicated. The starter shall be equipped with 3 overload relays of the automatic reset type. Its control circuit shall be wired as indicated. The integral weatherproof compartment shall contain a suitably sized 120-volt ac, single-phase, 60-Hz space heater to prevent moisture condensation on electrical components.

4. **Manufacturers:**

- a. **EIM**
- b. **Limitorque Corp**
- c. **Rotork**

C. **Electric Motor Actuators (AC Modulating Control Type)**

- 1. **General:** Where indicated, modulating electric motor actuators shall be the ac modulating type complete with a local control station with open/close/auto/hold functions.
- 2. **Control Module:** The control module shall be of the electronic solid-state ac type with dry contact output to control the operation of the motor.
- 3. **Starter:** The actuator shall control a reversing starter designed for minimum susceptibility to power line surges and spikes. The starter and control module shall be rated for continuous modulating applications. Power supply shall be 208-volt, 3-phase, 60-Hz.
- 4. **Construction:** The control unit shall be microprocessor-based and shall contain an analog/digital converter, separate input-output switches, and calibration parameters and push-button calibration elements for field-setup. Potentiometer adjustments shall contain a PID control function internally. In addition, the controller shall contain as standard feature a loss of command signal protection selectable to lock in last valve position and a valve position output signal in 4-20 mA. As an alternative to the construction requirement, the motor shall be capable of modulating at a rate of 600 starts per hour at the 50 percent to 85 percent travel range of the valve.
- 5. The valve shall respond to a 4-20mA position signal.
- 6. Each AC Modulating Control Type Actuator shall be provided with four limit switches, 2 for full open indication and 2 for full closed indication.
- 7. Provide a 4-20 mA output signal from actuator linear to the position of the valve.

D. **Manufacturers:**

- 1. **EIM**
- 2. **Limitorque**
- 3. **Rotork**

PART 3 — EXECUTION

3.1 **SERVICES OF MANUFACTURER**

A. **Field Adjustments**

1. Field representatives of manufacturers of valves or gates with pneumatic, hydraulic, or electric actuators shall adjust actuator controls and limit-switches in the field for the required function.

3.2 INSTALLATION

- A. All valve and gate actuators and accessories shall be installed in accordance with Section 15200, "Valves, General." Actuators shall be located to be readily accessible for operation and maintenance, without obstructing walkways. Actuators shall not be mounted where shock or vibrations will impair their operation, nor shall the support systems be attached to handrails, process piping, or mechanical equipment.
- B. **Inspection, Startup, and Field Adjustment:** An authorized representative of the Manufacturer shall visit the site and witness the following:
- C. Installation of the equipment for not less than 2 days.
- D. Inspection, checking, and adjusting the equipment for not less than 1 day.
- E. Startup and field-testing for proper operation for not less than 1 day.
- F. **Instruction of OWNER'S Personnel:** The authorized service representative shall visit the site for not less than 2 days to instruct the OWNER'S personnel in the operation and maintenance of the equipment including step-by-step troubleshooting procedures with necessary test equipment.

- END OF SECTION -

SECTION 15202 - BUTTERFLY VALVES

PART 1 – GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide butterfly valves and appurtenances, complete and operable, in accordance with the Contract Documents.
- B. The requirements of Section 11000 – Equipment General Provisions apply to this Section.
- C. The requirements of Section 15200 - Valves, General apply to this Section.
- D. The requirements of Section 15201 - Valve Actuators apply to this Section.

1.2 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish submittals in accordance with Section 15200.
- B. Shop Drawings
 - 1. Complete Shop Drawings of butterfly valves and actuators.
 - 2. Drawings showing valve port diameter complete with dimensions, part numbers and materials of construction.
 - 3. Certification of proof-of-design test from the valve manufacturer.
 - 4. Manufacturer's Certification that the valve complies with all applicable provisions of AWWA C504 – Rubber-Seated Butterfly Valves.

1.3 QUALITY ASSURANCE

- A. Valves shall be subjected to performance, leakage, and hydrostatic tests in accordance with procedures and acceptance criteria established by AWWA C504.

PART 2 – PRODUCTS

2.1 RUBBER SEATED BUTTERFLY VALVES 25 TO 150 PSI (AWWA)

- A. **General:** Butterfly valves for steady-state water working pressures and steady-state differential pressure up to 150 psi and for fresh water service having a pH range from 6 to 10 and temperature range from 33 to 125 degrees F shall conform to AWWA C504 and be as indicated.
- B. Valves shall be of the body type, pressure class, end joint, and actuator indicated.
- C. **Construction:** Unless otherwise indicated, all materials of construction shall be in accordance with AWWA C504, suitable for the service. The seats shall be positively clamped or bonded into the disc or body of the valve, but cartridge-type seats which rely on a high coefficient of friction for retention shall not be acceptable.

Description	Material Standards
Valve Bodies	ASTM A 48, Class 40 or Cast iron, ASTM A 126, Class B, or Ductile iron, ASTM A 536, grade 65-45-12 or 70-50-05
End flanges	The same material as the valve bodies
Valve shafts	Stainless steel ASTM A 276, Type 316
Valve discs	The same material as for the valve bodies.
Rubber sets	New natural or synthetic rubber
Seat mating surfaces	Stainless steel, ASTM A 276, Type 316
Clamps and retaining rings	Type 316 retaining rings and cap screws.
Valve bearings	Self lubricating materials per AWWA C504
Shaft seals	Resilient non-metallic materials suitable for service
Painting and coating	Refer to Section 09800 – Protective Coating

D. **Manufacturers, or Equal**

1. **De Zurik Corporation**
2. **Keystone**
3. **M & H**
4. **Mueller Company**
5. **Henry Pratt Company**
6. **Lineal**

2.2 **RUBBER SEATED BUTTERFLY VALVES, 250 PSI (AWWA).**

- A. **General:** Butterfly valves for steady-state water working pressures and steady-state differential pressure up to 250 psi and for fresh water service having a pH range from 6 to 10 and temperature range from 33 to 125 degrees F shall conform to AWWA C504. Valves shall be designed and manufactured in accordance with the intent of AWWA C504 except valves shall be suitable for 250 psi service and as indicated herein.
- B. Valves shall be of the body type, pressure class, end joint, and actuator indicated.
- C. One prototype valve for each size of valve required by the project shall be subjected to proof of design test in accordance with the procedures established by AWWA C504. Certificate of proof-of-design test shall be submitted to the ENGINEER prior to delivery of the valves.
- D. **Construction:** Unless otherwise indicated, all materials of construction shall be in accordance with AWWA C 504, suitable for the service. The seats shall be positively clamped or bonded into the disc or body of the valve, but cartridge-type seats, which rely on a high coefficient of friction for retention, shall not be acceptable.

Designation	Materials Standards
Valve Bodies	ASTM A 48, Class 40 or Cast iron, ASTM A 126, Class B, Ductile iron, ASTM A 536, grade 65-45-12 or 70-50-05
End flanges	The same material as the valve bodies
Valve shafts	Stainless steel ASTM A 276, Type 316
Valve discs	The same material as for the valve bodies.
Rubber sets	New natural or synthetic rubber
Seat mating surfaces	Stainless steel, ASTM A 276, Type 316
Clamps and retaining rings	Type 316 retaining rings and cap screws.
Valve bearings	Self lubricating materials per AWWA C504
Shaft seals	Resilient non-metallic materials suitable for service
Painting and coating	Refer to Section 09800 – Protective Coating

- E. **Manual Actuators:** Unless otherwise indicated, all manually-actuated butterfly valves shall be equipped with a handwheel and 2-inch square actuating nut and position indicator. Screw-type (traveling nut) actuators will not be permitted for valves 30 inches in diameter and larger.
- F. **Worm Gear Actuators:** Valves, 30 inch and larger, as well as all submerged and buried valves, shall be equipped with worm-gear actuators, lubricated and sealed to prevent entry of dirt or water into the housing.
- G. **Electric Actuators:** Electric actuators shall meet the requirements of AWWA C540. Electric actuators shall be rated to produce output torque of at least 1.5 times the required valve maximum seating or maximum dynamic torque whichever is greater. For valves in modulating service with dynamic torque exceeding the seating torque, the rated output torque of the actuator shall be twice the dynamic torque required by the valve. Actuator rated torque is defined as pullout torque rated at 10 percent below the rated voltage of the motor.
- H. **Manufacturers, or Equal**
 - 1. **De Zurik Corporation**
 - 2. **Henry Pratt Company**

2.3 HIGH PERFORMANCE (HP) BUTTERFLY VALVES

A. Flow Control Valve

- 1. All HP Butterfly valves shall have a wafer or lug style Class 150 body as shown. The valve shall meet ANSI B16.104 Class IV shut-off requirements and be suitable for 275 psi CWP. Valve materials shall be as follows:

Body: Carbon steel
Disc: 316 stainless steel
Shaft: 316 stainless steel
Seat: PTFE

Packing: PTFE

B. Electric Actuators: CONTRACTOR shall provide modulating electric motor three-phase actuators in accordance with Section 15201.

1. **Manufacturers:**

- a. **De Zurik Corporation;**
- b. **Neles - Jamesbury, Inc.;**
- c. **Watts Regulator.**

PART 3 – EXECUTION

3.1 **INSTALLATION**

A. All exposed butterfly valves shall be installed with a means of removing the complete valve assembly without dismantling the valve or operator. The installation shall be in accordance with Section 15200.

- END OF SECTION -

SECTION 15203 - CHECK VALVES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide check valves and appurtenances, complete and operable, in accordance with the Contract Documents.
- B. The requirements of Section 15200 - Valves, General apply to this Section.

1.2 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish submittals in accordance with Section 15200.

PART 2 -- PRODUCTS

2.1 SWING CHECK VALVES (3-INCH AND LARGER)

- A. **General:** Swing check valves for water, sewage, sludge, and general service shall be of the outside lever and spring or weight type, in accordance with ANSI/AWWA C 508 - Swing-Check Valves for Waterworks Service, 2 in. through 24 in. NPS, unless otherwise indicated, with full-opening passages, designed for a water-working pressure of 200 psi. They shall have a flanged cover piece to provide access to the disc and externally adjustable packing hinge pin seal.
- B. **Body:** The valve body and cover shall be of cast iron conforming to ASTM A 126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings, with flanged ends conforming to ANSI/ASME B 16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800, or mechanical joint ends, as indicated.
- C. **Disc:** The valve disc shall be of cast iron, ductile iron, or bronze conforming to ASTM B 62 - Composition Bronze or Ounce Metal Castings.
- D. **Seat and Rings:** The valve seat and rings shall be of bronze to conforming ASTM B 62 or B 148 - Aluminum-Bronze Castings, or of Buna-N.
- E. **Hinge Pin:** The hinge pin shall be of bronze or stainless steel.
- F. **MANUFACTURERS, or Equal**
 - 1. **American Flow Control (Darling)**
 - 2. **Clow**
 - 3. **Kennedy Valve**
 - 4. **Mueller Company (Grinnell Corporation)**
 - 5. **M & H**

6. **Stockham Valves and Fittings**

7. **SOSC (lever & weight)**

2.2 **SWING CHECK VALVES (2-1/2 INCH AND SMALLER)**

- A. **General:** Swing check valves for steam, water, oil, or gas in sizes 2-1/2 inch and smaller shall be suitable for a steam pressure of 150 psi and a cold water pressure of 300 psi. They shall have screwed ends, unless otherwise indicated, and screwed caps.
- B. **Body:** The valve body and cap shall be of bronze conforming to ASTM B 61 – Steam or Valve Bronze Castings, or ASTM B 62 with threaded ends conforming to ANSI/ASME B1.20.1 – Pipe Threads, General Purpose (inch).
- C. **Disc:** Valves for steam service shall have bronze or brass discs conforming to ASTM B 16 – Free-Cutting Brass Rod, Bar, and Shapes for Use in Screw Machines, and for cold water, oil and gas service replaceable composition discs.
- D. **Hinge Pin:** The hinge pins shall be of bronze or stainless steel.
- E. **Manufacturers, or Equal;**
 - 1. **Crane Company**
 - 2. **Milwaukee Valve Company**
 - 3. **Stockham Valves and Fittings**
 - 4. **Wm. Powell Company**

2.3 **OIL DAMPED SWING CHECK VALVES**

- A. **General:** Swing check valves for water shall be of the controlled closing type, designed for a working pressure of 200 psi. They shall have a flange cover piece to provide access to the disk and externally adjustable packing hinge pin seal.

A single cushioning device mounted on the external side of the valve shall control the valve closure by way of the interchange of oil to and from an oil reservoir. The use of air or gas pressurized oil reservoir shall not be permitted. The closing speed shall be adjustable in the field and shall be by way of a micrometer type needle valve.

- B. **Body:** The valve body shall be of cast iron conforming to ASTM A 126 – Gray Iron Castings for valves, flanges, and pipe fittings, with flanged ends conforming to ANSI/ASME B 16.1 – Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800, or mechanical joint ends, as indicated.
- C. **Disc:** The valve disc shall be of cast iron, ductile iron, or bronze conforming to ASTM B 62 – Composition Bronze or Ounce Metal Casings.
- D. **Seat and Rings:** The valve seat and rings shall be of bronze conforming to ASTM B62 or stainless steel conforming to ASTM A-157-C-9.

E. **Hinge Pin:** The hinge pin shall be of bronze or stainless steel, and installed above the water way.

F. **MANUFACTURERS, or Equal:**

1. **APCO (Valve and Primer Corp.)**
2. **Golden Anderson**
3. **Mueller Company (Grinnell Corporation)**

2.4 DUCKBILL CHECK VALVE

A. **General:** Valves are to be of the flow operated check type with a slip-on connection. Inlet port areas shall be 100% of the mating pipe port size. The port area shall contour down to a duckbill which shall allow passage of flow in one direction while preventing reverse flow. The bottom of the valve should not flare, and is to be straight and parallel to the pipeline axis throughout its entire length.

The check valve is designed to slip over the specified pipe outside diameter. The flexible duckbill sleeve shall be one piece rubber construction with fabric reinforcement. The check valves shall also have a protective Neoprene exterior wrapping for protection against sunlight attack. Check valves shall be attached to the pipe outside diameter by means of clamps.

B. **MANUFACTURERS, or Equal:**

1. **Red Valve**

PART 3 – EXECUTION

3.1 GENERAL

A. Valves shall be installed in accordance with provisions of Section 15200 - Valves, General.

- END OF SECTION -

SECTION 15204 - BALL VALVES

PART 1 – GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide ball valves and appurtenances, complete and operable, in accordance with the Contract Documents.
- B. The requirements of Section 15200 - Valves, General apply to this Section.
- C. The requirements of Section 15201 - Valve and Gate Actuators apply to this Section.

1.2 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish submittals in accordance with Section 15200 - Valves, General.

PART 2 – PRODUCTS

2.1 METAL BALL VALVES (4-INCH AND SMALLER)

- A. **General:** Unless otherwise indicated, general purpose metal ball valves in sizes up to 4-inch shall have actuators in accordance with Section 15201 - Valve and Gate Actuators.
- B. **Body:** Ball valves up to 1-1/2-inch (incl.) in size shall have bronze or carbon steel 2-or 3-piece bodies with screwed ends for a pressure rating of not less than 600 psi WOG. Valves 2-inch to 4-inch in size shall have bronze or carbon steel 2-or 3-piece bodies with flanged ends for a pressure rating of ANSI 200 psi unless otherwise indicated.
- C. **Balls:** The balls shall be solid chrome plated brass or bronze, or stainless steel, with standard port (single reduction) or full port openings.
- D. **Stems:** The valve stems shall be of the blow-out proof design, of bronze, stainless steel, or other acceptable construction, with reinforced Teflon seal.
- E. **Seats:** The valve seats shall be of Teflon or Buna-N, for bi-directional service and easy replacement.
- F. **Manufacturers, or Equal:**
 - 1. **Conbraco Industries, Inc. (Apollo)**
 - 2. **ITT Engineered Valves**
 - 3. **Neles-Jamesbury, Inc.**
 - 4. **NIBCO, Inc.**
 - 5. **Watts Regulator**

6. Worcester Controls

2.2 BALL VALVES (6-INCH AND LARGER)

- A. **Construction:** Unless otherwise indicated, ball valves shall be in accordance with ANSI/AWWA C 507 - Standard for Ball Valves 6in. through 48in., API 6D - American Petroleum Institute, Specification for Pipeline Valves, with cast iron, ductile iron, or cast steel bodies, flanged ends, suitable for velocities up to 35 fps, temperatures up to 125 degrees F, and design pressures to 250 psi. The balls shall be of cast iron, ductile iron, or cast steel, shaft- or trunnion-mounted, with tight shut-off, single or double seat, and full bore. The valves shall be metal-seated, with stainless steel, forged steel, or monel shafts or trunnions, and not less than one thrust bearing.
- B. **Actuators:** Valves shall have modulating three-phase electric motor actuators in accordance with provisions of Section 15201 - Valve and Gate Actuators.
- C. **Manufacturers, or Equal**
1. **Apco/Willamette**
 2. **GA Industries, Inc.**
 3. **Grove Valve and Regulator Company**
 4. **Neles-Jamesbury, Inc.**
 5. **Henry Pratt Company**

2.3 PLASTIC BALL VALVES

- A. **General:** Plastic ball valves for corrosive fluids shall be made of polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC), polypropylene (PP), or polyvinylidene fluoride (PVDF), as recommended by the Manufacturer for the specific application. Valves shall have manual actuators in accordance with Section 15201 - Valve and Gate Actuators, unless otherwise indicated.
- B. **Construction:** Plastic ball valves shall have union ends or flanged ends to mate with ANSI B 16.5, class 150 flanges, for easy removal. The balls shall have full size ports and Teflon seats. External (without entering into the wetted area) seat packing adjustment is preferred. Metal reinforced stems to prevent accidental breakage are preferred. The valves shall be suitable for a maximum working non-shock pressure of 200 psi at 73 degrees F for PVC and CPVC, with decreasing ratings for higher temperatures and other plastics.
- C. **Manufacturers, or Equal**
1. **ASAHI-America**
 2. **George Fischer, Inc.**
 3. **NIBCO Inc., (Chemtrol)**
 4. **Plast-O-Matic Valves, Inc.**

5. **Spears Mfg. Co.**

6. **Watts Regulator**

PART 3 – EXECUTION

3.1 GENERAL

- A. Valves shall be installed in accordance with Section 15200. Care shall be taken that valves in plastic lines are well supported at each end of the valve.

- END OF SECTION -

SECTION 15206 - GATE VALVES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide gate valves and appurtenances, complete and operable, in accordance with the Contract Documents.
- B. The requirements of Section 15200 - Valves, General apply to this Section.
- C. The requirements of Section 15201 - Valve and Gate Actuators apply to this Section.

1.2 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish submittals in accordance with Section 15200 - Valves, General.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Buried valves shall be of the inside screw, non-rising stem type. The valve actuators shall be as indicated, with counter-clockwise opening stems, in accordance with Section 15201.

2.2 RESILIENT-SEATED GATE VALVES (3- to 16-inch)

- A. **General:** Resilient-seated gate valves may be provided in lieu of metal-seated double-disc or solid-disc gate valves, at the discretion of the ENGINEER.
- B. **Construction:** Resilient-seated gate valves shall conform to ANSI/AWWA C 509 - Resilient-Seated Gate Valves for Water and Sewerage Systems. The valves shall be suitable for a design working water pressure of 200 psig, with flanged, bell and spigot, or mechanical joint ends. The valve body, bonnet, and disc shall be of cast iron or ductile iron and the disc or body shall be rubber-coated. Body and bonnet wall thickness shall be equal to or greater than the minimum wall thickness as listed in Table 2 of ANSI/AWWA C509. The stem, stem nuts, glands, and bushings shall be of bronze, with the stem seal per ANSI/AWWA C 509.
- C. **Actuators:** Unless otherwise indicated, resilient-seated gate valves shall have manual actuators in accordance with Section 15201 - Valve and Gate Actuators.
- D. Manufacturers, or Equal
 - 1. **American Flow Control**
 - 2. **Clow Valve Co.**
 - 3. **Kennedy Valve**
 - 4. **M & H Valve Company**
 - 5. **Mueller Company (Grinnell Corp.)**
 - 6. **U.S. Pipe Metroseal**

PART 3 -- EXECUTION

3.1 GENERAL

- A. Gate valves shall be installed in accordance with the provisions of Section 15200. Care shall be taken that valves in plastic lines are well supported at each end of the valve.

- END OF SECTION -

SECTION 15207 - PLUG VALVES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide plug valves and appurtenances, complete and operable, in accordance with the Contract Documents.
- B. The requirements of Section 15200 - Valves, General apply to this Section.
- C. The requirements of Section 15201 - Valve and Gate Actuators apply to this Section.

1.2 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish submittals in accordance with Section 15200.

PART 2 -- PRODUCTS

2.1 ECCENTRIC PLUG VALVES (1/2-inch to 72-inch)

- A. **Construction:** Eccentric plug valves shall be of the non-lubricated, eccentric plug design with cast iron bodies conforming to ASTM A 126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings, with ANSI 125 lb. flanged ends for valves 3-inch and larger, and screwed or flanged ends for smaller sizes. The plugs and shafts shall be of cast iron or ductile iron conforming to ASTM A 536 - Specification for Ductile Iron Castings, and the plugs shall be lined with a resilient coating, best suited for the specific service. The body shall be lined with a suitable elastomer, where required for a special service, or it shall be epoxy-lined in accordance with Section 09800 - Protective Coating. The seats shall be of nickel or stainless steel welded to the body. Eccentric plug valves for digester gas service shall have Type 316 stainless steel plugs and suitable resilient seating like Buna-N, Hycar, or equal. All top and bottom shaft bearings shall be of permanently lubricated stainless steel, or Teflon coated stainless steel. Grit seals of Teflon, Nylatron, or similar suitable material shall be at the top and bottom plug journals. Valves up to and including 20-inch in size shall have an unobstructed port area of not less than 80 percent of full pipe area, and not less than 70 percent for larger valves. All eccentric plug valves shall have a pressure rating of not less than 150 psi WOG, for bubble-tight shut-off in the standard flow direction, and 25 psi WOG in the reverse flow direction. When equipped with worm gear actuator, the pressure rating shall be 150 psi WOG in both directions. The stem seal shall consist of field adjustable packing, replaceable without removal of the actuator, or of self-adjusting U-cup packing.
- B. **Actuators:** Unless otherwise indicated, all eccentric plug valves 3-inch and smaller shall have operating levers; all larger valves shall have worm-gear actuators. Valve actuators shall be in accordance with Section 15201.
- C. Manufacturers, or Equal
 - 1. **Keystone**
 - 2. **Clow Valve Company**
 - 3. **Henry Pratt Company**

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. All plug valves shall be installed in strict accordance with the Manufacturer's published recommendations and the applicable provisions of Section 15200.
- B. **Eccentric Plug Valves:** Unless otherwise directed, the following rules shall be observed for the installation of eccentric plug valves on sewage, sludge, or other liquid systems containing solids, silt, or fine sand:
 - 1. The valves shall be positioned with the stem in the horizontal direction.
 - 2. In horizontal pipelines, the plug shall swing upwards when opening, to permit flushing out of solids.
 - 3. The orientation of the valve shall prevent the valve body from filling up with solids when closed; however, where the pressure differential through the valve exceeds 25 psi, the higher pressure for valves without worm gear, electric, or air operators shall be through the valve to force the plug against the seat.
 - 4. Valves which may be closed for extended periods (stand-by, bypass, or drain lines) and valves with reversed flow (higher pressure on downstream side, forcing the plug away from its seat), shall be equipped with worm gear operators for all sizes.
 - 5. For special applications or when in doubt, consult with the Manufacturer prior to installation.

- END OF SECTION -

SECTION 15212 -- IN-LINE SLEEVE VALVES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide in-line, sleeve-type flow regulating valve assemblies complete and operable as shown and specified herein including electric motor operators, epoxy coating, and appurtenances and accessories, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall submit shop drawings with complete information as outlined in Section 15200 - Valves, General.
- B. Included with the shop drawings shall be a set of fabrication drawings of the valve, showing all dimensions, tolerances, materials, etc.

PART 2 -- PRODUCTS

2.1 OPERATING REQUIREMENTS

- A. **Performance:** The valve shall be designed for horizontal in-line installation and it shall be guaranteed to operate throughout its range, without cavitation damage, for the conditions stated below:

1. Valve identification no.	-	FCV-3
2. Location	-	Flow Meter Vault
3. Service medium	-	Well Water
4. Size (in)	-	10
5. Working pressure (ft of water)	-	450
6. Pressure differential (ft of water)	-	350
7. Outlets head (ft of water)	-	10
8. Flow range (gpm)	-	1400-3500
9. Flange rating	-	ANSI 150#

2.2 EQUIPMENT REQUIREMENTS

- A. **Valve Assembly Components:** Each sleeve valve assembly shall consist of a flanged, Y-pattern body, a sliding cylindrical sleeve and a seal at the upper end with a seat at the downstream end. The seat ring shall be bolted to the body of the valve and be removable from the top of the valve without removing the valve from the pipeline. The sliding cylindrical sleeve shall be provided with control nozzles that direct the flow to the interior of the sleeve. The valves shall be controlled by a modulating electric motor operator.

B. **Motor Operator:** The modulating electric motor operator shall conform to the requirements of Section 15201 - Valve Operators and shall be as shown on electrical drawings. The operator shall be provided with mechanical and electrical limit stops which shall be field adjustable throughout the flow range.

C. Valve Manufacturers, or Equal:

1. **Chas. M. Bailey, Co., (A Division of CMB Industries);**

D. The valve manufacturer shall have designed and manufactured equipment which has been successfully operated for at least 10 years, comparable to the equipment required to be furnished.

2.3 MATERIAL REQUIREMENTS

A. Assembly components shall be manufactured from the following materials:

1. Valve body - Ductile iron
2. Fixed sleeve - Type 304 stainless steel
3. Sliding sleeve - Type 304 stainless steel
4. Valve shaft - Type 304 stainless steel
5. Seat ring - Type 304 stainless steel with stellite facing
6. Fasteners All studs, bolts, washers, and nuts in contact with water shall be Type 316 stainless steel.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Valve installation shall be in strict accordance with the manufacturer's printed recommendations, and the Contract Documents.

- END OF SECTION -

SECTION 15230 - MISCELLANEOUS VALVES

PART 1 – GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all miscellaneous valves and appurtenances, complete and operable, in accordance with the Contract Documents.
- B. The requirements of Section 15200 - Valves, General, apply to this Section.

1.2 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish submittals in accordance with Section 15200.

PART 2 – PRODUCTS

2.1 AIR-VACUUM AND AIR-RELEASE VALVES

- A. **Air and Vacuum Valves:** Air and vacuum valves shall be capable of venting large quantities of air while pipelines are being filled, and allowing air to re-enter while pipelines are being drained. They shall be of the size indicated, with flanged or screwed ends to match piping. Bodies shall be of high-strength cast iron. The float, seat, and all moving parts shall be constructed of Type 316 stainless steel. Seat washers and gaskets shall be of a material insuring water tightness with a minimum of maintenance. Valves shall be designed for minimum 150 psi water-working pressure, unless otherwise indicated.
- B. **Air-Release Valves:** Air-release valves shall vent accumulating air while system is in service and under pressure and be of the size indicated and shall meet the same general requirements as indicated for air and vacuum valves except that the vacuum feature will not be required. Valves shall be designed for a minimum water-working pressure of 150 psi, unless otherwise indicated.
- C. **Combination Air Valves:** Combination air valves shall combine the characteristics of air and vacuum valves and air release valves by exhausting accumulated air in systems under pressure and releasing or re-admitting large quantities of air while a system is being filled or drained, respectively. Valves shall have the same general requirements as indicated for air and vacuum valves.
- D. Manufacturers, or Equal
 - 1. **Crispin - Multiplex Manufacturing Company**
 - 2. **GA Industries**
 - 3. **Val-Matic (Valve and Manufacturing Corporation)**

2.2 BACKFLOW PREVENTER VALVES

- A. **General:** Backflow preventers shall work on the reduced pressure principle. They shall consist of 2 spring-loaded check valves, automatic differential pressure relief valve, drain

valves, and shut-off valves. The body material shall be bronze or cast iron for a working pressure of not less than 150 psi, with bronze or stainless steel trim. Drain lines with air gaps shall be provided. The backflow preventer valves shall be in accordance with AWWA C511 standard.

B. **Manufacturers, or Equal**

1. **Ames 400 Stainless Steel (Silver Bullet)**

2.3 **CORPORATION STOPS**

A. Unless otherwise indicated, corporation stops shall be made of solid brass for key operation, with screwed ends with corporation thread or iron pipe thread, as required.

B. **Manufacturer, or Equal**

1. **Ford Meter Box Company, Inc.**
2. **James Jones Company (Watts, ACV)**
3. **Mueller Company (Grinnell Corporation)**

2.4 **SOLENOID VALVES**

A. Solenoid valves shall be of the size, type, and class indicated and shall be designed for not less than 150 psi water-working pressure. Valves for water, air, or gas service shall have brass or bronze body with screwed ends, stainless steel trim and spring, Teflon or other resilient seals with material best suited for the temperature and fluid handled. Unless otherwise indicated, for chemicals and all corrosive fluids, solenoid valves with PVC, CPVC, polypropylene (PP), polyvinylidene fluoride (PVDF), or Teflon materials of construction, suitable for the specific application shall be provided. Enclosures shall be NEMA rated in accordance with the area designations of Section 16050 - Electrical Work, General. All coil ratings shall be for continuous duty. For electrical characteristics see electrical drawings or specifications.

B. **Manufacturers, or Equal**

1. For general duty:
 - a. **Automatic Switch Co. (ASCO), Model "RED HAT"**
 - b. **Skinner Valve (Parker Hannifin Corporation)**
 - c. **Magnatrol Valve Corporation**
 - d. **J. D. Gould Co.**
2. Metallic valves for corrosive fluids:
 - a. **Valcor Engineering Corporation**
3. Plastic valves for corrosive fluids:

- a. **+GF+ Plastic Systems, Inc.**
- b. **Spears Mfg. Co.**

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Backflow preventers shall be installed in potable water lines where required by applicable codes or regulations, and wherever there is any danger of contamination, and where indicated.
- B. Valves shall be installed in accordance with the manufacturer's printed recommendations, and with provisions of Section 15200.
- C. Backflow preventers, as well as air and vacuum release valves, shall have piped outlets to the nearest acceptable drain, firmly supported, and installed in such a way as to avoid splashing and wetting of floors and obstruction of traffic.

- END OF SECTION -

SECTION 16050 - ELECTRICAL GENERAL PROVISIONS

PART 1 -- GENERAL

1.1 RELATED SECTIONS

- A. Requirements specified within this section apply to all sections in Division 16, ELECTRICAL. Work specified herein shall be performed as if specified in the individual sections.

Each item of hardware, software, and/or firmware developed, delivered, installed, licensed, or modified under this contract shall be Year 2000 (Y2K) "Millennium Compliant".

1.2 DESIGN REQUIREMENTS

- A. All electronic boards as part of electrical equipment shall meet the atmospheric conditions of the space the equipment is installed in. All electronic boards which are not installed in a conditioned environment shall be fungus-resistant,
- B. All electrical equipment shall be rated for the conditions the equipment is installed in.

1.3 ELECTRICAL COORDINATION

- A. Work provided under this Contract:
 - 1. Provide and install 200 hp, 480v, solid state Reduced Voltage Starter and power panel as shown on the design drawings.
 - 2. Install a new ASR RTU as provided by and directed by the instrument CONTRACTOR.
 - 3. Provide all miscellaneous electrical including switches, terminations, fittings, etc. not specified but obviously necessary for a complete working system in place.

1.4 SUBMITTALS

- A. Quality Control Submittals:
 - 1. Voltage Field Test Results
 - 2. Voltage Balance Report
 - 3. Equipment Line Current Report
 - 4. Factory test certification and reports for all major electrical equipment.
 - 5. Site test certification and reports as specified in other Division 16, ELECTRICAL sections.
 - 6. Scaled plan layout of the electrical room(s) showing spatial relationships of all equipment as well as the overall size of the room. Minimum scale shall be ¼":1'.

1.5 ENVIRONMENTAL CONDITIONS

- A. All chemical rooms and areas shall be corrosive areas.
- B. All indoor chemical and process equipment areas shall be considered wet locations.

1.6 INSPECTION OF THE SITE AND EXISTING CONDITIONS

- A. The Electrical Drawings were developed from past record drawings and information supplied by the OWNER. Verify all scaled dimensions prior to submitting bids.
- B. Before submitting a bid, visit the site and determine conditions at the site and at all existing structures in order to become familiar with all existing conditions and electrical system which will, in any way or manner, affect the work required under this Contract. No subsequent increase in Contract cost will be allowed for additional work required because of the CONTRACTOR's failure to fulfill this requirement.
- C. Carry out any work involving the shutdown of the existing services to any piece of equipment now functioning in existing areas at such time as to provide the least amount of inconvenience to the OWNER. Do such work when directed by the ENGINEER.
- D. After award of Contract, locate all existing underground utilities at each area of construction activity. Protect all existing underground utilities during construction. Pay for all required repairs without increase in Contract cost, should damage to underground utilities occur during construction.

1.7 RESPONSIBILITY

- A. The CONTRACTOR shall be responsible for:
 - 1. Complete systems in accordance with the intent of these Contract Documents.
 - 2. Coordinating the details of facility equipment and construction for all Specification Divisions which affect the work covered under Division 16, ELECTRICAL.
 - 3. Furnishing and installing all incidental items not actually shown or specified, but which are required by good practice to provide complete functional systems.

1.8 INTENT OF DRAWINGS

- A. Electrical plan Drawings show only general location of equipment, devices, and raceway, unless specifically dimensioned. The CONTRACTOR shall be responsible for the proper routing of raceway, subject to the approval of the ENGINEER.
- B. All electrical equipment sizes and characteristics are based on manufacturer General Electric (GE). If the CONTRACTOR chooses to, and is allowed, to substitute, the CONTRACTOR shall be responsible for fitting all the equipment in the available space as shown on the Drawings.

1.9 Millennium Compliance Performance "Y2K"

- A. The CONTRACTOR warrants that each item of hardware, software, and/or firmware developed, delivered, installed, licensed, or modified under this Contract shall be "Millennium Compliant" and recognize and accurately process date data (including but

not limited to, calculating, comparing and sequencing) from, into, and between the twentieth and twenty-first centuries, including leap year calculations, when used in accordance with the documentation provided by the CONTRACTOR, provided that all items (e.g., hardware, software, firmware) used in combination with other designated items properly exchange data with it.

- B. "Millennium Compliant" is the quality of a system in any level of hardware or software including, but not limited to, microcode, firmware, applications programs, files and databases to provide all of the following functions:
1. Accurately process date information before, during, and after January 1, 2000, including but not limited to accepting date input, providing date input, providing date output, and performing calculations on dates or portions of dates, using data or program code referenced by dates:
 2. Function accurately and without interruption before, during, and after January 1, 2000 AD without any change in operation associated with the advent of the new century:
 3. Respond to two-digit year-date input in a way that resolves the ambiguity as to century in a disclosed, defined, and predetermined manner:
 4. Store and provide output of date information in ways that are unambiguous as to century.
- C. "Leap Year" shall mean the year during which the month of February contains 29 days. Leap Year occurs in all years divisible by 400 or evenly divisible by 4 and not evenly divisible by 100.
- D. Nothing in this warranty shall be construed to limit any rights or remedies the owner may otherwise have under this contract with respect to defects other than year 2000 performance.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Provide materials and equipment listed by UL wherever standards have been established by that agency.
- B. **Equipment Finish:**
1. Provide manufacturers' standard finish and color, except where specific color is indicated.
 2. If the manufacturer has no standard color, provide equipment with ANSI No. 61, light gray color.

PART 3 – EXECUTION

3.1 GENERAL

- A. Electrical Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned.
- B. Install work in accordance with NECA Standard of Installation, unless otherwise specified.

3.2 LOAD BALANCE

- A. Drawings and Specifications indicate circuiting to electrical loads and distribution equipment.
- B. Balance electrical load between phases as nearly as possible on switchboards, panelboards, motor control centers, and other equipment where balancing is required.
- C. When loads must be reconnected to different circuits to balance phase loads, maintain accurate record of changes made, and provide circuit directory that lists final circuit arrangement.

3.3 CHECKOUT AND STARTUP

A. Voltage Field Test:

- 1. Check voltage at point of termination of power company supply system to project when installation is essentially complete and is in operation.
- 2. Check voltage amplitude and balance between phases for loaded and unloaded conditions.
- 3. Record supply voltage (all three phases simultaneously on the same graph) for 24 hours during normal working day.
 - a. Submit Voltage Field Test Report within 5 days of test.

4. Unbalance Corrections:

- a. Make written request to power company to correct condition if balance (as defined by NEMA) exceeds 1 percent, or if voltage varies throughout the day and from loaded to unloaded condition more than plus or minus 4 percent of nominal.
- b. Obtain a written certification from a responsible power company official that the voltage variations and unbalance are within their normal standards if corrections are not made.

B. Equipment Line Current Tests:

- 1. Check line current in each phase for each piece of equipment.
- 2. Make line current check after power company has made final adjustments to supply voltage magnitude or balance.

3. If any phase current for any piece of equipment is above rated nameplate current, prepare Equipment Line Phase Current Report that identifies cause of problem and corrective action taken.

C. Startup:

1. Demonstrate satisfactory operation of all 480-volt electrical equipment. Participate with other trades in all startup activities.
2. Assist the Instrumentation and Control (I&C) CONTRACTOR in verifying signal integrity of all control and instrumentation signals.

3.4 STANDARDS, CODES, PERMITS, AND REGULATIONS

A. Perform all work; furnish and install all materials and equipment in full accordance with the latest applicable rules, regulations, requirements, and specifications of the following:

1. Local Laws and Ordinances
2. State and Federal Laws
3. National Electrical Code (NEC)
4. State Fire Marshal
5. Underwriters' Laboratories (UL)
6. National Electrical Safety Code (NESC)
7. American National Standards Institute (ANSI)
8. National Electrical Manufacturer's Association (NEMA)
9. National Electrical Contractor's Association (NECA)
10. Standard of Installation. Institute of Electrical and Electronics Engineers (IEEE)
11. Insulated Cable Engineers Association (ICEA)
12. Occupational Safety and Health Act (OSHA)
13. National Electrical Testing Association (NETA)
14. American Society for Testing and Materials (ASTM)

B. Conflicts, if any, that may exist between the above items will be resolved at the discretion of the ENGINEER.

C. Wherever the requirements of the Specifications or Drawings exceed those of the above items, the requirements of the Specifications or Drawings govern. Code compliance is mandatory. Construe nothing in the Contract Documents as permitting work not in compliance with these codes.

- D. Obtain all permits and pay all fees required by any governmental agency having jurisdiction over the work. Arrange all inspections required by these agencies. On completion of the work, furnish satisfactory evidence to the ENGINEER that the work is acceptable to the regulatory authorities having jurisdiction.

- END OF SECTION -

SECTION 16110 - RACEWAYS

PART 1 -- GENERAL

1.1 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Association of State Highway and Transportation Officials (AASHTO):
Division I, Standard Specifications for Highway Bridges, Fourteenth Edition.
 2. American National Standards Institute (ANSI):
 - a. C80.1, Rigid Steel Conduit-Zinc Coated.
 - b. C80.3, Electrical Metallic Tubing-Zinc Coated.
 - c. CS0.5, Rigid Aluminum Conduit.
 - d. C80.6, Intermediate Metal Conduit (IMC)-Zinc Coated.
 3. American Society for Testing and Materials (ASTM):
 - a. A123 EI, Standard Specification for Zinc-Coated (Galvanized) Coatings on Iron and Steel Products.
 - b. C857, Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
 4. National Electrical Contractor's Association, Inc. (NECA): 5055, Standard of Installation.
 5. National Electrical Manufacturers Association (NEMA):
 - a. RN 1, Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - b. TC 2, Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
 - c. TC 3, PVC Fittings for Use with Rigid PVC Conduit and Tubing.
 - d. TC 6, PVC and ABS Plastic Utilities Duct for Underground Installation.
 - e. VE 1, Metallic Cable Tray Systems.
 6. National Fire Protection Association (NFPA): 70, National Electrical Code. (NEC)
 7. Underwriters Laboratories, Inc. (UL):
 - a. 1, Standard for Safety Flexible Metal Conduit.
 - b. 6, Standard for Safety Rigid Metal Conduit.

- c. 360, Standard for Safety Liquid-Tight Flexible Steel Conduit.
- d. 514B, Standard for Safety Fittings for Conduit and Outlet Boxes.
- e. 514C, Standard for Safety Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers.
- f. 651, Standard for Safety Schedule 40 and 80 PVC Conduit.
- g. 651A, Standard for Safety Type EB and Rigid PVC Conduit and HDPF Conduit.
- h. 797, Standard for Safety Electrical Metallic Tubing.
- i. 870, Standard for Safety Wireways, Auxiliary Gutters, and Associated Fittings.
- j. 1242, Standard for Safety Intermediate Metal Conduit.
- k. 1660, Standard for Safety Liquid-Tight Flexible Nonmetallic Conduit.

1.2 SUBMITTALS

A. Shop Drawings:

- 1. Manufacturer's Literature:
- 2. Rigid galvanized steel conduit.
- 3. Electric metallic tubing.
- 4. Rigid aluminum conduit.
- 5. PVC Schedule 40 conduit.
- 6. PVC-coated rigid galvanized steel conduit.
- 7. Flexible metal, liquid-tight conduit.
- 8. Flexible, nonmetallic, liquid-tight conduit.
- 9. Conduit fittings.
- 10. Wireways.
- 11. Precast Manholes and Handholes:
- 12. Dimensional drawings and descriptive literature.
- 13. Traffic loading calculations.
- 14. Accessory information.
- 15. Cable Tray Systems:

16. Dimensional drawings, calculations, and descriptive information.
17. NEMA load/span designation and how it was selected.
18. Support span length and pounds-per-foot actual and future cable loading at locations, with safety factor used.
19. Location and magnitude of maximum simple beam deflection of tray for loading specified.
20. Layout drawings and list of accessories being provided.
21. Conduit Layout:
22. Plan and section type, showing arrangement and location of conduit and duct bank required for:
23. Low and medium voltage feeder and branch circuits.
24. Instrumentation and control systems.
25. Communications systems.
26. Empty conduit for future use.
27. Reproducible mylar; scale not greater than 1 inch equals 20 feet.
28. Equipment and machinery proposed for bending metal conduit.
29. Method for bending PVC conduit less than 30 degrees.

1.3 UL COMPLIANCE

- A. Materials manufactured within scope of Underwriters Laboratories shall conform to UL Standards and have an applied UL listing mark.

PART 2 -- PRODUCTS

2.1 CONDUIT AND TUBING

A. Rigid Galvanized Steel Conduit (RGS):

1. Meet requirements of ANSI C80.1 and UL6.
2. Material: Hot-dip galvanized, with chromated protective layer.

B. Electric Metallic Tubing (EMT):

1. Meet requirements of ANSI C80.3 and UL 797.
2. Material: Hot-dip galvanized, with chromated and lacquered protective layer.

C. Rigid Aluminum Conduit:

1. Meet requirements of ANSI C80.5 and UL 6.
2. Material: Type 6063, copper-free aluminum alloy.

D. PVC Schedule 40 Conduit:

1. Meet requirements of NEMA TC 2 and UL 651.
2. UL listed for concrete encasement, underground direct burial, concealed or direct sunlight exposure, and 90 degrees C insulated conductors.

E. PVC-Coated Rigid Galvanized Steel Conduit:

1. Meet requirements of NEMA RN 1.
2. Material:
 - a. Conduit: Meet requirements of ANSI C80.1 and UL 6
 - b. PVC Coating: 40 mils nominal thickness, bonded to metal.

F. Flexible Metal, Liquid-Tight Conduit:

1. UL 360 listed for 105 degrees C insulated conductors.
2. Material: Galvanized steel, with an extruded PVC jacket.

G. Flexible, Nonmetallic, Liquid-Tight Conduit:

1. Material: PVC core with fused flexible PVC jacket.
2. UL 1660 listed for:
 - a. Dry Conditions: 80 degrees C insulated conductors.
 - b. Wet Conditions: 60 degrees C insulated conductors.
3. Manufacturers:
 - a. **Carlton; Carflex or X-Flex.**
 - b. **T & B; Xtraflex LTC or EFC.**

2.2 FITTINGS

A. Rigid Galvanized Steel and Intermediate Metal Conduit:

1. General:
 - a. Meet requirements of UL 514B.

- b. Type: Threaded, galvanized. Set screw fittings not permitted.
- 2. Bushing:
 - a. Material: Malleable iron with integral insulated throat, rated for 150 degrees C.
 - b. Manufacturers:
 - 1) **Thomas & Betts; Type BIM.**
 - 2) **O.Z./Gedney; Type HB.**
- 3. Grounding Bushing:
 - a. Material: Malleable iron with integral insulated throat rated for 150 degrees C, with solderless lugs.
 - b. Manufacturers:
 - 1) **Appleton; Series GIB.**
 - 2) **O.Z. Gedney; Type HBLG.**
- 4. Conduit Hub:
 - a. Material: Malleable iron with insulated throat.
 - b. Manufacturers:
 - 1) **O.Z. Gedney; Series CH.**
 - 2) **T & B; Series 370.**
- 5. Conduit Bodies:
 - a. Material: Malleable iron, sized as required by NFPA 70.
 - b. Manufacturers (For Normal Conditions):
 - 1) **Appleton; Form 35 threaded Unilets.**
 - 2) **Crouse-Hinds; Form 7 or 8 threaded condulets.**
 - 3) **Killark; Series O Electrolets.**
 - c. Manufacturers (For Hazardous Locations):
 - 1) **Appleton.**
 - 2) **Crouse-Hinds.**
 - 3) **Killark.**
- 6. Couplings: As supplied by conduit manufacturer.
- 7. Conduit Sealing Fitting Manufacturers:
 - a. **Appleton; Type EYF, EYM, or ESU.**
 - b. **Crouse-Hinds; Type EYS or EZS.**
 - c. **Killark; Type EY or EYS.**
- 8. Drain Seal Manufacturers:

- a. **Appleton; Type SF.**
 - b. **Crouse-Hinds; Type EYD or EZD.**
9. **Drain/Breather Fitting Manufacturers:**
- a. **Appleton; Type ECDB.**
 - b. **Crouse-Hinds; ECD.**
10. **Expansion Fitting Manufacturers:**
- a. **Deflection/Expansion Movement:**
 - b. **Appleton; Type DF.**
 - c. **Crouse-Hinds; Type XD.**
11. **Expansion Movement Only:**
- a. **Appleton; Type XJ.**
 - b. **Crouse-Hinds; Type XJ.**
12. **Cable Sealing Fittings:**
- a. **To form watertight nonslip cord or cable connection to conduit.**
 - b. **For Conductors with OD of 1/2 Inch or less: Neoprene bushing at connector entry.**
 - c. **Manufacturers:**
 - 1) **Crouse-Hinds; CGBS.**
 - 2) **Appleton; CG-S.**
- B. Electric Metallic Tubing:**
1. **Meet requirements of UL 514B.**
 2. **Type: Steel body and locknuts with steel or malleable iron compression nuts. Setscrew and drive-on fittings not permitted.**
 3. **Compression Ring: Stainless steel.**
 4. **Coupling Manufacturers:**
 - a. **Appleton; Type 95T.**
 - b. **Crouse-Hinds; Type CPR.**
 5. **Connector Manufacturers:**

- a. **Appleton; Type 86T.**
 - b. **Crouse-Hinds; Type CPR.**
- C. Rigid Aluminum Conduit:**
- 1. **General:**
 - 2. **Meet requirements of UL 514B.**
 - 3. **Type: Threaded, copper-free. Set screw fittings not permitted.**
 - 4. **Insulated Bushing:**
 - a. **Material: Cast aluminum, with integral insulated throat, rated for 150 degrees C.**
 - 5. **Manufacturer: O.Z. Gedney; Type AB.**
 - 6. **Grounding Bushing:**
 - a. **Material: Cast aluminum with integral insulated throat, rated for 150 degrees, with solderless lugs.**
 - b. **Manufacturer: O.Z. Gedney; Type ABLG.**
 - 7. **Conduit Hub:**
 - a. **Material: Cast aluminum, with insulated throat.**
 - b. **Manufacturers:**
 - (1) **O.Z. Gedney; Type CHA.**
 - (2) **T & B; Series 370AL.**
 - 8. **Conduit Bodies:**
 - a. **Manufacturers (For Normal Conditions):**
 - 1) **Appleton; Form 85 threaded Unilets.**
 - 2) **Crouse-Hinds; Mark 9 or Form 7-SA threaded condulets.**
 - 3) **Killark; Series O Electrolets.**
 - b. **Manufacturers (For Hazardous Locations):**
 - 1) **Appleton.**
 - 2) **Crouse-Hinds.**
 - 3) **Killark.**
 - 9. **Couplings: As supplied by conduit manufacturer.**
 - 10. **Conduit Sealing Fitting Manufacturers:**
 - a. **Appleton; Type EYF-AL or EYM-AL.**

- b. **Crouse-Hinds; Type EYS-SA or EZS-SA.**
 - c. **Killark; Type EY or EYS.**
11. **Drain Seal Manufacturers:**
- a. **Appleton; Type EYDM-A.**
 - b. **Crouse-Hinds; Type EYD-SA or EZD-SA.**
12. **Drain/Breather Fitting Manufacturers:**
- a. **Appleton; Type ECDB.**
 - b. **Crouse-Hinds; ECD.**
13. **Expansion Fitting Manufacturers:**
- a. **Deflection/Expansion Movement: Steel City; Type DF-A.**
 - b. **Expansion Movement Only: Steel City; Type AF-A.**
14. **Cable Sealing Fittings: To form watertight nonslip cord or cable connection to conduit.**
- a. **Bushing: Neoprene at connector entry.**
 - b. **Manufacturer: Appleton CG-S.**

D. PVC Conduit and Tubing:

- 1. **Meet requirements of NEMA TC-3.**
- 2. **Type: PVC, slip-on.**

E. PVC-Coated Rigid Galvanized Steel Conduit:

- 1. **Meet requirements of UL 514B.**
- 2. **Type: Rigid galvanized steel, PVC coated by conduit manufacturer.**
- 3. **Overlapping pressure-sealing sleeves.**
- 4. **Conduit Hangers, Attachments, and Accessories: PVC-coated.**

F. Flexible Metal, Liquid-Tight Conduit:

- 1. **Metal insulated throat connectors with integral nylon or plastic bushing rated for 105 degrees C.**
- 2. **Insulated throat and sealing O-rings.**
- 3. **Long design type extending outside of box or other device at least 2 inches.**

4. **Manufacturer: T & B; Series 5300.**

G. Flexible, Nonmetallic, Liquid-Tight Conduit: Meet requirements of UL 514B.

1. **Type: One-piece fitting body, complete with lock nut, O-ring, threaded ferrule, sealing ring, and compression nut.**

2. **Manufacturers:**

a. **Carlton; Type LT.**

b. **Kellems; Polytuff.**

c. **T & B; LT Series.**

H. Watertight Entrance Seal Device:

1. **New Construction:**

a. **Material: Oversized sleeve, malleable iron body with sealing ring, pressure ring, grommet seal, and pressure clamp.**

b. **Manufacturer: O.Z./Gedney; Type FSK or WSK.**

2. **Gored-Hole Application:**

a. **Material: Assembled dual pressure disks, neoprene sealing ring, and membrane clamp.**

b. **Manufacturer: O.Z./Gedney; Series CSM.**

I. Hazardous Locations: Approved for use in the atmosphere involved.

1. **Manufacturer: Crouse-Hinds; Type ECGJH.**

J. Corrosive Locations:

1. **Material: 40-mil PVC-coated rigid steel.**

2. **Manufacturers:**

a. **Robroy Industries.**

b. **Carlton.**

c. **Crouse-Hinds.**

2.3 WIREWAYS

A. **Meet requirements of UL 870.**

B. **Type: Steel-enclosed, with removable, hinged cover.**

- C. **Rating:** Outdoor raintight if outdoor, and indoor if indoor.
- D. **Finish:** Gray, baked enamel.
- E. **Manufacturers:**
 - 1. **Square D.**

- 2. **B-Line Systems, Inc.**

2.4 CABLE TRAYS

- A. Meet requirements of NEMA VE 1.
- B. **Type:** Ladder of welded construction.
- C. **Material:** Copper-free aluminum alloy 6063-T6 finish.
- D. **Cover:** Louvered, minimum 0.40-inch thick aluminum.
- E. **Barrier Strip:** Vertical, solid type, with horizontal fittings and strip clamps.
- F. Fittings of same cross-sectional tray area and hardware of same material as cable tray.
- G. **Tray Grounding:** Conform to NFPA 70 and NEMA VE 1.
- H. Provide next higher NEMA VE 1 class designation than required for support of designed span length.
- I. **Design Loads:** Use working load adequate for actual cable installed plus 50 percent additional weight allowance for future cables plus 200-pound concentrated static load applied between side rails at midspan, with safety factor of 2 in accordance with NEMA VE 1, Table 3-1.
- J. **Expansion Joints:** NEMA VE 1 for 50 degrees F maximum temperature variation.
- K. Furnish Cable Tray with no sharp edges, burrs, or weld projections.
- L. **Manufacturers:**
 - 1. **B-Line Systems, Inc.**
 - 2. **Square D.**
 - 3. **P. W. Industries.**

2.5 PRECAST MANHOLES AND HANDHOLES

- A. **Concrete Strength:** Minimum, 3,000 psi compressive, in 28 days.
- B. **Loading:** AASHTO Division 1, H-20 in accordance with ASTM C857.

- C. **Access:** Provide cast concrete 6- or 12-inch risers and access hole adapters between top of manhole and finished grade at required elevations.
- D. **Drainage:**
1. Slope floors toward drain points, leaving no pockets or other non-draining areas.
 2. Provide drainage outlet or sump at low point of floor constructed with a heavy, cast iron, slotted or perforated hinged cover, and 4-inch minimum outlet and outlet pipe.
- E. **Raceway Entrances:**
1. Provide on all four sides.
 2. For raceways to be installed under this Contract, provide knockout panels or precast individual raceway openings.
 3. Minimum 12-inch high by 24-inch wide knockout panels for future raceway at entrances where raceways are to be installed by others, provide installation.
- F. **Embedded Pulling Iron:**
1. Material: 3/4-inch diameter stock, fastened to overall steel reinforcement before concrete is placed.
 2. Location:
 - a. Wall: Opposite each raceway entrance and knockout panel for future raceway entrance.
 - b. Floor: Centered below manhole or handhole cover.
- G. **Cable Racks:**
1. Arms and Insulators: Adjustable, of sufficient number to accommodate cables for each raceway entering or leaving manhole, including spares.
 2. Wall Attachment:
 - a. Adjustable inserts in concrete walls. Bolts or embedded studs not permitted.
 3. Insert Spacing: Maximum 3-foot on center entire inside perimeter of manhole.
 4. Arrange so that spare raceway ends are clear for future cable installation.
- H. **Manhole Frames and Covers:**
1. Material: Machined cast iron.
 2. Diameter: 32 inches.
 3. Cover Type: Indented, solid top design, with two drop handles each.

4. Cover Loading: AASHTO Division I, H-20.
5. Cover Designation: Cast, on upper side, in integral letters, minimum 2 inches in height, appropriate titles:
6. Above 600 Volts: ELECTRIC HV.
7. 600 Volts and below: ELECTRIC LV.
8. TELEPHONE.

I. **Handhole Frames and Covers:**

1. Material: Steel, hot-dipped galvanized.
2. Cover Type: Solid, bolt on, of checkered design.
3. Cover Loading: H-20.
4. Cover Designation: Burn by welder, on upper side in integral letters, minimum 2 inches in height, appropriate titles:
5. 600 Volts and Below: ELECTRIC LV. TELEPHONE
6. Hardware: Steel, hot-dip galvanized.
7. Furnish knockout for ground rod in each handhole and manhole.
8. Manufacturers:
 - a. **U.S. Precast.**
 - b. **Brooks Products, Inc.**
 - c. **Penn-Cast Products, Inc.**
 - d. **Concrete Conduit Co.**
 - e. **Associated Concrete Products, Inc.**
 - f. **Utility Vault Co.**
 - g. **Pipe, Inc.**

2.6 ACCESSORIES

A. **Duct Bank Spacers:**

1. Type: Nonmetallic, interlocking, for multiple conduit sizes.
2. Suitable for all types of conduit.
3. Manufacturer: **Underground Device, Inc.; Type WUNPEECE.**

B. Identification Devices:

1. Raceway Tags:
2. Material: Permanent, nylon.
3. Shape: Round.
4. Raceway Designation: Pressure stamped, embossed, or engraved.
5. Tags relying on adhesives or taped-on markers not permitted.
6. Warning Tape:
7. Material: Polyethylene, 4-mil gauge.
8. Color: Red.
9. Width: Minimum 6-inch.
10. Designation: Warning on tape that electric circuit is located below tape.
11. Manufacturers:
 - a. **Blackburn, Type RT.**
 - b. **Griffolyn Co.**

C. Buried Raceway Marker:

1. Material: Sheet bronze, consisting of double-ended arrows, straight for straight runs and bent at locations where runs change direction.
2. Designation: Incise to depth of 3/32 inch, **ELECTRIC CABLES.** in letters 1/4-inch high.
3. Minimum Dimension: 1/4-inch thick, 10 inches long, and 3/4-inch wide.

D. Raceway Coating:

1. Material: Bitumastic or plastic tape coating.
2. Manufacturers:
 - a. **Koppers bitumastic; No. 505.**
 - b. **Scotchwrap; No. 51, plastic tape.**

E. Wraparound Duct Band:

1. Material: Heat-shrinkable, cross-linked polyolefin, precoated with hot-melt adhesive.
2. Manufacturer: **Raychem; Type TWDB.**

PART 3 -- EXECUTION

3.1 GENERAL

- A. Conduit and Tubing sizes shown are based on the use of copper conductors. Reference Section 16120, CONDUCTORS, concerning conduit sizing for aluminum conductors.
- B. All installed Work shall comply with NECA 5055.
- C. Crushed or deformed raceways not permitted.
- D. Maintain raceway entirely free of obstructions and moisture.
- E. Immediately after installation, plug or cap raceway ends with watertight and dust-tight seals until time for pulling in conductors.
- F. **Aluminum Conduit:** Do not install in direct contact with concrete.
- G. **Sealing Fittings:** Provide drain seal in vertical raceways where condensate may collect above sealing fitting.
- H. Avoid moisture traps where possible. When unavoidable in exposed conduit runs, provide junction box and drain fitting at conduit low point.
- I. Group raceways installed in same area.
- J. **Proximity to Heated Piping:** Install raceways minimum 12 inches from parallel runs.
- K. Follow structural surface contours when installing exposed raceways. Avoid obstruction of passageways.
- L. Run exposed raceways parallel or perpendicular to walls, structural members, or intersections of vertical planes.
- M. **Block Walls:** Do not install raceways in same horizontal course with reinforcing steel.
- N. Install watertight fittings in outdoor, underground, or wet locations.
- O. Paint threads, before assembly of fittings, of galvanized conduit or IMC installed in exposed or damp locations with zinc-rich paint or liquid galvanizing compound.
- P. All metal conduit shall be reamed, burrs removed, and cleaned before installation of conductors, wires, or cables.
- Q. Do not install raceways in concrete equipment pads, foundations, or beams.

- R. Horizontal raceways installed under floor slabs shall lie completely under slab, with no part embedded within slab.
- S. Install concealed, embedded, and buried raceways so that they emerge at right angles to surface and have no curved portion exposed.

3.2 INSTALLATION IN CAST-IN-PLACE STRUCTURAL CONCRETE

- A. Minimum cover 1-1/2 inches.
- B. Provide support during placement of concrete to ensure raceways remain in position.
- C. **Floor Slabs:**
 - 1. Outside diameter of conduit not to exceed one-third of the slab thickness.
 - 2. Separate conduit by minimum six times conduit outside diameter, except at crossings.

3.3 CONDUIT APPLICATION

- A. Diameter: Minimum 3/4 inch.
- B. **Exterior, Exposed:**
 - 1. PVC Coated Rigid galvanized steel.
- C. **Interior, Exposed:**
 - 1. Rigid galvanized steel.
 - 2. Electric metallic tubing for ceiling portion of lighting circuits in a conditioned environment.
- D. **Interior, Concealed (Not Embedded in Concrete):**
 - 1. Rigid galvanized steel.
 - 2. PVC Schedule 40.
- E. **Aboveground, Embedded in Concrete Walls, Ceilings, or Floors:**
 - 1. PVC Schedule 40.
- F. **Direct Earth Burial:** PVC Schedule 80.
- G. **Concrete-Encased Raceways:** PVC Schedule 40.
- H. **Under Slabs-On-Grade:** PVC Schedule 40.
- I. **Corrosive Areas, Exterior:** PVC-coated rigid galvanized steel.

- J. **Corrosive Areas, Interior:** PVC Schedule 80.
- K. Conduits between VFD's and motors.
- L. PVC coated rigid galvanized steel (inside and outside).
- M. **Interior Equipment Area:** PVC coated rigid galvanized steel.

3.4 CONNECTIONS

- A. For motors, wall or ceiling mounted fans and unit heaters, dry type transformers, electrically operated valves, instrumentation, and other equipment where flexible connection is required to minimize vibration:
- B. **Conduit Size 4 Inches or less:** Flexible metal, liquid-tight conduit.
- C. **Conduit Size Over 4 Inches:** Non-flexible.
- D. **Corrosive Areas:** Flexible, nonmetallic, liquid or PVC-coated metallic, liquid-tight.
- E. **Length:** 18-inch minimum, 60-inch maximum, of sufficient length to allow movement or adjustment of equipment.
- F. **Lighting Fixtures in Dry Areas:** Flexible steel, non-liquid-tight conduit.
- G. **Outdoor Areas, Process Areas Exposed to Moisture, and Areas required to be Oil-tight and Dust-Tight:** Flexible metal, liquid-tight conduit.
- H. **Transition from Underground or Concrete Embedded to Exposed:** PVC Coated Rigid galvanized steel conduit.
- I. **Under Equipment Mounting Pads:** Rigid galvanized steel conduit.
- J. **Exterior Light Pole Foundations:** Rigid galvanized steel conduit.

3.5 PENETRATIONS

- A. Make at right angles, unless otherwise shown.
- B. Notching or penetration of structural members, including footings and beams, not permitted.
- C. Fire-Rated Walls, Floors, or Ceilings: Fire-stop openings around penetrations to maintain fire-resistance rating.
- D. Apply single layer of wraparound duct band to all metallic conduit in contact with concrete floor slabs to a point 2 inches above concrete surface.
- E. Concrete Walls, Floors, or Ceilings (Above ground): Provide non-shrink grout dry-pack, or use watertight seal device.

F. **Entering Structures:** General: Seal raceway at the first box or outlet with minimum 2 inches thick expandable plastic compound to prevent the entrance of gases or liquids from one area to another.

G. **Concrete Roof or Membrane Waterproofed Wall or Floor:**

1. Provide a watertight seal.
2. Without Concrete Encasement: Install watertight entrance seal device on each side.
3. With Concrete Encasement: Install watertight entrance seal device on the accessible side.
4. Securely anchor malleable iron body of watertight entrance seal device into construction with one or more integral flanges.
5. Secure membrane waterproofing to watertight entrance seal device in a permanent, watertight manner.
6. Heating, Ventilating, and Air Conditioning Equipment:
 - a. Penetrate equipment in area established by manufacturer.
 - b. Terminate conduit with flexible metal conduit at junction box or conduit attached to exterior surface of equipment prior to penetrating equipment.
 - c. Seal penetration with silicone type sealant.
7. Corrosive-Sensitive Areas:
 - a. Seal all conduits passing through chlorine and ammonia room walls.
 - b. Seal all conduits entering equipment panel boards and field panels containing electronic equipment.
 - c. Seal penetration with silicone type sealant as specified.
8. Existing or Precast Wall (Underground): Core drill wall and install watertight entrance seal device.
9. Non-waterproofed Wall or Floor (Underground, without Concrete Encasement):
 - a. Provide Schedule 40 galvanized pipe sleeve, or watertight entrance seal device.
 - b. Fill space between raceway and sleeve with an expandable plastic compound on each side.
10. Manholes and Handholes:
 - a. Metallic Raceways: Provide insulated grounding bushings.
 - b. Nonmetallic Raceways: Provide bell ends flush with wall.

- c. Install such that raceways enter as near as possible to one end of wall, unless otherwise shown.

3.6 SUPPORT

- A. Support from structural members only, at intervals not exceeding NFPA 70 requirements, and in any case not exceeding 10 feet. Do not support from piping, pipe supports, or other raceways.
- B. **Multiple Adjacent Raceways:** Provide ceiling trapeze. For trapeze-supported conduit, allow 40 percent extra space for future conduit.
- C. Provide and attach wall brackets, strap hangers, or ceiling trapeze as follows:
- D. **Wood:** Wood screws.
- E. **Hollow Masonry Units:** Toggle bolts.
- F. **Concrete or Brick:** Expansion shields, or threaded studs driven in by powder charge, with lock washers and nuts.
- G. **Steelwork:** Machine screws.
- H. Nails or wooden plugs inserted in concrete or masonry for attaching raceway not permitted. Do not weld raceways or pipe straps to steel structures. Do not use wire in lieu of straps or hangers.

3.7 BENDS

- A. Install concealed raceways with a minimum of bends in the shortest practical distance.
- B. Make bends and offsets of longest practical radius.
- C. Install with symmetrical bends or cast metal fittings.
- D. Avoid field-made bends and offsets, but where necessary, make with acceptable hickey or bending machine. Do not heat metal raceways to facilitate bending.
- E. Make bends in parallel or banked runs from same center or centerline with same radius so that bends are parallel.
- F. Factory elbows may be installed in parallel or banked raceways if there is change in plane of run, and raceways are same size.
- G. PVC Conduit:
- H. Bends 30-Degree and larger: Provide factory-made elbows.
- I. 90-Degree Bends: Provide rigid steel elbows.
- J. Use manufacturer's recommended method for forming smaller bends.

- K. Flexible Conduit: Do not make bends that exceed allowable conductor bending radius of cable to be installed or that significantly restricts conduit flexibility.

3.8 EXPANSION/DEFLECTION FITTINGS

- A. Provide on all raceways at all structural expansion joints, and in long tangential runs.
- B. Provide expansion/deflection joints for 50 degrees F maximum temperature variation.
- C. Install in accordance with manufacturer's instructions.

3.9 PVC CONDUIT

- A. **Solvent Welding:** Provide manufacturer recommended solvent; apply to all joints.
- B. Install such that joint is watertight.
- C. **Adapters:**
 - 1. PVC to Metallic Fittings: PVC terminal type.
 - 2. PVC to Rigid Metal Conduit or IMC: PVC female adapter.
 - 3. Belied-End Conduit: Bevel the unbelled end of the joint prior to joining.

3.10 PVC-COATED RIGID STEEL CONDUIT

- A. Install in accordance with manufacturer's instructions.
- B. Provide PVC boot to cover all exposed threading.

3.11 WIREWAYS

- A. Install in accordance with manufacturer's instructions.
- B. Locate with cover on accessible vertical face of wireway, unless otherwise shown.

3.12 CABLE TRAYS

- A. Install in accordance with Application Information Section of NEMA VE 1.
- B. Provide accessories as necessary for a complete system.
- C. Install such that joints are not made at support brackets.
- D. Install horizontal section support brackets between support point and quarter point of tray span.
- E. Provide ceiling trapeze for all horizontal cable tray.
- F. Install support within 2 feet on each side of expansion joints and within 2 feet of fitting extremity.

- G. Provide expansion joints in accordance with NEMA VE 1 for 50 degrees F maximum temperature variation.
- H. Install horizontal tray level, plumb, straight, and true to line or grade within a tolerance of 1/8 inch in 10 feet and within a cumulative maximum of 1/2 inch.
- I. Install vertical tray plumb within a tolerance of 1/8 inch in 10 feet.
- J. Install without exposed raw edges.
- K. Maintain 9-inch vertical separation between multi-tiered trays having a common support, and at all crossover locations.
- L. Provide bonding jumper at each expansion joint and adjustable connection.
- M. **Ground Conductor:** Provide properly sized clamps for each section, elbow, tee, cross, and reducer.

3.13 TERMINATION AT ENCLOSURES

A. **Cast Metal Enclosure:** Provide manufacturer's pre-molded insulating sleeve inside metallic conduit terminating in threaded hubs.

B. **Sheet Metal Boxes, Cabinets, and Enclosures:**

1. Rigid Galvanized Conduit:

- a. Provide one lock nut each on inside and outside of enclosure.
- b. Install grounding bushing.
- c. Provide bonding jumper from grounding bushing to equipment ground bus or ground pad; if neither ground bus nor pad exists, connect jumper to lag bolt attached to metal enclosure.
- d. Install insulated bushing on ends of conduit where grounding is not required.
- e. Provide insulated throat when conduit terminates in sheet metal boxes having threaded hubs.

2. Electric Metallic Tubing: Provide gland compression, insulated connectors.

3. Flexible Metal Conduit: Provide two screw type, insulated, malleable iron connectors.

4. Flexible, Nonmetallic Conduit: Provide nonmetallic, liquid-tight strain relief connectors.

5. PVC-Coated Rigid Galvanized Steel Conduit: Provide PVC-coated, liquid-tight, metallic connector.

6. PVC Schedule 40 Conduit: Provide PVC terminal adapter with lock nut.

- C. **Motor Control Center, Switchboard, Switchgear, and Free-Standing Enclosures:** Terminate conduit entering bottom with grounding bushing; provide a grounding jumper extending to equipment ground bus or grounding pad.

3.14 UNDERGROUND RACEWAYS

- A. **Grade:** Maintain minimum grade of 4 inches in 100 feet, either from one manhole, handhole, or pull box to the next, or from a high point between them, depending on surface contour.
- B. **Cover:** Maintain minimum 2-foot cover above conduit and concrete encasement, unless otherwise shown.
- C. Make routing changes as necessary to avoid obstructions or conflicts.
- D. **Couplings:** In multiple conduit runs, stagger so that couplings in adjacent runs are not in same transverse line.
- E. Union type fittings not permitted.
- F. **Spacers:**
 - 1. Provide preformed, nonmetallic spacers, designed for such purpose, to secure and separate parallel conduit runs in a trench or concrete encasement.
 - 2. Install at intervals not greater than that specified in NFPA 70 for support of the type conduit used, but in no case greater than 10 feet.
- G. Support conduit so as to prevent bending or displacement during backfilling or concrete placement.
- H. Installation with Other Piping Systems:
- I. **Crossings:** Maintain minimum 12-inch vertical separation.
- J. **Parallel Runs:** Maintain minimum 12-inch separation.
- K. Installation over valves or couplings not permitted.
- L. **Metallic Raceway Coating:** At couplings and joints and along entire length, apply wraparound duct band with one-half tape width overlap to obtain two complete layers.
- M. **Concrete Encasement:** As specified in Section 03300, CAST-IN-PLACE CONCRETE.
- N. **Concrete Color:** Gray, dust top of concrete ductbank with powdered red concrete dye before concrete sets and trowel dry onto top of ductbank.
- O. Do not backfill until inspected by ENGINEER.

3.15 MANHOLES AND HANDHOLES

- A. Excavate, shore, brace, backfill, and final grade in accordance with Section 02100.

- B. Do not install until final raceway grading has been determined.
- C. Install such that raceways enter at nearly right angles and as near as possible to one end of wall, unless otherwise shown.
- D. **Grounding:** As specified in Section 16450, GROUNDING.
- E. **Identification:** Field stamp covers with manhole or handhole number as shown. Stamped numbers to be 1-inch minimum height.

3.16 EMPTY RACEWAYS

- A. Provide permanent, removable cap over each end.
- B. Provide PVC plug with pull-tab for underground raceways with end bells.
- C. Provide nylon pull cord.
- D. Identify, as specified in Paragraph IDENTIFICATION DEVICES, with waterproof tags attached to pull cord at each end, and at intermediate pull point.

3.17 IDENTIFICATION DEVICES

- A. **Raceway Tags:** Identify origin and destination.
- B. Install at each terminus, near midpoint, and at minimum intervals of every 50 feet of exposed Raceway, whether in ceiling space or surface mounted.
- C. Provide nylon strap for attachment.
- D. **Warning Tape:** Install approximately 12 inches above underground or concrete-encased raceways. Align parallel to, and within 12 inches of, centerline of runs.
- E. **Buried Raceway Markers:** Install at grade to indicate direction of underground raceways. Install at all bends and at intervals not exceeding 100 feet in straight runs. Embed and secure to top of concrete base, sized 14 inches long, 6 inches wide, and 8 inches deep; top set flush with finished grade.

3.18 PROTECTION OF INSTALLED WORK

- A. Protect products from effects of moisture, corrosion, and physical damage during construction.
- B. Provide and maintain manufactured watertight and dust-tight seals over all conduit openings during construction.
- C. Touch up painted conduit threads after assembly to cover nicks or scars.
- D. Touch up damage to coating on PVC-coated conduit with patching compound approved by manufacturer.

- END OF SECTION -

SECTION 16115 - CONDUCTORS

PART 1 – GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American National Standards Institute (ANSI): 386, Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V.
2. American Society for Testing and Materials (ASTM):
 - a. A167, Standard Specification for Stainless and Heat Resisting Chromium-Nickel-Plated Steel Plate, Sheet, and Strip.
 - b. B3, Standard Specification for Soft or Annealed Copper Wire.
 - c. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
 - d. B263, Standard Test Method for Determination of Cross- Sectional Area of Stranded Conductors.
3. Association of Edison Illuminating Companies (AEIC):
 - a. CS 5, Crosslinked Polyethylene Insulated Shielded Power Cables Rated 5 through 35 kV.
 - b. CS 6, Ethylene- Propylene-Rubber-Insulated Shielded Power Cables Rated 5 through 69 kV.
4. Insulated Cable Engineer's Association, Inc. (ICEA): T-29-250, Procedure for Conducting Vertical Cable Tray Flame Test with a Theoretical Heat Input of 210,000 Btu/hour.
5. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. 48, Standard Test Procedures and Requirements or High-Voltage Alternating Current Cable Terminations.
 - b. 404, Standard for Cable Joints for Use with Extruded Dielectric Cable Rated 5,000V through 46,000V and Cable Joints for Use with Laminated Dielectric Cable Rated 2,500V through 500,000V.
6. National Electrical Contractors Association, Inc. (NECA): 5055, Standard of Installation.
7. National Electrical Manufacturers' Association (NEMA):
 - a. CC 1, Electric Power Connectors for Substations.

- a. CC 1, Electric Power Connectors for Substations.
 - b. WC 3, Rubber-insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
 - c. WC 5, Thermoplastic Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
 - d. WC 7, Crosslinked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
 - e. WC 8, Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
 - f. WC 55, Instrumentation Cables and Thermocouple Wire.
8. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
9. Underwriters Laboratories, Inc. (UL):
- a. 13, Standard for Safety Power-Limited Circuit Cables.
 - b. 44, Standard for Safety Rubber-Insulated Wires and Cables.
 - c. 62, Standard for Safety Flexible Cord and Fixture Wire.
 - d. 486A, Standard for Safety Wire Connector and Soldering Lugs for Use with Copper Conductors.
 - e. 486B, Standard for Safety Wire Connectors and Soldering Lugs for Use with Aluminum Conductors.
 - f. 510, Standard for Safety Insulating Tape.
 - g. 854, Standard for Safety Service-Entrance Cables.
 - h. 910, Standard for Safety Test Method for Fire and Smoke Characteristics of Electrical and Optical-Fiber Cables Used in Air Handling Spaces.
 - i. 1072, Standard for Safety Medium-Voltage Power Cables.
 - j. 1277, Standard for Safety Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.
 - k. 1581, Standard for Safety Reference Standard for Electrical Wires, Cables, and Flexible Cords.

1.2 SUBMITTALS

A. Shop Drawings:

1. Wire and cable descriptive product information.

2. Wire and cable accessories descriptive product information.
3. Cable fault detection system descriptive product information.
4. Manufactured wiring systems descriptive product information.
5. Manufactured wire systems rating information.
6. Manufactured wire systems dimensional drawings.
7. Manufactured wire systems special fittings.
8. Busway descriptive product information.
9. Busway rating information.
10. Busway dimensional drawings.
11. Busway special fitting information.
12. Busway-equipment interface information for equipment to be connected to busways.

B. Quality Control Submittals:

1. Certified Factory Test Report for conductors 600 volts and below.
2. Certified Factory Test Report per AEIC CS6, including AEIC qualification report for conductors above 600 volts.

1.3 UL COMPLIANCE

- A. Materials manufactured within scope of Underwriters Laboratories shall conform to UL Standards and have an applied UL listing mark.**

PART 2 -- PRODUCTS

2.1 CONDUCTORS 600 VOLTS AND BELOW

- A. Conform to applicable requirements of NEMA WC 3, WC 5, and WC 7.**
- B. Conductor Type:**
1. 120- and 277-Volt Lighting, No. 10 AWG and Smaller: Solid copper.
 2. 120-Volt Receptacle Circuits, No. 10 AWG and Smaller: Solid copper.
 3. All Other Circuits: Stranded copper.

C. Insulation: Type THHN/THWN, except for sizes No. 6 and larger, with XHHW insulation.

D. Direct Burial and Aerial Conductors and Cables:

1. Type USE/RHH/RHW insulation, UL IC54 listed, Type RHW-2/USE-2.
2. Conform to physical and minimum thickness requirements of NEMA WC 3.

E. Flexible Cords and Cables:

1. Type SOW-A50 with ethylene propylene rubber insulation in accordance with UL 62.
2. Conform to physical and minimum thickness requirements of NEMA WC 8.

F. Cable Tray Conductors and Cables: Type TC.

2.2 CONDUCTORS ABOVE 600 VOLTS

A. EPR Insulated Cable:

1. Extrusion: Single-pass, triple-tandem, of conductor screen, insulation, and insulation screen.
2. Type: 5 kV, shielded, UL 1072, Type MV-90.
3. Conductors: Copper, concentric lay Class B round stranded in accordance with ASTM B3, ASTM B8, and ASTM B263.
4. Conductor Screen: Extruded, semi-conducting ethylene-propylene rubber in accordance with NEMA WC 8 and AEIC CS 6.
5. Insulation: 133 percent insulation level, ethylene-propylene rubber (EPR), containing no polyethylene in accordance with NEMA WC 8, and AEIC CS 6.
6. Insulation Thickness: 0.26 inch, 25 kV, nominal.
7. Insulation Screen: Thermosetting, semi-conducting ethylene-propylene rubber (EPR), extruded directly over insulation in accordance with NEMA WC 8, and AEIC CS 6.
8. Metallic Shield: Uncoated, 5-mil, copper shielding tape, helically applied with 17-1/2 percent minimum overlap.
9. Jacket: Extruded polyvinyl chloride (PVC) compound applied over the metallic shield in accordance with NEMA WC 8.
10. Operating Temperature: 90 degrees C continuous normal operations, 130 degrees C emergency operating conditions, and 250 degrees C short-circuit conditions.

11. Manufacturers:

- a. Okonite Co.
- b. Pirelli Wire and Cable.
- c. Cablec Corp.
- d. Southwire.

2.3 600-VOLT RATED CABLE

A. General:

1. Type: TC, meeting requirements of UL 1277, including Vertical Tray Flame Test at 20,000 Btu/hr, and NFPA 70, Article 340, or UL 13 Listed Power Limited Circuit Cable meeting requirements of NFPA 70, Article 725.
2. Permanently and legibly marked with manufacturer's name, maximum working voltage for which cable was tested, type of cable, and UL listing mark.
3. Suitable for installation in open air, in cable trays, or conduit.
4. Minimum Temperature Rating: 90 degrees C dry locations, 75 degrees C wet locations.
5. Overall Outer Jacket: PVC, flame-retardant, sunlight- and oil-resistant.

B. CABLE Type "A", Wire and Connectors

1. Cable shall be rated for 600 volts and shall meet the requirements below:
2. Conductors shall be stranded
3. All wire shall be brought to the job in unbroken packages and shall bear the data of manufacturing; not older than 12 months.
4. Type of wire shall be XHHW or THHN, rated 75 degrees C suitable for wet locations except where required otherwise by the drawings.
5. No wire smaller than No. 12 gauge shall be used unless specifically indicated.
6. Conductor metal shall be copper.
7. All conductors shall be megger tested after installation and insulation must comply with the Insulated Power Cable Engineers Association Minimum Values of Insulation Resistance.

C. Type I-Multiconductor Control Cable:

1. Conductors:

- a. No. 14 AWG, seven-strand copper.
 - b. Insulation: 15-mil PVC with 4-mil nylon.
 - c. UL 1581 listed as Type THHN/THWN rated VW-1.
 - d. Conductor group bound with spiral wrap of barrier tape.
 - e. Color Code: In accordance with NEMA WC 5, Method 1, Sequence K-2.
2. Cable: Passes the ICEA T-29-520 210,000 Btu/hr Vertical Tray Flame Test.
3. Cable Sizes:

No. of Conductors	2.01 2.02	Max. Outside Diameter (inches)	2.03 2.04	Jacket Thickness (mils)
3	2.05	0.41	2.06	45
5	2.07	0.48	2.08	45
7	2.09	0.52	2.010	45
12	2.011	0.72	2.012	60
19	2.013	00.83	2.014	60
25	2.015	1.00	2.016	60
37	2.017	1.15	2.018	80

4. Manufacturers:
- a. Okonite Co.
 - b. Rome Cable.

D. Type 2-Multiconductor Power Cable:

1. Conductors:
- a. Class B stranded coated copper.
 - b. Insulation: Chemically crosslinked ethylene-propylene with Hypalon jacket.
 - c. UL 1581 listed as Type EPR rated VW-1.
 - d. Color Code: Conductors, size No. 8 AWG and smaller, colored conductors, NEMA WC5 Method 1, color 5 per Article POWER CONDUCTOR COLOR CODING. Conductors, size No. 6 AWG and larger, NEMA WC5, Method 4.
2. Cable passes the ICEA T-29-520 210,000 Btu/hr Vertical Tray Flame Test.

3. Cable Sizes:

Conductor Size	Minimum Ground Wire Size	No. of Conductors	Maximum Outside Diameter (Inches)	Nominal Jacket Thickness (Mils)
12	12	2	0.42	45
		3	0.45	45
		4	0.49	45
10	10	2	0.54	60
		3	0.58	60
		4	0.63	60
8	10	3	0.66	60
		4	0.72	
6	8	3	0.74	60
		4	0.81	
4	6	3	0.88	60
		4	0.97	80
2	6	3	1.01	80
		4	1.11	
1/0	6	3	1.22	80
		4	1.35	
2/0	4	3	1.32	80
		4	1.46	
4/0	4	3	1.56	80
		4	1.78	

4. Manufacturers:

- a. Okonite Co.
- b. Rome Cable.

E. Type B-No. 16 AWG, Twisted, Shielded Pair, Instrumentation Cable: Single pair, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 55 requirements.

- 1. Outer Jacket: 45-mil nominal thickness.
- 2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer overlapped to provide 100 percent coverage.
- 3. Dimension: 0.31-inch nominal OD.
- 4. Conductors:
 - a. Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8
 - b. 20 AWG, seven-strand tinned copper drain wire.

- c. Insulation: 15-mil nominal PVC.
 - d. Jacket: 4-mil nominal nylon.
 - e. Color Code: Pair conductors black and red.
5. Manufacturers:
- a. Okonite Co.
 - b. Alpha Wire Corp.
6. The following test shall be performed on instrumentation and control system cables. All tests shall be end-to-end test of installed cables with the ends supported in free air, not adjacent to any ground object. All test data shall be recorded on forms acceptable to the Engineer. Complete records of all tests shall be made and delivered to the Engineer.
- a. Continuity tests shall be performed by measuring wire/shield loop resistances of signal cable as the wires, taken one at a time, are shorted to the channel shield. No loop resistance measurement shall carry by more than ± 2 ohms from the calculated average loop resistance value.
 - b. Insulation resistance tests shall be performed by using a 500 volt megohmmeter to measure the insulation resistance between each channel wire and channel shield, between individual channel shields in a multi-channel cable, between each individual channel and the overall cable shield in multi-channel cable, between each wire and ground, and between each shield and ground. Values of resistance less than 10 megohms shall be unacceptable.
- F. Type B1-No. 16 AWG, Twisted, Shielded Triad Instrumentation Cable: Single triad, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 55 requirements.
- 1. Outer Jacket: 45-mil nominal.
 - 2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer, overlapped to provide 100 percent coverage.
 - 3. Dimension: 0.32-inch nominal OD.
 - 4. Conductors:
 - a. Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8.
 - b. 20 AWG, seven-strand, tinned copper drain wire.
 - c. Insulation: 15-mil nominal PVC.
 - d. Jacket: 4-mil nylon.

- e. Color Code: Triad conductors: black, red, and blue.
5. Manufacturers:
- a. Okonite Co.
 - b. Alpha Wire Corp.
- G. Type B2-No. 18 AWG, Multi-Twisted, Shielded Pairs with a Common, Overall Shield Instrumentation Cable: Designed for use as instrumentation, process control, and computer cable, meeting NEMA WC 55 requirements.

1. Conductors:

- a. Bare soft annealed copper, Class B, seven-strand concentric, in accordance with ASTM B8
 - b. Tinned copper drain wires.
 - c. Pair drain wire size AWG 20, group drain wire size AWG 18.
 - d. Insulation: 15-mil PVC.
 - e. Jacket: 4-mil nylon.
 - f. Color Code: Pair conductors black and red with red conductor numerically printed for group identification.
 - g. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer.
2. Cable Shield: 2.35-mil, double-faced aluminum/synthetic polymer, overlapped for 100 percent coverage.
3. Cable Sizes:

Number of Pairs	Maximum Outside Diameter (inches)	Nominal Jacket Thickness (mils)
4	0.50	45
8	0.68	60
12	0.82	60
16	0.95	80
24	1.16	80
36	1.33	80
50	1.56	80

4. Manufacturers:

- a. Okonite Co.
- b. Alpha Wire Corp.

H. Type B3-No. 18 AWG, Multi-twisted Pairs with a Common Overall Shield Instrumentation Cable: Designed for use as instrumentation, process control, and computer cable meeting NEMA WC 55.

1. Conductors:

- a. Bare soft annealed copper, Class B, seven-strand concentric, in accordance with ASTM B8.
- b. Tinned copper drain wire size 18 AWG
- c. Insulation: 15-mil nominal PVC.
- d. Jacket: 4-mil nylon.
- e. Color Code: Pair conductors black and red, with red conductor numerically printed for group identification.

2. Cable Shield: 2.35-mil, double-faced aluminum/synthetic polymer, overlapped for 100 percent coverage.

3. Cable Sizes:

Number of Pairs	Maximum Outside Diameter (inches)	Nominal Jacket Thickness (mils)
4	0.46	45
8	0.63	60
12	0.75	60
16	0.83	60
24	1.06	80
36	1.21	80
50	1.42	80

4. Manufacturers:

- a. Okonite Co.
- b. Alpha Wire Corp.

2.4 GROUNDING CONDUCTORS

- A. Equipment: Stranded copper with green, Type USE/RHH/RHW-XLPE or THHN/THWN, insulation.
- B. Direct Buried: Bare stranded copper.

2.5 ACCESSORIES FOR CONDUCTORS 600 VOLTS AND BELOW

A. Tape:

1. General Purpose, Flame-Retardant: 7-mil, vinyl plastic, Scotch Brand 33, rated for 90 degrees C minimum, meeting requirements of UL 510.
2. Flame Retardant, Cold and Weather Resistant: 8.5-mil, vinyl plastic, Scotch Brand 88.
3. Arc and Fireproofing:
 - a. 30-mil, elastomer
 - b. Manufacturers and Products:
 - (1) Scotch; Brand 77, with Scotch Brand 69 glass cloth tape binder.
 - (2) Plymount; Plyarc 30, with Plymount Plyglas glass cloth tape binder.

B. Identification Devices:

1. Sleeve: Permanent, PVC, yellow or white, with legible machine-printed black markings.
2. Marker Plate: Nylon, with legible designations permanently hot stamped on plate.
3. Grounding Conductor: Permanent green heat-shrink sleeve, 2-inch minimum.

C. Connectors and Terminations:

1. Nylon, Self-Insulated Crimp Connectors:
 - a. Manufacturers and Products:
 - 1) Thomas & Betts; Sta-Kon.
 - 2) Burndy; Insulink.
 - 3) ILSCO.
2. Nylon, Self-Insulated, Crimp Locking-Fork, Torque-Type Terminator:
 - a. Manufacturers and Products:
 - 1) Thomas & Betts; Sta-Kon.
 - 2) Burndy; Insulink.
 - 3) ILSCO.

D. Cable Lugs:

1. In accordance with NEMA CC I.
2. Rated 600 volts of same material as conductor metal.
3. Insulated, Locking-Fork, Compression Lugs:

- a. **Manufacturers and Products:**
 - 1) Thomas & Betts; Sta-Kon.
 - 2) ILSCO; ILSCONS.
 - 4. **Un-insulated Crimp Connectors and Terminators:**
 - a. **Manufacturers and Products:**
 - 1) Square D; Versitide.
 - 2) Thomas & Betts; Color-Keyed.
 - 3) ILSCO.
 - 5. **Un-insulated, Bolted, Two-Way Connectors and Terminators:**
 - a. **Manufacturers and Products:**
 - 1) Thomas & Betts; Locktite.
 - 2) Burndy; Quiklug.
 - 3) ILSCO.
 - E. **Cable Ties: Nylon, adjustable, self-locking, and reusable.**
 - 1. **Manufacturer and Product: Thomas & Betts; TY-RAP.**
 - F. **Heat Shrinkable Insulation: Thermally stabilized, crosslinked polyofin.**
 - 1. **Manufacturer and Product: Thomas & Betts; SHRINK-KON.**
- 2.6 ACCESSORIES FOR CONDUCTORS ABOVE 600 VOLTS**
- A. **Molded Splice Kits:**
 - 1. **Components necessary to provide insulation, metallic shielding and grounding systems, and overall jacket.**
 - 2. **Capable of making splices that has a current rating equal to, or greater than the cable ampacity, conforming to IEEE 404.**
 - 3. **5-kV class, with compression connector, EPDM molded semi-conductive insert, peroxide-cured EPDM insulation, and EPDM molded semi-conductive outer shield.**
 - 4. **Pre-molded splice shall be re-jacketed with a heat shrinkable adhesive-lined sleeve to provide a waterproof seal.**
 - 5. **Manufacturers:**
 - a. **Elastimold.**
 - b. **Cooper industries.**

B. Heat Shrinkable Splice Kits:

1. Components necessary to provide insulation, metallic shielding and grounding systems, and overall jacket.
2. Capable of making splices that has a current rating equal to, or greater than the cable ampacity, conforming to IEEE 404.
3. 5 kV class, with compression connector, splice insulating and conducting sleeves, stress-relief materials, shielding braid and mesh, and abrasion-resistant heat shrinkable adhesive-lined re-jacketing sleeve to provide a waterproof seal.
4. Manufacturers:
 - a. Raychem.
 - b. 3M Co.

C. Termination Kits:

1. Capable of terminating a 5 kV, single-conductor, polymeric-insulated shielded cables plus a shield ground clamp.
2. Capable of producing a termination with a current rating equal to, or greater than, the cable ampacity, meeting Class 1 requirements of IEEE 48.
3. Capable of accommodating any form of cable shielding or construction without the need for special adapters and/or accessories.
4. Manufacturers:
 - a. Raychem.
 - b. 3M Co.

D. Bus Connection Insulation:

1. Heat shrinkable tubing, tape, and sheets of flexible crosslinked polymeric material formulated for high dielectric strength.
2. Tape and sheet products to have coating to prevent adhesion to metal surfaces.
3. Insulating materials to be removable and reusable.
4. Manufacturer: Raychem.

E. Cable Lugs:

1. In accordance with NEMA CCI.
2. Rated 5 kV of same material as conductor metal.

- a. Square D; Versitide.
- b. Thomas & Betts; Color-Keyed.
- c. ILSCO.

4. Manufacturers and Products, Uninsulated, Bolted, Two-Way Connectors and Terminators:

- a. Thomas & Betts; Locktite.
- b. Burndy; Quiklug.
- c. JLSCO.

2.7 PULLING COMPOUND

- A. Nontoxic, non-corrosive, noncombustible, nonflammable, wax-based lubricant; UL listed.
- B. Suitable for rubber, neoprene, PVC, polyethylene, hypalon, CPE, and lead-covered wire and cable.
- C. Suitable for zinc-coated steel, aluminum, PVC, bituminized fiber, and fiberglass raceways.
- D. Manufacturers and Products:
 - 1. Ideal Co.; Yellow 77.
 - 2. Polywater, Inc.
 - 3. Cable Grip Co.

2.8 BUSWAY

- A. Low impedance, copper bus bar, outdoor copper-free 1/8-inch extruded aluminum housing with full neutral (where specified) and internal ground bus, totally enclosed non-ventilated and joint insulation of polyester film.
- B. UL listed for support and spacing provided, meeting NFPA 70 requirements, NEMA BU-1, UL B57, ANSI C37.23, and totally enclosed throughout its length.
- C. Suitable for mounting in vertical (edgewise) or horizontal position without derating and capable of withstanding short-circuits of 100,000 amperes symmetrical.
- F. Provide expansion fitting when the bus crosses a building expansion joint.
- G. Provide integral weather seal on all outdoor entrance points.
- H. Provide flanged ends or end cable tap box on all indoor end points.

- I. Manufactured by Square D, Model I-Line II, or approved equal.

2.9 MANUFACTURED WIRING SYSTEMS

A. System Rating:

1. 20 amperes load-carrying capacity each phase with final assemblies consisting of maximum of three phase conductors.
2. Composition: Type MC cable with 90 degrees C insulation and stranded copper conductors.

B. Cable Configuration: Three, single-phase, five-wire circuit with standard color wire coding:

1. 208/120-Volt: Black, red, blue, white, green.
2. 480/277-Volt: Brown, orange, yellow, gray, green.

C. Locking Mechanism: Latch/strike with voltage clearly marked on latch.

D. UL 910 listed for use in air handling plenums, listed to connect or disconnect under load, and manufactured in accordance with NFPA 70, Article No. 604.

2.10 WARNING TAPE

- A. As specified in Section 16110, RACEWAYS.

2.11 SOURCE QUALITY CONTROL

- A. Conductors 600-Volts and below: Test in accordance with UL 44 and 854 Standards.
- B. Conductors Above 600 Volts: Test in accordance with NEMA W8 and AEIC CS 6 partial discharge level test for EPR insulated cable.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Conductor installation to be in accordance with NECA 5055.
- B. Conductor and cable sizing shown is based on copper conductors, unless noted otherwise.
- C. Do not exceed cable manufacturer's recommendations for maximum pulling tensions and minimum bending radii.
- D. Tighten screws and terminal bolts in accordance with UL 486A for copper conductors.
- E. Cable Lugs: Provide with correct number of holes, bolt size, and center-to-center spacing as required by equipment terminals.

- F. Bundling: Where single conductors and cables in manholes, handholes, vaults, and other indicated locations are not wrapped together by some other means, bundle conductors from each conduit throughout their exposed length with cable ties placed at intervals not exceeding 18 inches on center.
- G. Ream, remove burrs, and clear interior of installed conduit before pulling wires or cables.
- H. Concrete-Encased Raceway Installation: Before installation of conductors, pull through each raceway a mandrel approximately 1/4-inch smaller than raceway inside diameter.
- I. Cable Tray Installation:
 - 1. Install wire and cable parallel and straight in tray.
 - 2. Bundle, in groups, all wire and cable of same voltage having a common routing and destination; use cable ties, at maximum intervals of 8 feet.
 - 3. Clamp cable bundles prior to making end termination connections.
 - 4. Separate cables of different voltage rating in same cable tray with barriers.
 - 5. Fasten wires, cables, and bundles to tray with nylon cable straps at the following maximum intervals:
 - a. Horizontal Runs: 20 feet.
 - b. Vertical Runs: 5 feet.

3.2 POWER CONDUCTOR COLOR CODING

A. Conductors 600 Volts and Below:

- 1. No. 6 AWG and Larger. Apply general purpose, flame retardant tape at each end, and at accessible locations wrapped at least six full overlapping turns, covering an area 1-1/2 to 2 inches wide.
- 2. No. 8 AWG and Smaller: Provide colored conductors.
- 3. Colors:

System	Conductor	Color
All Systems	Equipment Grounding	Green
240/120 Volts Single-Phase, Three-Wire	Grounded Neutral One Hot Leg Other Hot Leg	White Black Red
208Y/120 Volts Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	White Black Red Blue

240/120 Volts Three-Phase, Four-Wire Delta, Center Tap Ground on Single-Phase	Grounded Neutral Phase A High (wild) Leg Phase C	White Black Orange Blue
480Y/277 Volts Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	Gray Brown Orange Yellow
NOTE: Phase A, B, C implies direction of positive phase rotation		

4. Tracer: Outer covering of white with an identifiable colored strip other than green in accordance with NFPA 70.
- B. Conductors Above 600 Volts: Apply general purpose, flame retardant tape at each end, and at accessible locations wrapped at least six full overlapping turns, covering an area 1-1/2 to 2 inches wide.
1. Colors:
 - a. Grounded Neutral: White.
 - b. Phase A: Brown
 - c. Phase B: Orange.
 - d. Phase C: Yellow.

3.3 CIRCUIT IDENTIFICATION

- A. Circuits Appearing in Circuit Schedules: identify power, instrumentation, and control conductor circuits, using circuit schedule designations, at each termination and in accessible locations such as manholes, handholes, panels, switchboards, motor control centers, pull boxes, and terminal boxes.
- B. Circuits Not Appearing in Circuit Schedules:
 1. Assign circuit name based on device or equipment at load end of circuit.
 2. Where this would result in same name being assigned to more than one circuit, add number or letter to each otherwise identical circuit name to make it unique.
- C. Method:
 1. Conductors No. 3 AWG and Smaller: Identify with sleeves.
 2. Cables, and Conductors No. 2 AWG and Larger:
 - a. Identify with marker plates.
 - b. Attach marker plates with nylon tie cord.
 3. Taped-on markers or tags relying on adhesives not permitted.

3.4 CONDUCTORS 600 VOLTS AND BELOW

- A. Install 10 AWG or 12 AWG conductors for branch circuit power wiring in lighting and receptacle circuits.
- B. Do not splice incoming service conductors and branch power distribution conductors No. 6 AWG and larger unless specifically indicated or approved by ENGINEER. Do not splice submersible pump motor conductors inside of the ASR well casing.
- C. Connections and Terminations:
 - 1. Install wire nuts only on solid conductors.
 - 2. Install nylon self-insulated crimp connectors and terminators for instrumentation, control, and power circuit conductors No. 6 AWG and smaller.
 - 3. Install uninsulated crimp connectors and terminators for instrumentation, control, and power circuit conductors No. 4 AWG through No. 2/0 AWG.
 - 4. Install uninsulated, bolted, two-way connectors and terminators for power circuit conductors No. 4/0 AWG and larger.
 - 5. Install uninsulated bolted, two-way connectors for motor circuit conductors No. 12 and larger.
 - 6. Tape insulate all uninsulated connections.
 - 7. Place no more than one conductor in any single-barrel pressure connection.
 - 8. Install crimp connectors with tools approved by connector manufacturer.
 - 9. Install terminals and connectors acceptable for type of material used.
 - 10. Compression Lugs
 - a. Attach with a tool specifically designed for purpose.
 - b. Tool shall provide complete controlled crimp and shall not release until crimp is complete.
 - c. Do not use plier type crimpers.
- D. Do not use soldered mechanical joints.
- E. Splices and Terminations:
 - 1. Indoors: Use general purpose, flame retardant tape.
 - 2. Outdoors: Use flame retardant, cold- and weather-resistant tape.

F. Cap spare conductors and conductors with UL listed end caps.

G. Cabinets, Panels, and Motor Control Centers:

1. Remove surplus wires, bundle and secure.
2. Where conductors pass through openings or over edges in sheet metal, remove burrs, chamfer edges, and install bushings and protective strips of insulating material to protect the conductors.

H. Control and Instrumentation Wiring:

1. Where terminals provided will accept such lugs, terminate control and instrumentation wiring, except solid thermocouple leads, with insulated, locking-fork compression lugs.
2. Terminate with methods consistent with terminals provided, and in accordance with terminal manufacturer's instructions.
3. Locate splices in readily accessible cabinets or junction boxes using terminal strips.
4. Where connections of cables installed under this section are to be made under Section 17100 – Process Control and Instrumentation System, leave pigtails of adequate length for bundled connections.

5. Cable Protection:

- a. Under Infinite Access Floors: May be installed without bundling.
- b. All Other Areas: Install individual wires, pairs, or triads in flex conduit under the floor or grouped into bundles at least 1/2-inch in diameter.
- c. Maintain integrity of shielding of instrumentation cables.
- d. Ensure grounds do not occur because of damage to jacket over the shield.

I. Extra Conductor Length: For conductors to be connected by others, install minimum 6 feet of extra conductor in freestanding panels and minimum 2 feet in other assemblies.

3.5 CONDUCTORS ABOVE 600 VOLTS

- A. Do not splice unless specifically indicated or approved by the ENGINEER.
- B. Make joints and terminations with splice and termination kits, in accordance with kit manufacturer's instructions
- C. Install splices or terminations as continuous operation in accessible locations under clean, dry conditions.
- D. Single Conductor Cable Terminations: Provide heat shrinkable stress control and outer non-tracking insulation tubing, high relative permittivity stress relief mastic for insulation

shield cutback treatment, and a heat-activated sealant for environmental sealing, plus a ground braid and clamp.

- E. Install terminals or connectors acceptable for type of conductor material used.
- F. Provide outdoor rain skirts for all riser pole and outdoor switchgear terminations.
- G. Provide shield termination and grounding for all terminations.
- H. Provide necessary mounting hardware, covers, and connectors.
- I. Where elbow connectors are specified, install in accordance with manufacturer's instructions.
- J. Connections and Terminations:
 - 1. Install uninsulated crimp connectors and terminators for instrumentation, control, and power circuit conductors No. 4 AWG through No. 210 AWG.
 - 2. Install uninsulated, bolted, two-way connectors and terminators for power circuit conductors No. 4/0 AWG and larger.
 - 3. Install uninsulated bolted, two-way connectors for motor circuit conductors No. 12 and larger.
 - 4. Insulate bus connections with heat shrinking tubing, tape, and sheets.
 - 5. Make all bus connections removable and reusable in accordance with manufacturer's instructions.
- K. Give 2 working days' notice to ENGINEER prior to making splices or terminations.

3.6 CONDUCTOR ARC AND FIREPROOFING

- A. Install arc and fireproofing, tape on 600-volt single conductors and cables except those rated Type TC in manholes, handholes, vaults, cable trays, and other indicated locations.
- B. Install arc and fireproofing tape on 25 kV cables throughout their entire exposed length in manholes, handholes, vaults, cable trays, and other indicated locations.
- C. Wrap conductors of same circuit entering from separate conduit together as a single cable.
- D. Follow tape manufacturer's installation instructions.
- E. Secure tape at intervals of 5 feet with bands of tapebinder. Each band to consist of a minimum of two wraps directly over each other.

3.7 BUSWAY

- A. Install in strict accordance with manufacturer's recommendations and NFPA 70.

B. Maximum Support Spacing: 10 feet.

3.8 UNDERGROUND DIRECT BURIAL CABLE

A. Install in trench as specified in Section 02200 – Earthwork.

B. **Warning Tape:** Install approximately 12 inches above cable, aligned parallel to, and within 12 inches of centerline of the run.

- END OF SECTION -

SECTION 16120 - BASIC WIRING AND METHODS

PART 1 -- GENERAL

1.1 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. American National Standards Institute (ANSI):
 - a. C55.1, Standard for Shunt Power Capacitors.
 - b. C62.11, Standard for Metal-Oxide Surge Arrestors for AC Circuits.
 - c. Z55.1, Gray Finishes for Industrial Apparatus and Equipment.
2. American Society for Testing and Materials (ASTM):
 - a. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - b. A240, Standard Specification for Heat-Resisting Chromium and Chromium Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.
 - c. A570, Standard Specification for Steel, Sheet, and Strip, Carbon, Hot-Rolled, Structural Quality.
3. Federal Specifications (FS):
 - a. W-C-596, Connector, Receptacle, Electrical.
 - b. W-S-896E, Switches, Toggle, Flush Mounted.
4. National Electrical Contractor's Association, Inc. (NECA): 5055, Standard of Installation.
5. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. AB 1, Molded Case Circuit Breakers and Molded Case Switches.
 - c. CP I, Shunt Capacitors.
 - d. ICS 2, Industrial Control Devices, Controllers, and Assemblies.
 - e. KS 1, Enclosed Switches.
 - f. LA I, Surge Arrestors.
 - g. PB 1, Panelboards.

- h. ST 20, Dry-Type Transformers for General Applications.
- i. WD I, General Requirements for Wiring Devices.
- 6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
- 7. Underwriters Laboratories, Inc. (UL):
 - a. 67, Standard for Panelboards.
 - b. 98, Standard for Enclosed and Dead-Front Switches.
 - c. 198C, Standard for Safety High-Interrupting-Capacity Fuses, Current-Limiting Types.
 - d. 198E, Standard for Class Q Fuses.
 - e. 486E, Standard for Equipment Wiring Terminals.
 - f. 489, Standard for Molded Case Circuit Breakers and Circuit Breaker Enclosures.
 - g. 508, Standard for Industrial Control Equipment.
 - h. 810, Standard for Capacitors.
 - i. 943, Standard for Ground-Fault Circuit Interrupters.
 - j. 1059, Standard for Terminal Blocks.
 - k. 1561, Standard for Dry-Type General-Purpose and Power Transformers.

1.2 SUBMITTALS

A. Shop Drawings:

- 1. Device boxes for use in hazardous areas.
- 2. Junction and pull boxes used at, or below, grade.
- 3. Hardware.
- 4. Terminal junction boxes.
- 5. Panelboards and circuit breaker data.
- 6. Fuses.
- 7. Contactors.
- 8. Transformers.

9. All other miscellaneous material part of this project.

10. Wire pulling compound.

B. Quality Control Submittals:

1. Test Report: Sound test certification for dry type power transformers (0 to 600-volt, primary).

1.3 QUALITY ASSURANCE

A. UL Compliance: Materials manufactured within scope of Underwriters Laboratories shall conform to UL Standards and have an applied UL listing mark.

B. Hazardous Areas: Materials and devices shall be specifically approved for hazardous areas of the class, division, and group shown and of a construction that will ensure safe performance when properly used and maintained.

1.4 SPARE PARTS

A. Furnish, tag, and box for shipment and storage the following spare parts:

1. Fuses, 0 to 600 Volts: Six of each type and each current rating installed.

PART 2 -- PRODUCTS

2.1 JUNCTION AND PULL BOXES

A. Outlet Boxes Used as Junction or Pull Box: As specified under Article OUTLET AND DEVICE BOXES.

B. Large Sheet Steel Box: NEMA 250, Type 1.

1. Box: Code-gauge, galvanized steel.

2. Cover: Full access, screw type.

3. Machine Screws: Corrosion-resistant.

C. Large Cast Metal Box: NEMA 250, Type 4.

1. Box: Cast malleable iron, hot-dip galvanized finished, with drilled and tapped conduit entrances.

2. Cover: Hinged with screws.

3. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.

4. Manufacturers, Surface Mounted Type:

a. Crouse-Hinds; Series W.

- b. O.Z./Gedney; Series Y.
- 5. Manufacturers, Recessed Type:
 - a. Crouse-Hinds; Type WJBF.
 - b. O.Z./Gedney; Series YR.
- D. Large Stainless Steel Box: NEMA 250, Type 4X.
 - 1. Box: 14-gauge, ASTM A240, Type 304 stainless steel.
 - 2. Cover: Hinged with screws.
 - 3. Hardware and Machine Screws: ASTM A167, Type 304 stainless steel.
 - 4. Manufacturers:
 - a. Hoffman Engineering Co.
 - b. Robroy Industries.
- E. Large Steel Box: NEMA 250, Type 4.
 - 1. Box: 12-gauge steel, with white enamel painted interior and gray primed exterior, over phosphate surfaces, with final ANSI Z55.1, No. 61 gray enamel on exterior surfaces.
 - 2. Cover: Hinged with screws.
 - 3. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
 - 4. Manufacturers:
 - a. Hoffman Engineering Co.
 - b. Robroy Industries.
- F. Large Nonmetallic Box:
 - 1. NEMA 250, Type 4X.
 - 2. Box: High-impact, fiberglass-reinforced polyester or engineered thermoplastic, with stability to high heat.
 - 3. Cover: Hinged with screws.
 - 4. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
 - 5. Conduit hubs and mounting lugs.

6. Manufacturers:
 - a. Crouse-Hinds; Type NJB.
 - b. Carlon; Series N, C, or H.
 - c. Robroy Industries.

G. Concrete Box:

1. Box: Reinforced, cast concrete.
2. Cover: Cast iron.
3. Cover Marking: ELECTRICAL, TELEPHONE, or as shown.
4. Manufacturers:
 - a. Brooks Products Inc.; No. 36/36T.
 - b. Qwikset; W 17.

2.2 CIRCUIT BREAKER, INDIVIDUAL, 0 TO 600 VOLTS

- A. NEMA AB I, UL 489 listed for use at location of installation.
- B. Minimum Interrupt Rating: As shown or as required.
- C. Thermal-magnetic, quick-make, quick-break, indicating type, showing ON/OFF and TRIPPED indicating positions of the operating handle.
- D. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
- E. Locking: Provisions for padlocking handle.
- F. Multipole breakers to automatically open all poles when an overload occurs on one-pole.
- G. Enclosure: NEMA 250, Type 12, Industrial Use, 4X - outdoors, wet locations and corrosive areas, unless otherwise shown.
- H. Interlock: Enclosure and switch shall interlock to prevent opening cover with switch in the ON position.
- I. Do not provide single-pole circuit breakers with handle ties where multipole circuit breakers are shown.

2.3 NONFUSED SWITCH, INDIVIDUAL, 0 TO 600 VOLTS

- A. NEMA KS
- B. Quick-make, quick-break, motor rated, load-break, heavy-duty (HD) type with external markings clearly indicating ON/OFF positions.

- C. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
- D. Enclosure: NEMA 250, Type 12, industrial use, 4X- outdoors, wet locations and corrosive areas, unless otherwise shown.
- E. Interlock: Enclosure and switch to prevent opening cover with switch in the ON position.
- F. Provide switch with 2 normally open and two normally closed auxiliary contacts to indicate switch position.

2.4 FUSE, 0 TO 600 VOLTS

- A. Current-limiting, with 200,000 ampere rms interrupting rating.
- B. Provide to fit mountings specified with switches and features to reject Class H fuses.
- C. Motor and Transformer Circuits, 0- to 600-Volt:
 - 1. Amperage: 0 to 600.
 - 2. UL 198E, Class RK-1, dual element, with time delay.
 - 3. Manufacturers:
 - a. Bussmann; Type LPS-RK.
 - b. Littlefuse; Type LLS-RK.
- D. Motor and Transformer Circuits, 0- to 250-Volt:
 - 1. Amperage: 0 to 600.
 - 2. UL 198E, Class RK-1, dual element, with time delay.
 - 3. Manufacturers:
 - a. Bussmann; Type LPN-RK.
 - b. Littlefuse; Type LLN-RK.
- E. Feeder and Service Circuits, 0- to 600-Volt:
 - 1. Amperage: 0 to 600.
 - 2. UL 198E, Class RK-I, dual element, with time delay.
 - 3. Manufacturers:
 - a. Bussmann; Type LPS-RK.
 - b. Littlefuse; Type LLS-RK.

F. Feeder and Service Circuits, 0- to 250-Volt:

1. Amperage: 0 to 600.
2. UL 198E, Class RK-I, dual element, with time delay.
3. Manufacturers:
 - a. Bussmann; Type LPN-RK.
 - b. Littlefuse; Type LLN-RK.

G. Feeder and Service Circuits, 0- to 600-Volt:

1. Amperage: 601 to 6,000.
2. UL 198C, Class L, double O-rings and silver links.
3. Manufacturers:
 - a. Bussmann; Type KRP-C.
 - b. Littlefuse; Type KLPC.

2. 5 PUSHBUTTON, INDICATING LIGHT, AND SELECTOR SWITCHES

- A. Contact Rating: NEMA ICS 2, Type A600.
- B. Selector Switch Operating Lever: Standard.
- C. Indicating Lights: Push-to-test.
- D. Pushbutton Color:
 1. ON or START: Black.
 2. OFF or STOP: Red.
- E. Pushbuttons and selector switches lockable in the OFF position where indicated.
- F. Legend Plate:
 1. Material: Aluminum.
 2. Engraving: 11 character/spaces on one line, 14 character/spaces on each of two lines, as required, indicating specific function.
 3. Letter Height: 7/64 inch.
- G. Manufacturers:
 1. Heavy-Duty, Oiltight Type:

- a. General Electric; Type CR 104P.
 - b. Square D; Type T.
 - c. Cutler-Hammer; Type 10250T.
2. Heavy-Duty, Watertight, and Corrosion-Resistant Type:
- a. Square D; Type SK.
 - b. General Electric; Type CR 104P.
 - c. Cutler-Hammer; Type E34.
 - d. Crouse-Hinds; Type NCS.

2.6 TERMINAL JUNCTION BOX

- A. Cover: Hinged, unless otherwise shown.
- B. Terminal Blocks: Provide separate connection point for each conductor entering or leaving box.
 1. Spare Terminal Points: 25 percent.
- C. Interior Finish: Paint with white enamel or lacquer.

2.7 TERMINAL BLOCK (0 TO 600 VOLTS)

- A. UL 486E and UL 1059.
- B. Size components to allow insertion of necessary wire sizes.
- C. Capable of termination of all control circuits entering or leaving equipment, panels, or boxes.
- D. Screw clamp compression, dead front barrier type, with current bar providing direct contact with wire between the compression screw and yoke.
- E. Yoke, current bar, and clamping screw of high strength and high conductivity metal.
- F. Yoke shall guide all strands of wire into terminal.
- G. Current bar shall ensure vibration-proof connection.
- H. Terminals:
 1. Capable of wire connections without special preparation other than stripping.
 2. Capable of jumper installation with no loss of terminal or rail space.
 3. Individual, rail mounted.

- I. Marking system allowing use of preprinted or field-marked tags.
- J. Manufacturers:
 - 1. Weidmuller.
 - 2. Ideal.
 - 3. Electrovert.

2.8 MAGNETIC CONTROL RELAY

- A. NEMA ICS 2, Class A600 (600 volts, 10 amps continuous, 7,200VA make, 720VA break), industrial control with field convertible contacts.
- B. Time Delay Relay Attachment:
 - 1. Pneumatic type, timer adjustable from 0.2 to 60 seconds (minimum).
 - 2. Field convertible from ON delay to OFF delay and vice versa.
- C. Latching Attachment: Mechanical latch having unlatching coil and coil clearing contacts.
- D. Manufacturers:
 - 1. Cutler-Hammer; Type M-600.
 - 2. General Electric; Type CR120B.

2.9 RESET TIMER

- A. Drive: Synchronous motor, solenoid-operated clutch.
- B. Mounting: Semi-flush, panel.
- C. Contacts: 10-amp, 120-volt.
- D. Manufacturers:
 - 1. Eagle Signal; Bulletin 125.
 - 2. Automatic Timing and Controls; Bulletin 305.

2.10 ELAPSED TIME METER

- A. Drive: Synchronous motor.
- B. Range: 0 to 99,999.9 hours, nonreset type.
- C. Mounting: Semi-flush, panel.

D. Manufacturers:

1. General Electric; Type 240, 2-1/2-inch Big Look.
2. Eagle Signal; Bulletin 705.

2.11 MAGNETIC CONTACTOR

A. NEMA ICS 2, UL 508.

B. Electrically operated, electrically held.

C. Main Contacts:

1. Power driven in one direction with gravity dropout.
2. Silver alloy with wiping action and arc quenchers.
3. Continuous-duty rated 30 amperes, 600-volt.
4. Three-pole.

D. Control: Two-wire.

E. One normally open and one normally closed auxiliary contact rated 10 amperes at 480-volt.

F. Enclosure: NEMA 250, Type 12, unless otherwise shown.

G. Manufacturers:

1. Westinghouse; Class A211.
2. General Electric; CR 353.
3. Allen-Bradley; Bulletin 500 Line.

2.12 THERMOSTAT

A. Rating: 7.4 amps continuous, 44 amps locked rotor current at 120 volts and 3.7 amps continuous, 22 amps locked rotor current at 240 volts.

B. Line voltage, single-stage, treated to resist corrosion, dust, dirt, and humidity with sealed SPDT contacts.

C. Heating Adjustment Range: 35 to 100 degrees Fahrenheit

D. Cooling or Ventilating Adjustment Range: 70 to 140 degrees Fahrenheit

E. Manufacturer: Honeywell; Type T631F1084.

2.13 DRY TYPE TRANSFORMER (0- TO 600-VOLT PRIMARY)

- A. UL 1561, NEMA ST 20, unless otherwise indicated.
- B. Self-cooled, two winding, UL K-4 rated for nonlinear loads.
- C. Insulation Class and Temperature Rise: Manufacturer's standard.
- D. Core and Coil:
 - 1. Encapsulated for single-phase units ½ to 25 kVA and for three-phase units 3 to 15 kVA.
 - 2. Thermosetting varnish impregnated for single-phase units 37.5 kVA and above, and for three-phase units 30 kVA and above.
- E. Enclosure:
 - 1. Single-Phase, 3 to 25 kVA: NEMA 250, Type 3R, non-ventilated.
 - 2. Single-Phase, 37-1/2 kVA and above: NEMA 250, Type 2, ventilated.
 - 3. Three-Phase, 3 to 15 kVA: NEMA 250, Type 3R, non-ventilated.
 - 4. Three-Phase, 30 kVA and above: NEMA 250, Type 2, ventilated.
 - 5. Outdoor Transformers: NEMA 250, Type 3R.
- F. Wall Bracket: For single-phase units, 15 to 37-1/2 kVA, and for three-phase units, 15 to 30 kVA.
- G. Voltage Taps:
 - 1. Single-Phase, 3 to 10 kVA: Four 2-1/2 percent, full capacity; two above and two below normal voltage rating.
 - 2. Single-Phase, 15 kVA and Above: Four 2-1/2 percent, full capacity; two above and two below normal voltage rating.
 - 3. Three-Phase, 3 to 15 kVA: Four 2-1/2 percent, full capacity; two above and two below normal voltage rating.
 - 4. Three-Phase, 30 kVA and Above: Four 2-1/2 percent, full capacity; two above and two below normal voltage rating.
- H. Impedance: 4.5 percent minimum on units 75 kVA and larger.
- I. Maximum Sound Level: NEMA ST 20:
 - 1. 40 decibels for 0 to 9 kVA.
 - 2. 45 decibels for 10 to 50 kVA.

3. 50 decibels for 51 to 150 kVA.
4. 55 decibels for 151 to 300 kVA.
5. 60 decibels for 301 to 500 kVA.

J. Vibration Isolators:

1. Rated for transformer's weight.
2. Isolation Efficiency: 99 percent, at fundamental frequency of sound emitted by transformer.
3. Less Than 30 kVA: Isolate entire unit from structure with external vibration isolators.
4. 30 kVA and above: Isolate core and coil assembly from transformer enclosure with integral vibration isolator.

K. Manufacturers:

1. Square D; or equal

2.14 SUPPORT AND FRAMING CHANNELS

A. Material:

1. Dry indoor - galvanized.
2. All Other Areas: ASTM A167, Type 316 stainless steel or fiber-reinforced epoxy, as required.

B. Finish:

1. Dry indoor - galvanized.
2. All Other Areas: ASTM A167, Type 316 stainless steel or fiber-reinforced epoxy, as required.

C. Inserts: Continuous.

D. Beam Clamps: Gray cast iron.

E. Manufacturers:

1. B-Line.
2. Unistrut.

2.15 NAMEPLATES

A. Material: Laminated plastic.

- B. Attachment Screws: Stainless steel.
- C. Color: White, engraved to a black core.
- D. Engraving:
 - 1. Pushbuttons/Selector Switches: Name of drive controlled on one, two, or three lines, as required.
 - 2. Panelboards: Panelboard designation, service voltage, and phases.
- E. Letter Height:
 - 1. Pushbuttons/Selector Switches: 1/8 inch.
 - 2. Panelboards: 1/4 inch.

2.16 TRANSIENT VOLTAGE SURGE SUPPRESSION

- A. This section describes the material and installation requirements for transient voltage surge suppression devices (TVSS) in switchboards, panelboards, and motor control centers for the protection of all AC electrical circuits.
- B. TVSS shall be listed and component recognized in accordance with UL 1449 and UL 1283.
- C. TVSS shall be installed and warranted by and shipped from the electrical distribution equipment manufacturer's factory.
- D. TVSS shall provide surge current diversion paths for all modes of protection; L-L, L-N, L-G, N-G in WYE systems, and L-L, L-G in DELTA systems.
- E. TVSS shall be modular in design. Each module shall be fused with a surge rated fuse.
- F. A UL approved disconnect switch shall be provided as a means of disconnect in the switchboard device only.
- G. TVSS shall meet or exceed the following criteria:
 - 1. Maximum surge current capability (single pulse rated) shall be:
 - a. Service entrance switchboard 300kA
 - b. Branch panelboards 150kA
 - c. Motor control centers 80kA
 - 2. UL 1449 Listed and Recognized Component Suppression Voltage Ratings shall not exceed the following:

<u>Voltage</u>	<u>L-N</u>	<u>L-G</u>	<u>N-G</u>
208Y/120	400V	400V	400V

- H. TVSS shall have a minimum EMI/RFI filtering of -50dB at 100kHz with an insertion ration of 50:1 using MIL STD. 220A methodology.
 - I. TVSS shall be provided with 1 set of NO/NC dry contacts.
 - J. TVSS shall have a warranty for a period of five years, incorporating unlimited replacements of suppressor parts if transients destroy them during the warranty period. Warranty will be the responsibility of the electrical distribution equipment manufacturer.
 - K. Approve manufactures are:
 - 1. Cutler Hammer CPS Series
 - 2. General Electric Tranquell Series
 - 3. Siemans TPS Series
 - 4. Square D Company XTE Series
- 2.17 Warning Light, Indoor/Outdoor:
- 1. General:
 - a. Function: Visual alarm.
 - b. Type: Rotating reflector or flashing bulb.
 - c. Parts: Light and spare bulbs.
 - 2. Performance:
 - a. Temperature, Operating: Minus 35 to 190 degrees F.
 - b. Flash Rate: Nominally 90 per minute.
 - 3. Features:
 - a. Dome Color: Amber, unless otherwise noted.
 - b. Lamp Life: 200 hours.
 - c. Lamp: Incandescent/25 watts.
 - 4. Enclosure:
 - a. Type: Water-resistant closed cell neoprene gasket.
Mounting: Wall bracket, unless otherwise noted.
UL Listing: Indoor/outdoor use.
 - 5. Power: 120V ac, 50/60-Hz.

6. Spare Bulbs: Two for each light.
7. Manufacturers:
 - a. Federal Signal, Model 225.
 - b. Benjamin Electric Manufacturing, Series KL-4000.

2.18 Horn:

- A. Horn shall produce one of three different high decibel tone outputs from same unit. The tone choice shall be "wail", "yelp" or horn and it shall be user selectable by reconfiguring internal jumpers.
- B. Horn shall be capable of producing up to 111 dB at 10 feet, made of rugged high impact plastic construction, resistant to ultraviolet light, and rated NEMA 3R.
- C. Horn shall be mounted on No. 4A969 weatherproof box. It shall be pointed within 360° half sphere of area.
- D. The horn shall have standard voltages of 24VDC, 120VAC or 240VAC field selectable and shall be UL listed (464) indoor, outdoor; Canadian Underwriters Laboratories approved (464).
- E. Horn shall be manufactured by Federal Signal Corporation model 1N742 or approved equal.

2.19 Control System

- A. The MANUFACTURER shall provide a complete and fully functional control system to manually or automatically operate the control system as specified herein and in other applicable sections of these specifications. All MANUFACTURER'S recommended safety devices shall be furnished to protect operators. All control devices, unless specified otherwise, shall be mounted in the Control Panel.
- B. Control Panel Construction
 1. The control panel shall consist of a main circuit breaker, a motor circuit protector and magnetic starter for each motor, and a 120-volt control power transformer (fused on primary and secondary). All control components shall be mounted in one common enclosure. Control switches shall provide means to operate each motor manually or automatically.
 2. The electrical control equipment shall be mounted within a NEMA type 4X enclosure, constructed of not less than 12 gauge 316 stainless steel. Latches shall be quarter turn quick release type. The enclosure shall be equipped with a door and shall incorporate a removable back panel on which control components shall be mounted. Back panel shall be secured to enclosure with collar studs. Door shall be interlocked with main circuit breaker.
 3. All motor branch circuit breakers, motor starters and control relays shall be of highest industrial quality, securely fastened to the removable back panels with

screws and lock washers. Back panels shall be tapped to accept all mounting screws. Self-tapping screws shall not be used to mount any component.

4. A thermal-magnetic air circuit breaker, Type HFD as manufactured by Westinghouse/Cutler-Hammer, shall be furnished for the main breaker. All circuit breakers shall be sealed by the manufacturer after calibration to prevent tampering. Each circuit breaker shall be adequately sized to meet the equipment operating conditions. Motor Circuit Protectors (MCP) shall be Type Series CHMCP as manufactured by Westinghouse/Cutler-Hammer.
5. A mechanical disconnect mechanism shall be installed on each circuit breaker to provide a means of disconnecting power to the motors.
6. An open frame, across-the-line, NEMA-rated magnetic motor/starter, Type A200 as manufactured by Westinghouse/Cutler-Hammer, shall be furnished for each motor. All motor starters shall be provided with motor circuit protectors and equipped to provide under-voltage release and overload protection on all three phases. Motor starter contacts shall be easily replaceable without removing the motor starter from its mounted position. Overload reset push buttons shall be located on the exterior of the control compartment door,
7. Auxiliary contacts shall be provided for remote run indication and indication of each status and alarm condition. Additional controls shall be provided as specified herein and as required by Divisions 13, 16 and as shown on the drawings.
8. All operating control and instruments shall be securely mounted on the exterior door. All controls and instruments shall be clearly labeled to indicate function. All exterior mounted equipment shall be NEMA 4X.
9. Mode selector switches shall be Hand-Off-Auto type to permit override of automatic control and manual actuation of shutdown. Switches shall be NEMA 4X modules, as manufactured by Westinghouse/Cutler-Hammer, providing three (3) switch positions, each of which shall be clearly labeled according to function.
10. Indicator lamps shall be LED full voltage type and mounted in NEMA 4X modules, as manufactured by Westinghouse/Cutler-Hammer. Lamp modules shall be equipped to operate at 120 volt input. Lamps shall be easily replaceable from the front of the control compartment door without removing lamp module from its mounted position.
11. A six (6) digit, nonreset elapsed time meter shall be connected to each motor starter to indicate the total running time of each pump/motor in 'hours' and 'tenth of hours'. The elapsed time meter shall be NEMA 4X rated, Type TSO as manufactured by ENM or equal.
12. A failure alarm with horn and beacon light shall be provided. Silence and reset pushbuttons shall also be furnished.
13. The control panel shall operate on a power supply of 480 volts, 3- phase, 60 hertz.
14. The control diagrams and overload tables shall be laminated to the inside of the door.

15. Print storage pockets shall be provided on the inside of each panel. Pockets shall be of sufficient size as required to hold all prints necessary to service the equipment. A set of reduced drawings shall be provided for each panel, fixed to fit in the storage pocket.
16. A duplex GFCI utility receptacle (circuit breaker protected) providing 120 volts, 60 hertz, single phase current shall be mounted on the side of the enclosure.
17. Alternators shall be provided to sequence motors, alternators shall be 008-1 2013SP or 009-120-23AP as manufactured by Sta-con, or equal.
18. A phase monitor shall be provided for the control panel to alarm condition, monitors shall be model SUA-440-ASA as manufactured by Diversified Electronics Inc., or equal.
19. All exterior mounted equipment shall be rated NEMA 4X. NEMA 4X stainless steel viewing windows will be permitted where such equipment is not available with a NEMA 4X rating.
20. The control panel shall be provided with a surge suppressor.
21. All control panel wiring shall be numbered at both ends with type written heatshrinkable wire markers.
22. Wiring shall be stranded copper, minimum size #14 AWG (except for shielded instrumentation cable), with 600 volt, 90 degree C, flame retardant, type MTW thermoplastic insulation.
23. All foreign voltage control wiring shall be yellow.
24. The control panel shall be provided with nameplates identifying each component, selector switches, pilot lights, etc.. Nameplates shall be permanently affixed using an epoxy process (inner door nameplates shall be fastened with stainless steel screws). Nameplates shall be laminated plastic, engraved white letters with a black background.
25. All control panels shall be provided with a master nameplate located on the exterior door.
26. Where applicable provide a nameplate which reads as follows "CAUTION - THIS PANEL CONTAINS TWO OR MORE VOLTAGES FROM EXTERNAL SOURCES." Letters shall be black on a high visibility yellow background.
27. Corrosion Inhibitor Emitter: Inclusion of an industrial corrosion inhibitor emitter that shall protect internal components of control panel from corrosion for up to one year. One spare emitter shall be provided for each control panel.
28. All control relays shall be provided with LED indicators to show relay status.
29. The completed control panel assembly shall be UL certified.

C. Spare Parts

1. The following total number of spare parts shall be furnished for the control panel(s).
 - a. 1 Indicator light assembly,
 - b. 2 control relays for each type furnished.
 - c. 5 fuses for each type/size furnished.
 - d. 1 set thermal overloads for each size furnished.
 - e. 1 selector switch for each type furnished.
 - f. 1 starter coil for each size furnished.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Install equipment in accordance with NECA 5055.

3.2 JUNCTION AND PULL BOXES

- A. Install where shown and where necessary to terminate, tap-off, or redirect multiple conduit runs.
- B. Install pull boxes where necessary in raceway system to facilitate conductor installation.
- C. Install in conduit runs at least every 150 feet or after the equivalent of three right-angle bends.
- D. Use outlet box as junction and pull boxes wherever possible and allowed by applicable codes.
- E. Installed boxes shall be accessible.
- F. Do not install on finished surfaces.
- G. Install plumb and level.
- H. Support boxes independently of conduit by attachment to building structure or structural member.
- I. Install bar hangers in frame construction, or fasten boxes directly with wood screws on wood, bolts and expansion shields on concrete or brick, toggle bolts on hollow masonry units, and machine screws or welded threaded studs on steelwork.
- J. Threaded studs driven in by powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields.
- K. Boxes embedded in concrete or masonry need not be additionally supported.

L. At or Below Grade:

1. Install boxes for below grade conduit flush with finished grade in locations outside of paved areas, roadways, or walkways.
2. If adjacent structure is available, box may be mounted on structure surface just above finished grade in accessible but unobtrusive location.
3. Obtain Engineer's written acceptance prior to installation in paved areas, roadways, or walkways.
4. Use boxes and covers suitable to support anticipated weights.

M. Flush Mounted:

1. Install with concealed conduit.
2. Holes in surrounding surface shall be no larger than required to receive box.
3. Make edges of boxes flush with final surface.

N. Mounting Hardware:

1. Non-corrosive Interior Areas: Galvanized.
2. All Other Areas: Stainless steel.

O. Location/Type:

1. Finished, Indoor, Dry: NEMA 250, Type 1.
2. Unfinished, Indoor, Dry: NEMA 250, Type 12.
3. Unfinished, Indoor and Outdoor, Wet and Corrosive: NEMA 250, Type 4X.
4. Unfinished, Indoor and Outdoor, Wet, Dust, or Oil: NEMA 250, Type 13.
5. Unfinished, Indoor and Outdoor, Hazardous: NEMA 250, Type 7 and Type 9, where indicated.
6. Underground Conduit: Concrete Encased.
7. Corrosive Locations: Nonmetallic.

3.3 TERMINAL JUNCTION BOX

- A. Install in accordance with Paragraph JUNCTION AND PULL BOXES.
- B. Label each block and terminal with permanently attached, non-destructible tag.
- C. Do not install on finished outdoor surfaces.

D. Location:

1. Finished, Indoor, Dry: NEMA 250, Type 1.
2. Unfinished, Indoor, Dry: NEMA 250, Type 12.
3. Unfinished, Indoor and Outdoor, Wet and Corrosive: NEMA 250, Type 4X.
4. Unfinished, Indoor and Outdoor, Wet, Dust, or Oil: NEMA 250, Type 13.

3.4 DRY TYPE TRANSFORMER (0- TO 600-VOLT PRIMARY)

- A. Load external vibration isolator such that no direct transformer unit metal is in direct contact with mounting surface.
- B. Provide moisture-proof, flexible conduit for electrical connections.
- C. Connect voltage taps to achieve (approximately) rated output voltage under normal plant load conditions.
- D. Provide wall brackets for single-phase units, 15 to 167-1/2 kVA, and three-phase units, 15 to 112 kVA.

3.5 SUPPORT AND FRAMING CHANNEL

- A. Furnish zinc-rich primer; paint cut ends before installation, where applicable.
- B. Install where required for mounting and supporting electrical equipment and raceway systems.

3.6 MOTOR SURGE PROTECTION

- A. Ground in accordance with NFPA 70.
- B. Low Voltage: Ground terminals to equipment bus.

- END OF SECTION -

SECTION 16450 - GROUNDING

PART 1 -- GENERAL

1.1 REFERENCES

- A. The following is a list of standards which may be referenced in this Section:
1. American National Standards Institute (ANSI): C2, National Electrical Safety Code (NESC).
 2. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).

1.2 SUBMITTALS

- A. Shop Drawings:
1. Product Data:
 - a. Exothermic weld connectors.
 - b. Mechanical connectors.
 - c. Compression connectors.

1.3 UL COMPLIANCE

- A. Materials manufactured within scope of Underwriters Laboratories shall conform to U.L. standards and have an applied U.L. listing mark.

PART 2 -- PRODUCTS

2.1 GROUND ROD

- A. Material: Copper clad.
- B. Diameter: Minimum 5/8 inch.
- C. Length: 20 feet.

2.2 GROUND CONDUCTORS

- A. As specified in Section 16115, CONDUCTORS.

2.3 CONNECTORS

- A. Exothermic Weld Type
1. Outdoor Weld: Suitable for exposure to elements or direct burial.

2. Indoor Weld: Use low-smoke, low-emission process.
3. Manufacturers:
 - a. Erico Products, Inc.; Cadweld and Cadweld Exolon.
 - b. Thermoweld.

B. Compression Type

1. Compress deforming type; wrought copper extrusion material.
2. Single indentation for conductors 6 AWG and smaller.
3. Double indentation with extended barrel for conductors 4 AWG and larger.
4. Barrels pre-filled with oxide-inhibiting and anti-seizing compound and sealed.
5. Manufacturers:
 - a. Burndy Corp.
 - b. Thomas and Betts Co.
 - c. Ilso Corp.

C. Mechanical Type: Split-bolt, saddle, or cone screw type; copper alloy material.

1. Manufacturers:
 - a. Burndy Corp.
 - b. Thomas and Betts Co.

2.4 GROUNDING WELLS

A. Ground rod box complete with cast iron riser ring and traffic cover marked GROUND ROD.

1. Manufacturers:
 - a. Christy Co.; No. G5.
 - b. Lightning and Grounding Systems, Inc.; I-R Series.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Grounding shall comply with NFPA 70 and ANSI C2.**

- B. Ground electrical service neutral at service entrance equipment to supplementary grounding electrodes.
- C. Ground each separately derived system neutral to nearest effectively grounded building structural steel member or separate grounding electrode.
- D. Bond together system neutrals, service equipment enclosures, exposed non-current-carrying metal parts of electrical equipment, metal raceways, ground conductor in raceways and cables, receptacle ground connections, and metal piping systems.
- E. Shielded Power Cables: Ground shields at each splice or termination in accordance with recommendations of splice or termination manufacturer.
- F. Shielded Control Cables:
 - 1. Ground shield to ground bus at power supply for analog signal.
 - 2. Expose shield minimum 1-inch at termination to field instrument and apply heat shrink tube.
 - 3. Do not ground control cable shield at more than one point.

3.2 WIRE CONNECTIONS

- A. Ground Conductors: Install in conduit containing power conductors and control circuits above 50 volts.
- B. Nonmetallic Raceways and Flexible Tubing: Install an equipment-grounding conductor connected at both ends to non-current carrying grounding bus.
- C. Connect ground conductors to raceway grounding bushings.
- D. Extend and connect ground conductors to ground bus in all equipment containing a ground bus.
- E. Connect enclosure of equipment containing ground bus to that bus.
- F. Bolt connections to equipment ground bus.
- G. Bond grounding conductors to metallic enclosures at each end, and to intermediate metallic enclosures.
- H. Junction Boxes: Furnish materials and connect to equipment grounding system with grounding clips mounted directly on box, or with 3/8-inch machine screws.

3.3 MOTOR GROUNDING

- A. Extend equipment ground bus via grounding conductor installed in motor feeder raceway; connect to motor frame.
- B. Nonmetallic Raceways and Flexible Tubing: Install an equipment-grounding conductor connected at both ends to non-current carrying grounding bus.

- C. Motors Less Than 10 hp: Furnish compression, spade-type terminal connected to conduit box mounting screw.
- D. Motors 10 hp and above: Tap motor frame or equipment housing; furnish compression, one-hole, lug type terminal connected with minimum 5/16-inch brass threaded stud with bolt and washer.
- E. Circuits 20 Amps or Above: Tap motor frame or equipment housing; install solderless terminal with minimum 5/16-inch diameter bolt.

3.4 GROUND RODS

- A. Install full length with conductor connection at upper end.
- B. Install with connection point below finished grade, unless otherwise shown.

3.5 GROUNDING WELLS

- A. Install inside buildings, asphalt, and paved areas.
- B. Install riser ring and cover flush with surface.
- C. Place 9 inches of crushed rock in bottom of each well.

3.6 CONNECTIONS

A. General:

1. Above grade connections: Use exothermic weld, mechanical, or compression-type connectors; or brazing.
2. Below grade connections: Install exothermic weld or compression type connectors.
3. Remove paint, dirt, or other surface coverings at connection points to allow good metal-to-metal contact.
4. Notify ENGINEER before backfilling ground connections.

B. Exothermic Weld Type:

1. Wire brush or file contact point to bare metal surface.
2. Use welding cartridges and molds in accordance with manufacturer's recommendations.
3. Avoid using badly worn molds.
4. Mold to be completely filled with metal when making welds.
5. After completed welds have cooled, brush slag from weld area and thoroughly clean joint.

C. Compression Type:

1. Install in accordance with connector manufacturer's recommendations.
2. Install connectors of proper size for grounding conductors and ground rods specified.
3. Install using connector manufacturer's compression tool having proper sized dies.

D. Mechanical Type:

1. Apply homogeneous blend of colloidal copper and rust and corrosion inhibitor before making connection.
2. Install in accordance with connector manufacturer's recommendations.
3. Do not conceal mechanical connections.

3.7 METAL STRUCTURE GROUNDING

- A. Ground metal sheathing and exposed metal vertical structural elements to grounding system.
- B. Bond electrical equipment supported by metal platforms to the platforms.
- C. Provide electrical contact between metal frames and railings supporting pushbutton stations, receptacles, and instrument cabinets, and raceways carrying circuits to these devices.

3.8 MANHOLE AND HANDHOLE GROUNDING

- A. Install one ground rod inside each.
- B. Ground Rod Floor Protrusion: 4 to 6 inches above floor.
- C. Make connections of grounding conductors fully visible and accessible.
- D. Connect all non current-carrying metal parts, and any metallic raceway grounding bushings to ground rod with No. 6 AWG copper conductor.

3.9 TRANSFORMER GROUNDING

- A. Bond neutrals of transformers within buildings to system ground network, and to any additional indicated grounding electrodes.
- B. Bond neutrals of substation transformers to substation grounding grid and system grounding network.
- C. Bond neutrals of pad-mounted transformers to four locally driven ground rods and buried ground wire encircling transformer and system ground network.

3.10 SURGE PROTECTION EQUIPMENT GROUNDING

- A. Connect surge arrestor ground terminals to equipment ground bus.

3.11 INSTRUMENT GROUNG - SURGE SUPPRESSION

- A. Connect all instrument surge protection with #6 insulated copper groundwire (in conduit where above grade) to closest plant ground system.

3.12 BONDING

- A. Bond to Main Conductor System.
- B. All roof mounted ventilators, fans, air handlers, masts, flues, cooling towers, handrails, and other sizeable metal objects.
- C. Roof flashing, gravel stops, insulation vents, ridge vents, roof drains, soil pipe vents, and other small metal objects if located within 6 feet of main conductors or another grounded object.
- D. Provide air terminals as required.
- E. Bond steel columns or major framing members to grounding system per National Electrical Code.
- F. Bond each main down conductor to grounding system.

3.13 GROUNDING SYSTEM

A. Grounding Conductor:

1. Completely encircle building structure.
2. Bury minimum 30" below finished grade.
3. Minimum 2 feet distance from foundation walls.
4. Interconnect ground rods by direct-buried copper cables.

B. Connections:

1. Install ground cables continuous between connections.
2. Exothermic welded connections to ground rods, cable trays, structural steel, handrails, and buried and non-accessible connections.
3. Provide bolted clamp type mechanical connectors for all exposed secondary connections.
4. Use bolted offset parapet bases or through-roof concealed base assemblies for air terminal connections.

5. Provide interconnections with electrical and telephone systems and all underground water and metal pipes.
6. Provide electric service arrestor ground wire to building water main.

- END OF SECTION -

SECTION 16490 - SOLID STATE REDUCED VOLTAGE STARTER

PART 1 -- GENERAL

1.1 SCOPE OF WORK

- A. Provide the solid state reduced voltage starter (SSRVS) as shown on the drawings and/or as specified herein. The SSRVS shall be microprocessor controlled suitable for use with three phase induction motors rated 600 VAC or less. It shall provide a closed loop current ramp for smooth and stepless motor acceleration and deceleration.

1.2 SYSTEM DESCRIPTION AND QUALIFICATIONS

- A. The SSRVS shall be the product of a manufacturer who has produced SSRVS for a minimum of 10 consecutive years.
- B. The SSRVS shall be manufactured by:
 1. Benschaw, Inc., Redi-Start Micro Series, or ENGINEER approved equal
- C. The SSRVS shall be U.L. labeled where U.L. has such a listing.
- D. The SSRVS shall be designed, manufactured and tested to conform, where applicable, with the following industry standards and specifications:
 1. ANSI
 2. CSA
 3. IEEE
 4. UL
 5. NEC
 6. EEMAC
 7. NEMA
 8. OSHA
- E. SSRVS performance requirements
 1. Nominal operating ambient temperatures: 0 - 40 deg C (32 deg F to 104 deg F) with relative humidity of up to 95% (noncondensing).
 2. Power: Operate with three phase AC power at nominal voltages of 200 through 600 VAC.
 3. Frequency: operates on 25 through 70 Hz.
 4. Meet Uniform Building Code on non-building structures, Section 2338 for Zone 1, 2, 3, and 4 requirements.

F. Design Criteria:

DESCRIPTION	SPECIFICATION
Horsepower	200 HP
Power Ratings	500% for 30 sec. and 125% cont.
PIV	2.5 x line voltage or 1200 PIV min.
Starting Torque	0 to 100%
Ramp Time	0 to 120 seconds
Decel Time	0 to 60 seconds
Nominal ratings	200 through 600 VAC. 25 through 70 Hz. With frequency tracking within this range
Standard Insulation Test	2500 VAC minimum
Overall Efficiency	Average 99.7%
SCR Firing Technique	Hard Drive with "picket fence"
Transient Voltage Protection	DV/DT=s or SIOV=s
Diagnostics and LEDs	Power On Gate Power Micro Computer Fault SCR Condition LCD display (16 char. X two lines.)
Control Input	120 VAC or dry contac, 2/3 wire.

1.3 SUBMITTALS

- A The following drawings/information shall be supplied by the SSRVS manufacturer in the shop drawings and with the shipment of each starter:
1. Elementary wiring diagrams.
 2. Wiring and interconnect diagrams.
 3. Enclosure frontal elevation and dimension drawings.
 4. Internal component layout diagrams
 5. Available conduit entry and exit locations.
 6. Instruction manuals required for proper operation of the SSRVS.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualification: The manufacturer of the SSRVS shall be a firm experienced in manufacturing the equipment as specified herein for this project and who has a record of successful in-service performance.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Handling and shipment of the equipment shall be in such a manner to prevent internal component damage, breakage, and denting and scoring of the enclosure finish.

PART 2 -- PRODUCTS

2.1 MANUFACTURERS

- A. Benshaw, Inc., or ENGINEER approved equal.

2.2 GENERAL.

- A. Provide SSRVS where and as shown on the plans and as described by frontal elevation drawings, one-line diagrams, and/or equipment schedules.
- B. The SSRVS assembly shall include the necessary interface relays, timers, and those additional items necessary for interface to the pumps controls as identified on the plans.
- C. The complete SSRVS shall be rated for an available fault current of 100,000 asymmetrical.

2.3 ENCLOSURE CONSTRUCTION

- A. The SSRVS shall be mounted in a custom control panel.
- B. The dimensions of the over-all enclosure shall be maximum as shown on the plans and include a door mounted operator interface panel.

2.4 DISCONNECTS

- A. The SSRVS package shall be supplied complete with a circuit breaker used as a means of removing line power from the starter as well as for short circuit protection.
- B. The circuit breaker shall be supplied as shown on the drawings and as indicated within this section. Where no circuit breaker ratings are specified on the drawings or within this section, the circuit breaker shall be supplied to meet the normal standards of the manufacturer of the SSRVS. As a minimum, the circuit breaker shall conform to the requirements of the National Electric Code (NEC).
- C. The disconnect shall be interlocked via the disconnect handle mechanism such that entry to any part of the enclosure is prevented until power to the SSRVS is removed.

2.5 BYPASS CONTACTORS

- A. A bypass contactor shall be supplied. This bypass contactor shall bypass the SCRs of the SSRVS once the motor is up to speed. The effect of the bypass contactor during run shall eliminate the heat buildup resulting from the voltage drop across the SCRs of the SSRVS.
- B. It is the intent of the owner to use the bypass contactor also as a means of starting the motor should problems be encountered with the SSRVS. Therefore, the bypass contactor shall be rated for motor starting duty and a selector switch shall be mounted inside the enclosure such that the starting means can be selected as being either via the SSRVS or via the contactor as across-the-line.

2.6 SSRVS LOGIC CONTROL CONFIGURATION

A. Description

1. The SSRVS shall be supplied standard with programming buttons and local start/stop buttons on one main keypad with LCD display.
2. Standard starter control logic shall be located on a microprocessor-based PC card which provides the sequential logic for the starter and gate signals to the power card which is used to drive the SCRs.
3. Design control logic to perform timing required for operation of the SSRVS and bypass contactor while continuously monitoring motor and starter for faults. If a fault is detected, the control logic of the SSRVS shall provide fault indication via an LCD display. In the event of a fault condition, the control logic shall safely shut down the starter to disable the motor.
4. The PC cards of the SSRVS shall be interchangeable with other control logic cards on starters of a similar design.

B. Electrical

1. The logic control of the SSRVS shall incorporate a micro computer which consists of all circuitry required to drive the power semiconductors and provide motor and starter monitoring functions.
2. The SSRVS logic shall provide the following standard features:
 - a. Adjustable Ramp Time (0-120 seconds)
 - b. Adjustable Initial Current (50-400% of motor FLA)
 - c. Adjustable Max Current (200-600% of motor FLA)
 - d. Adjustable Decel Profile for Pumps
 - e. Line Phase Loss Detection
 - f. Adjustable Line Current Imbalance Detection (10-40%)
 - g. Adjustable Over/Under Line Voltage Protection (10-30%)
 - h. Up To Speed Indication
 - i. Line Phase Sequence Sensitivity or Insensitivity
 - j. Selectable Solid State Overload Class (10, 20, 30, None)
 - k. Selectable Motor Service Factor (1.0, 1.15, or 1.25)
 - l. Adjustable Motor Full Load Amperes
 - m. Adjustable Current Transformer Ratio
 - n. Battery "Backup" of Set Starter Parameters
 - o. Selectable Passcode Protection of Set Starter Parameters
 - p. Line Voltage Independent Operation
 - q. Line Frequency Tracking (25Hz Through 70Hz)
 - r. Instantaneous Overcurrent Detection
 - s. Shorted SCR Detection
 - t. Software Selectable (Via LCD) Relay Outputs
 - u. "Revolving" Event Recorder (99 most recent events)
 - v. LCD Status Display
3. Standard features shall operate concurrently.
4. The following optional features shall be included with each SSRVS:

- a. Selectable Automatic Energy Savings Feature
- b. Over/Under Current Fault Protection used in pumping applications for indicating pump jam
- c. Starts Per Hour Limiter
- d. Elapsed Time Meter (Via LCD Display)
- e. Time Between Starts Limiter

C. Software Selectable Relay Outputs

1. Two selectable relay outputs shall be provided with each SSRVS.
2. Relay outputs shall be selectable via LCD display.
3. Selectable relay outputs shall be from the following menu:
 - a. Run
 - b. Up To Speed
 - c. Shorted SCR Trip
 - d. Motor Thermal Overload Trip
 - e. Motor Thermal Overload Warning
 - f. Motor Thermal Overload Lockout
 - g. SHT Fault Relay
4. The selectable relay outputs shall be in addition to one fixed general fault relay output. This general fault relay shall indicate any of the following faults:
 - a. Line Phase Loss
 - b. Line Phase Imbalance
 - c. Low Three Phase Line
 - d. Line Phase Sequence Change
 - e. Motor Thermal Overload Trip
 - f. Battery Backup Failure (Computer PC Card)
 - g. Instantaneous Overcurrent
 - h. Shorted SCR Fault
 - i. Three Phase Line Frequency Deviation
 - j. Control Power Failure
 - k. Computer Error
 - l. Up To Speed Fault (Stall Time Has Expired)
5. Contact ratings for output relays shall be rated 5 amps inductive and 10 amps resistive.

D. LCD Status Display Display

1. Each SSRVS shall have a keyboard/LCD display assembly designed to:
 - a. Set or examine operating parameters.
 - b. Provide starter status information.
 - c. Provide real-time information about line current, voltage and frequency.
 - d. Provide a means to start and stop the SSRVS.
2. The LCD display for the SSRVS shall be mounted on the door of the starter enclosure for viewing from the outside of the enclosure.

E. LED Indicators

1. The following LED indicators shall be provided for advisory status and fault annunciation:
 - a. Power On
 - b. Micro Computer Fault
 - c. SCR Gate Drive Power
 - d. SCR Condition

PART 3 -- EXECUTION

3.1 SHIPPING AND HANDLING

- A. All equipment parts shall be properly protected in accordance with manufacturer requirements so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation.
- B. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the ENGINEER.
- C. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.
- D. Each box or package shall be properly marked to show its net weight in addition to its contents.
- E. All scratched or otherwise marred painted surfaces shall be touched-up after installation to match original finishes.

3.2 INSTALLATION AND STARTUP

- A. The manufacturer, through the CONTRACTOR, shall examine all areas and conditions under which the variable frequency drives, motors, and isolation transformers are to be installed. The manufacturer shall notify the CONTRACTOR, in writing of conditions detrimental to the proper completion of the work. No work shall proceed until all unsatisfactory conditions have been corrected in a manner acceptable to the CONTRACTOR.
- B. If there are any difficulties in installation or operation of the equipment due to the manufacturer's design or fabrication, additional services shall be provided at no cost or expense to the OWNER.
- C. The CONTRACTOR shall be responsible for furnishing a manufacturer's ENGINEER to assist in installation, to inspect and adjust the equipment before initial service, and during startup. Testing, checkout, and start-up of the variable frequency drive system shall be performed under the technical direction of the manufacturer's service engineer. Under no circumstances, are any portions of the drive system to be energized without authorization from the manufacturer's representative.
- D. Install SSRVS's and motors in accordance with the equipment manufacturer's written instructions and with recognized industry practices; complying with applicable requirements of NEC, U.L. and NEMA standards, to insure that products fulfill

requirements.

- E. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in U.L. Standards 486A and B, and the National Electrical Code. The SSRVS enclosure shall not be used as a raceway for wiring unless a dedicated wiring space is provided. Wiring shall not run through or between components not served.
- F. Prior to energization of SSRVS equipment, check with ground resistance tester, phase-to-phase and phase-to-ground insulation resistance levels to ensure requirements are fulfilled. Check circuitry for electrical continuity, and for short-circuits, and ensure that direction of rotation of each motor fulfills requirements.
- G. Provide equipment grounding connections for SSRVS equipment as indicated. Tighten connections to comply with tightening torques specified in U.L. Standard 486A to assure permanent and effective grounding.
- H. Upon completion of installation of SSRVS equipment and electrical circuitry, energize SSRVS circuitry and demonstrate functioning of equipment in accordance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and retest to demonstrate compliance.

3.4 SERVICES OF MANUFACTURER'S REPRESENTATIVE

- A. The CONTRACTOR shall provide the services of a qualified manufacturer's technical representative who shall adequately supervise the installation and testing of and start up of all equipment furnished under this Contract and instruct the CONTRACTOR'S personnel and the OWNER'S operating personnel in its maintenance and operation as outlined in the General Conditions. The services of the Manufacturer's representative shall be provided for the periods stated in the following schedule:

	<u>INSTALLATION TRIP (DAYS)</u>	<u>OPERATION TRIP* (DAYS)</u>	<u>GUARANTEE PERIOD TRIP (DAYS)</u>
For each Type of SSRVS	2	2	2

* During the operation trip, the manufacturer shall instruct OWNER'S personnel.

A total of six (6) service days (48 hours) shall be provided by the manufacturer's representative.

- B. The manufacturer's representative shall direct all final adjustments necessary for the drive system to meet all operational and performance requirements outlined herein.
- C. Any additional time required to achieve successful installation and operation shall be at the expense of the CONTRACTOR. The manufacturer's representative shall sign in and out at the office of the resident representative on each day of arrival at the project.

3.5 WARRANTY

- A. Equipment furnished under this Section shall be guaranteed for two (2) years from the date of substantial completion.
- B. Work shall include labor, materials, and travel time for necessary repairs at the job site.

- END OF SECTION -

SECTION 17100 - PROCESS CONTROL AND INSTRUMENTATION SYSTEM

PART 1 – GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall furnish, install and place into service operating process instrumentation, control systems and panels including accessories, related to this facility, all as shown on plans and specified herein.
- B. Work Includes: Engineering, furnishing, installing, programming, calibrating, adjusting, testing, documenting, starting up, and OWNER training for a complete Instrumentation and Control System.

Major parts are:

- 1. Instrumentation including primary elements, transmitters, and control devices.
 - 2. Remote Telemetry Units and associated programming, see section 17150.
- C. Instrument and Control (I&C) Supplier work scope:
- 1. For I&C equipment and ancillaries provide the following:
 - a. Completing detail design.
 - b. Required Submittals.
 - c. Equipment and ancillaries.
 - d. Instructions, details, and recommendations to, and coordination with, CONTRACTOR for proper installation.
 - e. Verify readiness for operation.
 - f. Verify the correctness of final power and signal connections .
 - g. Adjusting and calibrating.
 - h. Starting up.
 - i. Testing and coordination of testing.
 - j. Training.
 - 2. Verify following work not by I&C Supplier is provided:
 - a. Correct type, size, and number of signal wires with their raceways.
 - b. Correct electrical power circuits and raceways.
 - c. Correct size, type, and number of I&C related pipes, valves, fittings, and tubes.
 - d. Correct size, type, materials, and connection of process mechanical piping for in-line primary elements.
 - 3. For equipment not provided under I&C Supplier, but directly connected to equipment required by I&C Supplier:
 - a. Obtain from CONTRACTOR, manufacturer's information on installation, interface, function, and adjustment.
 - b. Coordinate with CONTRACTOR to allow required interface and operation with I&C System.

- c. For operation and control, verify that installations, interfacing signal terminations, and adjustments have been completed with manufacturer's recommendations.
 - d. Test to demonstrate required interface and operation with I&C System.
 - e. Examples of items in this category, but not limited to the following:
 - 1) Valve operators, position switches, and controls.
 - 2) Chemical feed pump and feeder speed/stroke controls.
 - 3) Automatic samplers.
 - 4) Motor control centers.
 - 5) Adjustable speed drive systems.
 - f. Examples of items not in this category:
 - 1) Internal portions of equipment provided under Division 16, Electrical, that are not directly connected to equipment under I&C System.
 - 2) Internal portions of I&C Systems provided as part of package systems and that are not directly connected to equipment provided under I&C System.
4. Wiring external to equipment provided by I&C Supplier:
- a. Special control and communications cable: Provided by I&C Supplier.
5. All aspects of specification 17150

- D. Each item of hardware, software, and/or firmware developed, delivered, installed, licensed, or modified under this contract shall be Year 2000 (Y2K) "Millennium Compliant".

1.2 SINGLE INSTRUMENT SUPPLIER

- A. The CONTRACTOR shall assign to the Single Instrument and Control (I&C) supplier full responsibility for the functional operation of all new instrumentation systems. The CONTRACTOR shall have said supplier perform all engineering necessary in order to select, to furnish, to program, to supervise installation, connection, to calibrate, to place into operation of all sensors, instruments, alarm equipment, control panels, accessories, and all other equipment as specified herein.
- B. The single instrument and controls supplier shall demonstrate his ability to successfully complete projects of similar sizes and nature. Provide references (including phone number and contact name) for at least three projects successfully completed in which the following tasks were performed: system engineering, documentation including panel assembly, schematics and wiring diagram, programming, field testing, calibration and start-up, operator instruction and maintenance training. The foregoing shall enable the CONTRACTOR and the OWNER to be assured that the full responsibility for the requirements of this Section shall reside in an organization which is qualified and experienced in the water management field and its process technology on a functional systems basis. The single I&C supplier shall have a UL approved shop and shall build all panels according to UL 508A.
- C. The single software engineering supplier shall demonstrate his ability to successfully complete projects of similar sizes and nature. Provide references (including phone number and contact name) for at least three projects successfully completed in which the following tasks were performed: ladder logic programming, computer based SCADA

system configuration, documentation, field testing, start-up, and operator instruction.

1.3 INSTALLATION WORK

- A. Nothing in this part of the Specifications shall be construed as requiring the CONTRACTOR to utilize personnel supplied by his assigned instrument manufacturer's organization, or any division thereof, to accomplish the physical installation of any elements, instruments, accessories or assemblies specified herein. However, the CONTRACTOR shall employ installers who are skilled and experienced in the installation and connection of all elements, instruments, accessories and assemblies; portions of their work shall be supervised or checked as specified in Part 3, herein.

1.4 PREPARATION OF SUBMITTAL OF DRAWINGS AND DATA

- A. It is incumbent upon the CONTRACTOR to coordinate the work specified in these Sections so that a complete I&C system for the facility shall be provided and shall be supported by accurate Shop and record Drawings. As a part of the responsibility as assigned by the CONTRACTOR, the Single I&C supplier shall prepare and submit through the CONTRACTOR, complete organized Shop Drawings, as specified in Part 2.2, herein. Interface between instruments, motor starters, etc. shall be included in his Shop Drawing submittal.
- B. During the period of preparation of this submittal, the CONTRACTOR shall authorize direct, informal liaison between his Single I&C supplier and the ENGINEER for exchange of technical information. As a result of this liaison, certain minor refinements and revisions in the systems as specified may be authorized informally by the ENGINEER, but these shall not alter the scope of work or cause increase or decrease in the Contract Price. During this informal exchange, no oral statement by the ENGINEER shall be construed to give formal approval of any component or method, nor shall any statement be construed to grant formal exception to, or variation from these Specifications.

1.5 ADDITIONAL TECHNICAL SERVICES

- A. At no separate additional cost to the OWNER, the CONTRACTOR shall provide the following services of qualified technical representatives of the Single I&C supplier (See Part 3, herein).
 - 1. To supervise installation and connection of all instruments, elements, and components of every system, including connection of instrument signals to primary measurement elements and to final control elements such as pumps, valves, and chemical feeders;
 - 2. To make all necessary adjustments, calibrations and tests; and
 - 3. To instruct plant operating and maintenance personnel on instrumentation. This time shall be in addition to whatever time is required for other facets of work at the site, and shall be during the OWNER'S normal working days and hours.

1.6 GUARANTEE

- A. The CONTRACTOR shall guarantee all equipment and installation, as specified herein,

for a period of one (1) year following the date of completion of the work. To fulfill this obligation, the CONTRACTOR shall utilize technical service personnel designated by the Single I&C supplier to which the CONTRACTOR originally assigned project responsibility for instrumentation. Services shall be performed within two (2) calendar days after notification by the OWNER.

1.7 ADDITIONAL PROVISIONS

- A. The applicable provisions of the following Sections under Electrical Work shall apply to work and equipment specified herein, the same as if stated in full, herein:
1. Codes and Standards
 2. Equipment, Materials and Workmanship
 3. Testing
 4. Grounding
 5. Equipment Anchoring
 6. Conductor and Equipment Identification
 7. Terminal Cabinets and Control Compartments
 8. Process Control Devices

1.8 NEWEST MODEL COMPONENTS

- A. All meters, instruments, and other components shall be the most recent field proven models marketed by their manufacturers at the time of submittal of Shop Drawings unless otherwise specified to match existing equipment. All technical data publications included with submittals shall be the most recent issue.

1.9 INSPECTION OF THE SITE AND EXISTING CONDITIONS

- A. The instrumentation drawings were developed from past record drawings and information supplied by the OWNER.
- B. Before submitting a bid, visit the site and determine conditions at the site and at all existing structures in order to become familiar with all existing conditions and instrumentation and control systems which will, in any way or manner, affect the work required under this Contract. No subsequent increase in Contract cost will be allowed for additional work required because of the CONTRACTOR'S failure to fulfill this requirement.

1.10 RELATED WORK

- A. Division 16 - Electrical
- B. Division 11 - Equipment
- C. Division 15 - Equipment

1.11 Millennium Compliance Performance "Y2K"

- A. The CONTRACTOR warrants that each item of hardware, software, and/or firmware developed, delivered, installed, licensed, or modified under this contract shall be "Millennium Compliant" and recognize and accurately process date data (Including but not limited to, calculating, comparing and sequencing) from, into, and between the twentieth and twenty-first centuries, including leap year calculations, when used in

accordance with the documentation provided by the CONTRACTOR, provided that all items (e.g., hardware, software, firmware) used in combination with other designated items properly exchange data with it. "Millennium Compliant" is the quality of a system in any level of hardware or software including, but not limited to, microcode, firmware, applications programs, files and databases to provide all of the following functions:

1. Accurately process date information before, during, and after January 1, 2000 A.D., including but not limited to accepting date input, providing date input, providing date output, and performing calculations on dates or portions of dates, using data or program code referenced by dates;
 2. Function accurately and without interruption before, during, and after January 1, 2000 A.D. without any change in operation associated with the advent of the new century;
 3. Respond to two-digit year-date input in a way that resolves the ambiguity as to century in a disclosed, defined, and predetermined manner; and
 4. Store and provide output of date information in ways that are unambiguous as to century.
- B. "Leap Year" shall mean the year during which the month of February contains 29 days. Leap Year occurs in all years divisible by 400 or evenly divisible by 4 and not evenly divisible by 100.
- C. Nothing in this warranty shall be construed to limit any rights or remedies the OWNER may otherwise have under this contract with respect to defects other than year 2000 performance.

PART 2 – PRODUCTS

2.1 INSTRUMENTATION CRITERIA

- A. **Designation of Components:** In these Specifications and on the Drawings, all systems, meters, instruments, and other elements are represented schematically, and are designated by numbers, as derived from criteria in Instrument Society of American Standard ANSI/ISA S5.1-1973. The nomenclature and numbers designated herein and on the Drawings shall be employed exclusively throughout Shop Drawings, data sheets, and similar materials. Any other symbols, designations, and nomenclature unique to the manufacturer's standard methods shall not replace these prescribed above, used, herein and on the Drawings.
- B. **Signal Characteristics:** Signals shall be electrical, as indicated herein, and shall vary in direct linear proportion to the measured variable, except as noted. Electrical signals outside control panel(s) shall be 4 to 20 milliamperes DC, except as noted. Signals within enclosures may be 1-5 volts DC.
- C. **Matching Style, Appearance, and Type:** All instruments to be panel mounted at the control panels shall have matching style and general appearance. Instruments performing similar functions shall be of the same type, model, or class, and shall be of one (1) manufacturer.

- D. **Accuracy and Repeatability:** The overall accuracy of each instrumentation system or loop shall be as prescribed in the Specifications for that system or loop. Each system's accuracy shall be determined as a probable maximum error; this shall be the square root of the sum of the squares of certified "accuracy s" of certain designated components in each system, expressed as a percentage of the actual span or value of the measured variable. Each individual electronic instrument shall have a minimum accuracy of ± 0.7 percent of full scale and a minimum repeatability of ± 0.4 percent of full scale unless otherwise specified. Instruments which do not conform to or improve upon these criteria are not acceptable.
- E. **Signal Isolators, Converters, and Power Supplies:** Signal isolators shall be furnished and installed in each measurement and control loop, wherever required, to insure adjacent component impedance match or where feedback paths may be generated. Signal converters shall be included where required to resolve any signal level incompatibilities. Signal power supplies shall be included, as required by the manufacturer's instrument load characteristics, to insure sufficient power to each loop component.
- F. **Alternative Equipment or Methods:** Equipment or methods requiring redesign of any project details are not acceptable without prior approval of the ENGINEER. Any changes inherent to a proposal alternative shall be at no additional cost to the OWNER. The required approval shall be obtained in writing by the I&C Subcontractor through the CONTRACTOR prior to submittal of Shop Drawings and data. Any proposal for approval of alternative equipment or methods shall include evidence of improved performance, operational advantage and maintenance enhancement over the equipment or method specified, or shall include evidence that a specified component is not available. Otherwise, alternative equipment (other than direct, equivalent substitutions) and alternative methods shall not be proposed.

2.2 DETAILED SYSTEMS DRAWINGS AND DATA

- A. **Content:** The CONTRACTOR shall submit detailed Shop Drawings and data prepared and organized by the Single I&C supplier designated at the time of bidding. These Drawings and data shall be submitted as a complete bound package at one time within 80 calendar days after date of Notice to Proceed and shall include:
1. Drawings showing definite diagrams for every instrumentation loop system. These diagrams shall show and identify each component of each loop or system using legend and symbols from ISA Standard S5.4, each having the format of ISA Standard S5.1 as used on the Project Drawing. (Each system or loop diagram shall be drawn on a separate Drawing sheet.)
 2. Data sheets for each component, together with a technical product brochure or bulletin. The data sheets shall show:
 - a. Component function description used herein and on the Drawings;
 - b. Manufacturer's model number or other product designation;
 - c. Project tag number used herein and on the Drawings;
 - d. Project system loop of which the component is a part;
 - e. Project location or assembly at which the component is to be installed;

- f. Input and output characteristics;
 - g. Scale range and units (if any) and multiplier (if any);
 - h. Requirements for electric supply (if any);
 - i. Requirements for air supply (if any);
 - j. Materials of component parts to be in contact with, or otherwise exposed to, process media;
 - k. Calibration curves as required.
 - l. Special requirements or features.
3. A complete index shall appear in the front of each bound submittal volume. A separate technical brochure or bulletin shall be included with each instrument data sheet. The data sheets shall be indexed in the submittal by systems or loops, as a separate group for each system or loop. If, within a single system or loop, a single instrument is employed more than once, one data sheet with one brochure or bulletin may cover all identical uses of that instrument in that system. Each brochure or bulletin shall include a list of tag numbers for which it applies. System groups shall be separated by labeled tags.
 4. Drawings showing both schematic and wiring diagrams for control circuits. Complete details on the circuit interrelationship of all devices within and outside each control panel shall be submitted first, using schematic control diagrams. Subsequent to return of this first submittal by the ENGINEER, piping and wiring diagrams shall be prepared and submitted for review by the ENGINEER; the diagrams shall consist of component layout Drawings to scale, showing numbered terminals on components together with the unique number of the wire to be connected to each terminal. Piping and wiring diagrams shall show terminal assignments from all primary measurement devices, such as flow meters, and to all final control devices, such as samplers, pumps, valves, and chemical feeders. The CONTRACTOR shall furnish all necessary equipment supplier's Shop Drawings to facilitate inclusion of this information by the I&C system supplier.

Schematic and wiring diagram criteria shall be followed as established in NEMA Standards Publication ANSI/NEMA 1CS-1-1978, "Industrial Control and Systems."

5. Assembly and construction Drawings for each control panel and for other special enclosed assemblies for field installation. These Drawings shall include dimensions, identification of all components, surface preparation and finish data, nameplates, and the like. These Drawings also shall include enough other details, including prototype photographs, to define exactly the style and overall appearance of the assembly; a finish treatment sample shall be included.
6. Installation, mounting and anchoring details for all components and assemblies to be field-mounted, including conduit connection or entry details.
7. Complete and detailed bills of materials. A master Bill of Materials listing all field mounted devices, control panels and other equipment that shall be shipped to the job site. A Bill of Materials for each control panel listing all devices within the panel.
8. Modifications to existing equipment. A complete description of all proposed modifications to existing instrumentation equipment, control panels, control devices, cabinets, etc., shall be submitted with the Shop Drawings complete with

detailed Drawings of the proposed modifications.

- B. **Organization and Binding:** The organization of initial Shop Drawing submittal required above shall be compatible to eventual inclusion with the Technical Manuals submittal and shall include final alterations reflecting "as built" conditions. Accordingly, the initial multiple copy Shop Drawing submittal shall be separately bound in 3-ring binders of the type specified under Part 2. 3, herein, for the Technical Manuals.

2.3 TECHNICAL MANUALS

- A. Five (5) final sets of technical manuals shall be supplied for the OWNER, and one (1) final set shall be supplied for the ENGINEER, as a condition of acceptance of the project. Each set shall consist of one (1) or more volumes, each of which shall be bound in a standard size, three-ring, loose-leaf, vinyl plastic hard cover binder suitable for bookshelf storage. Binder ring size shall not exceed 3.0 inches.
- B. Initially, two (2) sets of these manuals shall be submitted to the ENGINEER for favorable review after return of favorably reviewed Shop Drawings and data required under Part 3, herein. Following the ENGINEER'S review, one (1) set shall be returned to the CONTRACTOR with comments. The sets shall be revised and/or amended as required and the requisite final sets shall be submitted to the ENGINEER fifteen (15) days prior to start-up of systems. The ENGINEER shall distribute the copies.
- C. In addition to updated Shop Drawing information to reflect actual existing conditions, each set of technical manuals shall include installation, connection, operating, troubleshooting, maintenance, and overhaul instructions in complete detail. This shall provide the OWNER with comprehensive information on all systems and components to enable operation, service, maintenance, and repair. Exploded or other detailed views of all instruments, assemblies, and accessory components shall be included together with complete parts lists and ordering instructions.

2.4 SPARE PARTS

- A. The CONTRACTOR shall include, as part of the bid package, a list of recommended spare parts covering items required under these Specifications. The total price of these spare parts shall not be less than \$5,000.00 and this sum shall be a part of the CONTRACTOR'S total bid price (This is in addition to the spare parts listed in section 17150). The Single I&C supplier in fact shall be responsible for delivery of the spare parts, as directed by the OWNER after plant start-up. Prior to delivery of the spare parts, the OWNER shall have the option of adding or exchanging any originally enumerated component based on current list prices for each item. The CONTRACTOR shall also submit a list of recommended equipment for maintaining and calibrating equipment furnished under this Section.

2.5 CONTROL PANELS

- A. **General:** New control panels shall be furnished and installed under this Contract. They shall house the instrumentation, control devices, indicating lights, PLC, RTU, alarm chassis, displays, all necessary accessories, wiring and terminal blocks as necessary and as shown on the Drawings and as described herein. Control panel doors shall be equipped with a door latch kit or a fast operating clamp assembly as applicable. 120 volt AC control voltage in a control panel shall be supplied with a line noise suppressing

transformer specified elsewhere in this Section. Each control panel shall be properly grounded and as such be provided with a ground terminal block. Control panels shall be properly sized for installation through new and existing entry ways and custom fit for locations as shown on the drawings.

B. Cooling: Control panels shall have sufficient cooling and/or ventilation not to exceed the maximum operating temperature of any of the internal components. Ambient temperature limits shall be 90 degrees F for indoor and 100 degrees F for outdoor control panels. Outdoor control panels with electronic equipment shall be furnished with sun shields around and on top of the control panels.

C. Signal and Control Circuit Wiring:

1. **WIRE TYPE AND SIZES:** Conductors shall be flexible stranded copper wire; these shall be U.L. listed Type THHN and shall be rated 600 volts. Wire for control signal circuits and alarm input circuits shall be 16 AWG. All instrumentation cables shall be shielded No. 20 AWG with a copper drain wire. All special instrumentation cable such as between sensor and transmitter shall be supplied by the I&C supplier.
2. **WIRE INSULATION COLORS:** Conductors supplying 120 volt AC power on the line side of a disconnecting switch shall have a black insulation for the ungrounded conductor. Grounded circuit conductors shall have white insulation. Insulation for ungrounded 120 volt AC control circuit conductors shall be red. All wires energized by a voltage source external to the control board(s) shall have yellow insulation. Insulation for all DC conductors shall be blue.
3. **WIRING INSTALLATION:** All wires shall be run in plastic wireways except (1) field wiring, (2) wiring run between mating blocks in adjacent sections, (3) wiring run from components on a swing-out panel to components on a part of the fixed structure, and (4) wiring run to panel mounted components. Wiring run from components on a swing-out panels to other components on a fixed panel shall be made up in tied bundles. These shall be tied with nylon wire ties, and shall be secured to panels at both sides of the "hinge loop" so that conductors are not strained at terminals. Wiring run to control devices on the front panels shall be tied together at short intervals with nylon wire ties and secured to the inside face of the panel using adhesive mounts. Wiring to rear terminals on panel mount instruments shall be run in plastic wireways secured to horizontal brackets run above or below the instruments in about the same plane as the rear of the instruments. Shields of shielded instrument cable shall only be grounded on one side of each cable run. The side to be grounded shall always be in the field as applicable. Care shall be exercised to properly insulate the ungrounded side, to prevent ground loops from occurring.

Conformance to the above wiring installation requirements shall be reflected by details shown on the Shop Drawings for the ENGINEER'S review.

4. **WIRE MARKING:** Each signal, control, alarm, and indicating circuit conductor connected to a given electrical point shall be designated by a single unique number which shall be shown on all Shop Drawings. These numbers shall be marked on all conductors at every terminal using permanently marked heat-shrink plastic. Instrument signal circuit conductors shall be tagged with unique multiple

digit numbers. Black and white wires from the circuit breaker panelboard shall be tagged including the one (1) or two (2) digit number of the branch circuit breaker.

5. **TERMINAL BLOCKS:** Terminal blocks shall be molded plastic with barriers and box lug terminals, and shall be rated 15 amperes at 600 volts. White marking strips, fastened securely to the molded sections, shall be provided and wire numbers or circuit identifications shall be marked thereon with permanent marking fluid. Terminal blocks shall be **General Electric Type CR 151A1** with mounting rack, equivalent to **Cinch-Jones** or equal.

- D. **Painting:** Control panels shall be coated in accordance to Division 09800.

2.6 ACCESSORIES

- A. General purpose relays in the control panels shall be plug in type with contacts rated 10 amperes at 120 volts AC. The quantity and type of contacts shall be as shown on the Drawings. Each relay shall be enclosed in a clear plastic heat and shock resistant dust cover. Sockets for relays shall have screw type terminals. Relays shall be **Potter and Brumfield Type KRP or KUP, Square-D Type K, or equal.**
- B. Time delay relays shall be solid state on-delay or off-delay type with contacts rated 10 amperes at 120VAC. Units shall include adjustable dial with graduated scale or digital switch setting covering the time range in each case. Time delay relays shall be **Agastat Series 7000, Omron series H3, SSAC type TDM or approved equal.**
- C. Additional slave relays shall be installed when the number or type of contacts shown exceed the contact capacity of the specified relays and timers.
- D. Switches and indicating lights shall be round 30.5mm configuration, heavy duty and corrosion resistant. Legend plate shall be standard size square style laminate with white field and black markings as shown.

Indicating lights shall have 6VAC lamps and integral transformer for operation from 120VAC, unless otherwise noted. Lens color shall be as noted. All indicating lights shall be push-to-test type. Pushbuttons shall include full guard with flush button and selector switches shall include a black non-illuminated knob on switch, unless otherwise noted. Contact arrangement and configuration shall be as shown.

Devices shall be **Cutler Hammer Type E-30, General Electric Type CR104, Square D class 9001 type Sk, Allen Bradley Bulletin 800 or equal.**

- E. Selector switches shall be of the rotary type with the number of positions as shown on the Drawings. Color, escutcheon engravings, contact configurations and the like shall be as shown. Devices shall be **Cutler Hammer Type E-24, General Electric Type CR104, or equal.**
- F. Circuit breakers shall be single pole, 120 volt, 15 ampere rating or as required to protect wires and equipment and mounted inside the panels as shown.
- G. Nameplates shall be supplied for identification of all field mounted elements, including flow meters and their transmitters. These nameplates shall identify the instrument, or meter, descriptively, as to function and system. These nameplates shall be fabricated

from black-face, white-center, laminated engraving plastic. A nameplate shall be provided for each signal transducer, signal converter, signal isolator, each electronic trip, and the like, mounted inside the control panels. These shall be descriptive, to define the function and system of such element. Adhesives shall be acceptable for attaching nameplates. Painted surfaces must be prepared to allow permanent bonding of adhesives. Nameplates shall be provided for instruments, function titles for each group of instruments and other components mounted on the front of the control panels as shown. These nameplates and/or individual letters shall be fabricated from **VI-LAM, Catalog No. 200, manufactured by N/P Company, or equivalent by Formica, or equal**. Colors, lettering, style and sizes shall be as shown or as selected by the ENGINEER.

- H. Solenoid Valves if not otherwise noted shall be globe valve directly actuated by solenoid and not requiring minimum pressure differential for operation. Materials shall be brass globe valved bodies and Buna-N valve seats. The size shall be 1/4" normally closed. The coil shall be 115 VAC coil, Nema 4 solenoid enclosure. Manufacturer shall be **ASCO; Red Hat, or equal**.

2.7 TRANSIENT VOLTAGE SURGE SUPPRESSION (TVSS) PROTECTION

- A. **General:** TVSS protection shall be provided to protect the electronic instrumentation system from induced surges propagating along the signal and power supply lines. The protection systems shall be such that the protective level shall not interfere with normal operation, but shall be lower than the instrument surge withstand level, and be maintenance free and self-restoring. Instruments shall be housed in a suitable case, properly grounded. Ground wires for all TVSS shall be connected to a good earth ground and where practical, each ground wire run individually and insulated from each other. These protectors shall be mounted within the instrument enclosure or a separate NEMA 4X junction box coupled to the enclosure.
- B. **Power Supply:** Protection of all 120 VAC instrument power supply lines shall be provided. Control panels shall be protected by line noise suppressing isolation transformers and TVSS. Field instruments shall be protected by TVSS. For control panels, the line noise suppressing isolation transformer shall be **Topaz Series 30 Ultra isolators or approved equal**. The suppressor shall be **Edco HSP-121**.
- C. **Analog Signals:** Protection of analog signal lines originating and terminating not in the same building shall be provided by TVSS. For analog signal lines the TVSS shall be **Edco PC-642**. For field mounted two-wire instruments the TVSS shall be encapsulated in stainless steel pipe nipples, and shall be **Edco SS64 series**. For field mounted four-wire 120VAC instruments, the TVSS shall be in a NEMA 4X polycarbonate enclosure, **Edco SLAC series**.

2.8 FIELD INSTRUMENTS

- A. **Pressure and Differential Pressure Transmitter (Electronic):** This specification covers the following services: gauge pressure and flow inferred from differential pressure. Gauge and differential pressure transmitters shall be of the capacitance type with a field adjustable 10:1 input range. Span and zero shall be continuously adjustable externally over the entire range. Transmitter shall be of the smart type microprocessor-based. Transmitters shall be Nema 4X construction with 316 stainless steel process wetted parts, if not otherwise stated. Accuracy, including nonlinearity, hysteresis and

repeatability errors shall be + 0.1% of calibrated span. The maximum zero elevation and maximum zero suppression shall be adjustable to 150% of maximum span. Output shall be linear isolated 4-20 mA 24 VDC. Power supply shall be 24 VDC, two wire design. Each transmitter shall be furnished with a junction box, external zero and indicator calibrated in engineering units and mounting hardware as required. Overload capacity shall be rated at a minimum of 200% of maximum range. Each transmitter shall have a stainless steel tag with calibration data attached to body.

1. Range: 30 inches to 200 psig. Refer to the instrument schedule for calibrated span for the individual instrument(s).
2. Maximum Static Pressure: 2,000 psig.
3. Humidity: 10 to 100 percent non-condensing.
4. Sensing Element: Diaphragm type.
5. Vent/Drain Valve: One per sensing cavity.
6. Material: Sensing element components to be 316 stainless steel, or as shown on the instrument schedule.
7. Process Connection: 0.5 inch NPT, unless noted otherwise in the instrument schedule.
8. Electrical: 0.5 inch rigid conduit with screw terminals. Provide electrical protection against lightning.
9. Freeze Protection: If the transmitter and process piping are located outdoors, provide freezing protection for both.

B. Provide block and shutoff valves. Meet the following requirements:

1. Size: 0.5 inch (1.0 inch for diaphragm seal installations).
2. Type: Ball.
3. Pressure: Up to 400 psi.
4. Body: Brass or bronze, for non-corrosive atmosphere, PVC or epoxy coated for corrosive atmosphere.
5. Seats and Seals: Teflon.
6. Ball and Stem: Same material as sensing element.
7. Manufacturer: **Gemini valve series 76**, or equivalent.

C. Differential pressure transmitters: Differential pressure indicating transmitters shall be the same as the gauge pressure transmitter except for body specifications. Differential pressure units shall be furnished with close coupled stainless steel three valve manifold assembly. Manifold assembly shall be HEX Products Model HM, or equal. Overpressure limits shall be as scheduled.

Differential pressure transmitters shall have an integral square root extractor to provide a linear 4-20 mA flow signal output. In addition, each flow transmitter shall be furnished with laminated flow versus differential pressure curves wall mounted adjacent to the transmitter. Where scheduled, transmitters shall be furnished with remote diaphragm seals and 316 stainless steel sealed capillary tubes to isolate the transmitter from the process fluid.

Provide corrosive resistant mounting hardware for mounting the instrument. Unless otherwise shown on the instrument schedule, provide NEMA 4X enclosure, pipe mounted.

Provide differential pressure transmitters complete with a three-valve manifold Meet the following requirements:

1. **Materials:** Same as block and shutoff valves.
2. **Process Connection:** 0.5 inch NPT.
3. **Outlet Ports:** 0.5 inch NPT.
4. **Purge Taps:** 0.5 inch NPT located between block valves and outlet ports.

Transmitter shall be as manufactured by **Rosemount model 1151 smart, or approved equal.**

- D. Level Switch (Suspended Float):** Level switches of the direct acting float-operated design shall be comprised of a sealed, approximately five (5) inch diameter plastic casing float, containing mercury switches and flexibly supported by means of a heavy neoprene or PVC jacket, with three (3) conductor cable a minimum of 20-feet in length. Unless otherwise specific, media specific gravity is .95 to 1.05. Mercury switches shall be one (1) normally open and one (1) normally closed, 5 amp, 115 volt AC capacity. Float hangers and supports shall be provided as shown on the installation detail Drawings. Float switches shall be as manufactured by **Flygt or approved equal.**
- E. Signal Isolators:** Signal isolators have complete isolation of input, output and power input. Signal input shall be 4-20 MA into 50 ohms maximum, signal output shall be 4-20 MA into 1000 ohms minimum. Power input shall be 120 VAC 60 Hz. Span and zero shall be adjustable, accuracy shall be +0.1 percent of span. Units shall be surface or plug-in socket mounted. Signal isolators shall be **Beckman series 8000, Wilkerson Mighty Module, AGM Electronics Model TA-4000 or equal.**
- E. Level Element And Transmitter (Submersible):** The submersible level transmitter shall be constructed of a fully welded titanium pressure module with a diameter of .69" and length of 7.8", utilizing a micromachined silicon piezo-resistive pressure sensor. The overall accuracy shall be $\pm 0.25\%$ FS BSL with a temperature error band of $\pm 2.0\%$ FS. The pressure transmitter shall be a loop powered device with a supply voltage of between 9 and 30 Volts dc and have an output of 4 - 20mA. The cell is to be a gauge version with 4mA representing atmospheric pressure. The polyurethane cable containing a vent tube is to be molded to the transducer body. The operating temperature range shall be -5 to 150°F (-20 to 60°C). The pressure transmitter shall be supplied with the following optional equipment:
1. Nema 4X Desiccant Kit / Junction box with clear cover for maintaining a dry environment for the cell vent and termination of the polyurethane cable. Desiccant shall be removable for regeneration when baked in an oven.
 2. Kellems Grip for cable support and attachment to the well pipe head.
 3. The pressure transmitter shall be **Consilium US, Inc model PT30T or Druck, Type PTX 1830** with STE 110 termination enclosure.
- F. Flow Element, Venturi:**
1. Unit shall be bi-directional or unidirectional as required Venturi type of pressure differential producer, utilizing static pressure sensed at the throat and at the inlet.
 2. Unit shall have an uncalibrated accuracy of plus or minus 1 percent over a flow

- range of 5:1 minimum.
3. Pipe size, flow, range, approximate pressure differential at maximum flow, and maximum head loss shall be as noted. Provide supporting calculations for actual pressure differential and verify actual pipe ID at submittal time. Fluid metered shall be water with a maximum upstream temperature of 200 degrees F unless otherwise noted.
 4. Units shall have carbon steel body and Type 316 stainless steel throat, unless otherwise noted. Unless otherwise noted, the interior shall be unlined. Holding Flange: Carbon steel with epoxy coating.
 5. The flow element shall consist of an entrance section, throat, holding flange and recovery cone.
 6. Provide meter and transmitter combination that is capable of meeting the following performance requirements when installed in accordance with the manufacturer's recommendations:
 - a. Accuracy: +/- 1.0 percent of flow rate in 10 to 100 percent of flow range.
 - b. Repeatability: +/- 1.0 percent of flow rate in 10 to 100 percent of flow range.
 - c. Head Loss: 0.2 psi at maximum differential pressure.
 - d. Drift: Less than 0, 1 percent of span in six months.
 - e. Temperature Effect: Less than 0.01 percent of span per degree F for -30 to +150 degrees F.
 - f. Operating Temperature: 0-150 degrees F.
 - g. Operating Pressure: 0-150 psig.
 - h. Provide a meter that has been hydraulically calibrated at the manufacturer's facility against a master meter traceable to the National Bureau of Standards. Provide a computer printout of the actual calibration data with the meter.
 7. Units shall be designed for mounting between 125-pound ANSI flanges, unless otherwise noted. Unit pressure rating shall meet or exceed the flange rating. Units shall have no debris-collecting cavities or annular chambers.
 8. Unit shall have a permanent stainless steel nameplate engraved with the tag number, pipe size, throat inside diameter and pressure rating.
 9. Pressure tap connections shall be 1/2-inch NPT taps. A minimum of two internal taps shall be provided at both the inlet and the throat. The high pressure taps shall be through the upstream flange and the low pressure taps shall be through the meter body. Provide vent and drain ports on 90 degree planes with the metering tap.
 10. Note: When fluid is hot water or other volatile liquid, be sure pressure in throat will be above fluid saturation pressure to prevent cavitation.
 11. Provide a sizing computation for each venturi tube installation which includes flow conditions, differential pressure at minimum and maximum flow, and pipe size and configuration.

Units shall be Fischer & Porter Series 10F1070; Badger Meter Type PMT-S.

- G. **Dissolved Oxygen System:** The dissolved oxygen system shall consist of at least four major parts for monitoring Dissolved Oxygen on a continuous basis in wastewater treatment plants and similar applications.

1. The Monitor

2. The Sensor
3. The Mounting Hardware
4. The Electrolyte and Membranes

The monitor shall be housed in a Fiberglas NEMA 4X lockable enclosure with brackets for wall or standard round handrail mounting. It shall have a digital display controlled by microprocessor circuitry. The monitor shall NOT require any charts or manual inputs of any kind to determine the Dissolved Oxygen or to calibrate the system. All program memory and features of the instrument will be unaffected by power interruptions and will not require any type of battery backup. The monitor shall have the following general electronic capabilities:

1. One button air calibration or in-tank calibration to a known value, selectable by program mode.
2. Programmable self-cleaning cycle.
3. Two programmable relays with unlimited individual programmable hysteresis on each.
4. Sensor and analyzer self-diagnostics with separate alarm relay for diagnostics error indication.
5. RS485 serial communication port for dissolved oxygen and temperature.
6. 0-1 VDC voltage output equal to D.O.
7. 4-20 MADC output equal to temperature. (optional isolation)
8. Programmable isolated 4-20 MADC equal to D.O. for any span from 0-99.9 PPM.

In the Air Calibration Mode: Specific error message indicating:

1. The temperature of the sensor was not found to be stable after a 5 minute wait.
2. The D.O. output of the sensor was not found to be stable after a 5 minute wait.
3. The output level of the sensor is too weak.

The monitor shall have the following specific programming capabilities which will be secured by a code which must be set properly to access the programming functions:

1. Type of calibration method
 - a. In air.
 - b. In situ to a known value without removing sensor.
2. Elevation offset above sea level in 500 foot increments.
3. Constant chlorinity value offset programmable from 0 to 25 parts per thousand.
4. Membrane thickness in .5 mil increments.

5. Sensor auto self-cleaning, programmable to be on or off.
6. Programmable sensor self-cleaning for duration, intensity, and interval.

SELF-CLEANING is described as a non-mechanical, non-hydraulic, non-intrusive or manual action specifically targeted at preventing fouling due to biological growth on the sensor membrane. The analyzer shall contain circuitry that will initiate a timed electrochemical reaction within the sensor to form chlorine gas which diffuses through the membrane. The periodic presence of this gas at the membrane surface makes the membrane unattractive to biological organisms and kills those which do not attach themselves.

The sensor shall be a self-generating, galvanic cell type having a platinum cathode and lead anode. It shall have a zero output, repeatable at zero D.O. The probe shall be of the membrane type, utilizing a one mil Teflon membrane and shall be equipped with a thermistor circuit providing continuous, automatic, active temperature compensation in the range from 0-50 degrees centigrade. The sensor shall be constructed of cast epoxy, non-corrosive metal parts and supplied with a specified length of polyurethane covered cable. The membrane, electrolyte, lead anode and cable shall be field replaceable if required.

The mounting hardware shall be a STANDARD design of similar method for mounting the sensor at least a fifteen degree angle, off of perpendicular, in the tank. All the components shall be either anodized aluminum or 316 stainless steel.

Provide a 316 stainless steel junction box mounted in close proximity to sensor probe assembly. The junction box shall be provided with an environmental connector to allow for easy removal of probe assembly for maintenance and membrane replacement.

Each system (monitor and sensor) shall come with at least 24 replacement membranes, 32 ounces of the electrolyte solution and interconnecting cable between the monitor, junction box, and the sensor.

The system shall be Royce Instrument Corporation model 9200 dissolved oxygen analyzer with model 96A T sensor or approved equal.

H. Conductivity Element and Transmitter:

1. General:
 - a. Function: Measure, indicate, and transmit the conductivity of the noted process liquid.
 - b. Type: Probe with electrode or electrodeless sensor.
 - c. Parts: Element, transmitter, interconnecting cable, junction box, and expendables.
2. Performance:
 - a. Range: As noted.
 - b. Accuracy: Plus or minus 0.5 percent of measured range.
3. Features:

- a. Temperature Compensation: Automatic thermocompensator for process liquid temperatures 0 to 200 degrees C.
 - b. Temperature Slope: Adjustable from 0 to 5 percent per degree C.
4. Element:
- a. Type: With electrode, unless otherwise noted.
 - b. Electrode Material: 316 stainless steel, unless otherwise noted.
 - c. Other wetted Parts: Nonmetallic synthetic materials; manufacturer to confirm compatibility with process liquid.
 - d. Probe Constant: As noted.
 - e. Mounting/Process Connection: As shown on the Drawings.
 - f. Mounting Hardware: As recommended by the manufacturer for the specific application and/or as shown on the Drawings.
5. Transmitter:
- a. Features:
 - 1) Indicator: LCD or LED digital display.
 - 2) Scale Range: As noted.
 - 3) Contact Set Point: Set point adjustable from 0 to 100 percent of full range, initial setting as noted.
 - b. Signal interface:
 - 1) Output: Isolated 4 to 20 mA dc for load impedance 0 to 500 ohms minimum for 24V dc supply without load adjustments .
 - 2) Contacts: When noted, SPST rated 3A continuous at 120V ac, minimum.
 - c. Enclosure:
 - 1) Type: NEMA 4X.
 - 2) Mounting: Wall, unless otherwise noted.
 - d. Power:
 - 1) Four Wire Unit: Unless otherwise noted; 120V ac, 50/60-Hz.
 - 2) Two-Wire Unit: When noted; powered from a remote 24V dc power supply.
6. Cable: Length as required to accommodate the device locations,
7. Junction Box: Aluminum, explosion-proof and weatherproof, unless otherwise noted.
8. Expendables (for Each Unit Provided): One 16-oz bottle of 2,000 microS/cm conductivity standardizing solution if appropriate for noted range.
9. Manufacturers (Four-Wire Units):
- a. GLI International Model C53 analyzer with model 3422, 3433, 3444 or 3455 series sensor as required.
 - b. Rosemount Analytical.
 - 1) Electrode Type: Model 100 series conductivity element and Model 1054C Transmitter.
 - 2) Electrodeless Type: Model 200 series electrodeless conductivity element and Model 1054T transmitter.
 - c. Foxboro:
 - 1) Electrode Type: Model 871CC contacting conductivity element and Model 872 transmitter.

- 2) Electrodeless Type: Model 871EC electrodeless conductivity element and Model 872 transmitter.

10. **Manufacturers (Two-Wire Units):**

- a. **Rosemount Analytical:**
 - 1) Electrode Type: Model 100 series conductivity element and Model 1181C transmitter.
 - 2) Electrodeless Type: Model 200 series electrodeless conductivity element and Model 1181T transmitter.
- b. **Foxboro:**
 - 1) Electrode Type: Model 871CC contacting conductivity element and Model 870CC transmitter.
 - 2) Electrodeless Type: Model 871EC electrodeless conductivity element and Model 870EC transmitter.

I. **Turbidity Element And Transmitter**

1. **General:**

Provide turbidity analyzers that are designed for continuous measurement, and consist of a sensor, analyzer/transmitter with local indicator, sample pump, valves, Y-strainer, sample lines, mounting hardware and other accessories necessary for operation as recommended by the manufacturer and as indicated on the installation detail.

- a. **Function:** Measure, indicate, and transmit the turbidity of a process stream.
- b. **Type:** Flow-through 90-degree side-scatter using photocell sensed, nephelometric measurement.
- c. **Parts:** Turbidity element, transmitter, interconnecting cable, and accessories.

2. **Performance:**

- a. **Range:** As noted (maximum of 0 to 100 NTU).
- b. **Accuracy:** Plus or minus 2 percent from 0 to 30 NTU and plus or minus 5 percent from 30 to 100 NTU.
- c. **Zero Stability:** Zero indication at zero turbidity, adjustable.
- d. **Response Time:** 5 minutes, maximum, to read 90 percent of a Full Scale step change.

3. **Features:**

- a. **Approval:** EPA approved for potable water service.
- b. **Element:**
 - 1) **Type:** Photocell sensed, nephelometric sensor used for continuous flow, continuous reading.
 - a. Photo cell detection of 90 degree scattering of a beam of light by suspended particles. The scattered light is proportional to the volume of suspended solids in the fluid. Measurement is insensitive to the color of suspended particles.
 - 2) **Sample Flow:** 3.5 to 11.5 gallons per hour.
 - 3) **Sample Temperature Range:** 0 to 50 degrees C.
 - 4) **Ambient Temperature:** 32 to 140 degrees F.

- 5) Materials. Corrosion-resistant plastic.
- 6) Process Connections: Adaptable to plastic pipe or tubing.
 - a. Inlet. 1/8-inch NPT, 1/4-inch hose barb.
 - b. Drain: 3/4-inch NPT, 3/4-inch hose barb.
 - c. Bubble Trap: Integral part of element.
 - d. Mounting: Surface or wall mounting, as shown.
 - e. Enclosure: Hermetically sealed photocell
 - f. Transmitter:
 - 1) Features:
 - a. Type: Microprocessor based.
 - b. Indicator: Four-digit LED readout which continuously displays turbidity in the range from 0.001 to 100.0 NTU.
 - c. Scale Range: 0 to 100.0 NTU.
 - d. Diagnostics: Self-test diagnostics to automatically indicate possible instrument malfunctions. System warning and system shutdown alarms, each activating a SPDT contact on a system fault.
 - e. Turbidity Switch Set Point: Initial setting as noted.
 - f. Modular construction with plug-in circuit boards for easy service/repair.
 - 2) Enclosure:
 - a. Type: NEMA 4X plastic with clear polycarbonate front cover secured with hinges and plastic screws.
 - b. Mounting: Wall.
 - 3) Signal Interface:
 - a. Output: 4 to 20 mA dc signal for load impedance 0 to 500 ohms minimum for 24V dc supply without load adjustments.
 - b. Contacts: When noted, SPDT rated 5A continuous at 120V ac, minimum.
 - 4) Transmitters provided shall be equipped with the following indicators/display:
 - a. Two LED alarm indicators that can be set to different turbidity levels.
 - b. Digital display of turbidity level in Nephelometric Turbidity Units (NTUs.)
 - 5) Power: 120V ac, 60-Hz.
 - g. Cable: Length as required to accommodate the device locations.
 - h. Optional components shall be mounted on a head assembly that can be removed for service without disturbing sample flow.
 - i. Accessories (for Each Unit Provided):
 - 1) Calibration Kit: One calibration cylinder, one bottle of Formazin primary standard, pipet, 1 liter volumetric flask.
 - 2) Bubble trap extraction tool.
 - j. Manufacturers:
 - 1) Hach Low Range Turbidimeter, Model 1720C.
 - 2) GLI International

J. Limit Switch (Position Type):

the plant operator has set a recharge flow set point. FCV-1 may be operated locally utilizing local/off/remote and open/close control switches located on the valve. Valve position will be transmitted to the Water Treatment Plant Wellfield Control system for operator information.

Recovery Mode:

Recovery mode requires valves FCV-1 to be fully closed. In general, the canal shall have priority for any flow choice issue. The recovery to the WTP flow control valve (FCV-2) operates on a PID controller resident in the PLC. PID flow input will be from FIT-1-2B and the flow setpoint is from the Water Treatment Plant Wellfield Control system. Recovery flow to WTP setpoint has to be above a minimum and below a maximum allowed flow during the recovery mode. The valve is interlocked to open when the pump is running and the plant operator has set a recovery flow setpoint. FCV-2 may be operated locally utilizing local/off/remote and open/close control switches located on the valve. Valve position will be transmitted to the Water Treatment Plant Wellfield Control system for operator information.

The recovery to the canal flow control valve (FCV-3) operates on a PID controller resident in the PLC. PID flow input will be from FIT-3 and the flow setpoint is from the Water Treatment Plant Wellfield Control system. Recovery flow to the canal setpoint has to be above a minimum and below a maximum allowed flow during the recovery mode. The valve is interlocked to open only when the pump is running and the plant operator has set a recovery to canal flow setpoint. FCV-3 may be operated locally utilizing local/off/remote and open/close control switches located on the valve. Valve position will be transmitted to the Water Treatment Plant Wellfield Control system for operator information.

Sum of flow recovery to WTP set point and flow recovery to canal set point has to be above a minimum and below a maximum allowed flow during the recovery mode.

The ASR well pump is supplied with a solid-state reduced voltage starter (SSRVS) and is controlled from logic resident in the PLC. Pump operation for start/stop is provided from the Water Treatment Plant Wellfield Control system. Pump is interlocked to run only if recharge valve FCV-1 is closed, SSRVS is not in fault, local switch is in remote position and loop 29 (system over pressure alarm) is not activated. Local pump operation for start/stop is provided from the local starter panel. Local controls do not utilize any interlocks except SSRVS fault. Fault and running will be transmitted to the Water Treatment Plant Wellfield Control system for operator information.

Alarm shall be generated in the PLC if any actual flow deviates from its set point by more than 15% (adjustable) longer than 2 (adjustable) minutes.

Pressure alarm generated in the PLC from PIT-29A located on the well recovery will shut down the well pump if a high pressure persists for a preset 30-second time. This interlock will not reset automatically and must be manually reset by the Water Treatment Plant Wellfield Control system by first commanding a stop and then restarting the well pump. An alarm at the Water Treatment Plant Wellfield Control system will alert the operator of this condition.

Level alarm generated in the PLC from LT-1 will shut down the Recovery mode on preset low level alarm.

Well vault flood switch LS-10, meter vault flood switch LS-11, Meter vault intrusion switch ZS-30A & B, well vault intrusion switch ZS 32, RTU panel intrusion switch ZS-31, RTU loss of power ES-40 and RTU panel over temperature TS-50 will each alarm at the Water Treatment Plant Wellfield Control system to alert the operator of this condition.

Pressure transmitters PIT-29A & B signals are scaled and retransmitted to the Water Treatment Plant Wellfield Control system for operator indication and alarm on high/low conditions.

Flow transmitter FIT-3 provides the control input for loop FCV-3 PID control. This signal is scaled and retransmitted to the Water Treatment Plant Wellfield Control system for operator indication, recording and totalizing.

Flow transmitter FIT-1-2B provides the control input for loop FCV-2 PID control. This signal is scaled and retransmitted to the Water Treatment Plant Wellfield Control system for operator indication, recording and totalizing.

Flow transmitter FIT-1-2A provides the control input for loop FCV-1 PID control. This signal is scaled and retransmitted to the Water Treatment Plant Wellfield Control system for operator indication, recording and totalizing.

ASR discharge to the canal is monitored for conductivity by CIT-20. This signal is scaled and retransmitted to the Water Treatment Plant Wellfield Control system for operator indication, recording and alarming on out of tolerance conditions.

ASR discharge to the canal is monitored for turbidity by AIT-21. This signal is scaled and retransmitted to the Water Treatment Plant Wellfield Control system for operator indication, recording and alarming on out of tolerance conditions.

ASR discharge to the canal is monitored for dissolved oxygen by AIT-24. This signal is scaled and retransmitted to the Water Treatment Plant Wellfield Control system for operator indication, recording and alarming on out of tolerance conditions.

ASR flow to/from the WTP monitored for conductivity by CIT-22. This signal is scaled and retransmitted to the Water Treatment Plant Wellfield Control system for operator indication, recording and alarming on out of tolerance conditions.

2.10 LOOP DESCRIPTIONS

Following are the typical loop descriptions for the ASR well functions and equipment as shown on the P&ID diagrams:

Loop 1 - ASR well recharge flow control valve FCV-1- Provides a 4-20 mdc analog output to modulate the valve to control recharge flow FIT1-2A, provides a 4-20 mdc analog input to the PLC for remote valve position monitoring and monitors a dry contact from the valve indicating valve open (not fully closed). LT1 measures the level/pressure at the bottom near the ASR pump.

Loop 2 - ASR well discharge to WTP flow control valve FCV-2 - Provides a 4-20 mdc analog output to modulate the valve to control recovery flow FIT1-2B to the WTP, provides a 4-20 mdc analog input to the PLC for remote valve position monitoring and

monitors a dry contact from the valve indicating valve open (not fully closed).

Loop 3 - ASR well discharge to canal flow control valve FCV-3 - Provides a 4-20 mdc analog output to modulate the valve to control flow FIT-3 to the canal, provides a 4-20 mdc analog input to the PLC for remote valve position monitoring and monitors a dry contact from the valve indicating valve open (not fully closed). ZS3 shall start/stop peristaltic sample pump through HS3.

Loop 10 - ASR well vault high level - Monitors a dry contact from the high level switch indicating well pit flooding.

Loop 11 - ASR meter vault high level - Monitors a dry contact from the high level switch indicating meter pit flooding.

Loop 20 - ASR well discharge to canal conductivity - Provides a 4-20 mdc analog input to the PLC for remote conductivity monitoring.

Loop 21- ASR well discharge to canal turbidity - Provides a 4-20 mdc analog input to the PLC for remote turbidity monitoring.

Loop 22- ASR well discharge to WTP conductivity - Provides a 4-20 mdc analog input to the PLC for remote conductivity monitoring.

Loop 24- ASR well discharge to canal dissolved oxygen (DO) - provides a 4-20 mdc analog input to the PLC for remote DO monitoring.

Loop 29- ASR well recharge pressure (PIT29B) and discharge pressure (PIT29A)- Provides a 4-20 mdc analog input to the PLC for remote pressure monitoring.

Loop 30 A & B - ASR meter vault intrusion - Monitors a dry contact from the vault intrusion/limit switch indicating tampering of either entrance.

Loop 31 – ASR RTU panel and control panel intrusion - Monitors a dry contact from the panel intrusion switch indicating tampering.

Loop 32 – ASR well vault intrusion - Monitors a dry contact from the ASR well vault intrusion switch indicating tampering.

Loop 40 – ASR RTU loss of power - Monitors a dry contact from the power monitor indicating loss of 120 vac power.

Loop 50 – ASR RTU high temperature - Monitors a dry contact from the panel temperature switch indicating loss of cooling.

Loop 81 – Measures the flow of the FAMW, records it as well as sends it to the WTP.

Loop 82 – Measures the pressure of the FAMW, records it as well as sends it to the WTP.

Loop 83 – Float switch shall activate upon water level rise in the FAMW vault.

Loop 100 - ASR well pump - Provides a dry contact digital output to the pump motor

starter to start/stop the pump, monitors a dry contact from the pump starter indicating pump running and monitors a dry contact from the pump starter indicating pump fault.

2.11 INSTRUMENT LIST

TAG NO.	COMPONENT	COMPONENT TITLE	COMPONENT OPTIONS	REMARKS
LT-1	Level Transmitter (Submersible)	ASR Water level above pump		0-170 ft of head (gauge)
CE/CIT-20	Conductivity Transmitter	Conductivity to Canal	Flow through housing	0-1,500 micros/cm
AE/AIT-21	Turbidity Transmitter	Turbidity to Canal	Flow through housing	0-100 NTU
CE/CIT-22	Conductivity Transmitter	Conductivity to WTP	Flow through housing	0-1,500 micros/cm
AE/AIT-24	Dissolved Oxygen (DO) Transmitter	DO to Canal	Flow through housing	0-10 ppm
FE-1-2	Bi-directional Venturi Flowmeter	ASR well Flow to/from WTP	Specification 15082	100" WC at full flow max flow 4,000 gpm min flow 1,400 gpm
FE-3	Venturi Flowmeter	ASR Flow to Canal		100" WC at full flow max flow 4,000 gpm min flow 1,400 gpm
FIT-1-2A	Flow Indicating Transmitter	ASR recharge flow		100" WC at full flow 0-4,000 gpm
FIT-1-2B	Flow Indicating Transmitter	ASR flow to WTP		100" WC at full flow 0-4,000 gpm
FIT-3	Flow Indicating Transmitter	ASR flow to canal		100" WC at full flow 0-4,000 gpm
PIT-29A & B	Pressure Indicating Transmitter	ASR recharge & discharge pressure		0-150 PSI
ZS-30A & B	Limit Switch (position type)	Meter vault intrusion		
ZS-31	Intrusion Switch	Panel Intrusion		

ZS-32	Limit Switch (position type)	ASR well vault intrusion		
ES-40	Loss of Power Relay	Loss of RTU Power		
TS-50	Panel Thermostat	RTU Panel Temperature High		
PI	Pressure Indicator	ASR Well Pressure		0-150 PSI
LS-10	Level Switch suspended float	ASR well vault flood		
LS-11	Level Switch suspended float	ASR meter vault flood		
FIT-81	Flow element and transmitter, electronic	FAMW flow to lift station	3 inch pipe	0-200 gpm
PIT-82	Pressure transmitter	FAMW pressure		0-20 psig
PIR-82/FIR- 81	Recorder paperless	FAMW pressure & flow		In CP FAMW recorder, provide air heat exchanger in CP with sunshields and painted two coats of white
LS-83	Level switch suspended float	FAMW vault flood		

PART 3 – EXECUTION

3.1 INSTALLATION, CALIBRATION, TESTING, START-UP AND INSTRUCTION

A. **General:** Under the supervision of the Single I&C supplier, all systems specified in this Section shall be installed, connected, calibrated and tested, and in coordination with the ENGINEER and the OWNER, shall be started to place the processes in operation. This shall include final calibration in concert with equipment specified elsewhere in these Specifications, including pumps, valves, as well as certain existing equipment.

B. **Installation and Connection:**

1. The CONTRACTOR shall install and connect all field mounted components and assemblies under the criteria imposed in Part 1.1, herein. The installation personnel shall be provided with a final reviewed copy of the Shop Drawings and

2. **Proof of Conformance** - The burden of proof of conformance to specified accuracy and performance is on the CONTRACTOR using its designated Single I&C supplier. The CONTRACTOR'S designer shall supply necessary test equipment and technical personnel if called upon to prove accuracy and/or performance, at no separate additional cost to the OWNER, wherever reasonable doubt or evidence of malfunction or poor performance may appear within the guarantee period.

D. Testing

All systems shall be exercised through operational tests in the presence of the ENGINEER in order to demonstrate achievement of the specified performance. Operational tests depend upon completion of work specified elsewhere in these Specifications. The scheduling of tests shall be coordinated by the CONTRACTOR among all parties involved so that the tests may proceed without delays or disruption by incomplete work.

1. **Factory Demonstration Tests:** Test all non-loop-specific functions including, but not limited to the following:
 - a. **Failure Mode and Backup Procedures:** Power failure, auto restart, disk backup and reload, retentive outputs.
 - b. **Communication with the computer system.**
 - c. **Programming and documentation methods and features.**

2. I/O Checkout

The CONTRACTOR is responsible for testing all I/O connections to the PLC and verifying proper contact status and scaling in the PLC. An I/O checkout sign-off sheet will be provided by the CONTRACTOR to document each point as it is tested and accepted by the OWNER.

See section 3. 2 supplements for sample "Loop Status Report" and "Functional Acceptance Test Sheet".

- E. **Start-up And Instruction:** When all systems are assessed by the CONTRACTOR to have been successfully carried through complete operational tests with a minimum of simulation, and the ENGINEER concurs in this assessment, plant start-up by the OWNER'S operating personnel can follow. For a minimum of eight (8) hours for two (2) times prior to start-up, operating and maintenance personnel shall be instructed in the functions and operation of each system and shall be shown the various adjustable and set point features which may require readjustment, resetting or checking, re-calibration or maintenance by them from time to time. This instruction shall be scheduled at a time arranged with the OWNER at least two (2) weeks in advance. Instruction shall be given by qualified persons who have been made familiar in advance with the systems. All equipment shall be checked during the first year of operation at intervals of three months for a period of not less than one day or as may be required to correct any defects to the satisfaction of the OWNER.
- F. **Modifications To Existing Facilities:** The CONTRACTOR shall make all modifications to existing equipment and control devices which are required to successfully install and

integrate all new instrumentation equipment. All costs for any required modification and rehabilitation effort shall be included in the CONTRACTOR'S original bid amount and no additional payment shall be allowed.

G. **Plant Shutdowns:** The Single I&C supplier shall carefully examine all work to be performed relative to existing I&C equipment and the installation of new equipment and control devices. Work shall be scheduled to minimize required plant shutdown times.

H. **Coordination With Other Concurrent Projects:** The single I&C supplier shall coordinate extensively with other I&C suppliers of concurrent projects. Some of the equipment shown in this contract as existing might be installed while this contract is underway.

3.2 SUPPLEMENTS

A. Supplements listed below, following "END OF SECTION" are part of this Specification.

1. Instrumentation Calibration Sheet
2. Loop Status Report
3. Functional Acceptance Test Sheet

-END OF SECTION-

INSTRUMENTATION CALIBRATION SHEET

COMPONENT CODE: _____ NAME: _____	MANUFACTURER: _____ MODEL: _____ SERIAL: _____	PROJECT NUMBER: _____ NAME: _____
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RANGE VALUE UNITS <input type="checkbox"/> INDICATE/ CHART RECORD SCALE _____ <input type="checkbox"/> TRANS/ INPUT CONVERT OUTPUT _____	<input type="checkbox"/> COMPUTE FUNCTIONS _____ _____ _____	<input type="checkbox"/> CONTROL ACTION (DIRECT/REVERSE) MODES (P/I/D) _____ <input type="checkbox"/> SWITCH UNIT RANGE (VALUE/UNITS) _____ DIFFERENTIAL (FIXED/ADJUSTABLE) _____ RESET (AUTOMATIC/MANUAL) _____
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REQUIRED			AS CALIBRATED				REQUIRED			AS CALIBRATED
IN	SCALE	OUT	SCALE	OUT	SCALE	OUT	NUMBER	TRIP PT	RESET PT	TRIP PT
C. MODE SETTINGS: P I										

	COMPONENT CALIB START-UP BY _____ DATE _____
	TAG NO. _____

SECTION 17150 - REMOTE TELEMETRY UNITS AND APPURTENANCES

PART 1 — GENERAL

1.1 GENERAL

- A. The CONTRACTOR shall furnish and install new remote Radio Telemetry equipment to operate in conjunction with the existing WTP #9 well telemetry system, as specified and as shown on the Contract Documents. It is the intent of these specifications to have a single SUBCONTRACTOR be responsible for all hardware, software, system integration, programming, testing, and startup.
- B. All remote telemetry units shall be of first class workmanship and shall be entirely designed and suitable for outdoor services. All materials used in fabricating of the equipment shall be new and undamaged.
- C. Before submitting a bid, visit the site and determine conditions at the site and at all existing structures in order to become familiar with all existing conditions and instrumentation and control systems which will, in any way or manner, affect the work required under this Contract. No subsequent increase in Contract cost will be allowed for additional work required because of the CONTRACTOR's failure to fulfill this requirement.
- D. The contractor, as part of this contract is required to provide a radio survey (see Paragraph 2.3.D of this specification).

1.2 SUBMITTALS

- A. General: Prior to release for fabrication, the Vendor shall submit for approval shop drawings and Operation and Maintenance instructions and other information for all equipment proposed.
- B. Operations and Maintenance Manuals: The Vendor shall submit operation and maintenance manuals for all equipment proposed.
- C. The contractor shall perform a radio survey at all sites to verify a proper communication path with the existing master telemetry radio station and submit certified results.

1.3 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. All equipment parts shall be properly protected in accordance with manufacturer requirements so that no damage or deterioration will occur.
- B. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the OWNER.
- C. Each box or package shall be properly marked to show its net weight in addition to its contents.

PART 2 — PRODUCTS

2.1 REMOTE TELEMETRY UNITS AND APPURTENANCES

- A. The Remote Telemetry Units shall be microprocessor based, user programmable, Programmable Logic Controllers (PLCs) which shall serve as an interface to accumulate, process, transmit and receive discrete and analog status and control messages between the RTU base stations and the remote RTU sites.
- B. Each RTU shall be PLC based, with sufficient battery backed RAM, and EEPROM non volatile backup memories to provide all discrete and analog status, monitoring and control functions and shall be designed to operate in an outdoor industrial environment.
- C. The Programmable Logic Controller (PLC) shall be designed to operate in an industrial environment. The PLC shall be capable of operation in an ambient temperature range of 0° -60°C and a relative humidity of 5-95 percent, non-condensing. The PLC shall be capable of operation on supply voltages of 24VDC.
- D. All components of the PLC system shall be of the same manufacturer who is regularly engaged in the manufacture of programmable controllers. The manufacturer shall have fully tested units similar to that being furnished in an industrial environment with associated electrical noise. The processing unit shall perform the operations functionally described herein based on the program stored in memory and the status of the inputs and outputs.
- E. LED-type indicating lights shall be provided as follows: READY, RUN, BATTERY LOW, MODBUS, MODBUS Plus.
- F. Programmable controllers and accessory equipment shall be **Modicon Model 984-145**, unless otherwise noted.
- G. All RTU's shall be powered with 115 VAC through a power supply capable of float charging sealed Gel-Cell batteries and shall include an AC power monitor with alarm output to the RTU on loss of AC power. Power supply shall be of sufficient capacity to provide all required DC power to all RTU equipment, discrete and analog input/output circuitry, under full load, communications interface equipment, RF modems, radios, and other radio interface/conditioning equipment and appurtenances, as required. Batteries shall be sized to provide a minimum of 30 minutes of full load backup in the event of AC power loss.
- H. Input/output modules shall be configured for ease of wiring and maintenance. The modules shall be connected to wiring arms (fanning strips) which are moveable to permit removal of a module without disturbing field wiring. Covers shall be provided to prevent operator personnel from inadvertently touching the terminals.
- I. Input/output modules shall be plug-in type in associated I/O rack assemblies and shall have individual indicators that show the on/off status of each input or output device connected to it. Each unit shall be capable of handling the required number of process inputs and outputs plus ten percent active spares. All inputs and outputs (both discrete and analog) shall be separately fused and furnished with lightning surge protection devices.
 1. Digital inputs shall be 24VDC from field dry contacts. Individual inputs shall be optically isolated from system bus or other I/O Modules. The modules shall have

LED's to indicate status of each discrete input. The input module shall have a minimum of 16 points each. The discrete input modules shall be **Modicon BDEP-216**.

2. Digital outputs shall be 24-110 VDC/24-250 VAC relay contacts from the PLC. The modules shall have LED's to indicate status of each discrete output and shall have a minimum of 8 independent points each and shall be **Modicon BDAP-208**.
3. Analog input circuits shall be isolated, 12-bit resolution type. Analog input hardware shall be provided as required for all types of analog inputs being transmitted to the PLC. The analog input modules shall have a minimum of 4 points each and shall be **Modicon BADU-205**.
4. Analog outputs shall be coordinated with the receivers but shall generally be isolated 24V 4-20 mA outputs powered from the PLC. Each input/output circuit shall have optical isolation to protect the equipment against high voltage transients. Optical isolation shall be rated at not less than 1500 V RMS. Lightning/surge protection shall be provided on all inputs and outputs to the PLC. The analog output modules shall have a minimum of 2 points each and shall be **Modicon BDAU-202**. No analog output modules are required.

J. Programming software shall be Modsoft Lite as supplied by Modicon.

2.2 RTU COMMUNICATIONS INTERFACE

- A. Bi-directional communications of status, commands and radio diagnostic between the RTU's and the RTU base station shall be provided by the RTU communications interface subsystem. The PLC Modbus serial interface port shall serve as the RTU communications interface. The data transmission rate shall be (asynchronous).
- B. The RTU communications interface shall control the modem during the polling sequence. It shall be possible to assign a basic address to each RTU through the data interface. The addressing scheme shall allow a minimum of 254 RTUs for each data link. The communications protocol for narrow band radios shall be master-slave **Modbus RTU**, no exceptions.

2.3 RTU SPREAD SPECTRUM RADIO SECTION AND APPURTENANCES

- A. The radio section shall consist of a Microwave Data Systems Model 9810 set with RS-232 asynchronous serial interface and cable and time out to inhibit communications lockup. Radio transceiver shall include automatic frequency, control, loopback and SMART diagnostics remote maintenance module to monitor: power out, RSSI, voltage level, internal temperature and forward/reflected power. Radio enclosure shall include RF shield.
- B. Remote terminal unit antenna shall be heavy duty pole mounted directional type furnished with the necessary length of low loss coaxial antenna cable, line adapter, lightning protector and appurtenances. Antenna and accessories shall be as manufactured by **Decibel Products**, or equal. Minimum antenna height shall be 12 feet above grade.
- C. The complete communications subsystem including all interconnecting cables shall contain lightning, surge and transient protection.

- D The contractor shall perform a radio survey at all sites to verify a proper communication path and submit results during shop drawing submittal process. Any proposed modifications to the system communication as a result of the radio survey resulting in changes to antenna locations must be brought to the attention of the engineers prior to modification of the present design requirements. It is the contractors ultimate responsibility for the proper location and application of communication equipment.
- E. Spare radios are required to be installed in all RTU panels. These spare radios are not to be wired and sufficient cable lengths for battery, communication and antenna shall be provided to allow connection of the spare radio without tools or equipment movement. Spare radios shall be pre-programmed for the RTU location address where installed.

2.4 PANELS

- A. Panels for all RTU's shall be thermal insulated 316 stainless steel NEMA 3R weatherproof construction with white epoxy exterior finish. All doors shall be fitted with common keyed locks.
- B. Panels shall be 11 USS gauge with overall dimensions of 24-inches long by 24-inches wide by 12-inches depth (minimum).
- C. The panels shall be constructed so that no screws or bolt heads are visible when viewed from the front. Punch cut-outs for instruments and other devices shall be cut, punched, or drilled and smoothly finished with rouged edges.
- D. The temperature inside each enclosure containing an RTU shall be continuously monitored and shall generate an alarm input to the associated RTU input-output subsystem if the temperature rises to an adjustable, preset high temperature. A tamper switch shall be included to report the status of the access door to the associated RTU input/output subsystem.
- E. Enclosures shall be furnished with integral grounded RFI shielding.
- F. All panels shall be constructed to UL 508A and be labeled accordingly.

2.5 HILLSBORO ASR WELL AND WATER TREATMENT PLANT 9S CONTROL SYSTEM INTERFACE PROGRAMMING

- A. The interface to the existing Water Treatment Plant 9S Control system is not shown on the project drawings. Programming of the plant control system for control of the ASR well is a part of this project and will be completed as part of this project. See specification 17100 section 2.09 for a description of the requirements broken down as follows:
 - 1. The ASR PLC programming
 - 2. Master PLC programming located at WTP 9S
 - 3. MMI programming located at WTP 9S.
- B. The ASR PLC and modifications in Hillsboro Canal West RTU/PLC shall be programmed by C.C.Control Corp.. This PLC will communicate with a master PLC at the Water Treatment Plant 9S, and this master PLC is connected to a MMI.

- C. The master PLC will perform all the register mapping from the ASR and Hillsboro Canal West RTU/PIC. C.C.Control Corp. shall obtain the services of U.S. Filter to perform all the work associated with the master PLC as part of their bid price.
- D. C.C.Control Corp. shall obtain the services of Hillers Electrical Engineering, Inc. to perform all the work associated with the MMI as part of their bid price.

The contractor shall include, as part of their bid, time to attend two coordination meetings.

2.6 CORROSION PROTECTION

- A. All indoor and outdoor panels shall be fitted with vapor phase corrosion inhibitor capsules; **ZERUST Model VC-6-2**, or equal. Capsules shall be labeled with the date of activation. Six spare capsules shall be furnished.

2.7 TVSS

- A. See specification section 17100 for TVSS specifications.

PART 3 — EXECUTION

3.1 GENERAL

- A. The CONTRACTOR shall furnish the services of a factory trained Engineer to check the complete installation and to make all necessary adjustments for satisfactory operation of the new RTUs. The CONTRACTOR shall demonstrate the operation of the new RTUs, and shall include an additional 40 hours of programming as part of their bid in excess of the normal contract requirements.
- B. The CONTRACTOR shall program the PLCs. The CONTRACTOR shall provide services to demonstrate the operation of the new PLC programs and communication with the central station.
- C. The CONTRACTOR shall furnish the following spare parts:
 - 1. Two surge suppressor/arresters of each type
 - 2. One spare PLC of each type
 - 3. One spare radio of each type
 - 4. One spare antenna of each type
 - 5. One spare power supply
- D. The CONTRACTOR shall furnish the OWNER a complete set of operation and maintenance manuals and Drawings.
- E. Cabinets and panels shall provide mounting for power supplies, control equipment, input/output subsystems, panel mounted equipment and appurtenances. Ample space shall be provided between equipment to facilitate servicing and cooling.
- F. Terminal blocks shall be factory assembled on a miniature mounting channel and the channel bolted to the steel strap. Terminals shall be miniature screw type unless otherwise required and shall be rated at least 300 volts, 20A, **Square D type G**, or equal.

- G. The terminals shall be marked vertically with a permanent, continuous marking strip from top to bottom. One side of each terminal strip shall be reserved exclusively for field incoming conductors. common connections and jumpers required to internal wiring shall not be made on the field side of the terminal. Subject to the approval of the OWNER, a vendor's pre-engineered and prefabricated wiring termination system will be acceptable.
- H. Wiring shall comply with accepted standard instrumentation and electrical practices and codes. For each pair of parallel terminal blocks, the field wiring shall be between the blocks. solderless horseshoe (spade) connectors, with insulating sleeves, shall be used for connecting wires to terminal blocks.
- I. All wiring shall be bundled and run open or enclosed in vented plastic wireway, as required. All conductors run open shall be bundled and bound at regular intervals, not exceeding 12 inches, with nylon cable ties. Care shall be taken to separate electronic signal, discrete signal, and power wiring. A copper ground bus shall be installed the full length of each panel. Interior panel wiring and field wiring shall be tagged at all terminations with machine-printed plastic sleeves. The wire number shall be the ID number listed in the input/output schedules.
- J. Wires shall be color coded as follows:
- Neutral - White
 - Ground - Green
 - Power - Red
 - Signal - Black and White
 - Control - Violet
 - Special - Blue
- K. Panels shall be provided with a main circuit breaker and circuit breaker on each individual branch circuit distributed from the panel. Main breaker and branch breaker sizes shall be coordinated such that a fault in a branch circuit will trip only the branch breaker but not the main breaker.
- L. Panels shall be provided with 120 volt duplex receptacles for service equipment. Provide separate 120 volt feeder circuit complete with circuit breaker and on/off switch.
- M. Panels shall be furnished with red laminated plastic warning signs in each section. The sign shall be inscribed "WARNING - This Device is Connected To Multiple Sources Of Power". Letters shall be 1-inch high, white.
- N. Equipment shall be mounted on a 21-inch by 21-inch removable sub panel (backplate) to permit withdrawal of the equipment for maintenance or adjustment. Panels shall be designed to permit front access for all service and removal of equipment. The interconnection between equipment and panel shall be by means of flexible cables provided to permit withdrawal of the equipment from the cabinet without disconnecting the plugs.

-END OF SECTION-