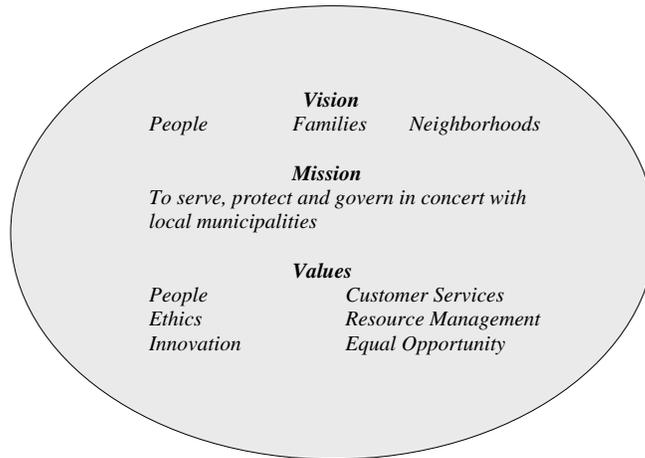




FULTON COUNTY



REQUEST FOR PROPOSAL NO. 07RFP57405K-RS

BIG CREEK WATER RECLAMATION FACILITY MEMBRANE SYSTEM TECHNOLOGY REQUEST FOR PROPOSALS

For

PUBLIC WORKS

RFP DUE DATE AND TIME: September 24, 2007 11:00 A.M.

RFP ISSUANCE DATE: August 15, 2007

PURCHASING CONTACT: Rholanda Stanberry (404) 730-4200

E-MAIL: rholanda.stanberry@fultoncountyga.gov

LOCATION: FULTON COUNTY DEPARTMENT OF PURCHASING &

CONTRACT COMPLIANCE

130 PEACHTREE STREET, S.W., SUITE 1168

ATLANTA, GA 30303

**07RFP57405K-RS - BIG CREEK WRF MEMBRANE SYSTEM
TECHNOLOGY REQUEST FOR PROPOSALS
TABLE OF CONTENTS**

Section/Page

SECTIONS 1-9

1.0	INTRODUCTION	1-1
1.1	Purpose	1-1
1.2	Project Description	1-2
1.3	County Objectives	1-2
1.4	Purchasing the RFP	1-3
1.5	Pre-Proposal Conference	1-3
1.6	Proposal Due Date	1-3
1.7	Delivery Requirements	1-4
1.8	Contact Person and Inquiries	1-4
2.0	INSTRUCTIONS TO PROPOSERS	2-1
2.1	Procurement Process	2-1
2.2	Definitions.....	2-2
2.3	No Contact During Procurement Process.....	2-18
2.4	Clarification & Addenda	2-19
2.5	Required Submittals	2-20
2.6	Proposal Evaluation.....	2-20
2.7	Disqualification of Proposers	2-20
2.8	Reserved Rights	2-20
2.9	Applicable Laws	2-21
2.10	Minimum Participation Requirements for Prime Contractors	2-21
2.11	Insurance and Risk Management Provisions	2-21
2.12	Accuracy of RFP and Related Documents	2-21
2.13	Responsibility of Proposer	2-22
2.14	Confidential Information.....	2-22
2.15	County Rights and Options.....	2-22
2.16	Cost of Proposal Preparation and Selection Process	2-24
2.17	Termination of Negotiation	2-24
2.18	Wage Clause.....	2-25
2.19	Additional or Supplemental Information.....	2-25
2.20	Georgia Security and Immigration Compliance Act	2-25
2.21	Technology RFP General Requirements.....	2-26
3.0	PROPOSAL REQUIREMENTS	3-1
3.1	Submission Requirements.....	3-1
	3.1.1 Proposal Submission Date and Submittal Format	3-1
	3.1.2 Number of Copies.....	3-2
3.2	Overview of Proposal Requirements	3-2
3.3	Scope of Work.....	3-2
3.4	Technical Proposal Format and Content	3-2

**07RFP57405K-RS - BIG CREEK WRF MEMBRANE SYSTEM
TECHNOLOGY REQUEST FOR PROPOSALS
TABLE OF CONTENTS**

		Section/Page
	3.5 Cost Proposal Format and Content	3-11
4.0	EVALUATION CRITERIA	4-1
4.1	Proposal Evaluation - Overview	4-1
4.2	Evaluation Criteria	4-1
4.2.1	Technical Proposal Evaluation.....	4-1
4.2.2	Cost Proposal Evaluation	4-3
5.0	PROPOSAL FORMS	5-1
5.1	Introduction.....	5-1
5.2	Technical Proposal Forms Description	5-2
5.2.1	Certification Regarding Debarment.....	5-2
5.2.2	Non-Collusion Affidavit of Bidder/Offeror	5-2
5.2.3	Certificate of Acceptance of Technical RFP	5-2
5.2.4	Disclosure Form and Questionnaire	5-2
5.2.5	Declaration of Employee-Number Categories.....	5-2
5.2.6	Georgia Security and Immigration Contractor Affidavit/Agreement	5-2
5.2.7	Georgia Security and Immigration Subcontractor Affidavit	5-3
5.2.8	Proposal Transmittal Letter.....	5-3
5.2.9	Membrane System.....	5-3
5.2.10	Equipment and Systems	5-3
5.2.11	Disclaimer Statement.....	5-4
5.2.12	Information Certification	5-4
5.2.13	Technical Requirements Certification	5-4
5.2.14	Royalty and License Fees	5-4
5.3	Cost Proposal Forms Description	5-4
5.3.1	Fixed Membrane System Price.....	5-5
5.3.2	Maximum Power Consumption	5-5
5.3.3	Maximum Chemical Usage	5-5
5.3.4	Guaranteed Membrane Life and Guaranteed Membrane Replacement Cost	5-5
Forms Included at End of This Section		
6.0	CONTRACT COMPLIANCE REQUIREMENTS	6-1
6.1	Non-Discrimination in Contracting and Procurement.....	6-1
6.2	Required Forms and EBO Plan	6-3
	Exhibit A - Promise of Non-Discrimination	
	Exhibit B – Employment Report	
	Exhibit C – Schedule of Intended Subcontractor Utilization	
	Exhibit D – Letter of Intent to Perform as a Subcontractor or Provide Materials or Service	

**07RFP57405K-RS - BIG CREEK WRF MEMBRANE SYSTEM
TECHNOLOGY REQUEST FOR PROPOSALS
TABLE OF CONTENTS**

Section/Page

	Exhibit E – Declaration Regarding Subcontracting Practices	
	Exhibit F – Joint Venture Affidavit	
	Exhibit G – Prime Contractor/Subcontractor Utilization Report	
7.0	INSURANCE AND RISK MANAGEMENT PROVISIONS	7-1
8.0	EXHIBITS	8-1
	Exhibit 1 – Sample Construction Contract for Contractor Awarded the Construction Project	
	Exhibit 2 – Required Submittal Checklist	
9.0	APPENDICES	9-1
	Appendix 1 – Technical Requirements (Includes Attachment 1)	A1-1
	Appendix 2 – Minimum Technical Specifications	A2-1

SECTION 1 INTRODUCTION

1.1 PURPOSE

Fulton County, Georgia (“County”) is planning to upgrade and expand the Big Creek Water Reclamation Facility (WRF). The Big Creek WRF will be constructed as a traditional design/bid/build project. The Big Creek WRF is located at 1030 Marietta Highway, Roswell, Georgia. The plant will be expanded to treat the maximum 30-day average flow rate of 38 million gallons per day (MGD).

Through the issuance of this Technology Request For Proposals (“RFP”), the County is soliciting Proposals from qualified Proposers to select a Membrane System, which will be part of the membrane bioreactor (MBR) treatment train at the Big Creek WRF.

Proposals provided in response to this Technology RFP that comply with the submittal requirements set forth in Section 3.0, including all forms and certifications, will be evaluated in accordance with the criteria and procedures described in Section 4.0. Based on the results of the evaluation, the County will select a Membrane System Supplier.

Following selection of the Membrane System Supplier, the final Proposal will be included as part of the Bidding Documents for the Construction Project, which will be prepared by the Engineer.

The Membrane System Supplier will be required to guarantee that it will enter into a subcontract with the Contractor for the Construction Project that contains all the terms and conditions of its’ final Proposal to the County. This guarantee will be secured by the Membrane System Supplier Proposal Security.

It is anticipated that the Construction Contract will be awarded to a Contractor on or about January 2009. A sample construction contract for the Contractor awarded the Construction Project is included as Exhibit 1.

The potential respondents to this Technology RFP should carefully review this document and other materials provided in their entirety to ensure a clear understanding of the County’s needs, objectives, and work scope.

1.2 PROJECT DESCRIPTION

The County, by this Technology RFP, intends to pre-select one Membrane System Supplier to provide equipment, accessories, and other named services as described herein.

The Membrane System design and construction will be implemented in three phases:

Phase 1: The Membrane System Supplier will be selected via this Technology RFP.

Phase 2: The selected Membrane System Supplier will prepare equipment shop drawing documents for the County's review and approval, which will be utilized by the Engineer in the preparation of the Bidding Documents for the Construction Project.

Phase 3: When the Construction Project is bid, the Fixed Membrane System Price, delivery schedule, warranty and other terms and conditions of the selected Membrane System Supplier's final Proposal will be included in the Bidding Documents for the Construction Project with the Fixed Membrane System Price being stipulated as a separate Bid Item in the Fixed Construction Contract Price. The successful bidder of the Construction Project, the Contractor, will be required to enter into a subcontract with the selected Membrane System Supplier consistent with the terms and conditions of the Membrane System Supplier's final Proposal and the Fixed Membrane System Price. The County shall have no contractual relationship with the selected Membrane System Supplier and will look solely to the Contractor for all aspects of the Construction Project. The Contractor will be required to utilize the selected Membrane System Supplier's Scope of Supply in the Construction Project.

1.3 COUNTY OBJECTIVES

In selecting the Membrane System Supplier for the Big Creek WRF Upgrade and Expansion Project, the County seeks to accomplish the following goals and objectives:

1. Select the most advantageous Membrane System to the County for the Big Creek WRF.
2. Reliably meet NPDES Permit effluent limits for discharge to the Chattahoochee River with flexibility to meet more stringent effluent limits in the future.

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3. Construct a facility that will be amenable to safe, effective, flexible and reliable operation by the County or its contract operator at a reasonable cost in compliance with Applicable Law.
 4. Obtain long-term performance, reliability, and flexibility from the Plant, which will allow improved and upgraded services.
 5. Provide compatibility with the State and Regional objectives, such as those outlined in the Chattahoochee River Basin Management Plan and by the North Georgia Metropolitan Water Planning District.

This Technology RFP will assist the County to meet these objectives by selecting the Membrane System Supplier in advance of completing the Bidding Documents for the Construction Project. Proposers must submit a Proposal in accordance with the requirements set forth in the Technology RFP. THE PROPOSAL MUST INCLUDE A FIXED MEMBRANE SYSTEM PRICE for the Membrane System that satisfies all requirements of this Technology RFP.

1.4 PURCHASING THE RFP

This document and supporting documents can be downloaded at the Fulton County Website, <http://www.fultoncountyga.gov> under "Bid Opportunities".

Figure A1-5, Site Layout Plan is available on CD and can be obtained by contacting Rholanda Stanberry, Chief Assistant Purchasing Agent at (404) 730-4200 or by email at rhollanda.stanberry@fultoncountyga.gov

1.5 PRE-PROPOSAL CONFERENCE

The County will hold a Pre-Proposal Conference, on **August 27, 2007 at 10:00 A.M.** in the Bid Conference Room of the Department of Purchasing and Contract Compliance, Fulton County Public Safety Building, Suite 1168, 130 Peachtree Street, S.W., Atlanta, Georgia 30303. Attendance at the Pre-Proposal Conference is voluntary for responding to this Technology RFP, however Proposers are encouraged to attend. The purpose of the Pre-Proposal Conference is to provide information regarding the Project and to address any questions and concerns regarding the services sought by the County through this Technology RFP.

1.6 PROPOSAL DUE DATE

All Proposals are due in the Department of Purchasing and Contract Compliance of Fulton County located in the Public Safety Building, Suite 1168, 130 Peachtree St, S.W., Atlanta Georgia 30303 on or before **September 24, 2007 at 11:00 A.M.** legal

prevailing time. All submitted Proposals will be time and date stamped according to the clock at the front desk of the Fulton County Department of Purchasing and Contract Compliance. Any Proposals received after this appointed schedule will be considered late and subject to be returned unopened to the Proposer. The proposal due date can be changed only by addendum.

1.7 DELIVERY REQUIREMENTS

Any Proposal received after the above stipulated due date and time will not be considered and will be rejected and returned. It shall be the sole responsibility of the Proposer to have his/her Proposal delivered to the Fulton County Department of Purchasing and Contract Compliance for receipt on or before the above stipulated due date and time. If a Proposal is sent by U.S. Mail, the Proposer shall be responsible for its timely delivery to the Department of Purchasing and Contract Compliance.

1.8 CONTACT PERSON AND INQUIRIES

Any questions or suggestions regarding this Technology RFP should be submitted in writing to the following Purchasing Department contact person:

Ms. Rholanda Stanberry, Chief Purchasing Agent
Department of Purchasing and Contract Compliance
Fulton County Public Safety Building, Suite 1168
130 Peachtree St, S.W., Atlanta Georgia 30303
(404) 730-4200
rholanda.stanberry@fultoncountyga.gov

Any response made by the County will be provided in writing to all Proposers by addendum. No verbal responses shall be authoritative.

SECTION 2 INSTRUCTIONS TO PROPOSERS

2.1 PROCUREMENT PROCESS

The County is planning to upgrade and expand the Big Creek WRF. The Big Creek WRF will be constructed as a traditional design/bid/build project. The County, by this Technology RFP, intends to pre-select one Membrane System Supplier to provide equipment, accessories, and other named services, as described herein. The Proposer selected by this Technology RFP will be required to enter into a subcontract with the Contractor of the Construction Project.

The pre-selection will be on a formally advertised basis. All technical requirements, unless otherwise specified, must be met, or be capable of being met by the Proposer or their Proposal will be disqualified as being non-responsive.

The Membrane System Supplier pre-selection process generally consists of the following steps:

1. Technology RFP issuance.
2. Pre-proposal meeting.
3. Technology RFP clarification process.
4. Proposal development and submittal.
5. Proposal evaluation process during which Proposals are identified as responsive or non-responsive.
6. Clarification of Proposals and possible interviews and site visits.
7. Identification of Proposals reasonably susceptible for selection.
8. Possible negotiation with those Proposers who have submitted Proposals deemed to be reasonably susceptible for selection.
9. Evaluation of Proposals using the Evaluation Criteria.
10. Notice of Selection to the responsive and responsible Proposer whose Proposal is determined to be the most advantageous to the County, based on the Evaluation Criteria set forth in this Technology RFP.

2.2 DEFINITIONS

In addition to any other terms that may be defined in this solicitation, the following terms have the following meaning:

Acceptance Date	The date, which is the number of days that the Contractor guarantees to have achieved Acceptance.
Acceptance Date Conditions	Has the meaning specified in the Construction Contract.
Acceptance Test Procedures and Standards	Those test procedures and standards that the Contractor must undertake and meet in order to achieve the County's Acceptance of the Work,
Acceptance Testing Plan	The plan prepared by the Contractor to address the details of required acceptance testing specified in the Construction Contract.
Acceptance Testing Report	The certified written report that the Contractor shall furnish describing and certifying the Acceptance Testing Plan has been executed and the results of the Acceptance Tests.
Addendum	Revision to the Technology RFP documents issued by the County prior to the receipt of Proposals.
Advertisement Date	The date the Construction Project is formally advertised for bidding.
Agreement	Refers to the executed Contract between the County and Contracting Entity.
Appendix	Any of the documents attached to this Technology RFP or the Bidding Documents and thereby incorporated into the Construction Contract, as applicable and so designated as an "Appendix", including any and all exhibits and appendices, all of which may be amended or modified from time to time in accordance with the Construction Contract as applicable, and Applicable Laws.

Applicable Law	<p>Applicable Law means:</p> <ol style="list-style-type: none"> (1) any federal, State of Georgia, Fulton County or local law, code, regulation, consent order or agreement; (2) any formally adopted and generally applicable rule, requirement, determination, standard, policy, implementation schedule, consent order or agreement or other order of any Governmental Body having appropriate jurisdiction; (3) any established interpretation of law or regulation utilized by an appropriate regulatory Governmental Body if such interpretation is documented by such regulatory body ; and (4) any Governmental Approval, in each case having the force of law from time to time: <ol style="list-style-type: none"> (a) to the siting, design, acquisition, construction, equipping, financing, ownership, possession, start-up, testing, operation, maintenance, repair, replacement, or management of municipal wastewater treatment systems; (b) to the conveyance, treatment, storage, or discharge of the Influent or the Effluent; (c) to the air and odor emissions from municipal wastewater treatment systems; and (d) to the transfer, handling, processing transportation or disposal of Sludge and Residuals.
Approved	<p>Where used in conjunction with the County’s response to submittals, requests, applications, inquiries, reports and claims by the Contractor, the meaning of the term “approved” shall be held to limitations of the County’s responsibilities and duties as described herein. In no case shall “approval” be interpreted as a release of the Contractor from responsibilities to fulfill the requirements of the Construction Contract.</p>
Award Date	<p>The date listed in the Notice of Award to the apparent successful Contractor.</p>
Bankruptcy Code	<p>Means the United States Bankruptcy Code (11 U.S.C. §101, et seq.), as amended from time to time and any successor statute thereto. "Bankruptcy Code" shall also include any similar state law relating to bankruptcy, insolvency, the rights and remedies of creditors, the appointment of receivers or</p>

the liquidation of companies and estates that are unable to pay their debts when due.

Bidding Documents The entire and integrated document including bidding requirements, general requirements, contract requirements, technical specifications, appendices, and drawings advertised for bids from prospective contractors for the Construction Project.

Big Creek Water Reclamation Facility (BCWRF) or New Plant The upgraded and expanded County-owned water reclamation facilities to be constructed as part of the Construction Project to serve the Big Creek Service Area of North Fulton County, Georgia that will discharge effluent into the Chattahoochee River.

Billing Period Means each calendar month, except that (1) the first Billing Period shall begin on the Construction Contract Date and shall continue to the last day of the month in which the Construction Contract Date occurs and (2) the last Billing Period shall end on the last day of the Term of the Construction Contract.

CERCLA Means the Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. §9601 et seq., and the applicable regulations promulgated thereunder, each as amended or superseded from time to time.

Change in Law Means any of the following acts, events or circumstances to the extent that compliance therewith materially increases the cost of performing, or materially increases the scope, of a party's obligations hereunder:

- (a) the adoption, amendment, promulgation, issuance, modification, repeal or written change in administrative or judicial interpretation of any Applicable Law on or after the Contract Date, unless such Applicable Law was on or prior to the Contract Date duly proposed and published in the Federal Register or was adopted, promulgated, issued or otherwise officially modified or changed in interpretation, in each case in final form, to become effective without any further action by any Governmental Body;
- (b) the order or judgment of any Governmental Body

issued on or after the Contract Date (unless such order or judgment is issued to enforce compliance with Applicable Law which was effective as of the Contract Date) to the extent such order or judgment is not the result of willful or negligent action, breach of the Construction Contract, violation of law, illegal act, error or omission or lack of reasonable diligence of the Contractor or of the County, whichever is asserting the occurrence of a Change in Law; provided, however, that the contesting in good faith or the failure in good faith to contest any such order or judgment shall not constitute or be construed as such a willful or negligent action, error or omission or lack of reasonable diligence;

- (c) except with respect to any Governmental Approval required for the construction of the Construction Project as provided in item (ii) below pertaining to exclusions from "Change in Law", the denial of an application for, a delay in the review, issuance or renewal of, or the suspension, termination, or interruption of any Governmental Approval, or the imposition of a term, condition or requirement which is more stringent or burdensome than the Contract Standards in connection with the issuance, renewal or failure of issuance or renewal of any Governmental Approval, to the extent that such occurrence is not the result of willful or negligent action, breach of this Construction Contract, violation of law, illegal act, error or omission or a lack of reasonable diligence of the Contractor or of the County, whichever is asserting the occurrence of a Change in Law; provided, however, that the contesting in good faith or the failure in good faith to contest any such occurrence shall not be construed as such a willful or negligent action or lack of reasonable diligence. It is specifically understood, however, that none of the following shall constitute a "Change in Law":
- (i) a change in the nature or severity of the actions typically taken by a Governmental Body to enforce compliance with Applicable Law which was effective as of the Contract Date;
 - (ii) all matters directly relating to obtaining and maintaining EPA, EPD or local Governmental Approvals of the design, construction and

operation of the Construction Project, including any delay, non-issuance or imposition of terms and conditions upon the issuance or renewal of any Governmental Approval necessary in connection therewith, or the entry of an amended or replacement administrative order relating thereto;

- (iii) any action by a Governmental Body or any other event that affects generally applicable working conditions or standards that is not specific to the wastewater treatment industry or to the New Plant, and that does not require a Capital Modification in order to effectuate compliance therewith; and
- (iv) any action by a Governmental Body relating to sales or use taxes including the imposition or increase in any such taxes.

Change Order	A written order approved by the County and signed by the County's Contract Representative authorizing and approving a change to the scope of services. The change order must be processed pursuant to Fulton County policy and procedure 800-6, which is incorporated herein as if fully set forth herein, and shall be valid and binding on the County only where the change is approved by the County as set forth in policy 800-6. Should there be a conflict between any provisions in the Construction Contract and policy 800-6, Fulton County Policy and Procedures 800-6 shall take precedence and govern.
Competitive Sealed Bidding	A method of soliciting public works construction contracts whereby the award is based upon the lowest, responsive, responsible bid.
Competitive Sealed Proposals	A method of soliciting public works contracts whereby the award is based upon criteria identified in a request for proposals.
Complete	That the Work is 100% done and accepted by the County, including the punch list.

Construction Contract	The entire and integrated agreement (including drawings, specifications, appendices, and all addenda) between the County and the Contractor concerning the Construction Project.
Construction Contract Bid Bond	Surety in penal sum of 5% of Fixed Construction Contract Price submitted with each bid to the County, that the Contractor will forfeit to County should it fail to enter into a subcontract with the Membrane System Supplier within two months of Construction Contract Date consistent with the terms and conditions of the Membrane System Suppliers final Proposal and the Fixed Membrane System Price, along with the other conditions for forfeiting contained in the Bidding Documents.
Construction Contract Date	The date that the Construction Contract has been executed by the County and the Contractor.
Construction Cost Index or CCI	Construction Cost Index as published by the Engineering News Record.
Construction Period	Means the period from and including the Construction Contract Date to and including the day preceding the Acceptance Date.
Construction Project	The Construction Work necessary for the Contractor to meet the obligations of the Construction Contract to construct the New Plant and upgrade the Existing Plant for the expansion of the Big Creek WRF to a Design Flow of 38 mgd.
Construction Schedule	A detailed plan for completion of the Construction Project in compliance with the Construction Contract and specified activities and any interim milestones.
Construction Work	The employment and furnishing of all labor, materials, equipment, supplies, tools, scaffolding, transportation, insurance, temporary facilities, and other things and services of every kind whatsoever necessary for the full performance and completion of the Construction Project's construction, management, start-up, training, equipment testing, acceptance testing, and related obligations with respect to the Construction Project. A reference to Construction Work shall mean any part and all of the Construction Work unless the context otherwise requires, and shall include all extra

	Construction Work authorized by Change Order.
Contact Person	Purchasing staff designated by the Fulton County Department of Purchasing and Contract Compliance to submit any questions and suggestions to.
Contract Representative	In the case of the Contractor, the individual specified in writing by the Contractor as the representative of the Contractor for all purposes of the Construction Contract and, in the case of the County, the Director of Public Works or such other representative as shall be designated in writing by the County from time to time.
Contract Standards	The most stringent of the standards, terms, conditions, methods, techniques and practices imposed and required by: (1) Applicable Law; (2) the Minimum Technical Requirements; (3) the Effluent Requirements; (4) Good Engineering and Construction Practice; (5) Good Industry Practice; (6) applicable equipment manufacturers specifications; (7) applicable Insurance Requirements; and (8) any other standard, term, condition or requirement specifically provided in the Construction Contract to be observed by the Contractor.
Contractor	The selected Bidder with whom the County executes the Construction Contract.
Contractor Fault	Means any breach (including the untruth or breach of any Contractor representation or warranty herein set forth), failure, nonperformance or noncompliance by the Contractor with respect to its obligations under this Construction Contract to the extent not directly attributable to any Uncontrollable Circumstance or County Fault, and which materially and adversely affects the County's rights or obligations under the Construction Contract.
Cost Proposal	The section of the Proposal that includes all cost information in accordance with the Technology RFP and which is to be submitted separately from the Technical Proposal.
County	Fulton County, Georgia.

County Fault	Means any breach (including the untruth or breach of any County representation or warranty herein set forth), failure, nonperformance or noncompliance by the County with respect to its obligations under this Construction Contract to the extent not directly attributable to any Uncontrollable Circumstance or Contractor Fault, and which materially and adversely affects the Contractor's rights, obligations or ability or costs to perform under this Construction Contract.
County Property	Means any structures, improvements, equipment, fire alarm systems, wastewater and water mains, valves, pumping systems, hydrants, hydrant connections, duct lines, streets, lamps, lampposts, monuments, sidewalks, curbs, trees or any other systems, fixtures, or real or personal property owned, leased, operated, maintained, or occupied by the County.
CPI	Consumer Price Index for All Urban Consumers (CPI-U), Atlanta, GA, Metropolitan Area (as published monthly by the Department of Commerce, Bureau of Labor Statistics, Chicago, IL).
Data CD-ROM	A CD-ROM included with the Technology RFP that was developed by the County to provide Proposers with any data relating to the Construction Project.
Definitions	The list defining terms applicable to the Technology RFP and upon which the Construction Contract is based.
Design Flow	The average daily flow during the maximum month.
Draft NPDES Permit	Draft NPDES Permit No. GA0024333 to be issued by EPD for the operation of the New Plant.
Effluent	Wastewater discharged from the Existing Plant or the New Plant.
Effluent Requirements	The most stringent of the requirements pertaining to the discharge of Effluent specified in the Technology RFP.
Emergency	Any situation resulting in imminent danger to the public health or safety or the loss of an essential governmental service.

Emergency Response Plan	The plan prepared by the Contractor to serve as a guide in responding to emergency situations as defined in the Construction Contract.
Encumbrance	Any lien, lease, mortgage, security interest, charge, judgment, judicial award, attachment or encumbrance of any kind with respect to the Construction Project.
Engineer or Design Consultant	The engineering firm or joint venture partnership under contract by the County to provide study, design, bidding, and construction administration services for the Construction Project.
EPA or USEPA	United States Environmental Protection Agency or any successor agency.
EPD or GAEPD	Georgia Environmental Protection Department or any successor department.
Equal Business Opportunity Plan (EBO Plan)	The Proposer's plan to utilize small minority and female owned businesses to provide the Membrane System Scope of Supply as set forth in Section 6 of the Technology RFP.
Evaluation Committee	The committee of individuals assigned by the County to evaluate the Proposals in order to determine which Proposal is the most advantageous to the County.
Evaluation Criteria	The factors related to the Technical Proposal and Cost Proposal to be considered in evaluating proposals as defined in Section 4 of the Technology RFP.
Event of Default	Those items specified in the Construction Contract, with respect to the County and the Contractor.
Existing Plant	Collectively, all process systems, structures, tanks, pipes, pumps, and equipment, together with all appurtenant and ancillary systems, used to handle and treat the influent into the Big Creek WRF located at 1030 Marietta Highway, Roswell, Georgia prior to the Construction Project and as generally described in Appendix 1.
Extension Period	Has the meaning specified in the Construction Contract.

Final NPDES Permit	The final, effective permit to be issued by the EPD regulating discharges from the New Plant.
Fixed Construction Contract Price	The total bid price set forth on the Bid Form to perform the Construction Work.
Fixed Membrane System Price	The guaranteed price set forth on Cost Proposal Form A to provide the Membrane System Scope of Supply in accordance with the specified schedule and specified terms and conditions. The Fixed Membrane System Price will be included as a separate Bid Item in the Fixed Construction Contract Price.
Fixed Membrane System Price Adjustment Factor	The factor, which is defined in Appendix 1, to be used to escalate the Fixed Membrane System Price to the month of the Construction Contract Date in the event the Construction Contract Date does not occur within 16 months of the Technology Proposal Submission Date.
Good Engineering and Construction Practice	The methods, techniques, standards and practices which, at the time they are to be employed and in light of the circumstances known or reasonably believed to exist at such time, are generally recognized and accepted as good design, engineering, equipping, installation, construction, and commissioning practices in the municipal wastewater treatment industry as followed in the Southeast region of the United States.
Good Industry Practice	Those methods, techniques, standards and practices which, at the time they are to be employed and in light of the circumstances known or reasonably believed to exist at such time, are generally recognized and accepted as good operation, maintenance, repair, replacement, and management practices in the municipal wastewater treatment industry as observed in the Southeast region of the United States.
Governmental Approvals	All approvals, permits, licenses, authorizations, consents, certifications, exemptions, registrations, rulings, and entitlements of whatever kind and however described which are required under Applicable Law to be obtained or maintained by any person with respect to the Construction Project.

Governmental Body	Any federal, state, regional or local legislative, executive, judicial or other governmental board, agency, authority, commission, administration, court or other body, or any official thereof having jurisdiction over the Existing Plant and the New Plant or any aspect thereof including, without limitation, the design, operation, repair, maintenance, construction and upgrade thereof.
Influent	All wastewater, infiltration, and inflows entering the Existing Plant or the New Plant.
Insurance Requirements	Any rule, regulation, code, or requirement issued by any fire insurance rating bureau or any body having similar functions or by any insurance company that has issued a policy of insurance as specified in the Construction Contract.
Invitation To Bid	The solicitation for bids to select an entity to construct the Construction Project using a traditional Design/Bid/Build delivery method.
Legal Proceeding	Every action, suit, litigation, arbitration, administrative proceeding, and other legal or equitable proceeding having a bearing upon this Construction Contract or the New Plant, and all appeals therefrom.
Loss-and-Expense	Means any and all actual loss, liability, forfeiture, obligation, damage, delay, fine, penalty, judgment, deposit, cost, expense, claim, Tax, or expense, including all Fees and Costs, except as explicitly excluded or limited under any provision of this Construction Contract.
Membrane Bioreactor or "MBR"	The technology selected for the new MBR treatment train that will provide a portion of the wastewater treatment process. The MBR treatment train includes the fine screens, biological nutrient removal (BNR) basins, Membrane System, and other related equipment.
Membrane System	The part of the process for the new MBR treatment train at the upgraded and expanded Big Creek WRF that will achieve the solids separation objectives of the process. The Membrane System includes membranes and equipment related to their operation.

Membrane System Escalation Date	The 16 month anniversary from the Technology Proposal Submission Date.
Membrane System Scope of Supply	The portion of the MBR process, defined in Appendix 1 of the Technology RFP, which is supplied by the Membrane System Supplier. This includes membranes and related equipment, as well as services related to design assistance, installation oversight, start-up, operation and training.
Membrane System Supplier	The entity, which the County selects based on the Technology Proposal evaluation process that provides the Membrane System Scope of Supply. The Membrane System Supplier will provide the Membrane System Scope of Supply through an agreement with the Contractor for the Construction Project.
Membrane System Supplier Proposal Security	Surety in penal sum of 5% of Membrane System Supplier's Fixed Membrane System Price submitted in its Technology Proposal to the County, that the Membrane System Supplier will forfeit to the County should it fail to enter into a subcontract with the Contractor within two (2) months of Construction Contract Date consistent with the terms and conditions of the Membrane System Supplier's final proposal and the Fixed Membrane System Price along with the other conditions for forfeiture contained in the Technology RFP.
Milestone	Major milestone and activities identified in the Construction Schedule to be prepared and submitted by the Contractor in accordance with the Construction Contract.
Mixed Liquor Feed (MLF)	The mixed liquor flow entering the Membrane Basins, ie, the flow from the BNR/AS Basins to the Membrane Basins
Mixed Liquor Recycle (MLR)	The mixed liquor flow exiting the Membrane Basins, ie, the flow being returned from the Membrane Basins back to the BNR/AS Basins
Mixed Liquor Suspended Solids (MLSS)	The total suspended solids (TSS) concentration of mixed liquor in the Existing and New Plant, as analyzed according to "Standard Methods for the Analysis of Water and Wastewater".
Notice of Award	Is applicable to the Contractor. Is provided by the County to the apparent successful Bidder, and indicates that it is the



County's intent to award the Construction Contract to that Bidder, contingent upon the Bidder's execution of the Construction Contract and submission of the other necessary documents as specified in the Bidding Documents, and contingent upon the County's subsequent acceptance of same and formal approval of the Construction Contract by the Fulton County Board of Commissioners.

Notice of Selection	Is applicable to Membrane System Supplier. Is provided by the County to the apparent successful Membrane System Supplier, that the Fulton County Board of Commissioners has accepted its Technology Proposal.
Notice To Proceed	The written notification given to the Contractor by the County to begin the Construction Project.
NPDES	National Pollutant Discharge Elimination System.
NPDES Permit	The National Pollution Discharge Elimination System Permit as issued by the EPD to control quantity and quality of effluent discharges.
Offeror or Proposer	The entity of individual submitting a Proposal in response to this Technology RFP.
Operations and Maintenance (O&M) Manual	The manual prepared and submitted by the Contractor in accordance to the requirements outlined in Construction Contract, regarding the Good Industry Practice of the New Plant, including, but not limited to, detailed standard operating and maintenance procedures and other specific instructions, policies, directives, routines, and schedules.
Operations and Maintenance Plan	The plan prepared by the Contractor specifying all maintenance and testing to be conducted specific to and inclusive of all facilities and equipment as defined in the Construction Contract.
Overdue Rate	The maximum rate of interest permitted by the laws of the State, if applicable, or the Prime Rate, whichever is lower.
Owner	Fulton County Government.
Payment Bond	The surety bond which guarantees the timely payment by the Contractor for all labor, materials, supplies, implements, and

	<p>machinery and equipment furnished with respect to the Construction Project, and which shall be provided in accordance with the Construction Contract.</p>
Performance Bond	<p>The surety bond which guarantees the timely performance by the Contractor of its obligations to the County for the Construction Project, and which shall be provided in accordance with the Construction Contract.</p>
Performance Criteria	<p>Those performance criteria specified in Appendix 1 of this Technology RFP and the Construction Contract that the Contractor warrants the New Plant will continuously meet through Good Industry Practice by the County and its operations contractor.</p>
Plant	<p>The existing Big Creek WRF, as applicable and the real property on which it is located, as described in Appendix 1, consisting of buildings, structures, fixtures and equipment, and the roads, grounds, fences and landscaping appurtenant thereto, utilized for preliminary treatment, primary treatment, secondary treatment and advanced treatment of influent, effluent disinfection and, sludge treatment, maintenance functions, laboratory functions, and administrative functions.</p>
Plant Realty	<p>The parcels of real property upon which the Existing and New Plant, or any portions thereof, are located.</p>
Prime Rate	<p>The prime rate as published in The Wall Street Journal (Eastern Edition), or a mutually agreeable alternative source of the prime rate if it is no longer published in The Wall Street Journal (Eastern Edition) or the method of computation thereof is substantially modified.</p>
Process and Instrumentation Diagram (P&ID)	<p>A drawing showing treatment processes, related systems, related equipment, and their connectivity. Specifically, a P&ID includes tankage, equipment, piping, valves, control panels, instrumentation, and the function of instrumentation in control systems.</p>
Project	<p>The Big Creek WRF Upgrade and Expansion Project.</p>
Proposal or Technology Proposal	<p>The document submitted for evaluation in response to the Technology RFP, detailing the Proposer's plan to provide the Membrane System Scope of Supply, in accordance with the</p>

	Technology RFP, and is comprised of the Technical Proposal and the Cost Proposal together.
Proposal Form	Any of the Technical or Cost Proposal Forms provided in Section 5 of the Technology RFP that must be completed by the Proposer and appended to the Technical and Cost Proposals, respectively.
Proposal Submission Date	The date and time by which the Technology Proposal is required to be submitted to the County by the Proposer, in accordance with Section 3 of the Technology RFP.
Proposer	The sole entity (including any corporation, joint venture, partnership, or other business entity) submitting a Technology Proposal in response to the Technology RFP.
Public Works Construction	The building, altering, repairing, improving, or demolishing of any public structure or building or other public improvements of any kind to any public real property. Does not include the routine operation, repair, or maintenance of existing structures, bildings, or real property.
Rating Services	Moody's Investors Services, Inc. or Standard & Poor's Ratings Services, a division of The McGraw-Hill Companies, Inc., or any of their respective successors and assigns and, if such corporations shall be dissolved or liquidated or shall no longer perform the functions of a securities rating agency, "Rating Services" shall be deemed to refer to any other nationally recognized securities rating agency designated by the County.
RCRA	The Resource Conservation and Recovery Act, 42 U.S.C.A. § 6901 et seq., and applicable regulations promulgated thereunder, each as amended from time to time.
Residuals	Any liquid, semi-solid or solid material generated by or as a result of the operations, maintenance, repair, and management of the Existing and New Plant, excluding Sludge that is land filled or otherwise disposed of and not further processed.
Retainage	Each milestone payment to the Contractor will be subject to a 10% holdback until 50% of the value of the Fixed Construction Contract Price, including change orders and

other additions to the Construction Contract, is due and the manner and progress of the Construction Work performed is satisfactory to the County, at which time further payments will not be subject to additional retainage holdbacks unless the County determines that the Construction Work is unsatisfactory or has fallen behind schedule in which case the amount of retainage will be resumed at the previous level. Upon Substantial Completion, the amounts retained minus 200% of the estimated value of the outstanding Construction Work will be released to the Contractor.

Request for Proposal (RFP) or Technology RFP	The document entitled "Fulton County, Georgia, Big Creek Water Reclamation Facility Membrane System Technology Request for Proposals", as amended by addenda and issued to solicit Proposals to supply the Membrane System Scope of Supply based on specified requirements.
SCADA	In the context of data gathering and telemetry systems, means "Supervisory Control and Data Acquisition".
Schedule of Values	A breakdown of the cost of the Construction Work, which totals the Fixed Construction Contract Price, as specified in the Construction Contract.
Scope of Project	The work required by the original Construction Contract for the Construction Project and any subsequent change orders required or appropriate to accomplish the intent of the Bidding Documents for the Construction Project.
Scope of Work	The work that is described in Section 3.3 of the RFP.
SEC	Securities Exchange Commission
Security Instruments	The Payment Bond, the Construction Performance Bond, the Bid Bond and the Membrane System Supplier Proposal Security.
Sludge	The biosolids generated by the treatment of Influent at the Existing and New Plant.
Solids Retention Time (SRT)	The average amount of time that a solid particle remains in the MBR process. SRT is calculated by dividing the mass of solids within the process by the rate at which solids are removed from the process.

Start-Up & Equipment Testing Plan State	The plan prepared by the Contractor to facilitate equipment start-up and testing as defined in the Construction Contract. The State of Georgia.
Subcontract	An agreement or purchase order issued by the Contractor to a Subcontractor.
Subcontractor	Every person (other than employees of the Contractor) employed or engaged by the Contractor or any person directly or indirectly in privity with the Contractor (including all Subcontractors and every sub-subcontractor of whatever tier) for any portion of the Construction Project, whether for the furnishing of labor, materials, equipment, supplies, services, or otherwise.
Substantial Completion Tax	Has the meaning specified in the Construction Contract. Any tax, fee, levy, duty, impost, charge, surcharge, assessment or withholding, or any payment-in-lieu thereof, and any related interest, penalty or addition to tax.
Technical Proposal	The section of the Technology Proposal that contains the technical and business aspects of the Proposer's plan to provide the Membrane System Scope of Supply in accordance with the Technology RFP, and which is to be submitted separately from the Cost Proposal.
Term	Has the meaning specified in the Construction Contract.
Total Suspended Solids ("TSS")	Solids that either float on the surface of, or are in suspension in wastewater, the analysis of which shall conform to 40 C.F.R. 136, "Guidelines Establishing Test Procedures for the Analysis of Pollutants."
WLA	Waste Load Allocation.
WRF	Water reclamation facility.

2.3 NO CONTACT DURING PROCUREMENT PROCESS

It is the policy of Fulton County that the evaluation and selection/award process for County proposals/contracts shall be free from both actual and perceived impropriety, and that contacts between potential vendors and County officials, elected officials and staff regarding pending selection/awards of County proposals/contracts shall be prohibited.

- A. No person, firm, or business entity, however situated or composed, obtaining a copy of or responding to this solicitation, shall initiate or continue any verbal or written communication regarding this solicitation with any County officer, elected official, employee, or designated County representative, between the date of the issuance of this solicitation and the date of the County Manager's recommendation to the Board of Commissioners for selection/award of the subject proposal/contract, except as may otherwise be specifically authorized and permitted by the terms and conditions of this solicitation.
- B. All verbal and written communications initiated by such person, firm, or entity regarding this solicitation, if same are authorized and permitted by the terms and conditions of this solicitation, shall be directed to the Purchasing Agent.
- C. Any violation of this prohibition of the initiation or continuation of verbal or written communications with County officers, elected officials, employees, or designated County representatives shall result in a written finding by the Purchasing Agent that the submitted bid or Proposal of the person, firm, or entity in violation is "non-responsive", and same shall not be considered for selection/award.

2.4 CLARIFICATION & ADDENDA

Proposers may submit requests for clarifications or interpretations regarding this Technology RFP.. Proposers must prepare such requests in writing for the County's consideration as set forth in this section of this Technology RFP. While the County has not placed an initial limitation on the number of requests which can be submitted, Proposers are cautioned that if Proposers do not request meaningful clarifications or interpretations in an organized manner (e.g., limited frequency of requests), the County will set restrictions on the frequency and number of requests permitted. The County will not respond to requests, oral or written, received after **September 17, 2007 at 5:00 PM**, local prevailing time. Proposers are advised that this section places no obligation on the part of the County to respond to any or all requests for clarification or interpretation, and that the County's failure to respond to any such request will not relieve the Proposer of any obligations or conditions required by this Technology RFP.

Requests for clarification or interpretation regarding this Technology RFP shall only be submitted in writing (letter, fax or email) to:

Fulton County Department of Purchasing and Contract Compliance

Attn: Rholanda Stanberry

Public Safety Building

130 Peachtree Street S.W. Suite 1168

Atlanta GA 30303

Email: rhollanda.stanberry@fultoncountyga.gov

F: 404-893-1744 or 404-730-0358

RE: 07RFP57405K-RS - Big Creek WRF Membrane System

All responses to written requests for clarification, interpretation, or additional information will be distributed as addenda to this Technology RFP to all persons registered with the County to have received a copy of the Technology RFP.

No oral interpretation, instruction, or information concerning this Technology RFP given by any employee or agent of the County shall be binding on the County. Proposers who submit a Proposal in reliance on any such oral information risk having their response to this Technology RFP deemed non-responsive by the County. Only written responses issued by addendum to this Technology RFP should be considered by the Proposers.

During the period provided for the preparation of Proposals, the County may issue addenda to this Technology RFP. These addenda will be numbered consecutively and will be distributed to those who have been issued a copy of this Technology RFP. Additionally, the addenda will be posted on the Fulton County website, www.fultoncountyga.gov. These addenda will be issued by, or on behalf of, the County and will constitute a part of this Technology RFP. Each Proposer is required to acknowledge receipt of each addendum by submitting an executed acknowledgment form. This acknowledgment shall include all addenda distributed prior to the Proposal Submission Date. All responses to this Technology RFP shall be prepared with full consideration of the addenda issued prior to the Proposal Submission Date.

2.5 REQUIRED SUBMITTALS

See **Exhibit 2** for the Required Submittal Checklist. This checklist will assist you to ensure that all required submittals are submitted. Failure to submit all required submittals may deem your Proposal non-responsive.

2.6 PROPOSAL EVALUATION

All Proposals will be evaluated using the criteria specified in Section 4 of this Technology RFP. Selection will include an analysis of Proposals by a selection committee composed of two/three members from Department of Public Works and one/two Purchasing Staff who will review the Proposal submittals in accordance with the submittal requirements and the evaluation criteria set forth in Section 4 of this Technology RFP. The Engineer will act as a technical advisor to the selection committee. The selection committee may request oral interviews and/or site visits.

2.7 DISQUALIFICATION OF PROPOSERS

The submission of more than one (1) Proposal to the County as the primary Proposer or member of a joint venture for the same work by and individual firm, partnership or corporation under the same or different names may be considered as sufficient for disqualification of a Proposer and the rejection of the Proposal.

2.8 RESERVED RIGHTS

The County reserves the right to accept or reject any and/or all Proposals, to waive irregularities and technicalities, and to request resubmission. Any sole response that is received may or may not be rejected by the County depending on available competition and timely needs of the County. There is no obligation on the part of the County to select a proposal or award a contract to the lowest Proposer and the County reserves the right to select a proposal or award a contract to the responsible Proposer submitting responsive Proposals with resulting agreements most advantageous and in the best interest of the County. The County shall be the sole judge of the Proposals and the resulting agreements that are in its best interest and its decision shall be final. Also, the County reserves the right to make such investigation as it deems necessary to determine the ability of any Proposer to perform the work or service requested. Information the County deems necessary to make this determination shall be provided by the Proposer. Such information may include, but shall not be limited to, current financial statements by an independent CPA; verification of availability of personnel; and past performance records.

2.9 APPLICABLE LAWS

All applicable laws and regulations of the State of Georgia and ordinances and regulations of Fulton County shall apply. Protestors shall seek resolution of their complaints in the manner provided in the Fulton County Code of Laws §2-324 which is incorporated by reference herein. All permits and any related easements required for the Construction Project shall be obtained by the Contractor.

2.10 MINIMUM PARTICIPATION REQUIREMENTS FOR PRIME CONTRACTORS

Pursuant to Fulton County Code 102-357, Prime Bidders on the project must perform no less than 51% of the scope of work required under the project.

2.11 INSURANCE AND RISK MANAGEMENT PROVISIONS

Insurance and Risk Management provisions and Indemnification and Hold Harmless provisions are outlined in Section 7 of this Technology RFP.

2.12 ACCURACY OF RFP AND RELATED DOCUMENTS

The County assumes no responsibility that the specified technical and background information presented in this Technology RFP, or otherwise distributed or made available during this procurement process, is complete or accurate. Without limiting the generality of the foregoing, the County will not be bound by or be responsible for any explanation or interpretation of the Proposal documents other than those given in writing as an addendum to this Technology RFP.

Should a recipient of this Technology RFP find discrepancies in or omissions from this Technology RFP and related documents, the recipient of this Technology RFP shall immediately notify the Purchasing Contact Person identified in Section 1.8 in writing at the following address: Fulton County Department of Purchasing and Contract Compliance, Public Safety Bldg, 130 Peachtree Street S.E., Suite 1168 Atlanta, GA 30303. A written addendum, if necessary, then will be made available to each recipient of this Technology RFP.

2.13 RESPONSIBILITY OF PROPOSER

Each Proposer is encouraged to conduct all necessary investigations and review all available and relevant data and information, which are necessary in its judgment in order to assume this responsibility prior to the submittal of its Proposal. Proposers are reminded of Fulton County's "**No Contact During Procurement**" policy and may only contact the person designated by the Technology RFP.

2.14 CONFIDENTIAL INFORMATION

If any Proposal contains technical, financial, or other confidential information that the Proposer believes is exempt from disclosure, the Proposer must clearly label the specific portions sought to be kept confidential and specify on what the exemption is based. The County, at its sole discretion and subject to applicable law, will determine whether such exemption applies. The County has sole discretion to make such determination regarding the disclosure of information, and by responding to this Technology RFP, Proposers waive any challenge to the County's decisions in this regard. Marking all or substantially all of a Proposal as confidential may result in the Proposer being deemed non-responsive to this Technology RFP.

Notwithstanding the foregoing, Proposers recognize and agree that the County, its staff, and its Consultants will not be responsible or liable in any way for any losses that the Proposer may suffer from the disclosure of information or materials to third parties.

2.15 COUNTY RIGHTS AND OPTIONS

This Technology RFP constitutes an invitation to submit Proposals to the County. Without limitation or penalty, the County reserves and holds at its sole discretion, the following rights and options:

- This Technology RFP does not obligate the County to select, procure or contract for any services whatsoever
- The County reserves the right to change or alter the schedule for any events associated with this procurement and, if required, notify the Proposers. A Proposer, by submitting a Proposal, agrees to be bound by any modifications made by the County
- All costs incurred by a Proposer in connection with responding to this Technology RFP, the evaluation and selection process undertaken in connection with this procurement, and any negotiations with the County will be borne by the Proposer.
- The County reserves the right to reject all Proposals and components thereof to eliminate all Proposers responding to this Technology RFP from further consideration for this procurement, and to notify such Proposers of the County's determination.
- The County may cancel this Technology RFP without the substitution of another Technology RFP and terminate this procurement at any time without any liability whatsoever.
- The County reserves the right to waive any technicalities or irregularities in the Proposals.
- The County reserves the right to eliminate any Proposer who submits incomplete or inadequate responses or is not responsive to the requirements of this Technology RFP.
- The County may request Proposers to send representatives to the County for interviews and presentations.

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- To the extent deemed appropriate by the County, the County may enter into discussions and negotiations with the Proposer(s) submitting Proposal(s), which are found to be reasonably susceptible for selection.
 - The County reserves the right to discontinue negotiations with any Proposer.
 - The County reserves the right, without prior notice, to supplement, amend, or otherwise modify this Technology RFP.
 - All Proposals (other than portions thereof subject to patent or copyright protection) become the property of the County and will not be returned, and the County reserves the right to utilize all such information contained in the Proposals without further cost to the County
 - The County may add to or delete from the Project Scope of Work set forth in this Technology RFP.
 - Any and all Proposals not received by the Proposal Submission Date shall be rejected and returned unopened.
 - Neither the County, its staff, its representatives, nor any of its Consultants or attorneys will be liable for any claims or damages resulting from the solicitation, collection, review, or evaluation of responses to this Technology RFP.
 - The County, including its representatives and Consultants, reserves the right to visit and examine any of the facilities referenced in any Proposal and to observe and investigate the operations of such facilities.
 - The County reserves the right to conduct investigations of the Proposers and their responses to this Technology RFP and to request additional evidence to support the information included in any such response.

By responding to this Technology RFP, Proposers acknowledge and consent to the rights and conditions set forth in this Technology RFP.

2.16 COST OF PROPOSAL PREPARATION AND SELECTION PROCESS

Each Proposal, including preparation of all information required to be included in a Proposal pursuant to this Technology RFP, shall be prepared at the sole cost and expense (including, but not limited to, engineering and legal costs) of the Proposer. In addition, the Proposer shall be solely responsible for all costs (including engineering and legal costs) incurred by such Proposer in connection with this selection process, including any costs incurred by the Proposer in any subsequent negotiations entered into in connection with developing the Proposal. There shall be no claims whatsoever against the County, its staff, or its Consultants for reimbursement for the costs or expenses (including, but not limited to, engineering and legal costs) incurred during the preparation of the Proposal or other information required by this Technology RFP or procurement process or in connection with the selection process or any negotiations.

2.17 TERMINATION OF NEGOTIATIONS

The County at its sole discretion may, at any time, to the extent permitted by Applicable Law, exclude a Proposer from further participation in any negotiation process if the County determines that such Proposer is failing to progress in the negotiations or if the terms of its Proposal are less advantageous than those of other Proposers and such Proposer is deemed to be no longer susceptible of selection. The County will give written notice of its decision to the Proposer, which shall be sent in writing, signed by the County.

2.18 WAGE CLAUSE

Pursuant to Fulton County Code 102-391, a Proposer, if selected, shall agree that in the performance of the Membrane System Scope of Supply he will comply with all lawful agreements, if any, which the Proposer had made with any association, union, or other entity, with respect to wages, salaries, and working conditions, so as not to cause inconvenience, picketing, or work stoppage.

2.19 ADDITIONAL OR SUPPLEMENTAL INFORMATION

After receipt of the Proposals, the County will evaluate the responses, including the references, financial statements, experience and other data relating to the Proposer's qualifications. If requested by the Fulton County Department of Purchasing and Contract Compliance, Proposer's may be required to submit additional or supplemental information to determine whether the Proposer meets the requirements of the Technology RFP and to clarify the submitted Proposal.

2.20 GEORGIA SECURITY AND IMMIGRATION COMPLIANCE ACT

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1. Effective as of July 1, 2007, and pursuant to O.C.G.A. 13-10-91, every public employer, every contractor of a public employer, and every subcontractor of a public employer's contractor must register and participate in a federal work authorization program as follows:
 - (a) No public employer shall enter into a contract for the physical performance of services within this state unless the contractor registers and participates in a federal work authorization program to verify the work eligibility information all new employees.
 - (b) No contractor or subcontractor who enters into a contract with a public employer shall enter into such a contract or subcontract in connection with the physical performance of services within this state unless such contractor or subcontractor registers and participates in a federal work authorization program to verify the work eligibility information of all new employees.
 2. In accordance with O.C.G.A. 13-10-91, the requirements of paragraphs (a) and (b) of paragraph (1) shall apply to public employers, their contractors and subcontractors, as follows:
 - (a) On or after July 1, 2007, to public employers, contractors, or subcontractors of 500 or more employees;
 - (b) On or after July 1, 2008, to public employers, contractors or subcontractors of 100 or more employees; and
 - (c) On or after July 1, 2009, to all other public employers, their contractors, or subcontractors.

See Section 5, Technical Proposal Forms, for declarations and affidavits.

2.21 TECHNOLOGY RFP GENERAL REQUIREMENTS

The County's general requirements for Technology RFP's follows this section.

**FULTON COUNTY DEPARTMENT OF PURCHASING AND CONTRACT
COMPLIANCE**

TECHNOLOGY REQUEST FOR PROPOSAL (RFP) GENERAL REQUIREMENTS

07RFP57405K-RS – BIG CREEK WRF MEMBRANE SYSTEM

The following information pertains to the submission of a Proposal to Fulton County (“County”), and contains instructions on how Proposals must be presented in order to be considered. If specific conditions or instructions in the text of the Technology Request for Proposal (“RFP”) conflict with the General Requirements as listed here, those conditions or instructions in the Technology RFP shall prevail.

1. Proposals submitted in response to the attached Technology RFP must be formatted as specified in the Technology RFP. Additional sheets, literature, etc., should be clearly identified.
2. The original and the required number of copies of the Proposal must be returned to:

Fulton County Purchasing Agent
Fulton County Department of Purchasing and Contract Compliance
130 Peachtree Street, S.W., Suite 1168
Atlanta, Georgia 30303

3. The envelope in which the Proposal is submitted must be sealed and clearly labeled with the Technology RFP project name and number, due date and time, and the name of the company or individual submitting the Proposal. Proposals must be received by the opening date and time shown on this Technology RFP in order to be considered. The Purchasing Agent has no obligation to consider Proposals which are not in properly marked envelopes. The Technical Proposal, Cost Proposal and Contract Compliance submittals shall be submitted in separate sealed envelopes. The inclusion of any cost information in the Technical Proposal may result in such Proposal being rejected by the County.
4. Proposals received after the time and date specified will not be opened or considered.
5. By submitting a signed Proposal, Offeror agrees to accept a Notice of Selection made as a result of the submission of the prices and terms contained in that Proposal. Prices proposed must be audited by the Offeror to insure correctness before the Proposal is submitted. Person signing the Proposal is responsible for the accuracy of information in it. The specifications, provisions, and the terms

and conditions of the Technology RFP and Proposal shall become the basis of a valid subcontract between the Contractor of the Construction Project and the Offeror upon Notice of Selection of Proposal in writing and/or issuance of a purchase order.

6. Any Proposal selected or contract awarded as a result of this Proposal, shall comply fully with all Local, State, and Federal laws and regulations.
7. Absolutely no fax Proposals or reproduction Proposals will be accepted, except that if multiple copies of the Proposal are required, photocopies of the original may be submitted as the additional copies, provided that they are clearly marked as such.
8. Type or neatly print company name, as well as the full legal name and title of the person signing the Proposal, in all appropriate places. The Offeror's signature must be executed by a Principal of the company duly authorized to make contracts and bind the company to all terms being proposed.
9. Proposals may be withdrawn upon receipt of a written request prior to the stated due date and time. If a firm seeks to withdraw a Proposal after the due date and time, the firm must present a notarized statement indicating that an error was made, with an explanation of how it occurred. The withdrawal request must be accompanied by documentation supporting the claim. Prior to approving or disapproving the request, an opinion will be obtained from Fulton County's Legal Counsel indicating whether the firm is bound by its Proposal.

Proposals for projects that are solicited pursuant to the Georgia Local Government Public Works Construction Law (O.C.G.A. § 36-91-1 et seq.) may be withdrawn as follows:

The County must advise Offerors in the request for Proposals of the number of days that Offerors will be required to honor their Proposals. If an Offeror is not selected within 60 days of opening the Proposals, any Offeror that is determined by the governmental entity to be unlikely of being selected for contract award will be released from the Proposal.

10. Show information and prices in the format requested. Prices are to be quoted F.O.B. destination, and must include all costs chargeable to the Offeror in providing the Membrane System Scope of Supply, including taxes. Unless otherwise provided in the selected Membrane System Supplier's final Proposal, Fulton County shall have no liability for any cost not included in the Fixed Membrane System Price. The Offeror shall provide Fulton County the benefit through a reduction in price of any decrease in the Offeror's costs by reason of tax exemptions based upon Fulton County's status as a tax-exempt entity.

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11. Propose all items specified or indicate under each item what alternative is being proposed and why it should be considered in lieu of the original specification. Failures to indicate any exceptions shall be interpreted as the Offeror's intent to fully comply with the Technology RFP requirements as written. Conditional or qualified Proposals (except as specifically allowed in the specifications) are subject to rejection in whole or in part.
 12. Fulton County shall be the sole judge of the quality and the applicability of all Proposals. Design, features, overall quality, local facilities, terms and other pertinent considerations will be taken into account in determining acceptability.
 13. The successful Offeror must assume full responsibility for delivery of all goods and services proposed and agree to relieve Fulton County of all responsibility and costs for prosecuting claims.
 14. The successful Offeror must assume full responsibility for replacement of all defective or damaged goods and/or performance of services within thirty (30) days notice by the County of such defect, damage or deficiency.
 15. The successful Offeror must assume full responsibility for providing warranty service on all goods, materials, or equipment provided to the County with warranty coverage. Should a vendor be other than the manufacturer, the vendor and not the County is responsible for contacting the manufacturer. The Offeror is solely responsible for arranging for the service to be performed.
 16. The successful Offeror shall be responsible for the proper training and certification of personnel used in the performance of the services proposed.
 17. The successful Offeror shall not assign, transfer, convey, sublet, or otherwise dispose of any contract resulting from the Technology RFP or of any of all of its rights, title or interest therein without prior written consent of the Fulton County Board of Commissioners.
 18. Proposals must contain references which reflect successful completion of contracts for the types of goods, materials, equipment, or services for which the vendor is submitting a Proposal to the County. In instances where that does not apply, the Proposal must contain a statement and supporting documentation demonstrating such expertise, knowledge, or experience to establish the vendor submitting the Proposal as capable of meeting the demands of the Proposal should an award be made to them.
 19. Offerors submitting Proposals may be required to furnish evidence that they maintain permanent places of business of a type and nature compatible with

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- their Proposal, and are in all respects competent and eligible vendors, able to fulfill the terms of the specifications. Fulton County may make such investigations as it deems necessary to determine the ability of the Offeror to perform such work, and reserves the right to reject any Proposal if evidence fails to indicate that the proposed vendor is qualified to carry out the requirements of the Technology RFP and to complete the work satisfactorily.
20. By submitting a signed Proposal, Offeror certifies that there has been no collusion with any other Offeror. Reasonable grounds for believing Offeror has an interest in more than one Proposal will result in rejection of all Proposals in which the Offeror has an interest. Any party to collusion may not be considered in future Proposals for the same or similar work.
 21. Upon notice of selection, the Offeror submitting the Proposal is obligated to perform. Should a successful Offeror refuse to enter into a contract subsequent to an award, a penalty may be assessed and/or the Offeror may be found to be “non-responsible” in the future.
 22. In case of default by the successful Offeror, Fulton County may procure the articles or services from another source and hold the successful Vendor responsible for any resultant excess cost.
 23. The selected Membrane System Supplier shall directly enter into a Subcontract with the Contractor for the Construction Project and is the party obligated to provide the Membrane System Scope of Supply. This Subcontract may not be assigned and any failure to provide the Membrane System Scope of Supply in accordance with the selected Membrane System Supplier’s final Proposal will constitute a breach of contract and may result in the Proposer being found to be “non-responsible” in the future.
 24. Invoice(s) must list each item separately and must show Fulton County’s purchase order number as well as the proper department and address to whom the service or product was provided.
 25. Fulton County reserves the right to accept or reject any or all Proposals, or any part thereof, and to waive any technicalities. Fulton County reserves the right to select a Proposal based on this Technology RFP and the Proposal(s) received (in whole or in part) to one or more Proposers.
 26. Selection will not necessarily be based on cost alone. Other factors, as detailed in the Technology RFP, will be considered in determining what Proposal will be deemed to best meet the needs of Fulton County.

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27. All Proposals and bids submitted to Fulton County are subject to the Georgia "Open Records Act", Official Code of Georgia, Annotated (O.C.G.A.) § 50-18-70 et seq.
 28. All Proposals and bids submitted to Fulton County involving Utility Contracting are subject to the Georgia law governing licensing of Utility Contractors, O.C.G.A. §43-14-8.2(h). The Utility Contractor License number of the person who will perform the utility work shall be written on the face of the bid envelope.
 29. Prior to beginning any work, the successful Offeror shall furnish to Fulton County (for the contracting firm and for any subcontractors) a certificate from an insurance company showing issuance of Workers' compensation coverage for the State of Georgia or a certificated from the Georgia Workers' Compensation Board showing proof of ability to pay compensation directly.
 30. It is the policy of Fulton County that the evaluation and selection/award process for County proposals/contracts shall be free from both actual and perceived impropriety, and that contacts between Proposers and County officials, elected officials and staff regarding pending selections/awards of County proposals/contracts shall be prohibited.
 - A. No person, firm, or business entity, however situated or composed, obtaining a copy of or responding to this solicitation, shall initiate or continue any verbal or written communication regarding this solicitation with any County officer, elected official, employee, or designated County representative, between the date of the issuance of this solicitation and the date of the County Manager's recommendation to the Board of Commissioners for selection of the subject Proposal, except as may otherwise be specifically authorized and permitted by the terms and conditions of this solicitation.
 - B. All verbal and written communications initiated by such person, firm, or entity regarding this solicitation, if same are authorized and permitted by the terms and conditions of this solicitation, shall be directed to the Purchasing Agent.
 - C. Any violation of this prohibition of the initiation or continuation of verbal or written communications with County officers, elected officials, employees, or designated County representatives shall result in a written finding by the Purchasing Agent that the submitted bid or Proposal of the person, firm, or entity in violation is "non-responsive", and same shall not be considered for selection.
 31. Any Offeror intending to respond to this solicitation as a Joint Venture must submit an executed Joint Venture Agreement with this offer. This agreement must designate those persons or entities authorized to execute documents or

otherwise bind the Joint Venture in all transactions with the Contractor for the Construction Project, or be accompanied by a document, binding upon the Joint Venture and its constituent members, making such designation. Offers from Joint Ventures that do not include these documents will be rejected as being “non-responsive”.

32. Any Offeror intending to respond to this solicitation must complete all of the Procurement Affidavit Forms provided in Section 5. Proposals that do not include these completed documents will be rejected as being “non-responsive”.

SECTION 3 PROPOSAL REQUIREMENTS

3.1 SUBMISSION REQUIREMENTS

3.1.1 Proposal Submission Date and Submittal Format

All Proposals, including all attachments, must be received by the County in a sealed package no later than **September 24, 2007 at 11:00 A.M.** and must be addressed to:

**REQUEST FOR TECHNOLOGY PROPOSALS
RFP 07RFP57405K-RS – Big Creek WRF Membrane System
Fulton County Department of Purchasing & Contract Compliance
Public Safety Building
130 Peachtree Street S.E. Suite 1168
Atlanta GA 30303**

The Proposal shall consist of a Technical Proposal, a Cost Proposal and all documents listed on the Required Submittal Checklist (Exhibit 2). The Technical Proposal shall include Proposer information, technical information, business-related information, and any Technical Proposal Forms requested. The Cost Proposal shall include the Cost Proposal Forms and any information describing the basis for pricing and must be separately, sealed, marked and packaged.

The required content of the Technical Proposal and Cost Proposal is further specified in this section of the Technology RFP. The Proposal must be signed and acknowledged by the Proposer, including certain information to be provided under oath as required under applicable law, in accordance with the instructions herein and the various proposal forms.

THE TECHNICAL PROPOSAL, THE COST PROPOSAL AND CONTRACT COMPLIANCE EXHIBITS SHALL BE SUBMITTED IN SEPARATE, SEALED ENVELOPES OR PACKAGES. THE INCLUSION OF ANY COST INFORMATION IN THE TECHNICAL PROPOSAL MAY RESULT IN SUCH PROPOSAL BEING REJECTED BY THE COUNTY.

Each envelope or package shall be clearly marked as follows:

TECHNOLOGY REQUEST FOR PROPOSALS
RFP# 07RFP57405K-RS – Big Creek WRF Membrane System
[Technical Proposal or Cost Proposal or Contract Compliance Exhibits]
Proposer’s Name and Address

3.1.2 Number of Copies

Proposers shall submit one (1) original and five (5) copies each of the Technical and Cost Proposals. Proposers shall submit one (1) original and two (2) copies of the Contract Compliance Exhibits. Proposers shall submit one (1) original of the Financial Information with the Technical Proposal marked “Original” and one (1) copy in a separate sealed envelope. All Proposals must be complete with all requested information.

3.2 OVERVIEW OF PROPOSAL REQUIREMENTS

Proposers shall submit Proposals in accordance with the content and format requirements set forth in this Technology RFP. Proposals should be clearly organized and structured in a manner that allows materials included in the document to be located easily.

Each of the instructions set forth in this section must be followed for a Proposal to be deemed responsive to this Technology RFP. In all cases, the County reserves the right to determine, at its sole discretion, whether any aspect of the Proposal meets the requirements set forth in this section. The County reserves the right to reject any Proposal, which in its judgment, does not comply with these Proposal submission requirements.

Information provided in the final Proposal from the selected Membrane System Supplier may be incorporated by the County without substantial modification into the Bidding Documents for the Construction Project.

3.3 SCOPE OF WORK

The Membrane System scope of work is based on the following:

- Technical Requirements presented in Appendix 1.
- Minimum technical specifications included in Appendix 2 as a reference for establishing the minimum standards of quality.

3.4 TECHNICAL PROPOSAL FORMAT AND CONTENT

The Technical Proposal shall include the appropriate and requested information in sufficient detail to allow efficient application of the Evaluation Criteria set forth in Section 4.

In order to facilitate Proposal preparation and the evaluation efforts, the Technical Proposal will be limited to a total of 150 single-sided pages, excluding drawings and Proposal Forms. To meet this limit, Proposers are encouraged to summarize information, to the extent possible, in tabular form. Failure of the Proposer to organize the information required by this Technology RFP as outlined may result in the County, at its sole discretion, deeming the Proposal non-responsive to the requirements of this Technology RFP and eliminating the Proposal from further consideration. Proposers using variations from the established Proposal format bear the risk that the County may fail to locate and review required information. Proposers, however, may reduce the repetition of identical information within several sections of their Proposals by making the appropriate cross-references to other sections of their Proposals. However, such cross-references must satisfy the informational requirements for each applicable section. Separate attachments or exhibits to Proposals for certain technical information such as drawings and diagrams may be used to facilitate Proposal preparation.

The Proposal shall be bound and typed on 8½" x 11" paper in English using 12-point font. Hard copies of the drawings shall be provided on 11" x 17" paper. A table of contents shall identify the major sections of the Proposal as outlined herein, and any illustrations, tables, charts, or graphics included in the Proposal. The Technical Proposal shall also be submitted on CD-ROM with all files formatted in a version of Microsoft Word that is compatible with Microsoft Word 2003, in a version of Microsoft Excel that is compatible with Microsoft Excel 2003, and in AutoCAD 2006, as appropriate. **The typed, hardbound proposal shall take precedence over information on the CD-ROM.** The CD-ROM shall be submitted in a separate sealed envelope with the same information on the envelope as the Technical Proposal.

The Technical Proposal shall be arranged and include content as described below:

Section 1 - Executive Summary

The executive summary shall include a brief statement of approach to the work, understanding of the Project's goals and objectives and demonstrated understanding of the Project's potential problems and concerns. The Executive Summary shall briefly summarize the other sections of the Technical Proposal. Do not present information that is not presented elsewhere in the Technical Proposal.

Proposal Security: A bid bond for an amount equal to five (5) percent of the Fixed Membrane System Price must accompany each Proposal. The Membrane System Supplier Proposal Security must be included in the Executive Summary Section of the Proposal to be valid. Checks of any type will not be accepted. Provide a completed and fully executed AIA Document A310.

If for any reason whatsoever the Proposer withdraws its Proposal from the competition after the selection of its Proposal, or if the successful Proposer fails to execute a subcontract with the Contractor within two (2) months from the Construction Contract Date consistent with the terms and conditions of the selected Membrane System Supplier's final Proposal and the Fixed Membrane System Price, the County will proceed on the Membrane System Supplier Proposal Security.

The Surety of the Membrane System Supplier Proposal Security shall be from a surety company authorized to do business in the State of Georgia, shall be listed in the Department of Treasury Circular 570 and shall have an underwriting limitation in excess of 100% of the Fixed Membrane System Price. The bid bond and Surety shall be subject to approval by the Attorney for the County.

Attorneys-in-fact who sign bid bonds or contract bonds must file with each bond a certified and effectively date copy of their power of attorney.

Section 2 – Project Plan

This section of the Proposal shall include the following:

1. Name, address and telephone number of one (1) individual to whom all future correspondence and/or communications will be directed.
2. The Project Plan must address the management approach in completing the work identified in Section 3.3 Scope of Work. At a minimum, the Project Plan must identify, for each of the three phases of the Project, all major tasks, the duration of the major tasks, the availability and commitment of resources to complete each major task, and the specific approach that will be utilized to successfully complete each major task. Describe methodologies including best practices and benchmarks to be used.
3. Description of all project deliverables during each of the three phases of the Project.
4. Resumes of all assigned staff during each of the three phases of the Project.

Section 3 – Proposer Qualifications

This section of the Proposal must present general information about the Proposer. The Proposal shall include details about the type of firm or organization such as, corporation, partnership, limited liability company, joint venture partnerships that will execute and deliver the Membrane System Scope of Supply, including ownership and management structure:

- Brief history of the Proposer's business activities, including ownership, markets, organization, and background.
- Listing of all members or partners indicating status of general or limited partner. If the Proposer or joint venture is a subsidiary of a parent company, information about when the subsidiary was formed and its place in the corporate structure of the parent company. If a subsidiary is or will be created for the purposes of responding to this Technology RFP, the reasons for this action must be fully disclosed.
- Location and address of corporate and regional offices.

Section 4 – Relevant Project Experience

In accordance with the evaluation criteria in Section 4 of this Technology RFP, the Proposer shall provide relevant experience for United States MBR installations treating municipal wastewater for nutrient removal. Provide, as a minimum, Proposer's last five applicable MBR installations (or all applicable MBR installations if less than five); a brief description of the each project, including the following information:

- Name and Location of project.
- Client and Owner.
- Names, titles, telephone, fax numbers, and e-mail addresses of key contact persons at a management level of the owner.
- Description of MBR system designed and supplied, including size, capacity, average flows, effluent goals/limits, last 6 months of operating data including power and chemical consumption, and other information as appropriate.
- Number of change orders requested by the Proposer under relevant contracts and the percentage of the membrane system price represented by

the sum of all change orders presented under such contract and explanation of change orders.

- Summarize major accomplishments.
- Indicate the project delivery method (i.e., Design/Bid/Build, Design/Build, etc.) and if the project included membrane system startup, testing, and training.
- Proposer's submitted experience shall justify (i.e., with actual operating data, etc.) Proposer-selected MLSS concentrations, mixed liquor recycle rates, flux rates, air scour rates, membrane cleaning sequence, quantity of membranes, Guaranteed Membrane Life, Guaranteed Maximum Power Consumption, and Guaranteed Maximum Chemical Usage.

Section 5 – Technical Approach

The Technical Approach section shall describe in detail the proposed Membrane System, including the following:

- Provide a description of the Membrane System and membranes themselves, augmenting data provided in the Technical Proposal Forms. Provide the net and instantaneous flux rates corresponding to the Condition 1 and Condition 2 net permeate production requirements specified in Appendix 1.
- Complete the Technical Proposal Forms and provide a BioWin Modeling Report for the proposed MBR process as specified in Appendix 1.
- Provide a section titled "Membrane System Supplier's Design Recommendations". This section shall list design recommendations that the Membrane System Supplier feels would help maintain the long-term health of the Membrane System such as: preliminary treatment screening requirements; screening of the MLR (ie. is it recommended, etc.); exceptions to the proposed design; etc.
- Provide process and instrumentation diagram(s) (P&IDs) showing the proposed Membrane System, including related elements that will be required to be provided by the Contractor. The P&IDs shall include everything between the mixed liquor feed (from biological treatment), mixed liquor recycle (to biological treatment), and permeate (to UV disinfection).
- The P&IDs shall show the following, as applicable: individual membrane tanks or racks, membrane subunits, mixed liquor pumps, mixed liquor screening equipment, air scour equipment, permeate pumps, air separation

system, and backwash/cleaning systems. Also show interconnecting piping and valves, indicating clearly which items will be provided by the Contractor. Indicate material and size of pipes and valves included in the Membrane System Scope of Supply. Indicate any local control panels that are included in the Membrane System Scope of Supply.

- The P&IDs shall show all control valves and instrumentation that are part of the Membrane System Scope of Supply. Indicate the connection of field instruments to the Membrane System control system.
- Provide general arrangement drawing(s) showing the configuration of the proposed Membrane System and MBR Treatment Train, including related elements to be provided by the Contractor (such as Membrane Basins, BNR/AS Basins, mixed liquor feed pumps, major piping, and lifting devices). Include, as applicable; mixed liquor screening equipment, mixed liquor recycle pumps, air scour system, permeate pumps, air separation system, and backwash/cleaning systems. Indicate the load requirements of lifting devices. Note that all equipment related to the proposed Membrane System will be located in an enclosed Membrane Building and the Membrane Basins will be covered with an open-sided roof structure. The Membrane Basins will include removable flat covers and the headspace will be ventilated for odor control.
- Provide dimensioned layout plans and sections of the Membrane Building and the Membrane Basins for the proposed Membrane System. Include an Electrical Building adjacent to the Membrane Building for all electrical gear (to be provided by the Contractor) associated with the proposed Membrane System. Include in the Membrane Building space for a mechanical room, operations room, storage room, and lavatories. Assume all walls for water holding basins will be 24 inches thick and all other walls will be 12 inches thick. Assume all slabs for water holding basins will be 36 inches thick and all other slabs will be 18 inches thick.
- Indicate on the sections the finished grade elevations, the finished floor elevations, and the water surface elevations and permeate collection header pressure under all flow conditions. Minimum freeboard of 2 feet shall be provided.
- The general arrangement drawings and dimensioned layout plans and sections of the Membrane Building and Membrane Basins shall be based on the following:
 - Condition 1: constructing the Membrane Building and Membrane Basins

for 19 MGD with Membrane System installed for 14 MGD (see Appendix 1 for details). The Membrane System Scope of Supply shall be based on Condition 1.

- Condition 2: installing an additional 5 MGD of Membrane System equipment in the Phase 1 Membrane Building and Membrane Basins and constructing a 19-MGD expansion to the Membrane Building and Membrane Basins for a total of 38 MGD (see Appendix 1 for details).
- Provide an electrical one-line diagram showing motors and other electrical equipment for the proposed Membrane System. Power for the proposed Membrane System will be provided from an Electrical Building adjacent to the Membrane Building, which will be shown on a general arrangement drawing and the dimensioned layout plans and sections.
- Describe the proposed Membrane System equipment, as applicable, such as permeate pumps, mixed liquor screening equipment, mixed liquor recycle pumps, air scour system, air separation system, and backwash/cleaning systems, augmenting data provided on the Technical Proposal Forms.
- Describe the proposed Membrane System control system, including control system architecture, redundancy features, ultimate expansion capacity, operating controls and operator interfaces, report generation capabilities, historic data storage and analysis capabilities, self-diagnostic capabilities, alarm management features, maintenance support capabilities, integration of additional equipment, and power supplies. Include description of control system hardware and software, including control panels, remote terminal units, redundancy features, process failure alarms, and alarm features, and provisions for automatic shutdown. Include detailed block diagrams illustrating the complete control system. Proposals must describe the level of automation, monitoring, and control required for remote operation.
- Provide a complete description of the membrane integrity test system including all parameters to be monitored, field instruments to be utilized, and how a membrane integrity failure will be determined and annunciated.
- Provide a narrative describing operation of the proposed Membrane System, including startup, production, and all types of membrane cleaning, such as backwash (with and without chemicals), relax (i.e., membranes not producing permeate, with or without air scour), daily maintenance, and periodic recovery cleaning (chemical clean-in-place) for permeability recovery.
- Provide equations for calculating guaranteed maximum rate of temperature-

corrected permeability decline as a function of mixed liquor temperature, MLSS concentration, and flux. Guaranteed maximum rate of temperature-corrected permeability decline shall have units of gallons per square foot per day per pounds per square inch per day (gfd/psi-d).

- Provide equations for calculating guaranteed minimum membrane temperature-corrected permeability following a recovery clean. Guaranteed minimum membrane temperature-corrected permeability following a recovery clean may be expressed as a constant or as a function of mixed liquor temperature, MLSS concentration, and flux.
- For the proposed Membrane System, describe the membrane integrity monitoring, membrane testing and repair, and membrane subunit replacement procedures.
- Provide time required for preparation of shop drawings following notice to proceed and time required for delivery of the proposed Membrane System after final shop drawing approval.
- Provide a list of spare parts (two-year supply), which will be provided as part of the Membrane System Scope of Supply.
- Identify materials of construction for all components to be provided as part of the Membrane System Scope of Supply. Provide materials of construction requirements for all components to be provided by the Contractor related to the Membrane System.
- Describe in detail the assistance that the Membrane System Supplier will provide in support of the Engineer during preparation of the Bidding Documents, to meet the requirements described in Appendix 1.
- Describe in detail the assistance that the Membrane System Supplier will provide in support of the Contractor during startup, training, construction, and testing, to meet the requirements described in Appendix 1.

Section 6 – Proposer’s Financial Information

Proposer’s financial statements will be reviewed. The review will focus on the Proposer’s Statement of Income, Balance Sheet and Cash Flow Statements.

The following documentation and statements are required. Failure to provide the required submittals shall result in your firm receiving a “Fail” for the “Financial Responsibility” criteria for the Proposal Evaluation Criteria provided in Section 4.

Financial Statement/Capability

In order for the County to complete its financial review the following documentation is requested:

- (1) Provide annual reports and financial statement for the last three (3) years, including income statements, balance sheets, and any changes in financial position.
- (2) The latest quarterly financial report and a description of any material changes in financial position since the last annual report.
- (3) Proposer's most recent Dun & Bradstreet, Value Line Reports or other credit ratings/report.

Section 7 - Confidential and Proprietary Information

This section of the Proposal shall present technical, financial, other confidential information, and proprietary information that the Proposer claims are exempt from public disclosure, as set forth in Section 2 of the Technology RFP.

Section 8 - Technical Proposal Forms

Proposers must provide the requested information and complete in detail all the Technical Proposal Forms provided in Section 5 of the Technology RFP.

Section 9 - Location of Proposer

Local Preference is given to businesses that have a business location within the geographic boundaries of Fulton County. In order to receive the Local Preference points, the Proposer must provide one of the following supporting documentation to the Department of Purchasing & Contract Compliance:

1. Copy of occupational tax certificate (business license);
2. Copy of a lease or rental agreement;
3. Proof of ownership interest in a location within the geographical boundaries of Fulton County.

The term business location means a physical structure, office or suite but does not include a post office box or a temporary job or project site location. If submitting as a Joint Venture or Partnership, provide a copy of the Joint Venture or Partnership agreement including the business address of all members.

Failure to provide the required supporting documentation with your proposal submittal shall result in your firm receiving a zero (0) points for the “Local Preference” criteria for the Technical Proposal Evaluation Criteria provided in Section 4.

3.5 COST PROPOSAL FORMAT AND CONTENT

The Cost Proposal shall be provided in a **separate sealed envelope** in accordance with Section 3.1. The Cost Proposal shall include current information and shall be arranged and include content as described below:

Section 1 - Introduction

The Proposer shall include an introduction which outlines the contents of the Cost Proposal. In this section, the Proposer shall highlight how the technical approach selected for the Proposal impacts the Fixed Membrane System Price and discuss the benefits of the selected approach. The Proposer shall also describe the approach and assumptions used to determine the Fixed Membrane System Price.

Section 2 – Derivation of Costs

In this section, the Proposer shall provide a detailed breakdown of major costs such as equipment and membranes, engineering and design, training and startup, etc. The level of detail within the Cost Proposal shall be sufficient to allow evaluation using the process outlined in Section 4 of this Technology RFP, and shall demonstrate thoughtful consideration of the requirements of this Technology RFP.

Section 3 - Completed Cost Proposal Forms

The Proposer is required to complete **all** of the Cost Proposal Forms included in Section 5 of the Technology RFP. Section 5 provides a description of the Cost Proposal Forms.

SECTION 4 EVALUATION CRITERIA

4.1 PROPOSAL EVALUATION – OVERVIEW

Proposals will be evaluated using the evaluation criteria specified in this Section of the Technology RFP. Selection will include an analysis of Proposals by a selection committee composed of two/three members from the Department of Public Works and one/two members from the Department of Purchasing. The selection committee may request oral interviews, site visits, and any additional information required to clarify the Proposals. This additional information may include but is not limited to:

- Data sheets and catalog information for each item of the Membrane System Scope of Supply clearly identifying all features, components, materials of construction, dimensions, weights, electrical requirements, etc.
- Drawing plans, sections, and details of the proposed Membrane System layout, configuration, and provisions for future expansion.
- Operational data to further support the proposed Membrane System design and values submitted on the Technical Data Forms.

The selection committee will report its findings and recommendations to the Director of Public Works who shall then make a recommendation to the County Manager.

4.2 EVALUATION CRITERIA

The criteria that will be used to evaluate the Proposals submitted in response to this Technology RFP are described below.

4.2.1 Technical Proposal Evaluation 75 points max

The Technical Proposal will be evaluated based on the following criteria:

Experience (25 points max)

This criterion will be evaluated based on the information contained in Sections 3 and 4 of the submitted Proposal. Experience of the Proposer with furnishing the elements of the Membrane System Scope of Supply, including membranes, equipment, design services, construction services, start-up services and operation services for membrane systems will be evaluated. The item will consider the number, size, and length of time in service of similar MBR installations of similar nature, magnitude and

complexity with specific emphasis on large (≥ 5 MGD QMAX30 design capacity) MBR installations designed and operating for enhanced biological nutrient removal to meet the following effluent standards:

- 0.5 mg/L Ammonia Nitrogen
- 3.0 mg/L Total Nitrogen
- 0.3 mg/L Total Phosphorus

Proposers should provide client references (name, title, address, phone numbers), list of membrane installations (design capacity, location, length of operation), and detailed project descriptions including operating data. Demonstrated past performance supporting owners, engineers, general contractors and owner representatives during the design, construction, start-up, and operation of membrane systems will be evaluated.

Technical Approach (25 points max)

This criterion will be evaluated based on the information contained in Sections 5 and 8 of the submitted Proposal. Justification and basis for proposed design parameters (type of membrane, flux, mixed liquor conditions, approach to permeability recovery, etc.) will be compared to actual Proposer experience. The likelihood of the proposed Membrane System to comply with the specified requirements will be considered. The layout/footprint, expandability, redundancy and reliability of the proposed Membrane System to meet the requirements and a range changes in conditions will be assessed. Constructability, complexity of the system, impact on construction sequencing, and other related requirements will be considered. Operational complexity and maintenance requirements will also be evaluated.

Capability and Availability (10 points max)

This criterion will be evaluated based on the information contained in Section 2 of the submitted Proposal. Capability, availability, and commitment of the Proposer to support the Engineer during the design and the Contractor during construction, start-up, operational and training efforts pertaining to the proposed Membrane System will be considered. Provide resumes of assigned staff that have qualifications and experience to provide technical assistance, coordination, and support during the design and construction of the project and availability of proposed personnel (3 pages maximum per resume).

Local Preference (10 points max)

As described in Section 3 of the RFP, this criterion will be evaluated based on the information contained in Section 9 of the submitted Proposal.

Financial Responsibility (5 points max)

As described in Section 3 of the RFP, this criterion will be evaluated based on the information contained in Section 6 of the submitted Proposal.

4.2.2 Cost Proposal Evaluation

25 points max

Proposers shall submit the Cost Proposal in a separate sealed envelope as described in Section 3 of the RFP. The Cost Proposal evaluation will consider the net present value (NPV) life-cycle cost of the proposed Membrane System and associated MBR Treatment Train. The following procedures and assumptions will be used to perform the Cost Proposal evaluation:

- The pricing provided in the Cost Proposal Forms will be utilized.
- The cost to install the proposed Membrane System will be evaluated.
- The installed cost of the Membrane Basins will be evaluated based on the following: structural/mechanical (concrete, roof structure, covers, handrail, bridge crane, etc.) is \$8.00 per gallon; excavation and backfill is \$30 per cubic yard of below grade structure; interior protective coating (if required) will be based on the information provided on Technical Proposal Form I.
- Relocation of existing electrical duct bank and existing 48-inch secondary effluent pipeline will be evaluated.
- The installed cost of the BNR/AS Basins will be evaluated based on the following: structural/mechanical (concrete, handrail, mixers, diffusers, etc.) is \$2.50 per gallon; excavation and backfill is \$30 per cubic yard of below grade structure; process air blowers, which will be based on the submitted BioWin modeling report (see Appendix 1) and the associated cost will be determined.
- The installed cost of the Membrane Building that will contain the Membrane System equipment will be evaluated based on \$200 per square foot of building area plus \$30 per cubic yard of below grade structure for excavation and backfill.
- The installed cost of any required MLF pumping system (to the Membrane Basins) will be evaluated.

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- The installed cost of major piping and concrete conveyance/flow distribution channels will be evaluated. Piping used to convey flow shall be sized based on the following criteria:
 - Minimum flow velocity shall be 1.5 fps at QMIN (including MLR/MLF)
 - Maximum flow velocity shall be 8 fps at QPK (including MLR/MLF)

Concrete channels used to convey flow shall be sized based on the following criteria:

- Minimum flow velocity shall be 1.5 fps at QMIN (including MLR/MLF)
- Maximum flow velocity shall be 8 fps at QPK (including MLR/MLF)

Concrete channels used to distribute flow to the Membrane and BNR/AS Basins shall be sized based on the following criteria:

- Maximum velocity at QPK shall be 0.5 fps (including MLR/MLF)

- The installed cost of associated electrical systems and equipment (ie. MCCs, VFDs, conduit and wire) will be evaluated based on the number and size of the motors and the number of field instruments required.
- NPV life-cycle cost will be based on a 20-year operating period and a discount rate of 6 percent. The discount rate includes inflation. The average annual permeate flow rate in each of the 20 years is equal to 11.4 MGD, as described in Appendix 1.
- Operating costs considered in the evaluation will include the following, as they pertain to the Membrane System and associated MBR Treatment Train: power consumption, chemical usage, membrane replacement, maintenance labor, and maintenance materials:
 - Power consumption: includes the power usage guaranteed by Cost Proposal Form B (MLR pumping, permeate pumping, air scour, membrane chemical systems, etc.), MLF pumping (if required), and process aeration, which will be based on the submitted BioWin modeling report (see Appendix 1) and the associated cost will be determined. The unit power cost is \$0.052 per kilowatt-hour.

- Chemical usage: includes the chemical usage guaranteed by Cost Proposal Form C (membrane maintenance and cleaning chemicals) and chemical usage for the biological process (ie. lime and ferric chloride), which will be based on the submitted BioWin modeling report (see Appendix 1) and the associated costs will be determined. The use of proprietary cleaning chemicals and flux enhancing chemicals during permeate production is explicitly prohibited. Chemical unit costs are as follows:

CHEMICAL UNIT COSTS (1)	
CHEMICAL	UNIT COST
Sodium Hypochlorite (12.5 weight percent solution)	\$ 0.62 per pound Cl ₂
Citric Acid (50 weight percent solution)	\$ 0.63 per pound C ₆ H ₈ O ₇
Pebble Lime	\$0.06 per dry pound Ca(OH) ₂
Ferric Chloride	\$ 0.24 per dry pound FeCl ₃

Note 1: Chemical unit costs not listed above shall be as indicated in the Proposal with submitted price quote from local supplier, which will be subject to confirmation during the evaluation.

- Membrane replacement cost will be based on the Guaranteed Membrane Life and Guaranteed Membrane Replacement Cost included in Cost Proposal Form D.
- Maintenance labor requirements and other maintenance expenses will be estimated based on the complexity and level of automation of the proposed Membrane System and the number and size of the rotating machinery.
- Where the Proposal indicates that the proposed Membrane System will exceed minimum requirements, value-added will be considered.

SECTION 5 PROPOSAL FORMS

5.1 INTRODUCTION

To be deemed responsive to this Technology RFP, Proposers must provide the information requested and complete in detail all Technical and Cost Proposal Forms. The appropriate individual(s) authorized to commit the Proposer to the requirements of this Technology RFP must sign the Proposal Forms. Proposers should reproduce each Proposal Form, as required, and complete the appropriate portions of the forms provided in this section.

Technical Proposal Forms

Technical Proposal Form A - Certification Regarding Debarment
Technical Proposal Form B - Non-Collusion Affidavit of Bidder/Offeror
Technical Proposal Form C - Certificate of Acceptance of Technical RFP Requirements
Technical Proposal Form D - Disclosure Form and Questionnaire
Technical Proposal Form E – Declaration of Employee-Number Categories
Technical Proposal Form F – Georgia Security and Immigration Contractor Affidavit/Agreement
Technical Proposal Form G – Georgia Security and Immigration Subcontractor Affidavit
Technical Proposal Form H - Proposal Transmittal Letter
Technical Proposal Form I - Membrane System
Technical Proposal Form J - Equipment and Systems
Technical Proposal Form K - Disclaimer Statement
Technical Proposal Form L - Information Certification
Technical Proposal Form M - Technical Requirements Certification
Technical Proposal Form N - Royalty and License Fees

Cost Proposal Forms

Cost Proposal Form A - Fixed Membrane System Price
Cost Proposal Form B - Maximum Power Consumption
Cost Proposal Form C - Maximum Chemical Usage
Cost Proposal Form D - Guaranteed Membrane Life, and Guaranteed Membrane Replacement Cost

5.2 TECHNICAL PROPOSAL FORMS DESCRIPTION

The following paragraphs present an overview of each Technical Proposal Form required.

5.2.1 Certification Regarding Debarment

Proposer shall complete and submit Technical Proposal Form A, which certifies that neither it nor its subcontractors are presently debarred, suspended, proposed for debarment, declared ineligible, or otherwise excluded from doing business with any government agency.

5.2.2 Non-Collusion Affidavit of Bidder/Offeror

Proposal shall include a copy of Technical Proposal Form B, executed by an authorized officer of the corporation. Proposals developed by a joint venture shall be similarly executed by all joint venture participants.

5.2.3 Certificate of Acceptance of Technical RFP

Proposer shall complete and submit Technical Proposal Form C, which certifies that Proposer has read the solicitation including all addenda, exhibits, attachments and appendices.

5.2.4 Disclosure Form and Questionnaire

Proposer shall complete and submit Technical Proposal Form D, which requests disclosure of business information and litigation.

5.2.5 Declaration of Employee-Number Categories

Proposer shall complete and submit Technical Proposal Form E, which requests the employee-number category applicable to your company.

5.2.6 Georgia Security and Immigration Contractor Affidavit and Agreement

Proposer shall complete and submit Technical Proposal Form F, in order to comply with the requirements of O.C.G.A. 13-10-91 and the Georgia Department of Labor Rule 300-10-01-.02.

5.2.7 Georgia Security and Immigration Subcontractor Affidavit

Proposer shall ensure that any subcontractor(s) that will be utilized for this project shall complete and submit Technical Proposal Form G, Subcontractor Affidavit.

5.2.8 Proposal Transmittal Letter

Proposer shall copy and complete the Proposal Transmittal Letter to warrant the specified conditions. Together with each original and copy of the Proposal, the County must receive one original Proposal Transmittal Letter, as provided in Technical Proposal Form H, on the official letterhead of the Proposer acknowledging, among other things, that the Proposer has completely reviewed and understands and agrees to be bound by the requirements of this Technology RFP and such letter commits the Proposer, if selected, to carry out the provisions of the Proposal.

5.2.9 Membrane System

The Proposer shall complete Technical Proposal Form I for the proposed Membrane System. The information on the form will be used to evaluate the proposed Membrane System design.

5.2.10 Equipment and Systems

The Proposer shall duplicate and complete Technical Proposal Form J for all major equipment and systems. The Proposer should provide a level of detail in each Technical Proposal Form J submitted to allow the County to assess the material quality, performance capacity, and overall durability of the proposed components of the Membrane System Scope of Supply. At a minimum, the forms shall be prepared and submitted for the following equipment and systems:

1. All motor-driven equipment.
2. All electrical equipment.
3. All chemical storage tanks and metering pumps.
4. All instrumentation, control, process monitoring, and communication systems.
5. All piping and valves.
6. All linings and coatings.

Proposers shall include a separate page for each piece of equipment, treatment system, or other applications followed by a separate page for each major piece of equipment used in that system, as appropriate.

Technical Proposal Form J has been developed such that Proposers can modify and refine the forms to provide a description of the proposed equipment and systems. This information may be provided within the forms or attached to the forms.

5.2.11 Disclaimer Statement

Proposers shall complete and submit Technical Proposal Form K which releases the County from responsibility for the accuracy of information contained in this Technology RFP.

5.2.12 Information Certification

Proposers shall complete and submit Technical Proposal Form L, which certifies that the Proposal contains true and accurate information.

5.2.13 Technical Requirements Certification

Proposers shall complete and submit Technical Proposal Form M, which certifies that the Proposer has read and agrees to meet the Technical Requirements contained in Appendix 1. In addition, the Proposer certifies that the costs specified in Cost Proposal Form A – Fixed Membrane System Price includes the Technical Requirements contained in Appendix 1.

5.2.14 Royalty and License Fees

Proposer shall complete and submit Technical Proposal Form N, which certifies that all initial and future royalty and license fees applicable to the Membrane System Scope of Supply are included in the Fixed Membrane System Price.

5.3 COST PROPOSAL FORMS DESCRIPTION

The subsequent paragraphs present an overview of each Cost Proposal Form, including the requirements to which the Proposer must adhere when completing and incorporating the Cost Proposal Forms into the Cost Proposal.

The pricing information contained on the Cost Proposal Forms will escalate in accordance with the applicable Fixed Membrane System Price Adjustment Factor as detailed in Appendix 1.

5.3.1 Fixed Membrane System Price

The Proposer shall complete Cost Proposal Form A by providing a breakdown of the Fixed Membrane System Price. The items listed on this form are not intended to represent a complete itemization of the Membrane System Scope of Supply. Proposers shall add items as appropriate, or include such missing items into other line items, but shall include such additions in the subtotals included on this form. Each line item price should be inclusive of all taxes (including Georgia state sales tax, as applicable).

5.3.2 Maximum Power Consumption

The Proposer shall complete Cost Proposal Form B and identify the Maximum Power Consumption corresponding to Membrane System startup (i.e., new membranes) and overall (i.e., membranes at end of life). The rates will be used in the Cost Proposal evaluation as described in Section 4.

5.3.3 Maximum Chemical Usage

The Proposer shall complete Cost Proposal Form C and identify the Maximum Chemical Usage corresponding to Membrane System startup (i.e., new membranes) and overall (i.e., membranes at end of life). The rates used in the Cost Proposal evaluation are described in Section 4.

5.3.4 Guaranteed Membrane Life and Guaranteed Membrane Replacement Cost

The Proposer shall complete Cost Proposal Form D. The use of this information in the evaluation is described in Section 4.

TECHNICAL PROPOSAL FORM A CERTIFICATION REGARDING DEBARMENT

- (1) The Offeror certifies that neither it or its subcontractors is presently debarred, suspended, proposed for debarment, declared ineligible, or otherwise excluded from doing business with any government agency. Any such exclusion may cause prohibition of your firm from participating in any procurement by the Fulton County Government.
- (2) If the Offeror is unable to certify to any of the statements in this certification, such Offeror or subcontractor shall attach an explanation to this bid or proposal.

INSTRUCTIONS FOR CERTIFICATION

By signing and submitting this certification, the Offeror is providing the certification set out below:

- (1) The certification in this clause is a material representation of fact upon which reliance will be placed. If it is later determined that the prospective Offeror knowingly rendered a false certification, the Purchasing Agent may pursue all available remedies, including suspension and/or debarment, for withdrawal of award or termination of a contract.
- (2) The prospective Offeror shall provide immediate written notice to the Purchasing Agent if at anytime the Offeror learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.
- (3) Offeror shall be under a continuing duty to immediately inform the Purchasing Agent in writing of any changes, if as a result of such changes, the Offeror certification regarding debarment is affected.

DEBARMENT ORDINANCE

The following Section 2-322 of Fulton County Code of Laws establishes the debarment procedure.

(a) ***Authority to suspend.***

After reasonable notice to the entity involved and reasonable opportunity for that entity to be heard, the Purchasing Agent, after consultation with user department, the County Manager and the County Attorney shall have the authority to suspend

an entity for cause from consideration for award of County contracts. As used in this section, the term entity means any business entity, individual, firm, contractor, subcontractor or business corporation, partnership, limited liability corporation, firm, contractor, subcontractor or business structured; provided, further, that any such entity shall also be subject to suspension under this section if any of its constituents, members, subcontractors at any tier of such entity's and the entity, or any constituent or member, knew or should have known of the commission of the act. The suspension shall be for a period not to exceed three (3) years unless cause is based on a felony conviction for an offense related or associated with fraudulent contracting or misappropriation of funds wherein the suspension shall not exceed seven (7) years.

(b) Causes for Suspension. The causes for suspension include:

- 1) Conviction for commission of a criminal offense as an incident to obtain or attempting to obtain a public or private contract or subcontract, or in performance of such contract or subcontract;
- 2) Conviction of state or federal statutes of embezzlement, theft, forgery, bribery, falsification or destruction of records, receiving stolen property or other offense indicating a lack of business integrity or business honesty which currently, seriously and directly affects responsibility as a county contractor.
- 3) Conviction of state or federal anti-trust statutes arising out of the solicitation and submission of bids and proposals;
- 4) Violation of contract provisions, as set forth below, of a character which is regarded by the Purchasing Agent to be so serious as to justify suspension action:
 - a. Failure to perform in accordance with the specifications within a time limit provided in a county contract;
 - b. A recent record of failure to perform or unsatisfactory performance in accordance with the terms of one or more contracts; provided, that failure to perform or unsatisfactory performance caused by acts beyond the control of the contractor shall not be considered to be a basis for suspension;
 - c. Material representation of the composition of the ownership or workforce or business entity certified to the County as a minority business enterprise; or
 - d. Falsification of any documents.

-
- i. For violation of the ethical standards set forth in Fulton County Code Chapter 9, Code of Ethics.
 - ii. Knowing misrepresentation to the County, of the use which a majority owned contractor intends to make a minority business enterprise (a business entity at least 51 percent of which is owned and controlled by minority persons, as defined in Fulton County Code Chapter 6, Article B, Minority Business Enterprise Affirmative Action Program and certified as such by the County) as a subcontractor or a joint venture partner, in performing work under contract with the County.

Failure to fully and truthfully provide the information required, may result in the disqualification of your bid/proposal from consideration or termination of the contract, once awarded. This document must be completed and included as a part of the bid/proposal package along with other required documents.

[SIGNATURES ON NEXT PAGE]

Under penalty of perjury, I declare that I have examined this certification and all attachments hereto, if applicable, to the best of my knowledge and belief, and all statements contained hereto are true, correct, and complete.

On this _____ day of _____, 2007

(Legal Name of Proponent) (Date)

(Signature of Authorized Representative) (Date)

(Title)

**TECHNICAL PROPOSAL FORM B
NON-COLLUSION AFFIDAVIT OF BIDDER/OFFEROR**

STATE OF _____

COUNTY OF _____

I, _____ certify that pursuant to Fulton County Code Section 2-320 (11), this bid or proposal is made without prior understanding, agreement or connection with any corporation, firm or person submitting a bid for the same work, labor or service to be done or the supplies, materials or equipment to be furnished and is in all respects fair and without collusion or fraud. I understand collusive bidding is a violation of state and federal law and can result in fines, prison sentences and civil damages awards. I agree to abide by all conditions of this bid or proposal and certify that I am authorized to sign this bid or proposal for the bidder.

Affiant further states that pursuant to O.C.G.A. Section 36-91-21 (d) and (e), _____ has not, by itself or with others, directly or indirectly, prevented or attempted to prevent competition in such bidding or proposals by any means whatsoever. Affiant further states that (s)he has not prevented or endeavored to prevent anyone from making a bid or offer on the project by any means whatever, nor has Affiant caused or induced another to withdraw a bid or offer for the work.

Affiant further states that the said offer of _____ is bona fide, and that no one has gone to any supplier and attempted to get such person or company to furnish the materials to the bidder only, or if furnished to any other bidder, that the material shall be at a higher price.

(COMPANY NAME)

(PRESIDENT/VICE PRESIDENT)

Sworn to and subscribed before me this _____ day of _____, 200__.

(SECRETARY/ASSISTANT SECRETARY)

(Affix corporate seal here, if a corporation)

Notary Public: _____

County: _____

Commission Expires: _____

NOTE:

IF THE OFFEROR IS A PARTNERSHIP, ALL OF THE PARTNERS AND ANY OFFICER, AGENT, OR OTHER PERSON WHO MAY HAVE REPRESENTED OR ACTED FOR THEM IN BIDDING FOR OR PROCURING THE CONTRACT SHALL ALSO MAKE THIS OATH.

IF THE OFFEROR IS A CORPORATION, ALL OFFICERS, AGENTS, OR OTHER PERSONS WHO MAY HAVE ACTED FOR OR REPRESENTED THE CORPORATION IN BIDDING FOR OR PROCURING THE CONTRACT SHALL MAKE THE OATH.

**TECHNICAL PROPOSAL FORM C
CERTIFICATE OF ACCEPTANCE OF
TECHNICAL RFP REQUIREMENTS**

This is to certify that on this day, Offeror acknowledges that he/she has read this solicitation document, pages # _____ to # _____ inclusive, including any addenda # _____ to # _____ exhibit(s) # _____ to # _____, attachment(s) # _____ to # _____, and/or appendices # _____ to # _____, in its entirety, and agrees that no pages or parts of the document have been omitted, that he/she understands, accepts and agrees to fully comply with the requirements therein, and that the undersigned is authorized by the offeror to submit the proposal herein and to legally obligate the offeror thereto.

Company: _____

Signature: _____

Name: _____

Title: _____ Date: _____

(Affix Corporate Seal)

TECHNICAL PROPOSAL FORM D DISCLOSURE FORM AND QUESTIONNAIRE

1. Please provide the names and business addresses of each of the Offeror's firm's officers and directors.

For the purposes of this form, the term "Offeror" means an entity that responds to a County solicitation by either submitting a Proposal in response to a Request for Proposal or a Request for Qualification or a Bid in response to an Invitation to Bid.

Describe accurately, fully and completely, their respective relationships with said Offeror, including their ownership interests and their anticipated role in the management and operations of said Offeror.

2. Please describe the general development of said Offeror's business during the past five (5) years, or such shorter period of time that said Offeror has been in business.
3. Please state whether any employee, agent or representative of said Offeror who is or will be directly involved in the subject project has or had within the last five (5) years: (i) directly or indirectly had a business relationship with Fulton County; (ii) directly or indirectly received revenues from Fulton County; or (iii) directly or indirectly receives revenues from the result of conducting business on Fulton County property or pursuant to any contract with Fulton County. Please describe in detail any such relationship.

LITIGATION DISCLOSURE:

Failure to fully and truthfully disclose the information required, may result in the disqualification of your bid or proposal from consideration or termination of the contract, once awarded.

1. Please state whether any of the following events have occurred in the last five (5) years with respect to said Offeror. If any answer is yes, explain fully the following:
 - (a) whether a petition under the federal bankruptcy laws or state insolvency laws was filed by or against said Offeror, or a receiver fiscal agent or similar officer was appointed by a court for the business or property of said Offeror;
 - (b) whether Offeror was subject of any order, judgment, or decree not subsequently reversed, suspended or vacated by any court of

competent jurisdiction, permanently enjoining said Offeror from engaging in any type of business practice, or otherwise eliminating any type of business practice; and

(c) whether said Offeror's business was the subject of any civil or criminal proceeding in which there was a final adjudication adverse to said or Offeror, which directly arose from activities conducted by the business unit or corporate division of said Offeror which submitted a bid or proposal for the subject project. If so please explain.

2. Have you or any member of your firm or team to be assigned to this engagement ever been indicted or convicted of a criminal offense within the last five (5) years?

Circle One: YES NO

3. Have you or any member of your firm or team been terminated (for cause or otherwise) from any work being performed for Fulton County or any other Federal, State or Local Government?

Circle One: YES NO

4. Have you or any member of your firm or team been involved in any claim or litigation adverse to Fulton County or any other federal, state or local government, or private entity during the last three (3) years?

Circle One: YES NO

5. Has any Offeror, member of Offeror's team, or officer of any of them (with respect to any matter involving the business practices or activities of his or her employer), been notified within the five (5) years preceding the date of this offer that any of them are the target of a criminal investigation, grand jury investigation, or civil enforcement proceeding?

Circle One: YES NO

If you have answered "YES" to any of the above questions, please indicate the name(s) of the person(s), the nature, and the status and/or outcome of the information, indictment, conviction, termination, claim or litigation, the name of the court and the file or reference number of the case, as applicable. Any such information should be provided on a separate page, attached to this form and submitted with your proposal.

NOTE: If any response to any question set forth in this questionnaire has been disclosed in any other document, a response may be made by attaching a copy of such disclosure. (For example, said Offeror's most recent filings with the Securities and Exchange Commission ("SEC") may be provided if they are responsive to certain items within the questionnaire.) However, for purposes of clarity, Offeror should correlate its responses with the exhibits by identifying the exhibit and its relevant text.

Disclosures must specifically address, completely respond and comply with all information requested and fully answer all questions requested by Fulton County. Such disclosure must be submitted at the time of the bid or proposal submission and included as a part of the bid/proposal submitted for this project. Disclosure is required for Offerors, joint venture partners and first-tier subcontractors.

Failure to provide required disclosure, submit officially signed and notarized documents or respond to any and all information requested/required by Fulton County can result in the bid/proposal declared as non-responsive. This document must be completed and included as a part of the bid/proposal package along with other required documents.

[SIGNATURES ON NEXT PAGE]

Under penalty of perjury, I declare that I have examined this questionnaire and all attachments hereto, if applicable, to the best of my knowledge and belief, and all statements contained hereto are true, correct, and complete.

On this _____ day of _____, 2007

(Legal Name of Proponent)

(Signature of Authorized Representative)

(Title)

Sworn to and subscribed before me,

this _____ day of _____, 2007

(Notary Public)

(Seal)

Commission Expires _____
(Date)

**TECHNICAL PROPOSAL FORM E
DECLARATION OF EMPLOYEE-NUMBER CATEGORIES**

Please affirmatively indicate by checking the appropriate box the employee-number category applicable to your organization:

- 500 or more employees
- 100 or more employees
- fewer than 100 employees

Organization Name: _____

I certify that the above information is true and correct and that the classification noted is applicable for this Project.

Signed: _____

Printed: _____

Title: _____

Date: _____

**TECHNICAL PROPOSAL FORM F
GEORGIA SECURITY AND IMMIGRATION
CONTRACTOR AFFIDAVIT/AGREEMENT**

Instructions:

Contractors must attest to compliance with the requirements of O.C.G.A 13-10-91 and the Georgia Department of Labor Rule 300-10-01-.02 by executing the Contractor Affidavit. The affidavit should be executed by Contractors with 500 or more employees.

STATE OF GEORGIA

COUNTY OF FULTON

**FORM F: GEORGIA SECURITY AND IMMIGRATION CONTRACTOR
AFFIDAVIT/AGREEMENT**

By executing this affidavit, the undersigned contractor verifies its compliance with O.C.G.A. 13-10-91, stating affirmatively that the individual, firm or corporation which is engaged in the physical performance of services under a contract with **[insert name of prime contractor]** _____ on behalf of **Fulton County Government** has registered with and is participating in a federal work authorization program* [any of the electronic verification of work authorization programs operated by the United States Department of Homeland Security or any equivalent federal work authorization program operated by the United States Department of Homeland Security to verify information of newly hired employees, pursuant to the Immigration Reform and Control Act of 1986 (IRCA), P.L. 99-603], in accordance with the applicability provisions and deadlines established in O.C.G.A. 13-10-91.

The undersigned further agrees that, should it employ or contract with any subcontractor(s) in connection with the physical performance of services to this contract with **Fulton County Government**, contractor will secure from such subcontractor(s) similar verification of compliance with O.C.G.A. 13-10-91 on the Subcontractor Affidavit provided in Rule 300-10-01-.08 or a substantially similar form. Contractor further agrees to maintain records of such compliance and provide a copy of each such verification to the **Fulton County Government** at the time the subcontractor(s) is retained to perform such service.

EEV/Basic Pilot Program* User Identification Number

BY: Authorized Officer of Agent
(Insert Subcontract Name)

Title of Authorized Officer or Agent of Subcontractor

Printed Name of Authorized Officer or Agent

Sworn to and subscribed before me this _____ day of _____, 200__.

Notary Public: _____

County: _____

Commission Expires: _____

NOTE:

* As of the effective date of O.C.G.A. 13-10-91, the applicable federal work authorization program is the “EEV/Basic Pilot Program” operated by the U.S. Citizenship and Immigration Services Bureau of the U.S. Department of Homeland Security, in conjunction with the Social Security Administration (SSA).

**TECHNICAL PROPOSAL FORM G
GEORGIA SECURITY AND IMMIGRATION
SUBCONTRACTOR AFFIDAVIT**

Instructions:

In the event that your company is awarded the contract for this project, and will be utilizing the services of any subcontractor(s) in connection with the physical performance of services pursuant to this contract, the following affidavit must be completed by such subcontractor(s). Your company must provide a copy of each such affidavit to Fulton County Government, Department of Purchasing & Contract Compliance with the proposal submittal.

All subcontractor affidavit(s) shall become a part of the contract and all subcontractor(s) affidavits shall be maintained by your company and available for inspection by Fulton County Government at any time during the term of the contract. All subcontractor(s) affidavit(s) shall become a part of any contractor/subcontractor agreement(s) entered into by your company.

STATE OF GEORGIA

COUNTY OF FULTON

FORM G: GEORGIA SECURITY AND IMMIGRATION SUBCONTRACTOR AFFIDAVIT

By executing this affidavit, the undersigned subcontractor verifies its compliance with O.C.G.A. 13-10-91, stating affirmatively that the individual, firm or corporation which is engaged in the physical performance of services under a contract with **[insert name of prime contractor]** _____ behalf of **Fulton County Government** has registered with and is participating in a federal work authorization program* [any of the electronic verification of work authorization programs operated by the United States Department of Homeland Security or any equivalent federal work authorization program operated by the United States Department of Homeland Security to verify information of newly hired employees, pursuant to the Immigration Reform and Control Act of 1986 (IRCA), P.L. 99-603], in accordance with the applicability provisions and deadlines established in O.C.G.A. 13-10-91.

EEV/Basic Pilot Program* User Identification Number

BY: Authorized Officer of Agent
(Insert Subcontract Name)

Title of Authorized Officer or Agent of Subcontractor

Printed Name of Authorized Officer or Agent

Sworn to and subscribed before me this _____ day of _____, 200__.

Notary Public: _____

County: _____

Commission Expires: _____

NOTE:

* As of the effective date of O.C.G.A. 13-10-91, the applicable federal work authorization program is the “EEV/Basic Pilot Program” operated by the U.S. Citizenship and Immigration Services Bureau of the U.S. Department of Homeland Security, in conjunction with the Social Security Administration (SSA).

TECHNICAL PROPOSAL FORM H PROPOSAL TRANSMITTAL LETTER

(To be typed on Proposer's letterhead)

Date:

Proposer:

Address:

Telephone:

Contact Person:

Type of Business Entity and State of Organization (Corporation, Limited Liability Company, Partnership, Joint Venture, Other):

1. In submitting this Proposal, the Proposer warrants and represents that:
 - A. The Proposer has reviewed and understands the requirements of this Technology RFP and all Addenda to this Technology RFP, and, if selected, will carry out all of the provisions of the Proposal including execution of all necessary subcontracts with the Contractor for the Construction Project that are consistent with all terms and conditions of the final Proposal accepted by the County and Proposer further guarantees that it will in no way deviate from the schedule, price and warranties or other terms and conditions contained in the final Proposal accepted by the County.
 - B. Proposer understands and guarantees that should it fail to contract with the Contractor within two (2) months from the Construction Contract Date at consistent with the terms and conditions of the Membrane System Supplier's final Proposal and the Fixed Membrane System Price, that it forfeits the Membrane System Supplier Proposal Security to the County. The Membrane System Supplier, if selected, guarantees and warrants that it will negotiate with the Contractor in good faith.
 - C. All information submitted in support of the Proposal is accurate and factual and is submitted fairly, and the Proposer represents that it will enter into a subcontract with the Contractor for the Construction

Project to provide the proposed Membrane System Scope of Supply on the terms and conditions set forth in its final Proposal.

- D. All representations made regarding the Proposer's willingness to meet the required Performance Criteria, and the Proposer's concurrence with the proposed business arrangement, are true.
- E. The individuals who will be the Proposer's key technical and business representatives for this procurement are set forth below:

Name	Title	Address	Phone

- F. The contact person who will serve as the interface between the County and the Proposer is:

NAME
TITLE
ADDRESS
PHONE
FAX
E-MAIL

- 2. The Proposal is submitted pursuant to due authorization by, and is in all respects binding upon, the Proposer.
- 3. The Proposer is duly organized and validly existing in good standing and is duly qualified to transact business in each and every jurisdiction where such qualification is required to enable the Proposer to perform its obligations. Neither the Proposer nor any and all of its proposed subcontractors have been debarred from contracting in the State of Georgia. The submittal of this Proposal has been authorized by all required action of the Proposer, including any action required by any charter, by-laws, partnership agreement, and/or operating agreement, as the case may be, and any Applicable Laws, which regulate the conduct of the Proposer's affairs. The performance of all obligations of the Proposer set forth in the Proposal do not conflict with and do not constitute a breach of or event of default under any charter, by-laws partnership agreement,

and/or operating agreement, as the case may be, of the Proposer or any agreement, indenture, mortgage, contract or instrument to which the Proposer is a party or by which it is bound.

4. There is no action, suit or proceeding, at law or in equity, before or by any court or similar governmental body against the Proposer wherein an unfavorable decision, ruling or finding would materially adversely affect the performance by the Proposer of its obligations with the Contractor under the Construction Contract or the other transactions contemplated thereby, or which, in any way, would materially adversely affect the validity or enforceability of the obligations proposed to be undertaken by the Proposer, or any agreement or instrument entered into by the Proposer in connection with the transaction contemplated hereby.
5. No corporation, partnership, individual or association, officer, director, employee, manager, parent company, subsidiary, affiliate or principal shareholder of the Proposer has been adjudicated to be in violation of any state or federal environmental law, or charged with or convicted of bribery, fraud, collusion, or any violation of any state or federal anti-trust or similar statute within the preceding five years, or previously adjudged in contempt of any court order enforcing such laws.
6. The Proposer certifies, under the penalties of perjury that to its best knowledge and belief, has filed all Georgia state tax returns and paid all Georgia state taxes and all other taxes required by law.
7. Proposer agrees that in the performance of the Membrane System Scope of Supply, Proposer will comply with all lawful agreements, if any, which the Proposer has made with any association, union, or other entity, with respect to wages, salaries, and working conditions, so as not to cause inconvenience, picketing, or work stoppage.

State Taxpayer Identification Number¹: _____

Federal Taxpayer Identification Number¹: _____

Name of Proposer

Name of Authorized Signatory

Signature

Title

Note 1: The Proposer shall indicate if applied for.

TECHNICAL PROPOSAL FORM I MEMBRANE SYSTEM

Parameter	Value
1. Membranes	
Material (e.g., PVDF)	
Type (hollow fiber, flat sheet)	
Proprietary descriptor of membrane	
Designation of large membrane subunit (e.g., cassette, rack)	
Designation of small membrane subunit (e.g., module, cartridge)	
Nominal pore size (microns)	
Absolute pore size (microns)	
Membrane thickness (mm)	
Membrane backing thickness (mm)	
Hollow fiber inside diameter (mm)	
Hollow fiber outside diameter (mm)	
Acceptable pH range during normal operation	
Acceptable pH range during maintenance cleaning	
Acceptable pH range during recovery cleaning	
Allowable free chlorine exposure (ppm-hours/year)	
Allowable combined chlorine exposure (ppm-hours/year)	
Small membrane subunit wetted feed-side surface area (sqft)	
Maximum dry weight of clean large membrane subunit filled with small membrane subunits (lb)	
Maximum wet weight of clean large membrane subunit filled with small membrane subunits (lb)	
Maximum transmembrane pressure during permeate production (psi)	
Maximum transmembrane pressuring during backwash (psi)	
Liquid displacement per small membrane subunit (cuft)	
Liquid displacement per large membrane subunit with all small membrane subunits removed (cuft)	

Parameter	Value
2. Membrane Basins	
Number of membrane basins	
Number of installed large membrane subunits per membrane basin	
Number of uninstalled spare large membrane subunits per membrane basin	
Number of installed small membrane subunits per large membrane subunit	
Number of uninstalled spare small membrane subunits per large membrane subunit	
Inside length of each membrane basin (ft)	
Inside width of each membrane basin (ft)	
Water depth at upstream end of membrane basin (ft)	
Water depth at downstream end of membrane basin(ft)	
Minimum freeboard in membrane basin (ft)	
Total volume (all membrane basins including freeboard)	
Recommended protective lining/coating system for inside of membrane basins (system, number of coats, thickness/coat)	
3. Service Cycle (Small Membrane Subunit Basis)	
Duration of repeating service cycle (min:sec)	
Amount of time producing permeate per cycle (min:sec)	
Amount of time relaxing per cycle (min:sec)	
Amount of time backwashing per cycle (min:sec)	
Instantaneous backwash flow rate [per small membrane subunit] (gpm)	
Source of backwash water (e.g., permeate)	
First chemical added to backwash water (e.g., none, NaOCl)	
Concentration of first chemical added to backwash water (e.g., mg/L as Cl ₂)	
Second chemical added to backwash water (e.g., none, citric acid)	
Concentration of second chemical added to backwash water (e.g., mg/L C ₆ H ₈ O ₇)	
Number of times per service cycle that air scour starts and stops	

Parameter	Value
Total amount of time using air scour per cycle (min:sec)	
Maximum instantaneous air scour flow rate [per small membrane subunit] (scfm)	
4. Membrane Maintenance Cleaning (Membrane Basin Basis)	
Cleaning interval (days)	
Duration of cleaning event (minutes)	
First chemical used for cleaning (e.g., none, NaOCl)	
Amount of first chemical used per cleaning event [per membrane basin] (e.g., lb as Cl ₂)	
Second chemical used for cleaning (e.g., none, citric acid)	
Amount of second chemical used per cleaning event [per membrane basin] (e.g., lb C ₆ H ₈ O ₇)	
Range of pH at membrane basin walls and floor (s.u.)	
Range of residual Cl ₂ at membrane basin walls and floor (mg/L)	
5. Membrane Recovery Cleaning (Membrane Basin Basis)	
Cleaning interval (days)	
Duration of cleaning event (minutes)	
First chemical used for cleaning (e.g., none, NaOCl)	
Amount of first chemical used per cleaning event [per membrane basin] (e.g., lb as Cl ₂)	
Second chemical used for cleaning (e.g., none, citric acid)	
Amount of second chemical used per cleaning event [per membrane basin] (e.g., lb C ₆ H ₈ O ₇)	
Range of pH at membrane basin walls and floor (s.u.)	
Range of residual Cl ₂ at membrane basin walls and floor (mg/L)	
6. Membrane Air Scour	
Submergence of air scour diffusers in membrane basins (ft)	
Average air scour flow rate per online membrane surface area (scfm/sqft)	
Average air scour flow rate per offline membrane surface area (scfm/sqft)	
Frequency of intermittent air scour for offline membrane basin (e.g., four times per day)	
Duration of intermittent air scour for offline membrane basin (min:sec)	

Parameter	Value
Number of air scour aerator flushes per day per membrane train	
Duration of each aerator flush (min:sec)	
Manufacturer of Air Scour Blowers	
Blower Type (ie. centrifugal, etc.)	
Blower Model Number (attach catalog cut)	
Number of Duty Blowers	
Number of Standby Blowers	
Capacity of Each Blower (scfm)	
Operating Discharge Pressure of Each Blower (psig)	
Blower noise level at design point (dBA at 1 meter)	
Blower Motor Size (HP)	
Blower Motor Speed (rpm)	
Blower Motor Efficiency (%)	
Blower Motor Power Supply (volts/phases/hertz)	
Blower Coupling Type	
Blower Coupling Materials	
7. Mixed Liquor Conveyance	
From BNR/AS Basins to Membrane Basins (MLF):	
-Type (ie, pumped, gravity, etc)	
-Firm Capacity (MGD)	
-Average Flow Rate (MGD)	
-TDH Required at BNR/AS Basins	
-Nominal Discharge Header Pipe Size (inches-diameter)	
-Concrete Channel Dimensions (ft x ft x ft)	
-Velocity @QMIN (fps)	
-Velocity @QPK (fps)	
From Membrane Basins to BNR/AS Basins (MLR):	
-Type (ie. pumped, gravity, etc)	
-Firm Capacity (MGD)	
-Average Flow Rate (MGD)	
-TDH Required at Membrane Basins	
-Nominal Discharge Header Pipe Size (inches)-diameter	
-Concrete Channel Dimensions (ft x ft x ft)	
-Velocity @QMIN (fps)	

Parameter	Value
-Velocity @QPK (fps)	
Mixed Liquor Recycle (MLR) Pumps	
-Number of duty pumps or control valves	
-Number of standby pumps or control valves	
-Pump manufacturer	
-Pump model number (attach catalog cut)	
-Pump flow at design point (gpm) (attach pump curve)	
-Pump head at design point (ft)	
-Pump flow at minimum speed (gpm) (attach pump curve)	
-Pump head at minimum speed (ft)	
-Pump noise level at design point (dBA at 1 meter)	
-Pump Best Efficiency (%)	
-Pump efficiency at design point (%)	
-Pump efficiency at minimum speed (%)	
-Pump net positive suction head suction head required at design point (ft)	
-Pump net positive suction head required at minimum speed (ft)	
-Pump casing material	
-Pump impeller material	
-Pump shaft material	
-Pump base plate material	
8. Permeate System	
Method of permeate production (pumped or gravity flow through control valves)	
Firm capacity of permeate system (MGD)	
Permeate Header Size (inches diameter)	
Number of duty pumps or control valves	
Number of standby pumps or control valves	
Pump manufacturer	
Pump model number (attach catalog cut)	
Pump flow at design point (gpm) (attach pump curve)	
Pump head at design point (ft)	
Pump flow at minimum speed (gpm) (attach pump curve)	
Pump head at minimum speed (ft)	

Parameter	Value
Pump noise level at design point (dBA at 1 meter)	
Pump Best Efficiency (%)	
Pump efficiency at design point (%)	
Pump efficiency at minimum speed (%)	
Pump net positive suction head suction head required at design point (ft)	
Pump net positive suction head required at minimum speed (ft)	
Pump casing material	
Pump impeller material	
Pump shaft material	
Pump base plate material	
Pump motor type	
Pump motor size (HP)	
Pump Motor speed (rpm)	
Pump Motor efficiency (%)	
Pump motor power supply (volts/phases/hertz)	
Pump coupling type	
Pump coupling materials	
9. Compressed Air System	
Average compressed air flow for air extraction	
Manufacturer of receiver-mounted air compressors	
Model number of receiver-mounted air compressors	
Number of duty compressors	
Number of standby compressors (minimum 1)	
Capacity of each compressor (scfm)	
Operating discharge pressure of compressor (psig)	
Compressor noise level at design point (dBA at 1 meter)	
Compressor motor size (HP)	
Compressor motor speed (rpm)	
Compressor motor efficiency (%)	
Compressor motor power supply (volts/phases/hertz)	
Number of air receivers	
Volume of each air receiver (actual cuft)	
Minimum and maximum receiver discharge pressure (psig)	

Parameter	Value	
Maximum and allowable receiver working pressure (psig)		
Manufacturer of desiccant air dryer		
Model number of desiccant air dryer		
Number of duty dryers		
Number of standby dryers (minimum 1)		
Rated outlet flow of each dryer (scfm)		
Pressure dew point of dryer (F)		
Dryer motor size (HP)		
Dryer motor speed (rpm)		
Dryer motor efficiency (%)		
Dryer motor power supply (volts/phases/hertz)		
10. Proposer-Selected Activated Sludge Process Design Parameters	Condition¹	
	1	2
Total volume of activated sludge tankage (Mgal)		
Maximum 30-day average mixed liquor suspended solids (MLSS) concentration in Mixed Liquor Feed (MLF) (mg/L)		
Corresponding 30-day average MLSS concentration in mixed liquor recycle (MLR) (mg/L)		
Maximum 7-day average MLSS concentration in MLF (mg/L)		
Corresponding 7-day average MLSS concentration in MLR (mg/L)		
Maximum daily average MLSS concentration in MLF (mg/L)		
Corresponding daily average MLSS concentration in MLR (mg/L)		
Minimum biological process solids retention time (days)		
Maximum opening size of secondary influent fine screen (millimeter)		
Type of flow from activated sludge tankage to Membrane System (MLF) (pumped or gravity)		
Maximum MLF flow rate (MGD)		
Type of flow from Membrane System to activated sludge tankage (MLR) (pumped or gravity)		
Maximum MLR flow rate (MGD)		
Note 1: As described in Appendix 1		

TECHNICAL PROPOSAL FORM J EQUIPMENT AND SYSTEMS

Proposer shall provide specifications for all equipment included in the Membrane System Scope of Supply. Proposer may submit specification sheets in the Proposer's standard form or copy and use this form as necessary. Proposer shall attach supplemental catalog information and performance data to each completed specification sheet.

General Information

Proposer-Specified Information

Name of Equipment/System

Manufacturer

Identification/Model No.

Number of Units

Design/Operational Parameters ⁽¹⁾

Proposer-Specified Information ⁽²⁾

Capacity

Size/Dimensions

Weight

Horsepower/Amps

Voltage/Phase

Materials of Construction ⁽³⁾

Proposer-Specified Information ⁽⁴⁾

**TECHNICAL PROPOSAL FORM K
DISCLAIMER STATEMENT**

The information contained in this Technology RFP has been prepared by the County and while such information is believed to be accurate and reliable, the County makes no representation as to such accuracy or reliability. In no way shall any such information constitute a representation or warranty by the County or any of its officials, employees, agents, consultants, attorneys, representatives, contractors, and subcontractors ("County Representatives") whatsoever. By submittal of this Proposal, the Proposer releases and forever discharges the County and the County Representatives from any and all claims, demands, causes of action of any kind or nature, known or unknown, which such Proposer has, had or may hereafter have arising out of any information contained in this Technology RFP or produced by the County in connection with this Technology RFP.

Name of Proposer

Name of Authorized Signatory

Signature

Title

**TECHNICAL PROPOSAL FORM L
INFORMATION CERTIFICATION**

The undersigned execution officer of the Proposer hereby certifies, under oath, that the information contained in this Proposal is true and accurate. Without limiting the foregoing, the undersigned hereby certifies that the information provided to the County with respect to the Proposer's previous performance on projects of comparable magnitude, the Proposer's environmental compliance record, and any civil or criminal penalties incurred by the Proposer during the last five years is true and accurate.

Name of Proposer

Name of Execution Officer

Signature

Title

(Notary Public)

State of _____
County of _____

On this _____ day of _____, 20____ before me appeared _____, personally known to me to be the person described in and who executed this _____ and acknowledged that (he/she) signed the same freely and voluntarily for the uses and purposes therein described.

In witness thereof, I have hereunto set my hand and affixed my official seal the day and year last written above.

TECHNICAL PROPOSAL FORM M TECHNICAL REQUIREMENTS CERTIFICATION

By submitting this Technical Proposal Form, the Proposer certifies that it has read and agrees to meet the Technical Requirements, as set forth in Appendix 1. In addition, the Proposer certifies that the costs specified in Cost Proposal Form A – Fixed Membrane System Price - fully encompass and reflect the Technical Requirements contained in Appendix 1.

Proposer shall attach a summary explaining any and all exceptions to the Technical Requirements, contained in Appendix 1, the Proposer wishes to make.

Name of Proposer

Name of Authorized Signatory

Signature

Title

TECHNICAL PROPOSAL FORM N ROYALTY AND LICENSE FEES

By submitting this Technical Proposal Form, the Proposer certifies that it has included in its Fixed Membrane System Price any royalty and/or license fees that the County or Contractor must pay. The Proposer certifies that the County will not be charged additional royalty and/or license fees for the continued use of the provided Membrane System Scope of Supply if and when the County should decide to expand the facility beyond the capacity of the current Membrane System Scope of Supply.

Name of Proposer

Name of Authorized Signatory

Signature

Title

**COST PROPOSAL FORM A
FIXED MEMBRANE SYSTEM PRICE**

Item	Cost
<i>Membranes and Equipment (Including Motors for Driven Equipment)</i>	
Membranes	
Mixed Liquor Recycle Pumping System	
Permeate Pumping System	
Air Separation System	
Membrane Air Scour System	
Membrane Chemical Storage, and Feed and Cleaning Systems	
Compressed Air System	
Control System, Instrumentation, and Control Valves	
Other Recommended Miscellaneous Equipment	
All Remaining Equipment and Materials Furnished by the Membrane Supplier	
SUBTOTAL	
<i>Engineering, Startup, and Training</i>	
Design and Bidding Assistance (To Be Provided Following Selection And Prior To The Construction Contract Date And Included In the Contractor's First Pay Application To The County)	
Factory Inspection and Testing	
Construction Assistance	
O&M Manual and Operator Training	
Start-Up and Functional Testing	
Acceptance Testing	
Commissioning Assistance	
Warranty	
SUBTOTAL	
<i>Other</i>	
Shipment of Equipment to Jobsite	
Equipment Storage	
Spare Parts	
SUBTOTAL	
<i>Total Membrane System Scope of Supply</i>	
TOTAL FIXED MEMBRANE SYSTEM PRICE	
Percentage to be used to determine Fixed Membrane System Price Adjustment Factor as specified in Appendix 1 (n_{db})	

SECTION 6

CONTRACT COMPLIANCE REQUIREMENTS

6.1 NON-DISCRIMINATION IN CONTRACTING AND PROCUREMENTS

It is the policy of Fulton County Government that discrimination against businesses by reason of the race, color, gender or national origin of the ownership of any such business is prohibited. Furthermore, it is the policy of the Board of Commissioners (“Board”) that Fulton County and all vendors and contractors doing business with Fulton County shall provide to all businesses the opportunity to participate in contracting and procurement paid, in whole or in part, with monetary appropriations of the Board. Similarly, it is the policy of the Board that the contracting and procurement practices of Fulton County should not implicate Fulton County as either an active or passive participant in the discriminatory practices engaged in by private contractors or vendors seeking to obtain contracts with Fulton County.

Equal Business Opportunity Plan (EBO Plan): In addition to the proposal submission requirements, each vendor **must** submit an Equal Business Opportunity Plan (EBO Plan) with their bid/proposal. The EBO Plan is designed to enhance the utilization of a particular racial, gender or ethnic group by a bidder/proposer, contractor, or vendor or by Fulton County. The respondent **must** outline a plan of action to encourage and achieve diversity and equality in the available procurement and contracting opportunities with *this solicitation*.

The Plan **must** identify and include:

1. Potential opportunities within the scope of work of *this solicitation* that will allow for participation of racial, gender or ethnic groups. (Ex: subcontracting, joint venturing, etc.)
2. Efforts that will be made by the bidder/proposer to encourage and solicit minority and female business utilization in *this solicitation*. (Ex: media solicitation directed to M/FBEs, contacting Fulton County certified M/FBEs listed in the M/FBE Directory, etc.)

Fulton County encourages joint ventures, teaming, partnering and mentor-protégé relationships with minority and female businesses in an effort to achieve contracting and procurement diversity.

Prompt Payment: The Contractor for the Construction Project **must** certify in writing and **must** document on the Exhibit G Form (Prime Contractor/Subcontractor Utilization Report) that all subcontractors, sub-consultants and suppliers have been promptly paid for work and materials, (less any retainage by the prime contractor prior to receipt of any further progress payments). In the event the Contractor is unable to pay subcontractors, sub-consultants or suppliers until it has received a progress payment from Fulton County, the Contractor shall pay all subcontractors, sub-consultants or

suppliers funds due from said progress payment within forty-eight (48) hours of receipt of payment from Fulton County. In no event shall a subcontractor, sub-consultant or supplier be paid later than fifteen (15) days as provided for by state law.

6.2 REQUIRED FORMS AND EBO PLAN

In order to be compliant with the intent and provisions of the Fulton County Non-Discrimination in Purchasing and Contracting Ordinance (99-0960), bidders/proposers **must** submit the following completed documents. Failure to provide this information **shall** result in the proposal being deemed non-responsive.

- Exhibit A – Promise of Non-Discrimination
- Exhibit B – Employment Report
- Exhibit C – Schedule of Intended Subcontractor Utilization
- Exhibit D – Letter of Intent to Perform as a Subcontractor or Provide Materials or Services
- Exhibit E – Declaration Regarding Subcontractors Practices
- Exhibit F – Joint Venture Disclosure Affidavit
- Equal Business Opportunity Plan (EBO Plan). This document is not a form rather a statement created by the bidder/proposer on its company letter head addressing the EBO Plan requirements.

The following document must be completed by the Contractor as instructed following award of the Construction Project:

- Exhibit G – Prime Contractor’s Subcontractor Utilization Report

All Contract Compliance documents (Exhibits A – F and EBO Plan) are to be placed in a **separate sealed envelope** clearly marked “Contract Compliance”. The EBO Plan must be submitted on company letterhead. These documents are considered part of and should be submitted with the Technical Proposal.

EXHIBIT A – PROMISE OF NON-DISCRIMINATION

“Know all persons by these presents, that I/We (_____),
Name

_____ Title _____ Firm Name
Hereinafter “Company”, in consideration of the privilege to bid/propose on or obtain contracts/subcontracts funded, in whole or in part, by Fulton County, hereby consent, covenant and agree as follows:

- 1) No person shall be excluded from participation in, denied the benefit of, or otherwise discriminated against on the basis of race, color, national origin or gender in connection with any bid/proposal submitted to Fulton County for the performance of any resulting there from,
- 2) That it is and shall be the policy of this Company to provide equal opportunity to all businesses seeking to contract or otherwise interested in contracting with this Company without regard to the race, color, gender or national origin of the ownership of this business,
- 3) That the promises of non-discrimination as made and set forth herein shall be continuing in nature and shall remain in full force and effect without interruption,
- 4) That the promise of non-discrimination as made and set forth herein shall be made a part of, and incorporated by reference into, any contract or portion thereof which this Company may hereafter obtain,
- 5) That the failure of this Company to satisfactorily discharge any of the promises of non-discrimination as made and set forth herein shall constitute a material breach of contract entitling the Board to declare the contract/subcontract in default and to exercise any and all applicable rights and remedies, including but not limited to cancellation of the contract/subcontract, termination of the contract/subcontract, suspension and debarment from future contracting opportunities, and withholding and/or forfeiture of compensation due and owing on a contract/subcontract; and
- 6) That the Bidder/Proposer shall provide such information as may be required by the Director of Contract Compliance pursuant to Section 4.4 of the Fulton County Non-Discrimination in Purchasing and Contracting Ordinance.

SIGNATURE: _____

ADDRESS: _____

TELEPHONE NUMBER: _____

EXHIBIT B – EMPLOYMENT REPORT

The demographic employment make-up for the Bidder/Proposer must be identified and submitted with this Bid/Proposal. In addition, if subcontractors will be utilized by the Bidder/Proposer to complete this project, then the demographic employment make-up of the subcontractor(s) must be identified and submitted with this Bid/Proposal.

EMPLOYEES

CATEGORY	NATIVE AMERICAN		AFRICAN AMERICAN		ASIAN AMERICAN		HISPANIC AMERICAN		CAUCASIAN AMERICAN		OTHER	
	M	F	M	F	M	F	M	F	M	F	M	F
Male/Female												
Mgmt/Official												
Professional												
Supervisors												
Office/ Clerical												
Craftsmen												
Laborers												
Other (specify)												
TOTALS												

FIRM'S NAME: _____

ADDRESS: _____

TELEPHONE NUMBER: _____

This completed form is for (Check one) _____ Bidder/Proposer _____
 Subcontractor

Submitted by: _____ **Date Completed:** _____

EXHIBIT C - SCHEDULE OF INTENDED SUBCONTRACTOR UTILIZATION

If the bidder/proposer intends to subcontract any portion of this scope of work/service(s), this form **must be** completed and **submitted with the bid/proposal**. All bidders/proposers **must** include Letter(s) of Intent (Exhibit D) in the bid/proposal for all subcontractors who will be utilized under the scope of work/services.

Bidder/Proposer: _____

ITB/RFP Number: _____

Project Name or Description of Work/Service(s): _____

1. My firm, as Bidder/Proposer on this scope of work/service(s) is _____ is not _____ a minority or female owned and controlled business enterprise. (Please indicate below the portion of work, including, percentage of bid/proposal amount that your firm will carry out directly):

2. If the Bidder/Proposer is a Joint Venture, please complete Exhibit F: Joint Venture Disclosure Affidavit and attach a copy of the executed Joint Venture Agreement.

3. Sub-Contractors (including suppliers) to be utilized in the performance of this scope of work/service(s), if awarded, are:

SUBCONTRACTOR NAME: _____

ADDRESS: _____

PHONE: _____

CONTACT PERSON: _____

ETHNIC GROUP*: _____ COUNTY CERTIFIED** _____

WORK TO BE PERFORMED: _____

DOLLAR VALUE OF WORK: \$ _____ PERCENTAGE VALUE: _____ %

***Ethnic Groups: African American (AABE); Asian American (ABE); Hispanic American (HBE); Native American (NABE); White Female American (WFBE); **If yes, please attach copy of recent certification.**

SUBCONTRATOR NAME: _____
ADDRESS: _____

PHONE: _____
CONTACT PERSON: _____
ETHNIC GROUP*: _____ COUNTY CERTIFIED** _____
WORK TO BE PERFORMED: _____

DOLLAR VALUE OF WORK: \$ _____ PERCENTAGE VALUE: _____ %

SUBCONTRATOR NAME: _____
ADDRESS: _____

PHONE: _____
CONTACT PERSON: _____
ETHNIC GROUP*: _____ COUNTY CERTIFIED** _____
WORK TO BE PERFORMED: _____

DOLLAR VALUE OF WORK: \$ _____ PERCENTAGE VALUE: _____ %

SUBCONTRATOR NAME: _____
ADDRESS: _____

PHONE: _____
CONTACT PERSON: _____
ETHNIC GROUP*: _____ COUNTY CERTIFIED** _____
WORK TO BE PERFORMED: _____

DOLLAR VALUE OF WORK: \$ _____ PERCENTAGE VALUE: _____ %

SUBCONTRATOR NAME: _____
ADDRESS: _____

PHONE: _____
CONTACT PERSON: _____
ETHNIC GROUP*: _____ COUNTY CERTIFIED** _____
WORK TO BE PERFORMED: _____

DOLLAR VALUE OF WORK: \$ _____ PERCENTAGE VALUE: _____ %

***Ethnic Groups: African American (AABE); Asian American (ABE); Hispanic American (HBE); Native American (NABE); White Female American (WFBE); **If yes, please attach copy of recent certification.**

Total Dollar Value of Subcontractor Agreements: (\$)

Total Percentage Value: (%)

CERTIFICATION: The undersigned certifies that he/she has read, understands and agrees to be bound by the Bid/Proposer provisions, including the accompanying Exhibits and other terms and conditions regarding sub-contractor utilization. The undersigned further certifies that he/she is legally authorized by the Bidder/Proposer to make the statement and representation in this Exhibit and that said statements and representations are true and correct to the best of his/her knowledge and belief. The undersigned understands and agrees that if any of the statements and representations are made by the Bidder/Proposer knowing them to be false, or if there is a failure of the intentions, objectives and commitments set forth herein without prior approval of the County, then in any such event the Bidder/Proposer acts or failure to act, as the case may be, shall constitute a material breach of contract, entitling the County to terminate the Contract/Proposal for default. The right to so terminate shall be in addition to, and in lieu of, any other rights and remedies the County may have for other defaults under the Contract/Proposal.

Signature: _____ **Title:** _____

Firm or Corporate Name: _____

Address: _____

Telephone: () _____

Fax Number: () _____

Email Address: _____

EXHIBIT D

**LETTER OF INTENT TO PERFORM AS A SUBCONTRACTOR
OR
PROVIDE MATERIALS OR SERVICES**

This form **must** be completed by **ALL** known subcontractors and submitted with the bid/proposal. The Bidder/Proposer **must** submit Letters of Intent for **ALL** known subcontractors at time of bid/proposal submission.

To: _____
(Name of Bidder/Proposer Firm)

From: _____
(Name of Subcontractor Firm)

ITB/RFP Number: _____

Project Name: _____

The undersigned is prepared to perform the following described work or provide materials or services in connection with the above project (specify in detail particular work items, materials, or services to be performed or provided):

Description of Work	Project Commence Date	Project Completion Date	Estimated Dollar Amount

(Bidder/Proposer)

(Subcontractor)

Signature _____

Signature _____

Title _____

Title _____

Date _____

Date _____

EXHIBIT E - DECLARATION REGARDING SUBCONTRACTING PRACTICES

If the Bidder/Proposer **does not intend to subcontract** any portion of the scope of work services(s), this form **must be** completed and submitted with the bid/proposal.

_____ hereby declares that it is my/our intent to
(Bidder/Proposer)

perform 100% of the work required for _____
(ITB/RFP Number)

(Description of Work)

In making this declaration, the bidder/proposer states the following:

1. That the Bidder/Proposer does not customarily subcontract elements of this type project, and normally performs and has the capability to perform and will perform **all elements** of the work on this project with his/her own current work forces;
2. If it should become necessary to subcontract some portion of the work at a later date, the Bidder/Proposer will comply with all requirements of the County's Non-Discrimination Ordinance in providing equal opportunities to all firms to subcontract the work. The determination to subcontract some portion of the work at a later date shall be made in good faith and the County reserves the right to require additional information to substantiate a decision made by the Bidder/Proposer to subcontract work following Contract award/Proposal selection. Nothing contained in this provision shall be employed to circumvent the spirit and intent of the County's Non-Discrimination Ordinances;
3. The Bidder/Proposer will provide, upon request, information sufficient for the County to verify Item Number one.

AUTHORIZED COMPANY REPRESENTATIVE

Name: _____ **Title:** _____ **Date:** _____

Signature: _____

Firm: _____

Address: _____

Phone Number: _____

Fax Number: _____

Email Address: _____

EXHIBIT F - JOINT VENTURE DISCLOSURE AFFIDAVIT

ITB/RFP No. _____

Project Name _____

This form must be completed and submitted with the Bid/Proposal if a joint venture approach is to be undertaken.

In order to evaluate the extent of small, minority and female business involvement being proposed by a Bidder/Proposer, certain relevant information must be provided prior to contract award/proposal selection. The information requested below is to clearly identify and explain the extent of small business participation in the proposed joint venture. All items must be properly addressed before the business entity can be evaluated.

1. Firms:

1) **Name of Business:** _____

Street Address: _____

Telephone No.: _____

Nature of Business: _____

2) **Name of Business:** _____

Street Address: _____

Telephone No.: _____

Nature of Business: _____

3) **Name of Business:** _____

Street Address: _____

Telephone No.: _____

Nature of Business: _____

NAME OF JOINT VENTURE (If applicable): _____

ADDRESS: _____

PRINCIPAL OFFICE: _____

OFFICE PHONE: _____

Note: Attach additional sheets as required

1. Describe the capital contributions by each joint venturer and accounting thereof.
2. Describe the financial controls of the joint venture, e.g., will a separate cost center be established? Which venturer will be responsible for keeping the books? How will the expense therefore be reimbursed? What is the authority of each joint venture to commit or obligate the order?
3. Describe any ownership, options for ownership, or loans between the joint ventures. Identify terms thereof.
4. Describe the estimated contract cash flow for each joint venturer.
5. To what extent and by whom will the on-site work be supervised?
6. To what extent and by whom will the administrative office be supervised?
7. Which joint venturer will be responsible for material purchases including the estimated cost thereof? How will the purchase be financed?
8. Which joint venturer will provide equipment? What is the estimated cost thereof? How will the equipment be financed?
9. Describe the experience and business qualifications of each joint venturer.
10. Submit a copy of all joint venture agreements and evidence of authority to do business in the State of Georgia as well as locally, to include all necessary business licenses.
11. Percent of Minority/Female Business Enterprises ownership by each joint venture in terms of profit and loss sharing: _____

12. The authority of each joint venturer to commit or obligate the other: _____

13. Number of personnel to be involved in project, their crafts and positions and whether they are employees of the Minority/Female Business Enterprises enterprise, the majority firm or the joint venture: _____

14. Identification of control and participation in venture; list those individuals who are responsible for day-to-day management and policy decision-maker, including, but not limited to, those with prime responsibility for areas designated below; (use additional sheets if necessary)

<u>Name</u>	<u>Race</u>	<u>Sex</u>	<u>Financial Decisions</u>	<u>Supervision Field Operation</u>
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

In connection with any work that these firms, as a joint venture, might be authorized to perform in connection with above captioned contract, we each do hereby authorize representatives of the Fulton County Department of Contract Compliance, Departments of Purchasing and Contract Compliance, and Finance, under the direction of the County Manger's Office, to examine, from time to time, the books, records and files to the extent that such relate to this County project.

WE DO SOLEMNLY DECLARE AND AFFIRM UNDER THE PENALTIES OF PERJURY THAT THE CONTENTS OF THE FOREGOING DOCUMENT ARE TRUE AND CORRECT, AND THAT WE ARE AUTHORIZED, ON BEHALF OF THE ABOVE FIRMS, TO MAKE THIS AFFIDAVIT AND GRANT THE ABOVE PRIVILEGE.

FOR _____
(Company)

Date: _____

(Signature of Affiant)

(Printed Name)

(Company)

Date: _____

(Signature of Affiant)

(Printed Name)

State of _____:

County of _____:

On this ____ day of _____, 20____, before me, appeared _____, the undersigned officer, personally appeared _____, known to me to be the person described in the foregoing Affidavit and acknowledges that he (she) executed the same in the capacity therein stated and for the purpose therein contained.

EXHIBIT – G PRIME CONTRACTOR/SUB-CONTRACTOR UTILIZATION REPORT

This report **must** be submitted by the **tenth day** of each month, along with a copy of your monthly invoice (schedule of values/payment application) to Contract Compliance. Failure to comply **shall** result in the County commencing proceedings to impose sanctions to the prime contractor, in addition to pursuing any other available legal remedy. Sanctions may include the suspending of any payment or part thereof, termination or cancellation of the contract, and the denial of participation in any future contracts awarded by Fulton County.

REPORTING PERIOD		PROJECT NAME:	
FROM:		PROJECT NUMBER:	
TO:		PROJECT LOCATION:	

	PRIME CONTRACTOR	Contract Award Date	Contract Award Amount	Change Order Amount	Contract Period	% Complete to Date
Name:						
Address:						
Telephone #:						

AMOUNT OF REQUISITION THIS PERIOD: \$ _____
 TOTAL AMOUNT REQUISITION TO DATE: \$ _____

SUBCONTRACTOR UTILIZATION (add additional rows as necessary)

Name of Sub-Contractor	Description of Work	Contract Amount	Amount Paid To Date	Amount Requisition This Period	Contract Period	
					Starting Date	Ending Date
TOTALS						

Executed By: _____ (Signature) _____ (Printed Name)
 Notary: _____ Date: _____
 My Commission Expires: _____

Should you have questions regarding any of the documents contained in Section 6, please feel free to contact the Office of Contract Compliance at (404) 763-6300, for further assistance.

SECTION 7

INSURANCE AND RISK MANAGEMENT PROVISIONS

It is Fulton County Government's practice to obtain Certificates of Insurance from our Contractors and Vendors. Insurance must be written by a licensed agent in a company licensed to write insurance in the State of Georgia. Respondents shall submit with the bid/proposal evidence of insurability satisfactory to Fulton County Government as to form and content. Either of the following forms of evidence is acceptable:

- A letter from an insurance carrier stating that upon your firm/company being the successful Bidder/Respondent that a Certificate of Insurance shall be issued in compliance with the Insurance and Risk Management Provisions outlined below.
- A Certificate of Insurance complying with the Insurance and Risk Management Provisions outlined below (Request for Bid/Proposal number and Project Description must appear on the Certificate of Insurance).

Upon selection of Proposal/award of Contract, the Contractor/Vendor must maintain at their expense, insurance with policy limits equal to or greater than the limits described below. Any and all Insurance Coverage(s) and Bonds required under the terms and conditions of the contract shall be maintained during the entire length of the contract, including any extensions or renewals thereto, and until all work has been completed to the satisfaction of Fulton County Government.

Accordingly the Respondent shall provide a certificate evidencing the following:

1. WORKERS COMPENSATION/EMPLOYER'S LIABILITY INSURANCE – STATUTORY (In compliance with the Georgia Workers Compensation Acts and any other State or Federal Acts or Provisions in which jurisdiction may be granted)

Employer's Liability Insurance	BY ACCIDENT - EACH ACCIDENT	\$500,000
Employer's Liability Insurance	BY DISEASE - POLICY LIMIT	\$500,000
(Aggregate)	BY DISEASE - EACH EMPLOYEE	\$500,000

2. COMMERCIAL GENERAL LIABILITY INSURANCE (Including contractual Liability Insurance)

Bodily Injury and Property Damage Liability	Each Occurrence	-	\$1,000,000
(Other than Products/Completed Operations)	General Aggregate	-	\$2,000,000
Products\Completed Operation	Aggregate Limit	-	\$1,000,000
Personal and Advertising Injury	Limits	-	\$1,000,000
Fire Damage	Limits	-	\$ 100,000

**3. BUSINESS AUTOMOBILE LIABILITY INSURANCE
Combined Single Limits** Each Occurrence - \$1,000,000
(Including operation of non-owned, owned, and hired automobiles).

4. ELECTRONIC DATA PROCESSING LIABILITY
(Required if computer contractor) Limits - \$1,000,000

5. UMBRELLA LIABILITY
(In excess of above noted coverage's) Each Occurrence - \$2,000,000

6. PROFESSIONAL LIABILITY Each Occurrence - \$1,000,000
(Required if respondent providing bid/quotation for professional services).

USE OF PREMISES

Contractor/Vendor shall confine its apparatus, the storage of materials and the operations of its workers to limits/requirements indicated by law, ordinance, permits and any restrictions of Fulton County Government and shall not unreasonably encumber the premises with its materials.

PROTECTION OF PROPERTY

Contractor/Vendor will adequately protect its own work from damage, will protect Fulton County Government's property from damage or loss and will take all necessary precautions during the progress of the work to protect all persons and the property of others from damage or loss.

Contractor/Vendor shall take all necessary precautions for the safety of employees of the work and shall comply with all applicable provisions of the Federal, State and local safety laws and building codes to prevent accidents or injury to persons on, about, or adjacent to the premises where work is being performed.

Contractor/Vendor shall erect and properly maintain at all times as required by the conditions and progress of the work, all necessary safeguards for the protection of its employees, Fulton County Government employees and the public and shall post all applicable signage and other warning devices to protect against potential hazards for the work being performed.

INDEMNIFICATION AND HOLD HARMLESS AGREEMENT

Contractor/Vendor hereby agrees to release, indemnify, defend and hold harmless Fulton County, its Commissioners, officers, employees, subcontractors, successors, assigns and agents, from and against any and all losses (including death), claims, damages, liabilities, costs and expenses (including but not limited to all actions, proceedings, or investigations in respect thereof and any costs of judgments, settlements, court costs, attorney's fees or expenses, regardless of the outcome of any such action, proceeding, or investigation), caused by, relating to, based upon or arising out of any act or omission by Contractor/Vendor, its directors, officers, employees, subcontractors, successors, assigns or agents, or otherwise in connection (directly or indirectly) with its acceptance, or the performance, or nonperformance, of its obligations under these agreements. Such obligations shall not be construed to negate, abridge or otherwise reduce any other rights or obligations of indemnity which would otherwise exist as to any party or person as set forth in this paragraph.

Contractor/Vendor's obligation to protect, defend, indemnify and hold harmless, as set forth hereinabove, shall also include, but is not limited to, any matter arising out of any actual or alleged infringement of any patent, trademark, copyright, or service mark, or other actual or alleged unfair competition disparagement of product or service, or other tort or any type whatsoever, or any actual or alleged violation of trade regulations.

Contractor/Vendor further agrees to protect, defend, indemnify and hold harmless Fulton County, its Commissioners, officers, employees, subcontractors, successors, assigns and agents from and against any and all claims or liability for compensation under the Worker's Compensation Act, Disability Benefits Act, or any other employee benefits act arising out of injuries sustained by any employees of Contractor/Vendor. These indemnities shall not be limited by reason of the listing of any insurance coverage.

If the bid/quotation involves construction services Contractor/Vendor will be responsible fully for any and all damage to the work during the course of construction, until the point of Final acceptance by Fulton County.

FULTON COUNTY ACKNOWLEDGES THAT ALL PROVISIONS OF THIS INDEMNITY AGREEMENT MAY NOT BE APPLICABLE TO THE CONTRACTOR/VENDOR'S BUSINESS. TO THE EXTENT THAT CONTRACTOR/VENDOR MAY DEMONSTRATE SUCH NONAPPLICABILITY, FULTON COUNTY MAY NEGOTIATE AMENDMENTS TO THIS AGREEMENT AS THE CIRCUMSTANCES DICTATE.

CONTRACTOR/VENDOR ACKNOWLEDGES HAVING READ, UNDERSTANDING, AND AGREEING TO COMPLY WITH THIS INDEMNIFICATION AND HOLD HARMLESS AGREEMENT, AND THE REPRESENTATIVE OF THE CONTRACTOR/VENDOR IDENTIFIED BELOW IS AUTHORIZED TO SIGN CONTRACTS ON BEHALF OF THE RESPONDING CONTRACTOR/VENDOR.

COMPANY: _____ SIGNATURE: _____

NAME: _____ TITLE: _____

DATE: _____

SECTION 8 EXHIBITS

The following exhibits are included as part of this Technology RFP:

- Exhibit 1 – Sample Contract for Contractor Awarded the Construction Project
- Exhibit 2 - Required Submittal Checklist

EXHIBIT 1 - SAMPLE CONTRACT FOR CONTRACTOR AWARDED CONSTRUCTION PROJECT



FULTON COUNTY

Vision

People Families Neighborhoods

Mission

To serve, protect and govern in concert with local municipalities

Values

*People Customer Services
Ethics Resource Management
Innovation Equal Opportunity*

**PURCHASING DEPARTMENT
REQUEST FOR INVITATION TO BID NO. [ENTER BID NUMBER]**

PROJECT TITLE

For

DEPARTMENT OF PUBLIC WORKS

**BID DUE TIME AND DATE: 11:00 A.M. [INSERT BID DATE], 2007
BID ISSUANCE DATE: [INSERT DATE]
PURCHASING CONTACT: FIRSTNAME LASTNAME at (404) 730-XXXX
E-MAIL: firstname.lastname@fultoncountyga.gov**

**LOCATION: FULTON COUNTY PURCHASING DEPARTMENT
130 PEACHTREE STREET, S.W., SUITE 1168
ATLANTA, GA 30303**

Table of Contents

<u>Section</u>	<u>Title</u>
Division 0 – Bidding and Contract Requirements	
00020	Invitation to Bid Description of Project Bid Documents Term of Contract No Contact Provision Bid Contact Basis of Award Pre-Bid Conference
00100	Instructions to Bidders Contract Documents Bid Preparation and Execution Addenda and Interpretations Site Examination Bidder's Modification and Withdrawal of Bids Bid and Contract Security Right to Reject Bids Applicable Laws Examination of Contract Documents Termination Indemnification and Hold Harmless Agreement Bid Opening Determination of Successful Bidder Wage Clause Notice of Award of Contract Execution of Contract Documents Joint Venture Contractors Compliance with Procurement Bid General Requirements Required Bid Submittal Checklist for ITB
00300	Bid Form
00410	Bid Bond
00420	Purchasing Forms & Instructions Form A - Non-Collusion Affidavit of Prime Bidder/Offeror Form B - Certificate of Acceptance of Request for Bid Requirements Form C - Contractor's Georgia Utility License Certification Form D - Certification regarding Debarment Form E - Disclosure Form & Questionnaire

00430	Contract Compliance Requirements
	Non-Discrimination in Contracting and Procurement Required Forms and EBO Plan Exhibit A – Promise of Non-Discrimination Exhibit B – Employment Report Exhibit C – Schedule of Intended Subcontractor Utilization Exhibit D – Letter of Intent to Perform As a Subcontractor or Provide Materials or Services Exhibit E – Declaration Regarding Subcontracting Practices Exhibit F – Joint Venture Disclosure Affidavit Exhibit G – Prime Contractor/Subcontractor Utilization Report
00490	Insurance and Risk Management Provisions
00500	Contractual Agreement
00610	Performance Bond Requirements
00620	Payment Bond Requirements
00700	General Conditions
00800	Special Conditions
Division 1 – General Requirements	
01010	Summary of Work
01011	Unique Requirements
01016	Occupancy
01025	Measurement and Payment
01055	Construction Staking
01060	Regulatory Requirements
01091	Codes and Standards
01200	Project Meetings
01310	Construction Schedules
01320	Construction Photographs
01340	Shop Drawings, Product Data and Samples
01410	Testing Laboratory Services
01510	Temporary Facilities
01540	Job Site Security
01562	Dust Control
01569	Safety in Wastewater Works
01580	Project Identification and Signs
01590	Field Offices
01630	Substitutions and Product Options
01710	Cleaning

- 01720 Record Documents
- 01740 Warranties and Bonds

[LIST ALL APPLICABLE SECTIONS INDIVIDUALLY UNDER EACH DIVISION, OR DELETE THE DIVISION TITLE]

Division 2 – Sitework

- 02110 Clearing and Grubbing
- 02110 Site Clearing
- 02125 Erosion and Sedimentation Control
- 02225 Trench Excavation and Backfill
- 02229 Bore and Jack Casings
- 02528 Pavement Patching
- 02575 Removing and Replacing Pavement
- 02665 Water Mains and Accessories
- 02720 Pipebursting
- 02730 Sewers and Accessories
- 02735 Sewer Service Connections
- 02930 Grassing
- 02933 Seeding

Division 3 – Concrete

Division 4 – Masonry

Division 5 – Metals

Division 6 – Wood and Plastic

Division 7 – Thermal and Moisture Protection

Division 8 – Doors and Windows

Division 9 – Finishes

Division 10 – Specialties

Division 11 – Equipment

Division 12 – Furnishings

Division 13 – Special Construction

Division 14 – Conveying Systems

Division 15 – Mechanical

Division 16 – Electrical

Division 17 – Instrumentation

Exhibits

[List Project Drawings]

Appendices

[List Appendices]

INVITATION TO BID
[INSERT PROJECT NUMBER AND PROJECT TITLE]

Sealed Bids for furnishing all materials, labor, tools, equipment and appurtenances necessary for the construction of [Insert Project Name] will be received by the Fulton County Department of Purchasing and Contract Compliance at 130 Peachtree Street, S.W. Suite 1168 Atlanta, GA 30303, until 11:00a.m., local time, on Monday, [Insert Bid Date, Month and Year], and then at said office publicly opened and read aloud.

Description of Project:

The Project consists of obtaining all permits, furnishing all materials and equipment, and performing all labor necessary for the construction of [Insert description of the project]

OR

The Project consists of the following major elements: construction of [Insert description of the project]

Bid Documents:

The Instructions to Bidders, Bid and Contract Requirements (Bid Form, Bid Bond, Performance Bond, Payment Bond, Contract Agreement), and other Documents (Drawings and/or Specifications) may be examined at the following locations:

[Insert list from Contract Compliance or modify the table below]

McGraw Hill Construction Dodge
555 Walnut Street
Macon, Georgia 31201

Fulton County
Public Works Department
141 Pryor ST, S.W., Ste 6001
Atlanta, Georgia 30303

AGC Builders Exchange
1940 The Exchange
STE 300
Atlanta, Georgia 30339

Reed Construction Data
30 Technology Blvd
STE 100
Norcross Georgia 30092

FW Dodge Corporation
2129 Northwest Parkway
STE 105
Marietta, Georgia 30067

Minority Business Development Agency
401 West Peachtree St
Summit Bldg STE 1715
Atlanta Georgia 30308

This document and supporting documents can be downloaded at the Fulton County Website, <http://www.fultoncountyga.gov> under "Bid Opportunities".

Applications for documents, along with a non-refundable \$50.00 payment must be made to Department of Public Works, 141 Pryor Street, S.W., Suite 6001, Atlanta, Georgia 30303. Payment must be in the form of a company or personal check payable to **Fulton Construction Management Partners**. Checks returned for any reason will result in the bid being deemed non-responsive. This amount includes all fees for printing and distribution and will be used to defray a portion of the printing cost that may have been incurred for the tendering of the Project. Partial sets of the bid document will not be issued.

For payment information, contact Pamela Cody, FCMP, Department of Public Works at 404-612-0880. All other questions should be addressed by the procedures outlined in this ITB to [insert

Purchasing Agent name], Fulton County Department of Purchasing and Contract Compliance at [insert Purchasing Agent phone #], [insert Purchasing Agent name]@fultoncountyga.gov.

Term of Contract:

The Bidder agrees hereby to commence work under this Contract, with adequate personnel and equipment, on a date to be specified in a written order of the Contracting Officer and to fully complete all work under this Contract within **[Insert contract term or calendar days]** consecutive calendar days from and including said date.

The County will make payments, within **45** days, in response to the Contractor's monthly Applications for Payment, which are accompanied by the Engineer's Certificate for Payment, for work performed to date plus cost of stored materials, less retainage. Payments, Applications for Payment, Certificates for Payment, and retainage shall be in accordance with the provisions of the Contract Documents.

No Contact Provision

It is the policy of Fulton County that the evaluation and award process for County contracts shall be free from both actual and perceived impropriety, and that contacts between potential vendors and County officials, elected officials and staff regarding pending awards of County contracts shall be prohibited.

- A. No person, firm, or business entity, however situated or composed, obtaining a copy of or responding to this solicitation, shall initiate or continue any verbal or written communication regarding this solicitation with any County officer, elected official, employee, or designated County representative, between the date of the issuance of this solicitation and the date of the County Manager's recommendation to the Board of Commissioners for award of the subject contract, except as may otherwise be specifically authorized and permitted by the terms and conditions of this solicitation.
- B. All verbal and written communications initiated by such person, firm, or entity regarding this solicitation, if same are authorized and permitted by the terms and conditions of this solicitation, shall be directed to the Purchasing Agent.
- C. Any violation of this prohibition of the initiation or continuation of verbal or written communications with County officers, elected officials, employees, or designated County representatives shall result in a written finding by the Purchasing Agent that the submitted Bid or proposal of the person, firm, or entity in violation is "non-responsive", and same shall not be considered for award.

Bid Contact

Information regarding the bid or bid requirements, either procedural or technical, may be obtained by submitting questions in writing to:

Fulton County Department of Purchasing and Contract Compliance
Attn: [INSERT NAME], Assistant Purchasing Agent
Fulton County Public Safety Building
130 Peachtree Street, S.W. Suite 1168
Atlanta, GA 30303
Phone: (404) 730-XXXX
Fax: (404) 893-1744
Reference Bid # [INSERT ITB NUMBER]

Or [Insert purchasing contact name]@fultoncountyga.gov

Basis of Award

The Contract, if awarded, will be awarded to the lowest responsive and responsible bidder. No bid may be withdrawn for a period of sixty (60) days after the date of bid opening except as permitted by O.C.G.A., §36-91-41 et seq., as amended. Each Bid must be accompanied by a Bid Bond in accordance with the Bid Bond Requirements provided in the Contract Documents, on a Surety Company's Standard Bid Bond Form acceptable to the County in an amount no less than 5% of the amount bid. The successful bidder will be required to furnish a Performance Bond and Payment Bond, **on or before** the issuance of Notice to Proceed, each in the amount of 100% of the Contract Amount. All other required Contract Documents must be fully completed and executed by the Contractor and his/her Surety, and submitted to the Owner **on or before** the issuance of the Notice to Proceed.

Pre-Bid Conference

Date: [INSERT DATE]
Time: [INSERT TIME]
Location: Fulton County Department of Purchasing and Contract Compliance,
Public Safety Building
130 Peachtree Street, S.W. Suite 1168
Atlanta, GA 30303

A [mandatory/optional] pre-bid conference will be held in the Fulton County Department of Purchasing and Contract Compliance Conference Room, located at 130 Peachtree Street, S.W. Suite 1168, Atlanta, Georgia 30303. ***Inquiries regarding the solicitation either technical or otherwise may be submitted in writing prior to the pre-bid conference and will be addressed at the pre-bid conference.*** Any additional questions asked at the pre-bid conference must be submitted in written form at the pre-bid conference and will be responded to in the form of an addendum with the County's official responses.

The Pre-bid conference will be conducted for the purpose of explaining the County's bid process, the specifications/technical documents, and to provide non-binding verbal responses to questions concerning these bid specifications and to discuss issues from the bidders perspective. However, no verbal response provided at the pre-bid conference binds the County. Only those responses to written questions that are responded to by the County in written communications will be official.

END OF SECTION

INSTRUCTIONS TO BIDDERS**A. Contract Documents**

The Contract Documents include the Contract Agreement, Contractor's Bid (including all documentation accompanying the Bid and any post-Bid documentation required by the County prior to the Notice of Award), Bonds, all Special Conditions, General Conditions, Supplementary Conditions, Specifications, Drawings and addenda, together with written amendments, change orders, field orders and the Construction Manager's written interpretations and clarifications issued in accordance with the General Conditions on or after the date of the Contract Agreement.

Shop drawing submittals reviewed in accordance with the General Conditions, geotechnical investigations and soils report and drawings of physical conditions in or relating to existing surface structures at or contiguous to the site are not Contract Documents.

The Contract Documents shall define and describe the complete work to which they relate.

B. Bid Preparation and Execution

All Bids must be made on the Bid forms contained herein. The original signed Bid with three (3) copies shall be submitted in a sealed envelope, addressed to the Department of Purchasing and Contract Compliance, Fulton County Public Safety Building, 130 Peachtree Street, S.W., Suite 1168 Atlanta, Georgia 30303, and labeled "Bid for ITB-[INSERT ITB NUMBER] [INSERT PROJECT TITLE].

If applicable insert the following:

Additionally, **THE BIDDER IS ALSO REQUIRED TO WRITE THEIR GEORGIA UTILITY CONTRACTOR LICENSE NUMBER ON THE OUTSIDE OF THE SEALED BID ENVELOPE.**

REQUIRED SUBMITTALS: The bidder **must complete and execute** the following:

1. Bid Form
2. Acknowledgement of each Addendum
3. Bid Bond
4. Purchasing Forms (See Submittal Check List at end of this Section), fully executed
5. Contract Compliance Forms (See Submittal Check List at end of this Section), fully executed
6. Risk Management Insurance Provisions Form

Any bids received after the stated time and date will not be considered. It shall be the sole responsibility of the bidder to have his/her bid delivered to the Fulton County Department of Purchasing and Contract Compliance for receipt on or before the stated time and date (see Section 00020). If a bid is sent by U.S. Mail, the bidder shall be responsible for its timely delivery to the Purchasing Department. Bids delayed by mail will not be considered, shall not be opened, and arrangements shall be made for their return at the bidder's request and expense.

Bid shall be publicly opened, with only the names and total bid price of the bidders disclosed at the opening.

C. Addenda and Interpretations

No interpretations of the meaning of the Drawings, Specifications or other pre-bid documents will be made to any Bidder orally.

Bidders requiring clarification or interpretation of the Contract Documents shall make a request in writing, either by mail, hand delivery, e-mail or fax, to the Purchasing Agent at the address below. To be given consideration, requests must be received no later than 2:00 PM, [INSERT Q&R DEADLINE (typ 7 days before bid) DAY MONTH AND YEAR]. The County will not respond to any requests, oral or written, received after this date. Telephone inquiries will not be accepted.

Fulton County Department of Purchasing and Contract Compliance
Attn: [INSERT NAME], Assistant Purchasing Agent
Fulton County Public Safety Building
130 Peachtree Street, S.W., 1168
Atlanta, GA 30303
Fax: (404) 893-1744
[INSERT NAME]@fultoncountyga.gov
Reference Bid # [INSERT ITB NUMBER]

Only communications from firms that are in writing and signed will be recognized by the County as duly authorized expressions on behalf of proposers/bidders. Any and all such interpretations and any supplemental instructions will be in the form of written Addenda to the Contract Documents which, if issued, will be mailed, shipped or faxed to all prospective Bidders (at the respective addresses furnished) prior to the date fixed for the opening of Bids.

Failure of Bidders to receive or acknowledge any Addendum shall not relieve them of any obligation under the Bid. All Addenda shall become part of the Contract Documents.

D. **Site Examination**

Select one of the following:

There will not be a scheduled site visit for this project. However, bidders are encouraged to visit the project site on their own.

OR

There will be a site visit for this project. It will be held on [INSERT DATE AND TIME]. Bidders [**CHOOSE (are) (are not)**] required to attend.

E. **Bidder's Modification and Withdrawal of Bids**

A Bidder may modify or withdraw its bid by written request, provided that the request is received by the County prior to the bid due date and time at the address to which bids are to be submitted. Provided further, that in case of an electronic request (i.e. facsimile, e-mail, etc.) a written confirmation thereof over the authorized signature of the Bidder must be received by the County at the address to which original Bids are to be submitted within three (3) calendar days after issue of the electronic message. Following withdrawal of its bid, the Bidder may submit a new bid, providing delivery is affected prior to the established bid opening date and time. **No bid may be withdrawn after bid due date for sixty (60) calendar days.**

F. **Bid and Contract Security**

A Bid Bond for an amount equal to five percent (5%) of the bid amount must accompany each Proposal. The bid bond shall be submitted in a separate, sealed envelope marked "Bid Bond".

Bids must be accompanied by a bid bond or certified check in an amount of five percent (5%) of the TOTAL AMOUNT of the base bid. The bid bond or certified check shall apply **ONLY TO THIS BID**. The bid name and contract number must appear on the security instrument. The bond must remain in full force and effect until the Bidder executes

the final Contract. Bids not satisfying the bonding requirements of this project will be declared non-responsive.

Any bid bond, performance bond, payment bond, or security deposit required for public works construction contract shall be approved and filed with purchasing agent. At the option of the County, if the surety named in the bond is other than a surety company authorized by law to do business in this state pursuant to a current certificate of authority to transact surety business by the Commissioner of Insurance, such bond shall not be approved and filed unless such surety is on the United States Department of Treasury's list of approved bond sureties.

A Purchasing Agent shall approve as to form and as to the solvency of the surety any bid bond, performance bond, or payment bond required by this. In the case of a bid bond, such approval shall be obtained prior to acceptance of the bid or proposal. In the case of payment bonds and performance bonds, such approval shall be obtained prior to the execution of the contract.

Whenever, in the judgment of the County:

- (1) Any surety on a bid, performance, or payment bond has become insolvent;
- (2) Any corporation surety is not longer certified or approved by the Commissioner of Insurance to do business in the state; or
- (3) For any cause there are no longer proper or sufficient sureties on any or all the bonds

The County may require the contractor to strengthen any or all of the bonds or to furnish a new or additional bond or bonds within ten days. Thereupon, if so ordered by the County, all work on the contract shall cease unless such new or additional bond or bonds are furnished. If such bond or bonds are not furnished within such time, the County may terminate the contract and complete the same as the agent of and at the expense of the contractor and his or her sureties.

As a condition of responsiveness the bidder must contain a Bid Bond for an amount equal to 5% of the bid amount. The Bid Bond shall be included in a separate envelope marked on the outside "Bid Bond". Checks or letters of credit of any type will not be accepted. A certified cashier's check will be acceptable. Provide a completed and fully executed Bid Bond. When the bidder's package is opened, a purchasing agent will verify the presence of the Bid Bond and remove it from the Proposal Package.

If the bidder withdraws its bid from the competition after the selection of its bid for a reason not authorized by Georgia law, the County will proceed on the Bid Bond, along with any other available remedies.

The Surety of the Bid Bond shall be from a surety company authorized to do business in the State of Georgia, shall be listed in the Department of Treasury Circular 570, and shall have an underwriting limitation in excess of 100% of the bid amount. The Bonds and Surety shall be subject to approval by the County Attorney.

Attorneys-in-fact for bidders who sign bid bonds or contract bonds must file with each bond a certified and effectively dated copy of their power of attorney.

G. Right to Reject Bids

The County reserves the right to reject any or all bids and to waive informalities. No bids will be received after the time set for opening bids. Any unauthorized conditions, limitations or provisions attached to the Bid, except as provided herein, will render it informal and may cause its rejection. Unbalanced bids will be subject to rejection. Any bidder may withdraw his/her bid, either personally or by telegraphic or written request, at any time prior to the

scheduled closing time for receipt of bids. Telegraphic or written requests for withdrawal must be in the possession of the County prior to the closing time for receipt of bids.

H. **Applicable Laws**

All applicable laws and regulations of the State of Georgia and ordinances and regulations of Fulton County shall apply. Protestors shall seek resolution of their complaints in the manner provided in the Fulton County Code of Laws §2-324, which is incorporated by reference herein.

I. **Examination of Contract Documents**

Prospective bidders shall examine the contract documents and before submitting a bid, shall make a written request to the County for an interpretation or correction of any ambiguity, in consistency or error therein which could be discovered by a bidder. At the bid opening each bidder shall be presumed to have read and be familiar with the contract documents.

J. **Termination**

The County may terminate the contract resulting from this solicitation at any time the vendor fails to carry out the contract provisions, if in the opinion of the County, the performance of the contract is unreasonably delayed, or the vendor is in direct violation of the contract conditions. The County shall provide the vendor with notice of any conditions which violate or endanger the performance of the contract and, if after such notice the contractor fails to remedy such conditions within thirty (30) days, to the satisfaction of the County, the County may exercise their option in writing to terminate the Contract without further notice to the Contractor and order the Contractor to stop work immediately and vacate the premises. Vendor agrees by its bid submission that the County's decision is final and valid.

K. **Indemnification and Hold Harmless Agreement**

See Section 00490, Insurance and Risk Management Provisions, Indemnification and Hold Harmless Agreement.

L. **Bid Opening**

Bids will be opened in public and read aloud. All bidders are requested to be present at the opening.

M. **Determination of Successful Bidder**

Fulton County desires to complete this work in a timely manner. The Contract will be awarded to the lowest responsive, responsible bidder(s), if awarded. Award will be made on the basis of the prices given in the Base Bid, not including alternates.

1. **Responsibility:** The determination of the bidder's responsibility will be made by the County based on whether the bidder meets the following minimum requirements:

[Insert any additional requirements for the specific project, below are examples of minimum requirements]

- a. The County reserves the right to reject any bid if the evidence submitted by, or investigation of, the bidder fails to satisfy the County that he/she is properly qualified to carry out the obligations of the Contract.

- b. Is properly licensed to perform this type of work in Fulton County. Bidders must have a utility contractors license to perform this work. O.C.G.A. §43-14-8.3 (h)
- c. Maintains a permanent place of business individually or in conjunction with the prime contractor.
- d. Has the appropriate and adequate technical experience. Designated Project Manager must be proficient in all aspects of contracted work.
- e. Has adequate personnel and equipment to do the work expeditiously.
- f. Has suitable financial means to meet obligations incidental to the work.

2. **Responsiveness:** The determination of responsiveness will be made by the County based on a consideration of whether the bidder has submitted a complete Bid form without irregularities, excisions, special conditions, or alternative bids for any item unless specifically requested in the Bid form.

N. Wage Clause

Pursuant to 102-391, Each Contractor shall agree that in the performance of the Contract he will comply with all lawful agreements, if any, which the Contractor had made with any association, union, or other entity, with respect to wages, salaries, and working conditions, so as not to cause inconvenience, picketing, or work stoppage.

O. Notice of Award of Contract

As soon as possible, and within sixty (60) days after receipt of bids, the County shall notify the successful Bidder of the Award of Contract.

The award shall be made by the Board of Commissioners of Fulton County to the lowest responsive, responsible bidder(s) as soon as possible after receipt of bids, taking into consideration price and the responsiveness to the requirements set forth in the Invitation for Bid. In such case, no claim shall be made by the selected Contractor(s) for loss of profit if the contract is not awarded or awarded for less work than is indicated and for less than the amount of his bid. The total of the awarded contract shall not exceed the available funds allocated for this project.

Should the County require additional time to award the contract, the time may be extended by mutual agreement between the County and the successful bidder. If an Award of Contract has not been made within sixty (60) days from the bid date or within the extension mutually agreed upon, the Bidder may withdraw the Bid without further liability on the part of either party.

Any award made by the Board of Commissioners as a result of this bid will begin from the date of the notice to proceed. The Bidder agrees hereby to commence work under this Contract, with adequate personnel and equipment, on a date to be specified in a written order from the user department. The contract shall become effective on the Contract Date and shall continue in effect until the end of the term of the contract or until the project has been closed-out unless earlier terminated pursuant to the termination provisions of the contract.

P. Execution of Contract Documents

Upon notification of Award of Contract, the County shall furnish the Contractor the conformed copies of Contract Documents for execution by the Contractor and Contractor's surety.

Within ten (10) days after receipt the Contractor shall return all the documents properly executed by the Contractor and the Contractor's surety. Attached to each document shall

be an original power-of-attorney for the person executing the bonds for the surety and certificates of insurance for the required insurance coverage.

After receipt of the documents executed by the Contractor and his surety with the power-of-attorney and certificates of insurance, the County shall complete the execution of the documents. Distribution of the completed documents will be made upon completion.

Should the contractor and/or surety fail to execute the documents within the time specified, the County shall have the right to proceed on the Bid Bond accompanying the bid.

If the County fails to execute the documents within the time limit specified, the Contractor shall have the right to withdraw the Contractor's bid without penalty.

Should an extension of any of the time limits stated above be required, this shall be done only by mutual agreement between both parties.

Any agreement or contract resulting from the acceptance of a bid shall be on a County approved document form. The County reserves the right to reject any agreement that does not conform to the Invitation for Bid and any County requirements for agreements and contracts. The County reserves the right to modify the agreement resulting from this bid upon the recommendation of the County Attorney.

Q. Joint Venture

Any Bidder intending to respond to this solicitation as a joint venture must submit an executed joint venture agreement with its offer. The agreement must designate those persons or entities authorized to execute documents or otherwise bind the joint venture in all transactions with Fulton County, or be accompanied by a document, binding upon the joint venture and its constituent members, making such designation. Offers from joint ventures that do not include these documents will be rejected as being non-responsive.

R. Contractors Compliance With All Assurances And/Or Promises Made In Response To Procurement

Should any Bidder submit a response to the County promising to provide a certain level of service for either the scope of work, MFBE participation, or any other matter, including where such promise or assurance is greater than what is required by the procurement documents, and should this response containing the promise or assurance be accepted by the County and made a part of the Contract Documents, then this degree or level of service promised by the bidder relating to the scope of work, MFBE participation, or other matter shall be considered to be a material part of the Agreement between the bidder and the County, such that the bidder's failure to provide the agreed upon degree or level of service or participation shall be a material breach of the Agreement giving the County just cause to terminate the Agreement for cause, pursuant to the General Conditions of the Agreement.

S. Bid General Requirements

The following information pertains to the submission of a Bid to Fulton County, and contains instructions on how Bids must be presented in order to be considered. Listed below are the requirements for all Bidders interested in doing business with Fulton County.

1. The Bid sheets included in this Invitation to Bid ("Bid") must be fully completed and returned with the Bid unless otherwise specified in writing by the Purchasing Department. Type or neatly print the date, company name, and the full legal name and title of the person(s) signing the Bid in the place provided at the bottom of each Bid sheet. Any additional sheets submitted must contain the same signature and Bidder information.

2. All signatures must be executed by person(s) having contracting authority for the Bidder.
3. Absolutely no fax Bids or reproduction Bids will be accepted, except that photocopies may be submitted in addition to the original when multiple copies of the Bid are specifically requested in the solicitation.
4. The envelope in which the Bid response is submitted must be sealed and clearly labeled with the Bid number, project title, due date and time, and the name of the company or individual submitting the proposal. Bids must be received by the opening date and time shown on this Bid in order to be considered. The Purchasing Agent has no obligation to consider Bids which are not in properly marked envelopes. Contract Compliance submittals shall be submitted in a separate sealed envelope or package.
5. The original and the required number of copies of the Bid must be returned to:

Fulton County Purchasing Agent
Fulton County Department of Purchasing and Contract Compliance
130 Peachtree Street, S.W., Suite 1168
Atlanta, Georgia 30303

Any inquiries, questions, clarifications or suggestions regarding this solicitation should be submitted in writing to the Purchasing Contact Person. Contact with any other County personnel in regard to a current solicitation is strictly prohibited in accordance with Fulton County "No Contact Provision" policy outlined in Section 35 and in Section 00020, Invitation to Bid.

6. Show information and prices in the format requested. Prices are to be quoted F.O.B. Destination, and must include all costs chargeable to the Contractor executing the Contract, including taxes. Unless otherwise provided in the Contract, Fulton County shall have no liability for any cost not included in the price. The Contractor shall provide Fulton County the benefit through a reduction in price of any decrease in the Contractor's costs by reason of any tax exemption based upon Fulton County's status as a tax-exempt entity.
7. All prices Bid must be audited by the Bidder to ensure correctness before the Bid is submitted. The Bidder is solely responsible for the accuracy of information placed on a Bid sheet, including prices. Clerical or mathematical error is insufficient to void a successful Bid but a Bidder may withdraw a sealed Bid prior to opening without a penalty.
8. All prices must be submitted in the format requested and less all trade discounts. When multiple items are being Bid, Bidder must show both the unit price and the total extended price for each item. When applicable, the Bidder must include an additional lump sum Bid for groups or items. In the event a Bidder is offering an additional discount on groups of items, Bidder must indicate the total lump sum Bid for the particular group of items before any extra discount, the amount of extra discount, and the net total for the particular group. In the event of an extension error, unit pricing shall prevail.
9. By submitting a signed Bid, Bidder agrees to accept an award made as a result of that Bid under the terms and conditions spelled out in the Bid documents. In the event of a conflict between the different Bid documents, the County's cover Contract (if used) shall have precedence, followed in order by the Invitation to Bid, Purchase Order, Bid,

Contractor's Warranty Agreement, Maintenance Agreement, and/or other Contractor provided agreements.

10. A Bidder may submit only one (1) Bid response for each specific Bid solicitation unless otherwise authorized in the specifications.
11. All prices submitted by the Bidder to Fulton County must be guaranteed by the authorized person(s) against any price increase for the time period designated in the Bid specifications, and Fulton County must be given the benefit of any price decrease occurring during such designated time period.
12. All items Bid must be new. Used, rebuilt and refurbished items will not be considered unless specifically authorized by Fulton County in the written specifications.
13. All Bidders must specify in the Bid response the earliest actual delivery date for each item unless otherwise specified in writing by Fulton County. The delivery date may be a factor in deciding the Bidder's capability to perform.
14. A successful Bidder's delivery ticket(s) and invoice(s) must list each item separately and must show Fulton County's purchase order number as well as the proper department and address to which delivery was made, as listed on the purchase order or in the Bidder's contract with Fulton County.
15. Unless clearly shown as "no substitute" or words to that effect, any items in this invitation to Bid which have been identified, described or referenced by a brand name or trade name are for reference only. Such identification is intended to be descriptive but not restrictive, and is to indicate the general quality and characteristics of products that may be offered. Each item Bid must be individually identified as to whether it is a specified item or an equivalent item by typing or printing after the item(s): The brand name; model or manufacturer's number, or identification regularly used in the trade. Deviations from the specifications must be clearly and fully listed on the Bid sheet, including photographs or cuts, specifications, and dimensions of the proposed "alternate". Fulton County is the sole judge of "exact equivalent", or "alternate". The factors to be considered are: function, design, materials, construction, workmanship, finishes, operating features, overall quality, local service facilities, warranty terms and service, and other relevant features of item(s) Bid.
16. For all Bids, Fulton County reserves the right to request representative samples. If requested, samples must be delivered at the Bidder's cost within three (3) business days. Samples are submitted at the risk of the Bidder and may be subjected to destructive tests by Fulton County. Samples must be plainly tagged with Fulton County's Bid number, item name, manufacturer, and the name of the Bidder.
17. Item(s) Bid must be complete and ready to operate. No obvious omissions of components or necessary parts shall be made even though the specifications may not detail or mention them. Unit(s) must be furnished with factory installed equipment and must be comparable with the basic form, fit, and functional requirements which are all to be included in the base price as well as any other equipment included as standard by the manufacturer or generally provided to the buying public.
18. All successful Bidders must assume full responsibility for all item(s) damaged prior to F.O.B. Destination delivery and agree to hold harmless Fulton County of all responsibility for prosecuting damage claims.

19. All successful Bidders must assume full responsibility for replacement of all defective or damaged goods within thirty (30) days of notice by Fulton County of such defect or damage.
20. All successful Bidders must assume full responsibility for providing or ensuring warranty service on any and all items including goods, materials, or equipment provided to the County with warranty coverage. If a successful Bidder is not the manufacturer, all manufacturers' warranties must be passed through to Fulton County. The Bidder and not Fulton County is responsible for contacting the manufacturer of the warranty service provided during the warranty period and supervising the completion of the warranty service to the satisfaction of Fulton County.
21. As a successful Bidder providing any equipment which requires fitting and assembly, the Bidder shall be solely responsible for such installation being performed by a manufacturer's authorized or approved servicer or an experienced worker, utilizing workmanship of the highest caliber. The Bidder must verify all dimensions at the site, shall be responsible for their correctness, and shall be responsible for the availability of replacement parts when specified in writing by Fulton County in the specifications, purchase order, or other contract.
22. A successful Bidder is solely responsible for disposing of all wrappings, crating, and other disposable material upon deliver of item(s).
23. All Bidders are required to be authorized distributors or regularly engaged in the sale or distribution of the type of goods, materials, equipment or services for which the Bidder is submitting a Bid response in addition, all Bidders are required to provide Fulton County with three (3) written references documenting the successful completion of Bids or contracts for the types of items including goods, materials, equipment, or services for which the Bidder is submitting a Bid response. In instances where a Bidder has never supplied such goods, material, equipment, or services before, the Bidder must submit with the Bid response a statement and supporting documentation demonstrating such expertise, knowledge, or experience to establish the Bidder as a responsible Bidder, capable of meeting the Bid requirements should an award be made. No exceptions to this provision will be made unless authorized in the Bid specifications.
24. Bidders may be required to furnish evidence that they maintain permanent places of business of a type and nature compatible with their Bid proposal, and are in all respects competent and eligible vendors to fulfill the terms of the specifications. Fulton County may make such investigations as it deems necessary to determine the ability of the Bidder to perform such work, and reserves the right to reject any Bidder if evidence fails to indicate that the Bidder is qualified to carry out the obligation of the Contract and to complete the work satisfactorily.
25. All Bidders must comply with all Fulton County Purchasing laws, policies, and procedures, non-discrimination in contracting and procurement ordinances, and relevant state and federal laws including but not limited to compliance with EEOC hiring guidelines and requirements under the Americans with Disabilities Act. Successful Bidder must obtain all permits, licenses, and inspections as required and furnish all labor, materials, insurance, equipment, tools, supervision, and incidentals necessary to accomplish the work in these specifications.
26. If a successful Bidder is unable or unwilling to enter into a Contract with Fulton County subsequent to being granted an award, or who fails to perform in accordance with the Bid specifications the Bidder will be subject to damages and all other relief allowed by law.

27. Successful Bidders contract directly with Fulton County and are the party or parties obligated to perform. Contracts may not be assigned and any failure to perform the Contract in accordance with the specifications will constitute a breach of Contract and may result in a Bidder being found to be “non-responsive” in the future.
28. In case of default by the successful Bidder, Fulton County may procure the articles for services from another source and hold the successful Bidder responsible for any resulting excess cost.
29. The County may award any Bid in whole or in part to one or more vendors or reject all Bids and/or waive any technicalities if it is in the best interests of the County to do so. In the event that all Bids are not rejected, Bids for items including goods, materials, equipment, and services will be awarded to the lowest “responsible” Bidder(s) as determined by Fulton County. Submitting the lowest Bid, as published at the Bid opening, does not constitute an award or the mutual expectation of an award of a Contract and purchase order. For purposes of this notice and the attached Bid sheets, a purchase order is a Contract to provide items including goods, materials, equipment, and services and is intended to have the full force and effect of a Contract. A breach of the terms and conditions of a purchase order constitutes a breach of Contract.
30. Bids for projects that are solicited pursuant to the Georgia Local Government Public Works Construction Law (O.C.G.A. § 36-91-1 et seq.) may withdrawn as follows:

Competitive sealed Bids (“Bid”) may not be revoked or withdrawn until 60 days after the time set by the governmental entity for opening of Bids. At the end of this time period, the Bid will cease to be valid, unless the Bidder provides written notice to the County prior to the scheduled expiration date that the Bid will be extended for a time period specified by the County.
31. In the evaluation of the Bids, any award will be subject to the Bid being:
 - a. Compliant to the specification – meets form, fit, and function requirements stated or implied in the specification.
 - b. Lowest cost to the County over projected useful life.
 - c. Administratively Compliant – Including all required bonds, insurance, established quality of work and general reputation, financial responsibility, relevant experience, and related criteria.
32. All proposals and Bids submitted to Fulton County are subject to the Georgia “Open Records Act”, Official Code of Georgia, Annotated (O.C.G.A.) §50-18-70 et seq.
33. All proposals and Bids submitted to Fulton County involving Utility Contracting are subject to the Georgia law governing licensing of Utility Contractors, O.C.G.A. §43-14-8.2(h). The Utility Contractor License number of the person who will perform the utility work shall be written on the face of the Bid envelope.
34. The apparent silence of this specification, and any supplement thereto, as to details, of the omission from it of a detailed description concerning any point, will be regarded as meaning only the best commercial practices are to prevail. Only materials of the highest quality, correct type, size, and design are to be used. All interpretations of this specification will be made upon the basis of this statement, with Fulton County interpretation to prevail.
35. It is the policy of Fulton County that the evaluation and award process for County contracts shall be free from both actual and perceived impropriety, and that contacts

between potential vendors and County officials, elected officials and staff regarding pending awards of County contracts shall be prohibited.

- a. No person, firm, or business entity, however situated or composed, obtaining a copy of or responding to this solicitation, shall initiate or continue any verbal or written communication regarding this solicitation with any County officer, elected official, employee, or designated County representative, between the date of the issuance of this solicitation and the date of the County Manager's recommendation to the Board of Commissioners for award of the subject contract, except as may otherwise be specifically authorized and permitted by the terms and conditions of this solicitation.
 - b. All verbal and written communications initiated by such person, firm, or entity regarding this solicitation, if same are authorized and permitted by the terms and conditions of this solicitation, shall be directed to the Purchasing Agent.
 - c. Any violation of this prohibition of the initiation or continuation of verbal or written communications with County officers, elected officials, employees, or designated County representatives shall result in a written finding by the Purchasing Agent that the submitted Bid or proposal of the person, firm, or entity in violation is "non-responsive", and same shall not be considered for award.
36. Any Bidder intending to respond to this solicitation as a Joint Venture must submit an executed Joint Venture Agreement with this Bid. This agreement must designate those persons or entities authorized to execute documents or otherwise bind the Joint Venture in all transactions with Fulton County, or are accompanied by a document, binding upon the Joint Venture and its constituent members, making such designation. Bids from Joint Ventures that do not include these documents will be rejected as being "non-responsive".
37. Any Bidder intending to respond to this solicitation must complete all of the Procurement Affidavit Forms provided in this solicitation. Bids that do not include these completed documents will be rejected as being "non-responsive".

Required Bid Submittal Check List for Invitation To Bid (ITB)

The following submittals shall be completed and submitted with each bid (see table below "Required Bid Submittal Check List."). Please check to make sure that the required submittals are in the envelope before it is sealed. Failure to submit all required submittals may deem your proposal non-responsive.

Submit one (1) Original bid, signed and dated and [Insert # of copies required here (typically at least three (3) copies)] () **complete** copies of the Original Bid including all required documents.

Item #	Required Bid Submittal Check List	Check (√)
1	Bid Form (Section 00300) – All dollar amounts must be both in writing AND figures and represent prices for the published scope of work without exceptions.	
2	Acknowledgement of each Addendum (acknowledged both on the Bid Form, Section 00300, and on the form included with each addendum).	
3	Bid Bond (Section 00410) (separate envelope if Public Works Construction project)	
4	Purchasing Forms (Section 00420) Form A - Non-Collusion Affidavit of Prime Bidder/Offeror Form B - Certificate of Acceptance of Request for Bid/Proposal Requirements Form C - Georgia Utility Contractor License Form D - Certificate Regarding Debarment Form E - Disclosure Form & Questionnaire	
5	Office of Contract Compliance Requirements (Section 00430) Exhibit A - Promise of Non-Discrimination (for Prime and each Sub) Exhibit B - Employment Record (for Prime and each Sub) Exhibit C - Schedule of Intended Subcontractor Utilization Exhibit D - Letter of Intent to Perform as Subcontractor Exhibit E - Declaration Regarding Subcontractor Practices Exhibit F - Joint Venture Disclosure Affidavit Exhibit G - Prime Contractor/Subcontractor Utilization Report Equal Business Opportunity Plan (EBO Plan)	
6	Risk Management Insurance Provisions Form (Section 00490) and proof of insurance, either letter from insurer or Certificate of Insurance.	
7	<u>Any additional requirements that the User Department would like to include should be added to this check list.</u>	
8		
9		

END OF SECTION

BID FORM

Submitted To: Fulton County Government

Submitted By: _____

For: [INSERT PROJECT # AND TITLE]

Submitted on _____, 20__.

The undersigned, as Bidder, hereby declares that the only person or persons interested in the Bid as principal or principals is or are named herein and that no other person than herein mentioned has any interest in this Bid or in the Contract to be entered into; that this Bid is made without connection with any other person, company or parties making a Bid; and that it is in all respects fair and in good faith without collusion or fraud.

The Bidder further declares that he has examined the site of the work and informed himself fully in regard to all conditions pertaining to the place where the work is to be done; that he has examined the Drawings and Specifications for the work and contractual documents relative thereto, and has read all instructions to Bidders and General Conditions furnished prior to the openings of bids; that he has satisfied himself relative to the work to be performed.

The Bidder proposes and agrees, if this Bid is accepted, to contract with the Board of Commissioners of Fulton County, Atlanta, Georgia, in the form of contract specified, to furnish all necessary materials, equipment, machinery, tools, apparatus, means of transportation and labor necessary, and to complete the construction of the work in full and complete accordance with the shown, noted, and reasonably intended requirements of the Specifications and Contract Documents to the full and entire satisfaction of the Board of Commissioners of Fulton County, Atlanta, Georgia, with a definite understanding that no money will be allowed for extra work except as set forth in the attached General Conditions and Contract Documents for the following prices.

THE BASE BID TOTAL IS THE AMOUNT UPON WHICH THE BIDDER WILL BE FORMALLY EVALUATED AND WHICH WILL BE USED TO DETERMINE THE LOWEST RESPONSIBLE BIDDER. Please make sure that all line items below are accurately calculated and total up to this inclusive amount.

The base bid may not be withdrawn or modified for a period of sixty (60) days following the receipt of bids.

BASE BID TOTAL: ITEMS 1 THROUGH 4 (BELOW), INCLUSIVE, IN THE
AMOUNT OF: _____

_____ DOLLARS

(\$ _____).

Make sure that all line items below are accurately calculated and total up to the inclusive BASE BID TOTAL amount entered on Page 1. Do not include Alternates in the base bid amount.

Method of Bidding

The unit or lump sum price for each of the several items in the Bid of each Bidder shall include its pro rata share of overhead and profit so that the sum of the products, obtained by multiplying the quantity shown for each item by the unit price, represents the total Bid. Any Bid not conforming to this requirement may be rejected. Additionally, Unbalanced Bids or conditional Bids will be subject to rejection. The special attention of all Bidders is called to this provision, for should conditions make it necessary to revise the quantities, no limit will be fixed for such increased or decreased quantities nor extra compensation allowed.

[List items in bid as appropriate]

ITEM __ - EROSION AND SEDIMENTATION CONTROL

a.	_____	Each	Construction Exits	\$_____/EA	\$_____
b.	_____	L.F.	[Sediment Barriers] [Silt Fence]	\$_____/LF	\$_____
c.	_____	L.F.	Reinforced Silt Fence	\$_____/LF	\$_____
d.	_____	Each	Silt Gates	\$_____/EA	\$_____
e.	_____	Each	Stone Check Dams	\$_____/EA	\$_____
f.	_____	Each	Sediment Traps	\$_____/EA	\$_____
g.	_____	Each	Inlet Filters	\$_____/EA	\$_____
h.	_____	Each	Sediment Boxes	\$_____/EA	\$_____
i.	_____	S.Y.	Rip Rap	\$_____/SY	\$_____
j.	_____	C.Y.	Temporary Stream Crossing	\$_____/CY	\$_____

ITEM __ - ROCK EXCAVATION

a.	_____	C.Y.	Mass Rock	\$_____/CY	\$_____
b.	_____	C.Y.	Trench Rock	\$_____/CY	\$_____

ITEM __ - EQUIPMENT ALLOWANCES

a.				\$	TBD
b.				\$	TBD
c.				\$	TBD

ITEM __ - CASH ALLOWANCES

a.	Soils and Concrete Testing	\$	TBD
b.	Construction Surveying	\$	TBD
c.	Blasting Monitoring	\$	TBD
d.	NPDES Permit Specialty Work	\$	TBD

***** ADDITIONAL WORK IF ORDERED BY THE ENGINEER *****

ITEM __ - TRENCH STABILIZATION

a. _____ C.Y. Beyond Bedding \$_____/CY \$_____

ITEM __ - REMOVAL OF UNSUITABLE MATERIAL AND REPLACEMENT WITH

a. _____ C.Y. Crushed Stone \$_____/CY \$_____

b. _____ C.Y. Suitable Earth Material \$_____/CY \$_____

*** ALTERNATE NO. XX ***

[DEDUCT \ ADD,] [CIRCLE ONE], FOR FURNISHING ALL PRODUCTS, MATERIALS AND EQUIPMENT AND PERFORMING ALL LABOR NECESSARY TO PROVIDE AND INSTALL *[insert alternate title/description here – keep it short, explain in 01025 and on drawings]*, THE AMOUNT OF:

DOLLARS (\$) _____).

The Bidder agrees hereby to commence work under this Contract, with adequate personnel and equipment, on a date to be specified in a written order of the Contracting Officer and to fully complete all work under this Contract within **[Insert Contract Duration]** consecutive calendar days from and including said date.

The Bidder declares that he understands that the quantities shown for the unit prices items are subject to either increase or decrease, and that should the quantities of any of the items of work be increased, the Bidder proposes to do the additional work at the unit prices stated herein; and should the quantities be decreased, the Bidder also understands that payment will be made on the basis of actual quantities at the unit price bid and will make no claim for anticipated profits for any decrease in quantities; and that actual quantities will be determined upon completion of work, at which time adjustments will be made to the contract amount by direct increase or decrease.

In case of discrepancies between the figures shown in the unit prices and the totals, the unit prices shall apply and the totals shall be corrected to agree with the unit prices. In case of discrepancies between written amounts and figures, written amounts shall take precedence over figures and the sum of all Bid extensions (of unit prices) plus lump sum items shall take precedence over BID TOTAL.

The Bidder furthermore agrees that, in the case of a failure on his part to execute the Contract Agreement and Bonds within ten (10) days after receipt of conformed contract documents for execution, the Bid Bond accompanying his bid and the monies payable thereon shall be paid into the funds of the Owner as liquidated damages for such failure.

Enclosed is a Bid Bond in the approved form, in the sum of: _____

_____ Dollars

(\$ _____) according to the conditions of "Instructions to Bidders" and provisions thereof.

The undersigned acknowledges receipt of the following addenda (list by the number and date appearing on each addendum) and thereby affirms that its Bid considers and incorporates any modifications to the originally issued Bidding Documents included therein.

ADDENDUM # _____ DATED _____

BID BOND

No bid for a contract in Fulton County for work to be done shall be valid for any purpose unless the Contractor shall give a Bid Bond with good and sufficient surety payable to, in favor of, and for the protection of Fulton County. The Bid Bond shall not be less than 5% of the total amount payable by the terms of the Contract. No bid shall be read aloud or considered if a proper bid bond has not been submitted.

Surety companies executing Bonds must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the State of Georgia.

Attestation for the corporation must be by the corporate officer; for a partnership by another partner; for an individual by a notary with the corporate seal.

BID BOND
[INSERT PROJECT # AND TITLE]
FULTON COUNTY GOVERNMENT

KNOW ALL MEN BY THESE PRESENTS, THAT WE _____

hereinafter called the PRINCIPAL, and _____

hereinafter call the SURETY, a corporation chartered and existing under the laws of the State of _____ and duly authorized to transact Surety business in the State of Georgia, are held and firmly bound unto the Fulton County Government (COUNTY), in the penal sum of _____ Dollars and Cents (\$ _____) good and lawful money of the United States of America, to be paid upon demand of the COUNTY, to which payment well and truly to be made we bind ourselves, our heirs, executors, and administrators and assigns, jointly and severally and firmly by these presents.

WHEREAS the PRINCIPAL has submitted to the COUNTY, for **[INSERT PROJECT # AND PROJECT TITLE]**, a Bid;

WHEREAS the PRINCIPAL desires to file this Bond in accordance with law:

NOW THEREFORE: The conditions of this obligation are such that if the Bid be accepted, the PRINCIPAL shall within ten (10) calendar days after receipt of written notification from the COUNTY of the award of the Contract execute the Contract in accordance with the Bid and upon the terms, conditions and prices set forth therein, in the form and manner required by the COUNTY, and execute sufficient and satisfactory Performance and Payments Bonds payable to the COUNTY, each in the amount of one hundred percent (100%) of the total contract price, in form and with security satisfactory to said COUNTY, then this obligation to be void; otherwise, to be and remain in full force and virtue in law; and the SURETY shall upon failure of the PRINCIPAL to comply with any or all of the foregoing requirements within the time specified above immediately pay to the COUNTY, upon demand the amount hereof in good and lawful money of the United States of America, not as a penalty, but as liquidated damages.

In the event suit is brought upon this Bond by the COUNTY and judgment is recovered, the SURETY shall pay all costs incurred by the COUNTY in such suit, including attorney's fees to be fixed by the Court.

Enclosed is a Bid Bond in the approved form, in the amount of _____
_____ Dollars

(\$_____) being in the amount of five percent (5%) of the Contract Sum.
The money payable on this bond shall be paid to the COUNTY, for the failure of the Bidder to
execute a Contract within ten (10) days after receipt of the Contract and at the same time furnish
a Payment Bond and Performance Bond.

(SIGNATURES ON NEXT PAGE)

IN TESTIMONY THEREOF, the PRINCIPAL and SURETY have caused these presents to be duly signed and sealed this _____ day of _____, 200_.

ATTEST:

PRINCIPAL

_____ BY _____

(SEAL)

CERTIFICATE AS TO CORPORATE PRINCIPAL

I, _____, certify that I am the Secretary of the Corporation named as principal in the within bond; that _____, who signed the said bond of said corporation; that I know this signature, and his/her signature thereto is genuine; and that said bond was duly signed, sealed and attested for in behalf of said Corporation by authority of its governing body.

SECRETARY

(CORPORATE SEAL)

SURETY

_____ BY _____

(SEAL)

END OF SECTION

PURCHASING FORMS & INSTRUCTIONS

This section contains the procurement forms that are required to be executed and submitted with the bid package. This section does not contain all forms required to be included with the bid package submittal.

To be deemed responsive to this RFP, Bidders must provide the information requested and complete in detail all Purchasing Forms. The appropriate individual(s) authorized to commit the Bidder to the Project must sign the Purchasing Forms. Bidders should reproduce each Purchasing Form, as required, and complete the appropriate portions of the forms provided in this section.

- Form A: Non-Collusion Affidavit of Prime Bidder/Offeror
- Form B: Certificate of Acceptance of Request for Bid/Proposal Requirements
- Form C: Contractor's Georgia Utility License Certification (***if applicable***)
- Form D: Certification Regarding Debarment
- Form E: Disclosure Form and Questionnaire

[If applicable, insert any additional forms required by your project]

FORM A: NON-COLLUSION AFFIDAVIT OF BIDDER/OFFEROR

STATE OF GEORGIA

COUNTY OF FULTON

I, _____ certify that pursuant to Fulton County Code Section 2-320 (11), this bid or proposal is made without prior understanding, agreement or connection with any corporation, firm or person submitting a bid for the same work, labor or service to be done or the supplies, materials or equipment to be furnished and is in all respects fair and without collusion or fraud. I understand collusive bidding is a violation of state and federal law and can result in fines, prison sentences and civil damages awards. I agree to abide by all conditions of this bid or proposal and certify that I am authorized to sign this bid or proposal for the bidder.

Affiant further states that pursuant to O.C.G.A. Section 36-91-21 (d) and (e), _____ has not, by itself or with others, directly or indirectly, prevented or attempted to prevent competition in such bidding or proposals by any means whatsoever. Affiant further states that (s)he has not prevented or endeavored to prevent anyone from making a bid or offer on the project by any means whatever, nor has Affiant caused or induced another to withdraw a bid or offer for the work.

Affiant further states that the said offer of _____ is bona fide, and that no one has gone to any supplier and attempted to get such person or company to furnish the materials to the bidder only, or if furnished to any other bidder, that the material shall be at a higher price.

(COMPANY NAME)

(PRESIDENT/VICE PRESIDENT)

Sworn to and subscribed before me this _____ day of _____, 200__.

(SECRETARY/ASSISTANT SECRETARY)

(Affix corporate seal here, if a corporation)

Notary Public: _____

County: _____

Commission Expires: _____

NOTE:

IF THE OFFEROR IS A PARTNERSHIP, ALL OF THE PARTNERS AND ANY OFFICER, AGENT, OR OTHER PERSON WHO MAY HAVE REPRESENTED OR ACTED FOR THEM IN BIDDING FOR OR PROCURING THE CONTRACT SHALL ALSO MAKE THIS OATH.

IF THE OFFEROR IS A CORPORATION, ALL OFFICERS, AGENTS, OR OTHER PERSONS WHO MAY HAVE ACTED FOR OR REPRESENTED THE CORPORATION IN BIDDING FOR OR PROCURING THE CONTRACT SHALL MAKE THE OATH.

**FORM B: FULTON COUNTY CERTIFICATE OF ACCEPTANCE OF BID/PROPOSAL
REQUIREMENTS**

This Is To Certify That On This Day Bidder/Proposer Acknowledges That He/She Has Read This Bid Document, Pages _____ To _____ Inclusive, Including Addendum(s) ____ To ____, And/Or Appendices ____ To ____, In Its Entirety, And Agrees That No Pages Or Parts Of The Document Have Been Omitted, That He/She Understands, Accepts And Agrees To Fully Comply With The Requirements Therein, And That The Undersigned Is Authorized By The Bidding/Proposing Company To Submit The Bid/Proposal Herein And To Legally Obligate The Bidder/Proposer Thereto.

Company: _____

Signature: _____

Name: _____

Title: _____

Date: _____

(Corporate Seal)

FORM C: CONTRACTOR'S GEORGIA UTILITY LICENSE CERTIFICATION

Contractor's Name: _____

Utility Contractor's Name: _____

Expiration Date of License: _____

(ATTACHED COPY OF LICENSE)

I certify that the above information is true and correct and that the classification noted is applicable to the Bid for this Project.

Signed: _____

Date: _____

FORM D: CERTIFICATION REGARDING DEBARMENT

- (1) The Offeror certifies that neither it or its subcontractors is presently debarred, suspended, proposed for debarment, declared ineligible, or otherwise excluded from doing business with any government agency. Any such exclusion may cause prohibition of your firm from participating in any procurement by the Fulton County Government.
- (2) If the Offeror is unable to certify to any of the statements in this certification, such Offeror or subcontractor shall attach an explanation to this bid or proposal.

INSTRUCTIONS FOR CERTIFICATION

By signing and submitting this certification, the Offeror is providing the certification set out below:

- (1) The certification in this clause is a material representation of fact upon which reliance will be placed. If it is later determined that the prospective vendor knowingly rendered a false certification, the Purchasing Agent may pursue all available remedies, including suspension and/or debarment, for withdrawal of award or termination of a contract.
- (2) The prospective Offeror shall provide immediate written notice to the Purchasing Agent if at anytime the Offeror learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.
- (3) Offeror shall be under a continuing duty to immediately inform the Purchasing Agent in writing of any changes, if as a result of such changes, the Offeror certification regarding debarment is affected.

DEBARMENT ORDINANCE

The following Section 2-322 of Fulton County Code of Laws establishes the procedure for the debarment of contractors.

(a) Authority to suspend.

After reasonable notice to the entity involved and reasonable opportunity for that entity to be heard, the Purchasing Agent, after consultation with user department, the County Manager and the County Attorney shall have the authority to suspend an entity for cause from consideration for award of county contracts. As used in this section, the term entity means any business entity, individual, firm, contractor, subcontractor or business corporation, partnership, limited liability corporation, firm, contractor, subcontractor or business structured; provided, further, that any such entity shall also be subject to suspension under this section if any of its constituents, members, subcontractors at any tier of such entity's and the entity, or any constituent or member, knew or should have known of the commission of the act. The suspension shall be for a period not to exceed three (3) years unless cause is based on a felony conviction for an offense related or associated with fraudulent contracting or misappropriation of funds wherein the suspension shall not exceed seven (7) years.

(b) Causes for Suspension. The causes for suspension include:

- (1) Conviction for commission of a criminal offense as an incident to obtain or attempting to obtain a public or private contract or subcontract, or in performance of such contract or subcontract;

- (2) Conviction of state or federal statutes of embezzlement, theft, forgery, bribery, falsification or destruction of records, receiving stolen property or other offense indicating a lack of business integrity or business honesty which currently, seriously and directly affects responsibility as a county contractor.
- (3) Conviction of state or federal anti-trust statutes arising out of the solicitation and submission of bids and proposals;
- (4) Violation of contract provisions, as set forth below, of a character which is regarded by the Purchasing Agent to be so serious as to justify suspension action:
 - a. Failure to perform in accordance with the specifications within a time limit provided in a county contract;
 - b. A recent record of failure to perform or unsatisfactory performance in accordance with the terms of one or more contracts; provided, that failure to perform or unsatisfactory performance caused by acts beyond the control of the contractor shall not be considered to be a basis for suspension;
 - c. Material representation of the composition of the ownership or workforce or business entity certified to the county as a minority business enterprise; or
 - d. Falsification of any documents.
- (5) For violation of the ethical standards set forth in Fulton County Code Chapter 9, Code of Ethics.
- (6) Knowing misrepresentation to the county, of the use which a majority owned contractor intends to make a minority business enterprise (a business entity at least 51 percent of which is owned and controlled by minority persons, as defined in Fulton County Code Chapter 6, Article B, Minority Business Enterprise Affirmative Action Program and certified as such by the County) as a subcontractor or a joint venture partner, in performing work under contract with the County.

Failure to fully and truthfully provide the information required, may result in the disqualification of your bid/proposal from consideration or termination of the Contract, once awarded. This document must be completed and included as a part of the bid/proposal package along with other required documents.

[SIGNATURES ON NEXT PAGE]

Under penalty of perjury, I declare that I have examined this certification and all attachments hereto, if applicable, to the best of my knowledge and belief, and all statements contained hereto are true, correct, and complete.

On this _____ day of _____, 200__

(Legal Name of Offeror) (Date)

(Signature of Authorized Representative) (Date)

(Title)

FORM E: DISCLOSURE FORM AND QUESTIONNAIRE

1. Please provide the names and business addresses of each of the Offeror’s firm’s officers and directors.

For the purposes of this form, the term “Offeror” means an entity that responds to a solicitation for a County contract by either submitting a proposal in response to a Request for Proposal or a Request for Qualification or a Bid in response to an Invitation to Bid.

Describe accurately, fully and completely, their respective relationships with said Offeror, including their ownership interests and their anticipated role in the management and operations of said Offeror.

2. Please describe the general development of said Offeror's business during the past five (5) years, or such shorter period of time that said Offeror has been in business.
3. Please state whether any employee, agent or representative of said Offeror who is or will be directly involved in the subject project has or had within the last five (5) years: (i) directly or indirectly had a business relationship with Fulton County; (ii) directly or indirectly received revenues from Fulton County; or (iii) directly or indirectly receives revenues from the result of conducting business on Fulton County property or pursuant to any contract with Fulton County. Please describe in detail any such relationship.

LITIGATION DISCLOSURE:

Failure to fully and truthfully disclose the information required, may result in the disqualification of your bid or proposal from consideration or termination of the Contract, once awarded.

1. Please state whether any of the following events have occurred in the last five (5) years with respect to said Offeror. If any answer is yes, explain fully the following:
 - (a) whether a petition under the federal bankruptcy laws or state insolvency laws was filed by or against said Offeror, or a receiver fiscal agent or similar officer was appointed by a court for the business or property of said Offeror;
 - (b) whether Offeror was subject of any order, judgment, or decree not subsequently reversed, suspended or vacated by any court of competent jurisdiction, permanently enjoining said Offeror from engaging in any type of business practice, or otherwise eliminating any type of business practice; and
 - (c) whether said Offeror's business was the subject of any civil or criminal proceeding in which there was a final adjudication adverse to said or Offeror, which directly arose from activities conducted by the business unit or corporate division of said Offeror which submitted a bid or proposal for the subject project. If so please explain.
2. Have you or any member of your firm or team to be assigned to this engagement been indicted or convicted of a criminal offense within the last five (5) years?

Circle One: YES NO

Under penalty of perjury, I declare that I have examined this questionnaire and all attachments hereto, if applicable, to the best of my knowledge and belief, and all statements contained hereto are true, correct, and complete.

On this _____ day of _____, 200__

(Legal Name of Proponent) (Date)

(Signature of Authorized Representative) (Date)

(Title)

Sworn to and subscribed before me,

this _____ day of _____, 200__

(Notary Public) (Seal)

Commission Expires _____
(Date)

END OF SECTION

CONTRACT COMPLIANCE REQUIREMENTS

NON-DISCRIMINATION IN CONTRACTING AND PROCUREMENT

Policy Statement: It is the policy of Fulton County Government that discrimination against businesses by reason of the race, color, gender or national origin of the ownership of any such business is prohibited. Furthermore, it is the policy of the Board of Commissioners ("Board") that Fulton County and all vendors and contractors doing business with Fulton County shall provide to all businesses the opportunity to participate in contracting and procurement paid, in whole or in part, with monetary appropriations of the Board. Similarly, it is the policy of the Board that the contracting and procurement practices of Fulton County should not implicate Fulton County as either an active or passive participant in the discriminatory practices engaged in by private contractors seeking to obtain contracts with Fulton County.

Equal Business Opportunity Plan (EBO Plan): In addition to the proposal submission requirements, each vendor **must** submit an Equal Business Opportunity Plan (EBO Plan) with their bid/proposal. The EBO Plan is designed to enhance the utilization of a particular racial, gender or ethnic group by a bidder/proposer, contractor, or vendor or by Fulton County. The respondent **must** outline a plan of action to encourage and achieve diversity and equality in the available procurement and contracting opportunities with *this solicitation*.

The EBO Plan **must** identify and include:

1. Potential opportunities within the scope of work of *this solicitation* that will allow for participation of racial, gender or ethnic groups.
2. Efforts that will be made by the bidder/proposer to encourage and solicit minority and female business utilization in this solicitation.

Fulton County encourages joint ventures, teaming, partnering and mentor-protégé relationships with minority and female businesses in an effort to achieve contracting and procurement diversity.

Prompt Payment: The prime contractor must certify in writing and must document on the Exhibit G Form (Prime Contractor/Subcontractor Utilization Report) that all subcontractors, sub-consultants and suppliers have been promptly paid for work and materials, (less any retainage by the prime contractor prior to receipt of any further progress payments). In the event the prime contractor is unable to pay subcontractors, sub-consultants or suppliers until it has received a progress payment from Fulton County, the prime contractor shall pay all subcontractors, sub-consultants or suppliers funds due from said progress payments within forty-eight (48) hours of receipt of payment from Fulton County. In no event shall a subcontractor, sub-consultant or supplier be paid later than fifteen (15) days as provided for by state law.

REQUIRED FORMS AND EBO PLAN:

In order to be compliant with the intent and provisions of the Fulton County Non-Discrimination in Purchasing and Contracting Ordinance (99-0960), bidders/proposers must submit the following completed documents. Failure to provide this information shall result in the bid/proposal being deemed non-responsive:

- **Exhibit A** - Promise of Non-Discrimination (for Prime and each Sub-contractor)
- **Exhibit B** - Employment Report (for Prime and each Sub-contractor)
- **Exhibit C** - Schedule of Intended Subcontractor Utilization
- **Exhibit D** - Letter of Intent to Perform As a Subcontractor or Provide Materials or Services
- **Exhibit E** - Declaration Regarding Subcontractor Practices
- **Exhibit F** - Joint Venture Disclosure Affidavit
- **Equal Business Opportunity Plan (EBO Plan)** – This document is not a form. It is a statement created by the bidder/proposer on its company letter head addressing the EBO Plan requirements.

All Contract Compliance documents (Exhibits A – F and EBO Plan) are to be placed in a **separate sealed envelope** clearly marked “Contract Compliance”. The EBO Plan must be submitted on company letterhead. These documents are considered part of and should be submitted with the Technical Proposal.

The following document must be completed as instructed if awarded the bid:

- **Exhibit G** - Prime Contractor’s Subcontractor Utilization Report

EXHIBIT A – PROMISE OF NON-DISCRIMINATION

“Know all persons by these presents, that I/WE (_____).
Name

_____ Title Firm Name

Hereinafter “Company”), in consideration of the privilege to bid on or obtain contracts funded, in whole or in part, by Fulton County, hereby consent, covenant and agree as follows:

- (1) No person shall be excluded from participation in, denied the benefit of, or otherwise discriminated against on the basis of race, color, national origin or gender in connection with any bid submitted to Fulton County for the performance of any resulting there from,
- (2) That it is and shall be the policy of this Company to provide equal opportunity to all businesses seeking to contract or otherwise interested in contracting with this Company without regard to the race, color, gender or national origin of the ownership of this business,
- (3) That the promises of non-discrimination as made and set forth herein shall be continuing in nature and shall remain in full force and effect without interruption,
- (4) That the promise of non-discrimination as made and set forth herein shall be made a part of, and incorporated by reference into, any contract or portion thereof which this Company may hereafter obtain,
- (5) That the failure of this Company to satisfactorily discharge any of the promises of non-discrimination as made and set forth herein shall constitute a material breach of contract entitling the Board to declare the contract in default and to exercise any and all applicable rights and remedies, including but not limited to cancellation of the contract, termination of the contract, suspension and debarment from future contracting opportunities, and withholding and/or forfeiture of compensation due and owing on a contract; and
- (6) That the bidder shall provide such information as may be required by the Director of Contract Compliance pursuant to Section 4.4 of the Fulton County Non-Discrimination in Purchasing and Contracting Ordinance.

SIGNATURE: _____

ADDRESS: _____

TELEPHONE NUMBER: _____

EXHIBIT B – EMPLOYMENT REPORT

The demographic employment make-up for the bidder **must** be identified and submitted with this bid/proposal. In addition, if subcontractors will be utilized by the bidder/proposer to complete this project, then the demographic employment make-up of the subcontractor(s) must be identified and submitted with this bid.

EMPLOYEES

CATEGORY	NATIVE INDIAN		AFRICAN AMERICAN		ASIAN AMERICAN		HISPANIC AMERICAN		CACUSIAN AMERICAN		OTHER	
	M	F	M	F	M	F	M	F	M	F	M	F
Male/Female												
Mgmt/Official												
Professional (Arch., P.E., etc.)												
Supervisors												
Office/ Clerical												
Craftsmen												
Laborers												
Others (Specify)												
TOTALS												

FIRM'S NAME: _____

ADDRESS: _____

TELEPHONE NUMBER: _____

This completed form is for (Check one) _____ Bidder/Proposer _____ Subcontractor

Submitted by: _____ Date Completed: _____

EXHIBIT C – SCHEDULE OF INTENDED SUBCONTRACTOR UTILIZATION

If the bidder/proposer intends to subcontract any portion of this scope of work/service(s), this form **must be** completed and **submitted with the bid/proposal**. All prime bidders/proposers **must** include Letter(s) of Intent (Exhibit D) in the bid document for all subcontractors who will be utilized under the scope of work/services.

Prime Bidder/Proposer:_____

ITB/RFP NUMBER:_____

Project Name or Description of Work/Service(s):_____

- 1. My firm, as Prime Bidder/Proposer on this scope of work/service(s) is_____ is not_____ a minority or female owned and controlled business. (Please indicate below the portion of work, including, percentage of bid amount that your firm will carry out directly):

If the Prime Bidder/Proposer is a Joint Venture, please complete Exhibit F: Joint Venture Disclosure Affidavit and attach a copy of the executed Joint Venture Agreement.

- 2. Sub-Contractors (Including suppliers) to be utilized in the performance of this scope of work/service(s), if awarded, are:

SUBCONTRACTOR NAME:_____

ADDRESS:_____

PHONE:_____

CONTACT PERSON:_____

ETHNIC GROUP*:_____ COUNTY CERTIFIED** _____

WORK TO BE PERFORMED:_____

DOLLAR VALUE OF WORK: \$ _____ PERCENTAGE VALUE: _____ %

*Ethnic Groups: African American (AABE); Asian American (ABE); Hispanic American (HBE); Native American (NABE); White Female American (WFBE);
**If yes, attach copy of recent certification letter.

EXHIBIT C – SCHEDULE OF INTENDED SUBCONTRACTOR UTILIZATION

SUBCONTRACTOR NAME: _____

ADDRESS: _____

PHONE: _____

CONTACT PERSON: _____

ETHNIC GROUP*: _____ COUNTY CERTIFIED** _____

WORK TO BE PERFORMED: _____

DOLLAR VALUE OF WORK: \$ _____ PERCENTAGE VALUE: _____ %

SUBCONTRACTOR NAME: _____

ADDRESS: _____

PHONE: _____

CONTACT PERSON: _____

ETHNIC GROUP*: _____ COUNTY CERTIFIED** _____

WORK TO BE PERFORMED: _____

DOLLAR VALUE OF WORK: \$ _____ PERCENTAGE VALUE: _____ %

SUBCONTRACTOR NAME: _____

ADDRESS: _____

PHONE: _____

CONTACT PERSON: _____

ETHNIC GROUP*: _____ COUNTY CERTIFIED** _____

WORK TO BE PERFORMED: _____

DOLLAR VALUE OF WORK: \$ _____ PERCENTAGE VALUE: _____ %

SUBCONTRACTOR NAME: _____

ADDRESS: _____

PHONE: _____

CONTACT PERSON: _____

ETHNIC GROUP*: _____ COUNTY CERTIFIED** _____

WORK TO BE PERFORMED: _____

DOLLAR VALUE OF WORK: \$ _____ PERCENTAGE VALUE: _____ %

***Ethnic Groups: African American (AABE); Asian American (ABE); Hispanic American (HBE); Native American (NABE); White Female American (WFBE); **If yes, attach copy of recent certification letter.**

EXHIBIT C – SCHEDULE OF INTENDED SUBCONTRACTOR UTILIZATION

Total Dollar Value of Subcontractor Agreements: (\$)

Total Percentage Value: (%)

CERTIFICATION: The undersigned certifies that he/she has read, understands and agrees to be bound by the Bid provisions, including the accompanying Exhibits and other terms and conditions regarding sub-contractor utilization. The undersigned further certifies that he/she is legally authorized by the Bidder to make the statement and representation in this Exhibit and that said statements and representations are true and correct to the best of his/her knowledge and belief. The undersigned understands and agrees that if any of the statements and representations are made by the Bidder knowing them to be false, or if there is a failure of the intentions, objectives and commitments set forth herein without prior approval of the County, then in any such event the Contractor's acts or failure to act, as the case may be, shall constitute a material breach of the contract, entitling the County to terminate the Contract for default. The right to so terminate shall be in addition to, and in lieu of, any other rights and remedies the County may have for other defaults under the contract.

Signature/Title: _____

Firm or Corporate Name: _____

Address: _____

Telephone: () _____

Fax Number: () _____

Email Address: _____

EXHIBIT D

**LETTER OF INTENT TO PERFORM AS A SUBCONTRACTOR
OR
PROVIDE MATERIALS OR SERVICES**

This form must be completed by ALL known subcontractors/suppliers and submitted with the bid. The Prime Contractor must submit Letters of Intent for ALL known subcontractors/suppliers at time of bid submission.

To: _____
(Name of Prime Contractor Firm)

From: _____
(Name of Subcontractor Firm)

ITB/RFP Number: _____

Project Name: _____

The undersigned is prepared to perform the following described work or provide materials or services in connection with the above project (specify in detail particular work items, materials, or services to be performed or provided):

Description of Work	Project Commence Date	Project Completion Date	Estimated Dollar Amount

(Prime Bidder)

(Subcontractor)

Signature _____

Signature _____

Title _____

Title _____

Date _____

Date _____

EXHIBIT E – DECLARATION REGARDING SUBCONTRACTING PRACTICES

If the bidder/proposer **does not intend to subcontract** any portion of the scope of work services(s), this form **must be** completed and submitted with the bid.

_____ Hereby declares that it is my/our intent to
(Bidder)

Perform 100% of the work required for _____
(IFB/RFP Number)

(Description of Work)

In making this declaration, the bidder/proposer states the following:

1. That the bidder does not customarily subcontract elements of this type project, and normally performs and has the capability to perform and will perform **all elements** of the work on this project with his/her own current work forces;
2. If it should become necessary to subcontract some portion of the work at a later date, the bidder will comply with all requirements of the County's Non-Discrimination Ordinance in providing equal opportunities to all firms to subcontract the work. The determination to subcontract some portion of the work at a later date shall be made in good faith and the County reserves the right to require additional information to substantiate a bidder's decision to subcontract work following the award of the contract. Nothing contained in this provision shall be employed to circumvent the spirit and intent of the County's Non-Discrimination Ordinances;
3. The bidder will provide, upon request, information sufficient for the County to verify Item Number one.

AUTHORIZED COMPANY REPRESENTATIVE

Name: _____ **Title:** _____ **Date:** _____

Signature: _____

Firm: _____

Address: _____

Phone Number: _____

Fax Number: _____

Email Address: _____

EXHIBIT F – JOINT VENTURE DISCLOSURE AFFIDAVIT

IFB No. _____

Project Name _____

This form must be completed and submitted with the bid if a Joint Venture approach is to be undertaken.

The firms listed below do hereby declare that they have entered into a joint venture agreement pursuant to the above mentioned project. The information requested below is to clearly identify and explain the extent of participation of each firm in the proposed joint venture. All items must be properly addressed before the business entity can be evaluated.

1. Firms:

1) Name of Business: _____
Street Address: _____
City/State/Zip: _____
County: _____
Nature of Business: _____

2) Name of Business: _____
Street Address: _____
City/State/Zip: _____
County: _____
Nature of Business: _____

3) Name of Business: _____
Street Address: _____
City/State/Zip: _____
County: _____
Nature of Business: _____

NAME OF JOINT VENTURE (If applicable): _____

OFFICE ADDRESS: _____

PRINCIPAL OFFICE: _____

OFFICE PHONE: _____

EXHIBIT F – JOINT VENTURE DISCLOSURE AFFIDAVIT CONTINUED

Note: Attach additional sheets as required

2. Describe the capital contributions by each joint venturer and accounting thereof. Indicate the percentage make-up for each joint venture partner.

3. Describe the financial controls of the joint venture, e.g., will a separate cost center be established? Which venturer will be responsible for keeping the books? How will the expense therefore be reimbursed? What is the authority of each joint venture to commit or obligate the order?

4. Describe any Ownership, options for Ownership, or loans between the joint ventures. Identify terms thereof.

5. Describe the estimate contract cash flow for each joint venturer.

6. To what extent and by whom will the on-site work be supervised?

7. To what extent and by whom will the administrative office be supervised?

8. Which joint venturer will be responsible for material purchases including the estimated cost thereof? How will the purchase be financed?

9. Which joint venturer will provide equipment? What is the estimated cost thereof? How will the equipment be financed?

10. Describe the experience and business qualifications of each joint venturer.

11. Submit a copy of all joint venture agreements and evidence of authority to do business in the State of Georgia as well as locally, to include all necessary business licenses.

12. Percent of ownership by each joint venture in terms of profit and loss sharing: _____

13. The authority of each joint venturer to commit or obligate the other: _____

14. Number of personnel to be involved in project, their crafts and positions and whether they are employees of the small business enterprise, the majority firm or the joint venture: _____

EXHIBIT F – JOINT VENTURE DISCLOSURE AFFIDAVIT CONTINUED

- 15. Identification of control and participation in venture; list those individuals who are responsible for day-to-day management and policy decision-maker, including, but not limited to, those with prime responsibility for areas designated below; (use additional sheets if necessary)

<u>Name</u>	<u>Race</u>	<u>Sex</u>	<u>Financial Decisions</u>	<u>Supervision Field Operation</u>
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

In connection with any work that these firms, as a joint venture, might be authorized to perform in connection with above captioned contract, we each do hereby authorize representatives of the Fulton County Department of Purchasing and Contract Compliance and Departments of Finance, under the direction of the County Manger’s Office, to examine, from time to time, the books, records and files to the extent that such relate to this County project.

WE DO SOLEMNLY DECLARE AND AFFIRM UNDER THE PENALTIES OF PERJURY THAT THE CONTENTS OF THE FOREGOING DOCUMENT ARE TRUE AND CORRECT, AND THAT WE ARE AUTHORIZED, ON BEHALF OF THE ABOVE FIRMS, TO MAKE THIS AFFIDAVIT AND GRANT THE ABOVE PRIVILEGE.

FOR: _____
(Company)

Date: _____

(Signature of Affiant)

(Printed Name)

(Company)

Date: _____

(Signature of Affiant)

(Printed Name)

State of _____:

County of _____:

On this _____ day of _____, 20_____, before me, appeared

_____, the undersigned known to me to be the person described in the foregoing Affidavit and acknowledge that he (she) executed the same in the capacity therein stated and for the purpose therein contained.

EXHIBIT G – PRIME CONTRACTOR/SUBCONTRACTOR UTILIZATION REPORT

This report is required to be submitted by the tenth day of each month, with a copy of your payment invoice (schedule of values/payment application) to Contract Compliance. Failure to comply may result in the County commencing proceedings to impose sanctions on the successful bidder, in addition to purchasing any other available legal remedy. Sanctions may include the suspending of any payment or part thereof, termination or cancellation of the contract, and the denial to participate in any future contracts awarded by Fulton County.

REPORTING PERIOD		PROJECT NAME:	
FROM:		PROJECT NUMBER:	
TO:		PROJECT LOCATION:	

PRIME CONTRACTOR		Contract Award Date	Contract Award Amount	Change Order Amount	Contract Period	% Complete to Date
Name:						
Address:						
Telephone #:						

AMOUNT OF REQUISITION THIS PERIOD:\$ _____
 TOTAL AMOUNT REQUISITION TO DATE:\$ _____

SUBCONTRACTOR UTILIZATION (add additional rows as necessary)

Name of Sub-contractor	Description of Work	Contract Amount	Amount Paid To Date	Amount Requisition This Period	Contract Period	
					Starting Date	Ending Date
TOTALS						

Executed By: _____ (Signature) _____ (Printed Name)

END OF SECTION

INSURANCE AND RISK MANAGEMENT PROVISIONS

It is Fulton County Government's practice to obtain Certificates of Insurance from our Contractors and Vendors. Insurance must be written by a licensed agent in a company licensed to write insurance in the State of Georgia, with an A.M. Best rating of at least A- VI, subject to final approval by Fulton County. Respondents shall submit with the bid/proposal evidence of insurability satisfactory to Fulton County Government as to form and content. Either of the following forms of evidence is acceptable:

- A letter from an insurance carrier stating that upon your firm/company being the successful Bidder/Respondent that a Certificate of Insurance shall be issued in compliance with the Insurance and Risk Management Provisions outlined below.
- A Certificate of Insurance complying with the Insurance and Risk Management Provisions outlined below (Request for Bid/Proposal number and Project Name, Number, and Description must appear on the Certificate of Insurance).

Upon award, the Contractor/Vendor must maintain at their expense, insurance with policy limits equal to or greater than the limits described below. Any and all Insurance Coverage(s) and Bonds required under the terms and conditions of the contract shall be maintained during the entire length of the contract, including any extensions or renewals thereto, and until all work has been completed to the satisfaction of Fulton County Government.

Accordingly the Respondent shall provide a certificate evidencing the following:

1. WORKERS COMPENSATION/EMPLOYER'S LIABILITY INSURANCE – STATUTORY (In compliance with the Georgia Workers Compensation Acts and any other State or Federal Acts or Provisions in which jurisdiction may be granted)

Employer's Liability Insurance	BY ACCIDENT	EACH ACCIDENT	\$1,000,000
Employer's Liability Insurance	BY DISEASE	POLICY LIMIT	\$1,000,000
(Aggregate)	BY DISEASE	EACH EMPLOYEE	\$1,000,000

2. COMMERCIAL GENERAL LIABILITY INSURANCE (Including contractual Liability Insurance)

Bodily Injury and Property Damage Liability (Other than Products/Completed Operations)	Each Occurrence	\$1,000,000
	General Aggregate	\$2,000,000
Products\Completed Operation	Aggregate Limit	\$2,000,000
Personal and Advertising Injury	Limits	\$1,000,000
Fire Damage	Limits	\$100,000

3. BUSINESS AUTOMOBILE LIABILITY INSURANCE

Combined Single Limits (Including operation of non-owned, owned, and hired automobiles).	Each Occurrence	\$1,000,000
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4. ELECTRONIC DATA PROCESSING LIABILITY

(Required if computer contractor)	Limits	\$1,000,000
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5. UMBRELLA LIABILITY

(In excess of above noted coverages)	Each Occurrence	\$10,000,000
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6. PROFESSIONAL LIABILITY

	Each Occurrence	\$5,000,000
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(To be provided when the Contract includes specified Professional Services, and will be written with all Environmental/Pollution exclusions deleted).

7. ENVIRONMENTAL/POLLUTION LIABILITY

Each Occurrence \$2,000,000

8. FIDELITY BOND

(Employee Dishonesty)

Each Occurrence \$100,000

9. BUILDERS RISK: "All-risk" form of builder's risk insurance providing coverage against loss or damage by fire or other peril on an "all-risk" form, including demolition and increased cost of construction, debris removal and the full replacement cost of the Project foundations and containing an agreed amount endorsement, and, until Final Completion and Acceptance of the Project. Such policy of insurance shall contain at least the following sub-limits of insurance and deductibles:

Sub-limits:

Property in Transit	\$1,000,000
Property in Offsite Storage	\$1,000,000
Plans & Blueprints	\$25,000
Debris Removal	25% of Insured Physical Loss
Delay in Completion / Soft Cost	TBD

Deductibles:

Flood and Earthquake	\$25,000
Water Damage other than Flood	\$100,000
All other Perils	\$10,000

Owner and Contractor waive all rights against each other and any of their subcontractors, sub-subcontractors, agents and employees, each of the other, for damages caused by fire or other causes of loss to the extent covered by property insurance obtained pursuant to this Section, or other property insurance applicable to the Work, accept such rights as they have to the proceeds of such insurance.

The policy will name Fulton County, The Contractor and Subcontractors of all tiers as Insureds under the policy.

Certificates of Insurance

Certificates shall state that the policy or policies shall not expire, be cancelled or altered without at least forty-five (45) days prior written notice to Fulton County Government. Policies and Certificates of Insurance are to list Fulton County Government as an Additional Insured (except for Workers' Compensation) and shall conform to all terms and conditions (including coverage of the indemnification and hold harmless agreement) contained in the Insurance and Risk Management Provisions. The General Liability Additional Insured language should apply to on-going and completed-operations, using ISO form CG 2010 (11/85 version) or equivalent.

If Fulton County Government shall so request, the Respondent, Contractor or Vendor will furnish the County for its inspection and approval such policies of insurance with all endorsements, or confirmed specimens thereof certified by the insurance company to be true and correct copies.

Such certificates and notices **must** identify the "Certificate Holder" as follows:

Fulton County Government - Purchasing and Contract Compliance Department
130 Peachtree Street, S.W.
Suite 1168
Atlanta, Georgia 30303-3459

Certificates **must** list Project Name and Project Number.

It is understood that **Insurance in no way Limits the Liability of the Contractor/Vendor.**

USE OF PREMISES

Contractor shall confine its apparatus, the storage of materials and the operations of its workers to limits/requirements indicated by law, ordinance, permits and any restrictions of Fulton County Government and shall not unreasonably encumber the premises with its materials.

PROTECTION OF PROPERTY

Contractor will adequately protect its own work from damage, will protect Fulton County Government's property from damage or loss and will take all necessary precautions during the progress of the work to protect all persons and the property of others from damage or loss.

Contractor shall take all necessary precautions for the safety of employees of the work and shall comply with all applicable provisions of the Federal, State and local safety laws and building codes to prevent accidents or injury to persons on, about, or adjacent to the premises where work is being performed.

Contractor shall erect and properly maintain at all times as required by the conditions and progress of the work, all necessary safeguards for the protection of its employees, Fulton County Government employees and the public and shall post all applicable signage and other warning devices to protect against potential hazards for the work being performed.

INDEMNIFICATION AND HOLD HARMLESS AGREEMENT

Contractor/Vendor hereby agrees to release, indemnify, defend and hold harmless Fulton County, its Commissioners, officers, employees, subcontractors, successors, assigns and agents, from and against any and all losses (including death), claims, damages, liabilities, costs and expenses (including but not limited to all actions, proceedings, or investigations in respect thereof and any costs of judgments, settlements, court costs, attorney's fees or expenses, regardless of the outcome of any such action, proceeding, or investigation), caused by, relating to, based upon or arising out of any act or omission by Contractor/Vendor, its directors, officers, employees, subcontractors, successors, assigns or agents, or otherwise in connection (directly or indirectly) with its acceptance, or the performance, or nonperformance, of its obligations under these agreements. Such obligations shall not be construed to negate, abridge or otherwise reduce any other rights or obligations of indemnity which would otherwise exist as to any party or person as set forth in this paragraph.

Contractor/Vendor's obligation to protect, defend, indemnify and hold harmless, as set forth hereinabove, shall also include, but is not limited to, any matter arising out of any actual or alleged infringement of any patent, trademark, copyright, or service mark, or other actual or alleged unfair competition disparagement of product or service, or other tort or any type whatsoever, or any actual or alleged violation of trade regulations.

Contractor/Vendor further agrees to protect, defend, indemnify and hold harmless Fulton County, its Commissioners, officers, employees, subcontractors, successors, assigns and agents from and against any and all claims or liability for compensation under the Worker's Compensation Act, Disability Benefits Act, or any other employee benefits act arising out of injuries sustained by any employees of Contractor/Vendor. These indemnities shall not be limited by reason of the listing of any insurance coverage.

If the bid/quotation involves construction services, the Contractor/Vendor will be responsible fully for any and all damage to the work during the course of construction, until the point of Final Acceptance by Fulton County.

FULTON COUNTY ACKNOWLEDGES THAT ALL PROVISIONS OF THIS INDEMNITY AGREEMENT MAY NOT BE APPLICABLE TO THE CONTRACTOR/VENDOR'S BUSINESS. TO THE EXTENT THAT CONTRACTOR/VENDOR MAY DEMONSTRATE SUCH NONAPPLICABILITY, FULTON COUNTY MAY NEGOTIATE AMENDMENTS TO THIS AGREEMENT AS THE CIRCUMSTANCES DICTATE.

CONTRACTOR/VENDOR ACKNOWLEDGES HAVING READ, UNDERSTANDING, AND AGREEING TO COMPLY WITH THIS INDEMNIFICATION AND HOLD HARMLESS AGREEMENT, AND THE REPRESENTATIVE OF THE CONTRACTOR/VENDOR IDENTIFIED BELOW IS AUTHORIZED TO SIGN CONTRACTS ON BEHALF OF THE RESPONDING CONTRACTOR/VENDOR.

COMPANY: _____ SIGNATURE: _____

NAME: _____ TITLE: _____

DATE: _____

OWNER - CONTRACTOR AGREEMENT

[INSERT PROJECT # AND TITLE]

Contractor: _____ Project No. _____

Address: _____ Telephone: _____

Contact: _____ Facsimile: _____

THIS AGREEMENT is effective as of the _____ day of _____, 20 , by and between Fulton County, a political subdivision of the State of Georgia (hereinafter called the "County"), and the above named CONTRACTOR in accordance with all provisions of this Construction agreement, consisting of the following Contract Documents:

- General Conditions
- Special Conditions
- Bid Form
- Scope of Work and Technical Specifications
- Drawings and Specifications
- Exhibits
- Purchasing Forms
- Office of Contract Compliance Forms
- Risk Management Insurance Provisions Forms

WITNESSETH: That the said Contractor has agreed, and by these presents does agree with the said County, for and in consideration of a Contract Price of _____ (\$_____) and other good and valuable consideration, and under the penalty expressed on Bonds hereto attached, to furnish all equipment, tools, materials, skill, and labor of every description necessary to carry out and complete in good, firm, and substantial, and workmanlike manner, the Work specified, in strict conformity with the Drawings and the Specifications hereinafter set forth, which Drawings and Specifications together with the bid submittals made by the Contractor, General Conditions, Special Provisions, Detailed Specifications, Exhibits, and this Agreement, shall all form essential parts of this Contract. The Work covered by this Contract includes all Work indicated on Plans and Specifications and listed in the Bid entitled:

Project Number: [INSERT PROJECT #]

[INSERT PROJECT NAME]

The Contractor shall commence the Work with adequate force and equipment within 10 days from receipt of Notice to Proceed from the County, and shall complete the work within **[INSERT CONTRACT DURATION]** calendar days from the Notice to Proceed or the date work begins, whichever comes first. The Contractor shall remain responsible for performing, in accordance with the terms of the contract, all work assigned prior to the expiration of the said calendar days allowed for completion of the work even if the work is not completed until after the expiration of such days.

[Insert if applicable For each calendar day that any work remains uncompleted after the time allowed for completion of the work, the Contractor shall pay the County the sum of \$500.00 not as a penalty but as liquidated damages, which liquidated damages the County may deduct from any money due the contractor. At the County's convenience and not to it prejudice the County may provide written notice of the commencement of the assessment of liquidated damages].

As full compensation for the faithful performance of this Contract, the County shall pay the Contractor in accordance with the General Conditions and the prices stipulated in the Bid, hereto attached.

It is further mutually agreed between the parties hereto that if, at any time after the execution of this Agreement and the Surety Bonds hereto attached for its faithful performance, the County shall deem the surety or sureties upon such bonds to be unsatisfactory, or, if, for any reason, such bonds cease to be adequate to cover the performance of the Work, the Contractor shall, at his expense, within five days after receipt of notice from the County so to do, furnish an additional bond or bonds in such form and amount, and with such surety or sureties as shall be satisfactory to the County. In such event no further payment to the Contractor shall be deemed to be due under this Agreement until such new or additional security for the faithful performance of the Work shall be furnished in manner and form satisfactory to the County.

The Contractor hereby assumes the entire responsibility and liability for any and all injury to or death of any and all persons, including the Contractor's agents, servants, and employees, and in addition thereto, for any and all damages to property caused by or resulting from or arising out of any act or omission in connection with this contract or the prosecution of work hereunder, whether caused by the Contractor or the Contractor's agents, Servants, or employees, or by any of the Contractor's subcontractors or suppliers, and the Contractor shall indemnify and hold harmless the County, the Construction Manager, or any of their subcontractors from and against any and all loss and/or expense which they or any of them may suffer or pay as a result of claims or suits due to, because of, or arising out of any and all such injuries, deaths and/or damage, irrespective of County or Construction Manager negligence (except that no party shall be indemnified for their own sole negligence). The Contractor, if requested, shall assume and defend at the Contractor's own expense, any suit, action or other legal proceedings arising there from, and the Contractor hereby agrees to satisfy, pay, and cause to be discharged of record any judgment which may be rendered against the County and the Construction Manager arising there from.

In the event of any such loss, expense, damage, or injury, or if any claim or demand for damages as heretofore set forth is made against the County or the Construction Manager, the County may withhold from any payment due or thereafter to become due to the Contractor under the terms of this Contract, an amount sufficient in its judgment to protect and indemnify it and the Construction Manager from any and all claims, expense, loss, damages, or injury; and the County, in its discretion, may require the Contractor to furnish a surety bond satisfactory to the County providing for such protection and indemnity, which bond shall be furnished by the Contractor within five (5) days after written demand has been made therefore. The expense of said Bond shall be borne by the Contractor. **[See General Conditions for similar provisions]**

This Contract constitutes the full agreement between the parties, and the Contractor shall not sublet, assign, transfer, pledge, convey, sell or otherwise dispose of the whole or any part of this Contract or his right, title, or interest therein to any person, firm or corporation without the previous consent of the County in writing. Subject to applicable provisions of law, this Contract shall be in full force and effect as a Contract, from the date on which a fully executed and approved counterpart hereof is delivered to the Contractor and shall remain and continue in full force and effect until after the expiration of any guarantee period and the Contractor and his sureties are finally released by the County.

This agreement was approved by the Fulton County Board of Commissioner on [Insert approval date and item number].

[SIGNATURES NEXT PAGE]

IN WITNESS THEREOF, the Parties hereto have caused this Contract to be executed by their duly authorized representatives as attested and witnessed and their corporate seals to be hereunto affixed as of the day and year date first above written.

OWNER:

CONTRACTOR:

FULTON COUNTY, GEORGIA

[Insert Company Name]

John H. Eaves, Commission Chair
Board of Commissioners

**[Insert Name & Title of person
authorized to sign contract]**

ATTEST:

ATTEST:

Mark Massey
Clerk to the Commission (Seal)

Secretary/
Assistant Secretary

(Affix Corporate Seal)

APPROVED AS TO FORM:

Office of the County Attorney

APPROVED AS TO CONTENT:

[Insert Department Head Name]
[Insert Department Head Title]

END OF SECTION

PERFORMANCE BOND

No contract with Fulton County for work to be done shall be valid for any purpose unless the Contractor provides a Performance Bond with good and sufficient surety payable to, in favor of, and for the protection of Fulton County. The Performance Bond shall be in the amount of 100% of the total contract amount, payable by the terms of the Contract, and shall be written on the following form.

Surety companies executing Bonds must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business as a surety in Georgia.

Attestation for the corporation must be by the corporate officer; for a partnership by another partner; for an individual by a notary with the corporate seal.

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS that _____
(Insert name of Contractor)
(hereinafter called the "Principal") and _____
(Insert name of Surety)
(hereinafter called the "Surety"), are held and firmly bound unto **FULTON COUNTY**, a political subdivision of the State of Georgia (hereinafter called the "Owner"), its successors and assigns, in the penal sum of _____
[100% of Contract amount], lawful money of the United States of America, for the payment of which the Principal and the Surety bind themselves, their administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered, or is about to enter, into a certain written contract with the Owner, dated _____, which is incorporated herein by reference in its entirety (hereinafter called the "Contract"), for construction-type services of a project known as **[NAME OF PROJECT]**, as more particularly described in the Contract (hereinafter called the "Project");

NOW, THEREFORE, the conditions of this obligation are as follows, that if the Principal shall fully and completely perform all the undertakings, covenants, terms, conditions, warranties, and guarantees contained in the Contract, including all modifications, amendments, changes, deletions, additions, and alterations thereto that may hereafter be made, then this obligation shall be void; otherwise it shall remain in full force and effect.

Whenever the Principal shall be, and declared by the Owner to be, in default under the Construction-Type Contract, the Surety shall promptly remedy the default as follows:

1. Complete the Contract in accordance with its terms and conditions; or, at the sole option of the Owner,
2. Obtain a bid or bids for completing the Contract in accordance with its terms and conditions, and upon determination by the Surety and the Owner of the lowest responsible bidder, arrange for a contract between such bidder and Owner and make available as the work progresses (even though there should be a default or succession of defaults under the Contract or contracts of completion arranged under this paragraph) sufficient funds to pay the cost of completion less the balance of the contract price; but not exceeding, including other costs and damages for which the Surety may be liable hereunder, the penal sum set forth in the first paragraph hereof, as may be adjusted, and the Surety shall make available and pay to the Owner the funds required by this Paragraph prior to the payment of the Owner of the balance of the contract price, or any portion thereof. The term "balance of the contract price," as used in this paragraph, shall mean the total amount payable by the Owner to the Contractor under the Contract, and any amendments thereto, less the amount paid by the Owner to the Contractor; or, at the sole option of the Owner,
3. Allow Owner to complete the work and reimburse the Owner for all reasonable costs incurred in completing the work.

In addition to performing as required in the above paragraphs, the Surety shall indemnify and hold harmless the Owner from any and all losses, liability and damages, claims, judgments, liens, costs and fees of every description, including reasonable attorney's fees, litigation costs and expert witness fees, which the Owner may incur, sustain or suffer by reason of the failure or default on the part of the Principal in the performance of any or all of the terms, provisions, and requirements of the Contract, including any and all amendments and modifications thereto, or

incurred by the Owner in making good any such failure of performance on the part of the Principal.

The Surety shall commence performance of its obligations and undertakings under this Bond promptly and without delay, after written notice from the Owner to the Surety.

The Surety hereby waives notice of any and all modifications, omissions, additions, changes, alterations, extensions of time, changes in payment terms, and any other amendments in or about the Contract, and agrees that the obligations undertaken by this Bond shall not be impaired in any manner by reason of any such modifications, omissions, additions, changes, alterations, extensions of time, change in payment terms, and amendments.

The Surety hereby agrees that this Bond shall be deemed amended automatically and immediately, without formal or separate amendments hereto, upon any amendment to the Contract, so as to bind the Principal and the Surety to the full and faithful performance of the Contract as so amended or modified, and so as to increase the penal sum to the adjusted Contract Price of the Contract.

No right of action shall accrue on this Bond to or for the use of any person, entity or corporation other than the Owner and any other obligee named herein, or their executors, administrators, successors or assigns.

This Bond is intended to comply with O.C.G.A. Section 36-91-1 et seq., and shall be interpreted so; as to comply with; the minimum requirements thereof. However, in the event the express language of this Bond extends protection to; the Owner beyond that contemplated by O.C.G.A. Section 36-91-1 et seq. and O.C.G.A. Section 13-10-1, as amended, or any other statutory law applicable to this Project, then the additional protection shall be enforced in favor of the Owner, whether or not such protection is found in the applicable statutes.

IN WITNESS WHEREOF the undersigned have caused this instrument to be executed and their respective corporate seals to be affixed and attested by their duly authorized representatives this _____ day of _____, _____.

_____(SEAL)
(Principal)

By: _____

Attest:

Secretary

_____(SEAL)
(Surety)

By: _____

Attest:

Secretary

(Address of Surety's Home Office)

(Resident Agent of Surety)

END OF SECTION

PAYMENT BOND

No Contract with Fulton County for work to be done shall be valid for any purpose unless the Contractor provides a Payment Bond with good and sufficient surety payable to Fulton County for the use and protection of all sub-contractors and all persons supplying labor, materials, machinery, and equipment in the prosecution of the work provided for in the Contract. The Payment Bond shall be in the amount of 100% of the total contract amount, payable by the terms of the Contract, and shall be written on the following form.

Surety companies executing Bonds must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the State of Georgia.

Attestation for the corporation must be by the corporate officer; for a partnership by another partner; for an individual by a notary with the corporate seal.

PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS that _____
(Insert name of Contractor)
(hereinafter called the "Principal") and _____
(Insert name of Surety)
(hereinafter called the "Surety"), are held and firmly bound unto **FULTON COUNTY**, a political subdivision of the State of Georgia (hereinafter called the "Owner"), its successors and assigns as obligee, in the penal sum of _____
[100% of Contract amount], lawful money of the United States of America, for the payment of which the Principal and the Surety bind themselves, their administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered, or is about to enter, into a certain written contract with the Owner, dated _____, which is incorporated herein by reference in its entirety (hereinafter called the "Contract"), for construction-type services of a project known as **[NAME OF PROJECT]**, as more particularly described in the Contract (hereinafter called the "Project");

NOW, THEREFORE, the condition of this obligation is such that if the Principal shall promptly make payment to all persons working on or supplying labor or materials under the Contract, and any amendments thereto, with regard to labor or materials furnished and used in the Project, and with regard to labor or materials furnished but not so used, then this obligation shall be void; but otherwise it shall remain in full force and effect.

1. A "Claimant" shall be defined herein as any subcontractor, person, party, partnership, corporation or the entity furnishing labor, services or materials used, or reasonably required for use, in the performance of the Contract, without regard to whether such labor, services or materials were sold, leased or rented, and without regard to whether such Claimant is or is not in privity of contract with the Principal or any subcontractor performing work on the Project, including, but not limited to, the following labor, services, or materials: water, gas, power, light, heat, oil, gasoline, telephone service or rental of equipment directly applicable to the Contract.
2. In the event a Claimant files a lien against the property of the Owner, and the Principal fails or refuses to satisfy or remove it promptly, the Surety shall satisfy or remove the lien promptly upon written notice from the Owner, either by bond or as otherwise provided in the Contract.
3. The Surety hereby waives notice of any and all modifications, omissions, additions, changes, alterations, extensions of time, changes in the payment terms, and any other amendments in or about the Contract and agrees that the obligations undertaken by this Bond shall not be impaired in any manner by reason of any such modifications, omissions, additions, changes, alterations, extensions of time, changes in payment terms, and amendments.
4. The Surety hereby agrees that this Bond shall be deemed amended automatically and immediately, without formal or separate amendments hereto, upon any amendment or modifications to the Contract, so as to bind the Principal and Surety, jointly and severally, to the full payment of any Claimant under the Contract, as amended or modified, provided only that the Surety shall not be liable for more than the penal sum of the Bond, as specified in the first paragraph hereof.
5. This Bond is made for the use and benefit of all persons, firms, and corporations who or which may furnish any materials or perform any labor for or on account of the

- construction-type services to be performed or supplied under the Contract, and any amendments thereto, and they and each of them may sue hereon.
6. No action may be maintained on this Bond after one (1) year from the date the last services, labor, or materials were provided under the Contract by the Claimant prosecuting said action.
 7. This Bond is intended to comply with O.C.G.A. Section 13-10-1, and shall be interpreted so as to comply with the minimum requirements thereof. However, in the event the express language of this Bond extends protection to the Owner beyond that contemplated by O.C.G.A. Section 13-10-1, or any other statutory law applicable to this Project, then the additional protection shall be enforced in favor of the Owner, whether or not such protection is found in the applicable statutes.

IN WITNESS WHEREOF the undersigned have caused this instrument to be executed and their respective corporate seals to be affixed and attested by their duly authorized representatives this _____ day of _____, _____.

_____(SEAL)
(Principal)

By: _____

Attest:

Secretary

_____(SEAL)
(Surety)

By: _____

Attest:

Secretary

(Address of Surety's Home Office)

(Resident Agent of Surety)

END OF SECTION

GENERAL CONDITIONS:

00700-1 FAMILIARITY WITH SITE

Execution of this agreement by the Contractor is a representation that the Contractor has visited the site, has become familiar with the local conditions under which the work is to be performed, and has correlated personal observations with the requirements of this agreement.

00700-2 CONTRACT DOCUMENTS

This agreement consists of Owner's invitation for bid, instructions to bidders, bid form, performance bond, payment bond, acknowledgments, the contract, general conditions, special conditions, specifications, plans, drawings, exhibits, addenda, and written change orders.

- A. Notice of Award of Contract:
- B. Execution of Contract Documents

Upon notification of Award of Contract, the Owner shall furnish the Contractor the conformed copies of Contract Documents for execution by the Contractor and the Contractor's surety.

Within ten (10) days after receipt the Contractor shall return all the documents properly executed by the Contractor and the Contractor's surety. Attached to each document shall be an original power-of-attorney for the person executing the bonds for the surety and certificates of insurance for the required insurance coverage.

After receipt of the documents executed by the Contractor and his surety with the power-of-attorney and certificates of insurance, the Owner shall complete the execution of the documents. Distribution of the completed documents will be made upon completion.

Should the Contractor and/or Surety fail to execute the documents within the time specified; the Owner shall have the right to proceed on the Bid Bond accompanying the bid.

If the Owner fails to execute the documents within the time limit specified, the Contractor shall have the right to withdraw the Contractor's bid without penalty.

Drawings and Specifications:

The Drawings, Specifications, Contract Documents, and all supplemental documents, are considered essential parts of the Contract, and requirements occurring in one are as binding as though occurring in all. They are intended to define, describe and provide for all Work necessary to complete the Project in an acceptable manner, ready for use, occupancy, or operation by the Owner.

In case of conflict between the Drawings and Specifications, the Specifications shall govern. Figure dimensions on Drawings shall govern over scale dimensions, and detailed Drawings shall govern over general Drawings.

In cases where products or quantities are omitted from the Specifications, the description and quantities shown on the Drawings shall govern.

Any ambiguities or need for clarification of the Drawings or Specifications shall be immediately reported to the Construction Manager in writing. Any such ambiguity or need for clarification shall be handled by the Construction Manager in writing. No clarification of the Drawings and Specifications hereunder by the Construction Manager shall entitle the Contractor to any additional monies unless a Change Order has been processed as provided by "Changes in the Contract" hereof.

Any work done by the Contractor following a discovery of such differing site condition or ambiguity or need for clarification in the Contract Drawings and Specifications prior to a written report to the Construction Manager shall not entitle the Contractor to additional monies and shall be done at the Contractor's risk.

The Construction Manager will furnish the Contractor five (5) copies of the Contract Drawings and the Specifications, one copy of which the Contractor shall have available at all times on the Project site.

00700-3 DEFINITIONS

The following terms as used in this agreement are defined as follows to the extent the definitions herein differ or conflict with those in the Instructions for Bidders, Section 00100, the definitions herein shall control.

Change Order - A written order to the Contractor issued by the County pursuant to Fulton County Policy and Procedures 800-6 for changes in the work within the general scope of the contract documents, adjustment of the contract price, extension of the contract time, or reservation of determination of a time extension.

Construction Manager or Engineer shall mean Fulton Construction Management Partners, the County authorized representative for this project.

Contractor shall mean the party of the second part to the Contract Agreement or the authorized and legal representative of such party.

Contract Documents include the Contract Agreement, Contractor's Bid (including all documentation accompanying the Bid and any post-Bid documentation required by the County prior to the Notice of Award), Bonds, all Special Conditions, General Conditions, Supplementary Conditions, Specifications, Drawings and addenda, together with written amendments, change orders, field orders and the Construction Manager's written interpretations and clarifications issued in accordance with the General Conditions on or after the date of the Contract Agreement.

Shop drawing submittals reviewed in accordance with the General Conditions, geotechnical investigations and soils report and drawings of physical conditions in or relating to existing surface structures at or contiguous to the site are not Contract Documents.

Contract Price - The sum specified in the Agreement to be paid to the Contractor in consideration of the Work.

Contract Time shall mean the number of consecutive calendar days as provided in the Contract Agreement for completion of the Work, to be computed from the date of Notice to Proceed.

Owner or County shall mean Fulton County Government, party of the first part to the Contract Agreement, or its authorized and legal representatives.

Day - A calendar day of twenty-four hours lasting from midnight of one day to midnight the next day.

Design Consultant shall mean the firm or corporation responsible for the detailed design drawings and specifications.

Director - Director of the Department of Public Works of Fulton County, Georgia or the designee thereof.

Final Completion shall mean the completion of all work as required in accordance with the terms and conditions of the contract documents.

Liquidated Damages shall mean the amount, stated in the Contract Agreement, which the Contractor agrees to pay to the Owner for each consecutive calendar day beyond the Contract time required to complete the Project or for failing to comply with associated milestones. Liquidated Damages will end upon written notification from the Owner of Final Acceptance of the Project or upon written notification of from the Owner of completion of the milestone.

Notice to Proceed - A written communication issued by the County to the Contractor authorizing it to proceed with the work, establishing the date of commencement and completion of the work, and providing other direction to the Contractor.

Products shall mean materials or equipment permanently incorporated into the work.

Program Manager - Not used in this contract. Delete all references.

Project Manual - The Contract Documents.

Provide shall mean to furnish and install.

Substantial Completion - The date certified by the Construction Manager when all or a part of the work, as established pursuant to General Condition 0700-81, is sufficiently completed in accordance with the requirements of the contract documents so that the identified portion of the work can be utilized for the purposes for which it is intended.

Work or Project - All of the services specified, indicated, shown or contemplated by the contract documents, and furnishing by the Contractor of all materials, equipment, labor, methods, processes, construction and manufacturing materials and equipment, tools, plans, supplies, power, water, transportation and other things necessary to complete such services in accordance with the contract documents to insure a functional and complete facility.

00700-4 CODES

All codes, specifications, and standards referenced in the contract documents shall be the latest editions, amendments and revisions of such referenced standards in effect as of the date of the request for proposals for this contract.

00700-5 REVIEW OF CONTRACT DOCUMENTS

Before making its proposal to the County, and continuously after the execution of the agreement, the Contractor shall carefully study and compare the contract documents and shall at once report to the Construction Manager any error, ambiguity, inconsistency or omission that may be discovered, including any requirement which may be contrary to any law, ordinance, rule, or regulation of any public authority bearing on the performance of the work. By submitting its proposal, the Contractor agrees that the contract documents, along with any supplementary written instructions issued by or through the Construction Manager that have become a part of the contract documents, appear accurate, consistent and complete insofar as can be reasonably determined. If the Contractor has timely reported in writing any error, inconsistency, or omission to the Construction Manager, has properly stopped the affected work until instructed to proceed, and has otherwise followed the instructions of the Construction Manager, the Contractor shall not be liable to the County for any damage resulting from any such error, inconsistency, or omission in the contract documents. The Contractor shall not perform any portion of the work without the contract documents, approved plans, specifications, products and data, or samples for such portion of the work. For purposes of this section "timely" is defined as the time period in which the contractor discovers, or should have discovered, the error, inconsistency, or omission, with the exercise of reasonable diligence.

00700-6 STRICT COMPLIANCE

No observation, inspection, test or approval of the County or Construction Manager shall relieve the Contractor from its obligation to perform the work in strict conformity with the contract documents except as provided in General Condition 00700-48.

00700-7 APPLICABLE LAW

All applicable State laws, County ordinances, codes, and rules and regulations of all authorities having jurisdiction over the construction of the project shall apply to this agreement. The Contractor shall comply with the requirements of any Fulton County program concerning non-discrimination in contracting.. All work performed within the right of way of the Georgia Department of Transportation and any railroad crossing shall be in accordance with Georgia Department of Transportation regulations, policies and procedures and, where applicable, those of any affected railroad. The Contractor shall comply with all laws, ordinances, codes, rules and regulations bearing on the conduct of the work as specified and the Contractor agrees to indemnify and hold harmless the County, its officers, agents and employees, as well as the Construction Manager and the Program Manager against any claim or liability arising from or

based on the violation of any law, ordinance, regulation, order or decree affecting the conduct of the work, whether occasioned by the Contractor, his agents or employees.

00700-8 PERMITS, LICENSES AND BONDS

All permits and licenses necessary for the work shall be secured and paid for by the Contractor. If any permit, license or certificate expires or is revoked, terminated, or suspended as a result of any action on the part of the Contractor, the Contractor shall not be entitled to additional compensation or time. The Contractor shall obtain and keep in force at all times performance and payment bonds payable to Fulton County in penal amounts equal to 100% of the Contract price.

00700-9 TAXES

- A. The Contractor shall pay all sales, retail, occupational, service, excise, old age benefit and unemployment compensation taxes, consumer, use and other similar taxes, as well as any other taxes or duties on the materials, equipment, and labor for the work provided by the Contractor which are legally enacted by any municipal, county, state or federal authority, department or agency at the time bids are received, whether or not yet effective. The Contractor shall maintain records pertaining to such taxes and levies as well as payment thereof and shall make the same available to the County at all reasonable times for inspection and copying. The Contractor shall apply for any and all tax exemptions which may be applicable and shall timely request from the County such documents and information as may be necessary to obtain such tax exemptions. The County shall have no liability to the Contractor for payment of any tax from which it is exempt.
- B. The Contractor is obligated to comply with all local and State Sales and Use Tax laws. The Contractor shall provide the Owner with documentation to assist the Owner in obtaining sales and/or use tax refunds for eligible machinery and equipment used for the primary purpose of reducing or eliminating air or water pollution as provided for in Chapter 48-8-3 (36) and (37) of the Official Code of Georgia. All taxes shall be paid by the Contractor. All refunds will accrue to the Owner.

Acceptance of the project as complete and final payment will not be made by the Owner until the Contractor has fully complied with this requirement.

00700-10 DELINQUENT CONTRACTORS

The County shall not pay any claim, debt, demand or account whatsoever to any person firm or corporation who is in arrears to the County for taxes. The County shall be entitled to a counterclaim, backcharge, and offset for any such debt in the amount of taxes in arrears, and no assignment or transfer of such debt after the taxes become due shall affect the right of the County to offset any taxes owed against said debt.

00700-11 LIEN WAIVERS

The Contractor shall furnish the County with evidence that all persons who have performed work or furnished materials pursuant to this agreement have been paid in full prior to submitting its demand for final payment pursuant to this agreement. A final affidavit, Exhibit A, must be completed, and submitted to comply with requirements of 00700-11. In the event that such evidence is not furnished, the County may retain sufficient sums necessary to meet all lawful claims of such laborers and materialmen. The County assumes no obligation nor in any way undertakes to pay such lawful claims from any funds due or that may become due to the Contractor.

00700-12 MEASUREMENT

All items of work to be paid for per unit of measurement shall be subject to inspection, measurement, and confirmation by the Construction Manager.

00700-13 ASSIGNMENT

The Contractor shall not assign any portion of this agreement or moneys due there from (include factoring of receivables) without the prior written consent of the County. The Contractor shall retain personal control and shall provide personal attention to the fulfillment of its obligations pursuant to this agreement. Any assignment without the express written consent of the County shall render this contract voidable at the sole option of the County.

00700-14 FOREIGN CONTRACTORS

In the event that the Contractor is a foreign corporation, partnership, or sole proprietorship, the Contractor hereby irrevocably appoints the Secretary of State of Georgia as its agent for service of all legal process for the purpose of this contract only.

00700-15 INDEMNIFICATION [there are two indemnification clauses, the other is in the Contract Cover Sheet]

The Contractor hereby assumes the entire responsibility and liability for any and all injury to or death of any and all persons, including the Contractor's agents, servants, and employees, and in addition thereto, for any and all damages to property caused by or resulting from or arising out of any act or omission in connection with this contract or the prosecution of work hereunder, whether caused by the Contractor or the Contractor's agents, servants, or employees, or by any of the Contractor's subcontractors or suppliers, and the Contractor shall indemnify and hold harmless the County, the Construction Manager and the Program Manager, or any of their subcontractors from and against any and all loss and/or expense which they or any of them may suffer or pay as a result of claims or suits due to, because of, or arising out of any and all such injuries, deaths and/or damage, irrespective of County or Construction Manager or Program Manager negligence (except that no party shall be indemnified for their own sole negligence). The Contractor, if requested, shall assume and defend at the Contractor's own expense, any suit, action or other legal proceedings arising there from, and the Contractor hereby agrees to satisfy, pay, and cause to be discharged of record any judgment which may be rendered against the County, the Construction Manager and the Program Manager arising there from.

In the event of any such loss, expense, damage, or injury, or if any claim or demand for damages as heretofore set forth is made against the County or the Construction Manager or the Program Manager, the County may withhold from any payment due or thereafter to become due to the Contractor under the terms of this Contract, an amount sufficient in its judgment to protect and indemnify it and the Construction Manager and the Program Manager from any and all claims, expense, loss, damages, or injury; and the County, in its discretion, may require the Contractor to furnish a surety bond satisfactory to the County providing for such protection and indemnity, which bond shall be furnished by the Contractor within five (5) days after written demand has been made therefore. The expense of said Bond shall be borne by the Contractor.

00700-16 SUPERVISION OF WORK AND COORDINATION WITH OTHERS

The Contractor shall supervise and direct the work using the Contractor's best skill and attention. The Contractor shall be solely responsible for all construction methods and procedures and shall coordinate all portions of the work pursuant to the contract subject to the overall coordination of the Construction Manager. All work pursuant to this agreement shall be performed in a skillful and workmanlike manner.

The County reserves the right to perform work related to the Project with the County's own forces and to award separate contracts in connection with other portions of the project, other work on the site under these or similar conditions of the contract, or work which has been extracted from the Contractor's work by the County.

When separate contracts are awarded for different portions of the project or other work on the site, the term "separate contractor" in the Contract Documents in each case shall mean the contractor who executes each separate County Agreement.

The Contractor shall cooperate with the County and separate contractors in arranging the introduction and storage of materials and equipment and execution of their work, and shall cooperate in coordinating connection of its work with theirs as required by the Contract Documents.

If any part of the Contractor's Work depends for proper execution or results upon the work of the County or any separate contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly report to the Construction Manager any apparent discrepancies or defects in such other work that render it unsuitable for such proper execution and results **within fourteen (14) days** of discovery of such discrepancy or defect. Failure of the Contractor to so report in writing shall constitute an acceptance of the County's or separate contractor's work as fit and proper to receive the Work, except as to any defects which may subsequently become apparent in such work by others.

Any costs caused by defective or untimely work shall be borne by the party responsible therefore.

Should the Contractor wrongfully cause damage to the work or property of the County or to other work or property on the site, including the work of separate contractors, the Contractor shall promptly remedy such damage at the Contractor's expense.

Should the Contractor be caused damage by any other contractor on the Project, by reason of such other contractor's failure to perform properly his contract with the County, no action shall lie against the County or the Construction Manager inasmuch as the parties to this agreement are the only beneficiaries hereof and there are no third party beneficiaries and neither the County nor the Construction Manager shall have liabilities therefore, but the Contractor may assert his claim for damages solely against such other contractor. The Contractor shall not be excused from performance of the contract by reason of any dispute as to damages with any other contractor or third party.

Where the Work of this Contract shall be performed concurrently in the same areas as other construction work, the Contractor shall coordinate with the Construction Manager and the separate contractors in establishing mutually acceptable schedules and procedures that shall permit all jobs to proceed with minimum interference.

If a dispute arises between the Contractor and separate contractors as to their responsibility for cleaning up, the County may clean up and charge the cost thereof to the Contractor or contractors responsible therefore as the County shall determine to be just.

00700-17 ADMINISTRATION OF CONTRACT

The Program Manager and the Construction Manager shall provide administration services as hereinafter described.

For the administration of this Contract, the Construction Manager shall serve as the County's primary representative during design and construction and until final payment to the Contractor is due. The Construction Manager shall advise and consult with the County and the Program Manager. The primary point of contact for the Contractor shall be the Construction Manager. All correspondence from the Contractor to the County shall be forwarded through the Construction Manager. Likewise, all correspondence and instructions to the Contractor shall be forwarded through the Construction Manager.

The Construction Manager will determine in general that the construction is being performed in accordance with design and engineering requirements, and will endeavor to guard the County against defects and deficiencies in the Work.

The Construction Manager will not be responsible for or have control or charge of construction means, methods, techniques, sequences, or procedures, or for safety precautions and programs in connection with the Work, nor will it be responsible for the Contractor's failure to carry out the Work in accordance with the Contract Documents. The Construction Manager will not be responsible for or have control or charge over the acts or omissions of the Contractor, its

engineers, consultants, subcontractors, or any of their agents or employees, or any other persons performing the Work.

Based on the Construction Manager's observations regarding the Contractor's Applications for Payment, the Construction Manager shall determine the amounts owing to the Contractor, in accordance with the payment terms of the Contract, and shall issue Certificates for Payment in such amount to the County.

The Construction Manager shall render interpretations necessary for the proper execution or progress of the Work. Either party to the Contract may make written requests to the Construction Manager for such interpretations.

Claims, disputes and other matters in question between the Contractor and the County relating to the progress of the Work or the interpretation of the Contract Documents shall be referred to the Construction Manager for interpretation.

All interpretations of the Construction Manager shall be consistent with the intent of and reasonably inferable from the Contract Documents and shall be in writing or in graphic form.

Except as otherwise provided in this Contract, the Construction Manager shall issue a decision on any disagreement concerning a question of fact arising under this Contract. The Construction Manager shall reduce the decision to writing and mail or otherwise furnish a copy thereof to the Contractor. The decision of the Construction Manager shall be final and conclusive unless, within thirty (30) days from the date of receipt of such copy, the Contractor files a written appeal with the Director of Public Works and mails or otherwise furnishes the Construction Manager a copy of such appeal. The decision of the Director of Public Works or the Director's duly authorized representative for the determination of such appeals shall be final and conclusive. Such final decision shall not be pleaded in any suit involving a question of fact arising under this Contract, provided such is not fraudulent, capricious, arbitrary, so grossly erroneous as necessarily implying bad faith, or is not supported by substantial evidence. In connection with any appeal proceeding under this Article, the Contractor shall be afforded an opportunity to be heard and to offer evidence in support of Contractor's appeal. Pending any final decision of a dispute hereunder, the Contractor shall proceed diligently with the performance of the Contract as directed by the Construction Manager.

The Construction Manager shall have authority to reject Work which does not conform to the Contract Documents. Whenever, in the Construction Manager's opinion, it is considered necessary or advisable for the implementation of the intent of the Contract Documents, the County shall have authority to require special inspection or testing of the Work whether or not such Work be then fabricated, installed or completed. The Contractor shall pay for such special inspection or testing if the Work so inspected or tested is found not to comply with the requirements of the contract; the County shall pay for special inspection and testing if the Work is found to comply with the contract. Neither the Construction Manager's authority to act under this Subparagraph, nor any decision made by the Construction Manager in good faith either to exercise or not to exercise such authority, shall give rise to any duty or responsibility of the Construction Manager to the Contractor, any subcontractor, any of their agents or employees, or any other person performing any of the Work.

The Contractor shall provide such shop drawings, product data, and samples as may be required by the Construction Manager and/or as required by these Contract Documents.

The Construction Manager shall conduct inspections to determine Substantial Completion and Final Completion, and shall receive and forward to the County for review written warranties and related documents required by the Contract Documents and assembled by the Contractor. The Construction Manager shall approve and issue Certificates for Payment upon compliance with Substantial and Final Completion requirements indicated in General Conditions 00700-81, 00700-82, 00700-84 and 00700-85 of this Agreement.

Except as provided in General Condition 00700-48, the Contractor shall not be relieved from the Contractor's obligations to perform the work in accordance with the contract documents by the

activities or duties of the County or any of its officers, employees, or agents, including inspections, tests or approvals, required or performed pursuant to this agreement.

00700-18 RESPONSIBILITY FOR ACTS OF EMPLOYEES

The Contractor shall employ only competent and skilled personnel. The Contractor shall, upon demand from the Construction Manager, immediately remove any superintendent, foreman or workman whom the Construction Manager may consider incompetent or undesirable.

The Contractor shall be responsible to the County for the acts and omissions of the Contractor's employees, subcontractors, and agents as well as any other persons performing work pursuant to this agreement for the Contractor.

00700-19 LABOR, MATERIALS, SUPPLIES, AND EQUIPMENT

Unless otherwise provided in this agreement, the Contractor shall make all arrangements with necessary support agencies and utility companies, provide and pay for all labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for the execution and completion of the work.

00700-20 DISCIPLINE ON WORK SITE

The Contractor shall enforce strict discipline and good order among its employees and subcontractors at all times during the performance of the work, to include compliance with the Fulton County Drug Free Work Place Policy. The Contractor shall not employ any subcontractor who is not skilled in the task assigned to it. The Construction Manager may, by written notice, require the Contractor to remove from the work any subcontractor or employee deemed by the Construction Manager to be incompetent.

00700-21 HOURS OF OPERATION

All work at the construction site shall be performed during regular business hours of the Fulton County government, except upon the Construction Manager's prior written consent to other work hours. It is further understood that the Contractor's construction schedule is based on a normal 40 hours, five day work week, less Fulton County-recognized holidays. Contractors work schedule shall not violate Fulton County Noise Ordinance by working hours inconsistent with the Fulton County Noise Ordinance. The County's current noise ordinance or other applicable ordinance shall govern. If the Contractor desires to work in excess of this limit, the Contractor shall submit a written request to the Construction Manager, a minimum of five days prior to the desired work date. The Contractor shall be responsible for any additional expenses incurred by the Owner as a result of the extended work hours, including resident inspection overtime. The cost associated with resident inspector overtime shall be deducted from the Contractor monthly payment request.

00700-22 FAMILIARITY WITH WORK CONDITIONS

The Contractor shall take all steps necessary to ascertain the nature and location of the work and the general and local conditions which may affect the work or the cost thereof. The Contractor's failure to fully acquaint itself with the conditions which may affect the work, including, but not limited to conditions relating to transportation, handling, storage of materials, availability of utilities, labor, water, roads, weather, topographic and subsurface conditions, other separate contracts to be entered into by the County relating to the project which may affect the work of the Contractor, applicable provisions of law, and the character and availability of equipment and facilities necessary prior to and during the performance of the work shall not relieve the Contractor of its responsibilities pursuant to this agreement and shall not constitute a basis for an equitable adjustment of the contract terms. The County reserves the right to perform with its own forces or to contract with other entities for other portions of the project work, in which case the Contractor's responsibility to assure its familiarity with work conditions hereunder shall include all coordination with such other contractors and the County necessary to insure that there is no interference between contractors as will delay or hinder any contractor in its prosecution of work on the project. The County assumes no responsibility for any understandings or representations

concerning conditions of the work made by any of its officers, agents, or employees prior to the execution of this agreement.

00700-23 RIGHT OF ENTRY

The County reserves the right to enter the site of the work by such agent, including the Construction Manager, as it may elect for the purpose of inspecting the work or installing such collateral work as the County may desire. The Contractor shall provide safe facilities for such access so that the County and its agents may perform their functions.

00700-24 NOTICES

Any notice, order, instruction, claim or other written communication required pursuant to this agreement shall be deemed to have been delivered or received as follows:

Upon personal delivery to the Contractor, its authorized representative, or the Construction Manager on behalf of the County. Personal delivery may be accomplished by in-person hand delivery or bona fide overnight express service.

Three days after depositing in the United States mail a certified letter addressed to the Contractor or the Construction Manager for the County. For purposes of mailed notices, the County's mailing address shall be 141 Pryor Street, 6th Floor, Atlanta, Georgia 30303, or as the County shall have otherwise notified the Contractor. The Contractor's mailing address shall be the address stated in its proposal or as it shall have most recently notified the Construction Manager in writing.

00700-25 SAFETY

A. SAFETY, HEALTH AND LOSS PREVENTION

The Contractor shall be responsible for implementing a comprehensive project-specific safety, health and loss prevention program and employee substance abuse program for this project. All Sub-Contractors must either implement their own program or follow the Contractor's safety, health and loss prevention program and employee substance abuse program.

The Contractor's safety, health and loss prevention program and employee substance abuse program must meet or exceed all governmental regulations (OSHA, EPA, DOT, State, local), and any other specific Fulton County requirements

B. COUNTY'S SAFETY, HEALTH, AND LOSS PREVENTION PROCESS GUIDELINES AND REQUIREMENTS

The County and its agents reserve the right, but assume no duty, to establish and enforce safety, health, and loss prevention guidelines and to make the appropriate changes in the guidelines, for the protection of persons and property and to review the efficiency of all protective measures taken by the Contractor. The Contractor shall comply with all safety, health, and loss prevention process guidelines and requirements and changes made by the County or its agent(s). The issuance of any such guidelines or changes by the County or its agent(s) shall not relieve the Contractor of its duties and responsibilities under this Agreement, and the County or its agent(s) shall not thereby assume, nor be deemed to have assumed, any such duties or responsibilities of the Contractor.

C. COMPLIANCE OF WORK, EQUIPMENT, AND PROCEDURES WITH ALL APPLICABLE LAWS and REGULATIONS

All Work, whether performed by the Contractor or its Sub-Contractors of any tier, or anyone directly or indirectly employed by any of them, and all equipment, appliances, machinery, materials, tools and like items incorporated or used in the Work, shall be in compliance with and conform to:

1. All applicable laws, ordinances, rules, regulations and orders of any public, quasi-public or other governmental authority relating to the safety of persons and their protection against injury, specifically including, but in no event limited to, the Federal Occupational Safety and Health Act of 1970, as amended, and all rules and regulations now or hereafter in effect pursuant to said Act.
2. All rules, regulations, and requirements of the County or its agent(s) and its insurance carriers relating there to. In the event of a conflict or differing requirements the more stringent shall govern.

D. PROTECTION OF THE WORK

1. The Contractor shall, throughout the performance of the Work, maintain adequate and continuous protection of all Work and temporary facilities against loss or damage from whatever cause, shall protect the property of the County and third parties from loss or damage from whatever cause arising out of the performance of the Work, and shall comply with the requirements of the County or its agent(s) and its insurance carriers, and with all applicable laws, codes, rules and regulations, (as same may be amended) with respect to the prevention of loss or damage to property as a result of fire or other hazards.
2. The County or its agent(s) may, but shall not be required to, make periodic inspections of the Project work area. In such event, however, the Contractor shall not be relieved of its aforesaid responsibilities and the County or its agent(s) shall not assume, nor shall it be deemed to have assumed, any responsibility otherwise imposed upon the assurance of Contractor by this Agreement.

E. SAFETY EQUIPMENT

1. The Contractor shall provide to each worker on the Project work area the proper safety equipment for the duties being performed by that worker and will not permit any worker on the Project work area who fails or refuses to use the same. The County or its agent shall have the right, but not the obligation, to order the removal of a worker from the Project work site for his/her failure to comply with safe practices or substance abuse policies.

F. EMERGENCIES

1. In any emergency affecting the safety of persons or property, or in the event of a claimed violation of any federal or state safety or health law or regulation, arising out of or in any way connected with the Work or its performance, the Contractor shall act immediately to prevent threatened damage, injury or loss and to remedy said violation. Failing such action the County or its agent(s) may immediately take whatever steps it deems necessary including, but not limited to, suspending the Work as provided in this Agreement.
2. The County or its agent(s) may offset any and all costs or expenses of whatever nature, including attorneys' fees, paid or incurred by the County or its agent(s) (whether such fees are for in-house counsel or counsel retained by the County or its agent), in taking the steps authorized by Section 00700-25(G) (1) above against any sums then or thereafter due to the Contractor. The Contractor shall defend, indemnify and hold the County, its officers, agents, and employees harmless against any and all costs or expenses caused by or arising from the exercise by the County of its authority to act in an emergency as set out herein. If the Contractor shall be entitled to any additional compensation or extension of time change order on account of emergency work not due to the fault or neglect of the Contractor or its Sub-Contractors, such additional compensation or extension of time shall be determined in accordance with General Condition 00700-52 and General Condition 00700-87 of this Agreement.

G. SUSPENSION OF THE WORK

1. Should, in the judgment of the County or its agent(s), the Contractor or any Sub-Contractor fail to provide a safe and healthy work place, the County or its agent shall have the right, but not the obligation, to suspend work in the unsafe areas until deficiencies are corrected. All costs of any nature (including, without limitation, overtime pay, liquidated damages or other costs arising out of delays) resulting from the suspension, by whomsoever incurred, shall be borne by the Contractor.
2. Should the Contractor or any Sub-Contractor fail to provide a safe and healthy work place after being formally notified in writing by the County or its agents of such non-compliance, the contract may be terminated following the termination provision of the contract.

H. CONTRACTOR'S INDEMNITY OF THE COUNTY FOR CONTRACTOR'S NON-COMPLIANCE WITH SAFETY PROGRAM

1. The Contractor recognizes that it has sole responsibility to assure its Safety Program is implemented and to assure its construction services are safely provided. The Contractor shall indemnify, defend and hold the County and its agents harmless, from and against any and all liability (whether public or private), penalties (contractual or otherwise), losses, damages, costs, attorneys' fees, expenses, causes of action, claims or judgments resulting, either in whole or in part, from any failure of the Contractor, its Sub-Contractors of any tier or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, to comply with the safety requirements of the contract. The Contractor shall not be relieved of its responsibilities under the safety requirements of the Contract should the County or its agent(s) act or fail to act pursuant to its rights hereunder.
2. The Contractor shall not raise as a defense to its obligation to indemnify under this Subparagraph I any failure of those indemnified hereunder to assure Contractor operates safely, it being understood and agreed that no such failure shall relieve the Contractor from its obligation to assure safe operations or from its obligation to so indemnify. The Contractor also hereby waives any rights it may have to seek contribution, either directly or indirectly, from those indemnified hereunder.
3. In any and all claims against those indemnified hereunder by any employee of the Contractor, any Sub-Contractor of any tier or anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, the indemnification obligation under this Subparagraph I shall not be limited in any way as to the amount or type of damages, compensation or benefits payable by or for the Contractor or any Sub-Contractor of any tier under any workers' compensation act, disability benefit or other employee benefit acts.

00700-26 BLASTING AND EXCAVATION

The Contractor acknowledges that it is fully aware of the contents and requirements of O.C.G.A. § 25-9-1 through 25-9-12 concerning blasting and excavation near underground gas pipes and facilities and shall fully comply therewith.

00700-27 HIGH VOLTAGE LINES

The Contractor acknowledges that it is fully aware of the contents and requirements O.C.G.A. § 46-3-30 through 46-3-39 concerning safeguards against contact with high voltage lines, and the Contractor shall fully comply with said provisions.

00700-28 SCAFFOLDING AND STAGING

The Contractor acknowledges that it is the person responsible for employing and directing others to perform labor within the meaning of O.C.G.A. § 34-1-1 and agrees to comply with said provisions.

00700-29 CLEAN-UP

The Contractor shall clean up all refuse, rubbish, scrap materials, and debris caused by its operations to the end that the site of the work shall present a neat, orderly and workmanlike appearance at all times.

00700-30 PROTECTION OF WORK

The Contractor shall be responsible for maintenance and protection of the work, which shall include any County-furnished supplies, material, equipment, until final completion of this agreement and acceptance of the work as defined herein. Any portion of the work suffering injury, damage or loss shall be considered defective and shall be corrected or replaced by the Contractor without additional cost to the County.

00700-31 REJECTED WORK

The Contractor shall promptly remove from the project all work rejected by the Construction Manager for failure to comply with the contract documents and the Contractor shall promptly replace and re-execute the work in accordance with the contract documents and without expense to the County. The Contractor shall also bear the expense of making good all work of other Contractors destroyed or damaged by such removal or replacement.

00700-32 DEFECTIVE WORK

If the Contractor defaults or neglects to carry out any portion of the work in accordance with the contract documents, and fails within three days after receipt of written notice from the Construction Manager to commence and continue correction of such default or neglect with diligence and promptness, the County may, after three days following receipt by the Contractor of an additional written notice and without prejudice to any other remedy the County may have, make good such deficiencies and complete all or any portion of any work through such means as the County may select, including the use of a separate Contractor. In such case, an appropriate change order shall be issued deducting from the payments then or thereafter due the Contractor the cost of correcting such deficiencies. In the event the payments then or thereafter due the Contractor are not sufficient to cover such amount, the Contractor shall pay the difference to the County on demand.

The County may, at its option, accept defective or nonconforming work instead of requiring its removal or correction. In such case, a change order shall be issued reducing the price due the contractor to the extent appropriate and equitable. Such contract price adjustment shall be effected whether or not final payment has been made.

00700-33 WARRANTY OF NEW MATERIALS

The Contractor warrants to the County that all materials and equipment furnished under this contract will be new unless otherwise specified, and the Contractor further warrants that all work will be of good quality, free from faults and defects, and in conformance with the contract documents. The warranty set forth in this paragraph shall survive final acceptance of the work.

00700-34 CONTRACTOR'S WARRANTY OF THE WORK

If within one year after the date of issuance of the certificate of final payment pursuant to General Condition 84, or within such longer period of time as may be prescribed by law or by the term of any applicable special warranty required by the contract documents, any of the work is found to be defective or not in accordance with the contract documents, the Contractor shall correct such work promptly after receipt of written notice from the Construction Manager to do so. This obligation shall survive both final payment for the work and termination of the contract.

00700-35 ASSIGNMENT OF MANUFACTURERS' WARRANTIES

Without limiting the responsibility or liability of the Contractor pursuant to this agreement, all warranties given by manufacturers on materials or equipment incorporated in the work are hereby assigned by the Contractor to the County. If requested, the Contractor shall execute formal assignments of said manufacturer's warranties to the County. All such warranties shall be directly enforceable by the County.

00700-36 WARRANTIES IMPLIED BY LAW

The warranties contained in this agreement, as well as those warranties implied by law, shall be deemed cumulative and shall not be deemed alternative or exclusive. No one or more of the warranties contained herein shall be deemed to alter or limit any other.

00700-37 STOP WORK ORDERS

In the event that the Contractor fails to correct defective work as required by the contract documents or fails to carry out the work in accordance with contract documents, the Construction Manager, in writing, may order the Contractor to stop work until the cause for such order has been eliminated. This right of the County to stop work shall not give rise to any duty on the part of the County or the Construction Manager to execute this right for the benefit of the Contractor or for any other person or entity.

00700-38 TERMINATION FOR CAUSE

If the Contractor is adjudged bankrupt, makes a general assignment for the benefit of creditors, suffers the appointment of a receiver on account of its insolvency, fails to supply sufficient properly skilled workers or materials, fails to make prompt payment to subcontractors or materialmen, disregards laws, ordinances, rules, regulations, or orders of any public authority having jurisdiction, fails to diligently prosecute the work, or is otherwise guilty of a material violation of this agreement and fails within seven days after receipt of written notice to commence and continue correction of such default, neglect, or violation with diligence and promptness, the County may, after seven days following receipt by the Contractor of an additional written notice and without prejudice to any other remedy the County may have, terminate the employment of the Contractor and take possession of the site as well as all materials, equipment, tools, construction equipment and machinery thereon. The County may finish the work by whatever methods the County deems expedient. In such case, the Contractor shall not be entitled to receive any further payment until the work is completed. If the unpaid balance of the contract price exceeds the cost of completing the work, such excess shall be paid to the Contractor. If such costs exceed the unpaid balance, the Contractor shall pay the difference to the County on demand. This obligation for payment shall survive the termination of the contract. Termination of this agreement pursuant to this paragraph may result in disqualification of the Contractor from bidding on future County contracts.

00700-39 TERMINATION FOR CONVENIENCE

The County may, at any time upon written notice to the Contractor, terminate the whole or any portion of the work for the convenience of the County. The effective date of the terminations shall be provided in the written notice. Said termination shall be without prejudice to any right or remedy of the County provided herein. In addition, in the event this agreement has been terminated due to the default of the Contractor, and if it is later determined that the Contractor was not in default pursuant to the provisions of this agreement at the time of termination, then such termination shall be considered a termination for convenience pursuant to this paragraph.

00700-40 TERMINATION FOR CONVENIENCE - PAYMENT

If the Contract is terminated for convenience by the Owner as provided in this article, Contractor will be paid compensation for those services actually performed as approved by the Owner or his representative. Partially completed tasks will be compensated for based on a signed statement of completion prepared by the Project Manager and submitted to the Contractor which shall itemize each task element and briefly state what work has been completed and what work remains to be

done. Contractor shall also be paid for reasonable costs for the orderly filing and closing of the project.

00700-41 TERMINATION FOR CONVENIENCE - PAYMENT LIMITATIONS

Except for normal spoilage, and except to the extent that the County shall have otherwise expressly assumed the risk of loss, there shall be excluded from the amounts payable to the Contractor the fair value, as determined by the Construction Manager, of property which is destroyed, lost, stolen or damaged so as to become undeliverable to the County or to another buyer.

00700-42 COST TO CURE

If the County terminates for cause the whole or any part of the work pursuant to this agreement, then the County may procure upon such terms and in such manner as the Construction Manager may deem appropriate, supplies or services similar to those so terminated, and the Contractor shall be liable to the County for any excess costs for such similar supplies or services. The Contractor shall continue the performance of this agreement to the extent not terminated hereunder.

00700-43 ATTORNEY'S FEES

Should the Contractor default pursuant to any of the provisions of this agreement, the Contractor and its surety shall pay to the County such reasonable attorney's fees as the County may expend as a result thereof and all costs, expenses, and filing fees incidental thereto.

00700-44 CONTRACTOR'S RESPONSIBILITIES UPON TERMINATION

After receipt of a notice of termination from the County, and except as otherwise directed by the Construction Manager, the Contractor shall:

1. Stop work under the contract on the date and to the extent specified in the notice of termination;
2. Place no further orders or subcontracts for materials, services or facilities, except as may be necessary for completion of such portion of the work under the agreement as is not terminated;
3. Terminate all orders and subcontracts to the extent that they relate to the performance of work terminated by the notice of termination;
4. Assign to the County in the manner, at the times, and to the extent directed by the Construction Manager, all of the rights, title and interest of the Contractor under the orders and subcontracts so terminated, in which case the County shall have the right, at its discretion, to settle or pay any and all claims arising out of the termination of such orders or subcontracts;
5. Settle all outstanding liabilities and all claims arising out of such termination of orders and subcontracts with the approval or ratification of the Construction Manager, to the extent the Construction Manager may require, which approval or ratification shall be final for all purposes;
6. Transfer title and deliver to the entity or entities designated by the Construction Manager, in the manner, at the times, and to the extent, if any, directed by the Construction Manager, and to the extent specifically produced or specifically acquired by the Contractor for the performance of such portion of the work as has been terminated:
 - a. The fabricated or un-fabricated parts, work, and progress, partially completed supplies, and equipment, materials, parts, tools, dyes, jigs, and other fixtures, completed work, supplies, and other material produced as a part of or acquired in connection with the performance of the work terminated by the notice of termination; and

- b. The completed or partially completed plans, drawings, information, and other property to the work.
7. Use its best efforts to sell in the manner, at the times, to the extent, and at the prices directed or authorized by the Construction Manager, any property described in Section 6 of this paragraph, provided, however, that the Contractor shall not be required to extend credit to any buyer and further provided that the proceeds of any such transfer or disposition shall be applied in reduction of any payments to be made by the County to the Contractor pursuant to this agreement.
8. Complete performance of such part of the work as shall not have been terminated by the notice of termination; and
9. Take such action as may be necessary, or as the Construction Manager may direct, for the protection and preservation of the property related to the agreement which is in the possession of the Contractor and in which the County has or may acquire an interest.

00700-45 RECORDS

The Contractor shall preserve and make available to the County all of its records, books, documents and other evidence bearing on the costs and expenses of the Contractor and any subcontractor pursuant to this agreement upon three days advance notice to the Contractor.

00700-46 DEDUCTIONS

In arriving at any amount due the Contractor pursuant to the terms of this agreement, there shall be deducted all liquidated damages, advance payments made to the Contractor applicable to the termination portion of the contract, the amount of any claim which the County may have against the Contractor, the amount determined

By the Construction Manager to be necessary to protect the County against loss due to outstanding potential liens or claims, and the agreed price of any materials acquired or sold by the Contractor and not otherwise recovered by or credited to the County.

00700-47 REIMBURSEMENT OF THE COUNTY

In the event of termination, the Contractor shall refund to the County any amount paid by the County to the Contractor in excess of the costs properly reimbursable to the Contractor.

00700-48 SUSPENSION, INTERRUPTION, DELAY, DAMAGES

The Contractor shall be entitled to only those damages and that relief from termination by the County as specifically set forth in this agreement. The Construction Manager may issue a written order requiring the Contractor to suspend, delay or interrupt all or any part of the work for such period of time as the County may determine to be appropriate for the convenience of the County. If the performance of the work is interrupted for an unreasonable period of time by an act of the County or any of its officers, agents, employees, contractors, or consultants in the administration of this agreement, an equitable adjustment shall be made for any increase in the Contractor's costs of performance and any increase in the time required for performance of the work necessarily caused by the unreasonable suspension, delay, or interruption. Any equitable adjustment shall be reduced to writing and shall constitute a modification to this agreement. In no event, however, shall an equitable adjustment be made to the extent that performance of this agreement would have been suspended, delayed or interrupted by any other cause, including the fault or negligence of the Contractor. No claim for an equitable adjustment pursuant to this paragraph shall be permitted before the Contractor shall have notified the Construction Manager in writing of the act or failure to act involved, and no claim shall be allowed unless asserted in writing to the Construction Manager within ten days after the termination of such suspension, delay or interruption.

00700-49 COMMENCEMENT AND DURATION OF WORK

The County may issue a Notice to Proceed at any time within 120 days following execution of the contract by the County. The Contractor shall commence work pursuant to this agreement within ten days of mailing or delivery of written notice to proceed. The Contractor shall diligently prosecute the work to completion within the time specified therefore in the Agreement. The capacity of the Contractor's construction and manufacturing equipment and plan, sequence and method of operation and forces employed, including management and supervisory personnel, shall be such as to insure completion of the work within the time specified in the Agreement. The Contractor and County hereby agree that the contract time for completion of the work is reasonable taking into consideration the average climatic conditions prevailing in the locality of the work and anticipated work schedules of other contractors whose activities are in conjunction with or may affect the work under this contract.

00700-50 TIME OF THE ESSENCE

All time limits stated in this agreement are of the essence of this contract.

00700-51 IMPACT DAMAGES

Except as specifically provided pursuant to a stop work order or change order, the Contractor shall not be entitled to payment or compensation of any kind from the County for direct or indirect or impact damages including, but not limited to, costs of acceleration arising because of delay, disruption, interference or hindrance from any cause whatsoever whether such delay, disruption, interference or hindrance is reasonable or unreasonable, foreseeable or unforeseeable, or avoidable, provided, however, that this provision shall not preclude the recovery of damages by the Contractor for hindrances or delays due solely to fraud or bad faith on the part of the County, its agents, or employees. The Contractor shall be entitled only to extensions in the time required for performance of the work as specifically provided in the contract.

00700-52 DELAY

The Contractor may be entitled to an extension of the contract time, but not an increase in the contract price or damages, for delays arising from unforeseeable causes beyond the control and without the fault or negligence of the Contractor or its subcontractors for labor strikes, acts of God, acts of the public enemy, acts of the state, federal or local government in its sovereign capacity, by acts of another separate contractor, or by an act or neglect of the County.

00700-53 INCLEMENT WEATHER

The Contractor shall not be entitled to an extension of the contract time due to normal inclement weather. Unless the Contractor can substantiate to the satisfaction of the Construction Manager that there was greater than normal inclement weather and that such greater than normal inclement weather actually delayed the work, the Contractor shall not be entitled to an extension of time therefore. The following shall be considered the normal inclement weather days for each month listed, and extensions of time shall be granted in increments of not less than one half day only for inclement weather in excess of the days set out.

January	10 days
February	10 days
March	7 days
April	6 days
May	4 days
June	3 days
July	4 days
August	2 days
September	2 days
October	3 days

November 6 days
December 9 days

00700-54 DELAY - NOTICE AND CLAIM

The Contractor shall not receive an extension of time unless a Notice of Delay is filed with the Construction Manager within ten days of the first instance of such delay, disruption, interference or hindrance and a written Statement of the Claim is filed with the Construction Manager within 20 days of the first such instance. In the event that the Contractor fails to comply with this provision, it waives any claim which it may have for an extension of time pursuant to this agreement.

00700-55 STATEMENT OF CLAIM - CONTENTS

The Statement of Claim referenced in Article 00700-54 shall include specific information concerning the nature of the delay, the date of commencement of the delay, the construction activities affected by the delay, the person or organization responsible for the delay, the anticipated extent of the delay, and any recommended action to avoid or minimize the delay.

00700-56 WORK BEHIND SCHEDULE, REMEDY BY CONTRACTOR

If the work actually in place falls behind the currently updated and approved schedule, and it becomes apparent from the current schedule that work will not be completed within the contract time, the Contractor agrees that it will, as necessary, or as directed by the Construction Manager, take action at no additional cost to the County to improve the progress of the work, including increasing manpower, increasing the number of working hours per shift or shifts per working day, increasing the amount of equipment at the site, and any other measure reasonably required to complete the work in a timely fashion.

00700-57 DILIGENCE

The Contractor's failure to substantially comply with the requirements of the preceding paragraph may be grounds for determination by the County that the Contractor is failing to prosecute the work with such diligence as will insure its completion within the time specified. In such event, the County shall have the right to furnish, from its own forces or by contract, such additional labor and materials as may be required to comply with the schedule after 48 hours written notice to the Contractor, and the Contractor shall be liable for such costs incurred by the County.

00700-58 SET-OFFS

Any monies due to the Contractor pursuant to the preceding paragraph of this agreement may be deducted by the County against monies due from the County to the Contractor.

00700-59 REMEDIES CUMULATIVE

The remedies of the County under Articles 00700-56, 00700-57, and 00700-58 are in addition to and without prejudice to all of the rights and remedies of the County at law, in equity, or contained in this agreement.

00700-60 TITLE TO MATERIALS

No materials or supplies shall be purchased by the Contractor or by any Subcontractor subject to any chattel mortgage or under a conditional sales contract or other agreement by which any interest is retained by the seller. The Contractor hereby warrants that it has good and marketable title to all materials and supplies used by it in the work, and the Contractor further warrants that all materials and supplies shall be free from all liens, claims, or encumbrances at the time of incorporation in the work.

00700-61 INSPECTION OF MATERIALS

All materials and equipment used in the construction of the project shall be subject to adequate inspection and testing in accordance with accepted standards and in accordance with the

requirements of the contract documents. Additional tests performed after the rejection of materials or equipment shall be at the Contractor's expense.

00700-62 CONSTRUCTION MANAGER'S PRESENCE DURING TESTING

All tests performed by the Contractor shall be witnessed by the Construction Manager unless the requirement therefore is waived in writing. The Construction Manager may perform additional tests on materials previously tested by the Contractor, and the Contractor shall furnish samples for this purpose as requested.

00700-63 MATERIALS INCORPORATED IN WORK

The Contractor shall furnish all materials and equipment to be incorporated in the work. All such materials or equipment shall be new and of the highest quality available. Manufactured materials and equipment shall be obtained from sources which are currently manufacturing such materials, except as otherwise specifically approved by the Construction Manager.

00700-64 STORAGE OF MATERIALS

Materials and equipment to be incorporated in the work shall be stored in such a manner as to preserve their quality and fitness for the work and to facilitate inspection.

00700-65 PAYROLL REPORTS

The Contractor may be required to furnish payroll reports to the Construction Manager as required by the Owner Controlled Insurance Program.

00700-66 CONTRACTORS' REPRESENTATIVE

Before beginning work, the Contractor shall notify the Construction Manager in writing of one person within its organization who shall have complete authority to supervise the work, receive orders from the Construction Manager, and represent the Contractor in all matters arising pursuant to this agreement. The Contractor shall not remove its representative without first designating in writing a new representative. The Contractor's representative shall normally be present at or about the site of work while the work is in progress. When neither the Contractor nor its representative is present at the work site, the superintendent, foreman, or other of the Contractor' employee in charge of the work shall be an authorized representative of the Contractor.

00700-67 SPECIALTY SUB-CONTRACTORS

The Contractor may utilize the services of specialty subcontractors on those parts of the project which, under normal contracting practices, are performed by specialty subcontractors. The Contractor shall not award more than seventy-five percent of the work to subcontractors.

00700-68 INSPECTION BY THE CONSTRUCTION MANAGER

All work pursuant to this agreement shall be subject to inspection by the Construction Manager for conformity with contract drawings and specifications. The Contractor shall give the Construction Manager reasonable advance notice of operations requiring special inspection of a portion of the work.

00700-69 WORK COVERED PRIOR TO CONSTRUCTION MANAGER'S INSPECTION

In the event that work is covered or completed without the approval of the Construction Manager, and such approval is required by the specifications or required in advance by the Construction Manager, the Contractor shall bear all costs involved in inspection notwithstanding conformance of such portion of the work to the contract drawings and specifications.

00700-70 SCHEDULING OF THE WORK

The work of this contract shall be planned, scheduled, executed, and reported as required by the Contract Documents.

00700-71 PROGRESS ESTIMATES

The Contractor shall prepare a written report for the Construction Manager's approval, on County forms, of the total value of work performed and materials and equipment obtained to the date of submission. Such a report must accompany each request for a progress payment and is subject to review and approval by the Construction Manager. Approval of a progress estimate or tendering of a progress payment shall not be considered an approval or acceptance of any work performed, and all estimates and payments shall be subject to correction in subsequent estimates. Progress payments shall be made for all completed activities and for materials suitably stored on-site.

00700-72 PROGRESS PAYMENTS

Upon approval of each monthly estimate of work performed and materials furnished, the Construction Manager shall approve payment to the Contractor for the estimated value of such work, materials, and equipment, less the amount of all prior payments and any liquidated damages. The Contractor will be paid 100 percent, less retainage, of the cost of materials received and properly stored on-site but not incorporated into the work. Payments for materials or equipment stored on the site shall be conditioned upon submission by the Contractor of bills of sale to establish the County's title to such materials or equipment. The Contractor's request for payment shall provide sufficient detail as to the work completed or materials purchased for which payment is requested to permit meaningful review by the Construction Manager.

00700-73 TIME OF PAYMENT

The Contractor will be paid within 45 days following receipt of an approved Progress Estimate. The Contractor expressly agrees that the payment provisions within this Contract shall supersede the rates of interest, payment periods, and contract and subcontract terms provided for under the Georgia Prompt Pay Act, O.C.G.A. §13-11-1 et seq., and that the rates of interest, payment periods, and contract and subcontract terms provided for under the Prompt Pay Act shall have no application to this Contract. The County shall not be liable for any late payment interest or penalty.

00700-74 RETAINAGE

The County shall retain from each progress payment ten percent of the estimated value of the work performed until the progress payments, including retainage, total 50 percent of the contract price. If a contract includes two or more projects or assignments that have been separately priced and have separate budgets, and the performances of such projects or assignments are not related to or dependent upon the performance of any other, the 50 per cent limit shall be based upon the price for each individual project or assignment. Thereafter, no further retainage shall be withheld so long as the Contractor is making satisfactory progress to insure completion of the work within the time specified therefore. The County may reinstate the ten percent retainage in the event the Construction Manager determines that the Contractor is not making satisfactory progress to complete the work within the time specified in this agreement or in the event that the Construction Manager provides a specific cause for such withholding. The County may also withhold retainage upon substantial completion of the work as provided in O.C.G.A. §13-10-81(c). Interest may be paid upon the retainage in accordance with Georgia law.

00700-75 PAYMENT OF SUBCONTRACTORS

The Contractor shall promptly pay each subcontractor upon the receipt of payment from the County. Such payment shall be made from the amount paid to the Contractor pursuant to the subcontractor's work. The Contractor shall also maintain the records of the percentage retained from payments to the Contractor pursuant to such subcontractor's work. The Contractor shall procure agreements from each subcontractor requiring each subcontractor to pay their subcontractors, agents and employees in a similar manner. The County reserves the right to inquire of any subcontractor, supplier, materialmen, or subconsultant, the status of any

indebtedness of the Contractor. The County further reserves the right to require the Contractor to designate on each instrument of payment exceeding \$400.00 to subcontractors, suppliers, materialmen, and subconsultants that such payment is on account of the work under this Contract.

00700-76 COUNTY'S RESPONSIBILITIES TO SUBCONTRACTORS

Neither the County nor the Construction Manager shall have any obligation to pay any subcontractor except as otherwise required by law.

00700-77 PROGRESS PAYMENTS - ACCEPTANCE OF WORK

Certification of progress payments, as well as the actual payment thereof, shall not constitute the County's acceptance of work performed pursuant to this agreement.

00700-78 PAYMENTS IN TRUST

All sums paid to the Contractor pursuant to this agreement are hereby declared to constitute trust funds in the hands of the contractor to be applied first to the payment of claims of subcontractors, laborers, and suppliers arising out of the work, to claims for utilities furnished and taxes imposed, and to the payment of premiums on surety and other bonds and on insurance for any other application.

00700-79 JOINT PAYMENTS

The County reserves the right to issue any progress payment or final payment by check jointly to the Contractor and any subcontractor or supplier.

00700-80 RIGHT TO WITHHOLD PAYMENT

The Construction Manager may decline to approve payment and may withhold payment in whole or in part to the extent reasonable and necessary to protect the County against loss due to defective work, probable or actual third party claims, the Contractor's failure to pay subcontractors or materialmen, reasonable evidence that the work will not be completed within the contract time or contract price or damage to the County or any other contractor on the project.

00700-81 CERTIFICATE OF SUBSTANTIAL COMPLETION

Upon the Contractor's submission of a request for a certificate of Substantial Completion, the Construction Manager shall inspect the work and determine whether the work is Substantially Complete. If the work is Substantially Complete, the Construction Manager shall issue a certificate of Substantial Completion of the work which shall establish the date of Substantial Completion, shall state the responsibilities of the County and the Contractor for security, maintenance, heat, utilities, damage to the work and insurance, and shall fix the time within which the Contractor shall complete the items submitted by the Contractor as requiring correction or further work. The certificate of substantial completion of the work shall be submitted to the County and the Contractor for their written acceptance of the responsibilities assigned to them pursuant to such certificate.

If in the sole opinion of the Construction Manager, the work is not substantially complete, the Construction Manager shall notify the Contractor of such, in writing, and outline requirements to be met to achieve Substantial Completion.

00700-82 PAYMENT UPON SUBSTANTIAL COMPLETION

Upon Substantial Completion of the work and upon application by the Contractor and approval by the Construction Manager, the County shall make payment reflecting 100% work completed, less value of work remaining as determined by Construction Manager and any authorized retainage.

00700-83 COMMENCEMENT OF WARRANTIES

Warranties required by this agreement shall commence on the date of final completion of the project as determined under Article 00700-84 unless otherwise provided in the certificate of Substantial Completion.

00700-84 FINAL PAYMENT - WAIVER OF CLAIMS, DISPUTE OF FINAL PAYMENT

The acceptance of the Substantial Completion payment shall constitute a waiver of all claims by the Contractor except those previously made in writing and identified by the Contractor as unsettled at the time of application for payment at Substantial Completion and except for the retainage sums due at final acceptance. Following the Construction Manager's issuance of the certificate of Substantial Completion and the Contractor's completion of the work pursuant to this agreement, the Contractor shall forward to the Construction Manager a written notice that the work is ready for final inspection and acceptance. If after inspection the Construction Manager certifies that the work is complete and issues written notification of such to the Contractor, the Contractor shall forward to the Construction Manager a final application for payment. The Construction Manager shall issue a certificate for payment, which shall approve final payment to the Contractor and shall establish the date of final completion.

In the event the Contractor timely disputes the amount of the final payment, the amount due the Contractor shall be deemed by the Contractor and the County to be an unliquidated sum and no interest shall accrue or be payable on the sum finally determined to be due to the Contractor for any period prior to final determination of such sum, whether such determination be by agreement of the Contractor and the County or by final judgment of the proper court in the event of litigation between the County and the Contractor. The Contractor specifically waives and renounces any and all rights it may have under O.C.G.A. §13-6-13 and agrees that in the event suit is brought by the Contractor against the County for any sum claimed by the Contractor under the Contract or for any extra or additional work, no interest shall be awarded on any sum found to be due from the County to the Contractor in the final judgment entered in such suit. All final judgments shall draw interest at the legal rate, as specified by law.

00700-85 DOCUMENTATION OF COMPLETION OF WORK

Neither the final payment nor the remaining retainage shall become due until the Contractor submits the following documents to the Construction Manager:

- a. An affidavit that all payrolls, bills for materials and equipment, and other indebtedness connected with the work have been paid other otherwise satisfied;
- b. The surety's consent to final payment; and
- c. Any other data reasonably required by the County or Construction Manager establishing payment or satisfaction of all such obligations, including releases, waivers of liens, and documents of satisfaction of debts.

In the event that a subcontractor refuses to furnish a release or waiver as required by the County or Construction Manager, the Contractor may furnish a bond satisfactory to the County to indemnify the County against such loss. In the event that any lien or indebtedness remains unsatisfied after all payments are made, the contractor shall refund to the County all moneys that the County may become compelled to pay in discharging such lien or other indebtedness, including all costs and reasonable attorney's fees.

00700-86 GOVERNING LAW

Each and every provision of this agreement shall be construed in accordance with and governed by Georgia law. The parties acknowledge that this contract is executed in Fulton County, Georgia and that the contract is to be performed in Fulton County, Georgia. Each party hereby consents to the Fulton Superior Court's sole jurisdiction over any dispute which arises as a result of the execution or performance of this agreement, and each party hereby waives any and all objections to venue in the Fulton Superior Court.

00700-87 CHANGES IN THE WORK

A. CHANGE ORDERS

- 1. A Change Order is a written order to the Contractor signed to show the approval and the authorization of the County, issued after execution of the Contract,

- authorizing a change in the Work and/or an adjustment in the Contract Sum or the Contract Time. Change Orders shall be written using forms designated by the County with Contractor providing supporting documentation as required by the Construction Manager. The Contract Sum and the Contract Time may be changed only by approved Change Order pursuant to Fulton County Procedure 800-6. The amount payable by the Change Order is payment in full for all direct and indirect costs incurred and related to the work under said Change Order, including but not limited to delays, imports, acceleration, disruption and extended overhead. A Change Order signed by the Contractor indicates the Contractor's agreement therewith, including the adjustment in either or both of the Contract Sum or the Contract Time.
2. The County, without invalidating the Contract, may order changes in the Work within the general scope of the Contract as defined herein. The time allowed for performance of the work and the contract price to be paid to the Contractor may be adjusted accordingly.
 3. The cost or credit to the County resulting from a change in the Work shall be determined in one or more of the following ways:
 - a. By mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
 - b. By unit prices stated in the Contract Documents or subsequently agreed upon;
 - c. By cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
 - d. By the method provided in Subparagraph A4 below.
 4. If none of the methods set forth in Subparagraphs 3a, 3b, or 3c above is agreed upon, the Contractor, provided a written order signed by the Construction Manager is received, shall promptly proceed with the Work involved. The cost of such Work shall then be determined by the Construction Manager on basis of the reasonable expenditures and savings of those performing the Work attributable to the change. The cost of the change shall include only the items listed in Subparagraph 5a below, and in the case of either a decrease or an increase in the Contract Sum, an allowance for overhead and profit in accordance with the schedules set forth in Subparagraphs 5b and 6 below shall be applied to the cost or credit.
 - a. In such case, and also under Subparagraph 3a above, the Contractor shall keep and present, in such form as the Construction Manager may prescribe, an itemized accounting of all actual costs expended, together with appropriate supporting data for inclusion in a Change Order.
 - b. All hourly rate charges shall be submitted to the Construction Manager for prior review and approval. All hourly rate charges shall be properly supported as required by the Construction Manager with certified payrolls, or their acceptable equivalent. When authorized to proceed for a given change and actual expenditures have been made prior to execution of a Change Order for the entire change, such actual expenditures may be summarized monthly, and if approved, incorporated into a Change Order. When both additions and credits covering related Work or substitutions are involved in any one change, the allowance for overhead and profit shall be figured on the basis of the net increase or decrease, if any, with respect to that change.
 5. In Subparagraphs 3 and 4 above, the items included in "Cost and "Overhead" shall be based on the following schedule:

- a. Unless otherwise provided in the Contract Documents, "Cost" shall be limited to the following: cost of materials incorporated into the Work, including sales tax and cost of delivery; cost of direct labor (labor cost may include a pro rata share of foreman's account of the change) including social security, old age and unemployment insurance, and fringe benefits required by agreement or custom; workers' or workmen's compensation insurance; rental value of equipment and machinery; costs for preparing Shop Drawings.
 - b. Unless otherwise provided in the Contract Documents, "Overhead" shall include the following: bond and insurance premiums including increase and decreases from change in the Work, supervision, superintendence, construction parking, wages of timekeepers, watchmen and clerks, small tools, consumable supplies, expendables, incidentals, general office expense, the cost of additional reproduction for the Contractor's subcontractors beyond that agreed upon in the Contract Documents, construction parking, any additional costs of craft supervision by the Contractor's or subcontractors' superintendents, and overhead charges which would be customary and expended regardless of the change in the Work due to other overlapping activities which are included as part of the original Contract, and all other expenses not included in "Cost" above.
 - c. In the event that a change is issued by the County which would require the expenditure of substantial amounts of special supervision (beyond the foreman level) by the Contractor, the Contractor may, at the sole direction of the Construction Manager, be allowed to incorporate these charges into the agreement cost for the change.
6. In Subparagraphs 3 and 4 above, the allowance for overhead and profit combined, included in the total cost or credit to the County, shall be based on the following schedule:
- a. For the Contractor, for any work performed by the Contractor's own forces, ten (10) percent of the cost.
 - b. For the Contractor, for any work performed by a Contractor's subcontractor, five (5) percent of the amount due the subcontractor.
 - c. For each subcontractor or sub-subcontractor involved, for any work performed by that subcontractor's or sub-subcontractor's own forces, ten (10) percent of the cost.
 - d. For each subcontractor, for work performed by a sub-subcontractor, five (5) percent of the amount due to the sub-subcontractor.
 - e. Cost to which overhead and profit is to be applied shall be determined in accordance with Subparagraph 5 above unless modified otherwise.
7. In order to facilitate checking of quotations for extras or credits, all proposals or bids, except those so minor that their propriety can be seen by inspection, shall be accompanied by a complete itemization of costs, including labor cost, materials and subcontracts. Labor and materials shall be itemized in the manner defined in Subparagraph 4 above. Where major cost items are subcontracts, they shall be itemized also. In no case shall a change be approved without such itemization.
8. No payment shall be made for any changes to the contract that are not included in a fully executed Change Order.
- B. CONCEALED, UNKNOWN AND DIFFERING CONDITIONS

1. Should concealed conditions be encountered in the performance of the Work below the surface of the ground, or should concealed or unknown conditions in an existing structure be at variance with the conditions indicated by the Contract Documents, or should unknown physical conditions below the surface of the ground or concealed or unknown conditions in an existing structure of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in this Contract, be encountered, the Contract Sum and Contract Time shall be equitably adjusted by Change Order upon request by either party made **within twenty (20) days after the first observance** of the conditions. No such request for equitable adjustment shall be valid unless the Contractor complies with this (20) days notice and Subparagraph C.1. below.
2. The Contractor shall promptly, and before such conditions are disturbed, notify the Construction Manager in writing of any claim of concealed, unknown or differing conditions pursuant to this paragraph. The Construction Manager shall authorize the Engineer to investigate the conditions, and if it is found that such conditions do materially so differ and cause an increase or decrease in the Contractor's cost of, or the time required for, performance of any part of the Work under this Contract, whether or not changed as a result of such conditions, an equitable adjustment shall be recommended to the Construction Manager.
3. No claim of the Contractor under this clause shall be allowed unless the Contractor has given the notice required in (a) above, prior to disturbing the condition.
4. No claim by the Contractor for an equitable adjustment shall be allowed if asserted after final payment under this Contract.
5. Any materially differing site condition as between what is shown on the Drawings and Specifications and actually found on site shall be immediately reported to the Construction Manager in writing prior to the commencement of Work at the site. Failure of the Contractor to notify the Construction Manager in writing of the differing site condition prior to performance of Work at the site shall constitute a waiver of any claim for additional monies. Any Change Order necessitated by the differing site condition shall be processed as provided under "Changes in the Contract".

C. REQUESTS FOR ADDITIONAL COST

1. If the Contractor wishes to request an increase in the Contract Sum, the Contractor shall give the Construction Manager written notice thereof within twenty (20) days after the occurrence of the event, or identification of the conditions, giving rise to such request. This notice shall be give by the Contractor before proceeding to execute the Work, except in an emergency endangering life or property in which case the Contractor shall proceed in accordance with Article 00700-25 and Subparagraph A.4 above. No such request shall be valid unless so made within the twenty (20) days specified above. If the County and the Contractor cannot agree on the amount of the adjustment in the Contract Sum, it shall be determined by the Construction Manager. Any change in the Contract Sum resulting from such claim shall be documented by Change Order.
2. If the Contractor claims that addition cost is involved because of, but not limited to (1) any written interpretation pursuant to General Condition 00700-17 of this Agreement, (2) any order by the County to stop the Work pursuant to Articles 00700-25 and 00700-37 of this Agreement where the Contractor was not at fault, or any such order by the Construction Manager as the County's agent, or (3) any written order for a minor change in the Work issued pursuant to Paragraph D

below, the Contractor shall submit a request for an increase in the Contract Sum as provided in Subparagraph C.1 above. No such claim shall be valid unless the Contractor complies with Subparagraph C.1 above and approved by the County pursuant to Change Order Policy 800-6.

D. MINOR CHANGES IN THE WORK

The Construction Manager may order minor changes in the Work not involving an adjustment in the Contract Price, extension of the time allowed for performance of the work and not inconsistent with the intent of the Contract Documents. Such changes shall be effected by a written Change Directive issued by the Construction Manager, and shall be binding on the County and the Contractor. The Contractor shall carry out such written orders promptly.

E. BONDS

If any change order results in an increase in the contract price, the contractor shall increase the penal sum of the performance and payment bonds to equal the increased price.

00700-88 DISAGREEMENT WITH ORDERS FOR CHANGE

Contractor's written acceptance of a Change Order or other order for changes shall constitute his final and binding agreement to the provisions thereof and a waiver of all claims in connection therewith, whether direct or consequential in nature. Should Contractor disagree with any order for changes, he may submit a notice of potential claim to the Construction Manager, at such time as the order is set forth in the form of a Change Order. Disagreement with the provisions of an order for changes shall not relieve Contractor of his obligation under Article 00700-87 of this Agreement.

00700-89 NO WAIVER OF REMEDIES

Exercise by the County of any remedy is not exclusive of any other remedy available to County and shall not constitute a waiver of any such other remedies. Failure of the County to exercise any remedy, including breach of contract remedies, shall not preclude the County from exercising such remedies in similar circumstances in the future.

00700-90 LAND AND RIGHTS-OF-WAY

The owner will provide, as indicated in the Contract Documents and prior to Notice to Proceed, the lands upon which the work is to be done, right-of-way for access thereto, and such other lands which are designated for the use of the Contractor. The Contractor shall confine the Contractor's work and all associated activities to the easements and other areas designated for the Contractor's use. The Contractor shall comply with any limits on construction methods and practices which may be required by easement agreements. If, due to some unforeseen reason, the necessary easements are not obtained, the Contractor shall receive an equitable extension of contract time dependent upon the effect on the critical path of the project schedule or the County may terminate the Contract for its convenience.

00700-91 COORDINATION WITH STATE DEPARTMENT OF TRANSPORTATION

No clearing or grading shall be completed by Contractor within the State Department of Transportation (DOT) area under construction. The Contractor must coordinate his construction scheduling with DOT.

If the Contractor begins work before DOT's completion date, he must obtain the approval of DOT before starting work in the area. The state DOT has the right to stop the Contractor's work the DOT area.

The Contractor shall receive no additional compensation or damages resulting from delay or work stoppage from DOT actions or scheduling.

Contractor shall obtain DOT drawings of the DOT, project area for verification of road geometry, storm drains, etc. from Georgia Department of Transportation or Fulton County. The Contractor is responsible for obtaining any pertinent DOT revisions.

I N D E X

<u>SUBJECT</u>	<u>GENERAL CONDITION ARTICLE #</u>
Administration of Contract	17
Applicable Law	7
Assignment	13
Blasting and Excavation	26
Changes	87, 88
Clean Site	29
Codes	4
Commencement of Work	49
Contract Documents	2
Contractor's Representative	66
Defective Work	31, 32
Definitions	3
Delay	51, 52, 54, 55
Extension of Time	52, 53, 54
Familiarity of Time	1, 22
Final Payment	84
Governing Law	86
High Voltage Lines	27
Inclement Weather	53
Indemnification	15
Inspections	23, 61, 62, 68, 69
Interruption	48
Licenses	8
Liquidated Damages	46, 48
New Materials	33, 63
Notices	24
Payment	72, 73, 75
Payment of Subcontractors	75, 76
Payment Upon Substantial Completion	82, 84
Payroll Reports	65
Permits	8
Progress Payments	72, 73, 77, 78, 79, 80
Protection of Work	30, 64
Records Inspection	45

Retainage	11, 74
Safety	25
Scaffolding and Staging	28
Scheduling	70
Service of Process	14
Stop Work Order	37
Subcontractors	67, 76
Substantial Completion	81
Suspension	48
Supervision of Work	16, 66
Surety's Responsibility	17
Taxes	9, 10
Termination for Cause	38, 44, 47
Termination for Convenience	39, 40, 41
Time of the Essence	50
Warranties	33, 34, 35, 36
Work Behind Schedule	56

EXHIBIT A
FINAL AFFIDAVIT

TO FULTON COUNTY, GEORGIA

I, _____, hereby certify that all suppliers of materials, equipment and service, subcontractors, mechanic, and laborers employed by _____ or any of his subcontractors in connection with the design and/or construction of _____ at Fulton County have been paid and satisfied in full as of _____, 200____, and that there are no outstanding obligations or claims of any kind for the payment of which Fulton County on the above-named project might be liable, or subject to, in any lawful proceeding at law or in equity.

Signature

Title

Personally appeared before me this _____ day of _____, 200____.
_____, who under Oath deposes and says that he is _____ of the firm of _____, that he has read the above statement and that to the best of his knowledge and belief same is an exact true statement.

Notary Public

My Commission expires

END OF SECTION

EXHIBIT 2 REQUIRED SUBMITTAL CHECKLIST

The following submittals shall be completed and submitted with each Proposal (see table below “Required Submittal Checklist.”). Please check to make sure that the required submittals are in the envelope before it is sealed. Failure to submit all required submittals may deem your Proposal non-responsive.

Item #	Required Submittal Checklist	Check (✓)
1	<p>One (1) Technical Proposal marked “Original” and five (5) copies:</p> <ul style="list-style-type: none"> • Section 1 – Executive Summary (include Membrane System Supplier Proposal Security) • Section 2 – Project Plan • Section 3 – Proposer Qualifications • Section 4 – Relevant Project Experience • Section 5 – Technical Approach • Section 6 – Financial Information (see Item #2) • Section 7 – Proprietary and Confidential Information • Section 8 – Technical Proposal Forms (see Item #3) • Section 9 – Location of Proposer (see Item #5) 	
2	<p>One (1) Financial Information package marked “Original” and included with the “Original” Technical Proposal and one (1) copy submitted in a separate sealed envelope:</p> <ul style="list-style-type: none"> • Annual Report and financial statement for last three (3) years, income statements, balance sheets, change in financial position. • Latest quarterly financial report, description of any material change in financial position since last the last annual report. • Most recent Dun & Bradstreet and/or Value Line Reports. 	
3	<p>Technical Proposal Forms (to be included with the Technical Proposal):</p> <ul style="list-style-type: none"> • Technical Proposal Form A - Certification Regarding Debarment • Technical Proposal Form B - Non-Collusion Affidavit of Bidder/Offeror • Technical Proposal Form C - Certificate of Acceptance of Technical RFP Requirements (see Item #6) • Technical Proposal Form D - Disclosure Form and Questionnaire • Technical Proposal Form E – Declaration of Employee-Number Categories 	

Item #	Required Submittal Checklist	Check (✓)
	<ul style="list-style-type: none"> • Technical Proposal Form F – Georgia Security and Immigration Contractor Affidavit/Agreement • Technical Proposal Form G – Georgia Security and Immigration Subcontractor Affidavit • Technical Proposal Form H - Proposal Transmittal Letter • Technical Proposal Form I - Membrane System • Technical Proposal Form J - Equipment and Systems • Technical Proposal Form K - Disclaimer Statement • Technical Proposal Form L - Information Certification • Technical Proposal Form M - Technical Requirements Certification • Technical Proposal Form N - Royalty and License Fees 	
4	BioWin Modeling Report (to be included as an appendix to the Technical Proposal)	
5	Local Preference Documentation: <ul style="list-style-type: none"> • Copy of occupational tax certificate (business license) <u>or</u> • Copy of a lease or rental agreement <u>or</u> • Proof of ownership interest in a location within the geographical boundaries of Fulton County 	
6	Acknowledgement of each Addendum (to be included after Technical Proposal Form C)	
7	One (1) CD-ROM of the Technical Proposal in a separate sealed envelope	
8	One (1) Cost Proposal marked “ Original ” and five (5) copies (submitted in a separate sealed envelope): <ul style="list-style-type: none"> • Section 1 – Introduction • Section 2 – Derivation of Costs • Section 3 – Cost Proposal Forms (see Item #9) 	
9	Cost Proposal Forms (to be included with the Cost Proposal): <ul style="list-style-type: none"> • Cost Proposal Form A – Fixed Membrane System Price • Cost Proposal Form B – Maximum Power Consumption • Cost Proposal Form C – Maximum Chemical Usage • Cost Proposal Form D – Guaranteed membrane Life and Guaranteed Membrane Replacement Cost 	

Item #	Required Submittal Checklist	Check (√)
10	One (1) set of Contract Compliance exhibits marked “ Original ” and two (2) sets of copies: <ul style="list-style-type: none"> • Exhibit A - Promise of Non-Discrimination • Exhibit B - Employment Report • Exhibit C - Schedule of Intended Subcontractor Utilization • Exhibit D - Letter of Intent to Perform as Subcontractor or Provide Materials or Service • Exhibit E - Declaration Regarding Subcontractor Practices • Exhibit F - Joint Venture Disclosure Affidavit • Equal Business Opportunity Plan (EBO Plan) 	
11	Risk Management Insurance Provisions Form	

SECTION 9 APPENDICES

The following appendices are included as part of this Technology RFP:

- Appendix 1 – Technical Requirements (Includes Attachment 1)
- Appendix 2 – Minimum Technical Specifications

APPENDIX 1

TECHNICAL REQUIREMENTS

SECTION 1 – Existing and Proposed Facilities

1.1 Existing Facilities

The existing Big Creek WRF is located at 1030 Marietta Highway, Roswell, Georgia. The facility currently has a rated capacity of 24 MGD on a maximum month basis. Recent flow data indicate that the incoming flow will reach the rated capacity in the near future and, therefore, the facility requires an expansion. The Big Creek WRF upgrade and expansion project (Project) will address this expansion as well as upgrade some of the existing facilities.

The Big Creek WRF currently treats the wastewater with preliminary treatment (screenings and grit removal), activated sludge secondary treatment, granular media filtration, UV disinfection, and post-aeration. The solids are aerobically stored and dewatered prior to disposal.

1.2 Proposed Facilities

Due to the proximity of neighbors, the Big Creek WRF is site constrained. Therefore, any expansion must occur within the limits of the existing property. The Project will expand the facility to be able to treat a total capacity of 38 MGD on a maximum month basis.

This expansion and upgrade will be accomplished through construction of new headworks, new primary clarifiers, fine screens and anaerobic digesters, a series of upgrades to existing equipment/infrastructure to increase the reliability of the existing conventional treatment train and solids handling facilities, and by the construction of a parallel 14-MGD (maximum month basis) Membrane Bio-Reactor (MBR) treatment train (Condition 1). The addition of primary clarification will allow the existing secondary treatment facilities to maintain a 24-MGD (maximum month basis) design capacity.

In the event that a future upgrade is required for additional nitrogen removal, the existing aeration basins would be converted to operate in an MBR mode and the Membrane System would be expanded to the full plant capacity of 38 MGD (maximum month basis) (Condition 2). Therefore, proposals submitted in response to this Technology RFP must address both a 14-MGD MBR treatment train and the future upgrade to a 38-MGD MBR process. In addition, the Membrane Basins and Membrane Building for the 14-MGD MBR treatment train shall be configured for 19 MGD (maximum month

basis), with Membrane System Scope of Supply provided only for 14 MGD (Condition 1).

The design will include metal salt addition (ferric chloride or alum) to the mixed liquor in the channel upstream of the Membrane Basins to convert soluble phosphorus to insoluble phosphorus, allowing its separation by the membranes. The metal salt will likely be ferric chloride (dosage range: 0-100 mg/l based on forward flow) however the flexibility will exist to switch to alum (dosage range: 0-150 mg/l based on forward flow). The metal salt addition capabilities will also serve as a backup in the instance that biological phosphorus removal completely fails.

Figure A1-1 shows the conceptual process flow diagram for the Project. Note that the treatment processes upstream of the MBR Treatment Train will include coarse screens (6 mm nominal openings – perforated plate), grit removal, primary clarifiers, and fine screens (2 mm nominal openings – perforated plate). Ferric chloride and anionic polymer addition facilities will be included for the primary clarifiers to allow operation in a chemically enhanced primary treatment (CEPT) mode if conditions require. The peak shaving capabilities provided by the 8-Mgal equalization tank will prevent the flow downstream of the equalization system from exceeding 76 MGD (28 MGD to the MBR Train under Condition 1). Figures A1-2 and A1-3 show the conceptual Condition 1 and Condition 2 process flow schematics, respectively. The preliminary hydraulic profile is shown in Figure A1-4. Figure A1-5 shows the preliminary site layout plan and general footprint available for the MBR Treatment Train.

If required by the Membrane System Supplier, the screenings infrastructure could be configured such that a portion of the mixed liquor recycle (MLR) from the Membrane Basin could be routed upstream of the fine screens.

1.2.1 Biological Nutrient Removal/Activated Sludge (BNR/AS) Process

Although the Engineer will be responsible for the activated sludge process design, the symbiotic relationship between the BNR/AS process and the Membrane System necessitates a clear understanding of the intended BNR/AS process design by the Membrane System Supplier. It is also understood that the Membrane System Supplier will provide input to the Engineer regarding the BNR/AS process as it affects the Membrane System during the preparation of Proposals for this Technology RFP and during the preparation of the Bidding Documents for the Construction Project by the Engineer.

As part of responding to this Technology RFP, the Membrane System Supplier shall provide process design of the BNR/AS process and Membrane System using BioWin to determine the BNR/AS volumes and configuration, process air demand, ferric chloride requirements and alkalinity requirements. The BioWin modeling guidelines and submittal requirements are specified in Attachment 1.

1.2.2 Membrane System

The Membrane System shall receive mixed liquor that is either pumped or flows by gravity from the BNR/AS System, described above. Permeate shall be produced by pressure- or vacuum-driven filtration through microfiltration or ultrafiltration membranes, leaving the separated solids (i.e., MLR) to be returned to the BNR/AS System. The method of mixed liquor conveyance (ie. pumped vs. gravity) to and from the Membrane System shall be determined by the Membrane System Supplier and indicated in their Proposal.

The Membrane Basins shall be divided into a minimum of four equal-sized trains. The Membrane Basins shall be configured such that one or more may be taken out of service for maintenance or membrane cleaning. Flow shall be split evenly to the online Membrane Basins. The hydraulic capacity of the Membrane System shall be as shown in Table A1-1, with any one Membrane Basin out of service and any one pump/blower from each pumping/blower system (largest unit) out of service. The Membrane System shall be configured with uninstalled membrane spare capacity such that the total installed membrane wetted feed-side surface area can be increased by 10% through the installation of additional large or small membrane subunits in each Membrane Basin with no further modifications to the Membrane System and Membrane Basins.

It is important to note that the mixed liquor from each BNR/AS Basin (MLF) shall be combined prior to equal distribution to the Membrane Basins. The maximum water surface elevation in the mixed liquor distribution channel shall not exceed the value shown on Figure A1-4. Conversely, the MLR from each Membrane Basin shall be combined prior to equal distribution to the BNR/AS Basins.

Permeate will be processed by a downstream ultraviolet light (UV) disinfection process. To provide a common basis for comparing Membrane System proposals, it shall be assumed that membrane permeate will leave the Membrane Building with a minimum residual

pressure value as shown on Figure A1-4 to allow gravity flow from the permeate collection header to the UV Disinfection Facility influent channel under all design net permeate production flow rates. This requirement must be met regardless of the permeate conveyance method selected (ie. pumped vs. gravity).

Spent membrane backwash water and cleaning solutions shall be returned to the BNR/AS process at a rate such that the BNR/AS process is not negatively impacted.

Section 2 – Process Design and Performance Criteria

2.1 Design Basis

The design basis for the MBR Treatment Train are as shown in the tables below. The Membrane System shall be designed to meet the peak net permeate production with the minimum day mixed liquor temperature.

**Table A1-1
Design Flows**

Flow Condition	Net Permeate Production (MGD) ⁵	
	Condition 1	Condition 2
Minimum Day Average Flow Rate (QMIN)	5.0	18.0
Annual Average Flow Rate (QAVG ¹)	11.4	30.7
Maximum 30-Day Average Flow Rate (QMAX30 ²)	14.0	38.0
Maximum 7-Day Average Flow Rate (QMAX7 ³)	17.7	47.8
Peak Flow Rate (QPK ⁴)	28.0	76.0

1. The average flow rate during the design year.
2. The maximum average flow rate over any 30-day period.
3. The maximum average flow rate over any 7-day period.
4. The maximum sustained flow rate over any 48-hour period.
5. The Membrane System will be required to meet the Condition 1 net permeate production requirements. If the Big Creek WRF is upgraded in the future to 100% MBR treatment system, this Membrane System will be expanded to meet the Condition 2 net permeate production requirements.

**Table A1-2
Design Primary Effluent Loads (lbs/day)**

Load Condition	COD	TSS	VSS	TKN	TP
QAVG	30,069	10,304	8,810	2,900	585
QMAX30	39,261	14,403	12,243	3,742	718
QMAX7	45,928	18,180	15,453	4,366	908
QPK	61,942	26,172	21,320	5,800	1,275

**Table A1-3
Design Mixed Liquor Temperature**

Condition	Mixed Liquor Temperature (°C)
Minimum Day	11.9
Minimum 7-Day	13.7
Minimum 30-Day	14.3
Average Annual	20.4
Maximum 30-Day	25.4
Maximum 7-Day	26.2

2.2 Membrane Basin Mixed Liquor Requirements

At all times when permeate is being produced, mixed liquor dissolved oxygen shall be no less than 2 mg/L at all locations in the Membrane Basins.

2.3 Permeate Quality Requirements

The anticipated NPDES Permit effluent limits are shown in Table A1-4.

**Table A1-4
Anticipated NPDES Permit Effluent Limits**

Parameter	Monthly Average Concentration
Carbonaceous Biochemical Oxygen Demand	2.9 mg/L
Chemical Oxygen Demand	45 mg/L
Total Organic Carbon	Monitor
Total Suspended Solids	5.0 mg/L
Ammonia Nitrogen	0.5 mg/L
Organic Nitrogen	Monitor
Total Phosphorous	0.3 mg/L
Ortho Phosphorous	Monitor
Fecal Coliform Bacteria	200/100 mL
Dissolved Oxygen	6.0 mg/L (minimum)
pH	6.0 – 9.0 s.u.
Temperature	Monitor

Membrane permeate shall meet the following requirements:

1. Membrane System permeate shall not contain a concentration of any permitted effluent parameter greater than the soluble concentration of that parameter in Membrane System feed.
2. Total Suspended Solids (TSS): no sample shall exceed 2 mg/L.
3. Turbidity: Turbidity less than or equal to 0.2 ntu at least 95 percent of the time and no sample shall exceed 0.5 ntu.

2.4 Membrane Cleaning Requirements

Membranes shall be cleaned in place using chemical solutions to restore membrane permeability. Use of proprietary flux enhancing and cleaning chemicals is prohibited. Maintenance cleaning of a given Membrane Basin shall not be performed more frequently than once in any 4-day period. Recovery cleaning (chemical clean-in-place) of a given Membrane Basin shall not be performed more frequently than four times per year.

SECTION 3 – Membrane System Scope of Supply

3.1 General

The Membrane System Scope of Supply consists of membranes and other elements of the MBR process associated with separating mixed liquor suspended solids from treated wastewater under Condition 1 flow rates to

produce permeate. The Contractor for the Construction Project will supply other elements of the MBR process.

3.1.1 Membrane System Components

Items included in the Membrane System Scope of Supply are listed below (see Section 3.1.3 for Items Provided By Others). Some items may not apply to all proposed Membrane Systems.

- Membranes and membrane housings or support structures.
- Permeate production (pumping or gravity) system.
- Entrained air separation system (if required).
- Mixed Liquor Recycle (MLR) pumps (from Membrane System to BNR/AS System) if required.
- Membrane air scour blowers.
- Permeate headers, air headers, and any other piping required to connect large membrane subunits to the headers.
- Membrane integrity testing system that allows the detection and isolation of defective membranes. Membrane integrity test system shall be suitable to satisfy local state permitting requirements. Membrane integrity test system shall be intended to be used for locating a loss of integrity such as indicated by a high permeate turbidity reading.
- All valves required on permeate headers, air headers, and any other piping used to connect large membrane subunits to the headers.
- Chemical storage and feed systems for membrane maintenance and cleaning. The chemical storage and feed systems shall be 'stand-alone' serving only the Membrane System. Storage capacity shall be sized for 30 days of storage under average annual conditions (minimum) at the following concentrations: sodium hypochlorite, 12.5%; sodium hydroxide, 25%; citric acid, 50%. Other chemicals shall be provided at commercially available concentrations suitable for the application.
- Compressed air system for air separation system, instrumentation (ie. field instruments: flow meters, pressure indicators, etc.), and control valves within the Membrane System Scope of Supply.
- Motors for equipment within the Membrane System Scope of Supply.
- Control valves, and other automatic valves associated with MLR pumping, permeate production, air separation, membrane

air scour, and membrane maintenance/cleaning chemical storage and feed systems.

- Membrane System control panels, PLC and Operator Interface hardware and software, UPS, data transfer and graphic emulation support, data link to the Plant control system, instrumentation, and all other components for a fully automated Membrane System.
- Local control panels for skid mounted or packaged equipment systems.
- Shipment to the jobsite of Membrane System equipment and materials according to the delivery schedule agreed upon by the Membrane System Supplier and the Contractor for the Construction Project.
- Two-year supply of spare parts.

This list is provided for guidance purposes only and is not intended to be the final Membrane System Scope of Supply. The Proposer shall determine all the required components needed to meet the Technology RFP requirements. The Membrane System shall be provided with all necessary equipment, components, accessories, and appurtenances required to make a complete and operable system. The Proposer shall indicate in their Proposal all the proposed components and note any exceptions to the listed Membrane System Scope of Supply.

3.1.2 Minimum Standards of Quality

General

The components supplied for the Membrane System shall generally be the Membrane System Supplier's standard. However, the components shall be evaluated against the minimum standards of quality shown in Table A1-5 and the minimum technical specifications included in Appendix 2. The minimum technical specifications shall be used as a reference to establish the expected minimum standards or quality. Other manufacturers than those listed in the minimum technical specifications will be considered. Table A1-5 also includes additional requirements that must be met.

Reliability

Membrane System components shall be provided with an adequate number of spare units to meet EPA Class 1 requirements for reliability and any additional requirements shown in Table A1-5.

3.1.3 Items Provided By Others

Items excluded from the Membrane System Scope of Supply are listed below. The Contractor for the Construction Project will provide these items.

- Membrane System installation.
- Membrane Basins: structure, stairs, walkways, grating, handrails, gates, and lighting.
- Interconnecting piping and pipe supports.
- Valves other than those described in Section 3.1.1 above.
- Electrical, control, and communication conduits and cables.
- Membrane Building: structure, stairs, lighting, and HVAC.
- BNR/AS Basins complete including: structure, stairs, walkways, grating, handrails, gates, process aeration blowers, air piping, diffusers, and mixers.
- Mixed Liquor Feed (MLF) pumps (from BNR/AS System to Membrane System) if required.
- Sludge wasting pumps.
- Lifting devices for membranes and equipment.
- MCCs, electrical switchgear, variable speed drives, panel boards, transformers and any other equipment necessary to provide power distribution and control for equipment included in the Membrane System Scope of Supply.

3.1.4 Additional Services

The Membrane System Scope of Supply shall also include the following services:

Design Assistance

During design of the Construction Project, the Membrane System Supplier shall assist the Owner and Engineer with preparation of the Bidding Documents for the Construction Project as it relates to the Membrane System. This effort shall include:

- Preparation of shop drawing-level documents with electronic drawing files provided to the Engineer in the most recent version of AutoCAD.
- Participation in five (5) design workshops at the Big Creek WRF with a duration of two (2) eight (8) hour days each. The Membrane System Supplier shall provide two qualified

representatives for each design workshop to discuss and coordinate process and facility design of the MBR Treatment Train.

Bidding Assistance

Attend a meeting in Atlanta to be attended by potential bidders for the Construction Contract. The meeting will be an opportunity for the potential bidders to ask specific questions about the components of the Membrane System Scope of Supply that will be installed by the Contractor. In addition to this meeting, the Membrane System Supplier shall respond in writing to questions from the bidders, acting through the County. One-on-one communication between potential bidders and the Membrane System Supplier will not be permitted.

Factory Inspection and Testing

The Membrane System Supplier shall inspect and test all major components of the Membrane System Scope of Supply for required construction, proper alignment, quiet operation, pumping capacity, satisfactory performance, electrical connection, and intended function. The Membrane System Supplier shall submit written certification of all factory tests to the Engineer prior to shipping.

The Owner shall witness the factory test of the entire Membrane System control system, which will include simulation of all PLC ladder logic and control programs. The Membrane System Supplier shall pay all travel expenses for five (5) Owner representatives.

Construction Assistance

The Membrane System Supplier shall furnish installation instructions and recommendations to the Contractor and shall provide assistance to Contractor during installation. The Membrane System Supplier shall provide field personnel who will observe and coordinate unloading and installation of the Membrane System to identify potential problems and recommend solutions to the Contractor. The Membrane System Supplier shall provide a minimum of 24 person days of on-site construction assistance.

O&M Manual and Operator Training

The Membrane System Supplier shall assist the Contractor for the Construction Project with preparation of an Operation and Maintenance Manual, as it pertains to the Membrane System, and conduct onsite training of the County representatives who will operate the Membrane System.

The Membrane System Supplier shall provide training to Owner's personnel and operations representatives as required for a complete understanding of process, mechanical, electrical, and control system requirements. Training shall be completed prior to commencement of Functional Testing. The Membrane System Supplier shall provide a minimum of 6 person days of on-site operator training.

Start-Up Assistance

The Membrane System Supplier shall assist the Contractor for the Construction Project with equipment start-up and testing of the Membrane System, as specified herein.

Commissioning Assistance

The Membrane System Supplier shall assist the Owner with commissioning of the Membrane System, as specified herein.

3.2 Equipment Start-Up and Testing Requirements

3.2.1 General

Following the Membrane System Supplier's calibration of all Membrane System field instruments, the Membrane System Supplier shall perform Functional and Acceptance Tests of the Membrane System. It will be the responsibility of the Membrane System Supplier and the Contractor to communicate to arrange the times for start-up and testing activities, however, the Contractor must confirm that these times are acceptable to the Owner.

3.2.2 Functional Testing

The Membrane System Supplier shall coordinate with the Contractor to perform Functional Testing of the Membrane System. For the Functional Testing, the Membrane System Supplier and the

Contractor shall verify operation of all system components, all control system functions, and all communication links. To perform the Functional Testing, the Membrane System Supplier shall operate all valves, controls, and other devices to ensure they are functional and ready for Acceptance Testing. Purpose of the Functional Testing shall be to demonstrate the effectiveness of the following system components and features:

1. Confirm specified performance of each pumping system, ie. flow rate, total dynamic head, efficiency, alarm systems, etc.
2. Confirm specified performance of all blowers and compressors, ie. flow rate, discharge pressure, efficiency, alarm systems, etc.
3. Confirm specified performance of each chemical feed system to deliver volumetric or mass flow rates of chemicals through the range of dosages likely to be needed for proper operation of the Membrane System.
4. Manual flow control of Membrane Basins.
5. Automatic START/STOP and flow control of Membrane Basins using Membrane System control system.
6. Automatic backwashing at various time intervals.
7. Automatic shutoff and alarm for various failure modes for each Membrane Basin and for entire Membrane System.
8. START and STOP of air scour system.
9. Membrane integrity test system.
10. Determination of temperature-corrected clean water permeability of each Membrane Basin.
11. Monitoring and recovery of operating data.
12. Monitoring and control from remote workstation.
13. Automatic switchover from normal power to emergency power, and from emergency power to normal power.
14. All control functions, both at local system and remote workstation.
15. Operation of systems for maintenance and recovery cleans.
16. Operation of all monitoring instruments.
17. Bubble point testing of the small membrane subunits.

The Membrane System Supplier shall inspect the installed Membrane System for correct operation, proper connection, and satisfactory function of all components. The Membrane System Supplier shall approve the installation and provide written certification that all components of the Membrane System have

been installed properly and are ready for operation.

The proposed Functional Testing procedure shall be developed by the Membrane System Supplier and shall be submitted to the Engineer before scheduling and performing Functional Testing. In the event of a non-conforming system as determined by the Engineer, advancement to Acceptance Testing shall not commence until the Membrane System Supplier has made, at no additional cost to the Owner, such adjustments and modifications as are necessary to correct the Membrane System, and has demonstrated this by repeating the Functional Testing until satisfactory.

3.2.3 Acceptance Testing

Following completion of the Training and Functional Testing, and following the submittal of all final shop drawings, O&M Manuals, and PLC programs, the Membrane System Supplier, Contractor, and the Owner shall conduct the Acceptance Test. Since the Membrane System is part of the MBR Treatment Train, during the Acceptance Test, the Membrane System Supplier shall take the lead and be responsible to test the Membrane System. The Contractor shall be responsible for testing all other equipment associated with the MBR Treatment Train. The Owner shall be responsible for controlling solids retention time and establishing MLSS concentrations as specified.

The Membrane System Supplier shall submit an Acceptance Test Report within 7 days of completion of the test period. To perform the Acceptance Test, the Membrane System Supplier shall continuously operate the Membrane System over a 60-day test period and collect and summarize data to demonstrate that the system meets the Acceptance Test requirements for the parameters listed below. In all cases, compliance shall be determined for each calendar day, and to successfully pass the Acceptance Test, the Membrane System must comply with requirements for each of the 60 days within the Acceptance Test period.

1. Production Capacity: Membrane System meets Condition 1 net permeate production requirements specified herein at the corresponding design net flux rates specified in the Membrane System Supplier's Technical Proposal.
2. Pressure Limitations: Membrane System operates within the TMP limit that is specified by the Membrane System

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3. Membrane Permeate Quality: Membrane permeate meets quality requirements specified herein.
 4. Maintenance Clean: Membrane maintenance cleaning operation frequency shall be equal to or less than specified herein.
 5. Recovery Clean: Perform recovery clean operation at the end of the 60-day test period on one Membrane Basin selected by Owner. Using the TMP and temperature corrected permeability data from the 60-day operation, the recovery clean interval, when averaged over 1 year, shall not exceed the minimum frequency specified herein.
 6. Power Consumption: Membrane System power consumption shall be less than or equal to the amount shown on Cost Proposal Form B for Startup. Such power consumption shall include all equipment listed on Cost Proposal Form B. Power consumption associated with permeate production shall be adjusted for permeate temperature and normalized to 20-degrees Celsius.
 7. Chemical Usage: Membrane System chemical usage shall be less than or equal to the amount shown on Cost Proposal Form C for Startup. Such chemical usage shall include all chemicals listed on Cost Proposal Form C.
 8. Control System: Verify that the Membrane System control system, SCADA, and network communications systems operate as intended. Verify that automatic transfer to redundant or backup systems is functional. Any manual intervention to restart or to re-establish normal operation of the Membrane System control system is considered a system failure.

Successful completion of the Acceptance Test will be defined as 60 continuous days of operation without a significant failure and demonstration that the Membrane System meets all Acceptance Test requirements specified herein. A significant failure of the Membrane System is one that decreases net permeate production below 75 percent of Condition 1 requirements for more than 24 hours, or, for control systems, a significant failure is any event that requires operator intervention to restart or to re-establish normal system operation.

If the Membrane System fails to complete the Acceptance Test successfully, Membrane System Supplier shall have the option of repeating the test over a second 60-day period. If the Membrane

System fails to complete the Acceptance Test successfully during a second test period, the Membrane System Supplier shall prepare a written plan for modifying the Membrane System to meet all Acceptance Test requirements as follows:

1. Membrane System Supplier shall submit the written plan within 7 days after the second unsuccessful test period ends.
2. If the proposed modifications are deemed acceptable by the Owner and the Engineer, the Membrane System Supplier shall modify the Membrane System within 30 days of receiving the Engineer's written approval. All modifications to the Membrane System shall be completed at no cost to the Owner or Contractor.
3. After modifications are completed, the Membrane System Supplier shall repeat the Acceptance Test.
4. If, in the opinion of the Owner or the Engineer, the Membrane System Supplier cannot modify or supplement its Membrane System to meet the Acceptance Test requirements specified herein, the Membrane System Supplier shall remove its Membrane System and shall install an alternate system as required to meet the Acceptance Test requirements at the sole cost of the Membrane System Supplier. This requirement shall be secured through the Contractor's Performance Bond.

During the Acceptance Test, the Contractor, Owner and Engineer shall all have the option of collecting samples for independent analyses to confirm measurements and analyses conducted by Membrane System Supplier. Owner and Engineer shall have the option of witnessing all testing performed by the Membrane System Supplier.

3.3 Commissioning

The Commissioning Period shall follow successful completion of Acceptance Testing. Compliance with the requirements for production capacity, membrane permeate quality, membrane cleaning frequency, power consumption, and chemical usage shall be determined during the Commissioning Period. The Commissioning Period shall begin and end at the Owner's discretion, within the limits defined herein:

1. Start of Commission: No later than 2 months after successful completion of Acceptance Testing.
2. Duration: 180 calendar days.

It is the Owner's intent for the Commissioning Period to coincide with peak flow conditions or to simulate those conditions using a portion of the Membrane System. The Owner shall operate the MBR Treatment Train during the Commissioning Period; however, the Membrane System Supplier shall provide onsite assistance.

The Membrane System Supplier shall be responsible for monitoring operating conditions and performance of the Membrane System during the Commissioning Period. The Owner and Engineer may conduct their own monitoring and record keeping during the Commissioning Period. The Membrane System Supplier shall summarize operating and performance data at the end of the Commissioning Period and prepare a written Commissioning Report summarizing the results to the Owner and the Engineer. The Commissioning Report shall include a narrative description, tables and graphs of production capacity, TMP versus time, permeate quality, chemical usage, power consumption, maintenance clean and recovery clean frequency, and other parameters to document the performance of the Membrane System. The Membrane System Supplier shall submit the Commissioning Report within 30 days following the end of the Commissioning Period. All provisions of the Membrane System Warranty specified herein are enforceable during the Commissioning Period.

3.4 Membrane System Warranty

The guaranteed Small Membrane Subunit Replacement Cost (SMSRC) shall be the value provided in Cost Proposal Form D. The guaranteed Large Membrane Subunit Replacement Cost (LMSRC) shall be the value provided in Cost Proposal Form D. Guaranteed SMSRC and LMSRC shall be adjusted proportionally to the Consumer Price Index for All Urban Consumers (CPI-U), United States City Average, All Items, 1982-84=100, without seasonal adjustment. The baseline CPI-U shall be its value at the time of Proposal submittal. Guaranteed SMSRC and LMSRC shall be Freight on Board (FOB) Fulton County, Georgia. The guaranteed SMSRC and LMSRC shall not exceed the Membrane System Supplier's advertised cost at the time of purchase.

The Proposer shall indicate the Guaranteed Membrane Life (GML) in Cost Proposal Form D. The GML shall not be prorated and shall be a minimum of five (5) years and a maximum of ten (10) years. The GML Warranty Period shall commence upon the successful completion of the Acceptance Test and the Substantial Completion date of the MBR Treatment Train.

The Membrane System Supplier shall repair or replace any small membrane

subunit that fails within the GML Warranty Period. The Membrane System Supplier may also add small or large membrane subunits, given available space in the Membrane Basins. Such actions shall be at no cost to the Owner.

Provided that the Membrane System has been operated and maintained per the Membrane System Supplier's recommendations, Membrane Failure or End of Membrane Life is generally defined as meeting any one of the following conditions during the GML Warrantee Period:

1. If there is a membrane integrity failure, as determined by the membrane integrity testing system.
2. If the Membrane System fails to meet the Condition 1 net permeate production requirements specified herein.
3. If the Membrane System can not achieve the design net flux rates specified in the Membrane System Supplier's Technical Proposal that correspond to the Condition 1 net permeate production requirements specified herein.
4. If the Membrane System exceeds the permeate quality requirements specified herein.
5. If the interval for maintenance and recovery cleaning is shorter than the specified frequency of cleaning to meet the Condition 1 net permeate production capacity specified herein or to meet the TMP limit that is specified by the Membrane System Supplier in Technical Proposal Form I.
6. If the Membrane System power consumption exceeds the amount shown on Cost Proposal Form B for End of Membrane Life. Such power consumption shall include all equipment listed on Cost Proposal Form B. Power consumption associated with permeate production shall be adjusted for permeate temperature and normalized to 20-degrees Celsius.
7. If the Membrane System chemical usage exceeds the amount shown on Cost Proposal Form C for End of Membrane Life. Such chemical usage shall include all chemicals listed on Cost Proposal Form C.

Failure or lack thereof shall be demonstrated at the Membrane System, not through shipment of membrane modules for offsite analysis. If the Membrane System Supplier is unable to correct the failure condition through replacement of membrane subunits or addition of membrane subunits, then the Membrane System Supplier shall be responsible for all costs associated with complete removal of the nonconforming Membrane System and for all costs associated with subsequent installation of a Membrane System that meets the performance requirements.

The Membrane System Supplier shall provide toll-free telephone support and a minimum of one site visit of at least two (2) days duration per calendar year throughout the GML warranty period. The site visit shall include membrane material (i.e., fiber or sheet) analysis of at least five samples from five separate large membrane subunits. The analysis is not required to be destructive, but shall be determined by the Membrane System Supplier as tests that are indicative of membrane life and gradual loss of effectiveness.

The GML shall be valid for the MBR Treatment Train operating conditions shown in Table A1-6. The Proposer shall clearly state in their Proposal any exceptions to these GML operating conditions or any additional applicable GML operating conditions.

**Table A1-6
GML MBR Treatment Train Operating Conditions**

Parameter	Value
FOG (mg/L as measured in raw sewage)	≤ 100
MLSS (mg/L as measured in MLR)	6,000-13,000
Temperature (°C)	10-30
Ferric Dose (mg/L as FeCl ₃)	0-100
Alum Dose (mg/L as Al ₂ (SO ₄) ₃ * 14H ₂ O)	0-150
Lime Dose (mg/L as CaCO ₃) ¹	0-75
Caustic Dose (mg/L as NaOH)	0-80
pH (s.u.)	6-8
Alkalinity (mg/L as CaCO ₃)	30-130
Total SRT (seven day moving average)	8-50 days
Notes:	
1. Lime slurry will be prepared from pebble lime using a slaker followed by a grit settling tank. Lime slurry will be added upstream of the primary clarifiers when ferric is used as the metal salt or lime slurry will be added downstream of the primary clarifiers when alum is used as the metal salt.	

Membrane System control valves that are actuated or started more than once per hour shall be warranted for a period of five (5) years from the successful completion of the Acceptance Test and the Substantial Completion date of the MBR Treatment Train. Membrane System Supplier shall make all repairs or replacements necessitated by defects in materials and workmanship that become evident within the warranty period. Such actions shall be at no cost to the Owner.

All other equipment supplied by the Membrane System Supplier and not specifically mentioned above shall be warranted against defects in

workmanship and materials for a period of two (2) years from the successful completion of the Acceptance Test and the Substantial Completion date of the MBR Treatment Train. Membrane System Supplier shall make all repairs or replacements necessitated by defects in materials and workmanship that become evident within the warranty period. Such actions shall be at no cost to the Owner.

Membrane System Supplier shall guarantee that, for components manufactured by the Membrane System Supplier, replacement parts shall continue to be available to the Owner for a minimum of 20 years from the date of successful completion of the Acceptance Test and the Substantial Completion date of the MBR Treatment Train. Membrane System Supplier shall guarantee that, if Membrane System Supplier or Membrane System Supplier's product line is sold, Membrane System Supplier shall make provisions such that all guarantees, warranties, and bonds will remain in effect and that replacement parts and operational support will continue to be available to the Owner for the time period specified above.

Membrane System Supplier agrees to hold the Owner harmless from liability of any kind arising from direct damage due to said defects. Membrane System Supplier shall make all repairs and replacements promptly upon receipt of written orders for same from Owner. If within 10 days after Owner has notified Membrane System Supplier of a defect, Membrane System Supplier has not started to make the necessary corrections, Owner is hereby authorized to make the corrections or to order the work to be done by a third party, and the costs of the corrections shall be paid by the Membrane System Supplier. Repetitive malfunction of Membrane System material and equipment shall be cause for replacement and an extension of the warranty period to a date one year following acceptable replacement. Include in the Proposal any tests and procedures required to continue the warranty following violation of a warranty or contract operating condition.

3.5 Fixed Membrane System Price Adjustment Factor

The Fixed Membrane System Price shall be adjusted in the event the Construction Contract Date does not occur within 16 months after the Proposal Submission Date. The Fixed Membrane System Price Adjustment Factor (FMSPAF) shall be based on the Construction Cost Index (CCI) as published by the Engineering News Record (ENR). The following formula illustrates the calculation of the FMSPAF to be applied to the Fixed Membrane System Price to adjust the price from a time 16 months after the Proposal Submission Date to the month of the Construction Contract Date:

$$FMSPAF = \left[n_{db} \left(\frac{CCI_{\text{month of the construction contract date}}}{CCI_{\text{16th month after the proposal submission date}}} - 1 \right) \right] + 1$$

(where n_{db} = Percentage proposed on Cost Proposal Form A)

Once the Fixed Membrane System Price is escalated from the 16th month after the Proposal Submission Date to the Construction Contract Date, no further escalation of the Fixed Membrane System Price shall occur.

In the event that the CCI is not available, the FMSPAF is to be calculated using a comparable index or price to be mutually agreed upon by the County and the Membrane System Supplier. If the base used in any such index or price is altered, the FMSPAF shall be calculated to reflect the actual percentage change in such index or price from the 16th month after the Proposal Submission Date to the Construction Contract Date.

3.6 Payment Schedule

The Membrane System Supplier will be compensated for the services and equipment described in this Technology RFP with the following guidelines:

1. Payment shall follow the items and associated costs provided by the Proposer in Cost Proposal Form A. Successful completion of each item will be a pre-requisite for payment approval.
2. Since the County will not enter into a contract with the Membrane System Supplier during the design and bidding phases, the Membrane System Supplier will not be compensated for those tasks (ie. Pre-construction engineering/design, shop drawing preparation, bidding assistance) until the Membrane System Supplier has entered into a contract with the selected Contractor for the Construction Project. In the event that a Construction Contract is not awarded for the upgrade/expansion of the Big Creek WRF, the County intends to reimburse the Membrane System Supplier for completed work associated with pre-construction tasks. The information provided in Cost Proposal Form A will serve as the basis to determine fair compensation.
3. The County will pay for materials/equipment stored on-site in accordance with the Construction Contract.
4. All amounts will be subject to the retainage applied to the Construction Contract.

TABLE A1-5: MINIMUM STANDARDS OF QUALITY - EQUIPMENT

Item/Equipment	Minimum Technical Specification (1)	Reliability/Additional Requirements
Hardware – Large Membrane Subunit	05010, 05050, 05061	Suitable for submergence in Membrane Basins during cleaning.
Painting	09900	
Equipment		
General	11000, 11100	
Membranes	Membrane System Supplier Standard	As described elsewhere in this RFP. Materials of construction for all components of small and large membrane subunits shall be suitable for the intended range of operating conditions and chemical exposure. Provide isolation valves for isolation of large membrane subunits.
Horizontal Non-Clog Centrifugal Pumps	11107	As described elsewhere in this RFP. The number of installed spare units provided shall meet EPA Class 1 reliability requirements, as a minimum at least one installed spare unit shall be provided. Seals shall be mechanical type with flushing water. Materials of construction for all components shall be suitable for the intended range of operating conditions and chemical exposure. Provide one set of spare parts per type/model of pump; parts to include one seal, one set of o-rings, etc. Maximum motor rpm = 1800.
Air Separation System	Membrane System Supplier Standard	To include vertical air separation columns of Type 316 stainless steel, eductors, compressed air supply, control valves, and level sensors. Use of vacuum pumps is not allowed.
Membrane Air Scour Blowers	11183, 11550	As described elsewhere in this RFP. The number of installed spare units provided shall meet EPA Class 1 reliability requirements, as a minimum at least one installed spare unit shall be provided. Provide one set of spare parts per type/model of blower. Positive displacement blowers shall be provided with acoustical enclosures rated for 80 dBA within 3 feet of the enclosure.

Item/Equipment	Minimum Technical Specification (1)	Reliability/Additional Requirements
Chemical Feed Pumps – Peristaltic	11170 (Type 2)	Minimum one installed spare per chemical feed system.
Chemical Storage Tanks	13207 (Polyethylene) 13209 (FRP)	Totes may be used for total storage requirement less than or equal to 500 gallons. Provide independent containment for each type of chemical storage. Materials of construction for all components shall be suitable for the intended range of operating conditions and chemical exposure. Sodium hypochlorite storage tanks shall comply with Chlorine Institute Pamphlet 96: Sodium Hypochlorite Manual.
Motors	15170	Service Factor = 1.15 unless motor is inverter duty rated (SF = 1.0). Motors to be located in wet process areas shall be TEFC.
Piping and Valves		
General	15000, 15095, 15100	
Piping	15008 (PVC/CPVC) 15012(SST)	Stainless Steel Type 316L. Wall thickness as required for the range of intended operating conditions. Termination point connections shall be ANSI standard flanges. Install true union fittings where disassembly may be required. Maximum flow velocity shall be limited to 8 feet per second.
Butterfly Valves	15101	Materials of construction for all components shall be suitable for the intended range of operating conditions and chemical exposure
Ball Valves	15104	Materials of construction for all components shall be suitable for the intended range of operating conditions and chemical exposure.
Check Valves	15105	Materials of construction for all components shall be suitable for the intended range of operating conditions and chemical exposure.

Item/Equipment	Minimum Technical Specification (1)	Reliability/Additional Requirements
Gate Valves	15108	4" through 16" - Non-rising stem design, min. 250 psi working pressure, 500 psi test pressure. Materials of construction for all components shall be suitable for the intended range of operating conditions and chemical exposure.
Plug Valves	15109	Materials of construction for all components shall be suitable for the intended range of operating conditions and chemical exposure.
Valve Actuators	15100	Use electric actuators for typical Open/Close and Modulating applications. See below for representative standards for pneumatic actuators used in cyclic aeration.
Cyclic Aeration Valves and Actuators	Membrane System Supplier Standard	Valves Application: Cyclic Aeration Type: High Performance Butterfly Valve Manufacturer: Tyco Keystone or Bray Actuators Application: Cyclic Aeration Type: Pneumatic, Scotch Yoke Manufacturer: Tyco Morin
Air Compressor System (Air Compressor and Air Dryer)	17303	Air Compressor - Duplex system, supply oil-free and dry instrument quality air, single-acting, two stage, air cooled, oilless reciprocating-type compressor Air Dryer - High temperature refrigerated type dryer, built-in air cooler
Electrical		
General	16000	
Building Wire and Cable	16123	
Boxes	16130	

Item/Equipment	Minimum Technical Specification (1)	Reliability/Additional Requirements
Wiring Devices	16141	
PLC Termination Cables	16161	
Ground and Bonding	16170	
Electrical Identification	16195	
Disconnect Switches	16440	
Dry Type Distribution Transformers	16461	
Enclosed Circuit Breakers	16476	
Individual Motor Controllers	16481	
Electric Controls and Relays	16902	
Controls & Instrumentation		
General	17000, 17030, 17040, 17050, 17060, 17070, 17071, 17072, 17073, 17080, 17100, 17200, 17698	
PLCs & OIU's	17120, 17125	PLC shall be provided with a minimum 25% spare memory space for additional/future programming. Provide "hot backup" redundant PLCs. Provide UPS for the PLCs capable of 30 minutes backup at full load minimum.
Uninterruptible Power Systems	17190	

Item/Equipment	Minimum Technical Specification (1)	Reliability/Additional Requirements
Powered Instruments	17700	
Enclosures/Panels	17500, 17510, 17512, 17520, 17550, 17560	NEMA 4X, 304 Stainless Steel
Magnetic Flow Meters	17701	Materials of construction for all components shall be suitable for the intended range of operating conditions and chemical exposure.
Level Transmitters	17740	Provide for all chemical storage tanks. Provide with local indication.
Pressure Transmitters	17760	Provide with isolating ring seals.
Temperature Transmitters	17770	
Turbidimeter	17821, 17822	
Flow Switches	17660	
Unpowered Instruments		
General	17600	
Rotameters	17635	
Vane Operated Flow Switches	17660	
Level Switches (Float Type)	17670	

Item/Equipment	Minimum Technical Specification (1)	Reliability/Additional Requirements
Pressure Switches	17675	
Temperatures Switches	17680	
Pressure Gauges	17650	Glycerin filled, provide with isolating ring seals.

Note 1: The information included in Appendix 2, Minimum Technical Specifications, is intended to be utilized by the Proposer as a reference for establishing the minimum standards of quality. In reviewing these specifications, the Proposer's focus should be the technical requirements.

ATTACHMENT 1 BIOWIN MODELING REQUIREMENTS

BioWin modeling using BioWin 2.2, with modifications to the model and other assumptions per below, shall be the basis for the BNR/AS process design including BNR/AS Basin sizing, process aeration requirements, metal salt addition requirements, and alkalinity addition requirements. The BNR/AS process design shall include enhanced biological phosphorus removal with ferric used for trim/backup. The minimum detention time for the anaerobic zone of the BNR/AS Basins shall be 1 hour based on 14 MGD forward flow.

The BNR/AS Basin sizing shall be based on the larger volume required to meet Condition 1 or Condition 2 below. The BNR/AS Basin volume and configuration shall be such that Condition 1 is met in the initial operating phase and the same reactor volume can be easily converted in the future to meet Condition 2 without additional reactor volume. Note that under Condition 2, the existing conventional aeration basins will be converted to operate in an MBR mode at a maximum month capacity of 28 MGD and the Membrane System provided for Condition 1 will be expanded to 38 MGD maximum month basis. The BNR/AS Basin volume shall be divided into four parallel trains with a maximum side water depth of 23 feet.

The required permeate quality shall be met at the maximum month design conditions at 13°C. The process aeration requirements, metal salt addition requirements, and alkalinity addition requirements to be used for the operating cost evaluation shall be based on Condition 1 annual average conditions at 20°C.

The primary effluent flows and loads for the annual average and maximum month scenarios shall be per below (includes solids handling recycle impacts but not membrane system backwash recycle impacts):

Condition 1 – Primary Effluent Flow and Load

Name	Annual Average Value	Maximum Month Value
Flow MGD	11.8	14.25
Total COD mg/L	315	331
Total Kjeldahl Nitrogen mgN/L	31.5	32.0
Total P mgP/L	5.8	6.0
Nitrate N mgN/L	0.5	0.5
pH	7.0	7.0
Alkalinity mmol/L	2.6	2.6
Inorganic S.S. mgTSS/L	14	16.3
Calcium mg/L (excludes lime addition impacts)	24	24
Magnesium mg/L	4.0	4.0
Dissolved oxygen mg/L	0	0

Condition 1 – Required BioWin Predicted Permeate Effluent Quality

Name	Value
NH ₃ -N, mgN/L	≤ 0.30
Total P mgP/L	≤ 0.20
Nitrate N mgN/L	≤ 10.0
pH	≥ 6.5
Alkalinity mg/L as CaCO ₃	≥ 50

Condition 2 – Primary Effluent Flow and Load

Name	Maximum Month Value
Flow MGD	10.2
Total COD mg/L	331
Total Kjeldahl Nitrogen mgN/L	32.0
Total P mgP/L	6.0
Nitrate N mgN/L	0.5
pH	7.0
Alkalinity mmol/L	2.6
Inorganic S.S. mgTSS/L	16.3
Calcium mg/L (excludes lime addition impacts)	24
Magnesium mg/L	4.0
Dissolved oxygen mg/L	0

Condition 2 – Required BioWin Predicted Permeate Effluent Quality

Name	Value
NH ₃ -N, mgN/L	≤ 0.30
Total Phosphorus mgP/L	≤ 0.20
Total Nitrogen mgN/L	≤ 3.0
pH	≥ 6.5
Alkalinity mg/L as CaCO ₃	≥ 50

Modeling shall be based on primary effluent modeling using a COD influent element with fractions per below:

Name	Value
Fbs - Readily biodegradable (including Acetate) [gCOD/g of total COD]	0.17
Fac - Acetate [gCOD/g of readily biodegradable COD]	0.12
Fxsp - Non-colloidal slowly biodegradable [gCOD/g of slowly degradable COD]	0.56
Fus - Unbiodegradable soluble [gCOD/g of total COD]	0.055
Fup - Unbiodegradable particulate [gCOD/g of total COD]	0.14
Fna - Ammonia [gNH ₃ -N/gTKN]	0.76

Name	Value
Fnox - Particulate organic nitrogen [gN/g Organic N]	0.434
Fnus - Soluble unbiodegradable TKN [gN/gTKN]	0.0218
FupN - N:COD ratio for unbiodegradable part. COD [gN/gCOD]	0.035
Fpo4 - Phosphate [gPO4-P/gTP]	0.75
FupP - P:COD ratio for influent unbiodegradable part. COD [gP/gCOD]	0.011
FZbh - Non-poly-P heterotrophs [gCOD/g of total COD]	1.00E-04
FZbm - Anoxic methanol utilizers [gCOD/g of total COD]	1.00E-04
FZba - Autotrophs [gCOD/g of total COD]	1.00E-04
FZbp - PAOs [gCOD/g of total COD]	1.00E-04
FZbpa - Propionic acetogens [gCOD/g of total COD]	1.00E-04
FZbam - Acetoclastic methanogens [gCOD/g of total COD]	1.00E-04
FZbhm - H2-utilizing methanogens [gCOD/g of total COD]	1.00E-04

Also the related Particulate Substrate COD/VSS Ratio (mg COD/mg VSS) and Particulate Inert COD/VSS Ratio (mg COD/mg VSS) shall both be changed to 1.7.

Default kinetic and stoichiometric parameters shall be used with the exception of the following:

- Kinetic Parameter - Autotrophic maximum specific growth rate = 0.8/day
- Switching Function – Autotrophic DO Limit = 0.5 mg O₂/L
- Kinetic Parameter – Heterotrophic Ammonification Rate = 0.05 L/mgNd
- Kinetic Parameter – Methanol Utilizer (Methylotroph) Kinetics:

Name	Value	Arrhenius
Max. spec. growth rate of methanol utilizers [1/d]	1.3	1.072
Methanol half sat. [mgCOD/L]	0.5	1.0
Aerobic decay rate of methanol utilizers [1/d]	0.04	1.029
Anoxic/anaerobic decay rate of methanol utilizers [1/d]	0.03	1.029

Process air requirements for purposes of calculating process air power costs will also be determined using the BioWin model. The aerobic zone (excluding the Membrane Basins) of the BNR/AS Basins shall be modeled as three completely mixed reactors in series. The aerobic zone (excluding the Membrane Basins) of the BNR/AS Basins will use fine bubble diffused air for process air requirements. The maximum allowable oxygen uptake rate (OUR) is 100 mg/L/hr. The following BioWin model parameters related to aeration shall be used:

- Diffuser Parameters: k₁ = 1.80, k₂ = 0.060, Y = 0.84, % of Basin Area Covered by Diffusers = 10 to 15%, 0.5 to 3.0 scfm/diffuser.

-
- Aeration Parameters:
 - Alpha for the fine bubble diffused air aerated zones (excluding the Membrane Basins) of the BNR/AS Basins shall be calculated and input to the BioWin model based on the operating MLSS concentration as follows:
 - $\text{Alpha} = e^{(-0.0771 \cdot \text{MLSS})}$, where MLSS is in g/L
 - Surface Pressure = 97.7 KPa
 - Fractional effective saturation depth = 0.35

The aeration requirements in the Membrane Basins for membrane scouring and process demand shall be the responsibility of the Membrane System Supplier using justifiable model parameters and simulation methodology. The airflow shall be input to the model (dynamically if air scour is cycled on and off) and the resulting DO predicted by the model. The minimum DO concentration at all times in the Membrane Basins shall be 2 mg/L.

The Membrane Basins shall be modeled in BioWin using an appropriate number of complete mix reactors in series, with dewatering elements in between to represent the permeate being drawn off across the tanks (resulting in variable permeate quality and increasing MLSS concentration across the Membrane Basins). The representation in BioWin shall be selected/justified based on the Membrane System Supplier's Membrane Basin length to width ratio and influent feed method.

The following additional BioWin model requirements/changes shall be made:

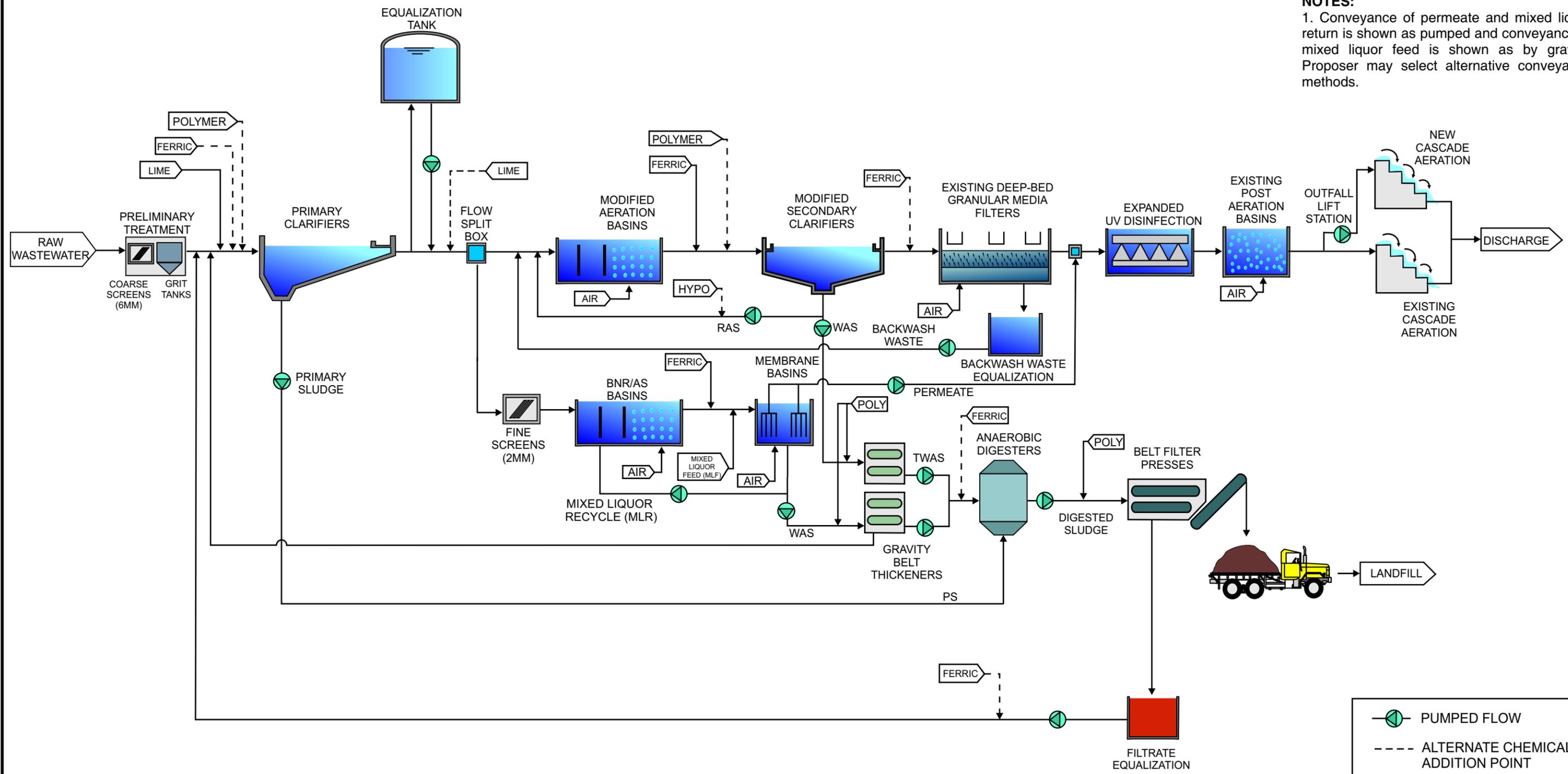
- Oxygen modeling, pH modeling, and metal phosphate precipitation modeling shall be turned on.
- Apply pH limitations in activated sludge kinetic equations.
- The minimum DO setpoint in the three aerobic zone reactors (excluding the Membrane Basins) shall be 2.0 mg/L.
- Ferric chloride shall be used in the model to trim phosphorus to meet the effluent limits and goals.
- The model parameter related to ferric precipitation, the Fe to P ratio, shall be changed to 3.2 mol Fe/mol P removed.
- pH/alkalinity shall be adjusted in the model using Ca(OH)_2 to meet the effluent goal for alkalinity and pH ($\text{pH} \geq 6.5$, alkalinity ≥ 50 mg/L as CaCO_3).
- Methanol shall be used to meet the Condition 2 TN requirements.

A BioWin Modeling Report shall be submitted with the Technical Proposal summarizing the simulations performed including at a minimum: configurations, recycle flows, volume requirements, performance, aeration requirements, metal salt addition requirements, alkalinity addition requirements, and supplemental carbon

addition requirements. The actual BioWin 2.2 files for all simulations shall be provided. The following BioWin simulation files shall be provided at a minimum:

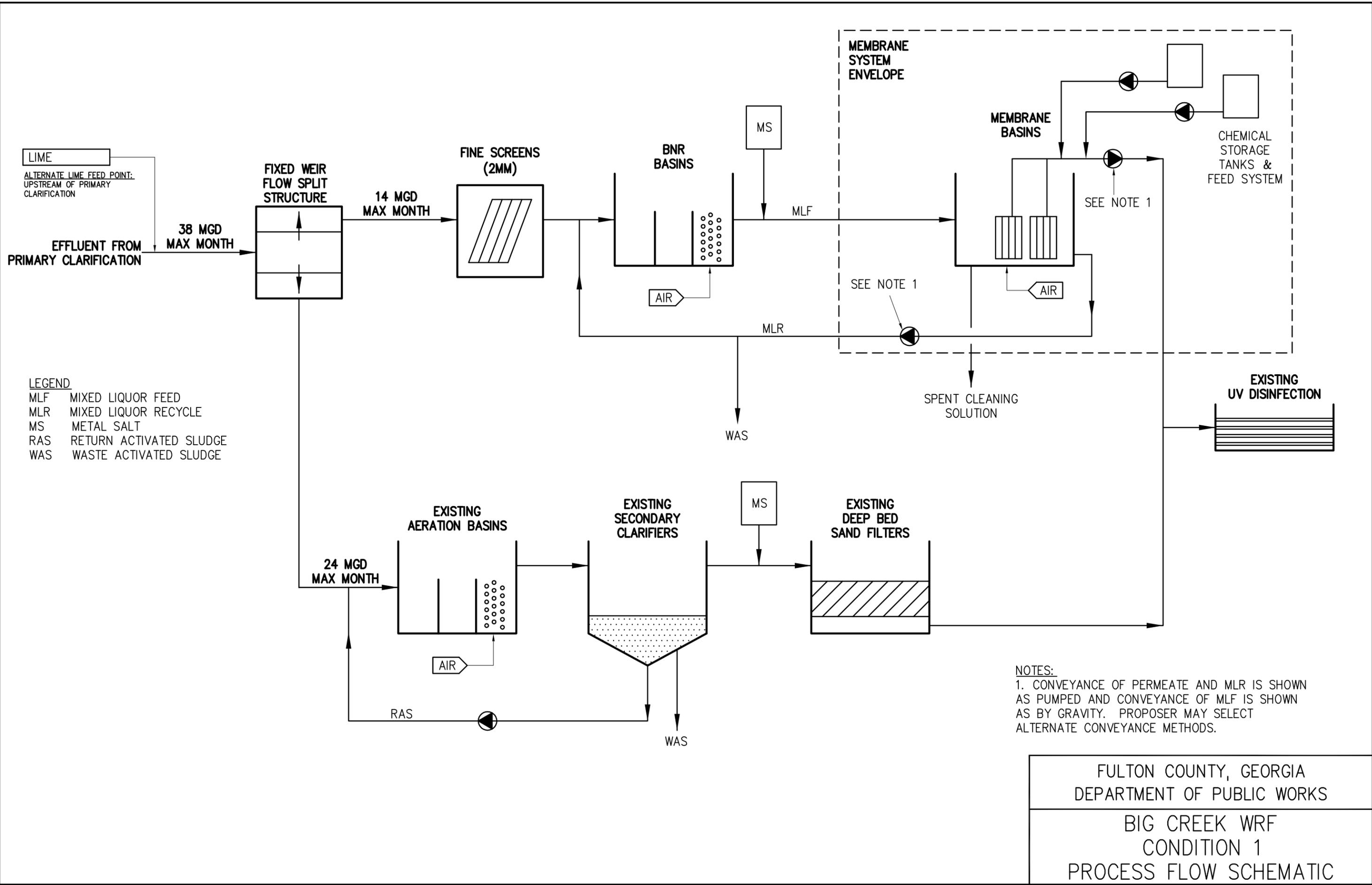
- Condition 1 at Maximum Month Values and 13°C
- Condition 1 at Annual Average Values and 20°C
- Condition 2 at Maximum Month Values and 13°C

FIGURE A1-1



FULTON COUNTY, GEORGIA
 DEPARTMENT OF PUBLIC WORKS

BIG CREEK WRF
 CONCEPTUAL PROCESS FLOW DIAGRAM



LIME
ALTERNATE LIME FEED POINT:
UPSTREAM OF PRIMARY
CLARIFICATION

38 MGD
MAX MONTH
EFFLUENT FROM
PRIMARY CLARIFICATION

FIXED WEIR
FLOW SPLIT
STRUCTURE

14 MGD
MAX MONTH

FINE SCREENS
(2MM)

BNR
BASINS

MS

MLF

AIR

MLR

MEMBRANE
SYSTEM
ENVELOPE

MEMBRANE
BASINS

SEE NOTE 1

AIR

CHEMICAL
STORAGE
TANKS &
FEED SYSTEM

SEE NOTE 1

SPENT CLEANING
SOLUTION

EXISTING
UV DISINFECTION

WAS

LEGEND
MLF MIXED LIQUOR FEED
MLR MIXED LIQUOR RECYCLE
MS METAL SALT
RAS RETURN ACTIVATED SLUDGE
WAS WASTE ACTIVATED SLUDGE

24 MGD
MAX MONTH

EXISTING
AERATION
BASINS

EXISTING
SECONDARY
CLARIFIERS

MS

EXISTING
DEEP BED
SAND FILTERS

AIR

RAS

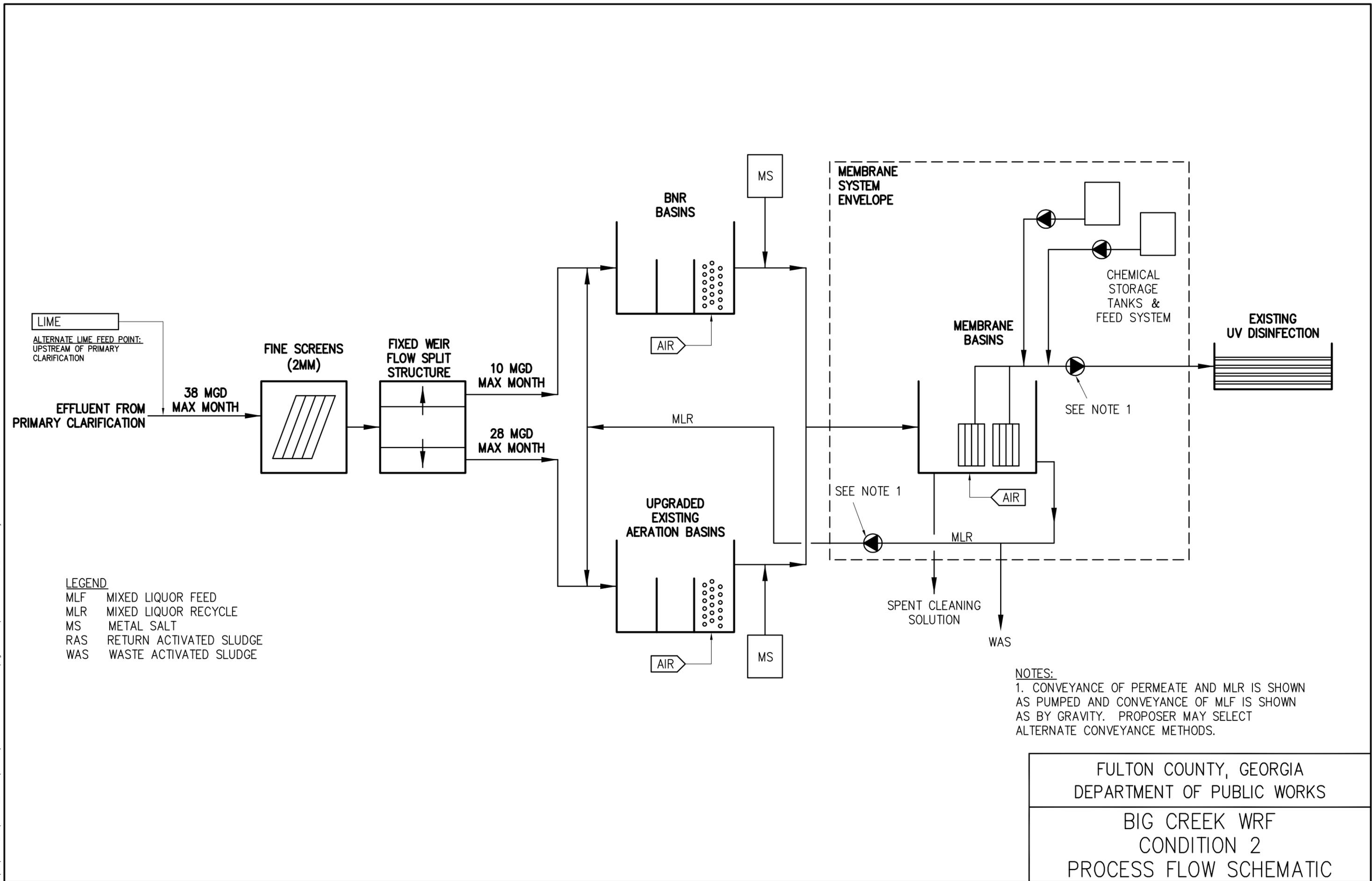
WAS

NOTES:
1. CONVEYANCE OF PERMEATE AND MLR IS SHOWN
AS PUMPED AND CONVEYANCE OF MLF IS SHOWN
AS BY GRAVITY. PROPOSER MAY SELECT
ALTERNATE CONVEYANCE METHODS.

FULTON COUNTY, GEORGIA
DEPARTMENT OF PUBLIC WORKS
BIG CREEK WRF
CONDITION 1
PROCESS FLOW SCHEMATIC

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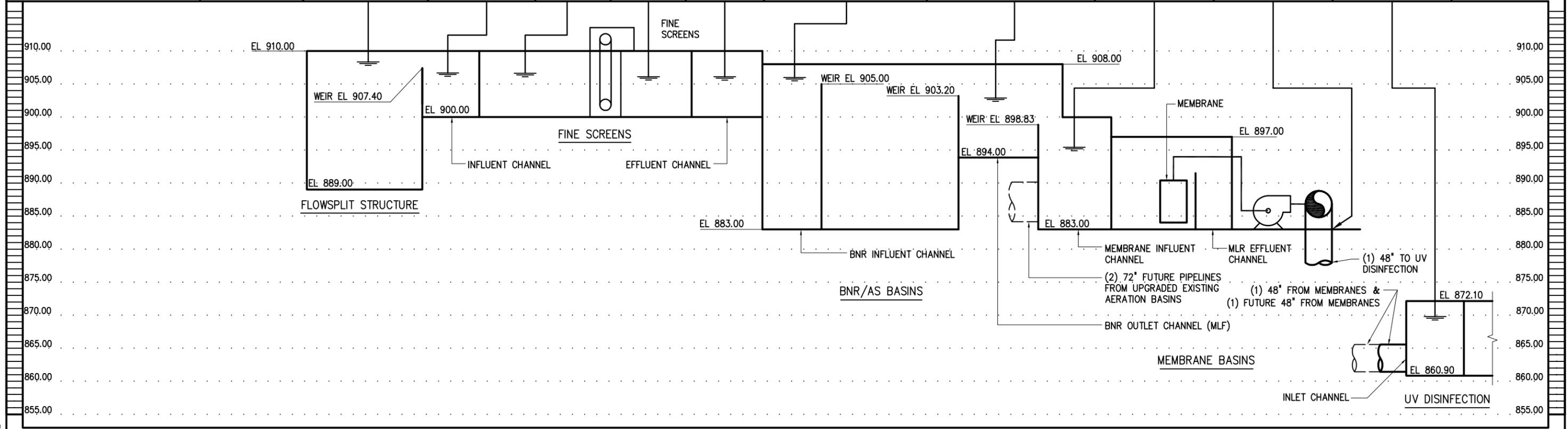


- LEGEND**
- MLF MIXED LIQUOR FEED
 - MLR MIXED LIQUOR RECYCLE
 - MS METAL SALT
 - RAS RETURN ACTIVATED SLUDGE
 - WAS WASTE ACTIVATED SLUDGE

NOTES:
 1. CONVEYANCE OF PERMEATE AND MLR IS SHOWN AS PUMPED AND CONVEYANCE OF MLF IS SHOWN AS BY GRAVITY. PROPOSER MAY SELECT ALTERNATE CONVEYANCE METHODS.

FULTON COUNTY, GEORGIA
 DEPARTMENT OF PUBLIC WORKS
 BIG CREEK WRF
 CONDITION 2
 PROCESS FLOW SCHEMATIC

CONDITION	FLOW	FLOW SPLIT	FINE SCREENS				BNR/AS BASINS		MEMBRANE BASINS		UV DISINFECTION	MIXED LIQUOR RECYCLE
									(SEE NOTE 8)	(SEE NOTE 9)		
MIN DAY FLOW (SEE NOTE 2)	6.6 MGD	907.75	905.76	905.72	905.32	905.32	905.31	900.98	895.42	874.12	869.50	33 MGD
MAX MONTH (SEE NOTE 3)	14 MGD	907.98	905.99	905.95	905.55	905.54	905.51	902.10	895.42	874.18	869.56	60 MGD
PEAK HR FLOW (SEE NOTE 4)	28 MGD	908.33	906.51	906.45	905.95	905.94	905.80	902.88	895.42	874.40	869.78	73 MGD
PEAK HR FLOW (SEE NOTE 5)	28 MGD	908.33	906.67	906.61	906.11	906.10	905.97	902.88	895.42	874.52	869.90	73 MGD
FUTURE PEAK HR FLOW (SEE NOTE 6)	76 MGD/20 MGD	905.82 (SEE NOTE 7)	908.11 (SEE NOTE 7)	907.71	907.30	907.29	905.78	902.08	895.42	874.52	869.90	198 MGD



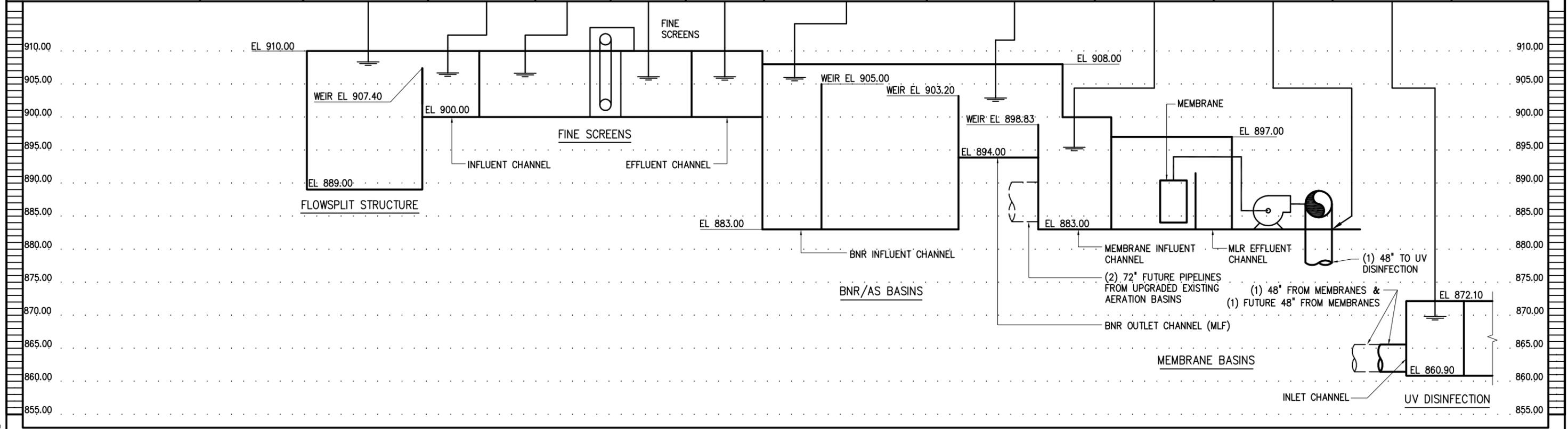
NOTES:

- ELEVATIONS ARE IN FEET, ABOVE MSL.
- MINIMUM DAY WATER SURFACE ELEVATIONS ARE WITH ALL UNITS IN SERVICE AT ALL FACILITIES. MIXED LIQUOR RETURN FLOW IS EQUAL TO 5 TIMES THE FORWARD FLOW TO BNR BASINS.
- MAXIMUM MONTH WATER SURFACE ELEVATIONS ARE WITH ALL UNITS IN SERVICE AT ALL FACILITIES. MIXED LIQUOR RETURN FLOW IS EQUAL TO 4.3 TIMES THE FORWARD FLOW TO BNR BASINS.
- PEAK HOUR WATER SURFACE ELEVATIONS ARE WITH ALL UNITS IN SERVICE AT ALL FACILITIES. PEAK HOUR FLOW DOWNSTREAM OF PRIMARY CLARIFIERS IS EQUALIZED TO 76 MGD. MIXED LIQUOR RETURN FLOW IS EQUAL TO 2.6 TIMES THE FORWARD FLOW TO BNR BASINS.
- PEAK HOUR WATER SURFACE ELEVATIONS ARE WITH ONE UNIT OUT OF SERVICE AT ALL FACILITIES. FOR THE FILTRATION FACILITY, ONE UNIT IS OUT OF SERVICE AND ONE UNIT IS IN BACKWASH. PEAK HOUR FLOW DOWNSTREAM OF PRIMARY CLARIFIERS IS EQUALIZED TO 76 MGD. MIXED LIQUOR RETURN FLOW IS EQUAL TO 2.6 TIMES THE FORWARD FLOW TO BNR BASINS.
- FUTURE PEAK HOUR WATER SURFACE ELEVATIONS ARE WITH ONE UNIT OUT OF SERVICE AT ALL FACILITIES AND FOR UPGRADED PLANT TO 100% MBR. SECONDARY CLARIFIERS AND EFFLUENT FILTERS ARE DECOMMISSIONED. EXISTING AERATION BASINS ARE UPGRADED AND WILL RECEIVE A FORWARD FLOW OF 56 MGD. FORWARD FLOW THROUGH FINE SCREENS IS 76 MGD AND FORWARD FLOW THROUGH BNR IS 20 MGD. MIXED LIQUOR RETURN FLOW IS EQUAL TO 2.6 TIMES THE FORWARD FLOW TO BNR BASINS AND UPGRADED EXISTING AERATION BASINS.
- FOR FUTURE PEAK FLOW CONDITION, FLOWSPLIT STRUCTURE MOVES TO DOWNSTREAM OF FINE SCREENS AND WEIR ELEVATION LOWERS TO 906.00.
- MAXIMUM WATER SURFACE ELEVATION IN MEMBRANE INFLUENT CHANNEL. WATER SURFACE IN MEMBRANE INFLUENT CHANNEL MAY DROP BELOW BUT NOT EXCEED THE STATED ELEVATION DURING MEMBRANE SYSTEM OPERATION.
- REQUIRED HYDRAULIC GRADE LEAVING MEMBRANE BUILDING FOR 2 PSI PRESSURE LOSS TO UV INLET CHANNEL.
- CONVEYANCE OF PERMEATE AND MIXED LIQUOR RECYCLE (MLR) IS SHOWN AS PUMPED AND CONVEYANCE OF MIXED LIQUOR FEED (MLF) IS SHOWN AS BY GRAVITY. PROPOSER MAY SELECT ALTERNATE CONVEYANCE METHODS.

FULTON COUNTY, GEORGIA
 DEPARTMENT OF PUBLIC WORKS
 BIG CREEK WRF
 MBR TREATMENT TRAIN
 PRELIMINARY HYDRAULIC PROFILE

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CONDITION	FLOW	FLOW SPLIT	FINE SCREENS				BNR/AS BASINS		MEMBRANE BASINS		UV DISINFECTION	MIXED LIQUOR RECYCLE
									(SEE NOTE 8)	(SEE NOTE 9)		
MIN DAY FLOW (SEE NOTE 2)	6.6 MGD	907.75	905.76	905.72	905.32	905.32	905.31	900.98	895.42	874.12	869.50	33 MGD
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- FOR FUTURE PEAK FLOW CONDITION, FLOWSPLIT STRUCTURE MOVES TO DOWNSTREAM OF FINE SCREENS AND WEIR ELEVATION LOWERS TO 906.00.
- MAXIMUM WATER SURFACE ELEVATION IN MEMBRANE INFLUENT CHANNEL. WATER SURFACE IN MEMBRANE INFLUENT CHANNEL MAY DROP BELOW BUT NOT EXCEED THE STATED ELEVATION DURING MEMBRANE SYSTEM OPERATION.
- REQUIRED HYDRAULIC GRADE LEAVING MEMBRANE BUILDING FOR 2 PSI PRESSURE LOSS TO UV INLET CHANNEL.
- CONVEYANCE OF PERMEATE AND MIXED LIQUOR RECYCLE (MLR) IS SHOWN AS PUMPED AND CONVEYANCE OF MIXED LIQUOR FEED (MLF) IS SHOWN AS BY GRAVITY. PROPOSER MAY SELECT ALTERNATE CONVEYANCE METHODS.

FULTON COUNTY, GEORGIA
 DEPARTMENT OF PUBLIC WORKS
 BIG CREEK WRF
 MBR TREATMENT TRAIN
 PRELIMINARY HYDRAULIC PROFILE

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APPENDIX 2 MINIMUM TECHNICAL SPECIFICATIONS

Included herein are minimum technical specifications as reference for establishing the minimum standards of quality described in Appendix 1, Table A1-5.

SECTION 05010
METAL MATERIALS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Metal materials not otherwise specified shall conform to the requirements of this Section.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Materials for fasteners are included in Section 05050, Metal Fastening.
- B. Requirements for specific products made from the materials specified herein are included in other sections of the Specifications. See the section for the specific item in question.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. ASTM A36 Standard Specification for Structural Steel
- B. ASTM A47 Standard Specification for Malleable Iron Castings
- C. ASTM A48 Standard Specification for Gray Iron Castings
- D. ASTM A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
- E. ASTM A167 Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
- F. ASTM A276 Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes
- G. ASTM A307 Standard Specification for Carbon Steel Externally Threaded Standard Fasteners
- H. ASTM A446 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) quality
- I. ASTM A500 Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
- J. ASTM A501 Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
- K. ASTM A529 Standard Specification for Structural Steel with 42 000 psi (290 Mpa) Minimum Yield Point (1/2 in. (12.7 mm) Maximum Thickness)

- L. ASTM A536 Standard Specification for Ductile Iron Castings
- M. ASTM A570 Standard Specification for Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality
- N. ASTM A992 Standard Specification for Structural Steel Shapes
- O. ASTM A666 Standard Specification for Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar for Structural Applications
- P. ASTM B26 Standard Specification for Aluminum-Alloy Sand Castings
- Q. ASTM B85 Standard Specification for Aluminum-Alloy Die Castings
- R. ASTM B108 Standard Specification for Aluminum-Alloy Permanent Mold Castings
- S. ASTM B138 Standard Specification for Manganese Bronze Rod, Bar, and Shapes
- T. ASTM B209 Standard Specification for Aluminum-Alloy Sheet and Plate
- U. ASTM B221 Standard Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
- V. ASTM B308 Standard Specification for Aluminum-Alloy Standard Structural Shapes, Rolled or Extruded
- W. ASTM B574 Standard Specification for Nickel-Molybdenum-Chromium Alloy Rod
- X. ASTM F468 Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use
- Y. ASTM F593 Standard Specification for Stainless Steel Fasteners

1.04 SUBMITTALS

- A. Material certifications shall be submitted along with any shop drawings for metal products and fabrications required by other sections of the Specifications.

1.05 QUALITY ASSURANCE

- A. Owner may engage the services of a testing agency to test any metal materials for conformance with the material requirements herein. If the material is found to be in conformance with Specifications the cost of testing will be borne by the Owner. If the material does not conform to the Specifications, the cost of testing shall be paid by the Contractor and all materials not in conformance as determined by the Engineer shall be replaced by the Contractor at no additional cost to the Owner. In lieu of replacing materials the Contractor may request further testing to determine conformance, but any such testing shall be paid for by the Contractor regardless of outcome of such testing.

PART 2 -- PRODUCTS

2.01 CARBON AND LOW ALLOY STEEL

A. Material types and ASTM designations shall be as listed below:

- | | |
|---|--------------------------|
| 1. Structural Fabrications | A992 |
| 2. Sheet Steel | A 570 Grade C |
| 3. Steel Angles and Plates | A36 |
| 4. Bars and Rods | A 36 or A307 Grade A |
| 5. Pipe - Structural Use | A53 Type E or S, Grade B |
| 6. Tubes | A500 Grade B or A501 |
| 7. Cold-Formed Structural Studs and Joists
(18-22 gauge) | A 446 Grade C |
| Cold-Formed Structural Studs and Joists
(12-16 gauge) | A 446 Grade D |

2.02 STAINLESS STEEL

A. All stainless steel fabrications exposed to underwater service shall be Type 316. All other stainless steel fabrications shall be Type 304, unless noted otherwise.

B. Material types and ASTM designations are listed below:

- | | |
|----------------------------|---------------------------|
| 1. Plates and Sheets | ASTM A167 or A666 Grade A |
| 2. Structural Shapes | ASTM A276 |
| 3. Fasteners (Bolts, etc.) | ASTM F593 |

2.03 ALUMINUM

A. All aluminum shall be alloy 6061-T6, unless otherwise noted or specified herein.

B. Material types and ASTM designations are listed below:

- | | |
|------------------------------------|------------------------|
| 1. Structural Shapes | ASTM B308 |
| 2. Castings | ASTM B26, B85, or B108 |
| 3. Extruded Bars | ASTM B221 - Alloy 6061 |
| 4. Extruded Rods, Shapes and Tubes | ASTM B221 - Alloy 6063 |
| 5. Plates | ASTM B209 - Alloy 6061 |
| 6. Sheets | ASTM B221 - Alloy 3003 |

C. All aluminum structural members shall conform to the requirements of Section 05140, Structural Aluminum.

- D. All aluminum shall be provided with mill finish unless otherwise noted.
- E. Where bolted connections are indicated, aluminum shall be fastened with stainless steel bolts.
- F. Aluminum in contact with dissimilar materials shall be insulated with an approved dielectric.

2.04 CAST IRON

- A. Material types and ASTM designations are listed below:

- | | |
|--------------|--------------------------|
| 1. Gray | ASTM A48 Class 30B |
| 2. Malleable | ASTM A47 |
| 3. Ductile | ASTM A536 Grade 60-40-18 |

2.05 BRONZE

- A. Material types and ASTM designations are listed below:

- | | |
|--------------------------|--------------------------|
| 1. Rods, Bars and Sheets | ASTM B138 - Alloy B Soft |
|--------------------------|--------------------------|

2.06 HASTELLOY

- A. All Hastelloy shall be Alloy C-276.

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 05050
METAL FASTENING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Furnish all materials, labor, and equipment required to provide all metal welds and fasteners not otherwise specified, in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 05010 - Metal Materials
- B. Section 05035 - Galvanizing
- C. Section 05061 – Stainless Steel
- D. Section 05120 - Structural Steel
- E. Section 05140 - Structural Aluminum

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

- 1. International Building Code
- 2. AISC Specification for Structural Joints Using ASTM A325 or A490 Bolts.
- 3. AISC Code of Standard Practice
- 4. AWS D1.1 Structural Welding Code - Steel
- 5. AWS D1.2 Structural Welding Code - Aluminum
- 6. AWS D1.6 Structural Welding Code – Stainless Steel
- 7. Aluminum Association Specifications for Aluminum Structures
- 8. ASTM A572/A572M-94C Standard Specification for High Strength Low-Alloy Columbium-Vanadium Structural Steel Grade 50

- | | | |
|-----|------------|--|
| 9. | ASTM A307 | Standard Specification for Carbon Steel Externally Threaded Standard Fasteners |
| 10. | ASTM A325 | Standard Specification for High-Strength Bolts for Structural Steel Joints |
| 11. | ASTM A489 | Standard Specification for Eyebolts |
| 12. | ASTM A490 | Standard Specification for Quenched and Tempered Alloy Steel Bolts for Structural Steel Joints |
| 13. | ASTM A563 | Standard Specifications for Carbon and Alloy Steel Nuts |
| 14. | ASTM F593 | Standard Specification for Stainless Steel Bolts; Hex Cap Screws, and Studs |
| 15. | ASTM F594 | Standard Specification for Stainless Steel Nuts |
| 16. | ASTM D1785 | Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe |
| 17. | ASTM F467 | Standard Specification for Nonferrous Nuts for General Use |

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300, Submittals.
 - 1. Shop Drawings providing the fastener's manufacturer and type and certification of the fastener's material and capacity.
 - 2. Copy of valid certification for each person who is to perform field welding.
 - 3. Certified weld inspection reports, when required.
 - 4. Welding procedures.

1.05 QUALITY ASSURANCE

- A. Fasteners not manufactured in the United States shall be tested and certification provided with respect to specified quality and strength standards. Certifications of origin shall be submitted for all U.S. fasteners supplied on the project.
- B. All steel welding shall be performed by welders certified in accordance with AWS D1.1. All aluminum welding shall be performed by welders certified in accordance with AWS D1.2. All stainless steel welding shall be performed by welders certified in accordance with AWS D1.6. Certifications of field welders shall be submitted prior to performing any field welds.

- C. Welds and high strength bolts used in connections of structural steel will be visually inspected in accordance with Article 3.04.
- D. The Owner may engage an independent testing agency to perform testing of welded connections and to prepare test reports in accordance with AWS. Inadequate welds shall be corrected or redone and retested to the satisfaction of the Engineer and/or an acceptable independent testing laboratory, at no additional cost to the Owner.
- E. Provide a welding procedure for each type and thickness of weld. For welds that are not prequalified, include a Performance Qualification Report. The welding procedure shall be given to each welder performing the weld. The welding procedure shall follow the format in Annex E of AWS D1.1 with relevant information presented.

PART 2 -- PRODUCTS

2.01 ANCHOR BOLTS

- A. Anchor bolts shall conform to ASTM A36 or ASTM A307 Grade A except where stainless steel or other approved anchor bolts are shown on the Drawings. Anchor bolts shall have hexagonal heads and shall be supplied with hexagonal nuts meeting the requirements of ASTM A563 Grade A.
- B. Where anchor bolts are used to anchor galvanized steel or are otherwise specified to be galvanized, anchor bolts and nuts shall be hot-dip galvanized in accordance with ASTM A307.
- C. Where pipe sleeves around anchor bolts are shown on the Drawings, pipe sleeves shall be cut from Schedule 40 PVC plastic piping meeting the requirements of ASTM D1785.

2.02 HIGH STRENGTH BOLTS

- A. High strength bolts and associated nuts and washers shall be in accordance with ASTM A325 or ASTM A490. Bolts, nuts and washers shall meet the requirements of AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts".
- B. Where high strength bolts are used to connect galvanized steel or are otherwise specified to be galvanized, bolts, nuts, and washers shall be hot-dip galvanized in accordance with ASTM A325.

2.03 STAINLESS STEEL BOLTS

- A. Stainless steel bolts shall conform to ASTM F-593. All underwater fasteners, fasteners in confined areas containing fluid, and fasteners in corrosive environments shall be Type 316 stainless steel unless noted otherwise. Fasteners for aluminum and stainless steel members not subject to the above conditions shall be Type 304 stainless steel unless otherwise noted.
- B. Stainless steel bolts shall have hexagonal heads with a raised letter or symbol on the bolts indicating the manufacturer, and shall be supplied with hexagonal nuts meeting the requirements of ASTM F594. Nuts shall be of the same alloy as the bolts.

2.04 CONCRETE ANCHORS

- A. Where concrete anchors are called for on the Drawings, one of the types listed below shall be used; except, where one of the types listed below is specifically called for on the Drawings, only that type shall be used. Unless otherwise noted, all concrete anchors which are submerged or are used in hanging items or have direct tension induced upon them, or which are subject to vibration from equipment such as pumps and generators, shall be adhesive anchors. The determination of anchors equivalent to those listed below shall be on the basis of test data performed by a commercial testing laboratory. There are two types used:
1. Expansion anchors shall be wedge, sleeve, or drop-in mechanical anchors.
 2. Adhesive anchors shall be two part injection type.
- B. Expansion anchors shall be Kwik Bolt 3 by Hilti, Inc., Trubolt Wedge Anchor by ITW Ramset/Redhead or "Wedge-All" by Simpson Strong-Tie Co. Sleeve anchors shall be "HLC Sleeve Anchors" by Hilti, Inc., "Dynabolt" by ITW Ramset/Redhead, or "Sleeve-All" by Simpson Strong-Tie Co. Drop-in anchors shall be "HDI/HDI-L/HDI-P" by Hilti, Inc., "Multi-Set II" by ITW Ramset/Redhead, or "Drop-In" by Simpson Strong-Tie Co. All anchors shall be embedded to the depths shown on the Drawings. If no embedment depth is given, the minimum embedment depth as recommended by the manufacturer shall be used. Expansion anchors shall not be used to hang items from above or in any other situations where direct tension forces are induced in anchor.
- C. Adhesive anchors shall consist of threaded rods or bolts anchored with an adhesive system into hardened concrete or grout-filled masonry. The adhesive system shall use a two-component adhesive mix and shall be injected with a static mixing nozzle following manufacturer's instructions. Thoroughly clean drill holes of all debris and drill dust with wire brush prior to installation of adhesive and threaded rod/bolt. Wipe rod free from oil that may be present from shipping or handling. The embedment depth of the rod/bolt shall provide a minimum allowable bond strength that is equal to the allowable tensile capacity of the rod/bolt (see Table 1) unless noted otherwise on the Drawings. The adhesive system shall be "Epcon System A7, C6, or G5" as manufactured by ITW Ramset/Redhead, "HIT HY-150 or RE-500 Injection Adhesive Anchor System" as manufactured by Hilti, Inc., or "SET/ET Epoxy-Tie" or "AT Acrylic-Tie" as manufactured by Simpson Strong-Tie Co.
- D. Concrete anchors used to anchor steel shall be of A36 steel unless noted otherwise. Where steel to be anchored is galvanized, concrete anchors shall also be galvanized.
- E. Concrete anchors used to anchor aluminum, FRP, or stainless steel shall be Type 304 stainless steel unless noted otherwise. All underwater concrete anchors shall be Type 316 stainless steel.

TABLE 1 Allowable Tensile Capacity (Kips)		
Size	A36 Threaded Rod/Bolt	SST Threaded Rod/Bolt
3/8"	2.1	1.9
1/2"	3.8	3.5
5/8"	5.9	5.6
3/4"	8.4	8.2
7/8"	11.5	11.4
1"	15.0	15.0

2.05 MASONRY ANCHORS

- A. Anchors for fastening to solid or grout-filled masonry shall be adhesive anchors as specified above for concrete anchors.
- B. Anchors for fastening to hollow masonry or brick shall be adhesive anchors consisting of threaded rods or bolts anchored with an adhesive system dispensed into a screen tube inserted into the masonry. The adhesive system shall use a two-component adhesive mix and shall inject into the screen tube with a static mixing nozzle. Thoroughly clean drill holes of all debris and drill dust with nylon (not wire) brush prior to installation of adhesive and anchor. Contractor shall follow manufacturer's installation instructions. The adhesive system shall be "Epcon System A7, C6, or G5" as manufactured by ITW Ramset/Redhead, "HIT HY-20 System" as manufactured by Hilti, Inc., or "SET/ET Epoxy-Tie" or "AT Acrylic-Tie" as manufactured by Simpson Strong-Tie Co.
- C. Masonry anchors used to anchor steel shall be of A36 steel unless noted otherwise. Where steel to be anchored is galvanized, anchors shall also be galvanized.
- D. Masonry anchors used to anchor aluminum, FRP, or stainless steel shall be Type 304 stainless steel unless noted otherwise. All underwater anchors shall be Type 316 stainless steel.

2.06 WELDS

- A. Electrodes for welding structural steel and all ferrous steel shall comply with AWS Code, using E70 series electrodes for shielded metal arc welding (SMAW), or F7 series electrodes for submerged arc welding (SAW).
- B. Electrodes for welding aluminum shall comply with the Aluminum Association Specifications and AWS D1.2.
- C. Electrodes for welding stainless steel and other metals shall comply with AWS D1.6.

2.07 WELDED STUD CONNECTORS

- A. Welded stud connectors shall conform to the requirements of AWS D1.1 Type C.

2.08 EYEBOLTS

- A. Eyebolts shall conform to ASTM A489 unless noted otherwise.

2.09 HASTELLOY FASTENERS

- A. Hastelloy fasteners and nuts shall be constructed of Hastelloy C-276.

2.10 ANTISEIZE LUBRICANT

- A. Antiseize lubricant shall be Graphite 50 Anti-Seize by Loctite Corporation, 1000 Anti-Seize Paste by Dow Corning, 3M Lube and Anti-Seize by 3M, or equal.

PART 3 -- EXECUTION

3.01 MEASUREMENTS

- A. The Contractor shall verify all dimensions and review the Drawings and shall report any discrepancies to the Engineer for clarification prior to starting fabrication.

3.02 BOLT INSTALLATION

- A. Anchor Bolts, Concrete Anchors, and Masonry Anchors

1. Anchor bolts shall be installed in accordance with AISC "Code of Standard Practice" by setting in concrete while it is being placed and positioned by means of a rigidly held template.
2. The Contractor shall verify that all concrete and masonry anchors have been installed in accordance with the manufacturer's recommendations and that the capacity of the installed anchor meets or exceeds the specified safe holding capacity.
3. Concrete anchors shall not be used in place of anchor bolts without Engineer's approval.
4. All stainless steel threads shall be coated with antiseize lubricant.

- B. High Strength Bolts

1. All bolted connections for structural steel shall use high strength bolts. High strength bolts shall be installed in accordance with AISC "Specification for Structural Joints, using A325 or A490 Bolts." All bolted joints shall be Type N, snug-tight, bearing connections in accordance with AISC Specifications unless noted otherwise on the Drawings.

- C. Adhesive Anchors

- 1 Adhesive Anchors shall be installed in strict conformance with the manufacturer's recommendations. A representative of the manufacturer must be on site when required by the Engineer.
2. At least 25 percent of the adhesive anchors installed shall be proof tested to 1.33 times the allowable load specified by the manufacturer, or as indicated on the Drawings.

D. Other Bolts

1. All dissimilar metal shall be connected with appropriate fasteners and shall be insulated with a dielectric or approved equal.
2. All stainless steel bolts shall be coated with antiseize lubricant.

3.03 WELDING

- A. All welding shall comply with AWS Code for procedures, appearance, quality of welds, qualifications of welders and methods used in correcting welded work.
- B. Welded stud connectors shall be installed in accordance with AWS D1.1.

3.04 INSPECTION

- A. High strength bolting will be visually inspected in accordance with AISC "Specification for Structural Joints Using A325 or A490 Bolts." Rejected bolts shall be either replaced or retightened as required.
- B. Field welds will be visually inspected in accordance with AWS Codes. Inadequate welds shall be corrected or redone as required in accordance with AWS Codes.

- END OF SECTION -

SECTION 05061
STAINLESS STEEL

PART 1 -- GENERAL

1.01 SECTION INCLUDES

- A. The Contractor shall furnish, install and erect the stainless steel work as shown on the Contract Drawings and specified herein.
- B. Stainless steel work shall be furnished complete with all accessories, mountings and appurtenances of the type of stainless steel and finish as specified or required for a satisfactory installation.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01300 - Submittals
- B. Section 05010 - Metal Materials
- C. Section 05050 - Metal Fastening
- D. Section 05500 - Metal Fabrications

1.03 REFERENCES

- A. ASTM A193 - Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
- B. ASTM A194 - Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service.
- C. ASTM A262 - Practice for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steel.
- D. ASTM A276 - Stainless and Heat-Resisting Steel Bars and Shapes.
- E. ASTM A314 - Stainless and Heat-Resisting Steel Billets and Bars for Forging.
- F. ASTM A380 - Practice for Cleaning and Descaling Stainless Steel Parts, Equipment and Systems.
- G. ASTM A473 - Stainless and Heat-Resisting Steel Forgings.
- H. ASTM A666 - Austenitic Stainless Steel, Sheet, Strip, Plate and Flat Bar.
- I. ASTM A774 - Stainless Steel Pipe Fittings

- J. ASTM A778 - Stainless Steel Pipe
- K. ASTM F593 - Stainless Steel Bolts, Hex Cap Screws and Studs.
- L. ASTM F594 - Stainless Steel Nuts.
- M. ANSI/ASME B1.1 - Unified Inch Screw Thread (UN and UNR Thread Form).

1.04 TESTS

- A. All stainless steel materials including stainless test welds, shall be checked for compliance with tests for susceptibility to intergranular attack. Such tests shall be Practices A, B and E of ASTM A262. Detailed procedures for the tests shall be submitted to the Engineer for approval prior to start of work. Practice A shall be used only for acceptance of materials but not for rejection of materials, and shall be used for screening material intended for testing in Practice B and Practice E. The maximum acceptable corrosion rate under Practice B shall be 0.004 inch per month, rounded off to the third decimal place. If the certified mill report indicates that such test has been satisfactory performed, the fabricator may not be required to repeat the test. Material passing Practice E shall be acceptable.
- B. Sample selection for the susceptibility to intergranular attack tests shall be as follows:
 - 1. One (1) sample per heat per heat treatment lot for plates and forgings;
 - 2. One (1) sample per each Welding Procedure Qualification regardless of the joint design;
 - 3. If tests indicate a reduction in corrosion resistance, welding procedure shall be adjusted or heat treatment determined as needed to restore required corrosion resistance.
 - 4. The samples so chosen shall have received all the post-weld heat treatments identical to the finished part.

1.05 SUBMITTALS

- A. The Contractor shall prepare and submit for approval shop drawings for all stainless steel fabrication in accordance with Section 01300, Submittals.
- B. Submittals shall include, but not be limited to, the following:
 - 1. Certified test reports for susceptibility to intergranular attack.
 - 2. Affidavit of compliance with type of stainless steel shown on the Contract Drawings or specified herein.
 - 3. Certified weld inspection reports.
 - 4. Cleaning and handling of stainless steel in accordance with Paragraph 3.04,

Cleaning and Handling.

- C. Samples of finish, on each type of stainless steel to be furnished, shall be submitted to the Engineer upon request.

1.06 QUALITY ASSURANCE

- A. Shop inspections may be made by the Engineer. The Contractor shall give ample notice to the Engineer prior to the beginning of any stainless steel fabrication work so that inspection may be provided. The Contractor shall furnish all facilities for the inspection of materials and workmanship in the shop, and the inspectors shall be allowed free access to the necessary parts of the works.
- B. Inspectors shall have the authority to reject any materials or work which does not meet the requirements of the Contract Drawings or the Specifications.
- C. Inspection at the shop is intended as a means of facilitating the work and avoiding errors, but is expressly understood that it will in no way relieve the Contractor from his responsibility for furnishing proper materials or workmanship.

1.07 HANDLING, STORAGE AND DELIVERY

- A. Mechanical damage (e.g., scratches and gouges) to the stainless steel material shall not be permitted and is cause for rejection. Care shall be taken in the material handling since such mechanical damage will result in the passive oxide film being "punctured" leading to a possible lower resistance to the initiation of corrosion than the surrounding chemically-passivated surface.
- B. Stainless steel plates and sheets shall be stored vertically in racks and not be dragged out of the racks or over one another. Racks shall be protected to prevent iron contamination.
- C. Heavy stainless steel plates shall be carefully separated and chocked with wooden blocks so that the forks of a fork-lift could be inserted between plates without mechanically damaging the surface.
- D. Stainless steel plates and sheets laid out for use shall be off the floor and be divided by wooden planks to prevent surface damage and to facilitate subsequent handling.
- E. Plate clamps, if used, shall be used with care as the serrated faces can dig in, indent and gouge the surface.
- F. Stainless steel fabrications shall be loaded in such a manner that they may be transported and unloaded without being overstressed, deformed or otherwise damaged.
- G. Stainless steel fabrications and packaged materials shall be protected from corrosion and deterioration and shall be stored in a dry area. Materials stored outdoors shall be supported above ground surfaces on wood runners and protected with approved effective and durable covers.

- H. Stainless steel fabrications shall not be placed in or on a structure in a manner that might cause distortion or damage to the fabrication. The Contractor shall repair or replace damaged stainless steel fabrications or materials as directed by the Engineer.

1.08 FIELD MEASUREMENTS

- A. The Contractor shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of the work.
- B. The Contractor shall review the Contract Drawings and any discrepancies shall be reported to the Engineer for clarification prior to starting fabrication.

PART 2 -- PRODUCTS

2.01 MATERIALS AND FINISHES

- A. Stainless steel shall be Type 304 unless it is used for underwater service. Stainless steel for underwater service shall be Type 316. Minimum mechanical finish shall be No. 4 as stated in Table 2 unless otherwise noted on the Contract Drawings.
- B. The basic mill forms (sheet, strip, plate and bar) are classified by size as shown on Table 1. Tables 2, 3 and 4 identify finishes and conditions in which sheet, bar and plate are available.
- C. Tables 2, 3 and 4 show numbered finishes and conditions for sheet, bar and plate. While there are no specific designations for polished finishes on bar or plate, the sheet finish designations are used to describe the desired effect. This also applies to finishes on ornamental tubing.
- D. There are three standard finishes for strip, which are broadly described by the finishing operations employed:
 - 1. No. 1 Strip Finish

No. 1 strip finish is approximately the same as No. 2D Sheet Finish. It varies in appearance from dull gray matte to a fairly reflective surface, depending largely on alloy composition and amount of cold reduction.
 - 2. No. 2 Strip Finish is approximately the same as a No. 2B sheet finish. It is smoother, more reflective than No. 1, and likewise varies with alloy composition.
 - 3. Bright annealed finish is a highly reflective finish that is retained by final annealing in a controlled atmosphere furnace.

Table 1

Classification of Stainless Steel Product Form

Item	Description	Dimensions		
		Thickness	Width	Diameter or Size
Sheet	Coils and cut length: Mill finishes Nos. 1, 2D and 2B Polished finishes Nos. 3, 4, 6, 7 & 8	under 3/16" under 3/16"	24" and over all widths	-- --
Strip	Cold finished, coils or cut lengths Polished finishes Nos. 3, 4, 6,7 & 8	under 3/16" under 3/16"	under 24" all widths	-- --
Plate	Flat rolled or forged	3/16" and over	over 10"	--
Bar	Hot finished rounds, squares, octagons and hexagons Hot finished flats	-- 1/8" to 8" incl.	-- 1/4" to 10" incl.	1/4" and over --
	Cold finished rounds, squares, octagons and hexagons Cold finished flats	-- 1/8" to 4-1/2"	-- 3/8" to 4-1/2"	over 1/8" --
Wire	Cold finishes only: (in coil) Round, square, octagon, hexagon and flat wire	under 3/16"	under 3/8"	--
Pipe & Tubing	Several different classifications, with differing specifications, are available.			
Extrusion	Not considered "standard" shapes. Currently limited in size to approximately 6-1/2" diameter or structurals.			

Table 2

Standard Mechanical Sheet Finishes

<p>Unpolished or Rolled Finishes: No. 1 A rough dull surface which results from hot rolling to the specified thickness followed by annealing and descaling.</p>	<p>No. 4 A polished surface obtained by finishing with a 120-150 mesh abrasive, following initial grinding with coarser abrasives. This is a general purpose bright finish with a visible "grain" which prevents mirror reflection.</p>
<p>No. 2D A dull finish which results from cold rolling followed by annealing and descaling, and may perhaps get a final light roll pass through unpolished rolls. A 2D finish is used where appearance is of no concern.</p>	<p>No. 6 A dull satin finish having lower reflectivity than No. 4 finish. It is produced by Tampico brushing the No. 4 finish in a medium of abrasive and oil. It is used for architectural applications and ornamentation where a high luster is undesirable, and to contrast with brighter finishes.</p>
<p>No. 2B A bright cold-rolled finish resulting in the same manner as No. 2D finish, except that the annealed and descaled sheet receives a final light roll pass through polished rolls. This is the general purpose cold-rolled finish that can be used as is, or as a preliminary step to polishing.</p>	<p>No. 7 A high reflective finish that is obtained by buffing finely ground surfaces but not to the extent of completely removing the "grit" lines. It is used chiefly for architectural and ornamental purposes.</p>
<p>Polished Finishes: No. 3 An intermediate polish surface obtained by finishing with a 100 grit abrasive. Generally used where a semi-finished polished surface is required. A No. 3 finish usually receives additional polishing during fabrication.</p>	<p>No. 8 The most reflective surface, which is obtained by polishing with successively finer abrasives and buffing extensively until all grit lines from preliminary grinding operations are removed. It is used for applications such as mirrors and reflectors.</p>

Table 3
Conditions and Finishes for Bar

Conditions	Surface Finishes¹
Hot worked only	(a) Scale not removed (excluding spot conditioning) (b) Rough turned ² (c) Pickled or blast cleaned and pickled.
Annealed or otherwise heat treated.	(a) Scale not removed (excluding spot conditioning) (b) Rough turned (c) Pickled or blast cleaned and pickled (d) Cold drawn or cold rolled (e) Centerless ground (f) Polished
Annealed and cold worked to high tensile strength ³	(d) Cold drawn or cold rolled (e) Centerless ground (f) Polished

¹ Surface finishes (b), (e) and (f) are applicable to round bars only.

² Bars of the 4xx series stainless steels which are highly hardenable, such as Types 414, 420, 420F, 431, 440A, 440B and 440C, are annealed before rough turning. Other hardenable grades, such as Types 403, 410, 416 and 416Se, may also require annealing depending on their composition and size.

³ Produced in Types 302, 303Se, 304 and 316.

Table 4

Conditions and Finishes for Plate

Condition and Finish	Description and Remarks
Hot rolled	Scale not removed. Not heat treated. Plates not recommended for final use in this condition. ⁴
Hot rolled, annealed or heat treated	Scale not removed. Use of plates in this condition is generally confined to heat resisting applications. Scale impairs corrosion resistance. ¹
Hot rolled, annealed or heat treated, blast cleaned or pickled	Condition and finish commonly preferred for corrosion resisting and most heat resisting applications.
Hot rolled, annealed, descaled and temper passed	Smoother finish for specialized applications.
Hot rolled, annealed, descaled cold rolled, annealed, descaled, optionally temper passed	Smooth finish with greater freedom from surface imperfection than the above.
Hot rolled, annealed or heat treated, surface cleaned and polished	Polished finishes refer to Table 2.

⁴ Surface inspection is not practicable on plates which have not been pickled or otherwise descaled.

PART 3 -- EXECUTION

3.01 FABRICATION

- A. Holes for bolts and screws shall be drilled. Fastenings shall be concealed where practicable. Joints exposed to the weather shall be formed to exclude water.
- B. As far as practicable, all fabricated units shall be fitted and assembled in the shop, with all cuts and bends made to precision measurements in accordance with details shown on approved shop drawings.
- C. Work shall be fabricated so that it is installed in a manner that will provide for expansion and contraction, prevent the shearing of bolts, screws and other fastenings, ensure rigidity, and provide close fitting of sections.
- D. All finished and/or machined faces shall be true to line and level. Stainless steel sections shall be well formed to shape and size with sharp lines and angles; curved work shall be sprung evenly to curves.
- E. All work shall be fitted together at the shop as far as possible, and delivered complete and ready for erection. Proper care shall be exercised in handling all work so as not to injure the finished surfaces.

3.02 WELDING

- A. Welding shall be done in a manner that will prevent buckling and in accordance with Specification 05050 – Metal Fastening, and as modified hereinafter.
- B. All welds exposed in the work shall be ground smooth and finished to match the finish of the adjacent stainless steel surfaces.
- C. Select weld rods that provide weld filler metal having corrosion resistant properties as nearly identical or better than the base metal to insure preservation of the corrosion-resistant properties. Provide heat treatment at welds where testing of weld procedure indicates it is required to restore the corrosion resistance.
- D. Thermal conductivity of stainless steel is about half that of other steels; and the following methods may be used to accommodate this situation:
 - 1. Use lower weld current setting.
 - 2. Use skip-weld techniques to minimize heat concentration.
 - 3. Use back-up chill bars or other cooling techniques to dissipate heat.
- E. Edges of the stainless steel to be welded shall be cleaned of contaminants.

3.03 FASTENERS

- A. Stainless steel fasteners shall be used for joining stainless steel work.
- B. Stainless steel fasteners shall be made of alloys that are equal to or more corrosion resistant than the materials they join.

3.04 CLEANING AND HANDLING

- A. All stainless steel surfaces shall be precleaned, descaled, passivated and inspected before, during and after fabrication in accordance with the applicable sections of ASTM A380 and as detailed in the procedures to be submitted to the Engineer for approval prior to start of work. Degreasing and passivation of stainless steel articles shall be conducted as the last step after fabrication.
- B. Measures to protect cleaned surfaces shall be taken as soon as final cleaning is completed and shall be maintained during all subsequent handling, storage and shipping.
 - 1. The Contractor shall submit for approval specific procedures listing all the steps to be followed in detecting contamination and in descaling, cleaning, passivation and protecting of all stainless steel.
 - 2. Area showing clear indications of contamination shall be recleaned, repassivated and reinspected.

- C. At approved stages in the shop operations, contaminants such as scale, embedded iron, rust, dirt, oil, grease and any other foreign matter shall be removed from the metal, as directed or approved by the Engineer. The adequacy of these operations shall be checked by the Engineer. Operations in the shop shall be conducted so as to avoid contamination of the stainless steel and to keep the metal surfaces free from dirt and foreign matter.
- D. In order to prevent incipient corrosion during fabrication, special efforts shall be made at all times to keep all stainless steel surfaces from coming in contact with other metals.
 - 1. Stainless steel and stainless steel welds shall be cleaned with clean sand free of iron, stainless steel wool, stainless steel brushes, or other approved means and shall be protected at all times from contamination by any materials, including carbon steel, that shall impair its resistance to corrosion.
 - 2. Approved methods of cutting, grinding and handling shall be used to prevent contamination. If air-arc, or carbon-arc cutting is used, additional metal shall be removed by approved mechanical means so as to provide clean, weldable edges. All grinding of stainless steel shall be performed with aluminum oxide or silicon carbide grinding wheels bonded with resin or rubber. Grinding wheels used on carbon steel shall not be used on stainless steel.
 - 3. Sand, grinding wheels, brushes and other materials used for cleaning stainless steel shall be checked periodically by the Engineer for contaminants. Cleaning aids found to contain contaminants shall not be used on the work.

3.05 INSTALLATION

- A. All stainless steel fabrications shall be erected square, plumb and true, accurately fitted, adequately anchored in place, set at proper elevations and positions.
- B. All inserts, anchor bolts and all other miscellaneous work specified in the Detailed Specifications or shown on the Contract Drawings or required for the proper completion of the work, which are embedded in concrete, shall be properly set and securely held in position in the forms before the concrete is placed.
- C. All stainless steel fabrications shall be installed in conformance with details shown on the Contract Drawings or on the approved shop drawings.

-END OF SECTION -

SECTION 09900

PAINTING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Furnish labor, materials, equipment and appliances required for complete execution of Work shown on Drawings and Specified herein.
- B. Section Includes:
 - 1. Paint Materials
 - 2. Shop Painting
 - 3. Field Painting
 - a. Surface Preparation
 - b. Piping and Equipment Identification
 - c. Schedule of Colors
 - d. Work in Confined Spaces
 - e. OSHA Safety Colors

1.02 RELATED SECTIONS

- A. Section 15030 - Piping and Equipment Identification Systems

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of these specifications the Work shall conform to the applicable requirements of the following documents:
 - 1. SSPC - Steel Structures Painting Council
 - a. SSPC-Vis 1 Pictorial Surface Preparation Standards for Painting Steel Structures
 - b. SSPC-SP2 Hand Tool Cleaning
 - c. SSPC-SP3 Power Tool Cleaning
 - d. SSPC-SP5 White Metal Blast Cleaning

- e. SSPC-SP6 Commercial Blast Cleaning
- f. SSPC-SP10 Near-White Metal Blast
- 2. NACE - National Association of Corrosion Engineers
- 3. ASTM D1737 - Test Method for Elongation of Attached Organic Coatings with Cylindrical Mandrel Apparatus
- 4. ASTM B117 - Method of Salt Spray (Fog) Testing
- 5. ASTM D4060 - Test Method for Abrasion Resistance of Organic Coating by the Taber Abraser
- 6. ASTM D3359 - Method for Measuring Adhesion by Tape Test

1.04 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300 - Submittals, submit the following:
 - 1. Manufacturer's literature and Material Safety Data Sheets for each product.
 - 2. Painting schedule identifying surface preparation and paint systems proposed. Cross-reference with Tables 9-1 and 9-2. Provide the name of the paint manufacturer, and name, address, and telephone number of manufacturer's representative who will inspect the work. Submit schedule for approval as soon as possible following the Award of Contract, so approved schedule may be used to identify colors and specify shop paint systems for fabricated items.

1.05 SYSTEM DESCRIPTION

- A. Work shall include surface preparation, paint application, inspection of painted surfaces and corrective action required, protection of adjacent surfaces, cleanup and appurtenant work required for the proper painting of all surfaces to be painted. Surfaces to be painted are designated within the Painting Schedule and may include new and existing piping, miscellaneous metals, equipment, buildings, exterior fiberglass, exposed electrical conduit and appurtenance.
- B. Perform Work in strict accordance with manufacturer's published recommendations and instructions, unless the Engineer stipulates that deviations will be for the benefit of the project.
- C. Paint surfaces which are customarily painted, whether indicated to be painted or not, with painting system applied to similar surfaces, areas and environments, and as approved by Engineer.
- D. Piping and equipment shall receive color coding and identification. Equipment shall be the same color as the piping system.

1.06 QUALITY ASSURANCE

- A. Painting operations shall be accomplished by skilled craftsman and licensed by the state to perform painting work.
- B. Provide a letter indicating that the painting applicator has five years of experience, and 5 references which show previously successful application of the specified or comparable painting systems. Include the name, address, and the telephone number for the Owner of each installation for which the painting applicator provided services.

1.07 STORAGE AND DELIVERY

- A. Bring materials to the job site in the original sealed and labeled containers.
- B. Container label to include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Store paint materials at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

PART 2 -- MATERIALS

2.01 GENERAL INFORMATION

- A. The term "paint" is defined as both paints and coatings including emulsions, enamels, stains, varnishes, sealers, and other coatings whether organic or inorganic and whether used as prime, intermediate, or finish coats.
- B. Purchase paint from an approved manufacturer. Manufacturer shall assign a representative to inspect application of their product both in the shop and field. The manufacturer's representative shall submit a report to the Engineer at the completion the Work identifying products used and verifying that surfaces were properly prepared, products were properly applied, and the paint systems were proper for the exposure and service.
- C. Provide primers and intermediate coats produced by same manufacturer as finish coat. Use only thinners approved by paint manufacturer, and only within manufacturer's recommended limits.
- D. Ensure compatibility of total paint system for each substrate. Test shop primed equipment delivered to the site for compatibility with final paint system. Provide an acceptable barrier coat or totally remove shop applied paint system when incompatible with system specified, and repaint with specified paint system.
- E. Use painting materials suitable for the intended use and recommended by paint manufacturer for the intended use.

- F. Require that personnel perform work in strict accordance with the latest requirements of OSHA Safety and Health Standards for construction. Meet or exceed requirements of regulatory agencies having jurisdiction and the manufacturer's published instructions and recommendations. Maintain a copy of all Material Safety Data Sheets at the job site of each product being used prior to commencement of work. Provide and require that personnel use protective and safety equipment in or about the project site. Provide respiratory devices, eye and face protection, ventilation, ear protection, illumination and other safety devices required to provide a safe work environment.

2.02 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Specifications, provide products from one of the following manufacturers:
 - 1. Tnemec Company Inc.
 - 2. Ameron
 - 3. CARBOLINE
 - 4. Sherwin-Williams

PART 3 -- EXECUTION

3.01 SHOP PAINTING

- A. Shop prime fabricated steel and equipment with at least one shop coat of prime paint compatible with finish paint system specified. Prepare surface to be shop painted in strict accordance with paint manufacturer's recommendations and as specified. Finish coats may be shop applied, if approved by the Engineer. Package, store and protect shop painted items until they are incorporated into Work. Repair painted surfaces damaged during handling, transporting, storage, or installation to provide a painting system equal to the original painting received at the shop.
- B. Identify surface preparation and shop paints on Shop Drawings. Verify compatibility with field applied paints.

3.02 SURFACE PREPARATION

- A. General
 - 1. Surfaces to be painted shall be clean and dry, and free of dust, rust, scale, and foreign matter. No solvent cleaning, power or hand tool cleaning shall be permitted unless approved by the Engineer.
 - 2. Protect or remove, during painting operations, hardware, accessories, machined surfaces, nameplates, lighting fixtures, and similar items not intended to be painted prior to cleaning and painting. Reposition items removed upon completion of painting operations.

3. Examine surfaces to be coated to determine that surfaces are suitable for specified surface preparation and painting. Report to Engineer surfaces found to be unsuitable in writing. Do not start surface preparation until unsuitable surfaces have been corrected. Starting surface preparation precludes subsequent claim that such surfaces were unsuitable for the specified surface preparation or painting.
4. Surface preparation shall be in accordance with specifications and manufacturer's recommendations. Provide additional surface preparation, and fill coats where manufacturer recommends additional surface preparation, in addition to requirements of specification.
5. Touch-up shop or field applied coatings damaged by surface preparation or any other activity, with the same shop or field applied coating; even to the extent of applying an entire coat when required to correct damage prior to application of the next coating. Touch-up coats are in addition to the specified applied systems, and not considered a field coat.
6. Protect motors and other equipment during blasting operation to ensure blasting material is not blown into motors or other equipment. Inspect motors and other equipment after blasting operations and certify that no damage occurred, or where damage occurred, the proper remedial action was taken.
7. Field paint shop painted equipment in compliance with Color Coding and as approved by Engineer.

B. Metal Surface Preparation

1. Conform to current Steel Structures Painting Council (SSPC) Specifications for metal surface preparation. Use SSPC-Vis-1 pictorial standards or NACE visual standards TM-01-70 or TM-01-75 to determine cleanliness of abrasive blast cleaned steel.
2. Perform blast cleaning operations for metal when following conditions exist:
 - a. Moisture is not present on the surface.
 - b. Relative humidity is below 80%.
 - c. Ambient and surface temperatures are 5°F or greater than the dew point temperature.
 - d. Painting or drying of paint is not being performed in the area.
 - e. Equipment is in good operating condition.
 - f. Proper ventilation, illumination, and other safety procedures and equipment are being provided and followed.
3. Sandblast ferrous metals to be shop primed, or component mechanical equipment in accordance with SSPC-SP5, White Metal Blast.

4. Sandblast field prepared ferrous metals in accordance with SSPC-SP10, Near White Metal Blast, where metal is to be submerged, in a corrosive environment, or in severe service.
5. Sandblast field prepared ferrous metals in accordance with SSPC-SP6 Commercial Blast, where metal is to be used in mild or moderate service, or non-corrosive environment.
6. Clean nonferrous metals, copper, or galvanized metal surfaces in accordance to SSPC-SP1, Solvent Cleaning, or give one coat of metal passivator or metal conditioner compatible with the complete paint system.
7. Prime cleaned metals immediately after cleaning to prevent rusting.
8. Clean rusted metals down to bright metal by sandblasting and immediately field primed.

C. Concrete Surface Preparation

1. Cure concrete a minimum of 30 days before surface preparation, and painting begins.
2. Test concrete for moisture content using test method recommended by the paint manufacturer. Do not begin surface preparation, or painting until moisture content is acceptable to manufacturer.
3. Brush-off blast (Reference ASTM D 4259) concrete to remove contaminants, open bugholes, surface voids, air pockets, and other subsurface irregularities. Do not expose underlying aggregate. Use dry, oil-free air for blasting operations. Surface texture after blasting shall be similar to that of medium grit sandpaper. Remove residual abrasives, dust, and loose particles by vacuuming or blowing with high pressure air.
4. Acid etch (Reference ASTM D 260) concrete floors to receive paint. Following method is a minimum requirement. Remove residual dust and dirt. Wet surface of concrete until surface is damp. Etch surface with 15% to 20% muriatic acid solution to produce a "medium sandpaper" texture. Do not allow acid solution to dry on concrete. Rinse concrete when bubbling action of the acid begins to subside. Continue rinsing process until pH is 7 or higher. Remove excess water and allow concrete to thoroughly dry before coating. Other methods may be used, if approved by Engineer.
5. Surface defects, such as hollow areas, bugholes, honeycombs, and voids shall be filled with polymeric filler compatible with painting system. Complete fill coats may be used in addition to specified painting system and as approved by the Engineer. Fins, form marks, and all protrusions or rough edges shall be removed.
6. Repair existing concrete surfaces which are deteriorated to the point that surface preparation exposes aggregate with fill coats or patching mortar as recommended by paint manufacturer and as directed by the Engineer.

7. Clean concrete of all dust, form oils, curing compounds, oil, tar, laitance, efflorescence, loose mortar, and other foreign materials before paints are applied.

D. Wood

1. Clean wood surfaces free of all foreign matter, with cracks and nail holes and other defects properly filled and smoothed. Remove sap and resin by scraping and wipe clean with rags dampened with mineral spirits.
2. Saturate end grain, cut wood, knots, and pitch pockets with an appropriate sealer before priming.
3. Prime and backprime wood trim before setting in place.
4. After prime coat has dried, fill nailholes, cracks, open joints, and other small holes with approved spackling putty. Lightly sand wood trim prior to applying second coat of paint.

E. Castings

1. Prepare castings for painting by applying a brush or a knife-applied filler. Fillers are not to be used to conceal cracks, gasholes, or excessive porosity.
2. Apply one coat of primer with a minimum thickness of 1.2 mils in addition to coats specified. Allow sufficient drying time before further handling.

F. Masonry

1. Cure for a minimum of 30 days prior to paint application.
2. Clean masonry surfaces free from all dust, dirt, oil, grease, loose mortar, chalky deposits, efflorescence, and other foreign materials.
3. Test masonry for moisture content. Use test method recommended by paint manufacturer. Do not begin painting until moisture content is acceptable to manufacturer.

G. Gypsum Drywall

1. Sand joint compound with sandpaper to provide a smooth flat surface. Avoid sanding of adjacent drywall paper.
2. Remove dust, dirt, and other contaminants.

H. Previously-Painted Surfaces

1. Totally remove existing paint when: surface is to be submerged in a severe environment, paint is less than 75% intact, brittle, eroded or has underfilm rusting.
2. Surfaces which are greater than 75% intact require removal of failed paints and then spot primed. Spot priming is in addition to coats specified.

3. Remove surface contamination such as oil, grease, loose paint, mill scale, dirt, foreign matter, rust, mold, mildew, mortar, efflorescence, and sealers.
4. Clean and dull glossy surfaces prior to painting in accordance with the manufacturer's recommendations.
5. Check existing paints for compatibility with new paint system. If incompatible, totally remove existing paint system or apply a barrier coat recommended by the paint manufacturer. Remove existing paints of undetermined origin. Prepare a test patch of approximately 3 square feet over existing paint. Allow test patch to dry thoroughly and test for adhesion. If proper adhesion is not achieved remove existing paint and repaint.

3.03 APPLICATION OF PAINT

- A. Apply paint by experienced painters with brushes or other applicators approved by the Engineer, and paint manufacturer.
- B. Apply paint without runs, sags, thin spots, or unacceptable marks.
- C. Apply at rate specified by the manufacturer to achieve at least the minimum dry mil thickness specified. Apply additional coats, if necessary, to obtain thickness.
- D. Special attention shall be given to nuts, bolts, edges, angles, flanges, etc., where insufficient film thicknesses are likely. Stripe paint prior to applying prime coat. Stripe painting shall be in addition to coats specified.
- E. Perform thinning in strict accordance with the manufacturer's instructions, and with the full knowledge and approval of the Engineer and paint manufacturer.
- F. Allow paint to dry a minimum of twenty-four hours between application of any two coats of paint on a particular surface, unless shorter time periods are a requirement by the manufacturer. Longer drying times may be required for abnormal conditions as defined by the Engineer and paint manufacturer. Do not exceed manufacturer's recommended drying time between coats.
- G. Suspend painting when any of the following conditions exist:
 1. Rainy or excessively damp weather.
 2. Relative humidity exceeds 85%.
 3. General air temperature cannot be maintained at 50°F or above through the drying period, except on approval by the Engineer and paint manufacturer.
 4. Relative humidity will exceed 85% or air temperature will drop below 40°F within 18 hours after application of paint.
 5. Surface temperature of item is within 5 degrees of dewpoint.

6. Dew or moisture condensation are anticipated.
7. Surface temperature exceeds the manufacturer's recommendations.

3.04 INSPECTION

- A. Each field coat of paint will be inspected and approved by the Engineer or his authorized representative before succeeding coat is applied. Tint successive coats so that no two coats for a given surface are exactly the same color. Tick-mark surfaces to receive black paint in white between coats.
- B. Use magnetic dry film thickness gauges and wet film thickness gauges for quality control. Furnish magnetic dry film thickness gauge for use by the Engineer.
- C. Coatings shall pass a holiday detector test.
- D. Determination of Film Thickness: Randomly selected areas, each of at least 107.5 contiguous square feet, totaling at least 5% of the entire control area shall be tested. Within this area, at least 5 squares, each of 7.75 square inches, shall be randomly selected. Three readings shall be taken in each square, from which the mean film thickness shall be calculated. No more than 20 percent of the mean film thickness measurements shall be below the specified thickness. No single measurement shall be below 80 percent of the specified film thickness. Total dry film thickness greater than twice the specified film thickness shall not be acceptable. Areas where the measured dry film thickness exceeds twice that specified shall be completely redone unless otherwise approved by the Engineer. When measured dry film thickness is less than that specified additional coats shall be applied as required.
- E. Holiday Testing: Holiday test painted ferrous metal surfaces which will be submerged in water or other liquids, or surfaces which are enclosed in a vapor space in such structures. Mark areas which contain holidays. Repair or repaint in accordance with paint manufacturer's printed instructions and retest.
 1. Dry Film Thickness Exceeding 20 Mils: For surfaces having a total dry film thickness exceeding 20 mils: Pulse-type holiday detector such as Tinker & Razor Model AP-W, D.E. Stearns Co. Model 14/20, 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. Dry Film Thickness of 20 Mils or Less: For surfaces having a total dry film thickness of 20 mils or less: Tinker & Razor Model M1 non-destructive type holiday detector, K-D Bird Dog, 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-Flow, shall be added to the water prior to wetting the detector sponge.
- F. Paint manufacturer or his representative shall provide their services as required by the Engineer. Services shall include, but not be limited to, inspecting existing paint, determination of best means of surface preparation, inspection of completed work, and final inspection of painted work 11 months after the job is completed.

3.05 PROTECTION OF ADJACENT PAINT AND FINISHED SURFACES

- A. Use covers, masking tape, other method when protection is necessary, or requested by Owner or Engineer. Remove unwanted paint carefully without damage to finished paint or surface. If damage does occur, repair the entire surface adjacent to and including the damaged area without visible lapmarks and without additional cost to the Owner.
- B. Take all necessary precautions to contain dispersion of sandblasting debris and paint to the limits of the work. Take into account the effect of wind and other factors which may cause dispersion of the sandblasting debris and paint. Suspend painting operations when sanding debris or paint cannot be properly confined. Assume all responsibilities and cost associated with damage to adjacent structures, vehicles, or surfaces caused by the surface preparation and painting operations.

3.06 PIPING AND EQUIPMENT IDENTIFICATION

- A. Piping and equipment identification shall be in accordance with Section 15030, Piping and Equipment Identification Systems.

3.07 SCHEDULE OF COLORS

- A. Match colors indicated. Piping and equipment colors are indicated in Section 15030. Colors which are not indicated shall be selected from the manufacturer's full range of colors by the Engineer. No variation shall be made in colors without the Engineer's approval. Color names and numbers shall be identified according to the appropriate color chart issued by the manufacturer of the particular product in question.

3.08 WORK IN CONFINED SPACES

- A. Provide and maintain safe working conditions for all employees. Supply fresh air continuously to confined spaces through the combined use of existing openings, forced-draft fans and temporary ducts to the outside, or direct air supply to individual workers. Exhaust paint fumes to the outside from the lowest level in the contained space. Provide explosion-proof electrical fans, if in contact with fumes. No smoking or open fires will be permitted in, or near, confined spaces where painting is being done. Follow OSHA, state and local regulations at all times.

3.09 OSHA SAFETY COLORS

- A. Paint wall around wall-mounted breathing or fire apparatus with the appropriate safety red color; area not exceed 2-feet wide by 3-feet high, unless apparatus covers the area. Fire apparatus include fire hoses, extinguisher, and hydrants.
- B. Paint hazardous areas and objects in accordance with OSHA regulations.

TABLE 9-1
PAINING SCHEDULE

SURFACE	APPLICATION	PAINTING SYSTEM & NO. OF COATS	PRODUCT REFERENCE (TABLE 9.2)	TOTAL MIN. DRY FILM THICKNESS (MILS)
<u>Metals</u>				
Interior and exterior nonsubmerged (gloss)	All new blowers, pumps, motors and mechanical equipment, piping, etc.	1 coat epoxy polyamide primer	104	4-6
		1 coat epoxy polyamide	102	4-6
		1 coat aliphatic polyurethane	115	3-5
Interior insulated		1 coat acrylic latex	103	4
Submerged water	All metal piping, and mechanical equipment, etc.	2 coats NSF approved epoxy polyamide	105	4-6/coat
Submerged Wastewater		2 coats high solids epoxy	119	8-10/coat
Steel doors, windows and door frames, steel stairs, monorails, structural steel, misc. metals (steel)		1 coat epoxy polyamide	102	5-8
		1 coat aliphatic polyurethane	115	3-4
Aluminum surfaces in contact with concrete		2 coats coal tar	107	26
Other PVC Piping		1 coat epoxy polyamide	102	5-8
		1 coat aliphatic polyurethane	115	3-4

TABLE 9-2
PRODUCT LISTING

REF.	SYSTEM	PURPOSE	PRODUCT			
			<u>Tnemec Series</u>	<u>AMERON</u>	<u>CARBOLINE</u>	<u>Sherwin-Williams</u>
101	Epoxy filler	Primer-sealer	130-6601	AMERCOAT 147	Sanitile 100	Cement-Plex 875
102	Epoxy polyamide	Finish coat semi-gloss or gloss	66	AMERCOAT 385	Carboline 890	Macropoxy 646
103	Acrylic latex	Sealer	6	AMERGUARD 220	Carboline 335DTM	DTM Acrylic Primer/Finish
104	Epoxy Polyamide – metal	Primer	66	AMERCOAT 385	Carboline 893SG	Macropoxy 646
105	Epoxy	Primer/Finish	20	--	Carboguard 561/56LT	Macropoxy 646 NSF
106	Coal tar epoxy	Finish high-coat build	46H-413	AMERCOAT 78HB	Bitumastic 300M	Hi-Mil Sher Tar Epoxy
107	Coal tar	Sealer	46-465	AMERCOAT 78HB	Bitumastic 300M	Hi-Mil Sher Tar Epoxy
108	Alkyd-medium oil	Finish coat	2H	AMERCOAT 5401 HS	Carbocoat 139	Industrial Enamel
109	Alkyd-long oil	Finish coat	23	AMERCOAT 5401 HS	Carbocoat 139	Industrial Enamel
110	Epoxy polyamide	Primer	66-1211	AMERCOAT 385	Carboguard 893SG	Macropoxy 646
112	Epoxy polyamide	Sealer	66-1211	AMERCOAT 385	Carboguard 893SG	Macropoxy 920 Pre-Prime
113	Urethane	Barrier coat	530	--	Rustbond	--
114	Polyamine Epoxy	Intermediate coat	27	--	Carboguard 893SG	--
115	Aliphatic Polyurethane	Finish coat	1074 or 1075	AMERCOAT 450 HS	Carbothane 134HB	Acrolon 218HS
116	Acrylic epoxy	Finish coat	113 or 114	AMERCOAT 335	Sanitile 255	Water-Based Catalyzed Epoxy
117	Epoxy block filler	Sealer	54-562	AMERLOCK 400 BF	Sanitile 600	Cement Plex 875
118	Catalyzed epoxy	Finish coat	84	AMERCOAT 320	Carboline 890	Macropoxy 646
119	High solids epoxy	Finish coat	104	AMERLOCK 400	Carboline 890	Tank Clad HS
120	Epoxy	Top coat	N69	--	Carboline 890	--

- END OF SECTION -

SECTION 11000

EQUIPMENT GENERAL PROVISIONS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, test, and place in acceptable operation all mechanical equipment and all necessary accessories as specified herein, as shown on the Drawings, and as required for a complete and operable system.
- B. The mechanical equipment shall be provided complete with all accessories, special tools, spare parts, mountings, and other appurtenances as specified, and as may be required for a complete and operating installation.
- C. It is the intent of these Specifications that the Contractor shall provide the Owner complete and operational equipment/systems. To this end, it is the responsibility of the Contractor to coordinate all interfaces with related mechanical, structural, electrical, instrumentation and control work and to provide necessary ancillary items such as controls, wiring, etc., to make each piece of equipment operational as intended by the Specifications.
- D. The complete installation shall be free from excessive vibration, cavitation, noise, and oil or water leaks.
- E. The requirements of this section shall apply to equipment furnished under Divisions 11, 13, 14, and 15.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. All equipment, materials, and installations shall conform to the requirements of the most recent editions with latest revisions, supplements, and amendments of the specifications, codes, and standards listed in Section 01090, Reference Standards.

1.03 PERFORMANCE AFFIDAVITS

- A. When required in the individual equipment Specifications, the Contractor shall submit manufacturer's Performance Affidavits for equipment to be furnished.
- B. By these affidavits, each manufacturer must certify to the Contractor and the Owner, jointly, that he has examined the Contract Documents and that the equipment, apparatus, or process he offers to furnish will meet in every way the performance requirements set forth or implied in the Contract Documents.
- C. The Contractor must transmit to the Engineer three (3) original copies of the affidavit given him by the manufacturer or supplier along with the initial Shop Drawing submittals.

- D. The Performance Affidavit must be signed by an officer of the basic corporation, partnership, or company manufacturing the equipment and witnessed by a notary public.

slip at full load; running, full load, and locked rotor current values; and safe running time-current curves.

11. Equipment and motor protective device details. Connection diagrams for motor and all protective devices.
12. Equipment shop coating systems, interior and exterior.
13. Panel layout drawings, schematic wiring diagrams, and component product data sheets for control panels.
14. A list of spare parts and special tools to be provided.
15. Any additional information required to show conformance with the equipment specifications.
16. Warranty documentation including statement of duration of warranty period and contact phone numbers and addresses for warranty issues.

B. SHOP DRAWINGS ON ITEMS REQUIRING PERFORMANCE AFFIDAVITS WILL NOT BE REVIEWED UNTIL ACCEPTABLE PERFORMANCE AFFIDAVITS ARE RECEIVED.

1.05 OPERATION AND MAINTENANCE INSTRUCTION/MANUALS

- A. Operation and Maintenance (O&M) manuals shall be submitted in accordance with Section 01300, Submittals.
- B. O&M manuals shall include instructions, equipment ratings, technical bulletins, and any other printed matter such as wiring diagrams and schematics, prints or drawings, containing full information required for the proper operation, maintenance, and repair of the equipment. Included in this submission shall be a spare parts diagram, complete spare parts list, bill of materials, OEM part numbers and manufacturer's catalog information of all equipment components.
- C. Each set of instructions shall be bound together in appropriate three-ring binders with a detailed Table of Contents..
- D. Written operation and maintenance instructions shall be required for all equipment items supplied for this project. The amount of detail shall be commensurate with the complexity of the equipment item.
- E. Information not applicable to the specific piece of equipment installed on this project shall be struck from the submission.
- F. Information provided shall include a source of replacement parts and names of service representatives, including address and telephone number.
- G. Extensive pictorial cuts of equipment are required for operator reference in servicing.

- H. When written instructions include Shop Drawings and other information previously reviewed by the Engineer, only those editions thereof which were approved by the Engineer, and which accurately depict the equipment installed, shall be incorporated in the instructions.

1.06 GENERAL INFORMATION AND DESCRIPTION

- A. All parts of the equipment furnished shall, be designed and constructed for the maximum stresses occurring during fabrication, transportation, installation, testing, and all conditions of operation. All materials shall be new, and both workmanship and materials shall be entirely suitable for the service to which the units are to be subjected and shall conform to all applicable sections of these Specifications.
- B. All parts of duplicate equipment shall be interchangeable without modification. Manufacturer's design shall accommodate all the requirements of these Specifications.
- C. Equipment and appurtenances shall be designed in conformity with ASTM, ASME, AIEE, NEMA, and other generally accepted applicable standards.
- D. All bearings and moving parts shall be adequately protected by bushings or other approved means against wear, and provision shall be made for accessible lubrication by extending lubrication lines and fittings to approximately 30 inches above finished floor elevation.
- E. Details shall be designed for appearance as well as utility. Protruding members, joints, corners, gear covers, etc., shall be finished in appearance. All exposed welds on machinery shall be ground smooth and the corners of structural shapes shall be rounded or chamfered.
- F. Machinery parts shall conform within allowable tolerances to the dimensions shown on the working drawings.
- G. All machinery and equipment shall be safeguarded in accordance with the safety codes of the USA and the State in which the project is located.
- H. All rotating shafts, couplings, or other moving pieces of equipment shall be provided with suitable protective guards of sheet metal or wire mesh, neatly and rigidly supported. Guards shall be removable as required to provide access for repairs.
- I. All equipment greater than 100 pounds shall have lifting lugs, eyebolts, etc., for ease of lifting, without damage or undue stress exerted on its components.
- J. All manufactured items provided under this Section shall be new, of current manufacture, and shall be the products of reputable manufacturers specializing in the manufacture of such products. .

1.07 EQUIPMENT WARRANTIES

- A. Warranty requirements may be added to or modified in the individual equipment specifications.
- B. The equipment furnished under this Contract shall be guaranteed to be free from defects in workmanship, design and/or materials for a period of one (1) year unless otherwise specified in the individual equipment specifications. The period of such warranties shall start on the date the particular equipment is placed in use by the Owner with corresponding start-up certification provided by the manufacturer's technical representative as specified herein, provided that the equipment demonstrates satisfactory performance during the thirty

day operational period after the equipment startup. If the equipment does not perform satisfactorily during the thirty day operational period, the start of the warranty period will be delayed until the equipment demonstrates proper operation. The Equipment Supplier shall repair or replace without charge to the Owner any part of equipment which is defective or showing undue wear within the guarantee period, or replace the equipment with new equipment if the mechanical performance is unsatisfactory; furnishing all parts, materials, labor, etc., necessary to return the equipment to its specified performance level.

- C. The Contractor shall provide an equipment warranty log book prepared specifically for this project and submit two (2) copies of the document to the Engineer prior to final payment. The equipment warranty log book shall include a summary listing of all equipment warranties provided, date received, and start date and end date of warranty period. A copy of each equipment warranty and equipment start-up certification shall also be provided in the document.
- D. The Equipment Supplier shall guarantee to the Owner that all equipment offered under these specifications, or that any process resulting from the use of such equipment in the manner stated is not the subject of patent litigation, and that he has not knowingly offered equipment, the installation or use of which is likely to result in a patent controversy, in which the Owner as user is likely to be made the defendant.

Where patent infringements are likely to occur, each Equipment Supplier shall submit, as a part of his bid, license arrangements between himself, or the manufacturer of the equipment offered, and the patent owner or the controller of the patent, which will permit the use in the specified manner of such mechanical equipment as he may be bidding.

Each Equipment Supplier, by submitting his bid, agrees to hold and save the Owner and Engineer or its officers, agents, servants, and employees harmless from liability of any nature or kind, including cost and expenses for, or on account of, any patented or unpatented invention, process, article, or appliance manufactured or used in the performance of the work under this contract, including the use of the same by the Owner.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. The materials covered by these Specifications are intended to be equipment of proven reliability, and as manufactured by reputable manufacturers having experience in the production of such equipment. The Contractor shall, upon request of the Engineer, furnish the names of not less than 5 successful installations of the manufacturer's equipment of the same size and model of that offered under this contract. The equipment furnished shall be designed, constructed, and installed in accordance with the industry accepted practices and shall operate satisfactorily when installed as shown on the Drawings and operated per manufacturer's recommendations.

2.02 ANCHORS AND SUPPORTS

- A. The Contractor shall furnish, install, and protect all necessary guides, bearing plates, anchor and attachment bolts, and all other appurtenances required for the installation of the devices

included in the equipment specified. Working Drawings for installation shall be furnished by the equipment manufacturer, and suitable templates shall be used by the Contractor when required in the detailed equipment Specifications.

- B. Anchor bolts and fasteners shall be furnished in accordance with Section 05050, Metal Fastening, and with the individual equipment Specifications. All anchor bolts shall be a minimum of 1/2-inch diameter. All anchor bolts, handrail bolts, washers, clips, clamps, and fasteners of any type shall be constructed of 316 stainless steel, unless otherwise specified the individual equipment Specifications.
- C. The Contractor shall provide all concrete pads or pedestals required for equipment furnished. All concrete equipment pads shall be a minimum of 6" high, unless otherwise shown on the Drawings and shall be doweled.
- D. Pipe sleeves or other means of adjusting anchor bolts shall be provided where indicated or required. Equipment shall be leveled by first using sitting nuts on the anchor bolts, and then filling the space between the equipment base and concrete pedestal with non-shrink grout, unless alternate methods are recommended by the manufacturer and are acceptable to the Engineer (such as shim leveling pumps, or chemical grout).

2.03 STRUCTURAL STEEL

- A. Structural steel used for fabricating equipment shall conform to the requirements of Section 05120, Structural Steel.
- B. All materials shall conform to applicable provisions of the AISC Specifications for the design and fabrication of structural steel, and to pertinent ASTM Standard Specifications.

2.04 DISSIMILAR METALS

- A. All dissimilar metals shall be properly isolated to the satisfaction of the Engineer.

2.05 GALVANIZING

- A. Where required by the equipment specifications, galvanizing shall be performed in accordance with Section 05035, Galvanizing.

2.06 STANDARDIZATION OF GREASE FITTINGS

- A. The grease fittings on all mechanical equipment shall be such that they can be serviced with a single type of grease gun. Fittings shall be "Zerk" type.

2.07 ELECTRICAL REQUIREMENTS

- A. All electrical equipment and appurtenances, including but not limited to motors, panels, conduit and wiring, etc., specified in the equipment specifications shall comply with the applicable requirements of the Division 16 specifications and the latest National Electric Code.

- B. Motors shall conform to the applicable requirements of Section 15170, Electric Motors. Medium voltage motors shall conform to the applicable requirements of Section 15171, Medium Voltage Electric Motors.
- C. In the individual equipment specifications, specified motor horsepower is intended to be the minimum size motor to be provided. If a larger motor is required to meet the specified operating conditions and performance requirements, the Contractor shall furnish the larger sized motor and shall upgrade the electrical service (conduit, wires, starters, etc.) at no additional cost to the Owner.
- D. Where variable frequency drives (VFDs) are specified, the Contractor shall be responsible for coordinating between equipment supplier and VFD supplier to ensure a complete and operational system. VFDs shall be furnished under Division 16 and shall be as specified in Section 16495, Variable Frequency Drive Systems.
- E. Motor starters and controls shall be furnished and installed under Division 16 and Division 17 unless otherwise specified in the individual pump specifications.

2.08 ACCESSORIES, SPARE PARTS, AND SPECIAL TOOLS

- A. Spare parts for equipment shall be furnished where indicated in the equipment Specifications or where recommended by the equipment manufacturer.
- B. Spare parts shall be identical and interchangeable with original parts.
- C. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.
- D. Painting requirements for spare parts shall be identical to those for original, installed parts. Where no painting or protective coating is specified, suitable provisions shall be made to protect against corrosion.
- E. Spare parts shall be delivered at the same time as the equipment to which they pertain. Spare parts shall be stored separately in a locked area, maintained by the Contractor, and shall be turned over to the Owner in a group prior to substantial completion. All of these materials shall be properly packed, labeled, and stored where directed by the Owner and Engineer.
- F. The Contractor shall furnish all special tools necessary to operate, disassemble, service, repair, and adjust the equipment in accordance with the manufacturers operation and maintenance manual.
- G. The Contractor shall furnish a one year supply of all recommended lubricating oils and greases. The manufacturer shall submit a list of at least four manufacturer's standard lubricants which may be used interchangeably for each type of lubricant required. All of these materials shall be properly packed, labeled and stored where directed by the Engineer.

2.09 EQUIPMENT IDENTIFICATION

- A. All mechanical equipment shall be provided with a substantial stainless steel nameplate, mechanically fastened with stainless steel hardware in a conspicuous place, and clearly inscribed with the manufacturer's name, year of manufacture, serial number, and principal rating data.
- B. Each pump and other piece of mechanical equipment shall also be identified as to name and number by a suitable laminated plastic or stainless steel nameplate mechanically fastened with stainless steel hardware; for example, "Raw Water Pump #1". Coordinate name and number with same on remotely located controls, control panel, and other related equipment.
- C. Nameplates shall not be painted over.

PART 3 -- EXECUTION

3.01 SHOP TESTING

- A. All equipment shall be tested in the shop of the manufacturer in a manner which shall conclusively prove that its characteristics comply fully with the requirements of the Contract Documents and that it will operate in the manner specified or implied.
- B. No equipment shall be shipped to the project until the Engineer has been furnished a certified copy of test results and has notified the Contractor, in writing, that the results of such tests are acceptable.
- C. Five (5) certified copies of the manufacturer's actual test data and interpreted results thereof shall be forwarded to the Engineer for review.
- D. If required by the individual equipment Specifications, arrangements shall be made for the Owner/Engineer to witness performance tests in the manufacturer's shop. The Engineer shall be notified ten working days before shop testing commences. Expenses are to be paid by Contractor.
- E. Shop testing of electric motors shall be in accordance with applicable requirements of Section 15170, Electric Motors; Section 15171, Medium Voltage Electric Motors, and Section 16000, Basic Electrical Requirements.

3.02 STORAGE OF EQUIPMENT AND MATERIALS

- A. Contractor shall store his equipment and materials at the job site in strict accordance with the manufacturer's recommendations and as directed by the Owner or Engineer, and in conformity to applicable statutes, ordinances, regulations, and rulings of the public authority having jurisdiction. Equipment and materials shall not be delivered to the site prior to 90 days in advance of the scheduled installation. Partial payment requests will not be processed for materials delivered prior to 90 days before installation or for materials that are not properly stored.
- B. Material or equipment stored on the job site is stored at the Contractor's risk. Any damage sustained of whatever nature shall be repaired to the Engineer's satisfaction at no expense

to the Owner. Stored electrical equipment is to be protected from the elements and shall have space heaters energized.

- C. Contractor shall not store unnecessary materials or equipment on the job site and shall take care to prevent any structure from being loaded with a weight which will endanger its security or the safety of persons.
- D. Contractor shall observe all regulatory signs for loadings on structures, fire safety, and smoking areas.
- E. Contractor shall not store materials or encroach upon private property without the written consent of the owners of such private property.

3.03 MANUFACTURER'S FIELD SERVICES

- A. The Contractor shall arrange for a qualified Technical Representative from each manufacturer or supplier of equipment who is regularly involved in the inspection, installation, start-up, troubleshooting, testing, maintenance, and operation of the specified equipment. Qualification of the Technical Representative shall be appropriate to the type of equipment furnished and subject to the approval of the Engineer and the Owner. Where equipment furnished has significant process complexity, furnish the services of engineering personnel knowledgeable in the process involved and the function of the equipment. When necessary, the Contractor shall schedule multiple Technical Representatives to be present at the same time for the purpose of coordinating the operation of multiple pieces of related equipment.
- B. For each site visit, the Technical Representative shall submit jointly to the Owner, the Engineer, and the Contractor a complete signed report of the results of his inspection, operation, adjustments, and testing. The report shall include detailed descriptions of the points inspected, tests and adjustments made, quantitative results obtained if such are specified.
- C. The manufacturer's Technical Representative shall provide the following services.
 - 1. Installation: The Technical Representative shall inspect the installed equipment to verify that installation is in accordance with the manufacturer's requirements. Where required by individual equipment specifications, the Technical Representative shall also supervise the installation of the equipment.
 - 2. Testing: After installation of the equipment has been completed and the equipment is presumably ready for operation, but before it is operated by others, the Technical Representative shall inspect, operate, test, and adjust the equipment as required to prove that the equipment is in proper condition for satisfactory operation under the conditions specified. Unless otherwise noted in the signed site visit report, the report shall constitute a certification that the equipment conforms to the requirements of the Contract and is ready for startup and that nothing in the installation will render the manufacturer's warranty null and void. The report shall include date of final acceptance field test, as well as a listing of all persons present during tests.

3. Startup: The Technical Representative shall start up the equipment for actual service with the help of the Contractor. In the event that equipment or installation problems are experienced, the Contractor and the representative shall provide the necessary services until the equipment is operating satisfactorily and performing according to the specifications at no additional cost to the Owner. Unless otherwise noted in the signed site visit report, the report shall constitute a certification that the equipment conforms to the requirements of the Contract and is ready for permanent operation and that nothing in the installation will render the manufacturer's warranty null and void.
 4. Training: The Technical Representative shall instruct the Owner's operating personnel in correct operation and maintenance procedures. The instruction shall demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment. Such instruction shall be scheduled at a time arranged with the Owner at least 2 weeks in advance of the training and shall be provided while the respective Technical Representative's equipment is fully operational. The Contractor shall have submitted, and had accepted, the O&M Manuals prior to commencement of training. Training shall be provided to three separate shifts of the Owner's personnel between the hours of 8:00 A.M. and 6:00 P.M. as necessary. The Contractor shall provide professional video taping of all training sessions. Completed, labeled tapes shall be provided to the Owner for each type of training session.
 5. Services after Startup: Where required by the individual equipment specifications, the Technical Representative shall return to the project site thirty (30) days after the start up date to review the equipment performance, correct any equipment problems, and conduct operation and maintenance classes as required by the Owner. This follow-up trip is required in addition to the specified services of Technical Representative prior to and during equipment startup. At this time, if there are no equipment problems, each manufacturer shall certify to the Owner in writing that his equipment is fully operational and capable of meeting operating requirements. If the equipment is operating incorrectly, the Technical Representative will make no certification to the Owner until the problems are corrected and the equipment demonstrates a successful thirty (30) days operating period.
- D. Services of the Technical Representative will require a minimum of two (2) site visits, one for installation and testing and one for startup and training, and will be for the minimum number of days recommended by the manufacturer and approved by the Engineer but will not be less than the number of days specified in individual equipment sections.
 - E. The Contract amount shall include the cost of furnishing the Technical Representative for the minimum number of days specified, and any additional time required to achieve successful installation and operation. The times specified for services by the Technical Representative in the equipment Specifications are exclusive of travel time to and from the facility and shall not be construed as to relieve the manufacturer of any additional visits to provide sufficient service to place the equipment in satisfactory operation.
 - F. The Contractor shall notify the Engineer at least 14 days in advance of each equipment test or Owner training session.

- G. The Technical Representative shall sign in and out at the office of the Engineer's Resident Project Representative on each day he is at the project.

3.04 INSTALLATION

- A. The Contractor shall obtain written installation manuals from the equipment manufacturer prior to installation. Equipment shall be installed strictly in accordance with recommendations of the manufacturer. A copy of all installation instructions shall be furnished the Engineer's field representative one week prior to installation.
- B. The Contractor shall have on hand sufficient personnel, proper construction equipment, and machinery of ample capacity to facilitate the work and to handle all emergencies normally encountered in work of this character. To minimize field erection problems, mechanical units shall be factory-assembled insofar as practical.
- C. Equipment shall be erected in a neat and workmanlike manner on the foundations at the locations and elevations shown on the Drawings.
- D. All equipment sections and loose items shall be match-marked prior to shipping.
- E. For equipment such as pumping units, which require field alignment and connections, the Contractor shall provide the services of the manufacturer's qualified mechanic, millwright, or machinist, to align the pump and motor prior to making piping connections or anchoring the pump base. Alignment shall be as specified herein.
- F. The Contractor shall furnish oil and grease for initial operation and testing. The manufacturer and grades of oil and grease shall be in accordance with the recommendations of the equipment manufacturer.

3.05 ALIGNMENT

- A. Set equipment to dimensions shown on drawings. Dimensions shall be accurate to +/- 1/16 inch unless otherwise noted on the drawings. Wedges shall not be used for leveling, aligning, or supporting equipment.
- B. General Equipment Leveling: Non-rotating equipment shall be set level to +/- 1/16 inch per 10 foot length (.005 inch per foot) unless otherwise noted on the drawings. Shims shall be used unless equipment is furnished with leveling feet. Set shims flush with equipment baseplate edges. When grouting is required, equipment shall be shimmed to allow a minimum of one inch grout thickness. Grout shall cover shims at least 3 inches. Final level check shall be held for inspection and approval by Engineer before proceeding.
- C. Grouting
 1. Fill anchor bolt holes or sleeves with grout, after bolt alignment is proven, and prior to placing grout under equipment bases.
 2. Surface Preparation. Roughen surface by chipping, removing laitance, and unsound concrete. Clean area of all foreign material such as oil, grease, and scale.

Saturate area with water at least 4 hours prior to grouting, removing excess water ponds.

3. Application. Place grout after the equipment base has been set and its alignment and level have been approved. Form around the base, mix grout, and place in accordance with the grout manufacturers published instructions. Eliminate all air or water pockets beneath the base using a drag chain or rope.
 4. Finishing. Point the edges of the grout to form a smooth 45 degree slope.
 5. After grout has cured (not before 3 days after placement) paint exposed surfaces of grout with shellac.
 6. Level Verification. After grout has cured, and immediately prior to drive alignment, recheck equipment for level and plumb. Re-level and square as necessary. Hold final checks for inspection and approval by Engineer.
- D. Inspect for and remove all machining burrs or thread pulls in female holes on mating surfaces of mounting frame and machine feet.
- E. Inspect and clean equipment mounting base pads, feet, and frames to remove all grease, rust, paint and dirt.
- F. Assembled equipment shafts shall be set level to .0015 inches per foot of shaft length (+/- .0005 inches) up to a maximum of 0.015 inches for any length shaft unless the manufacturers requirements are more stringent or unless otherwise noted in the equipment specifications. Use the machined surfaces on which the equipment sets for the base/mounting frame leveling plane. Use the machined shaft surface for equipment leveling plane.
- G. Sprocket and Sheave Alignment. Check shaft mounted components for face runout and eccentricity (outside diameter) runout by magnetically mounting a dial indicator on a stationary base and indicating over 360 degrees on a continuous machined surface at the outside diameter of the component. Maximum allowable total indicated face runout and eccentricity for sprockets and sheaves will be per ANSI Standard B29.1-1975.
- H. Belt tensioning. Set drive belt tension to manufacturer's specification for the belt type. Recheck alignment after drive tensioning.
- I. Thermal/Mechanical Growth. Thermal/mechanical growth corrections for driver and driven machines will be used in vertical and horizontal alignment where applicable. The equipment manufacturer will determine thermal/mechanical growth applicability for any machine and provide the correction offsets to be used.
- J. Rotating Shaft Alignment
1. Fixtures will be set up on the driver and driven machine, machines shaft surfaces. Machined coupling hubs may be used only if there is no clearance to mount fixtures directly on the shafts.

2. Primary alignment method for direct drive machines is when coupled. Uncoupled alignment will be used only when approved by the Engineer.
3. Account for possible coupling flex by always rotating coupled machines in the same direction during alignment.
4. Uncoupled machines must be connected so that both shafts turn together without relative motion during alignment.
5. Indicator bar sag will be measured and included for each reverse indicator alignment setup.

6. Reverse Dial Indicator. The final maximum allowable misalignment: vertical and horizontal from the desired targets of .000 inches (for a non-thermal growth machine) or from the given target readings (for a thermal growth machine) must meet BOTH of the following conditions simultaneously: 1/2 the final total indicator reading at each indicator will be no more than shown in the table below AND the final remaining correction at each machine foot be no more than .001 inches of required movement.

Machine Speed (RPM)	Total Misalignment* (inches)
Up to 1800	.002
1800 and greater	.001

* 1/2 indicator reading

3.06 FIELD TESTING

- A. All equipment shall be set, aligned and assembled in conformance with the manufacturer's drawings and instructions. Provide all necessary calibrated instruments to execute performance tests. Submit report certified by the pump manufacturer's representative.
- B. Preliminary Field Tests, Yellow Tag
1. As soon as conditions permit, after the equipment has been secured in its permanent position, the Contractor shall:
 - a. Verify that the equipment is free from defects.
 - b. Check for alignment as specified herein.
 - c. Check for direction of rotation.
 - d. Check motor for no load current draw.
 2. Contractor shall flush all bearings, gear housings, etc., in accordance with the manufacturer's recommendations, to remove any foreign matter accumulated during shipment, storage or erection. Lubricants shall be added as required by the manufacturer's instructions.
 3. When the Contractor has demonstrated to the Engineer that the equipment is ready for operation, a yellow tag will be issued. The tag will be signed by the Engineer, or his assigned representative and attached to the equipment. The tag shall not be removed.
 4. Preliminary field tests, yellow tag, must be completed before equipment is subjected to final field tests, blue tag.
- C. Final Field Tests, Blue Tag

1. Upon completion of the above, and at a time approved by the Engineer, the equipment will be tested by operating it as a unit with all related piping, ducting, electrical and controls, and other ancillary facilities.
 2. The equipment will be placed in continuous operation as prescribed or required and witnessed by the Engineer or his assigned representative and the Owner or his assigned representative.
 3. The tests shall prove that the equipment and appurtenances are properly installed, meet their operating cycles and are free from defects such as overheating, overloading, and undue vibration and noise. Operating field tests shall consist of the following:
 - a. Check equipment for excessive vibration and noise as specified herein.
 - b. Check motor current draw under load conditions. The rated motor nameplate current shall not be exceeded.
 - c. Recheck alignment with dial indicators where applicable, after unit has run under load for a minimum of 24 hours.
- D. In addition to the above described field tests, any other tests specifically required by Section 11100, Pumps-General, the individual equipment Specifications, or by the manufacturer shall be performed.
- E. Until final field tests are acceptable to the Engineer, the Contractor shall make all necessary changes, readjustments and replacements at no additional cost to the Owner.
- F. Upon acceptance of the field tests, a blue tag will be issued. The tag will be signed by the Engineer and attached to the unit. The tag shall not be removed and no further construction work will be performed on the unit, except as required during start-up operations and directed by the Engineer.
- G. Defects which cannot be corrected by installation adjustments will be sufficient grounds for rejection of any equipment.
- H. All costs in connection with field testing of equipment such as lubricants, temporary instruments, labor, equipment, etc., shall be borne by the Contractor. Power, fuel, chemicals, water, etc. normally consumed by specific equipment shall be supplied by the Owner unless otherwise specified in the individual equipment specifications.
- I. The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the Owner formally takes over the operation thereof.
- J. Field testing of electric motors shall be in accordance with Section 15170, Electric Motors; Section 15171, Medium Voltage Electric Motors, and Section 16000, Basic Electrical Requirements.

3.07 VIBRATION TESTING

- A. Unless specified otherwise in the detailed equipment specifications, each pump, blower, compressor, motor or similar item of stationary rotating equipment having a rated power in excess of 40HP shall be tested after installation for acceptable vibration levels.
- B. Vibration testing shall be performed by an experienced factory-trained and authorized third-party analysis expert (not a sales representative) retained by the Contractor and approved by the Engineer. Each unit or pump system shall be tested separately without duplicate equipment running. All field testing shall be done in the presence of the Engineer. The Engineer shall be furnished with four (4) certified copies of vibration test data for each test performed.
- C. For systems with variable speed drives, tests shall be conducted at various speeds between maximum and minimum. For systems with two-speed drives, tests shall be conducted at both speeds. For systems with constant-speed drive, tests shall be conducted under various loading conditions as determined by the Engineer.
- D. All field vibration tests shall be performed with the equipment operating on the product for which it is intended, or a substitute acceptable to the Engineer.
- E. The term displacement, as used herein, shall mean total peak-to-peak movement of vibrating equipment, in mils; velocity or speed of the vibration cycle, measured in G's. Displacement and velocity shall be measured by suitable equipment equal to IRD Mechanalysis, Bentley, Nevada.
- E. Frequency of vibration, in cycles per minute (cpm), shall be determined when vibration exceeds specified levels or as otherwise necessary. Vibration shall be measured on the bearing housing, unless other locations are deemed necessary by the vibration analysis expert and Engineer.
- F. For all equipment tested, vibration shall be checked in the radial and axial directions. Unless otherwise specified elsewhere, axial vibration shall not exceed 0.1 in/sec; and radial vibration shall not exceed 0.2 in/sec. For pumps radial vibration shall not exceed that permitted by the Hydraulic Institute Standards except that, at vibration frequencies in excess of 8,000 cpm, the velocity shall not exceed 0.2 in/sec.
- G. Copies of test results shall be submitted to the Engineer for review. Should the vibration field test results exceed shop test results, the manufacturer's recommendations, or the limits specified herein, the Contractor shall correct the deficiencies within thirty (30) days. After corrections have been completed, the vibration testing shall be re-run and the results re-submitted to the Engineer for review.
- H. Noise or vibration in any rotating equipment which the Engineer judges to be excessive or damaging, shall be cause for rejection.

3.08 FAILURE OF EQUIPMENT TO PERFORM

- A. Any defects in the equipment, or failure to meet the guarantees or performance requirements of the Specifications shall be promptly corrected by the Contractor by replacements or otherwise.
- B. If the Contractor fails to make these corrections, or if the improved equipment shall fail again to meet the guarantees or specified requirements, the Owner, notwithstanding his having made partial payment for work and materials which have entered into the manufacture of said equipment, may reject said equipment and order the Contractor to remove it from the premises at the Contractor's expense.
- C. The Contractor shall then obtain specified equipment to meet the contract requirements or upon mutual agreement with the Owner, adjust the contract price to reflect not supplying the specific equipment item.
- D. In case the Owner rejects said equipment, then the Contractor hereby agrees to repay to the Owner all sums of money paid to him for said rejected equipment on progress certificates or otherwise on account of the lump sum prices herein specified.
- E. Upon receipt of said sums of money, the Owner will execute and deliver to the Contractor a bill of sale of all his rights, title, and interest in and to said rejected equipment; provided, however, that said equipment shall not be removed from the premises until the Owner obtains from other sources other equipment to take the place of that rejected.
- F. Said bill of sale shall not abrogate Owner's right to recover damages for delays, losses, or other conditions arising out of the basic contract.

3.09 PAINTING

- A. All surface preparation, shop painting, field repairs, finish painting, and other pertinent detailed painting specifications shall conform to applicable sections of Section 09900, Painting.
- B. All shop coatings shall be compatible with proposed field coatings.
- C. All inaccessible surfaces of the equipment, which normally require painting, shall be finished painted by the manufacturer. The equipment and motor shall be painted with a high quality epoxy polyamide semi-gloss coating specifically resistant to chemical, solvent, moisture, and acid environmental conditions, unless otherwise specified.
- D. Gears, bearing surfaces, and other unpainted surfaces shall be protected prior to shipment by a heavy covering of rust-preventive compound sprayed or hand applied which shall be maintained until the equipment is placed in operation. This coating shall be easily removable by a solvent.

3.10 WELDING

- A. The Equipment Manufacturer's shop welding procedures, welders, and welding operators shall be qualified and certified in accordance with the requirement of AWS D1.1 "Structural Welding Code - Steel" or AWS D1.2 "Structural Welding Code - Aluminum" of the American Welding Society, as applicable.

- B. The Contractor's welding procedures, welders, and welding operators shall be qualified and certified in accordance with the requirements of AWS D1.1 "Structural Welding Code - Steel" or AWS D1.2 "Structural Welding Code - Aluminum" of the American Welding Society, as applicable.

- C. The Contractor shall perform all field welding in conformance with the information shown on the Equipment Manufacturer's drawings regarding location, type, size, and length of all welds in accordance with "Standard Welding Symbols" AWS A2.0 of the American Welding Society, and special conditions, as shown by notes and details.

- END OF SECTION -

SECTION 11100
PUMPS - GENERAL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, test, and make fully operational all pumping equipment, complete with all necessary accessories, in compliance with the Contract Documents.
- B. All pumping equipment shall be provided in accordance with the requirements of Section 11000, Equipment General Provisions.
- C. The provisions of this section shall apply to all pumps and pumping equipment specified except where specifically noted otherwise in the Contract Documents.
- D. The pumps shall be provided complete with all accessories, shims, sheaves, couplings, and other appurtenances as specified, and as may be required for a complete and operating installation.

1.02 SHOP DRAWINGS

- A. Shop Drawings shall include the following information in addition to the requirements of Section 01300, Submittals and Section 11000, Equipment General Provisions.
 - 1. Details of shaft sealing system
 - 2. Pump performance curves at rated speed and reduced speed (if reduced speeds are specified). Curves shall indicate flow, head, efficiency, brake horsepower, NPSH required, and minimum submergence. Curves shall include limits (minimum and maximum flows) for stable operation without cavitation, overheating, recirculation, or excessive vibration.
 - 3. General cutaway sections, materials, dimension of shaft projections, shaft and keyway dimensions, shaft diameter, dimension between bearings, general dimensions of pump, suction head bolt orientation, and anchor bolt locations and forces.
 - 4. Foundry certificates and results of Brinnell hardness testing showing compliance to ASTM A 532 (where required in the individual pump specifications).
 - 5. Submersible pump submittals shall also include:
 - a. Product data sheets for power and control cables and length of cables.
 - b. Details on pump guide rail system and mounting requirements.

PART 2 -- PRODUCTS

2.01 MATERIALS

- A. All materials employed in the pumping equipment shall be suitable for the intended application. Material not specifically called for shall be high-grade, standard commercial quality, free from all defects and imperfection that might affect the serviceability of the product for the purpose for which it is intended, and shall conform to the following requirements unless otherwise specified in individual pumping equipment Specifications:
 - 1. Cast iron pump casings and bowls shall be of close-grained gray cast iron, conforming to ASTM A 48, or equal.
 - 2. Bronze pump impellers shall conform to ASTM B 584, "G" bronze.
 - 3. Stainless steel pump shafts shall be of Type 400, Series. Miscellaneous stainless steel parts shall be of Type 316.
- B. Suction and discharge flanges shall conform to ANSI standard B16.1 or B16.5 dimensions.
- C. Handholes on pump casings shall be shaped to follow the contours of the casing to avoid any obstructions in the water passage.

2.02 APPURTENANCES

- A. Pressure Gauges
 - 1. The Contractor shall furnish and install pressure gauges on the suction and discharge of each pump, except wet-pit submersible pumps and vertical turbine pumps.
 - 2. The Contractor shall furnish and install pressure gauges on the discharge piping of each wet-pit submersible pump and vertical turbine pump in the locations shown on the Drawings or as directed by the Engineer.
 - 3. Suction gauges shall be of the single scale compound type to indicate both pressure and vacuum. Each suction gauge shall be graduated in feet of water over the span of 34 feet below and above zero.
 - 4. Discharge gauges shall be graduated in feet from zero to a minimum of five (5) feet of water above the respective pump shutoff head or to a minimum of 30% above the maximum operation pressure, whichever is greater. Graduation shall be in feet of water.
 - 5. All gauges shall be supplied by one manufacturer and shall be as specified in Section 17650, Pressure Gauges.
 - 6. All gauges shall be provided with diaphragm seals or isolating ring seals as specified in Section 17698, Instrumentation and Control Accessories.

- B. Flexible couplings for direct driven pumps shall be as manufactured by Falk, Dodge, Woods Corp., or equal and shall be furnished with guards in accordance with OSHA Rules and Regulations. Spacer couplings shall be provided where necessary to allow removal of the pump rotating element without disturbing the driver.

2.02 ELECTRICAL REQUIREMENTS

- A. All pumps shall be furnished with motors such that the motor shall not be overloaded throughout the full range of the pump operation, unless otherwise specifically approved by the Engineer.
- B. Where variable frequency drives (VFDs) are specified, the Contractor shall be responsible for coordinating between pump supplier and VFD supplier to ensure a complete and operational system. VFDs shall be furnished under Division 16 and shall be as specified in Section 16495, Variable Frequency Drive Systems.
- C. Motor starters and controls shall be furnished and installed under Division 16 and Division 17 unless otherwise specified in the individual pump specifications.

2.03 EQUIPMENT IDENTIFICATION

- A. In addition to the requirements of Section 11000, Equipment General Provisions, nameplate data for each pump shall include the rating in gallons per minute, rated head, speed, and efficiency at the primary design point.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Drains: All gland seals, air valves, and drains shall be piped to the nearest floor drain or trench drain with galvanized steel pipe or copper tube, properly supported with brackets.
- B. Solenoid Valves: Where required, the pump manufacturer shall furnish and install solenoid valves on the water or oil lubrication lines. Solenoid valve electrical rating shall be compatible with the motor control voltage and shall be furnished complete with all necessary conduit and wiring installation from control panel to solenoid.

3.02 SHOP TESTING

- A. Shop tests shall be performed in accordance with Section 11000, Equipment General Provisions, and except where stated otherwise herein, shall be conducted in accordance with applicable methods and standards of the American National Standard for Centrifugal Pump Tests by the Hydraulic Institute.
- B. Pump testing shall be witnessed by the Owner/Engineer where specified in the individual pump specifications. The testing procedure shall be submitted to the Engineer for review before scheduling the testing. The Engineer shall be given at least 2 weeks advanced notice of the scheduled testing date.

- C. Certified test curves for shall be provided for all centrifugal pumps unless otherwise specified in the individual pump specifications. Certified tests will not be required for submersible sump pumps (as specified in Sections 11133 and 11136) with motors less than 5 hp
- D. Pumps shall be within the tolerances specified by the Hydraulic Institute Standards with the following exceptions:
 - 1. At design heads, +10% of design capacities or at design capacities, +5% of design heads.
 - 2. No minus tolerances shall be allowed with respect to capacity, head, or efficiency at the design points.
- E. For wet pit submersible pumps and vertical turbine pumps, all tests shall be run at minimum pump submergence specified in the individual pump specifications.
- F. Where required in the individual pump specifications, each individual casting shall be Brinnell tested in a minimum of two places, in an area of representative casting thickness to ASTM Method E-10. Results shall be certified by a registered professional ENGINEER. Test results shall verify the satisfaction of the required Brinnell hardness of the finished product as specified in respective subsections.

3.03 FIELD TESTING

- A. Field tests shall be performed in accordance with in Section 11000, Equipment General Provisions and additionally as specified below and in the individual pump specifications.
- B. Final acceptance tests shall demonstrate the following:
 - 1. The pumps have been properly installed and are in proper alignment.
 - 2. The pumps operate without overheating or overloading of any parts and without objectionable vibration. Vibration shall be within the Hydraulic Institute limits, or manufacturer's limits if more stringent.
 - 3. The pumps can meet the specified operating conditions. All pumps shall be checked at maximum speed for a minimum of four points on the pump curve for capacity, head, and amperage. The rated motor nameplate current shall not be exceeded at any point. Pumps with drive motors rated at less than five horsepower shall only be tested for overcurrent when overheating or other malfunction becomes evident in general testing.

- END OF SECTION -

SECTION 11107

HORIZONTAL NON-CLOG PUMPS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, and place in satisfactory operation horizontal non-clog pumps at the locations shown on the Drawings and as specified herein. All pumps specified herein shall be supplied by the same manufacturer.
- B. Equipment shall be provided in accordance with the requirements of Section 11000, Equipment General Provisions and Section 11100, Pumps - General.

1.02 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

- A. Operating conditions shall be determined by the Proposer.

Pumps No. x – No.

Number of Units				x
Design Capacity (gpm)	xx	xx	xx	xx
Total Dynamic Head (feet)	xx	xx	xx	xx
Maximum Brake Horsepower	xx	xx	xx	xx
Maximum Pump Speed (rpm)				1800
Temperature of Liquid Pumped				Ambient
Suction Condition				Flooded
Minimum Size of Solids (Spherical Diameter, Inches)				3
Minimum Suction Diameter (In.)				xx
Minimum Discharge Diameter (In.)				xx

1.03 SUBMITTALS

- A. The following items shall be submitted with the Shop Drawings in accordance with, or in addition to the submittal requirements specified in Section 01300, Submittals; and Section 11000, Equipment General Provisions:

- 1. Performance Affidavit

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Each pump shall be a horizontal, non-clog, centrifugal pump, similar to the Fairbanks Morse, Aurora, Goulds, or equal.

2.02 MATERIALS

- A. The pump shall be end suction, side discharge construction. The volute shall be provided with a cleanout port to allow for removal of any foreign material blocking or impeding performance of the pump. The unit shall be designed such that the motor may be removed from the pump for independent servicing.
- B. Casing shall be made of close grained cast iron conforming to ASTM A48, Class 25 and 35 or ASTM 278, Class 30, and shall provide smooth unobstructed passages large enough to pass solids of the specified size. A cleanout handhole with removable cover shall be provided for non-clog type pumps. The inner contours of the handhole cover shall match the contours of the casing in which it fits. Casing shall be enclosed by a removable suction and stuffing box cover carefully machined and aligned. Casing shall be designed so that the impeller can be withdrawn without the need to remove the discharge casing or distribute the discharge piping. Suction and discharge connections shall be ANSI Standard flat faced 125 pound flanges, and shall be drilled and tapped for gauge, drain and vent connections or shall be self-venting. The necessary lifting bolts and eye lugs shall be provided for installation and maintenance of the pumps. Tops 1/2 inch diameter for gauge connections shall be provided on all nozzles. Gauges shall be furnished and installed under Section 11100, Pumps - General.
- C. Suction cover shall be constructed of the same material as the casing and shall be integrally cast with 125 pound ANSI standard flange. Cover shall be quickly removable for access to the impeller.
- D. Impeller shall be of the two vane, one piece, single suction, enclosed non-clog type and shall be made from closed-grain cast iron, conforming to ASTM A48, Class 25 and 35, and shall be statically, hydraulically, and dynamically balanced. The impeller shall be designed with smooth flow passages to pass solids of specified size and to prevent clogging by stringy materials. The impeller shall be bolted, keyed and locked to the pump shaft at the factory.
- E. Rotation of pumps shall be clockwise when viewed from the driven end, unless otherwise shown on the Drawings.
- F. Stuffing box cover shall be constructed of cast iron, ASTM A48, Class 25 and 35, and shall be designed with a machined self-centering fit with the pump casing. Stuffing box shall be readily accessible. Tapped holes shall be provided for oil or seal water connection as specified.
- G. [Sealing shall be accomplished by a double mechanical seal. The mechanical seal shall consist of two seals mounted back to back in the stuffing box. The stuffing box shall be pressurized with seal water. The mechanical seal shall consist of ceramic stationary seats, carbon washer, BUNA N or ethylene propylene flexible members, brass or stainless steel metal parts and 18-8 stainless steel spring.]
- H. Shaft shall be Type SAE 1045 steel, minimum, sufficiently large in diameter to transmit safely the maximum torque developed by the drive unit and of such a design as to provide a rigid support for the impeller and to prevent excessive vibration. The shaft shall be suitably heat-treated, turned, ground, and polished over its entire length and shall be protected

through the stuffing box by a removable hardened stainless steel shaft sleeve with seal to prevent leakage.

- I. Shaft sleeve shall be constructed of 420 series stainless steel hardened to 450 Brinell or better or corrosion resistant bronze, and secured to prevent reversal of rotation. An "O" ring seal shall be provided between the shaft and the impeller hub to prevent leakage under the sleeve. The shaft sleeve shall not be threaded.
- J. Bearings shall be of the anti-friction ball or tapered roller type in a dust-proof housing. Bearings shall be oil or grease lubricated with provisions for the addition or draining of lubricant. The bearings shall be designed for continuous heavy duty loads and for both axial and radial thrust loads. Bearings shall have a minimum AFBMA B-10 life of 100,000 hours under worst possible operating conditions. The bearing frame shall be of rigid cast iron construction to support the shaft and the bearings, and shall be designed so that the complete rotating element can be removed from the casing without disconnecting the piping.
- K. Bearing housing shall be constructed of cast iron, ASTM, A48, Class 30 designed to provide a fully enclosed bearing housing incorporating a seal water catch basin with a tapped drain and overflow ports where applicable.
- L. Wearing Rings - Wearing rings shall be of the removable type, of 400 series stainless steel hardened to 450 Brinell. One wearing ring shall be on the impeller and one on the casing.
- M. Wear Adjustment - Rotating assembly shall be readily adjustable by jack screws at the end of the bearing housing so that, as wear occurs, proper impeller-to-suction cover liner clearance can be maintained without dismantling the pump.
- N. Base – The combination pump and motor base shall be a heavy duty fabricated steel open channel base with openings to facilitate grouting.
- O. Coupling - Pump shaft connections to drives shall be directly connected through flexible couplings as manufactured by Falk, Dodge, or equal. Couplings shall be provided with coupling guards.

2.03 ELECTRICAL AND CONTROL REQUIREMENTS

- A. All electrical appurtenances furnished by the equipment manufacturer shall be rated for the location per NFPA 820 and the NEC.
- B. Electrical Requirements

	XXXXX Pumps
Motors	
Rating	460V, 3 ph, 60 Hz
Horsepower	x
Speed, rpm	1800
Enclosure	TEFC
Insulation	Class F
Inverter Duty	x

Service Factor	1.15
Space Heater	Yes
Motor Winding Temperature Switches	Yes
RTDs	xx
Separate Cooling Fan	xx
Motor Differential Current Transformers / Six-Lead External Wye Connection	xx

2.04 SPARE PARTS

- A. Spare parts shall be provided in accordance with Section 11000, Equipment General Provisions and shall include the following for each series of pumps

One (1) - set of wearing rings
 One (1) - shaft sleeve
 One (1) - set of motor and pump bearings
 One (1) - complete mechanical shaft seal assembly
 Two (2) - sets of gaskets and O-ring seals

PART 3 -- EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

- A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 11000, Equipment General Provisions. For each series of pumps, field services shall include the following site visits:

Service	Number of Trips	Number of Days/Trip
Installation and Testing	1	1
Startup and Training	1	1
Services after Startup	1	1

3.02 SHOP TESTING

- A. Shop testing shall be in accordance with Section 11000, Equipment General Provisions.

- END OF SECTION -

SECTION 11170

CHEMICAL METERING PUMPS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Furnish and install chemical metering pumps and accessories at the locations shown on the Drawings and as specified herein.
- B. Two pump types – Type 1 and Type 2 as specified herein. For some applications, only one of the two types is acceptable. These requirements are specified in Part 1.02.
- C. Wiring and signal requirements for each pump type may differ. Contractor shall coordinate wiring requirements for the pump furnished in compliance with the requirements of Divisions 1, 16 and 17.
- D. Pumps shall be skid-mounted where specified in Part 1.02. Skid-mounted pumps shall be furnished with accessories specified in Part 2.07.
- E. Pumps shall provide uniform delivery of the specified chemical over the entire range of minimum to maximum pumping capacity. Pump manufacturer shall advise as to the minimum recommended stroke length for the chemical to be pumped.
- F. Equipment shall be provided in accordance with the requirements of Section 11000, Equipment General Provisions, and Section 11100, Pumps – General.

1.02 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

- A. Operating conditions shall be determined by the Proposer.

1.03 PERFORMANCE AFFIDAVIT

- A. Submit performance affidavit in accordance with Section 11000, Equipment General Provisions.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. The metering pumps shall be one of two types: Sigma Series pumps as manufactured by Prominent Fluid Controls, Inc., and/or by Watson-Marlow/Bredel, or equivalent. Type 1 and Type 2 requirements are specified below.

2.02 CHEMICAL PROPERTIES

- A. The pump manufacturer is responsible for the coordination of corrosion-resistant materials and coating systems for the chemical solutions specified. The manufacturer shall include all features as necessary for satisfactory operation of the pumping systems for chemical solutions specified. Pumps shall perform satisfactorily over the range of plus and minus 5% of the specified solution concentration.

2.03 TYPE 1 METERING PUMP CONSTRUCTION

- A. Motor operated chemical metering pumps shall be of the positive displacement, mechanical diaphragm type. The stroke frequency adjust mechanism shall be driven by a direct coupled, variable speed AC motor, and shall actuate a PTFE faced composite diaphragm. A separate variable frequency drive, or SCR, or other separate speed control equipment shall not be required.
- B. All fasteners shall be 316 stainless steel (aqua ammonia and sodium hydroxide service) or Hastelloy C (sodium hypochlorite service).
- C. The metering pumps shall be provided with an oil-lubricated gear reducer and can-and-spring drive mounted in an aluminum housing. The housing shall be sealed into an outer plastic housing for corrosion protection with heat sink fins for cooling.
- D. The pump head shall provide for a complete leak-free seal. Positive flow shall be ensured via single ball cartridge-type check valves. The valve retainers shall have compression seal to the pump head and pipe connectors via O-rings. Valve service or removal shall not require any disturbances to the pump head pipeworks. A secondary diaphragm shall completely seal and separate the pump head from the drive unit, to minimize risk of cross-contaminating gearbox lubricant and process fluid. The liquid end shall be physically separated from the drive unit by a back plate with weep hole creating an air gap. An elastomer shaft wiper seal shall prevent contamination of the gear box if the primary diaphragm fails.
- E. The stroke adjust mechanism shall be housed in a corrosion resistant housing, such housing shall be sealed. Stroke rate shall be adjusted manually via a stroke length adjuster knob. A percent scale and vernier shall indicate stroke length in 1% increments. Feed rate shall be infinitely adjustable from 0 through 100%. Stroke length shall be adjustable over a 10:1 operating range. The manufacturer shall provide recommendations for minimum stroke length based on the chemical pumped. Repeatable metering accuracy shall be $\pm 2\%$ of full scale, at constant hydraulic conditions, over the operating range.
- F. The pump and motor shall be mounted on a common base. Each pump and motor shall have a corrosion resistant nameplate giving the manufacturer's model, serial number, rating, range, speed, and other pertinent data.
- G. Coating System-Equipment shall be shop painted with Manufacturer's recommended epoxy finish coating system.

- H. Compatible Materials Schedule – Materials listed below shall be reviewed by the pump manufacturer and confirmed for the specified chemical service.

	Aqua Ammonia	Sodium Hydroxide [Caustic] (≤50%)	Sodium Hypochlorite (≤20%)
Diaphragm	PTFE faced EPDM with Steel Core	PTFE faced EPDM with Steel Core	PTFE faced EPDM with Steel Core
Housing Material	Glass-filled Luranyl	Glass-filled Luranyl	Glass-filled Luranyl
Liquid End Material	Kynar	Kynar	Kynar
Ball Check Valve	PVDF with PTFE faced Viton Gasket Seals	PVDF with PTFE faced Viton Gasket Seals	PVDF with PTFE faced Viton Gasket Seals
Ball Check Valve Balls	Ceramic	Ceramic	Ceramic
O-Ring Seals	Teflon (PCTFE), EPDM	Teflon (PCTFE), Hypalon, Buna-N	Teflon (PCTFE), Viton
Hardware	316 SS	316 SS	Hastelloy C

2.04 TYPE 1 - METERING PUMP DRIVES AND CONTROLS

- A. Metering pumps control shall be microprocessor-based, variable speed motor with mechanically actuated diaphragm designed for continuous 24 hour operation 40°C ambient. The controller enclosure shall be NEMA 4X rated with protective keypad cover.
- B. In AUTO mode, the controller shall accept 24 Volt DC remote start/stop signals and a remote analog signal such that stroke frequency is proportional to a 4-20 mA remote signal input.
- C. The pump controller shall allow adjustment of the maximum stroke rate which corresponds to the maximum analog signal. Local operator controls on the controller keypad shall include stroke frequency control up/down keys, MANUAL/OFF/AUTO-selector, start/stop key, an LCD display, and indicating lights. Dry contact outputs shall be provided for running, AUTO mode, and a single failure output to include all fault/alarm conditions. Output contacts shall be rated for 120 volts, 5 Amps. 4-20mA pump operating stroke frequency speed output signal shall be provided (as a percentage of maximum stroke frequency).
- D. The microprocessor controller shall provide two modes of operation in response to the pump operating speed signal. In the first mode, the pump speed shall increase or decrease in response to the speed signal. When the pump speed reaches a preset minimum value, the microprocessor shall change to a full-speed, cycle operation. The pump manufacturer shall establish the preset minimum speed based on the characteristics of the chemical pumped.
- E. The electronic control system of the metering pump shall be continuously self-monitoring. In the event of a system error in the microprocessor, the pump shall switch off and an alarm shall be annunciated locally and fail signal shall be issued.

2.05 TYPE 2 – METERING PUMP CONSTRUCTION

A. Pumphead and Rotor

1. Pumphead shall consist of a fixed track, a hinged guard door, two spring-loaded tube clamp mechanisms, and spring-loaded roller rotor assembly. Pump tubing shall be in contact with the inside diameter of the track through an angle of 180 degrees and be held in space on the suction and discharge by a spring loaded self-adjusting clamp mechanism. At all times, one roller shall be fully engaged with the tubing providing complete compression and preventing back flow or siphoning. Tube occlusion and spring tension shall be factory set to accommodate 2.4mm wall thickness tubing and shall not require adjustment for accommodating tubing of 1.6mm to 9.6mm ID. Materials listed below shall be reviewed by the pump manufacturer and confirmed for the specified chemical service.

a. Pumphead Assembly

- 1) Pump Track Geometry: minimum 96.6mm swept diameter through a minimum track angle of 180 degrees
- 2) Provide high corrosion/impact resistant materials:
 - a) Track Construction: polyphenylene sulfide (PPS)
 - b) Guard Construction: hinged impact-resistant polycarbonate breakaway guard, tool un-lockable for operator safety.
 - c) Rotor Construction: polyphenylene sulfide (PPS)
 - d) Provide liners and coatings to guard and pump head assembly to resist damage if chemical leakage occurs.
- 3) Provide a factory-installed capacitance-type monitoring sensor which shall detect leakage of pumped product into the pump housing. Switch shall be wired to the pump controller to provide the specified output signals. Sensor shall be equipped with a sensitivity adjustment reset pushbutton, and fault indicator LED.

b. Tube Retainer Mechanism

- 1) Provide two spring-loaded adjustable tube retainer mechanism to secure the tubing at the entry and exit points of the pumphead

c. Rotor Assembly

- 1) Provide rotor assembly that ensures gradual tube occlusion and compensates for tube tolerance:
 - a) Twin spring-loaded roller arms located 180 degrees apart, each fitted with stainless steel helical springs and compressing roller for occlusion of the tube twice per rotor revolution
 - b) Compressing Rollers: 316SS with low friction stainless steel bearings and PTFE seals, minimum diameter of 18mm
 - c) Provide non-compressing guide rollers constructed of corrosion resistant Dylatron
 - d) Provide one (1) spare rotor assembly for each size of pump furnished.
- 2) Clutch: Equip rotor with a central handgrip hub and manually activated clutch to disengage the rotor from the drive for manual

- rotor rotation during tube loading. Clutch shall automatically reengage rotor to gearbox upon one complete revolution.
- 3) Mounting: To prevent slip, the rotor assembly shall be axially secured to the dogged output shaft of the gearmotor via a slotted collet and central retaining screw.

B. Tubing

1. Pumphead shall accept tubing materials including Marprene, Bioprene, Silicone, Sta-Pure & Chem-Sure. Pumps that require tools for adjustment or changing pumpheads to accept different tubing materials or sizes are not acceptable.
2. Pump tubing shall be constructed of Marprene II, a thermoplastic elastomer with 64 Shore A durometer and minimum 2.4mm wall thickness. If required for chemical compatibility, pump manufacturer shall recommend an alternate tubing material.
3. Supply one meter roll of specified tubing size for each different chemical service. For hydraulic stability, tubing with a wall thickness less than 2.4mm is not acceptable.

C. Fasteners

1. All fasteners shall be 316 stainless steel (aqua ammonia and sodium hydroxide series) or Hastelloy C (sodium hypochlorite series).

D. Nameplate: Provide corrosion resistant nameplate giving manufacturer's model, serial number, rating, range, speed, and other pertinent data.

E. Housing: Pressure cast aluminum with Alocrom pre-treatment and exterior grade corrosion resistant polyester powder coat.

2.06 TYPE 2 – METERING PUMPS DRIVES AND CONTROLS

A. Metering pumps control shall be microprocessor-based, variable speed motor designed for continuous 24 hour operation 40°C ambient. The controller enclosure shall be NEMA 4X rated with protective keypad cover.

B. In AUTO mode, the controller shall accept 24 Volt DC remote start/stop signals and a remote analog signal such that speed is proportional to a 4-20mA remote signal input.

C. The pump controller shall allow adjustment of the maximum speed which corresponds to the maximum analog signal. Local operator controls on the controller keypad shall include speed control keys, MANUAL/OFF/AUTO-selector, start/stop key, an LCD display, and indicating lights. Dry contact outputs shall be provided for running, AUTO mode, leak detected, and a single failure output to include all other fault/alarm conditions. Output contacts shall be rated for 120 volts, 5 Amps. 4-20mA pump operating speed output signal shall be provided (as a percentage of maximum speed).

D. The electronic control system of the metering pump shall be continuously self-monitoring. In the event of a system error in the microprocessor, the pump shall switch off and an alarm shall be annunciated locally and fail signal shall be issued.

2.07 ACCESSORIES FOR TYPE 1 AND TYPE 2 PUMPS

- A. Skid mounts: Pumping systems with accessories shall be skid mounted where specified in Part 1.02. Skid mount materials shall be 316 SST, polyethylene, polypropylene, or as recommended by pump manufacturer for the chemical service. All electrical conduit, couplings, fittings, etc., shall be PVC coated rigid galvanized steel and liquid tight, PVC coated, flexible metal conduit.

When skid mounted, units shall be factory pre-assembled and pre-piped such that only a single discharge connection, and power supply connection is required for each pump. On 2-pump skids, skids shall be arranged such that only one suction connection is required for each pair of pumps. Piping materials on each skid shall be schedule 80 PVC, or 316 SST as required for the chemical service. Skids shall be factory pre-assembled with the following accessories:

1. Flushing connection with wye strainer(s)
 2. Calibration column
 3. Pressure gauge for each pump (with isolator)
 4. Pressure relief valve for each pump
 5. Back-pressure valve for each pump
 6. Ball check-valve for each pump
 7. Isolation valves (ball valve or diaphragm valve)
 8. Pulsation dampener
- a. Flushing connection: Provide schedule 80 PVC or 316 stainless steel flushing connection with ¾-inch threaded female hose connection. Provide 316 stainless steel (caustic service and ammonia service) and/or non-metallic (sodium hypochlorite service) strainer as applicable for the specified chemical.
- b. Calibration chambers: Provide calibration chambers constructed of transparent acrylic or PVC construction with isolation valve. Calibration chambers shall provide a minimum capacity of 500 mL and have a calibrated scale with major graduations with numbers each 25 mL and minor graduations each 5 mL.
- c. Pressure gauges: Provide pressure gauges meeting requirements of Section 17650 on discharge of metering pumps. Each gauge shall have a range of zero to 150 psi. Each gauge shall be provided with a diaphragm seal and isolation valve constructed of materials which are completely resistant to corrosion by the chemicals specified in this section.
- d. Pressure Relief Valves: Provide PVC, adjustable setpoint pressure relief valves for the metering pumps with adjustable relief settings. Pressure relief valves shall be completely resistant to the chemicals for which they are provided. Refer to Section 15114.
- e. Back Pressure Valves: Provide PVC, adjustable set point back pressure valves for the metering pumps with adjustable pressure settings. Sizing of the back pressure valves shall be the responsibility of the metering pump manufacturer with the condition that the valve shall not be less than ½ inch diameter. Back pressure valves shall be completely resistant to the chemicals for which they are provided. Refer to Section 15114.

- f. Isolation Valves: Provide isolation valves. Refer to Section 15114 for valve materials specifications.
 - g. Pulsation Dampeners: Sizing of the pulsation dampeners shall be the responsibility of the pump manufacturer, and calculations shall be submitted with Shop Drawings. Diaphragm and body materials and configuration shall be supplied for the specific chemical for which the dampener is used without corrosion, wear, or other cause of abnormally short life. Each dampener shall be equipped with a charging valve and gas pad pressure gauge rated at 0 to 150 psi.
- B. Control Cables: Contractor shall be responsible for coordinating with pump supplier to furnish sufficient length of control cable for the pumping units and controls.

PART 3 -- EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

- A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 11000, Equipment General Provisions and Section 11100, Pumps - General. Field services shall include the following site visits per plant:

Service	Number of Trips	Number of Days/Trip
Installation and Testing	2	1
Startup and Training	1	2

3.02 SPARE PARTS

- A. Provide spare pumps as specified in the Schedule of Service conditions.
- B. Provide spare tubing where applicable and additional spare parts as recommended by the pump manufacturer.

- END OF SECTION -

SECTION 11183

MULTI-STAGE CENTRIFUGAL BLOWERS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, test, and place in satisfactory operation multi-stage centrifugal blower units including the electric motors, steel bases, inlet filter/silencers, inline inlet silencers, check valves, and all necessary auxiliary equipment, appurtenances and accessories, panels and controls, as shown on the Drawings, specified herein, or as required for a complete installation.
- B. Equipment shall be provided in accordance with the requirements of Section 11000 – Equipment General Provisions.
- C. All equipment specified in this section shall be designed and furnished by the blower manufacturer who shall be responsible for the suitability and compatibility of all included equipment.
- D. The Contractor shall make all alterations required to structures, equipment, piping, controls, or other work shown in the Contract Drawings which may be required for the blower systems ultimately furnished. The alterations shall be submitted to the Engineer for review, comment and acceptance.

1.02 PERFORMANCE REQUIREMENTS

- A. Operating conditions shall be determined by the Proposer.
- B. Surge volume is defined herein as the airflow rate at which the unthrottled blower exhibits the first indication of pressure pulsations or flow reversal.
- C. The blower shall have a "nonoverloading" characteristic through the use of backward leaning impellers.
- D. The blower system will be designed to deliver varying airflow rates if designed by throttling at the blower suction. Control of minimum airflow delivery will be based on blower motor amperage draw.

1.03 SUBMITTALS

- A. The following items shall be submitted with the Shop Drawings in accordance with, or in addition to the submittal requirements specified in Section 01300, Submittals; and Section 11000, Equipment General Provisions:
 - 1. The performance characteristic curve for the blower shall be submitted with the shop drawings. Performance curves shall be developed in terms of standard conditions of 14.7 psia, 68°F, and 36% relative humidity and the curve shall show standard

horsepower draw over the range of ICFM flow rates. Additional operational data for the blower shall be submitted including recommended vibration alarm settings and operational limits.

2. A detailed shop test plan, fully describing the manufacturer's test facilities and the test procedure to be used.
 3. Performance Affidavit
- B. Seven copies of certified test reports including all details of apparatus, procedure, and results and all required calculations shall be submitted for each shop test conducted. Reports for shop tests shall be approved by the Engineer prior to shipment.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The materials covered by these Specifications are intended to be of proven reliability and as manufactured by reputable manufacturers having experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Contract Drawings and operated per manufacturer's recommendations.
- B. The blowers shall be as manufactured by Gardner Denver - Lamson, Hibon, or equal.

2.02 MATERIALS

- A. The aeration blowers shall be multi-stage, vertically-split, centrifugal type, driven at the inlet end by direct coupled electric motors.
- B. A welded steel fabricated base shall be provided for mounting the blower, electric drive and driver base. The base shall be of a rigid box section shape. The box section shall be properly ribbed for stiffness and present large bearing areas for carrying the load on the foundation. Machined pads shall be provided as required to properly level the base. The base shall be rigid to prevent deflection during start-up and normal operation that would affect alignment. Rubber vibration isolation pads shall be provided between the concrete mounting and the base of the blower unit. Jackbolts shall be provided to facilitate motor alignment.
- C. The housing, inlet head, and outlet head shall be constructed of close grained cast iron sections, ASTM A48, fitted with babbitt joints held securely by steel tierods and able to withstand the operating pressures. Heads shall be provided with mounting legs. Approved eye bolts or lugs shall be provided for lifting.
 1. Inlet and outlet flange connections shall be ANSI Standard 125-pound drilled through bolt pattern, and will be an integral part of the heads.
 2. Where the blower shaft passes through both the inlet and outlet heads, non contact labyrinth seals with babbitt inserts or carbon ring seals shall be provided to prevent

air leakage and to assure non-contamination of the bearing lubricant. Internal seals between stages shall be of the labyrinth type to restrict interstage leakage.

3. Air passage shall be finished by hand or other means to obtain smooth surfaces and minimize friction losses. Casing shall be accurately machined to gauge, where necessary, to ensure interchangeability of all parts.
 4. The blowers shall be built from parts cast in patterns from which previous units have been built and tested. The compressor shall be of the manufacturer's standard design.
- D. Impellers shall be cast aluminum alloy, keyed to the shaft and held by a lock nut. Hubs of the impellers shall butt against each other directly or through one piece metal spacers. Impellers shall be individually precisely machine balanced. Impellers shall be individually replaceable. Air from impeller shall be vented towards the suction side.
 - E. Shaft shall be of sufficient diameter to operate below the first critical speed and be made of high grade hot-rolled steel. Shaft speed shall not exceed 3,600 rpm.
 - F. The entire rotating assembly (shaft and impellers) shall be dynamically balanced to maintain factory vibration specifications. Vibration shall not exceed 1.25 mils in the vertical plane measured at the blower bearing housing.
 - G. Each blower shall have two oil lubricated bearings which can be lubricated, inspected or replaced without disconnecting piping or disassembling the blower. The bearings shall be contained in outboard bearing housings designed to isolate the bearings from blower temperature. A balance piston will be integrally shaft mounted on the discharge end of the blower. The balance piston will reduce the thrust load on the thrust bearing by at least 75 percent. Lubrication shall be accomplished by means of an oil slinger which circulates lubrication oil from an inner reservoir through the bearing and returns the oil to the outer reservoir. Oil recirculation shall be at the rate of at least 1.5 pints per minute. Oil level sight glasses shall be installed on both sides of each oil reservoir so that oil levels can be visually monitored.
 - H. Flexible, disc spacer couplings of an approved type, with guard shall be furnished for connecting the blower and motor. The coupling design shall take care of inaccuracies of alignment and permit axial adjustment. The construction of the couplings shall be such that either hub of a unit may be removed without disturbing adjustment of the other blower or motor. The coupling spacer shall be of sufficient length to allow replacement of the blower inboard bearing without moving the motor. The manufacturer shall provide a suitable steel guard for the coupling between blower and motor. The guard shall be designed to meet current OSHA requirements.

2.03 ELECTRICAL AND CONTROL REQUIREMENTS

- A. The blower manufacturer shall be responsible for furnishing the electric motors for the blowers. The manufacturer shall be responsible for the proper selection, testing, installation, and operation of the motors and for coordinating the motors with the blower equipment.

B. Electrical Requirements

	Blowers No. xx
Motors	
Rating	460V, 3 ph, 60 Hz
Horsepower	xx
Maximum Speed, rpm	3600
Orientation	Horizontal
Enclosure	WP-1
Inverter Duty	xx
Insulation	Class H
Service Factor	1.15
Space Heater	Yes
RTDs	Yes
Motor Differential Current Transformers / Six-Lead External Wye Connection	xx
Maximum Sound Pressure at 3 feet, dBA	84

- C. Vibration detectors shall be provided for each blower bearing housing. Vibration detectors shall be 2-wire, 4 to 20 mA piezoelectrical velocity transmitters. A warning shall be activated through the monitor when vibration exceeds 0.4 inches/sec. An alarm and shutdown shall be provided when vibration exceeds 0.75 inches/sec.
- D. In addition to the blower motor winding RTDs, RTDs shall be provided to monitor blower inboard and outboard bearing temperature, discharge air temperature, and inlet air temperature. RTDs shall be 100 ohm platinum 4-wire units and shall be mounted in 316 stainless steel thermowells coordinated and furnished by the blower supplier. Initial warning and alarm/shutdown temperature shall be as recommended by the blower supplier (except for inlet air temperature which will be for indication only). The Contractor shall install 3/4" FPT connections for RTD's. Locations shall be coordinated with the blower manufacturer.
- E. A current transformer shall be provided in the motor starter under Division 16 – Electrical to monitor blower motor current. The Contractor shall coordinate scaling/calibration of the current transformer provided under Division with the control panel provided by the blower supplier.

2.10 BLOWER CONTROL PANELS

- A. The blower supplier shall furnish a blower control panel (BCP) for each of the blowers which shall incorporate all required components to control the blower equipment and auxiliary equipment as specified herein. In addition to the requirements specified herein, Blower Control Panels shall conform to the requirements for control panels in Sections 17500, 17510, 17550, and 17560, as well as all applicable requirements of Division 16 – Electrical.

- B. Each BCP enclosure shall be of NEMA 12 freestanding construction and shall be installed by the Contractor adjacent to the blower. The panels shall be front access only with fully gasketed doors extending the full width of the panels to provide full access to the panel mounted components.
- C. Each BCP shall be provided with 120V, single phase, 60 Hz power. The panels shall include all necessary circuit breakers and protective devices including lightning and surge suppressors.
- D. Each BCP shall be completely fabricated, assembled, pre-wired, and tested in the blower supplier's factory. The completed panel shall receive a UL label.
- E. Panel layout and wiring diagrams shall be submitted with the submittal drawings in accordance with the requirements of Section 17030.
- F. Engraved plastic nameplates shall be mounted on the front and inside of each blower panel to designate the blower served and to identify the various devices, instruments, etc. Nameplates shall have white letters on a black background.
- G. Each BCP shall include but not be limited to:
 - 1. Externally operated main disconnect switch
 - 2. Programmable logic controller (PLC) conforming to Specification Section 17120.
 - 3. Operator Interface Module (OIU) conforming to Specification Section 17125.
 - 4. A red mushroom-type emergency stop pushbutton.
 - 5. Controls, instruments and alarms as specified herein.
- H. The PLC shall provide for the following analog inputs as a minimum:
 - 1. Blower inboard bearing vibration
 - 2. Blower outboard bearing vibration
 - 3. Motor inboard bearing vibration
 - 4. Motor outboard bearing vibration
 - 5. Motor winding No. 1 RTD
 - 6. Motor winding No. 2 RTD
 - 7. Motor winding No. 3 RTD
 - 8. Motor inboard bearing temperature
 - 9. Motor outboard bearing temperature

10. Blower inboard bearing temperature
 11. Blower outboard bearing temperature
 12. Inlet air temperature
 13. Discharge air temperature
 14. Motor current
 15. Spares (4)
- I. The PLC in the BCP shall be connected to the plant control system through an Ethernet network connection. Additional requirements for the incorporation of the blower PLC into the plant control system are listed in Section 17120.
- J. The PLC Operator Interface Unit (OIU) shall provide the following display and setpoint entry functions as a minimum:
1. Horsepower (amperage) draw with “impending surge” warning, “surge” trip, and high horsepower setpoints as a bar graph and a digital readout. Setpoints shall be operator adjustable. Initial setpoints shall be as recommended by the blower supplier. Blower bearing vibration level with impending warning and trip setpoints as dual bar graphs and a digital readout. Setpoints shall be operator adjustable. Initial settings shall be as follows: Warning shall be activated through the monitor when vibration exceeds 0.4 inches/sec, Alarm and shutdown shall be provided when vibration exceeds 0.75 inches/sec.
 2. Blower bearing vibration level with impending warning and trip setpoints as dual bar graphs and a digital readout. Setpoints shall be operator adjustable. Initial settings shall be as follows: Warning shall be activated through the monitor when vibration exceeds 0.4 inches/sec, Alarm and shutdown shall be provided when vibration exceeds 0.75 inches/sec.
 3. Motor bearing vibration level with impending warning and trip setpoints as dual bar graphs and a digital readout. Setpoints shall be operator adjustable. Initial settings shall be as follows: Warning shall be activated through the monitor when vibration exceeds 0.4 inches/sec, Alarm and shutdown shall be provided when vibration exceeds 0.75 inches/sec
 4. Blower bearing temperature level with impending warning and trip setpoints as dual bar graphs and a digital readout. Setpoints shall be operator adjustable. Initial temperature setpoints shall be as recommended by the blower supplier.
 5. Motor bearing temperature level with impending warning and trip setpoints as dual bar graphs and a digital readout. Setpoints shall be operator adjustable. Initial temperature setpoints shall be as recommended by the blower supplier.

6. Motor winding temperature level with impending warning and trip setpoints as triple bar graphs and a digital readout. Setpoints shall be operator adjustable. Initial temperature setpoints shall be as recommended by the blower supplier.
 7. Blower inlet and discharge air temperature levels with impending warning and trip setpoints displayed as dual bar graphs and digital readouts. Setpoints shall be operator adjustable. Initial temperature setpoints shall be as recommended by the blower supplier (except for inlet air temperature which will be for indication only).
 8. Blower "Run" Indication (Red)
 9. Impending Surge/Vibration Warning/ Temperature Warning Indication (Amber)
 10. Surge/High Vibration/High Temperature Indication (Red)
- K. The following functional requirements shall be satisfied for each BCP:
1. Each BCP shall include control strategies for startup and shutdown of the blower. The blower shall be selected for manual or automatic operation from the OIU in the face of the BCP. In the hand or manual mode, the blowers shall be started, stopped and modulated through the OIU. In the automatic mode, the blower shall be started and stopped, and its output modulated, by the plant control system, as specified in Section 17950.
 2. The PLC shall provide a common failure indication at the OIU activated by any of the shutdown conditions included. A relay output shall be wired into the control circuit in the blower motor starter to shut down the blower. Shutdown conditions are as follows:
 - a. Blower surge
 - b. High horsepower draw
 - c. High blower vibration
 - d. High blower bearing temperature
 - e. High motor bearing temperature
 - f. High motor winding temperature
 - g. High blower discharge temperature
 3. Adjustable time delays shall be incorporated to allow uninterrupted motor start and to prevent nuisance shutdowns. Alarms shall not be annunciated under normal start-up and shut-down conditions.
 4. All trip functions shall be frozen upon a shutdown so that shutdown status can be determined and the values at shutdown preserved. The PLC shall store and display the 10 most recent shutdown alarms including identification of alarms, time and date of occurrence, and value on trip. These values shall be available through the OIU or the plant control system.

2.06 PRESSURE GAUGES

- A. Pressure gauges shall be provided by the blower manufacturer on the suction and discharge of each blower. Vacuum and pressure tap locations shall be selected for stable measurement and accurate evaluation of pressure rise across the blower. Gauges shall conform to the requirements of Section 17650 – Pressure Gauges.
- B. The inlet vacuum gauge shall be located upstream of the inlet throttling valve and shall be provided with a range of 0-20 inches water vacuum.
- C. The discharge pressure gauge shall be provided with a range of 0-15 psi with figure interval every 1 psi and minor graduations every 0.1 psi.

2.07 CHECK VALVES

- A. Check valves shall be provided on the discharge of each of the blowers.
- B. Check valve shall be flanged 125# class lightweight (flat face) cast iron body with aluminum internals suitable for 125 psi cold working pressure, or insert type ANSI B16.34.
- C. Check valve shall be double door type, springless, seatless design. Sealing members shall be silicone suitable for 500°F. Maximum pressure drop through the 16-inch diameter valve at 6000 scfm shall not exceed 0.02 psi.

2.08 MANUFACTURED FILTER HOUSING/CARTRIDGE FILTER SYSTEMS

- A. The blower manufacturer shall furnish a manufactured housing-type air filter/silencer system for each of the blowers. Air filters shall be Stoddard Model F22-184 with a rated capacity of 10,000 scfm with Type F2-106 washable polyester filter panels or equal products as manufactured by Universal, or Lamson. A side outlet shall be furnished as indicated on the Drawings. Diameter of outlet shall be 18-inches.

The filter/silencer shall provide the following performance:

Octave Band Center Frequency (Hertz)	125	250	500	1000	2000	4000	8000
Insertion Loss Decibels (dB)	6	8	10	12	15	16	15

2.09 SILENCERS

- A. The Contractor shall furnish and install an inline inlet silencer for each blower as shown on the Contract Drawings. Dimensions of the silencers shall be as indicated on the Contract Drawings. Inline silencers shall be Stoddard Model C26-18 or equal.
- B. All silencers shall be of rugged construction and free from defects in design, materials and workmanship. The silencers shall be of the annular absorption type, packed with either stainless steel or long strand fiberglass acoustical absorption material. The inlet silencer shall be carbon steel with stainless steel perforated plate. Flanges on the inlet and discharge sides of the silencers shall be ANSI 125 pound flanges matching the connecting piping.

- C. Each silencer shall be thoroughly cleaned after fabrication and before shipment to the job site. The manufacturer shall provide caps to protect the acoustical absorption material during shipment and site storage. Each silencer shall be shop primed with a primer compatible with the approved paint system and field painted to match the adjacent piping.
- D. After the installation of the silencers and the air piping the Contractor shall completely clean and remove all welding and construction debris from the interior of the piping. This shall be completed before any operation of the blowers and of diffusers.
- E. The inlet silencers shall have 18 inch inlet and discharge flange connections. Maximum allowable pressure drop shall not exceed 0.6 inches of water column at a face velocity of 3,500 fpm. The silencer shall provide the following performance for the application where air and noise flows are in opposite directions.

Octave Band Center Frequency (Hertz)	125	250	500	1000	2000	4000	8000
Insertion Loss Decibels (dB)	10	15	29	37	32	25	21

PART 3 -- EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

- A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 11000, Equipment General Provisions and shall include the following site visits:

Service	Number of Trips	Number of Days/Trip
Installation and Testing	1	2
Startup and Training	2	1
Services after Startup	1	1

3.02 INSTALLATION

- A. All equipment specified herein shall be installed in accordance with the manufacturer's instructions and checked by the respective manufacturers' representative, in conformity with the applicable sections of this specification. After installation, the equipment shall be aligned and adjusted as required for proper operation.

3.03 SHOP TESTING

- A. Shop testing shall be in accordance with Section 11000, Equipment General Provisions and with the following additional requirements.
- B. Shop running and performance tests for the rebuilt and new blowers shall be made by the manufacturer and certified curves and reports shall be submitted for approval prior to shipment. Each of the blowers shall be performance tested in accordance with the most

recent edition of the ASME Power Test Code for Centrifugal Compressors and Exhausters (PTC-10) and as specified herein. Test results shall be reported in accordance with the same code and as specified herein.

- C. Factory testing of the blowers and components prior to shop performance tests are required. Impellers shall be statically and dynamically balanced and oversped to 115% of rated speed. Dimension checks shall be made throughout fabrication.
- D. The shop performance tests shall be conducted for each blower to demonstrate compliance with all performance requirements. Performance tests shall include a minimum of six points to determine the blower flow-pressure-horsepower characteristic with inlet valve wide open over the full range of specified conditions. Test points shall include points to define the blower surge limit (with inlet modulating valve wide open). Tolerances allowable in testing shall be as approved by the Engineer.
- E. Shop test information shall include:
 - Barometer reading
 - Relative humidity
 - Inlet and discharge temperature
 - Inlet and discharge pressure
 - Capacity (flow measurement device calibration, readings, and calculations shall be fully documented)
 - Speed (measured)
 - Blower input horsepower
 - Performance at all specified operating conditions
 - Vibration measurement and recording
- F. In case of failure of any unit to meet the test requirements, the manufacturer, at his own expense, shall make such alterations as are necessary and the tests shall be repeated without additional cost to the Owner until the equipment is satisfactory.
- G. Complete instrumentation layout and manufacturer's information for all instrumentation used during testing shall be submitted including the arrangement and device for flow measurement, conversion tables/graphs, and accuracies over the specified flow range. All instruments and measuring devices that the manufacturer proposes to use for shop performance testing shall be calibrated by a laboratory not more than two months prior to the first performance test.
- H. The blower manufacturer shall prepare and submit test results, performance curves, and all calculations with a statement certifying that shop tests were successfully conducted in accordance with the test requirements and that all specified performance conditions were demonstrated for each blower system. Certified performance curves based on the results of the shop performance test shall be developed in terms of standard conditions of 14.7 psia, 68°F, and 36% relative humidity at the actual blower speed for each point. ICFM shall be plotted against pressure under 14.7 psia, 68°F and 36% relative humidity, and the curve shall show standard horsepower draw over the range of ICFM flow rates.

3.04 FIELD TESTS

- A. Field tests shall be conducted by the factory service people with assistance of the Contractor. Field tests shall consist of running tests.
- B. Running tests shall be conducted under actual operating conditions for a period of not less than 8 hours for each blower. Running tests shall demonstrate that the blower is free from all objectionable vibration and noise and overheating throughout the entire range of specified operation. Initial running tests shall demonstrate that all instruments, controls, and protective shutdown interlocks function properly.

- END OF SECTION -

SECTION 11550

POSITIVE DISPLACEMENT BLOWER PACKAGES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, test, and place in satisfactory operation positive displacement blower packages complete with all accessories including motors, steel bases, inlet filters, inlet silencers, discharge silencers, pressure relief valves, check valves, butterfly valves, pressure gauges, flexible connectors, V-belt drives, belt guards, vibration isolation, and other components for a complete blower package as shown on the Contract Drawings and as specified herein. The positive displacement blowers shall be provided with variable frequency drives. The variable frequency drives shall be furnished under Division 16 - Electrical.
- B. Blowers shall be as furnished by United Blower, Aerzen, Kaeser, or equal.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Division 1 - General Requirements
- B. Division 5 - Metals
- C. Section 09900 - Painting
- D. Section 11000 - Equipment General Provisions
- E. Division 15 – Mechanical
- F. Division 16 – Electrical
- G. Division 17 – Control and Information Systems

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Shall be as specified in Section 01090 - Reference Standards.

1.04 SUBMITTALS

- A. In addition to the submittal requirements specified in Section 01300 - Submittal and Section 11000 - Equipment General Provisions, submit the following:
 - 1. Support locations and loads that will be transmitted to bases and foundations. Weights of all system components and the total weight of the operating blowers.
 - 2. Complete electrical field termination drawings.

3. Electrical equipment product data sheets.
4. Overall equipment layout and piping interconnection drawings.
5. Copies of certified shop test reports.
6. Field test results.

1.05 OPERATION AND MAINTENANCE MANUALS

- A. Furnish Operation and Maintenance manuals as specified in Section 01300 and Section 11000.

1.06 CONTRACTOR'S RESPONSIBILITY

- A. The Manufacturer shall provide the services of qualified service persons with at least five (5) years of experience who are regularly involved in the inspection, installation, start-up, troubleshooting, testing, maintenance, and operation of positive displacement blower systems. The service persons shall:
 1. Check installation.
 2. Assist the Contractor in conducting field tests and preparing a written report as specified below.
 3. Witness and check start-up of the system.
 4. Assist the Contractor in making adjustments and modifications as necessary to optimize operation of system components.
 5. Troubleshoot and correct any mechanical or control problems which are noted during tests and start-up.
 6. Submit written certification that the system has been properly installed, tested, and adjusted; and that all controls and protective devices operate properly, including date of final acceptance test, as well as a listing of all persons present during the tests.
 7. Investigate and supervise correction of any operating problems which may arise up to the end of the guarantee period of the equipment.
 8. Instruct Owner personnel in the operation and maintenance of the equipment.
- B. The services of a qualified manufacturer's technical representative shall be provided at no additional cost to the Owner for a period of not less than two (2) days for each blower package, for a total of six (6) days.
- C. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor.

1.07 FACTORY TESTING

- A. After assembly, each blower system shall be factory lubricated, aligned and operationally tested. Run time on each blower shall be at least one hour after which each blower shall be rechecked for alignment and tension of V-belts and adjusted if necessary. If adjustments are made, the blower(s) shall be restarted and run an additional 15 minutes, shut down and rechecked again.
- B. A report on each blower system, shall be furnished with the O&M manuals giving as a minimum the following readings taken at/or near the end of the one hour run time:
 - 1. Motor current, per phase.
 - 2. Applied motor voltage, phase-to-phase
 - 3. Discharge pressure, psi
 - 4. Air Flow, scfm
 - 5. Surface temperatures of motor bearings and blower bearings and blower discharge air.
 - 6. Blower discharge air temperature
 - 7. Noise level in dbA measured at 3 ft from the blower system in the following six (6) locations: one on each short side of the blower, and two on each long side of the blower.
 - 8. Vibration levels in inch/second of blower and motor bearing housing in horizontal, vertical and axial direction and in six (6) locations specified for noise level measurement, but on the common base.

PART 2 – PRODUCTS

2.01 EQUIPMENT REQUIREMENTS

- A. The Proposer shall determine the operating conditions.
- B. The blower casing shall be of one piece with separate headplates, and shall be made of close-grained cast iron suitably ribbed to prevent distortion under the specified operating conditions.
- C. Each lobe shall be made from a ductile iron casting. Shafts shall be alloy steel forgings. The lobes shall be of the straight, tri-lobe involute type and shall operate without rubber or liquid seals or lubrication and shall be positively timed by a pair of accurately machine heat-treated alloy steel, helical tooth timing gears. The timing gears shall be mounted on the lobe shafts with a press fit and keyed. One gear shall be equipped with a hub and a gear to facilitate accurate and easy timing. Each lobe/shaft shall be supported by cylindrical roller bearings sized for a minimum of 100,000 hours B-10 life.

- D. The lube oil system shall be supplied with a sight glass and ample oil reservoir capacity. Piston ring oil seal shall be provided at each bearing, designed to prevent lubricant from leaking into the air stream. Rotary piston ring shaft seals shall be provided at the point where the shaft passes through the head plate (air seal). A total of 16 piston ring seals are to be provided for each blower. Further provision shall be made to vent lubricant into the air stream. Lip seals inside the blower are not acceptable. Lip seal is allowed at the drive shaft only complete with wear plate.
- E. The timing gears and the bearings shall be splash oil lubricated from oil slingers mounted on the driven shaft and dipping in oil. Grease lubricated bearings are not acceptable. To further reduce oil leaks, each bearing must be equipped with an oil deflector disc.
- F. Each blower must be provided with stiffener ribs and heavy-duty casings, end plates and reinforced inlet and discharge flanges, so that blowers can be directly mounted on the base without using blower feet.
- G. Each blower shall be given a factory mechanical test to assure mechanical integrity. If the test indicates that adjustments are necessary to insure conformance to the manufacturer's standards, such adjustments shall be made prior to shipment.
- H. A welded steel fabricated base discharge silencer combination shall be provided for each blower. The base shall support the blower and a pivoting frame supporting the motor. The inlet filter silencer shall be mounted directly to the blower inlet flange. The motor shall be mounted on the pivoting base complete with (2) springs to fine tune belt tension. The complete blower package shall be placed inside a "walk-in" acoustical enclosure. Installation shall conform to recommendations of the blower and V-belt component manufacturers including motor, V-belt drive, guard, controls, and all necessary items.
- I. The motors shall be 1800 rpm TEFC inverter duty rated suitable for 460V, 3-phase, 60 Hz operation. Aeration blower motors shall be inverter duty motors shall include a 120 VAC space heater and three normally closed temperature switches embedded in the motor windings. Motor base shall be capable of sliding by means of a two (2) bolt tensioning device. Motors shall provide minimum efficiencies and power factors as follows:

Percent of Full Load	150 Horsepower Motor		125 Horsepower Motor	
	Minimum Efficiency	Minimum Power Factor	Minimum Efficiency	Minimum Power Factor
100	95.8	85.7	95.4	84.2
75	96.2	83.9	95.6	81.6
50	95.9	78.1	95	74.5

- J. Pressure relief valve shall be provided for each blower. Pressure relief valve shall be installed as close to the blower discharge as feasible but outside of the acoustical enclosure. The pressure relief valve shall have an initial set pressure 0.50 psi over the specified design operating pressure. Pressure relief valve shall be weighted type relief valves, cast iron construction, as manufactured by Roots, or equal. Pressure relief valve shall be rated and sized to relieve 110% of the maximum calculated airflow at the specified local conditions.
- K. Ten inch diameter discharge check valves shall be provided on the discharge of each blower unit, outside of the acoustical enclosure and shall be API International. Check valve shall be ductile iron with 316 SST shaft, plate, and springs, and EPDM sealing member suitable for 300°F.
- L. Ten inch diameter butterfly valves shall be provided on the discharge of each blower unit, outside of the acoustical enclosure and shall be API International wafer style butterfly valves. Butterfly valve shall be cast iron with 410 SST shaft, aluminum bronze disc, and EPDM seat.
- M. Ten inch diameter inlet air filter silencers shall be provided on the inlet of each blower. Inlet filter silencer shall include sound absorbing materials. Inlet air filter shall be rated and sized to filter 150% of the maximum calculated airflow at specified local conditions. Ten inch diameter discharge silencers shall be provided on the discharge of each blower and shall be combination chamber – absorptive type, heavy duty, double shell, hot dip galvanized carbon steel and painted with two coats of Tnemec Series 66 epoxy paint.
- N. Provide molded, synthetic rubber and cork, vibration isolation pads for each blower, sized to fit the structural steel base. Isolators shall be as manufactured by Korfund or equal.
- O. Provide a differential pressure gauge to indicate pressure drop through the air filter for each blower equal to Model 2015 by Dwyer Instruments, Inc. UBI Filter Element Restriction Gauge, or equal.
 - 1. Range: 0 to 15 inches water gauge.
 - 2. Accuracy: 2% of full scale.
 - 3. Dial: 4-1/2"; 120° scale; 0.5 WC minor divisions.
 - 4. Mounting: Vertical
 - 5. Construction: Die cast aluminum case; silicone rubber diaphragm; calibrated range spring; samarium-cobalt magnet; heli of high magnetic permeability mounted in sapphire bearings; clear plastic cover with O-ring seal and zeroing screw; litho-printed scale; red-tipped pointer with rubber pointer stops.
 - 6. Vacuum gauge shall be located outside of the acoustical enclosure.
- P. Provide a liquid filled pressure gauge for each blower equal to type 1008A manufactured by Ashcroft, Precision Instruments Corporation, or equal.

1. Range: 0 to 15 psig.
 2. Accuracy: 1% of full scale.
 3. Dial: 4-inch diameter; 270° scale; heavy gauge aluminum with white background and black markings; 0.25 psig minor divisions.
 4. Case: Stainless steel.
 5. Ring: Stainless steel.
 6. Movement: Stainless Steel
 7. Bourdon Tube: Phosphor bronze, large bore tubing which is silver soldered to socket and tip.
 8. Connection: Forged brass 1/4" NPT black connection.
 9. Discharge pressure gauge shall be located outside of the acoustical enclosure on the discharge piping.
- Q. Provide a liquid filled bimetal thermometer for each blower manufactured by Ashcroft or equal.
1. Range: 50 to 300°F Series EL discharge and - 40 to 160°F inlet.
 2. Accuracy: 1% full span.
 3. Dial: 3" diameter; 270° scale; heavy gauge stainless steel with white background and black markings; 5°F minor divisions.
 4. Case: Stainless steel.
 5. Ring: Stainless steel.
 6. Movement: Stainless steel.
 7. Actuating Element: Type 304 stainless steel, precision rolled, fully annealed tubing.
 8. Compensation: Bimetal compensator to offset ambient temperature changes in case area.
 9. Discharge thermometer shall be located outside of the acoustical enclosure on the discharge piping.
- R. A high temperature switch for each blower shall be provided as manufactured by Murphy A25 Series, or equal with an operating range of 180° to 350°F. The maximum temperature capability shall be 400°F. Sensor is to be capillary type with remote 3-3/4"

brass bulb. Contractor shall provide 1/2" FPT in discharge piping near blower for thermostat well. Piping under 4 inches will require a tee with bushings to mount the well. Piping 4 inches and over may be drilled and tapped. Temperature switch shall be installed by the Contractor on the outside of the acoustical enclosure on the discharge piping.

- S. A high pressure switch for each blower shall be provided as manufactured by Murphy A25 Series, or equal. Pressure switch operating range shall be from 0 to 15 psig. Pressure switches shall have adjustable deadband, hermetically sealed switching element, and 316 stainless steel pressure port. Pressure switch shall be installed by the Contractor on the outside of the acoustical enclosure on the discharge piping.
- T. Control of the positive displacement blower packages shall be as described in Section 17950 – Functional Control Descriptions.

2.02 ACOUSTICAL ENCLOSURE

- A. For outdoor applications, an individual "walk-in" acoustical enclosure shall be provided for each blower system as previously specified herein. Each acoustical enclosure shall be compatible with the positive displacement blower systems furnished in this specification section and shall comprise a complete system. Each acoustical enclosure shall reduce blower noise level to a maximum of 80 dBA within 3 feet of the enclosure.
- B. Each enclosure shall be constructed to easily accommodate service and maintenance functions without removal of the enclosures. As a minimum, the exterior dimensions of each acoustical enclosure shall be approximately 128 inches wide by 102 inches long by 108 inches high and as required by blower manufacturer.
- C. Each enclosure shall be provided with access doors one on each side, equipped with latches which hold doors securely in place.
- D. Enclosure ventilation fans and louvers shall be mounted such as to allow sufficient cross ventilation for blower and motor cooling. The fans shall be 1/4 HP, 2,885 cfm, 18-inch fan rated for 120 volt, 60 hertz, single phase electrical service. The fan shall be capable of limiting the temperature within the acoustical enclosure to 105°F. Fan electric motor shall conform to the requirements of Section 15170 - Electric Motors. Blower enclosure fan shall be prewired to a thermostat and to a Hand-Off-Automatic selector switch. Enclosure shall be provided with a fluorescent light, light switch, and receptacle. The blower manufacturer shall provide a single junction box inside the electrical enclosure such that the electrical subcontractor shall make all electrical connections at a single location for each enclosure.
- E. Each enclosure shall consist of a 4½" wide base floor channel frame measuring approximately 128"x102", made of galvanized 14 gauge steel. At each corner shall be a 12"x12"x3/8" plate which includes an anchor bolt hole and ¾" jacking bolt. Channels and plates are welded together to form a one piece frame. Leveling bolts shall be required for field leveling as well as for lifting and setting enclosure in place in the field. Gaps under the floor channel shall be filled with nonshrinking grout after installation and leveling. Sound absorption panels (See F.) shall be mounted into the floor channel and reinforced at each corner with a 6" x 6" x 3/16" galvanized corner flashing member to

form a clean strong corner brace. Roof absorption (See F.) shall be laid upon the supporting walls. Each horizontal edge of the roof shall utilize a 6" x 6" x 3/16" galvanized roof flashing member to clearly and strongly secure the roof to the wall. Corners shall be mitered for a professional appearance.

F. Sound absorption panel construction shall conform to the following:

1. Sound absorbing panels shall be 4" thick and furnished in widths of up to 54" and in lengths as required. Panels shall consist of a 14 gauge galvanized steel perimeter channel frame. On one side (inner) a 20 gauge galvanized perforated steel face sheet shall be screwed, with self tapping galvanized screws, to the frame. On the other side (outer) an 18 gauge galvanized solid sheet shall be welded to the frame. Perforations shall be 3/32" diameter openings spaced 3/16" centers. Panel shall be adequately reinforced inside with stiffeners, to prevent twisting and racking during shipment and installation.
2. Each panel shall contain 4" thick sound absorbing mineral wool, 6 lbs. PCF, applied in the factory. Fill shall be incombustible, inert, mildew-resistant and vermin-proof, and wrapped in a 2 mil polyethylene cover to allow washing of the enclosure.
3. Galvanized panels shall be welded and screwed construction and shall contain sound absorbing and insulating fill material with ratings not less than the following when tested in accordance with ASTM E84-50T, NFPA Standard 255 or UL 723.

Flame Spread	-	15
Smoke Developed	-	0
Fuel Contribution	-	0

G. Man door construction shall conform to the following:

1. Door leaf shall be the same thickness and construction as the panels.
2. Frame shall be fabricated from 14 gauge galvanized steel.
3. Assembly and adjustment of door frame, acoustic seals and hinges shall take place at the factory and the entire unit shall be shipped to job site ready to install and operate. All doors shall be tested for proper operation in the factory, prior to shipment.
4. The door performance shall be comparable to the wall they are in and have the same sound attenuating capabilities as the wall.
5. Each door leaf shall be supplied with two (2) lift off mortise mount 300 series stainless steel door hinges.

H. Acoustical louver(s) shall be furnished and installed, as required, to provide adequate source ventilation. Louver(s) construction shall conform to the following:

1. Outer casing shall be of 16 gauge galvanized steel.

2. Louver baffles shall be of airfoil configuration and made of 22 gauge galvanized steel with acoustical shrouds to minimize noise.
 3. Static pressure drop of louvers shall not exceed 0.5 i.w.g. at a face velocity of 675 fpm for Model R and 850 fpm for Model LP.
- I. Where possible, provision shall be made to bring fresh outside air directly to the driver motor's cooling fan. Such provision shall not require electrical power nor compromise the overall noise requirement specified.

PART 3 -- EXECUTION

3.01 INSTALLATION AND TESTING

- A. The equipment shall be installed in accordance with the instructions and drawings of the manufacturer, Section 01400 - Quality Control, and Section 11000 - Equipment General Provisions.
- B. The Contractor shall install the blowers and all related items including proper support and anchoring of the blowers. All supports, fasteners, anchors, equipment, hardware, and other devices shall be furnished for a complete installation.
- C. Prior to field testing of blower equipment, the Contractor shall take all necessary precautions to insure that the piping is completely clean and free of any debris, dirt, or other foreign materials which could clog the underdrain system or interfere with acceptable operation.
- D. After each blower unit and its accessories have been completely installed and the electrical connections have been made, it shall be subjected to field tests conducted by the Contractor to determine if it is free from all objectionable vibration, bearing heating, noise or other defects. Vibration shall not exceed 3 mils at any bearing in any plane. Noise level shall be measured along each side of the enclosure to verify conformance to the maximum noise level specified. Each blower unit shall be subjected to running tests under actual operating conditions for a period of 12 hours during the field test. The Contractor shall make such changes or alterations to the blower units or their auxiliaries necessary for satisfactory operation as directed by the Engineer based on the results of the field tests.

3.02 PAINTING

- A. Painting shall be as specified in Section 09900 unless otherwise specified herein. Blowers shall be coated with the manufacturer's recommended premium paint system suitable for the blowers' intended use. Paint system shall be equivalent to PPG MPP-807 Universal Primer (red) at 3.0 to 4.0 mils and PPG AUE-300 Low VOC Polyurethane Enamel Paint at 2.0 to 3.5 mils.
- B. All inaccessible surfaces of the equipment, which normally require painting, shall be finished painted by the manufacturer. The equipment and motor shall be painted with a

high quality epoxy polyamide semi-gloss coating specifically resistant to chemical, solvent, moisture, and acid environmental conditions, unless otherwise specified.

- C. Gears, bearing surfaces, and other unpainted surfaces shall be protected prior to shipment by a heavy covering of rust-preventive compound sprayed or hand applied which shall be maintained until the equipment is placed in operation. This coating shall be easily removable by a solvent.

3.03 SPARE PARTS

- A. Furnish all special tools and appliances necessary to disassemble, service, repair and adjust the equipment and appurtenances.
- B. All materials shall be properly packed, labeled and stored where directed by the Engineer.
- C. Spare parts which are identical and interchangeable with the original parts shall be furnished in clearly identifiable and labeled containers. The Contractor shall provide the following spare parts for each series of blowers specified herein:
 - Eight (8) filter elements
 - One (1) year supply of manufacturers recommended oil, per blower
 - Eight (8) piston ring seals
 - Two (2) tubes of Permatex Gasket
 - Two (2) shaft seals

3.04 EQUIPMENT IDENTIFICATION

- A. The blowers shall be provided with a substantial brass or stainless steel nameplate, securely fastened in a conspicuous place, and clearly inscribed with the manufacturer's name, year of manufacture, serial number, design air flow, pressure and rpm.

- END OF SECTION -

SECTION 13207

POLYETHYLENE STORAGE TANKS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, deliver, install, test and place in satisfactory operation polyethylene storage tanks, complete with all necessary accessories at the locations shown on the Drawings and as specified herein.
- B. Equipment shall be provided in accordance with the requirements of Section 11000, Equipment General Provisions.

1.02 CONDITIONS OF SERVICE/STORAGE TANK SCHEDULE

- A. Operating conditions shall be determined by the Proposer.

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. American National Standards Institute (ANSI)
 - 1. ANSI B16.5 – Pipe Flanges and Flanged Fittings.
- B. American Society of Testing Materials (ASTM)
 - 1. ASTM D638 – Standard Test Methods for Tensile Properties of Plastics.
 - 2. ASTM D746 – Brittleness Temperature of Plastics and Elastomers by Impact.
 - 3. ASTM D790 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
 - 4. ASTM D883 – Standard Definitions of Terms Relating to Plastics.
 - 5. ASTM D1505 – Density of Plastics by the Density-Gradient Technique.
 - 6. ASTM D1525 – Vicat Softening Temperature of Plastics.
 - 7. ASTM D1693 – ESCR Spec. Thickness .125" F50-10% Igepal.
 - 8. ASTM D1998 – Standard Specification for Polyethylene Upright Storage Tanks.

1.04 SUBMITTALS

- A. The following items shall be submitted with the Shop Drawings in accordance with, or in addition to the submittal requirements specified in Section 01300, Submittals; and Section 11000, Equipment General Provisions:

1. Performance Affidavit
2. Installation list of the type and size being proposed, date installed, contact name, address and phone number
3. Warranty
4. Dimensions of tank, fittings and attachments
5. Wall thickness calculations per ASTM D 1998-97 using 600 psi design hoop stress @ 100°F
6. Location of fittings and attachments
7. Resin used and a complete manufacturers specification of the resin used
8. Weight of tanks
9. Statement that fabrication is in accordance with these Specifications
10. Samples
11. Instructions for handling, storage and installation of tanks.
12. Statement that materials and resin used are suitable for intended service.
13. Drawing details for ladder as recommended by Manufacturer and conforming with OSHA standards.
14. List of previous five similar use site installations in the past 36 months or provide a list of three or more customers using tanks for the same chemical applications and similar weather conditions for at least ten years.
15. Supporting information of UL tank manufacturing capabilities.
16. Supporting information of ISO 9001 certification.

1.05 QUALITY ASSURANCE

- A. Tanks shall be constructed by a firm that has at least ten years prior experience in construction of similar polyethylene tanks in similar applications.
- B. Tanks shall be manufactured by a firm with a nationally accepted quality standard (i.e., ISO 9001 or equal).

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. The polyethylene storage tank(s) shall be as manufactured by Poly Processing Company, Snyder Industries, or equal.

2.02 MATERIALS AND CONSTRUCTION

- A. The tanks shall be one-piece construction, rotationally molded, high density cross linked polyethylene or rotationally molded high density linear polyethylene. All materials shall be NSF 61 approved. Tank shall have a specific gravity rating of 1.9 and shall be completely resistant to corrosion by 50% aluminum sulfate. The Contractor and tank manufacturer shall be fully responsible for the structural design and integrity and watertightness of the tank, including all anchorages and connections. The tanks shall be capable of storing the specified chemical at temperatures up to 130°F.
- B. The plastic shall not contain any fillers. All plastic shall contain a minimum of 0.25 percent UV stabilizer and maximum of 0.60 percent. Pigments may be added as designated by the manufacturer, not to exceed 0.5 percent of dry blended or 2 percent if melt compound of the total weight of the tank.
- C. The nominal properties of the material are as follows based on molded parts:

Property	ASTM Specification	Value for Crosslinked Polyethylene	Value for Linear Polyethylene
Density	D1505	.940 to .945 g/cc	.940 to .948 g/cc
ESCR Specification Thickness .125" F50 10% Igepal	D1693	>1,000 hours	48 hours
Tensile Strength Ultimate 2 in/min	D638 Type IV Specification	3,000 psi	2950 psi
Elongation at Break 2 in/min.	D638	> 300 percent	>16.2 percent
Vicat Softening Temperature	D1525	240 degrees F	235 degrees F
Flextural Modulus	D790	100,000 to 110,000 psi	129,000 psi

D. Design Requirements

- 1. The minimum required wall thickness of the cylindrical shell at any fluid level shall be determined by the following equation, but shall not be less than 0.187 in thick.

$$T = P \times O.D./2 SD = 0.433 \times S.G. \times H \times O.D./2 SD$$

T = wall thickness
 SD = Hydrostatic design stress, PSI
 P = pressure (.433 x S.G. x H), PSI
 H = fluid head, ft.
 S.G. = specific gravity, g/cm³
 O.D. = outside diameter, in.

2. They hydrostatic design stress shall be determined by multiplying the hydrostatic design basis, determined by ASTM D2837 using rotationally molded samples, with a service factor selected for the application. The hydrostatic design stress is 600 PSI at 73 degrees Fahrenheit. The tank shall have a stratiform (tapered wall thickness) wall.
 3. The hydrostatic design stress shall be derated for service above 100 degrees Fahrenheit and for mechanical loading of the tank.
 4. The standard design specific gravity shall be 1.9.
 5. The minimum required wall thickness for the cylinder shell must be sufficient to support its own weight in an upright position without any external support. Flat areas shall be provided to allow locating large fittings on the cylinder straight shell.
 6. The top head must be integrally molded with the cylinder shell. The minimum thickness of the top head shall be equal to the top of the straight wall. The top head of tanks shall be designed to provide a minimum of 1300 square inches of flat area for fitting locations.
- E. All tank capacities (volumes) specified shall include only that volume in the straight shell below the overflow pipe invert elevation and above the top of the outlet pipe. At least four inches of freeboard shall be provided between the invert elevation of the overflow pipe and the top of the straight shell.
- F. Tanks shall be anchored to the concrete base by the Contractor in accordance with the Drawings.
- G. The tanks shall be cylindrical and vertical in orientation with tank penetrations as indicated on the Contract Drawings.
- H. The tank shall be provided with integrally molded cover. The cover shall be provided with a manway and connection as described herein and as shown on the Drawings.

2.03 CONNECTIONS AND ACCESSORIES

- A. All connections/openings shall be flanged in accordance with ANSI B 16.5 150 pounds. Flanged connections, nozzles and openings shall be reinforced and shall be perpendicular to the straight shell of the tank. All pipe supports, hardware, accessories, etc., shall be provided. All piping connected to the tanks shall be perpendicular or parallel to the straight shell of the tanks. All piping into the tanks shall be supported such that no weight is placed on the tank and its connections.
- B. Each tank connection shall be provided with a flexible connector resistant to the specified chemical to allow for lateral and vertical expansion and contraction of the tank and to isolate the tank from pump and piping vibration. Flexible connectors shall be provided by the tank manufacturer.
- C. Opening for pump suction line shall be Integrally Molded Flanged Outlets (IMFO's), Snyder Unitized Molded Outlet (SUMO) or other approved integrally molded full drain outlets.

Sidewall fittings above the chemical fill level shall be Schedule 80 PVC or CPVC bulkhead fittings. Sidewall fittings below chemical fill level shall be bolted double flange PVC or CPVC with polyethylene encapsulated bolts. Bolts shall be 316 stainless steel. Gaskets shall be EPDM

- D. Vent lines shall be top-mounted. Each vent shall be extended to the atmosphere and shall have a PVC vent insect screen. Vent lines shall be supplied and furnished by the Contractor as required or as directed by the Engineer.
- E. Each storage tank fill line shall be provided with a quick connect coupling with either a ball check valve located downstream or an integral check valve. The dry quick connections shall be provided between the delivery vehicle and the chemical storage tanks as shown on the Drawings. The dry quick connections shall be resistant to corrosion by the specified chemicals and shall be provided with fittings, quick lock coupling and dust cap and chain. Quick connect couplings shall be as specified in Section 15000. The Contractor shall furnish and install a sign at each chemical fill station to identify the chemical filled. The signage shall be as specified in Section 10400.
- F. The tank manufacturer shall provide Flange Insert Check Valves (FIV's) for interior storage tanks as shown on the Drawings. The FIVs shall be installed on the overflow lines and shall be complete with unions, liquid traps, and flanges as indicated in the Drawings. The valves shall be as specified in Section 15114, Check Valves.
- G. The tank shall be provided with a level instrument in accordance with Division 17, Control and Information Systems. The mounting and connecting requirements shall be coordinated with the Instrument Supplier.
- H. The tank shall be provided with a top-mounted chemically-resistant manway with a bolt-on type cover. Bolts shall be resistant to specified chemicals.
- I. Access Ladder - All tanks over five feet in height shall be equipped with an exterior access ladder for access to the manway. The ladders shall be constructed of FRP. . Ladder shall meet OSHA requirements. Ladder shall provide 18 inches between side rails and 12 inches between rungs. Angle clips shall be furnished for mounting the bottom of the ladder to the concrete pad. Ladders shall be furnished with gooseneck handrails at the top. The tank top shall be equipped with ladder clips to bolt ladder handrails thereto. Ladder clips shall be constructed of 316 stainless steel. Ladders must be mounted to the tank to allow for tank expansion and contraction due to temperature and loading changes. All top ladder mounts shall be connected to integrally molded in attachment lugs that allow for tank movement. Each tank ladder shall be equipped with a safety cage or fall prevention system equal to the North Consumer Products "Saf-T-Climb" system. All construction materials shall be identical to the materials of construction of the ladder. The fall prevention system shall be equipped with rung clamp assemblies at 6 ft. maximum spacing and a dismount section extending 4'-6" above the landing level or 2 ft. above a railing. The fall prevention system shall meet or exceed federal specification RR-S-001301 and all OSHA regulations. Equipment shall be tested according to ANSI 14.3.
- J. The tank shall be provided with a minimum of three lifting lugs integrally molded into the top head. Lifting lugs shall be capable of withstanding weight of an empty tank with a safety factor of 3 to 1.

- K. The tank shall be provided with a minimum of four tie-down lugs and all necessary anchor bolts. Tie-down lugs shall be constructed of stainless steel. Anchor bolts shall be constructed of 316 stainless steel or Hastelloy C (for sodium hypochlorite). The tie down system shall be designed to withstand buoyancy of an empty tank in a flooded containment area. Tie down system must meet seismic requirements per UBC 1997 code. Tie down system materials shall be completely resistant to corrosion by the specified chemicals.
- L. The tank shall be provided with a permanently attached label providing the following information:
- Type of material stored
 - Concentration of material stored
 - Specific gravity
 - Maximum temperature
 - Tank capacity
 - Manufacturer
 - Date of manufacture
- M. Where specified in the Storage Tank Schedule, the tanks shall be provided with a 2-inch thick polyurethane foam insulating layer. Insulation shall have a density of 2.0 – 3.0 lb/ft³ with an “R” value of 8.33/in. The insulating layer shall be protected by two full coverage coats of latex mastic coating applied to the surface of the insulation in such a manner to seal the insulation from the outside environment.
- N. Where specified in the Storage Tank Schedule, chemical storage tanks shall be provided with heating panels. A minimum of three (3) 500-watt, 120 VAC fully grounded electrical heating panels shall be provided for each tank to maintain the temperature of the tank contents at 40°F at an outside temperature of -10°F. The system shall be provided with 2 NEMA 4X thermostats, one to control the panels and one high limit. The heat panels shall be low watt density heat panels that shall operate without damage to the tank when the tank is empty.
- O. All metallic parts, fasteners, brackets, mounting hardware, and accessories provided by the tank manufacturer shall be constructed of corrosion resistant metals as specified in the Tank Schedule.

2.04 HORIZONTAL PIPING SUPPORT

- A. All PVC or CPVC piping inside the containment area and trench shall be supported by thermoplastic pads at maximum 5 foot intervals as shown in the Drawings to prevent the piping from resting directly on concrete.

PART 3 -- EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

- A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 11000, Equipment General Provisions and shall include the following site visits for each series of tanks:

Service	Number of Trips	Number of Days/Trip
Installation and Testing	1	1
Startup and Training	1	1
Services after Startup	1	1

3.02 INSTALLATION

- A. The Contractor shall furnish and install the polyethylene storage tanks, and related items in accordance with the manufacturers' recommendations and in accordance with Section 11000, Equipment General Provisions.
- B. All piping, valves, fittings, conduit, wiring, etc., required to interconnect system components shall be furnished and installed by the Contractor. Unless otherwise noted, piping shall be Schedule 80 CPVC.
- C. All metallic fasteners, brackets, mounting hardware, and accessories located in sodium hypochlorite and ferric chloride storage and feed areas shall be constructed of Hastelloy C. All metallic fasteners, brackets, mounting hardware, and accessories located in sodium bisulfite storage and feed areas shall be constructed of 316 stainless steel.
- D. The Contractor shall install 2 layers of roofing paper between each concrete pad and storage tank. The tanks shall be installed on level pads.

3.03 FIELD TESTING

- A. Field testing shall be performed in accordance with Section 11000, Equipment General Provisions.
- B. Upon completion of installation of tank and prior to connecting piping, the Contractor shall provide blind flanges or other suitable plugs for all openings in the tanks, fill tanks with clean water provided by the Owner from a source approved by the Engineer and conduct a leakage test as specified herein. Tanks shall be filled up to the top of the straight shell of the tank and left to sit over a 2-day test period. There shall be no leakage over the test period. Leakage around openings in the tanks shall be stopped by tightening nuts and bolts or replacing gaskets as required. Upon satisfactory completion of leakage test, Contractor shall drain the tanks and dispose of water in a suitable manner.

- END OF SECTION -

SECTION 13209

FIBERGLASS REINFORCED PLASTIC STORAGE TANKS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, deliver, install, test and place in satisfactory operation fiberglass reinforced plastic storage tanks, complete with all necessary accessories at the locations shown on the Drawings and as specified herein.
- B. Equipment shall be provided in accordance with the requirements of Section 11000, Equipment General Provisions.

1.02 CONDITIONS OF SERVICE/STORAGE TANK SCHEDULE

- A. Operating conditions shall be determined by the Proposer.

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Shall be as specified in Section 01090, Reference Standards.
- B. U.S. Department of Commerce Voluntary Product Standard PS-15-69
- C. ASTM C 581 - Chemical Resistance of Thermosetting Resins Used in Glass Fiber Reinforced Structures
- D. ASTM C 582 - Reinforced Plastic Laminates for Self-Supporting Structures in a Chemical Environment
- E. ASTM D 3299-00a – Filament-Wound Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks
- F. ASTM D 4097-01a – Contact-Molded Glass-Fiber-Reinforced Thermoset Resin Corrosion - Resistant Tanks

1.04 SUBMITTALS

- A. The following items shall be submitted with the Shop Drawings in accordance with, or in addition to the submittal requirements specified in Section 01300, Submittals; and Section 11000, Equipment General Provisions:
 - 1. Performance Affidavit

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. The fiberglass reinforced plastic storage tanks shall be as manufactured by Justin Tanks, LLC, Ershigs, Inc., or equal.
- B. The fiberglass reinforced plastic tank manufacturer shall specialize in manufacture, assembly, and field service of FRP chemical storage tanks with a minimum of ten years experience. The manufacturer shall have at least five (5) U.S. installations of the type, approximate size, and chemical service being proposed, each with a minimum of five (5) years of satisfactory service. The manufacturer shall submit references for the existing installations with shop drawings.

2.02 MATERIALS AND CONSTRUCTION

- A. The Contractor is responsible for the coordination and selection of corrosion resistant materials for the chemical solutions specified below. The fiberglass reinforced plastic storage tank manufacturers shall inform themselves of the characteristics of the specified chemical solutions and guarantee the suitability of the materials used in manufacturing of the tank and appurtenances. The Contractor and manufacturer shall include all features as necessary for satisfactory operation of the tank system for all specified chemical solutions.
- B. All tank capacities (volumes) specified shall include only that volume in the straight shell below the overflow pipe invert elevation and above the top of the outlet pipe. At least four inches of freeboard shall be provided between the invert elevation of the overflow pipe and the top of the straight shell.
- C. The resin for fiberglass reinforced plastic storage tanks shall be Derakane 510A, Hetrion FR992, CoREZYN 8440 or 8441, or equal. The resin used shall not contain any fillers, pigments, dyes, or colorants, which may interfere with visual inspection of laminate quality, except as required for viscosity control or as specified before. The initiators used will be of the type, manufacturing origin, and amounts specified by the resin manufacturer. Each major composite, or statistically relevant sampling of the composite manufacture, shall be evaluated by the resin manufacturer by Differential Scanning Calorimetry to establish the degree of cure. Degree of cure shall be 90% or greater. Resin pastes used to fill crevices before overlay are permitted. The resin shall conform with a Class 1 flame spread, as specified by the National Fire Protection Agency No. 91.
- D. The reinforcing material shall be a commercial grade glass fiber having a coupling agent which shall provide a suitable bond between the glass reinforcement and the resin and shall be suitable for the fabrication method used. The reinforcing material shall be comparable to that used to generate corrosion resistance.
- E. The inner surface of sodium hypochlorite tanks shall have two layers of synthetic veil for a total of 20 mils. BPO-DMA cure system shall be used for the sodium hypochlorite tanks. Material used as reinforcing on the surface exposed to chemical attack shall be a commercial grade chemical resistant glass fiber having a coupling agent.
- F. The inner surface laminate shall be not less than 0.02-inch thick, shall be resin-rich, reinforced with chemically resistant surfacing material. The surface shall be smooth, glossy, and free of pits.

- G. The interior layer shall be not less than 0.1-inch thick, reinforced only with noncontinuous glass strands applied in a minimum of two piles of chopped strand mat or in a minimum of two passes by the spray-up process. Glass strands shall not be shorter than 1.0 inch or longer than 2.0 inches.
- H. The combined thickness of inner surface and interior layer shall not be less than 0.12 inch.
- I. Before the reinforcement of the exterior layer is applied, the interior layer shall be allowed to cure completely so that the thickness of the corrosion barrier, consisting of the inner surface and interior layer, will not be reduced.
- J. The exterior layer shall provide additional strength necessary to meet the tensile and flexural requirements. The reinforcement shall be filament wound, contact molded or a combination of both and may consist of continuous roving, woven roving, chopped strand mat or chopped strands. Where separate layers of reinforcement are used, all layers shall be lapped a minimum of 1.0 inch. Laps shall be staggered as much as possible. If woven roving or cloth is used in successive layers, it shall be alternated with a layer of chopped strand glass.
- K. The thickness of the filament wound portion of the tank shell may vary with tank height, provided that all stress and other requirements are met at any height level.
- L. Glass content of the exterior layer shall be 50 to 80 percent by weight. All reinforcement used shall be resistant to corrosion by the particular chemical stored in the tank.
- M. Sandwich-type laminate construction, containing fillers such as foams, balsa or any other, shall not be accepted.
- N. The outer surface shall consist of chopped strands or surfacing mat, or both, over which shall be applied a resin-rich coating. The outer surface shall not be pigmented, painted or dyed except to prevent ultraviolet degradation of the tank contents. This surface shall be at least 0.02 inch thick.
- O. The resin shall not contain fillers except as required for viscosity control. The limit of filler shall be 5 percent by weight and shall not interfere with visual inspection. No fillers or bulking agents shall be used in the exterior structural layer to decrease the glass loading ratio. Tanks shall be dry heat post cured in accordance with resin manufacturer's guidelines.
- P. The tank top shall be domed with openings and connections as shown and specified. The tank top shall be able to support a 250-pound load on a 4-inch by 4-inch area. Tank bottom shall be seamless.
- Q. Where specified in the Tank Schedule, chemical storage tanks shall be provided with heating panels and insulation. Tank top and sidewalls shall be insulated with 2 inches of 2 lb/ft³ polyurethane foam board insulation. The insulation shall be overwrapped with a minimum 100-150 mil thick glass-fiber resin laminate with a light gray pigmented exterior gel coat weatherproof protective coating 10 mils thick.

2.03 CONNECTIONS AND ACCESSORIES

- A. All connections/openings shall be flanged in accordance with ANSI B16.5 150 pounds and provided with flanged gasket. Flanged connections, nozzles, and openings shall be FRP gusseted and flat face.
- B. All pipe supports, hardware, accessories, etc., shall be provided. Vertical piping into the tanks shall be supported every five feet and shall be parallel to the tank wall and not less than 6 inches from the tank wall.
- C. Tank drain connections shall be siphon drain connections. Each tank drain line shall be provided with a ball valve. The drain line shall connect to the overflow through a tee fitting as shown on the Drawings.
- D. Vent lines shall be top-mounted. Each vent shall be extended to the atmosphere and shall have a 180 degree return and a fiberglass vent insect screen. Vent lines shall be supplied and furnished by the Contractor as required or as directed by the Engineer.
- E. Each storage tank fill line shall be provided with a quick connect coupling with either a ball check valve located downstream or an integral check valve. The dry quick connections shall be provided between the delivery vehicle and the chemical storage tanks as shown on the Drawings. The dry quick connections shall be resistant to corrosion by the specified chemicals and shall be provided with fittings, quick lock coupling and dust cap and chain. Quick connect couplings shall be as specified in Section 15000. The Contractor shall furnish and install a sign at each chemical fill station to identify the chemical filled. The signage shall be as specified in Section 10400.
- F. The tank manufacturer shall provide Flange Insert Check Valves (FIV's) for interior storage tanks as shown on the Drawings. The FIVs shall be installed on the overflow lines and shall be complete with unions, liquid traps, and flanges as indicated in the Drawings. The valves shall be as specified in Section 15114, Check Valves.
- G. Each tank shall be provided with a level sensor as indicated on the Drawings and as specified in Division 17. The mounting and connecting requirements shall be coordinated with the instrument and control system subcontractor.
- H. Each tank shall be provided with flat-faced flanged manways with gaskets and blind flanges that are chemically resistant.
- I. Each storage tank shall be equipped with an exterior access ladder for access to the manway. The ladder for sodium hypochlorite and ferric chloride tanks shall be constructed of FRP, and the ladder for sodium bisulfite tanks shall be constructed of FRP or stainless steel. Ladder shall meet OSHA requirements, including allowable distance from the concrete floor or grating to the first rung. Ladder shall provide 18 inches between side rails and 12 inches between rungs. Angle clips shall be furnished for mounting the bottom of the ladder to the concrete pad or grating. Ladders shall be furnished with gooseneck handrails at the top. The tank top shall be equipped with ladder clips to bolt ladder handrails thereto. Each tank ladder shall be equipped with a fall prevention system equal to the North Consumer Products "Saf-T-Climb" system. All construction materials shall be identical to the materials of construction of the ladder. The fall prevention system shall be equipped with rung clamp assemblies at 6 ft. maximum spacing and a dismount section extending 4'-

6" above the landing level or 2 ft. above a railing. The fall prevention system shall meet or exceed federal specification RR-S-001301 and all OSHA regulations. Equipment shall be tested according to ANSI 14.3.

- J. Each tank shall be provided with a minimum of four lifting lugs, three of them around the top edge of the tank and one at the base of the tanks. Lifting lugs shall be capable of withstanding weight of an empty tank with a safety factor of 3 to 1.
- K. Each tank shall be provided with a minimum of six tie-down lugs and all necessary and anchor bolts. The tank shall withstand horizontal loadings of 40 pounds per square foot or the maximum wind load at the location in accordance with the latest building code for the area under the worst condition, whichever is greater. Tie-down lugs shall be capable of withstanding buoyancy of empty tank in a flooded containment area. The tank manufacturer shall submit calculations to verify that tie-down lugs can withstand buoyance and wind load.
- L. The tank shall be provided with a permanently attached label providing the following information:
 - 1. Type of material stored
 - 2. Concentration of material stored
 - 3. Specific gravity
 - 4. Maximum temperature
 - 5. Type of liner resin and reinforcement
 - 6. Type of surface veil
 - 7. Tank capacity
 - 8. Manufacturer
 - 9. Date of manufacture
- M. All metallic parts, fasteners, brackets, mounting hardware, and accessories provided by the tank manufacturer shall be constructed of corrosion resistant metals as specified in the Tank Schedule.

2.04 HORIZONTAL PIPING SUPPORT

- A. All PVC or CPVC piping inside the containment area and trench shall be supported by thermoplastic pads at maximum 5 foot intervals as shown in the Drawings to prevent the piping from resting directly on concrete.

2.05 ELECTRICAL AND CONTROL REQUIREMENTS

- A. Where specified in the Storage Tank Schedule, chemical storage tanks shall be provided with heating panels. A minimum of three (3) 500-watt, 120 VAC fully grounded electrical heating panels shall be provided for each tank to maintain the temperature of the tank contents at 40°F at an outside temperature of -10°F. The system shall be provided with 2 NEMA 4X thermostats, one to control the panels and one high limit. The heat panels shall be low watt density heat panels that shall operate without damage to the tank when the tank is empty.

PART 3 -- EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

- A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 11000, Equipment General Provisions and shall include the following site visits for each series of tanks:

Service	Number of Trips	Number of Days/Trip
Installation and Testing	1	1
Startup and Training	1	1
Services after Startup	1	1
Annual Inspections	5	1

3.02 INSTALLATION

- A. The Contractor shall furnish and install the Fiberglass Reinforced Plastic storage tanks, and related items in accordance with the manufacturers' recommendations and in accordance with Section 11000, Equipment General Provisions.
- B. All piping, valves, fittings, conduit, wiring, etc., required to interconnect system components shall be furnished and installed by the Contractor. Unless otherwise noted, piping shall be Schedule 80 CPVC.
- C. All metallic fasteners, brackets, mounting hardware, and accessories located in sodium hypochlorite and ferric chloride storage and feed areas shall be constructed of Hastelloy C. All metallic fasteners, brackets, mounting hardware, and accessories located in sodium bisulfite storage and feed areas shall be constructed of 316 stainless steel.
- D. The Contractor shall install 2 layers of roofing paper between each concrete pad and storage tank. The tanks shall be installed on level pads.

3.03 FIELD TESTING

- A. Field testing shall be performed in accordance with Section 11000, Equipment General Provisions.
- B. Upon completion of installation of tank and prior to connecting piping, the Contractor shall provide blind flanges or other suitable plugs for all openings in the tanks, fill tanks with clean water provided by the Owner from a source approved by the Engineer and conduct a leakage test as specified herein. Tanks shall be filled up to the top of the straight shell of the tank and left to sit over a 2-day test period. There shall be no leakage over the test period. Leakage around openings in the tanks shall be stopped by tightening nuts and bolts or replacing gaskets as required. Upon satisfactory completion of leakage test, Contractor shall drain the tanks and dispose of water in a suitable manner.

- END OF SECTION -

SECTION 15000

BASIC MECHANICAL REQUIREMENTS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install to the required line and grade, all piping together with all fittings and appurtenances, required for a complete installation. All piping located outside the face of structures or building foundations and all piping embedded in concrete within a structure or foundation shall be considered exterior piping.
- B. The Contractor shall furnish and install fittings, couplings, connections, sleeves, adapters, harness rods and closure pieces as required to connect pipelines of dissimilar materials and/or sizes herein included under this Section and other concurrent Contracts for a complete installation.
- C. The Contractor shall furnish all labor, materials, equipment, tools, and services required for the furnishing, installation and testing of all piping as shown on the Drawings, specified in this Section and required for the Work. Piping shall be furnished and installed of the material, sizes, classes, and at the locations shown on the Drawings and/or designated in this Section. Piping shall include all fittings, adapter pieces, couplings, closure pieces, harnessing rods, hardware, bolts, gaskets, wall sleeves, wall pipes, hangers, supports, and other associated appurtenances for required connections to equipment, valves, or structures for a complete installation.
- D. Piping assemblies under 4-inch size shall be generally supported on walls and ceilings, unless otherwise shown on the Drawings or ordered by the Engineer, being kept clear of openings and positioned above "headroom" space. Where practical, such piping shall be run in neat clusters, plumb and level along walls, and parallel to overhead beams.
- E. The Contractor shall provide taps on piping where required or shown on the Drawings. Where pipe or fitting wall thicknesses are insufficient to provide the required number of threads, a boss or pipe saddle shall be installed.
- F. The work shall include, but not be limited to, the following:
 - 1. Connections to existing pipelines.
 - 2. Test excavations necessary to locate or verify existing pipe and appurtenances.
 - 3. Installation of all new pipe and materials required for a complete installation.
 - 4. Cleaning, testing and disinfecting as required.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Division 1, General Requirements

- B. Division 2, Sitework
- C. Division 9, Finishes
- D. Division 11, Equipment
- E. Division 16, Electrical

1.03 MATERIAL CERTIFICATION AND SHOP DRAWINGS

- A. The Contractor shall furnish to the OWNER (through the Engineer) a Material Certification stating that the pipe materials and specials furnished under this Section conform to all applicable provisions of the corresponding Specifications. Specifically, the Certification shall state compliance with the applicable standards (ASTM, AWWA, etc.) for fabrication and testing.
- B. Shop Drawings for major piping (2-inches in diameter and greater) shall be prepared and submitted in accordance with Section 01300 – Submittals. In addition to the requirements of Section 01300 – Submittals, the Contractor shall submit laying schedules and detailed Drawings in plan and profile for all piping as specified and shown on the Drawings.
- C. Shop Drawings shall include, but not be limited to, complete piping layout, pipe material, sizes, class, locations, necessary dimensions, elevations, supports, hanger details, pipe joints, and the details of fittings including methods of joint restraint. No fabrication or installation shall begin until Shop Drawings are approved by the Engineer.

PART 2 -- PRODUCTS

2.01 GENERAL

- A. All specials and every length of pipe shall be marked with the manufacturer's name or trademark, size, class, and the date of manufacture. Special care in handling shall be exercised during delivery, distribution, and storage of pipe to avoid damage and unnecessary stresses. Damaged pipe will be rejected and shall be replaced at the Contractor's expense. Pipe and specials stored prior to use shall be stored in such a manner as to keep the interior free from dirt and foreign matter.
- B. Testing of pipe before installation shall be as described in the corresponding ASTM or AWWA Specifications and in the applicable standard specifications listed in the following sections. Testing after the pipe is installed shall be as specified in Section 3.09.
- C. Joints in piping shall be of the type as specified in the appropriate Piping System Schedule in Section 15390, Schedules.
- D. ALL BURIED EXTERIOR PIPING SHALL HAVE RESTRAINED JOINTS FOR THRUST PROTECTION UNLESS OTHERWISE SPECIFIED OR SHOWN ON THE DRAWINGS. ALL EXPOSED EXTERIOR PIPING SHALL HAVE FLANGED JOINTS, UNLESS OTHERWISE SPECIFIED OR SHOWN ON THE DRAWINGS.

- E. The Drawings indicate work affecting existing piping and appurtenances. The Contractor shall excavate test pits as required of all connections and crossings which may affect the Contractor's work prior to ordering pipe and fittings to determine sufficient information for ordering materials. The Contractor shall take whatever measurements that are required to complete the work as shown or specified.

2.02 WALL PIPES

- A. Where wall sleeves or wall pipes occur in walls that are continuously wet on one or both sides, they shall have water stop flanges at the center of the casting or as shown on the Drawings. Ends of wall pipes shall be flange, mechanical joint, plain end, or bell as shown on the Drawings, or as required for connection to the piping. Wall pipes shall be of the same material as the piping that they are connected to. If welded waterstop flanges are employed, welds shall be 360 degree continuous on both sides of flange. Unless otherwise shown on the Drawings, waterstop flanges shall conform to the minimum dimensions shown below:

<u>Pipe Size</u>	<u>Waterstop Flange Diameter</u>	<u>Waterstop Flange Thickness</u>
4" - 12"	OD + 3.10"	0.50"
14" - 24"	OD + 4.15"	0.75"
30" - 36"	OD + 4.50"	1.00"
42" - 48"	OD + 5.00"	1.25"
54"	OD + 5.90"	1.50"

2.03 SLEEVES

- A. Unless shown otherwise, all piping passing through walls and floors shall be installed in sleeves or wall castings accurately located before concrete is poured, or placed in position during construction of masonry walls. Sleeves passing through floors shall extend from the bottom of the floor to a point 3 inches above the finished floor, unless shown otherwise. Water stop flanges are required on all sleeves located in floors or walls which are continually wet or under hydrostatic pressure on one or both sides of the floor or wall.
- B. Sleeves shall be cast iron, black steel pipe, or fabricated steel in accordance with details shown on the Drawings. If not shown on the Drawings, the Contractor shall submit to the Engineer the details of sleeves he proposes to install; and no fabrication or installation thereof shall take place until the Engineer's approval is obtained. Steel sleeves shall be fabricated of structural steel plate in accordance with the standards and procedures of AISC and AWS. Steel sleeve surfaces shall receive a commercial sandblast cleaning and then be shop painted in accordance with Section 09900 – Painting.
- C. When shown on the Drawings or otherwise required, the annular space between the installed piping and sleeve shall be completely sealed against a maximum hydrostatic pressure of 20 psig. Seals shall be mechanically interlocked, solid rubber links, trade name "Link-Seal", as manufactured by the Thunderline Corp., Wayne, Michigan, or equal. Rubber link, seal-type, size, and installation thereof, shall be in strict accordance with the manufacturer's recommendations. For non-fire rated walls and floors, pressure plate shall

be glass reinforced nylon plastic with EPDM rubber seal and 304 stainless steel bolts and nuts. For fire rated walls and floors, two independent seals shall be provided consisting of low carbon steel, zinc galvanized pressure plates, silicon rubber seals and low carbon steel, zinc galvanized bolts and nuts.

- D. Cast iron mechanical joint; adapter sleeves shall be Clow # 1429, as manufactured by the Clow Corp., or equal. Mechanical joint adapter sleeves shall be provided with suitable gasket, follower ring, and bolts to effect a proper seal. In general, sleeves installed in walls, floors, or roofs against one side of which will develop a hydrostatic pressure, or through which leakage of liquid will occur, shall be so sealed. If welded waterstop flanges are employed, welds shall be 360 degree continuous on both sides of flange.

2.04 SOLID SLEEVE COUPLINGS

- A. Solid sleeve couplings shall be used to connect buried service piping where shown on the Drawings. Solid sleeves shall be ductile iron, long body and shall conform to the requirements of ANSI A21.10 (AWWA C110). Unless otherwise shown or specified, solid sleeve couplings shall be Style A11760 as manufactured by American Cast Iron Pipe Co., or equal.

2.05 FLEXIBLE COUPLINGS

- A. Flexible couplings shall be as manufactured by the Red Valve Company and shall consist of a molded reinforced fabric of cotton and natural rubber. Galvanized steel retaining rings shall be furnished. End connections shall match ANSI 125 pound flanges with a minimum pressure rating of 140 psi.

2.06 SLEEVE TYPE COUPLINGS

- A. Sleeve type, flexible couplings shall be furnished and installed where shown on the Drawings or otherwise required to resist internal operating pressures. In addition to that specified herein, harnessed, sleeve type flexible couplings shall be provided on all exposed pipe 3 inches and larger in diameter that spans any expansion joint in a building or structure.
- B. Materials shall be of high strength steel and couplings shall be rated for the same pressures as the connecting piping.
- C. Gaskets shall be rubber. Bolts and nuts shall be alloy steel, corrosion-resistant and prime coated.
- D. Couplings shall be shop primed with a premium quality primer compatible with the painting system specified in Section 09900 - Painting. Field painting of wetted area shall be done prior to installation.
- E. Harnessing
 - 1. Harness couplings to adjacent flanges as shown, specified or otherwise required to restrain all pressure piping.

2. Dimensions, sizes, spacing and materials for lugs, tie rods, washers, and nuts shall conform to the standards for the pipe size, and design pressure specified.
 3. No less than two (2) bolts shall be furnished for each coupling.
 4. Tie bolts, nuts and washers shall be ASTM A 193, Grade B7 steel or better.
 5. Harness rods shall have lengths less than 10 feet between adjacent flanged joints on fittings and shall be coated in accordance with Section 09900 – Painting.
- F. Couplings shall be as manufactured by Dresser Industries, Style 38, or equal as required and shown on the Drawings. All couplings shall be provided without interior pipe stop.

2.07 FLANGED ADAPTERS

- A. Flanged adapters shall be furnished as required and as shown on the Drawings.
- B. All flanged adapters, 12 inches in diameter and smaller, except as shown on the Drawings or directed by the Engineer, shall be locking type flanged adapters.
- C. Pressure and service shall be the same as connected piping.
- D. Materials shall be cast iron for pipes up to 12 inch diameter and high strength steel for pipes larger than 12 inch diameter.
- E. Flanged adapters shall be shop primed with a premium quality primer compatible with the paint system specified in Section 09900 – Painting. Field painting of wetted area shall be done prior to installation.
- F. Bolts and nuts shall be alloy steel, corrosion-resistant and prime coated.
- G. Flanged coupling adapters larger than 12 inches in diameter shall be harnessed by tying the adapter to the nearest pipe joint flange using threaded rods and rod tabs. The threaded rods and rod tabs shall be as shown on the Drawings.
- H. Flanged adapters shall be as manufactured by Dresser Industries, Style 127 or 128, Smith Blair Corporation, or equal.

2.08 MECHANICAL COUPLINGS (SPLIT TYPE - SHOULDERED END)

- A. Mechanical couplings (split type-shouldered end) shall be furnished as specified or shown on the Drawings.
- B. Materials shall be of malleable iron and couplings shall be rated for the same pressures as the connecting piping.
- C. Gaskets shall be rubber. Bolts and nuts shall be heat treated carbon steel track bolts and shall be plated.

- D. After installation, buried couplings shall receive two heavy coats of an approved coal tar which is compatible with the finish of the coupling. Exposed couplings shall be painted in accordance with Section 09900 - Painting.
- E. Couplings shall be as manufactured by Victaulic Company of America, Style 44, or equal.

2.09 TAPPING SLEEVES AND TAPPING SADDLES

- A. Tapping sleeves shall be similar to Mueller Outlet Seal, American Uniseal or Kennedy Square Seal. All sleeves shall have a minimum working pressure of 150 psi. All sleeves larger than twelve (12) inches shall be ductile iron. All taps shall be machine drilled; no burned taps will be allowed.
- B. Tapping saddles may be used on mains sixteen (16) inches and larger where the required tap size does not exceed one-half the size of the main (i.e. 8-inch tapping saddle for use on a 16-inch main). Tapping saddles shall be manufactured of ductile iron providing a factor of safety of at least 2.5 at a working pressure of 250 psi. Saddles shall be equipped with a standard AWWA C-110-77 flange connection on the branch. Sealing gaskets shall be "O" ring type, high quality molded rubber having an approximate seventy durometer hardness, placed into a groove on the curved surface of the tapping saddles. Straps shall be of alloy steel. The tapping saddle shall be the American tapping saddle, U.S. Pipe tapping saddle, or equal. All taps shall be machine cut, no burned taps will be allowed.

2.10 UNIONS

- A. For ductile iron, carbon steel, and grey cast iron pipes assembled with threaded joints and malleable iron fittings, unions shall conform to ANSI B16.39.
- B. For copper piping, unions shall have ground joints and conform to ANSI B16.18.
- C. For PVC and CPVC piping, unions shall be socket weld type with Viton O-ring.

2.11 THERMOPLASTIC TUBING AND FITTINGS

- A. Thermoplastic tubing shall be manufactured from polyallomor tubing. Tubing shall be protected from ultraviolet radiation degradation with a black coating or integral color conforming to ASTM D-1248, Type 1, Class C, Category 3. Fittings and connectors used with thermoplastic tubing shall be the flareless tube type constructed of brass conforming to SAE CA377, SAE CA360 or equal. Brass sleeves shall be used.
- B. Assembly of the thermoplastic tubing shall consist of pushing the tubing into the fitting and hand tightening the nut with final tightening with a wrench. Care shall be taken not to overtighten the nut. Plastic tube racks and bend holders shall be provided for holding the tubing in position. Needle valves used with thermoplastic tubing shall be the globe type constructed with a brass body, stem and seat and Buna-N "O"-ring seals. Installation shall be in accordance with the manufacturer's recommendations. Thermoplastic tubing, shall be the Impolene (polyallomor) system and needle valves, fittings and connectors shall be the Poly-Flo with 261 UB Universal Nut and Sleeve system as manufactured by Imperial Eastman, or equal.

2.12 HEAT TRACED PIPING

- A. Exposed pipes to be insulated shall also be protected from freezing by heat tracing. Freeze protection heat tracing shall consist of twin 16 AWG copper brass wires with a semiconductor polymer core where electrical resistance varies with temperature. The heat tracing shall have a fluoropolymer outer jacket for corrosion resistance. The heat tracing shall be rated for three (3) watts per foot output, self-regulating with a maximum

temperature of 150°F, equal to a Chromalox No. SRL3-1CT383400. Maximum length for tape shall be 300 feet for each circuit. Temperature controller shall be provided to sense pipe temperature to determine on or off condition of the heat tracing. Temperature control shall be equal to a Chromalox No. RTBC-2-384729. The heat tracing system shall operate on 120 VAC. See Drawings for installation detail. Heat tracing of piping shall be provided as specified in Section 15390 – Schedules.

2.13 FLEXIBLE RESTRAINED EXPANSION JOINTS

- A. Restrained expansion joints shall be manufactured of 60-42-10 ductile iron conforming to material and other applicable requirements of ANSI/AWWA C153/A21.53.
- B. Each pressure containing component shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the materials requirements of, and tested in accordance with, ANSI/AWWA C213 and shall meet or exceed the requirements of ANSI/AWWA C550.
- C. Seals shall conform to the applicable requirements of ANSI/AWWA C111/A21.11.
- D. All bolts used in the assemblies shall be stainless steel and shall be coated with a premium quality epoxy.
- E. Flanged ends shall comply with ANSI/AWWA C110/A21.10, with the addition of O-ring groove and O-ring.
- F. Mechanical joint ends shall comply with ANSI/AWWA C153/A21.53.
- G. Restrained expansion joints shall have a minimum pressure rating of 350 psi with a minimum safety factor of 3:1. Each assembly shall be tested at 350 psi before shipment.
- H. Restrained expansion joints shall provide for self restraint without tie rods and shall provide for expansion and contraction capabilities cast as an integral part of the end connection.
- I. Flexible restrained expansion joints shall allow for 8-inches (+6"-2") minimum expansion.
- J. Flexible restrained expansion joints shall consist of an expansion joint designed and cast as an integral part of a ball and socket type flexible joint having a minimum of 15° deflection per ball.
- K. Restrained expansion joints shall be the Single Ball or Double Ball FLEX-TEND Expansion Joint as manufactured by EBAA Iron Inc., or equal.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. All piping shall be installed by skilled workmen and in accordance with the best standard practice for piping installation as shown on the Drawings, specified or recommended by the pipe manufacturer. Proper tools and appliances for the safe and convenient handling and installing of the pipe and fittings shall be used. Great care shall be taken to prevent any pipe coating from being damaged on the inside or outside of the pipe and fittings. All pieces

shall be carefully examined for defects, and no piece shall be installed which is known to be cracked, damaged, or otherwise defective. If any defective pieces should be discovered after having been installed, it shall be removed and replaced with a sound one in a satisfactory manner by the Contractor and at his own expense. Pipe and fittings shall be thoroughly cleaned before they are installed and shall be kept clean until they are accepted in the complete work. All piping connections to equipment shall be provided with unions or coupling flanges located so that piping may be readily dismantled from the equipment. At certain applications, Dresser, Victaulic, or equal, couplings may also be used. All piping shall be installed in such a manner that it will be free to expand and contract without injury to itself or to structures and equipment to which it is connected. All piping shall be erected to accurate lines and grades with no abrupt changes in line or grade and shall be supported and braced against movement, temporary, or permanent. All exposed piping shall be installed with vertical and horizontal angles properly related to adjoining surfaces or pipes to give the appearance of good workmanship. Unless otherwise shown or approved, provided a minimum headroom clearance under all piping of 7 feet 6 inches.

- B. Unless otherwise shown or specified, all waste and vent piping shall pitch uniformly at a 1/4-inch per foot grade and accessible cleanouts shall be furnished and installed as shown and as required by local building codes. Installed length of waste and vent piping shall be determined from field measurements in lieu of the Drawings.
- C. All excavation shall be made in such a manner and to such widths as will provide ample room for properly installing the pipe and permit thorough compaction of backfill around the pipe. The minimum trench widths shall be in strict accordance with the "Trench Width Excavation Limits" as shown on the Drawings. All excavation and trenching shall be done in strict accordance with these specifications and all applicable parts of the OSHA Regulations, 29CFR 1926, Subpart P.
- D. ALL EXCAVATION REQUIRED BY THIS CONTRACT SHALL BE UNCLASSIFIED. NO ADDITIONAL PAYMENT WILL BE MADE FOR ROCK EXCAVATION REQUIRED FOR THE INSTALLATION OF PIPE OR STRUCTURES SHOWN ON THE DRAWINGS.
- E. Enlargements of the trench shall be made as needed to give ample space for operations at pipe joints. The width of the trench shall be limited to the maximum dimensions shown on the Drawings, except where a wider trench is needed for the installation of and work within sheeting and bracing. Except where otherwise specified, excavation slopes shall be flat enough to avoid slides which will cause disturbance of the subgrade, damage to adjacent areas, or endanger the lives or safety of persons in the vicinity.
- F. Hand excavation shall be employed wherever, in the opinion of the Engineer, it is necessary for the protection of existing utilities, poles, trees, pavements, or obstructions.
- G. No greater length of trench in any location shall be left open, in advance of pipe laying, than shall be authorized or directed by the Engineer and, in general, such length shall be limited to approximately one hundred (100) feet. The Contractor shall excavate the trenches to the full depth, width and grade indicated on the Drawings including the relevant requirements for bedding. The trench bottoms shall then be examined by the Engineer as to the condition and bearing value before any pipe is laid or bedding is placed.
- H. No pressure testing shall be performed until the pipe has been properly backfilled in place. All pipe passing through walls and/or floors shall be provided with wall pipes or sleeves in

accordance with the specifications and the details shown on the Drawings. All wall pipes shall be of ductile iron and shall have a water stop located in the center of the wall. Each wall pipe shall be of the same class, thickness, and interior coating as the piping to which it is joined. All buried wall pipes shall have a coal tar outside coating on exposed surfaces.

- I. JOINT DEFLECTION SHALL NOT EXCEED 75 PERCENT OF THE MANUFACTURERS RECOMMENDED DEFLECTION. Excavation and backfilling shall conform to the requirements of Section 02200 - Earthwork, and as specified herein. Maximum trench widths shall conform to the Trench Width Excavation Limits shown on the Drawings. All exposed, submerged, and buried piping shall be adequately supported and braced by means of hangers, concrete piers, pipe supports, or otherwise as may be required by the location.
- J. Following proper preparation of the trench subgrade, pipe and fittings shall be carefully lowered into the trench so as to prevent dirt and other foreign substances from gaining entrance into the pipe and fittings. Proper facilities shall be provided for lowering sections of pipe into trenches. UNDER NO CIRCUMSTANCES SHALL ANY OF THE MATERIALS BE DROPPED OR DUMPED INTO THE TRENCH.
- K. Water shall be kept out of the trench until jointing and backfilling are completed. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no water, earth, or other substance will enter the pipes, fitting, or valves. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored as required.
- L. All piping shall be installed in such a manner that it will be free to expand and/or contract without injury to itself or to structures and equipment to which it is connected. All piping shall be erected to accurate lines and grades with no abrupt changes in line or grade and shall be supported and braced against movement, temporary, or permanent. All exposed piping shall be installed with vertical and horizontal angles properly related to adjoining surfaces or pipes to give the appearance of good workmanship. Pipes crossing within a vertical distance of less than or equal to one (1) foot shall be encased and supported with concrete at the point of crossing to prevent damage to the adjacent pipes as shown on the Drawings.
- M. The full length of each section of pipe shall rest solidly upon the bed of the trench, with recesses excavated to accommodate bells, couplings, joints, and fittings. Before joints are made, each pipe shall be well bedded on a solid foundation; and no pipe shall be brought into position until the preceding length has been thoroughly bedded and secured in place. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid by the Contractor at his own expense. Pipe shall not be laid in water or when trench conditions are unsuitable for work.
- N. Proper and suitable tools and appliances for the safe convenient handling and laying of pipe shall be used and shall in general agree with manufacturer's recommendations.
- O. AT THE CLOSE OF EACH WORK DAY THE END OF THE PIPELINE SHALL BE TIGHTLY SEALED WITH A CAP OR PLUG SO THAT NO WATER, DIRT, OR OTHER FOREIGN SUBSTANCE MAY ENTER THE PIPELINE, AND THIS PLUG SHALL BE KEPT IN PLACE UNTIL PIPE LAYING IS RESUMED.

- P. During the laying of pipe, each pipe manufacturer shall provide his own supervisor to instruct the Contractor's pipe laying personnel in the correct procedure to be followed.
- Q. Ordinarily only full lengths of pipe (as furnished by the pipe manufacturer) shall be used. Exceptions: (closure pieces at manholes and areas where joint deflection is required):
- R. For gravity sewer installations, the Contractor shall use a laser device to maintain the trench and pipe alignment. The laser device shall be re-checked for correct elevation and pipe alignment prior to pipe installation if the device is left in the pipe overnight. Corrected invert elevations at each manhole and any adjustments will be coordinated and approved by the Engineer.
- S. ALL PIPING SHALL HAVE TYPE "A" BEDDING AS SHOWN ON THE DRAWINGS, UNLESS OTHERWISE SPECIFIED HEREIN OR INDICATED ON THE DRAWINGS.
- T. Detector tape shall be installed 12 inches below final grade and directly above all buried potable water piping. The tape shall be blue and silver and shall be clearly and permanently labeled "Water". Detector tape shall be Lineguard III as manufactured by Lineguard, Inc., or equal.
- U. AT THE CLOSE OF WORK EACH DAY PIPELINE TRENCHES SHALL BE COMPLETELY BACKFILLED. IN PAVED AREAS THE SURFACE SHALL BE RESTORED AS SPECIFIED IN SECTION 02510, PAVING AND SURFACING, TO ALLOW FOR TRAFFIC OVER THE TRENCH DURING NON-WORKING HOURS. UNDER NO CONDITIONS SHALL ANY PIPELINE TRENCH BE LEFT OPEN DURING NON-WORKING HOURS.

3.02 REINFORCED CONCRETE PIPE, CONCRETE CULVERT, AND DRAIN PIPE

- A. The laying of reinforced concrete pipe shall conform to the applicable sections of the Concrete Pipe Handbook as published by the American Concrete Pipe Association.

3.03 PRESTRESSED CONCRETE PIPE

- A. The laying of prestressed concrete pipe shall be in accordance with the manufacturer's recommendations and shall conform to the applicable sections of AWWA Manual M-9. Prior to assembling the spigot end into the bell end, both ends shall be thoroughly cleaned and the rubber gasket and the bell end of the previously laid pipe shall be coated with vegetable soap furnished by the manufacturer.
- B. For each crew that is inexperienced in laying this type of pipe, one reliable man shall be furnished by the manufacturer's representative with and instructed in the use of a set of steel inserts and feeler gauge to be used in determining if the rubber gasket is in proper position prior to the joint being pushed or pulled home. An experienced crew may omit the use of a feeler gauge. In either method of operation, the Contractor shall be responsible for a good, proper and sound joint. Any joint found in later tests to be faulty shall be repaired to the satisfaction of the Engineer.
- C. After the pipe is "home" a cloth diaper (minimum 7-inches wide) supplied by the pipe manufacturer shall be placed and wired around the outside of the pipe at the joint. This diaper shall serve as a form for pouring a 1:2 cement-sand grout in the external recess.

- D. Great care shall be taken to prevent the concrete core or jacket or the steel bell and spigot rings from being damaged, and any core, jacket or ring damaged in any way shall be repaired or replaced by the Contractor to the satisfaction of the Engineer.

3.04 DUCTILE IRON PIPE

- A. Ductile iron pipe (DIP) shall be installed in accordance with the requirements of the Ductile Iron Pipe Handbook published by the Ductile Iron Pipe Research Association, and AWWA C600.
- B. Where it is necessary to cut ductile iron pipe in the field, such cuts shall be made carefully in a neat workmanlike manner using approved methods to produce a clean square cut. The outside of the cut end shall be conditioned for use by filing or grinding a small taper, at an angle of approximately 30 degrees.
- C. UNLESS OTHERWISE APPROVED BY THE ENGINEER, FIELD WELDING OF DUCTILE IRON WILL NOT BE PERMITTED.

3.05 PVC/CPVC AND HDPE PIPE

- A. Polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC) and High Density Polyethylene (HDPE) pipe shall be laid and joints assembled according to the respective manufacturer's recommendation. PVC pipe installation shall comply with applicable sections of the Uni-Bell PVC Pipe Association Recommended Standard Specifications.
- B. Plastic piping shall not be installed when the temperature is less than 60°F except as otherwise recommended by the manufacturer and approved by the Engineer.

3.06 CARBON AND STAINLESS STEEL PIPE

- A. Installation of steel pipe shall be by skilled workmen and shall conform to the applicable sections of AWWA Manual M-11. Joints for steel piping shall be either screwed, welded, or flanged as shown on the Drawings or as specified.
- B. Welding in the field shall be performed only when requested on the shop drawings and permitted by the Engineer for carbon steel pipe. No welding of stainless steel pipe shall be allowed in the field. All field welds shall be radiographically inspected.
- C. Installation of the steel casing pipe shall be by skilled workmen and in accordance with the best standard practice for steel pipe installation. Joints for steel casing pipe shall be butt welded.
 - 1. The boring equipment to be used for installing the jacked casing shall be of such size and capacity to allow the boring to proceed in a safe and expeditious manner. The installation of the casing and boring of the hole shall be done simultaneously to avoid cave-ins or settlement and for safety of traffic above.
 - 2. The Contractor shall check the vertical and horizontal alignment of the casing by survey instrument at least once during each four feet of advance, or as directed by the Engineer. Pits shall be well sheeted and braced as necessary for safe and

adequate access for workmen, inspectors and materials and shall be of a size suitable to equipment and material handling requirements.

3. Under no conditions shall jetting or wet boring of encasement under pavement be allowed.
4. After installation of the carrier pipe, each end of the casing pipe shall be made watertight with a brick masonry bulkhead. In addition, a Class B concrete cradle shall be provided from each end of the bulkhead to the first pipe joint outside of the bulkhead.

3.07 COPPER PIPE

- A. Installation of copper pipe shall be by skilled workman in accordance with the manufacturer's recommendations. Use teflon tape at all fittings unless otherwise required for intended service. Install unions at the connections to each piece of equipment to allow removal of equipment without dismantling connecting piping.
- B. Wall sleeves shall be provided for all piping passing through exterior walls and shall be of the same material as the piping to which it is joined. All wall sleeves shall be provided with an acceptable waterstop.
- C. The Contractor shall provide hot and cold water mains with branches and risers complete from point indicated on the Drawings running to all fixtures and other outlets indicated. Mains and branches shall be run generally as shown on the Drawings. The Contractor shall provide all interior water piping, branches, and risers as shown on the Drawing and shall make connections to all plumbing fixtures, hose bibs, wall hydrants, and other points requiring water under this and other Divisions of the Specifications.
- D. All water mains and branches shall be pitched at least one (1) inch in twenty-five (25) feet toward fixtures. The piping installation shall be arranged so that the entire system can be drained through fixture supply connections.
- E. Unions shall be installed at the connections to each piece of equipment to allow for removal of equipment without dismantling connecting piping.
- F. Joints 1-1/4 inches and larger shall be made with silver solder. For joints less than 1-1/4 inches and all valves (regardless of size) use 95/5 solder. Soldered joints shall be prepared with a non-corrosive paste flux in accordance with manufacturer's instructions. All joints shall be thoroughly cleaned with emery cloth and reamed out before assembly. Acid core solder will not be permitted.

3.08 POLYPROPYLENE AND POLYVINYLIDENE FLUORIDE PIPE

- A. The pipe and fittings shall be of the same material for both inner and outer walls of the pipe.
- B. Polypropylene pipe shall be black UV stabilized co-polymer conforming to the requirements of ASTM D-4101. Where used in exterior locations, material shall provide a weathering resistance absent of further coating, covering, or wrapping unless specified herein or shown on the Drawings.

- C. Polyvinylidene flouride shall comply with ASTM D-3222. The material shall provide a translucence, thus enabling a visual inspection of liquid in the annular space between the inner and outer walls.
- D. Where elastomers are selected by the manufacturer, such selection shall be with regard to the application of the chemical solution to be transported.
- E. Pipe and associated fittings shall be rated for not less than 75 psi at 73°F.
- F. Double-walled pipe and fittings shall be molded and used throughout. Molded ribs shall maintain permanent alignment of the inner and outer walls of the pipe and fittings.
- G. Ends of fittings shall be flush, creating a single plane.
- H. Wall thickness of the inner and outer walls of double-walled pipe shall be identical, providing identical pressure ratings.
- I. Where shown on the Drawings, a leak detection system of the manufacturer's design shall be supplied, complete with vent pipes, manual drain outlet, and electric float switch. Switch shall be rated for 0.080 amps at 120 VAC.
- J. Polypropylene and polyvinylidene flouride pipe shall be laid and joints assembled by skilled workers according to the respective manufacturer's recommendations. Joints shall be butt fusion welded.
- K. Plastic piping shall not be installed when the ambient temperature is less than 60°F except as otherwise recommended by the manufacturer and approved by the Engineer.
- L. Wall sleeves shall be provided where piping passes through exterior walls. All sleeves shall be provided with an acceptable waterstop.
- M. Double walled pipe shall be Asahi/American or equal. Pipe shall be furnished complete with flanges or other appurtenant fittings by the same manufacturer and made especially for use with the double walled pipe.

3.09 JOINTS IN PIPING

- A. Restrained joints shall be provided on all pipe joints as specified herein and shown on the Drawings. Restrained joints shall be made up similar to that for push-on joints.
- B. Push-on joints include a single rubber gasket which fits into the bell end of the pipe. The gasket shall be wiped clean, flexed and then placed in the socket. Any bulges in the gasket which might interfere with the entry of the plain end of the pipe shall be removed. A thin film of lubricant shall be applied to the gasket surface which will come into contact with the spigot end of the pipe. The lubricant shall be furnished by the pipe manufacturer. The plain end of the pipe, which is tapered for ease of assembly, shall be wiped clean and a thick film of lubricant applied to the outside. The pipe shall be aligned and carefully entered into the socket until it just makes contact with the gasket. The joint assembly shall be completed by entering the pipe past the gasket until it makes contact with the bottom of the socket. The pipe shall be pulled "home" with an approved jack assembly as recommended by the pipe

manufacturer. If assembly is not accomplished by reasonable force, the plain end shall be removed and the condition corrected.

- C. Flanged joints shall be brought to exact alignment and all gaskets and bolts or studs inserted in their proper places. Bolts or studs shall be uniformly tightened around the joints. Where stud bolts are used, the bolts shall be uniformly centered in the connections and equal pressure applied to each nut on the stud. Pipes in all lines subject to temperature changes shall be cut short and cold sprung into place to compensate for expansion when hot.
- D. Mechanical joints shall be made up with gaskets, glands and bolts. When a joint is to be made up, the bell or socket and plain end shall be cleaned and washed with a solution or mild soap in water; the gland and gasket shall be slid onto the plain end and the end then entered into the socket until it is fully "home" on the centering ring. The gasket shall then be painted with soapy water and slid into position, followed by the gland. All bolts shall be inserted and made up hand tight and then tightened alternately to bring the gland into position evenly. Excessive tightening of the bolts shall be avoided. All nuts shall be pulled up using a torque wrench which will not permit unequal stresses in the bolts. Torque shall not exceed the recommendations of the manufacturer of the pipe and bolts for the various sizes. Care shall be taken to assure that the pipe remains fully "home" while the joint is being made. Joints shall conform to the applicable AWWA Specifications.
- E. Threaded and/or screwed joints shall have long tapered full depth threads to be made with the appropriate paste or jointing compound, depending on the type of fluid to be processed through the pipe. All pipe up to, and including 1-1/2-inches, shall be reamed to remove burr and stood on end and well pounded to remove scale and dirt. Wrenches on valves and fittings shall be applied directly over the joint being tightened. Not more than three pipe threads shall be exposed at each connection. Pipe, in all lines subject to temperature changes shall be cut short and cold sprung into place to compensate for expansion when hot. Joints in all piping used for chlorine gas lines shall be made up with a glycerine and litharge cement. Joints in plastic piping (PVC/CPVC) shall be laid and joints made with compounds recommended by the manufacturer. Installation shall conform to the requirements of ASTM D2774 and ASTM D2855. Unions required adjacent to valves and equipment.
- F. Soldered joints shall have the burrs removed and both the outside of pipe and the inside of fittings shall be thoroughly cleaned by proper tools recommended for that purpose. Flux shall be applied to both pipe and inside of fittings and the pipe placed into fittings and rotated to insure equal distribution of flux. Joints shall be heated and solder applied until it shows uniformly around the end of joints between fitting and pipe. All joints shall be allowed to self-cool to prevent the chilling of solder. Combination flux and solder paste manufactured by a reputable manufacturer is acceptable. Unions required adjacent to valves and equipment.
- G. Welded joints shall be made by competent operators in a first class workmanlike manner, in complete accordance with ANSI B31.1 and AWWA C206. Welding electrodes shall conform to ASTM A233, and welding rod shall conform to ASTM A251. Only skilled welders capable of meeting the qualification tests for the type of welding which they are performing shall be employed. Tests, if so required, shall be made at the expense of the Contractor, if so ordered by the Engineer. Unions shall be required adjacent to valves and equipment.

- H. Copper joints shall be thoroughly cleaned and the end of pipes uniformly flared by a suitable tool to the bevels of the fittings used. Wrenches shall be applied to the bodies of fittings where the joint is being made and in no case to a joint previously made. Dimensions of tubing and copper piping shall be in complete accordance with the fittings used. No flare joints shall be made on piping not suited for flare joints. Installations for propane gas shall be in accordance with NFPA 54 and/or 58.
- I. Solvent or adhesive welded joints in plastic piping shall be accomplished in strict accordance with the pipe manufacturer's recommendations, including necessary field cuttings, sanding of pipe ends, joint support during setting period, etc. Care shall be taken that no droppings or deposits of adhesive or material remain inside the assembled piping. Solvent or adhesive material shall be compatible with the pipe itself, being a product approved by the pipe manufacturer. Unions are required adjacent to valves and equipment. Sleeve-type expansion joints shall be supplied in exposed piping to permit 1-inch minimum of expansion per 100 feet of pipe length.
- J. Dielectric unions shall be installed wherever dissimilar metals are connected except for bronze or brass valves in ferrous piping. Unions shall be provided downstream of each valve with screwed connections. The Contractor shall provide screwed or flanged unions at each piece of equipment, where shown, and where necessary to install or dismantle piping.
- K. Eccentric reducers shall be installed where air or water pockets would otherwise occur in mains because of a reduction in pipe size.
- L. Joints in polypropylene and polyvinylidene fluoride pipe shall be butt fusion weld. All butt welding shall follow the requirements of ASTM D-2657 and the manufacturer's recommendations.

3.10 FLUSHING AND TESTING

- A. All piping shall be properly flushed and tested unless specifically exempted elsewhere in the Specifications or otherwise approved by the Engineer. Air and gas pipelines shall be flushed and tested with compressed air. Gravity sewer piping shall be flushed and tested as specified in Section 02604 - Utility Structures. All other liquid conveying pipelines shall be flushed and tested with water. The Contractor shall furnish and install all means and apparatus necessary for getting the air or water into the pipeline for flushing and testing including pumps, compressors, gauges, and meters, any necessary plugs and caps, and any required blow-off piping and fittings, etc., complete with any necessary reaction blocking to prevent pipe movement during the flushing and testing. All pipelines shall be flushed and tested in such lengths or sections as agreed upon among the Owner, Engineer, and Contractor. Test pressures shall be as specified in Section 15390 – Schedules, and shall be measured at the lowest point of the pipe segment being tested. The Contractor shall give the Owner and Engineer reasonable notice of the time when he intends to test portions of the pipelines. The Engineer reserves the right, within reason, to request flushing and testing of any section or portion of a pipeline.
- B. The Contractor shall provide water for all flushing and testing of liquid conveying pipelines. Raw water or non-potable water may be used for flushing and testing liquid pipelines not connected to the potable water system. Only potable water shall be used for flushing and testing the potable water system.

- C. Air and gas piping shall be completely and thoroughly cleaned of all foreign matter, scale, and dirt prior to start-up of the air or gas system.
- D. At the conclusion of the installation work, the Contractor shall thoroughly clean all new liquid conveying pipe by flushing with water or other means to remove all dirt, stones, pieces of wood, etc., which may have entered the pipe during the construction period. If after this cleaning any obstructions remain, they shall be corrected by the Contractor, at his own expense, to the satisfaction of the Engineer. Liquid conveying pipelines shall be flushed at the rate of at least 2.5 feet per second for a duration suitable to the Engineer or shall be flushed by other methods approved by the Engineer.
- E. Compressed/service air and gas piping shall be flushed by removing end caps from the distribution lines and operating one (1) compressor, in accordance with the manufacturer's instructions.
- F. After flushing, all air piping shall be pressure and leak tested prior to coating and wrapping of welded joints. Immediately upon successful completion of the pressure and leak test, welded joints shall be thoroughly cleaned of all foreign matter, scale, rust, and discoloration and coated in accordance with the Specifications.
- G. All process air piping shall be leak tested by applying a soap solution to each joint. Leak tests shall be conducted with one (1) blower in service at normal operating pressure.
- H. During testing the piping shall show no leakage. Any leaks or defective piping disclosed by the leakage test shall be repaired or replaced by the Contractor, at his own expense, and the test repeated until all such piping shows tight.
- I. All buried process air piping shall be pressurized to 25 psig and tested for leaks by applying a soap solution to each joint. The air supply shall be stopped and the pipe pressure monitored. System pressure shall not fall by more than 0.5% of the 25 psig test pressure over a one-hour test period. Should the system fail to hold the required pressure for one hour, the cause shall be determined and corrected and the test repeated until a successful test of the entire system is obtained.
- J. Field leakage tests shall be performed for all submerged process air piping. The procedure shall consist of operating the system under clear nonpotable water for visual identification of all leaks. All field leakage tests shall be witnessed by the Engineer. All submerged piping shall be installed free of any leaks.
- K. After flushing, all liquid conveying pipelines shall be hydrostatically tested at the test pressure specified in the appropriate Piping System Schedule in Section 15390 – Schedules. The procedure used for the hydrostatic test shall be in accordance with the requirements of AWWA C600. Each pipeline shall be filled with water for a period of no less than 24 hours and then subjected to the specified test pressure for 2 hours. During this test, exposed piping shall show no leakage. Allowable leakage in buried piping shall be in accordance with AWWA C600.
- L. Any leaks or defective pipe disclosed by the hydrostatic test shall be repaired or replaced by the Contractor, at his own expense, and the test repeated until all such piping shows tight.

- M. After flushing, all gas piping shall be leak tested in accordance with all local codes and regulations and in conformance with the recommendations or requirements of any National Institute or Association for the specific service application.

3.11 DISINFECTION

- A. All pipe and fitting connected to and forming a part of a potable water supply shall be disinfected in accordance with the procedures described in AWWA C 651. Disinfection shall also be in accordance with the requirements of the State of Georgia and the Owner.
- B. Disinfection shall be accomplished after the pipe has been flushed, if applicable, and passed the hydrostatic test. Such piping shall be filled with 50 parts per million (PPM) of chlorine and held in contact for not less than 24 hours. Final tests after 24 hours contact time shall show a minimum residual chlorine content of 10 ppm in all parts of the system. Disinfection shall be repeated as often as necessary, and as directed by the Engineer and/or state regulations and/or the Owner until the minimum residual chlorine content of 10 ppm has been reached. The Contractor shall obtain certificates of satisfactory bacteriological tests and furnish them to the Owner before the request is made for acceptance of the work. The Contractor shall furnish and install, at his own expense, all means and apparatus necessary for performing the disinfection. The chlorine solution shall be thoroughly flushed out prior to placing the new sections of pipe in service. The Contractor is cautioned that the spent chlorine solution must be disposed of in such a way as not to be detrimental to animal, plant, or fish life. Chlorine residual tests will be made after flushing to assure that residual is not in excess of 1 ppm at any point in system.

3.12 PAINTING AND COLOR CODING SYSTEM

- A. All exposed piping specified shall be color coded in accordance with the Owner's standard color designation system for pipe recognition and in accordance with Section 15030 – Piping and Equipment Identification Systems. In the absence of a standard color designation system, the Engineer will establish a standard color designation for each piping service category from color charts submitted by the Contractor in compliance with Section 09900 – Painting.
- B. All piping specified in this Section shall be painted in accordance with Section 09900 – Painting, except as follows:
 - 1. Copper pipe
 - 2. Stainless steel pipe. Flanges and supports or hangers shall be painted.

- END OF SECTION -

SECTION 15008

PVC/CPVC PIPE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Reference Section 15000, Basic Mechanical Requirements.

PART 2 -- PRODUCTS

2.01 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

- A. PVC pipe and fittings shall be manufactured in accordance with ASTM D 1785, D 1784 and F 441, "normal impact" pipe, Schedule 40 or 80 as specified.
- B. Fittings used with this pipe shall be socket type or flanged type as specified herein, in Section 15390 - Schedules, or indicated on the Drawings. Plastic piping shall be installed in full accordance with the manufacturer's recommendations for the specific installation. No field bending or distortion of the pipe will be permitted.
- C. PVC pipe shall be Type 1 Grade 1 conforming to ASTM D 1784 and D 1785. Fittings shall conform to the following standard specifications:
 - Socket Type (Schedule 40); ASTM D 2466
 - Socket Type (Schedule 80); ASTM D 2467
- D. Provide flanged fittings of the same material as the specified pipe and material conforming to ANSI B16.5 at all valves and equipment with Teflon filled or natural rubber gaskets. Bolts shall be type 316 stainless steel for flanged joints. Flanges are not required at true (double) union valves.
- E. Solvent cement for socket type joints shall conform to ASTM D 2564 for PVC pipe and fittings.
- F. C900-Class 200 shall be in sizes between 4 inches and 12 inches and shall meet the requirements of AWWA C900 "Poly Vinyl Chloride (PVC) Pressure Pipe" and shall conform to all the requirements of ASTM D1784 and ASTM D2241. The pipe shall be a minimum of DR 14 and shall be capable of withstanding the overburden pressures determined by the depth of burial in the field.
 - 1. Pipe material shall be made from clean, virgin, NSF approved Class 12454-A PVC compound conforming to resin specification ASTM D1784. Standard laying lengths shall be 20-feet (± 1 inch). Random lengths of not more than 15% of the total footage of each size may be shipped in lieu of the standard lengths. Reruns of reclaimed material shall not be accepted.

2. The pipe shall have bell and spigot ends with push-on, O-ring rubber gasket, compression type joints conforming to the requirements of ASTM 2672. Elastomeric gaskets shall conform to the requirements of ASTM D1869 and ASTM F477.
 3. Minimum pipe stiffness (F/dY) at 5% deflection shall be 914 psi for all sizes when tested in accordance with D2241.
 4. The pipe shall be designed to pass a quick burst test pressure of 985 psi applied in 60 to 70 seconds when tested in accordance with ASTM D1599, as referenced in ASTM D2241.
 5. Fittings for C900-Class 200, DR 14 shall be ductile iron, bolted mechanical joint.
- G. C900-Class 150 shall be in sizes between 4 inches and 12 inches and shall meet the requirements of AWWA C900 "Poly Vinyl Chlorine (PVC) Pressure Pipe" and shall conform to all the requirements of ASTM D1784 and ASTM D2241. The pipe shall be a minimum of DR 18 and shall be capable of withstanding the overburden pressures determined by the depth of burial in the field.
1. Pipe material shall be made from clean, virgin, NSF approved Class 12454-A PVC compound conforming to resin specification ASTM D1784. Standard laying lengths shall be 20-feet (± 1 inch). Random lengths of not more than 15% of the total footage of each size may be shipped in lieu of the standard lengths. Reruns of reclaimed material shall not be accepted.
 2. The pipe shall have bell and spigot ends with push-on, O-ring rubber gasket, compression type joints conforming to the requirements of ASTM 2677. Elastomeric gaskets shall conform to the requirements of ASTM D1869 and ASTM F477.
 3. Minimum pipe stiffness (F/dY) at 5% deflection shall be 435 psi for all sizes when tested in accordance with D2241.
 4. The pipe shall be designed to pass a quick burst test pressure of 755 psi applied in 60 to 70 seconds when tested in accordance with ASTM D1599, as referenced in ASTM D2241.
 5. Fittings for C900-Class 150, DR 18 shall be ductile iron, bolted mechanical joint.
- H. PVC pressure rated pipe (PR 160) shall be in sizes between 1 1/2 inches and 12 inches and shall conform to all the requirements of ASTM D1784 and ASTM D2241 and shall be a minimum of SDR 26 and shall be capable of withstanding the overburden pressures determined by the depth of burial in the field.
1. Pipe material shall be made from clean, virgin, NSF approved Class 12454-A PVC compound conforming to resin specification ASTM D1784. Standard laying lengths shall be 20-feet (± 1 inch). Random lengths of not more than 15% of the total footage of each size may be shipped in lieu of the standard lengths. Reruns of reclaimed materials shall not be accepted.
 2. The pipe shall have bell and spigot ends with push-on, O-ring rubber gasket, compression type joints conforming to the requirements of ASTM 2672. Elastomeric

gaskets shall conform to the requirements of ASTM D1869 and ASTM F477.

3. Minimum pipe stiffness (F/dY) at 5% deflection shall be 135 psi for all sizes when tested in accordance with ASTM D2241.
 4. The pipe shall be designed to pass a quick burst test pressure of 500 psi applied in 60 to 70 seconds when tested in accordance with ASTM D1599, as referenced in ASTM D2241.
 5. The pipe shall be designed to pass for 1000 hours a sustained test pressure of 340 psi when tested in accordance with ASTM D1598, as referenced in ASTM D2241.
- I. Fittings for PR 160, SDR 26 shall be PVC and designed for the pipe being supplied.
 - J. Acrylonitrile-butadiene-styrene (ABS) shall conform to the requirements of ASTM D 2661. Pipe and fittings shall have socket type couplings with solvent cement joints. Solvent cement shall conform to ASTM D 2235.
 - K. Type PSM polyvinyl chloride (PVC) pipe and fittings shall conform to the requirements of ASTM D 3034 with a maximum SDR of 35. Pipe and fittings shall have bell and spigot ends with O-ring rubber gasketed, compression type joints. Joints shall conform to the requirements of ASTM Specification D 3212. Reruns of reclaimed materials shall not be accepted. Unless indicated otherwise, PVC wall pipes shall be provided for all piping passing through exterior walls. Wall pipes shall have a water stop solvent-welded to the pipe. Each wall pipe shall be of the same class and type as the piping to which it is joined.
 - L. Perforated and closed drainage pipe and fittings shall be rigid PVC pipe, Schedule 40 unless otherwise shown or specified with solvent welded type joints, or approved equal. Pipe shall be slotted or have two rows of 1/4-inch diameter holes spaced 4-inches apart along the circumference of the pipe. Longitudinal spacing of holes shall be 5-inches maximum.

2.02 CHLORINATED POLYVINYL CHLORIDE (CPVC) PIPE AND FITTINGS

- A. CPVC shall be manufactured in accordance with ASTM D 1785, D 1784 and F 441, "normal impact" pipe, Schedule 40 or 80 as specified.
- B. Fittings used with this pipe shall be socket type or flanged type as specified herein or indicated on the Drawings. Plastic piping shall be installed in full accordance with the manufacturer's recommendations for the specific installation. No field bending or distortion of the pipe will be permitted.
- C. CPVC pipe shall be Type 4, Grade 1, Schedule 80, conforming to ASTM D 1784 and ASTM F 441. CPVC fittings shall be socket type conforming to ASTM F 439.
- D. Solvent cement for socket type joints shall conform to ASTM F 493 for CPVC pipe and fittings.

- END OF SECTION -

SECTION 15012

STEEL PIPE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Steel pipe and fittings shall conform to AWWA C200 for nominal pipe sizes 6-inches and larger. Steel pipe shall be new and shall meet or exceed the manufacturer and material requirements of ASTM A53, Grade B or ASTM A139, Grade B.
- B. The AWWA Specifications referenced in this section are supplemented as follows:
 - 1. An affidavit of compliance is required from the pipe manufacturer.
 - 2. The steel manufacturer's certification that the material meets the ASTM Specification will be accepted in lieu of tests on specimens taken from the fabricated pipe.
 - 3. The fabricator may purchase steel plates on the chemical basis only, and shall furnish to the Owner certified test reports.
 - 4. Joints shall be flanged unless otherwise indicated on the Drawings.
- C. All parts of the materials furnished shall be amply designed, manufactured and constructed for the maximum stresses occurring during fabrication and erection. All materials shall be new and both workmanship and materials shall be of the very best quality, entirely suitable for the service to which they will be subjected and shall conform to all applicable sections of these Specifications. Manufacturer's designs shall accommodate all the requirements of these Specifications.
- D. The Contractor shall be responsible for the structural design of the steel pipe. The Contractor shall submit certification that the steel pipe has been designed to resist all loads implied and reasonably anticipated.
- E. Reference Section 15000, Basic Mechanical Requirements.

PART 2 -- PRODUCTS

2.01 EXTERIOR STEEL PIPE AND FITTINGS (PROCESS AIR AND WATER)

- A. Exterior steel pipe shall be fabricated by either the spiral weld or single longitudinal seam method and shall be rated for at least 25 psig and 250°F. Steel pipe shall be fabricated by either the spiral weld or single longitudinal seam method with a minimum yield strength of 35,000 psi. Design stress in the pipe wall at the design pressure shall not exceed 50 percent of the minimum yield strength of the steel.

- B. Fittings shall be fabricated from the pipe specified and shall conform to AWWA C208, Table 1 (Figure 1). Fittings provided for the purpose of transition to other types of piping shall be in accordance with the applicable portions of AWWA C207 and AWWA C208, unless otherwise shown on the Drawings.
- C. Flanges shall be AWWA C207, Standard hub type, slip-on welding flanges, Class B, unless otherwise required for connection to equipment. Bolts shall be of the size and length called for and in accordance with the "American Standard" and comply with the requirements of the ANSI/AWWA Standards. The bolt for flanged joints shall be a minimum ASTM A307; Grade B carbon steel and be in accordance with ANSI A21.10, (AWWA C110). The bolts shall have hexagonal heads and nuts, no washers shall be used. All gaskets shall be the "Ring-Gasket type, 1/8-inch minimum thickness of material suitable for 250°F continuous service at 25 psig.
- D. Welded field connections shall be of the single "V" butt joint type in accordance with AWWA C206. Welded connections shall not be permitted where such connections would interfere with the removal of valves or equipment or create sections of pipe too large for removal from structures. All field welds shall be radiographically inspected when field welding is permitted.
- E. The minimum wall thickness for exterior steel pipe shall be .250-inch for pipe up to 30-inch diameter and .375-inch for larger than 30-inch diameter.
- F. Interior and exterior coatings for exterior steel pipe and fittings shall be as specified in this Section, paragraph 2.03.

2.02 INTERIOR STEEL PIPE AND FITTINGS (PROCESS AIR AND WATER)

- A. Steel pipe shall be fabricated by either the spiral weld or single longitudinal seam method with a minimum yield strength of 35,000 psi. Design stress in the pipe wall at the design pressure shall not exceed 50 percent of the minimum yield strength of the steel.
- B. Steel pipe shall be manufactured to the nominal pipe sizes listed and shall have the following minimum wall thicknesses:

Nominal Pipe Size	Minimum Sheet or Plate Thickness, inches		
	Process Air	100 psi Design Pressure	300 psi Design Pressure
6 or less	0.125	0.125	0.125
8-14	0.134	0.134	0.134
16	0.134	0.134	0.188
18	0.188	0.188	0.188
20-24	0.250	0.250	0.250
30	0.250	0.250	0.281
36	0.250	0.250	0.344
42	0.250	0.250	0.375
48-54	0.250	0.250	0.500
60-66	0.312	0.312	0.625

72-84	0.375	0.375	0.750
90	0.375	0.375	0.8125

- C. Fittings shall be fabricated from the pipe specified and shall conform to AWWA C208, Table 1 (Figure 1). Fittings provided for the purpose of transition to other types of piping shall be in accordance with the applicable portions of AWWA C207 and AWWA C208, unless otherwise shown on the Drawings.
- D. Flanges shall be AWWA C207, standard hub type slip-on welding flanges, in accordance with the following table, unless otherwise required for connection to equipment:

<u>Design Pressure</u>	<u>Flange Class</u>
86 psi or less (All sizes)	B
87 - 149 psi (4 - 12 inch)	D
87 - 175 psi (14 inch and larger)	D
150 - 275 psi	E
276 - 300 psi	F

- E. All gaskets shall be the "Ring-Gasket" type, 1/8-inch minimum thickness. Bolts shall be of the size and length called for and in accordance with the "American Standard" and comply with the requirements of the ANSI/AWWA Standards. The bolts for flanged joints shall be a minimum ASTM A307; Grade B, hot-dip galvanized carbon steel in accordance with ANSI A21.10 (AWWA C1110) unless otherwise specified. The bolts shall have hexagonal heads and nuts, no washers shall be used.
- F. The piping layout shown on the Drawings is based upon standard fittings available in ductile iron pipe in the case of water piping and typical fittings available in steel piping for process air. In some instances, flange joints shown may not be required for steel pipe. Welded joints may be substituted for flange joints subject to approval by the Engineer. Welded joints will not be acceptable where such joints would interfere with the removal of valves or equipment or create sections of piping too large for removal from structures as determined by the Engineer.
- G. Harnessed flexible couplings may also be used in lieu of flanges at locations approved by the Engineer. Lugs shall be welded to the pipe in accordance with the requirements of AWWA Manual M11 for Steel pipe where required for harnessing of flexible couplings.
- H. Welded field connections shall be of the single "V" butt joint type in accordance with AWWA C206. Welded connections shall not be permitted where such connections would interfere with the removal of valves or equipment or create sections of pipe too large for removal from structures. All field welds shall be radiographically inspected when field welding is permitted.
- I. Interior and exterior coatings for interior steel pipe and fittings shall be as specified in this Section, paragraph 2.03.

2.03 STEEL PIPE COATINGS

- A. Exterior and interior coatings for steel pipe and fittings used for process air or water piping shall be as follows:

<u>Type of Service</u>	<u>Exterior Coating</u>	<u>Interior Coating</u>
Water	Shop Prime per Section 09900 – Painting	Cement Mortar AWWA C 205

B. Exterior and interior coatings for steel pipe and fittings used for process air piping shall be as follows:

1. The steel pipe coatings and lining specified herein apply to all exposed and buried steel process air piping. Steel pipe shall have an interior lining and exterior coating for exposed or buried service as specified. Painting shall be in accordance with Section 09900 - Painting. Inspection of surface preparation and coating application is required in accordance with Section 09900 -Painting.
2. The interior of all steel pipe for process air service shall receive 3 mils (dry) of inorganic zinc primer service rated for 250°F (dry) and 100°F (wet) continuous which shall be Carbo Zinc 11 as manufactured by Carboline or equal. After the lining has cured, it shall be thoroughly washed with high pressure water to remove all detachable particles.
3. Areas of pipe to be welded shall receive 1 mil (dry) of weldable inorganic zinc primer such as Carbo Weld 11, as manufactured by Carboline, or equal.
4. Interior steel pipe and fittings:
 - a. The exterior of all interior steel pipe and fittings shall receive the same prime coat as that specified for the interior except for areas of pipe to be field welded. After welding and pressure and leakage testing are completed, welded joints shall be thoroughly cleaned of all foreign matter and any scale or rust and primed as specified for the pipe. Finish coat and wrap shall be applied to each joint as specified for the pipe for continuous coating and wrapping of all steel piping.
 - b. Final touch up of inorganic zinc primer shall be with a modified aluminum epoxy mastic such as Carbomastic 15 as manufactured by Carboline, or equal.
 - c. Shop coatings and field touch-ups shall be electrically inspected by the use of a holiday detector in accordance with AWWA C209 and Division 09900 - Painting.
5. Exterior steel pipe and fittings:

The exterior of all exposed steel pipe and fittings shall receive the same prime coat as that specified for interior steel pipe and fittings.

 - a. The exterior of all buried steel pipe and fittings shall receive a prime coat per the exterior tape system manufacturer's recommendations, except for areas of pipe to be field welded.

- b. The exterior of buried steel pipe shall receive, over the prime coat, a multi-layered, cold-applied tape wrap system which shall be shop applied and consist of a rubber and synthetic resin primer, one (20 mils) layer of inner wrapping and two (30 mils each) layer of outer wrap for a total system build in excess of 80 mils. The cold applied type wrap shall operate satisfactorily at a temperature of 200°F. The wrap shall be applied in accordance with AWWA C214 and as specified herein. Windings shall be spiral wrapped with at least 1" of overlap. All fittings shall be wrapped in accordance with AWWA C209. Successive layers shall be applied such that windings are staggered and overlay the midpoints of previous tape widths. Polyethylene backed coatings shall be protected from sunlight at all times. The wrapping shall terminate 6" from field weld sites. The tape wrap system shall be the YG III system as manufactured by the Polyken Division of Kendall Co., Boston MA, or equal.
- c. The exterior of exposed exterior steel pipe and fittings shall receive, over the inorganic zinc prime coat, 3 mils of modified acrylic latex service rated for 300°F (continuous) which shall be Carboline 3359 as manufactured by Carboline or equal, and 1-1/2 mil top coat of modified acrylic, service rated for 300°F (continuous), which shall be Carboline 4685 as manufactured by Carboline, or equal.
- d. After welding and pressure and leakage testing are completed, welded joints shall be thoroughly cleaned of all foreign matter and any scale or rust and primed as specified for the pipe. Finish coat and wrap shall be applied to each joint as specified for the pipe for continuous coating and wrapping of all steel piping.
- e. Final touch up of inorganic zinc primer shall be with a modified aluminum epoxy mastic such as Carbomastic 15 as manufactured by Carboline, or equal.
- f. Shop coatings and field touch-ups shall be electrically inspected by the use of a holiday detector in accordance with AWWA C209 and Section 09900 - Painting.

2.04 STAINLESS STEEL PIPE AND FITTINGS (PROCESS AIR AND WATER)

- A. Stainless steel piping for air piping of nominal sizes ranging from three (3) inches to sixty (60) inches shall be manufactured from ASTM A240 annealed and pickled sheets and plates and fabricated in accordance with ASTM A778 in Type 304L stainless steel. Only stainless steel pipe shall be provided; tubing shall not be allowed. Stainless steel pipe, at a minimum, shall be service rated for 250°F at 25 psig. Stainless steel pipe shall be as manufactured by Douglas Brothers, Felker Bros. Corp., or equal.
- B. The following information shall be provided:
 - 1. An affidavit of compliance is required from the pipe manufacturers.
 - 2. The steel manufacturer's certification that the material meets the ASTM specification will be accepted in lieu of tests on specimens taken from fabricated pipe.

3. The fabricator may purchase steel plates on the chemical basis only, and shall furnish to the Owner certified test reports.
 4. Only seamless or one (1) longitudinal seam shall be permitted unless otherwise required for fabrication of large diameter pipe in accordance with ASTM A774.
 5. Joints in piping 3-inches in diameter or larger shall be butt welded or flanged, unless otherwise shown on the Drawings. Joints in piping less than 3-inch diameter shall be threaded, unless otherwise shown on the Drawings.
- C. Fittings shall be fabricated from the pipe specified and shall conform to ASTM A774, unless otherwise shown on the Drawings or required for proper installation.
- D. Flanges where shown on the Drawings shall be a lap joint flange assembly consisting of a 304L S.S. slip-on rolled angle ring with a galvanized ductile iron follower flange conforming to ASTM A536, and shall conform dimensionally to ANSI B16.1, Class 125. Bolts shall be the size and length called for in accordance with the "American Standard" and comply with the requirements of the ANSI/AWWA Standards. The bolts for flanged joints shall be a minimum ASTM A307; Grade B, hot-dip galvanized carbon steel in accordance with ASTM A123 and A153, and be in accordance with ANSI A21.10, (AWWA C110) unless otherwise specified. The bolts shall have hexagonal heads and nuts, no washers shall be used.
- E. The angle leg shall not interfere with the flange bolt holes. The back-up flanges shall be supplied with the following nominal thicknesses.

<u>Nom. Pipe Size (in.)</u>	<u>Flange Thickness (in.)</u>
2-1/2 - 3	1/2
4	9/16
6 - 10	5/8
12 - 16	3/4
18 - 20	7/8
24 - 30	1
36	1-1/8
42	1-1/4
48	1-3/8
54	1-3/8
60	1-1/2

- F. Gaskets for water piping shall be "Ring Gasket" type, 1/8-inch minimum thickness, cloth inserted rubber, red rubber or neoprene and shall be suited for the service intended. For process air, all gaskets shall be 1/8-inch minimum thickness and shall be of a material suitable for 250°F continuous service at 25 psig. Dielectric gasket material service rated for 225°F continuous service at 25 psig shall be provided at all transitions to material other than mild steel.

- G. Welding practices for joints shall conform to those specified for the manufacture of the pipe and fittings in ASTM A774 and A778, and the specifications contained herein. All welds shall be free from burrs, snags or rough projections.
- H. Welding shall be performed by AWS certified welders in conformance with standard procedures. Piping with wall thickness up to 11 gauge (0.125") shall be welded with the TIG (GTAW) process. Heavier walls shall be properly beveled and have a root pass with the TIG (GTAW) process followed by subsequent passes with the TIG (GTAW), MIG (GMAW), or Metallic Arc (SMAW) process. Filler wire of 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 greater than the parent metal. Weld deposit shall be smooth and evenly distributed and have a crown of no more than 1/16 inch on the I.D. and 3/32 inch on the O.D. of the piping or fittings. Concavity, undercut, cracks or crevices shall not be allowed. Butt-welds shall have full penetration to the interior surface, and inert gas shielding shall be provided to the interior and exterior of the joint. Excessive weld deposits, slag, spatter and projections shall be removed by grinding. Angle face rings shall be continuously welded on both sides to the pipe or fitting. Welds on gasket surfaces shall be ground smooth.
- I. After welding, all welded joints shall be treated with a pickling solution, brushed with stainless wire brushes and rinsed clean.
- J. All fittings shall be welded with 304L filler metal. All elbows through 24 inch size shall be long radius, die formed and shall be automatically butt welded in accordance with ASTM A774 of the same material and thickness as the pipe, using gas tungsten-arc procedures with inert gas backing. Tees, crosses, true Y's and laterals shall be shop fabricated. All short radius, special radius, and reducing elbows and long radius elbows greater than 24 inch shall be 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. All reducers shall be straight tapered, cone type. Longitudinal welds on all fittings, except elbows, shall be accomplished by the same procedures as listed for pipe. Weld seams shall have full penetration and be free of oxidation, crevices, pits, cracks and protrusions. Fitting dimensions shall be in accordance with ANSI B16.9, and shall be terminated and dimensioned as indicated on the Drawings.
- K. Pipe spools shall be manually welded with 304L filler metal, using gas tungsten-arc procedures with internal gas purge where internal weld seams are not accessible. Where they are accessible, seams shall be welded both inside and outside, using manual shielded metal-arc procedures. Weld seams shall have full penetration and be free of oxidation, crevices, pits, cracks and protrusions.
- L. All pipe, fittings and spools shall be completely pickled and passivated by immersion in a nitric-hydrofluoric bath at the proper temperature and length of time to insure removal of all free iron, weld scale and other impurities and to insure the establishment of a passive surface. A clean water rinse shall follow the acid pickle.
- M. The field testing procedure for process air piping shall use air pressure only. Hydrostatic testing shall be utilized on all other stainless steel piping.
- N. The inspection of all welds shall be required. This shall be a visual inspection for crevices, pits, cracks, protrusions and oxidation deposits. Presence of any of these items found in the weld seams shall be considered as grounds for rejection of the joint.

- O. All fabricated piping shall have openings plugged and flanges secured for storage and/or transport after fabrication. All fabricated piping shall be piece marked with identifying numbers or codes which correspond to the Contractor's layout and installation drawings. The marks shall be located on the spools at opposite ends and 180 degrees apart.
- P. The piping supplier during manufacturing, fabrication and handling stages, and the Contractor during handling and installation stages, shall use extreme care to avoid the contact of any ferrous materials with the stainless steel piping. Only manufacturer recommended saws, drills, files, wire brushes, etc. shall be used for stainless steel piping. 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.
- Q. FIELD WELDING OF STAINLESS STEEL WILL NOT BE PERMITTED.
- R. Pipe shall be manufactured to nominal pipe sizes as listed in ANSI B36.19, Table 2, and shall have the following minimum wall thicknesses:

<u>Nominal Pipe Size</u>	<u>Schedule/Gauge/Plate</u>
8-inch diameter and smaller	Schedule 5S (.083 inches)
10-inch and 12-inch diameters	12 gauge (.109 inches)
14-inch thru 18-inch diameters	11 gauge (.125 inches)
20-inch diameter	10 gauge (.140 inches)
24-inch thru 36-inch diameters	3/16-inch (.187 inches)
42-inch and 48-inch diameters	1/4-inch (.250 inches)
54-inch and 60-inch diameters	5/16-inch (.312 inches)

- S. All parts of the materials furnished shall be amply designed, manufactured and constructed for the maximum stresses occurring during fabrication and erection. All materials shall be new and both workmanship and materials shall be of the very best quality, entirely suitable for the service to which they will be subjected and shall conform to all applicable sections of these Specifications. Manufacturer's designs shall accommodate all the requirements of these Specifications.
 - T. The Contractor shall be responsible for the structural design of the stainless steel pipe. The Contractor shall submit certification that the stainless steel pipe has been designed to resist all loads implied and reasonably anticipated.
- 2.05 STEEL PIPE AND FITTINGS FOR NATURAL GAS, PROPANE GAS AND COMPRESSED SERVICE AIR
- A. Steel pipe and fittings for natural gas, propane gas and compressed service air shall conform to ASTM A120, black, seamless, Schedule 40 or 80 as indicated in the Interior Piping System Schedule. Unless otherwise shown or required, all pipe and fittings shall be threaded. Fittings shall conform to ANSI B16.3, 300 pound class and shall be of the black

malleable iron screw type. All threaded joints shall conform to ANSI B2.1 with tapered threads at 3/4 inches per foot. Joints shall be made tight with an oil and graphite paste or teflon thread tape applied to the male threads only. All pipe 1-1/2-inches and smaller shall be reamed to remove scale and dirt.

2.06 STEEL PIPE AND FITTINGS FOR CHLORINE LIQUID AND GAS

- A. Steel pipe and fittings for chlorine liquid and gas shall be Schedule 80 seamless carbon steel pipe and shall conform to the requirements of ASTM A106, Grade B with threaded joints and forged carbon steel fittings rated at 2,000 lbs. cold water pressure. Fittings shall conform to the requirements of ASTM A694. Joints shall be made up with litharge and glycerine prepared immediately before use.

2.07 STEEL PIPE AND FITTINGS FOR CAUSTIC SOLUTION

- A. Steel pipe for caustic solution shall conform to the requirements of ASTM A120, Black, welded or seamless, Schedule 40. Joints for pipe shall be butt welded or flanged. Threaded joints shall not be allowed. All connection to existing piping valves, accessories, etc. shall be flanged with teflon gaskets. All pipe shall be reamed and flushed after welding to remove scale and dirt. Unions shall be provided at all valves and accessories at least every 50 feet in the piping system.

2.08 CORRUGATED METAL PIPE (CMP)

- A. Corrugated Metal Pipe (CMP) and fittings shall be of the sizes shown or specified and shall conform to every aspect of AASHTO M-36, latest revision.
- B. Corrugated metal pipe shall be fabricated from galvanized steel sheets. Corrugation profile shall be 2-2/3-inch crest to crest and 1/2-inch crest to valley, and sheet thickness shall be 16 gage/.064-inch minimum.
- C. Pipe sections shall be helically corrugated with each pipe end rerolled to obtain no less than two (2) annular corrugations.
- D. Bands for connecting pipe shall be fabricated from galvanized steel. Bands shall be flat with a continuous corrugation on each end to index the second pipe corrugation. Bands shall be 16 gage/.064-inch thick minimum, 10-1/2-inches wide minimum, and shall be drawn together by no less than two (2) 1/2-inch diameter galvanized steel bolts with nuts.
- E. All CMP utilized for permanent installation shall have gasketed joints.

2.09 STEEL CASING PIPE

- A. Casing pipe shall be smooth wall or spiral welded steel pipe with a minimum yield strength of 35,000 psi before cold forming. The minimum pipe size and wall thickness shall be as indicated in the table below. All joints shall be welded. The casing pipe shall be new and shall conform to ASTM A 139, Grade B, ASTM A53, Grade B, and AWWA C200-75. The carrier pipe shall be as specified.

Carrier Pipe Size (Nom.)	Casing Pipe Size (Min. O.D.)	Casing Pipe Wall Thickness (min)

2.10 MISCELLANEOUS STEEL PIPE AND FITTINGS

- A. Other steel pipe and fittings not specified elsewhere shall conform to ASTM A120, black or galvanized, as directed by the Engineer, seamless, Schedule 40 or 80 as indicated in the appropriate Piping System Schedule in Section 15390, Schedules.
- B. Unless otherwise shown or required, all piping and fitting shall be threaded. Fittings shall conform to ANSI B16.3, 300 pound class and shall be of the black malleable iron screw type. All threaded joints shall be made tight with an oil and graphite paste or teflon thread tape applied to the male threads only. All pipe 1-1/2 inches and smaller shall be reamed to removed scale and dirt. Pipe to be galvanized shall have a deep galvanized coating applied in full accordance with ASTM A123.

- END OF SECTION -

SECTION 15095
VALVES, GENERAL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install, complete with all assemblies and accessories, all valves shown on the Drawings and specified herein including all fittings, appurtenances and transition pieces required for a complete and operable installation.
- B. All valves shall be constructed of first quality materials which have strength, wearing, and corrosion resistance characteristics entirely suitable for the types of service for which the individual valves are designated. Except where noted otherwise, valves designated for water service shall conform to pertinent sections of the latest revision of AWWA C500 Specifications. Cast iron valve bodies and parts shall meet the requirements of the latest revision of ASTM Designation A-126, "Standard Specifications for Gray Iron Castings for Valves, Flanges, and Pipe Fittings, Class B."
- C. All valve body castings shall be clean, sound, and without defects of any kind. No plugging, welding, or repairing of defects will be allowed.
- D. Valves shall have flanged ends for exposed service and mechanical joint ends for buried service, unless otherwise shown on the Drawings or specified herein. Flanged ends shall be flat-faced, 125 lb. American Standard unless otherwise shown or specified in accordance with ANSI B16.1. All bolt heads and nuts shall be hexagonal of American Standard size. The Contractor shall be responsible for coordinating connecting piping. Valves with screwed ends shall be made tight with Teflon tape. Unions are required at all screwed joint valves.

1.02 SUBMITTALS

- A. The Contractor shall furnish to the Owner, through the Engineer, a Performance Affidavit where required in individual valve specifications, utilizing the format specified in Section 11000, Equipment General Provisions. Performance tests shall be conducted in accordance with the latest revision of AWWA C500 and affidavits shall conform to the requirements of the Specifications
- B. Shop Drawings conforming to the requirements of Section 01300, Submittals, are required for all valves, and accessories. Submittals shall include all layout dimensions, size and materials of construction for all components, information on support and anchoring where necessary, pneumatic and hydraulic characteristics and complete descriptive information to demonstrate full compliance with the Documents. Shop Drawings for electrically operated/controlled valves shall include all details, notes, and diagrams which clearly identify required coordination with the electrical power supply and remote status and alarm indicating devices. Electrical control schematic diagrams shall be submitted with the Shop Drawings for all electrical controls. Diagrams shall be drawn using a ladder-type format in accordance with JIC standards. Shop Drawings for pneumatically operated/controlled

valves shall include all details, notes, and diagrams which clearly identify required coordination with the compressed air (service air) system and electrical controls.

- C. Operation and maintenance manuals and installation instructions shall be submitted for all valves and accessories in accordance with the Specifications. The manufacturer(s) shall delete all information which does not apply to the equipment being furnished.

1.03 CONTRACTOR'S RESPONSIBILITIES

- A. The Contractor shall provide the services of a qualified representative of the manufacturer(s) of the equipment named below to check out and certify the installation(s), to supervise the initial operation, and to instruct the Owner's operating personnel in proper operation and maintenance procedures in accordance with the following schedule:

Item	Valve/Operator Type	Minimum On-Site Time Requirements
1.	Automatic Control Check Valve	One (1) 8-hour day
2.	Surge Anticipators	One (1) 8-hour day
3.	Motor Operated Modulating Valves	One (1) 8-hour day
4.	Motor Operated Open-Close Valves (required only if manufacturer is other than for Item 3 above)	One (1) 8-hour day
5.	Pneumatic Hydraulic Cylinder Operated Valves	One (1) 8-hour day

- B. 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 Engineer's Resident Project Representative on each day he is at the project.
- C. A written report covering the representative's findings and installation approval shall be mailed directly to the Engineer covering all inspection and outlining in detail any deficiencies notes.
- D. The times specified are exclusive of travel time to and from the facility and shall not be construed as to relieve the manufacturer of any additional visits to provide sufficient service to place the equipment in satisfactory operation.

PART 2 -- PRODUCTS

2.01 FLOW INDICATORS

- A. Flow indicators shall be the Akron ball-type as manufactured by Brooks Instrument Co., Fischer and Porter, or equal, and shall have bronze bodies, glass dome, and plastic ball.

2.02 CORPORATION STOPS

- A. Corporation stops shall be of bronze with tapered male iron pipe threads on inlets and outlets. Terminal outlets shall have screwed bronze hex head dust plugs or caps. Unions shall be used on all corporation stop outlets with connecting piping. Corporation stops shall

have a minimum working pressure rating of 250 psi and shall be as manufactured by Mueller Co., Hays Mfg. Div. of Zurn Industries, or equal.

2.03 FLOOR BOXES

- A. Floor boxes shall be provided for all nut operated or floor accessed valves. Floor boxes shall be of the adjustable, sliding type, cast iron, suitable to withstand heavy traffic, as manufactured by James B. Clow & Sons, Kennedy Valve Mfg. Co., or equal. The covers shall be marked with appropriate designations of piping contents (i.e.: water, sewer) and bases shall be the round type. All nut operated valves in this Section shall be clearly identified by stainless steel or laminated plastic identification tags. The tags shall be permanently affixed to the inside of the floor boxes, under grating, etc. and shall bear the embossed letters which clearly identify each valve by its appropriate designation.
- B. Two (2) valve operating wrenches shall be supplied in 4 foot lengths with tee handles for each size nut supplied. Valve wrenches shall be Model No. F-2520 as manufactured by James B. Clow & Sons, Kennedy Valve Mfg. Co., Figure No. 122, or equal.

2.04 VALVE BOXES

- A. The Contractor shall furnish and install valve boxes as shown on the Drawings and specified herein.
- B. All valve boxes shall be placed so as not to transmit shock or stress to the valve and shall be centered and plumb over the operating nut of the valve. The ground in the trench upon which the valve boxes rest shall be thoroughly compacted to prevent settlement. The boxes shall be fitted together securely and set so that the cover is flush with the finished grade of the adjacent surface. A concrete pad as detailed on the Drawings shall be provided around the valve box, sloped outwards.
- C. All valve boxes shall be 2-piece cast iron, sliding type, 5-1/4" shaft, with heavy duty traffic weight collar and the lid marked with the appropriate carrier product (i.e.: WATER). Boxes shall be as manufactured by James B. Clow & Sons, Kennedy Valve Mfg. Co., Charlotte Pipe and Foundry Company, or equal.

2.05 STRAINERS

- A. Y-Strainers shall be Y-pattern cast iron body, flanged or screwed ends with stainless steel or Monel, 20 mesh strainers. Strainers shall be 200 psi, cold-water service strainers, as manufactured by WATTS, Crane Co., Zurn, or equal.
- B. Caustic service Y-strainers shall be provided as shown on the drawings. Strainers shall be full port-full flow design manufactured of 304 or 316 stainless steel body. Y-strainers shall be furnished with flanged ends. The strainer screen shall be 1/32-inch perforation, easily removable, manufactured of the same material as the valve body.
- C. Manually cleaned strainers shall be the duplex basket tapered plug type.
 - 1. Strainers 3-inches in diameter and larger shall have flanged ends conforming to ANSI B16.1-125/150 pound standard.

2. Strainers less than 3-inches in diameter shall have screwed end connectors, unless otherwise shown on the Drawings.
3. Strainers shall be constructed with an ASTM A48, Class 30 cast iron body, ductile iron trim, removable 0.045 inch staggered hole perforation, 304 stainless steel filter baskets and gauges on the inlet and outlet.
4. All strainers shall be suitable for 125 psi service.
5. Switching flow from one basket to the other shall be accomplished by moving the handle through a 180° arc. The switching operation shall not stop flow through the strainer and shall provide for on-line removal of either basket with the other basket functional. The plug shall be automatically positioned with integral stops and shall be easily lifted and reseated under pressure.
6. The strainer shall be designed to minimize the possibility of material bypassing the plug while being rotated and to prevent debris from building up under the plug. The strainer covers shall be designed for quick opening with swing away yoke.
7. Each basket compartment shall have a side drain outlet.
8. All strainers shall be provided with support legs.
9. Duplex basket strainers shall be similar to the Model 53BTX as manufactured by Hayward, or equal.

2.06 QUICK DISCONNECT COUPLINGS

- A. Quick disconnect type coupling for compressed/service air shall be provided where indicated on the Drawings. Coupling shall provide for instantaneous shutoff in socket end when lines are disconnected. Couplings shall be constructed of 316 stainless steel with a BUNA-N O-ring and integral safety lock. Couplings shall comply with Military Specification 4109 (interchangeable with standard plug of the same size).

2.07 BACKFLOW PREVENTERS

- A. Backflow preventer shall be the size shown on the Drawings and shall be of the double check valve principle. Backflow preventer installation shall include isolation valves and four test cocks, furnished as an assembly. For backflow preventers less than 2-1/2", the installation assembly also shall include a strainer. Isolation valves for backflow preventers shall be ball valves, except for size 2-1/2" and larger which shall be resilient seat gate valves. Test cocks shall be located as recommended by the manufacturer to facilitate functional testing of the assembly. The backflow preventer shall be a WATTS 709, or equal.
- B. Reduced Pressure Backflow Preventer shall be of the size shown on the Drawings, and shall be of the reduced pressure principle type in accordance with AWWA Standards C510 and C511, with two (2) independent operating spring loaded check valves and one (1) spring loaded, diaphragm actuated, differential pressure relief valve shall be installed between the check valves. Backflow preventer shall be bronze body construction, with EPT rubber discs and Buna-N and nylon diaphragm. Screws and springs shall be of stainless steel. End connections shall be screwed, unless otherwise specified or shown on the

Drawings. Reduced pressure backflow preventer installations shall include isolation valves and four test cocks, furnished as an assembly. For reduced pressure backflow preventers less than 2-1/2" the installation assembly also shall include a strainer. Isolation valves for reduced pressure backflow preventers shall be ball valves, except for sizes 2-1/2" and larger which shall be resilient seat gate valves. Test cocks shall be located as recommended by the manufacturer to facilitate functional testing of the assembly. The reduced pressure backflow preventer shall be as manufactured by Beeco Division, Hersey Products Inc., Aergap Model 6CM, WATTS 909, or equal.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Except where noted otherwise herein, all valves shall be installing and tested in accordance with the latest revision of AWWA C500. Before installation, all valves shall be lubricated, manually opened and closed to check their operation and the interior of the valves shall be thoroughly cleaned. Valves shall be placed in the positions shown on the Drawings. Joints shall be made as directed under the Piping Specifications. The valves shall be so located that they are easily accessible for operating purposes, and shall bear no stresses due to loads from the adjacent pipe. The Contractor shall be responsible for coordinating connecting piping.
- B. All valves shall be tested at the operating pressures at which the particular line will be used. Any leakage or "sweating" of joints shall be stopped, and all joints shall be tight. All motor operated and cylinder operated valves shall be tested for control operation as directed by the Engineer.
- C. Provide valves in quantity, size, and type with all required accessories as shown on the Drawings.
- D. Install all valves and appurtenances in accordance with manufacturer's instructions. Install suitable corporation stops at all points shown or required where air binding of pipe lines might occur. Install all valves so that operating handwheels or wrenches may be conveniently turned from operating floor but without interfering with access, and as approved by Engineer. Unless otherwise approved, install all valves plumb and level. Valves shall be installed free from distortion and strain caused by misaligned piping, equipment or other causes.
- E. Valve boxes shall be set plumb, and centered with the bodies directly over the valves so that traffic loads are not transmitted to the valve. Earth fill shall be carefully tamped around each valve box to a distance of 4 feet on all sides of the box, or to the undisturbed trench face, if less than 4 feet.

3.02 SHOP AND FIELD TESTING

- A. Shop and field testing of valves shall be as follows:
 - 1. Certified factory testing shall be provided for all components of the valve and operator system. Valves and operators shall be shop tested in accordance with the requirements in the latest revision of AWWA C500, including performance tests,

leakage test, hydrostatic tests, and proof-of-design tests. The manufacturer through the Contractor shall submit certified copies of the reports covering the test for acceptance by the Engineer.

2. Shop testing shall be provided for the operators consisting of a complete functional check of each unit. Any deficiencies found in shop testing shall be corrected prior to shipment. The system supplier through the Contractor shall submit written certification that shop tests for the electrical/pneumatic system and all controls were successfully conducted and that these components provide the functions specified and required for proper operation of the valve operator system.
3. The Contractor shall conduct field tests to check and adjust system components, and to test and adjust operation of the overall system. Preliminary field tests shall be conducted prior to start-up with final field tests conducted during start-up. The factory service representative shall assist the Contractor during all field testing and prepare a written report describing test methods, and changes made during the testing, and summarizing test results. The service representative shall certify proper operation of the valve operator system upon successful completion of the final acceptance field testing.
4. Preliminary and final field tests shall be conducted at a time approved by the Engineer. The Engineer shall witness all field testing.
5. All costs in connection with field testing of equipment such as energy, light, lubricants, water, instruments, labor, equipment, temporary facilities for test purposes, etc. shall be borne by the Contractor. The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the Owner formally takes over the operation thereof.
6. Preliminary field tests shall be conducted prior to start-up and shall include a functional check of the entire valve operator system and all system components. Preliminary field tests shall demonstrate that the valve operator system performs according to specifications and that all equipment, valves, controls, alarms, interlocks, etc., function properly. The preliminary field test report must be approved by the Engineer prior to conducting final field acceptance tests. Based on results of preliminary field tests, the Contractor shall make any adjustments required to settings, etc., to achieve the required valve closing time and operation specified or otherwise directed by the Engineer.
7. Final field acceptance tests shall be conducted simultaneously with the start-up and field testing of the pumps, air compressors, process air blowers, etc. Field tests shall be conducted for the full range of operating modes and conditions specified and as directed by the Engineer. Each of the valves shall be tested at minimum, maximum, and normal head/flow conditions, and under all specified conditions of opening and closing. Performance of pneumatic valves and compressed air system under normal operating conditions and during simulated power failures shall be checked.

8. Field testing shall include optimization of opening and closing times of the valves. The Contractor shall provide the means for accurate measurement of pipeline pressures as directed by the Engineer. Valve opening and closing times shall be adjusted based on process requirements to optimize operation of the valves. Final valve opening and closing times as determined by field tests shall be approved by the Engineer prior to final acceptance of the system.

- END OF SECTION -

SECTION 15100

VALVE OPERATORS AND ELECTRIC VALVE ACTUATORS

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. Equipment shall be provided in accordance with the requirements of Section 11000 – Equipment General Provisions and Section 15000 – Basic Mechanical Requirements.
- B. Reference Section 15390 – Schedules for additional information on valves and operators/actuators.
- C. The electric valve actuators shall meet the signal requirements described in Specification 17060 – Signal Coordination Requirements, 17920 – Control System Input/Output Schedule, and 17950 – Functional Control Descriptions.
- D. Valve operators and electric valve actuators shall be designed to unseat, open or close, and seat the valve under the most adverse operating condition to which the valves will be subjected.
- E. Operator mounting arrangements shall be as indicated on the Drawings or as directed by the manufacturer and/or Engineer. There shall be no mounting restrictions on the electric valve actuator.
- F. The valve operators and electric actuators shall be the full and undivided responsibility of the valve manufacturer in order to ensure complete coordination of the components and to provide unit responsibility.

1.02 SUBMITTALS

- A. The following items shall be submitted with the Shop Drawings in accordance with, or in addition to the submittal requirements specified in Section 01300, Submittals; and Section 11000, Equipment General Provisions:
 - 1. A Performance Affidavit shall be submitted for electric actuators in accordance with Section 11000, Equipment General Provisions.
 - 2. Certification that the force required to operate all valves is as specified herein.

PART 2 -- PRODUCTS

2.01 GENERAL

- A. Manual operators shall be provided on all valves which do not receive electric actuators. Manual operator type shall be as specified herein and as shown on the Drawings.

- B. Quarter turn valves 8" and greater in size shall have geared operators. Gate valves 14" and greater in size shall have geared operators.
- C. Operators/actuators shall be furnished with conservatively sized extension bonnets, extension stems, or torque tubes, and all required appurtenances required for a complete installation. Operators furnished with extension bonnets shall include stainless steel extension stems, or stainless steel torque tubes.

2.02 MANUAL OPERATORS

- A. Unless otherwise specified or shown on the Drawings, manual operator type shall be as follows:
 - 1. Buried valves shall be equipped with nut operators, extended stems, and valve boxes.
 - 2. Exposed valves up to 6-inch shall be lever operated (except gate valves).
 - 3. Exposed valves 8-inches and larger shall be handwheel operated.
 - 4. Exposed gate valves shall be handwheel operated.
 - 5. Valves with centerline of operator located more than 6-feet above the floor or platform from which it is to be operated shall have a chainwheel operator. unless otherwise indicated on the Drawings.
- B. Manual operators shall be rigidly attached to the valve body unless otherwise specified or shown on the Drawings.
- C. All operators shall turn counter-clockwise to open and shall have the open direction clearly and permanently marked.
- D. Valve operators shall be designed so that the force required to operate the handwheel, lever, or chain (including breakaway torque requirements) does not exceed 80 pounds applied at the extremity of handwheel or chainwheel operator. Design pressures for sizing of valve operators shall be the piping test pressure for the piping in which the valve is to be installed as shown in the Piping Schedule in Section 15390 – Schedules.
- E. Handwheels for valves operators shall not be less than 12 inches in diameter. The maximum diameter of any handwheel shall not exceed 24".
- F. Nut operators shall have standard 2-inch square AWWA operating nuts designed in accordance with AWWA C504-94.
- G. Geared manual operators shall be of the worm gear, traveling nut or scotch yolk type except manual operators for butterfly valves 18-inch in diameter or larger which shall be worm gear, unless otherwise indicated in the individual valve specification. Gear operators shall be of the worm gear or bevel gear type. Gear box designs incorporating end of travel stops in the housing shall be equipped with AWWA input stops. Each

gearbox shall require a minimum of 10 turns for 90 degree rotation or full valve stem travel and shall be equipped with a mechanical valve position indicator.

- H. Manual operators on below grade (and vault installed) valves shall be permanently lubricated and watertight under an external water pressure of 10 psi.

2.03 ELECTRIC VALVE ACTUATORS

- A. Electric Actuators shall be open/close service or modulating service as specified in the Valve Schedule in Section 15390 – Schedules.

1. Open/Close (non-modulating) valve actuators shall be IQ series as manufactured by Rotork, SA series as manufactured by AUMA, or Series 2000 as manufactured by EIM Controls.
2. Modulating valve actuators shall be Type IQM as manufactured by Rotork, Type SAR as manufactured by AUMA, or Series 2000 Futronic as manufactured by EIM Controls.

- B. Performance Requirements

1. The actuators shall be designed for indoor and outdoor service and shall be capable of mounting in any position.
2. Torque capacity of the actuators shall be sufficient to operate the valves with the maximum pressure differential, as indicated in the Valve Schedule in Section 15390, with a safety factor of 1.5. Actuators in modulating service will be selected such that the required dynamic valve torque is no more than 60% of the electric actuator's maximum rated breakaway of torque.
3. Operating time for full limits of travel shall be not more than 2 seconds per inch diameter of the valve, +/- 50 percent through 20 inches; +/- 30 percent for valves 24 inches and larger. Operating time shall not be less than 60 seconds for all modulating valves.
4. Actuators shall be capable of operating in ambient temperatures ranging from 0 degrees F – 160 degrees F.
5. For open/close (non-modulating) actuators, the gearing, motor and contactor shall be capable of up to 600 starts per hour without overheating.
6. For modulating actuators, the gearing, motor and contactor shall be capable of up to 1200 starts per hour without overheating.

- C. The actuators shall include, in one integral housing, individual compartments for the motor, gearing, wiring terminals, and control circuits. The terminal compartment shall be separated from the inner electrical components of the actuator by means of a watertight seal. The inner seal shall protect the motor and all other internal electrical elements of the actuator from entrance of moisture and dust when the terminal cover is removed. Double cartridge shaft seals shall be provided on the hand wheel and output shafts for

weatherproof protection. All external fasteners shall be stainless steel. Compartments shall be provided with moisture and dust-proof rigid cast covers meeting NEMA 6, certified to submergence in 6 ft of water for 30 minutes. Where there is a concern about the actuator being submerged, actuator shall be rated IP68 – submergence in 20 feet of water for 72 hours. Actuators located in classified areas shall be suitable for use in Class 1, Division 1, Group D environments.

- D. IP68 RATED ACTUATORS: For actuators that are not IP68 rated, the actuators shall be provided with externally operable and lockable 480VAC circuit breakers integral to the control housing.
- E. All gearing shall be hardened alloy steel or bronze and shall be rated at twice the output torque of the operator and shall be designed to withstand the stall torque of the motor without failure. Output drive gearing shall consist of a worm shaft and worm gear pinion operating in an oil bath. The worm gear pinion shall be alloy bronze. Worm gear drive shall be self-locking to prevent creeping of the valve disc in an intermediate position. Heavy-duty grease shall protect gearing and sealed ball bearings of the main shaft for five years without changing. Motor reduction gearing shall be spur or planetary gearing and shall allow for field repair and change in gear ratio. For quarter turn applications, overtravel of the operator shall be prevented by internal mechanical stops cast into the actuator.
- F. A mechanical dial position indicator shall be furnished to continuously indicate the position of the valve at and between the fully open and fully closed positions. The indicator shall be driven by gearing driven off of the main worm gear pinion and shall operate when the actuator is in either the electrical mode or manual mode.
- G. A handwheel shall be permanently attached for manual operation. A gear assembly shall be provided between the handwheel and the worm shaft if required to reduce the force necessary to operate the handwheel to less than 40 pounds. A positive declutch mechanism shall engage the handwheel when required. When the actuator is set in the declutched position for handwheel operation, it shall return automatically to electric operation when actuator motor is energized. The handwheel shall not rotate during electric operation nor shall a fused motor prevent handwheel operation.
- H. The drive motor shall be specifically designed for actuator service and shall be characterized by high starting torque and low inertia. Motors shall be 460 volts, three phase, 60 Hz AC reversible squirrel cage induction type motors and shall be specifically designed for modulating service where indicated on the Valve Schedule in Section 15390. Motors shall be totally enclosed, non-ventilated, with NEMA Class F insulation minimum (Class H for modulating actuators) and a maximum continuous temperature rating of 120 degree C (rise plus ambient). A 120 VAC space heater shall be provided in the motor compartment. The electric motor shall have a time rating of at least 15 minutes at 104°F (40°C) or twice the valve stroking time, whichever is longer, at an average load of at least 33% of maximum valve torque. Motor bearings shall be permanently lubricated by premium lubricant. The motor shall have plug and socket electrical connection to facilitate easy removal and replacement. The actuator shall include a device to ensure that the motor runs with the correct rotation for the required direction of valve travel with either phase sequence of the three-phase power supply connected to the actuator. The motor shall include single phase protection. A suitable thermal protection device shall be incorporated in the motor or motor starter circuits,

connected to a tripping device. Fast acting fuses shall be provided to protect solid state components. The motor shall be capable of starting against the rated load in either the open or close direction when voltage to the motor terminals is plus or minus ten (10) percent of nameplate rating.

1. Open/Close actuators shall be furnished with electro-mechanical reversing starters.
 2. Modulating actuators shall be furnished with solid state reversing starters utilizing thyristors.
- I. Leads from the motor shall be brought to the control circuit (limit switch) compartment without external piping or conduit box. An adequately sized space heater shall be installed in the control circuit compartment to aid in the prevention of damage resulting in from condensation. The following items shall be located in the control circuit compartment.
1. Torque limit switches shall be provided to de-energize the motor control circuit in the event of a stall when attempting to unseat a jammed valve and when torque is exceeded during valve travel. Each actuator shall have an open direction torque switch and a close direction torque switch. The torque switches shall be mechanically operated and able to be set in torque units. Torque switches shall be calibrated prior to the actuator's assembly to the valve.
 2. Travel limit switches shall be provided to de-energize the motor control circuit when the actuator reaches the limits of travel in the open and close directions. The limit switch drive shall be of the counter gear type and "in step" with the actuator output drive at all times in either the electrical or manual mode of operation. A minimum of six (6) contacts, three (3) normally open and three (3) normally closed, shall be supplied at each end of valve travel. Four (4) additional contacts shall be provided to report end of travel or any desired position between ends of travel.
- J. Modulating actuators shall have a position feedback potentiometer mounted directly to the valve actuator gearing inside the gearing compartment. The potentiometer shall provide a 4-20 mA signal corresponding to valve position. Modulating valve actuators shall be designed to respond to either a 4-20mADC analog signal or a digital pulse signal as specified herein or as required to coordinate with the requirements of Division 17.
1. Modulating valve actuators designed to respond to a 4-20mADC signal shall be provided with a valve positioner which shall position the valve proportional to an externally generated 4-20mADC signal. The valve positioning control circuitry shall position the valve by comparing the command signal with the present valve position as indicated by the feedback potentiometer. The positioner shall be field adjustable to fail to the "open," "closed," or "last" position on loss of 4-20 mADC command signal.
 2. Modulating valve actuators designed to respond to "pulse" open/close signals shall operate the valve during the time the open or close pulse signal is high.

Modulating actuators designed to respond to “pulse” open/close signals shall have the latching circuitry described above for open/close actuators disabled.

- K. The electrical terminals shall be housed in a double sealed terminal compartment isolated from the rest of the actuator components. The actuators shall be designed to operate from a single 480VAC, 3-phase source. The actuators shall be furnished with fuses inside of the terminal compartment. A quantity of two – ¾ inch NPT conduit entries shall be furnished.
- L. Actuators shall contain wiring and terminals for the following control functions. All dry contacts shall be rated for 5A at 250VAC.

1. Open, Close, and Stop commands from external dry contacts (utilizing internal 24VDC or 120VAC power supply) and/or from an external signal of 12V to 120V. The inputs for the open, close, stop signals shall be field selectable to be respond to either maintained or momentary remote signals. In momentary mode, the actuator shall have internal latching circuitry that causes the operator to drive the valve to its limit of travel upon receipt of the momentary contact signal unless a stop signal is received.
2. Emergency override input from a normally closed or normally open contact. The actuator shall either open or close (field selectable) upon receiving the emergency override input.
3. Remote Local-Off-Remote selector switch, Open/Close pushbuttons, and Open/Closed pilot lights for a remote manual control station (see below). The remote Local-Off-Remote selector switch and Open/Close pushbuttons shall be a dry contact input to the actuator control circuitry. The Open/Closed pilot lights shall be powered from the valve actuator control power.
4. Four (4) unpowered contacts shall be provided which can be selected to indicate valve “Opened” and “Closed” position, “Remote” status of the actuator, and fail status of the actuator. The fail status contacts shall activate upon motor overtemperature and actuator overtorque as a minimum.
5. Terminals for 4-20mADC position command and 4-20mADC position feedback as described above for modulating actuators.

M. Local Controls

1. Actuators shall be furnished with a Local-Off-Remote selector switch; Open, Close, and Stop pushbuttons for local control; a red lamp indicating closed and a green lamp indicating open. L-O-R switch shall be padlockable in any of the three positions.
 - a. When the LOR is in the “Local” position, open/close control shall be by the open and close pushbuttons on the actuator. The stop push button shall stop the actuator travel.
 - b. When the LOR is in the “Off” position, the actuator shall not operate.

- c. When the LOR is in the "Remote" position, the actuator shall be controlled by remote inputs from the PLC or from the remote manual controls station.
2. The local controls shall be arranged so that the direction of travel can be reversed without the necessity of stopping the actuator.

N. Remote Manual Control Station

1. Manual actuator controls shall be furnished in a separate NEMA 4X stainless steel enclosure (NEMA 7 if located in a classified area). Manual control station controls shall include Hand-Off-Auto Selector switch; Open, Stop, and Close pushbuttons; a red lamp indicating closed and a green lamp indicating open.
 - a. When the HOA is in the "Hand" position, open/close control shall be by the open and close pushbuttons on the remote manual control station. The stop push button shall stop actuator travel.
 - b. When the HOA is in the "Off" position, the actuator shall not operate.
 - c. When the HOA is in the "Auto" position, the actuator shall be controlled by remote inputs to the valve actuator from the PLC.

2.04 ELECTRIC OPERATORS FOR PVC/CPVC VALVES

- A. Automatic electric operators shall be provided for PVC/CPVC valves where specified and/or as shown on the Drawings. Operators shall operate on 120 volt AC, single phase, 60 hertz power and be equipped with solid state electronic internal controls. Motors shall be brushless, capacitor-run, reversing type, suitable for high duty cycle applications and shall be specifically designed for open/close service. Motors shall be provided with integral thermal overload protection with auto-reset. Operator gears and shafts shall be constructed of heat treated high-alloy steel. Operator output shaft shall be electro-less nickel plated. Operator gear trains shall be permanently lubricated. The gear train shall withstand operator stall torque. Operator enclosures shall be NEMA 4. Operators shall be provided with internally wired, thermostatically controlled enclosure heaters to maintain an enclosure temperature of at least 40 degrees F. Operators shall be provided with positive visual position indication markings permanently affixed to the operator body and final output shaft. Operator drive output shall be provided with a declutchable manual override. A manual lever shall be provided for manual valve positioning. Operators shall be failsafe, utilizing a mechanical spring with a clutch mechanism to uncouple the motor during spring return operation, allowing the spring to relax and either open or close the valve. Selection of either fail-opened or fail-closed shall be made by selection of field wiring terminals.
- B. Independently adjustable cam-operated position limit switches shall be provided with dry contacts for remote fully opened and fully closed valve position indication. Operators shall respond to external dry contact open/close controls. The actuator shall have internal latching circuitry that causes the operator to drive the valve to its limit of travel upon receipt of the momentary contact open or close signal unless a stop signal is received. The all actuator control circuitry, including latching circuitry, shall be internal to

the valve actuator. Valve control circuits and components mounted in a separate enclosure external to the valve actuator assembly will not be permitted. Connections for external remote controls shall be powered from an internal 24VDC or 120VAC power supply. Limit switches shall be rated for 15 amps at 120 VAC. Valve remote status shall also be provided as specified in Section 17950. The Contractor shall coordinate operator controls with the functional requirements specified in Section 17950 – Functional Control Descriptions.

2.05 PNEUMATIC CYLINDER OPERATORS FOR OPEN-CLOSE TYPE VALVES

- A. Pneumatic cylinder operators for open-close type operation shall be as manufactured by Rotork Control, Inc., or equal.
- B. This specification relates to the design, construction and fabrication of pneumatic cylinder operators for quarter turn valves such as plug and butterfly valves. Actuators shall be designed to operate from the compressed service air system when a minimum pressure of 100 psi and a maximum pressure of 125 psi is applied to the cylinder. The valve sizing pressure shall be based on 60 psi. The operator shall be of the double acting single cylinder actuator type, unless otherwise specified herein or required for proper operation of the valve. Double acting actuator end travel torque shall be at least 1.5 times the mid-travel torque.
- C. The valve actuators shall be designed to operate in indoor and outdoor installations. The center body shall be of a fully enclosed design to preclude the possibility of injury to personnel during operation. The center body shall be capable of being lubricated by oil or grease.
- D. The actuator shall be fitted with a visual position indicator easily understood and readable.
- E. All actuators shall have a minimum safety factor on pressurized components of at least 4 to 1. The maximum safe working pressure shall be clearly indicated on the actuator.
- F. Each actuator shall have external, easily adjustable position stops. These stops shall be fully sealed to prevent leakage of oil from the center body. All materials of the actuator shall be suitable for normal operation over a temperature range of -10°F to 200°F.
- G. All components in rubbing contact with seals shall be electroless nickel plated. This is to ensure prolonged seal life and the maintain efficiency. Dynamic seals between the center body and the environment shall be of the double seal type to ensure integrity of the inner seal throughout the working life. An additional seal washer shall be provided on the torque plug to prevent ingress of particulate matter to the inner sealing surface.
- H. The center body cover shall be easily removable to allow for inspection of the center body without disassembling the entire unit or removing the unit from the valve.
- I. Cylinder construction shall be of the external tie rod type. Tie rods shall be designed to stretch within their elastic limit in the event of over pressurization of the cylinder.
- J. The center body shall be a one piece ductile iron casting designed to maintain correct bearing alignment. A removable cover shall be provided to totally enclose the center

body. This cover shall incorporate a weather tight vent. Sealing shall be provided to facilitate oil fill of the center body.

- K. Piston rods shall be turned, ground, and polished bar. Piston rods shall be electroless nickel plated over the entire surface. The yoke pin shall be of high grade steel capable of withstanding the high stresses inherent in this design.
- L. Cylinders shall be constructed of carbon steel to a finish of 16 micro-inch RMS, or better. Cylinders are to be electroless nickel plated on all surfaces.
- M. The yoke shall be constructed of high yield ductile iron and all surfaces shall be corrosion protected after machining. Piston rod bushings shall be of bronze or similar corrosion resistant material. Flanges shall be constructed of ductile iron. The actuator shall be designed so that it can be mounted in any position. Actuators shall be supplied with the center bodies pregreased at the factory.
- N. Manual handwheel overrides shall be provided and shall be designed to give the maximum torque output from the operator. Manual overrides shall be capable of being declutched.
- O. Full open and full closed limit switches shall be provided, each rated at 8 A minimum. Limit switches shall be wired to a terminal board for remote output.

PART 3 -- EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

- A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 11000, Equipment General Provisions and shall include the following site visits for electric actuators:

Service	Number of Trips	Number of Days/Trip
Installation and Testing	1	1
Startup and Training	1	1
Services after Startup	1	1

3.02 INSTALLATION

- A. All valve actuators shall be installed in accordance with the manufacturer's published recommendations and the applicable specification sections for valves, and motor controls.
- B. Valve actuators shall be factory coated in accordance with the manufacturer's standard paint system.

3.03 SHOP TESTING

- A. Shop testing shall be in accordance with Section 11000, Equipment General Provisions and with the following additional requirements:
1. Conduct a complete functional check of each unit. Correct any deficiencies found in shop testing prior to shipment.
 2. Submit written certification that:
 - a. Shop tests for the electrical system and all controls were successfully conducted;
 - b. Electrical system and all controls provide the functions specified and required for proper operation of the valve operator system.
 3. Each actuator shall be performance tested and individual test certificates shall be supplied free of charge. The test equipment shall simulate each typical valve load and the following parameters should be recorded:
 - a. Current at maximum torque setting
 - b. Torque at maximum torque setting
 - c. Flash Test Voltage
 - d. Actuator Output Speed or Operating Time
 - e. In addition, the test certificate should record details of specification, such as gear ratios for both manual and automatic drive, closing direction, and wiring diagram code number.
 - f. Verification of actuator torque rating with valve.

3.04 FIELD TESTS

- A. Field testing shall be in accordance with Section 11000, Equipment General Provisions and with the following additional requirements:
1. Valve actuators shall be field-tested together with the associated valves.
 2. Test all valves at the operating pressures at which the particular line will be used.
 3. Test all valves for control operation as directed.
 4. Field testing shall include optimization of opening and closing times of the valves. Valve opening and closing times shall be adjusted based on process requirements to optimize operation of the valves. Final valve opening and closing times as determined by field tests shall be approved by the Engineer prior to final acceptance of the system.

B. Preliminary Field Tests

1. General: Preliminary field tests shall be conducted prior to start-up and shall include a functional check of the entire valve operator system and all system components.
2. Scope: Preliminary field tests shall demonstrate that the valve operator system performs according to specifications and that all equipment, valves, controls, alarms, interlocks, etc., function properly.
3. Based on results of preliminary field tests, the Contractor shall make any adjustments required to settings, etc., to achieve the required valve closing time and operation, as specified or otherwise directed.

C. Final Field Tests

1. Final field tests shall be conducted in accordance with the latest revision of AWWA C500.
2. Final field tests shall be conducted simultaneously with the start-up and field testing of the pumps.
3. Final field tests shall be conducted for the full range of operating modes and conditions specified and as directed by the Engineer. Each of the valves shall be tested at minimum, maximum, and normal head/flow conditions, and under all specified conditions of opening and closing.
4. Certification of Equipment Compliance: After the final field tests are completed and passed, submit affidavit according to Section 11000.

- END OF SECTION -

SECTION 15101
BUTTERFLY VALVES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Reference Section 15000, Basic Mechanical Requirements.

PART 2 -- PRODUCTS

2.01 BUTTERFLY VALVES (WATER SERVICE)

- A. Butterfly valves (water service) shall be of the rubber-seated, tight-closing type conforming to the latest revision of AWWA C504 Specifications. The manufacturer shall have a minimum of 5 years experience in manufacturing butterfly valves of the sizes required in accordance with AWWA C504 Specifications. All butterfly valves shall be the product of one manufacturer. Butterfly valves shall be as manufactured by Pratt, Mueller Co., or equal. Each valve shall be performance and leak tested as specified in AWWA C504 revised as follows: In addition to the testing requirements of AWWA C504, each butterfly valve shall be thoroughly cleaned and opened and closed at least three (3) times prior to testing. Certified copies of the test results shall be submitted to the Engineer for approval prior to shipment of the valve.
- B. Butterfly valves shall be Class 150B, unless otherwise indicated in the valve schedules, and of the short body design with mechanical joint or flanged ends, as shown on the Drawings.
- C. Valve bodies shall be epoxy coated cast iron conforming to ASTM A-126, Grade B, ASTM A-48, Class 40 or Ductile Iron ASTM A536, Grade 65-45-12. Where required to meet design operating conditions, valve bodies shall be manufactured of higher strength materials. Valve bodies shall have integral hubs for housing shaft bearings and seals.
- D. Butterfly valves shall be of the concentric or eccentric shaft types. Valve discs shall be constructed of epoxy coated ductile iron, ASTM A536, Grade 65-45-12. Disks shall be of the "offset" design to provide a full 360 degree seating surface with no external ribs transverse to flow, and shall comply with the latest revision of AWWA C504 Specifications. The valve manufacturer shall furnish Shop Drawings which include end clearance dimensions when the disc is in the full open position.
- E. The resilient valve seat shall be synthetic rubber designed to seat against a pressure differential of 150 psi on either side of the valve, unless otherwise indicated. The resilient seat shall be mechanically attached to the valve disc or valve body. Any required seat attachment hardware shall be stainless steel. The resilient seat shall be capable of being adjusted or replaced in the field without moving the valve disc along the shaft axis, or removing the valve from the line. The mating seat surface shall be stainless steel or monel.

- The seats shall be factory tested as per AWWA C504 at a test pressure of 150 psig, unless otherwise indicated, and post adjusted for differential pressures indicated herein.
- F. Valve shafts shall be one-piece or two-piece units of stainless steel construction suitably sized to transmit the torques required to operate the valves under the conditions listed in the valve schedule with appropriate safety factor. Shafts shall be securely attached to valve disc by means of conservatively sized corrosion-resistant taper pins, threaded at one end and secured with lockwashers and nuts (i.e.: mechanically attached). Provide O-ring seal on taper pin if required to prevent leakage. Shaft key shall be constructed of corrosion-resistant material.
 - G. Shaft bearings shall be contained in the integral hubs of the valve body and shall be the permanently self-lubricated, corrosion resistant, sleeve type of teflon or heavy-duty bronze. The valve assembly shall be furnished with a factory set two-way thrust bearing designed to center the valve disc in the valve seat at all times. End cover bolts shall be of stainless steel construction.
 - H. The shaft seal shall be either the bronze cartridge type with at least two O-rings, monolithic V-Type, or pull down packing type. If monolithic V-Type or pull down packings are utilized, it shall be self-adjusting, self-compensating type. Packing shall be as manufactured by Chevron, or equal. Butterfly valves with pull down packings shall be designed with an extension bonnet so that repacking can be done without removal of the actuator. For buried valves with pull down packing the packing gland cover assembly shall be heavy duty, soil and water resistant. Stuffing boxes for pull down packing shall have a depth sufficient to accept at least four rings of self-compensating type packing specifically selected for the operating pressures to be encountered. Stuffing box bolts, studs and nuts shall be stainless steel.
 - I. The "O" ring type shaft seal shall be contained in a removable bronze cartridge. The bronze cartridge shall be manufactured from ASTM B505 copper alloy UNS #C93200 and shall meet the requirements of AWWA C504 for bronze, Grade E. The "O" ring material shall be nitrile, BUNA-N rubber, as intended for use with potable water or wastewater and per ASTM D-2000 with a hardness of 70 Shore A Durometer.
 - J. Manual operators for butterfly valves 18-inches in diameter or larger shall be the worm gear type conforming to AWWA C504. Manual operators for butterfly valves mounted above 6 feet from the operating floor shall be equipped with worm gear chainwheel actuators. Operators shall be equipped with adjustable AWWA limit stops, shall be sized according to Table IV for Class 150B, and shall require a minimum of 15 turns for 90 degrees or full stem valve travel. The capacity of the manual operator shall be adequate to drive the valve under the differential pressure of 150 psi and maximum anticipated flow, unless otherwise indicated in the appropriate valve schedule.
 - K. The manufacturer shall certify that the butterfly valves are capable of operating in continuous duty service under these pressures and flow conditions.
 - L. Each valve shall be hydrostatically tested and tested for bubble tightness after the operator has been mounted and adjusted. Copies of the hydrostatic and leakage test certification and certification of conformance shall be submitted to the Engineer prior to shipment.
 - M. All internal and external ferrous components and surfaces of the valves, with the exception of stainless steel and finished or bearing surfaces, shall be shop painted with two coats

(10 mils min. dry film thickness) of the manufacturer's premium epoxy for corrosion resistance. Damaged surfaces shall be repaired in accordance with the manufacturer's recommendations.

2.02 BUTTERFLY VALVES (PROCESS AIR)

- A. Isolation valves and throttling valves for low pressure (less than 15 psig) air service shall be rubber seated, conforming to AWWA C504, 25 psi working pressure, with ANSI B16.1 flanges, 125 pound rating. Valves shall otherwise be as described above under Butterfly Valves (Water Service), except that all valve elements including seat shall be capable of withstanding continuous operation at 250°F.

2.03 BUTTERFLY VALVES (PVC/CPVC)

- A. Butterfly valves (PVC/CPVC) shall be wafer style, constructed of solid Class 12454-B PVC or Class 23447-B CPVC with polypropylene disc and EPDM seats and seals. Valves intended for chemical service shall be constructed of materials suitable for the intended service. Butterfly valves shall provide bubble-tight seating, with stainless steel shaft and gear operator, and shall be as manufactured by ASAHI/AMERICA, or equal.

2.04 BUTTERFLY VALVES (RECTANGULAR)

- A. Rectangular butterfly valves shall be bubble tight with flow in either direction. Rectangular butterfly valves shall be manufactured by Pratt, Hydro Gate, or equal. The Valve body shall be fabricated carbon steel, designed for wall mounting. Valve manufacturer shall provide a double flanged wall thimble to be cast in place. The valve disc shall be fabricated of carbon steel with Type 304 stainless steel seating edge. Disc shall be streamlined in shape to prevent turbulence in full open position and to minimize pressure drop across valve. The valve seat, contained in the body of the valve, shall be a synthetic rubber compound with a durometer of 50.
- B. Seat adjustment shall not be less than 1/8 inch. Valve seat shall be fully field adjustable and replaceable without dismantling operator, disc, or shaft and without the use of special tools. Valve shaft shall be 304 stainless steel securely locked to disc by stainless steel taper pins.
- C. Each valve assembly shall be furnished with a 2-way thrust bearing assembly designed to hold the disc centered in the seat at all times. Thrust bearing shall be secured by locking device and easily accessible for field adjustment from operator end of valve.
- D. Valve operators shall conform to AWWA-C504 and shall be designed to hold the valve in any intermediate position between fully closed and fully open without creeping or fluttering. Manual operators shall be of the travelling nut, self-locking type and shall be equipped with mechanical stop-limiting devices to prevent over travel of the disc. Operators shall be fully enclosed and designed to produce the specified torque with a maximum pull of 80 lb. on the handwheel.
- E. All internal and external ferrous components and surfaces of the valves, with the exception of stainless steel and finished or bearing surfaces, shall be shop painted with two coats (10 mils min. dry film thickness) of the manufacturer's premium epoxy for corrosion

resistance. Damaged surfaces shall be repaired in accordance with the manufacturer's recommendations.

- F. The manufacturer shall certify that the rectangular butterfly valves are capable of operating in continuous duty service under the required pressures and flow conditions. Each valve shall be hydrostatically tested and tested for bubble-tightness after the operator has been mounted and adjusted. Copies of the hydrostatic and leakage test certification and certification of conformance shall be submitted to the Engineer prior to shipment.

- END OF SECTION -

SECTION 15104

BALL VALVES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Reference Section 15000, Basic Mechanical Requirements.
- B. Valves removed for chemical service shall be constructed of materials suitable for the intended service.

PART 2 -- PRODUCTS

2.01 BALL VALVES (WATER SERVICE)

- A. Ball valves (water service) shall be of the full port, single seated, metal to metal seated, tight-closing type conforming to the latest revision of AWWA C507 Specifications. The manufacturer shall have a minimum of 5 years experience in manufacturing ball valves of the sizes required in accordance with AWWA C507 Specifications. All ball valves shall be the product of one manufacturer. Ball valves shall be as manufactured by Willamette Valve, Inc., or equal.
- B. Each valve shall be performance and leak tested as specified in AWWA C507 revised as follows: In addition to the testing requirements of AWWA C507, each ball valve shall be thoroughly cleaned and opened and closed at least three (3) times prior to testing. Certified copies of the test results shall be submitted to the Engineer for approval prior to shipment of the valve.
- C. Ball valves shall be AWWA Class 150, unless otherwise indicated in the valve schedules, design with flanged ends, and installed as shown on the Drawings.
- D. The valve body shall be constructed of epoxy coated cast iron conforming to ASTM A 48, Class 35, with a full, unrestricted circular inlet and outlet, with nominal opening diameter equal to the rated size of the valve. Each valve body shall be provided with flanged ends conforming in diameter and drilling to ANSI B16.1, Class 125. All flanges shall be flat faced and finished to true plan surfaces within a tolerance limit of 0.005 inch. Each flange face shall be perpendicular to the longitudinal axis of the valve within a maximum angular variation tolerance of 0.002 inch per foot of flange diameter. Flange faces shall have concentric or spiral serrated finish. The body trunnions shall be fitted with ample sized bronze bearings of sufficient difference in hardness from the plug bearings to eliminate seizing and galling. Bearing pressure shall not exceed 1500 psi at full differential pressure of 150 psi. Valve designs employing teflon coated or other non-metallic material will not be acceptable. Bearings shall be machined in accurate alignment for reception of the plug trunnions.

- E. The body shall provide rigid means for supporting the valve operating mechanism without the necessity of additional supports and shall be of such design that it shall be capable of receiving the complete plug sub assembly. The valve body shall have integral hubs for housing shaft bearings and seals.
- F. The body shall have a rigidly attached metal seat. The body seat shall be Monel (Alloy 400) and shall be machined, ground and polished for contact with the stainless steel seat mounted on the plug.
- G. There shall be two (2) pipe connections, one for an air vent and the other for drain.
- H. The plug shall be constructed of epoxy coated cast iron conforming to ASTM A48, Class 35, with a full unobstructed, circular waterway with a diameter equal to the rated size of the valve. It shall have trunnion supports cast integral on the axis of rotation. An extension of one trunnion, called the operating shaft, shall pass through a shaft seal chamber and connect to the valve operation mechanism.
- I. The plug shall have a stainless steel seat conforming to ASTM A276, Type 304, mounted thereon which shall properly align with the body seat when the valve is in the closed position. The surfaces of the seat ring shall be spherically generated and shall be machined, ground and polished for contact with the body seat.
- J. The plug trunnions shall be fitted with bronze bearings of sufficient difference in hardness from the body bushings to eliminate seizing and galling.
- K. Bearing pressure shall not exceed 1500 psi at full differential pressure of 150 psi. Valve designs employing Teflon coated or other non-metallic bearing material will not be acceptable.
- L. Valve shafts shall be integral with the plug and shall connect the plug to the torque unit. The shaft shall be of chrome Molybdenum Steel (ASTM A 322 Grade 4140) with hard chrome plate through the seal chamber suitably sized to transmit the torques required to operate the valves under the conditions listed in the valve schedule with appropriate safety factor. Shafts shall be securely attached to valve plug by means of conservatively sized corrosion-resistant taper pins, threaded at one end and secured with lockwashers and nuts (i.e.: mechanically attached). Provide O-ring seal on taper pin if required to prevent leakage. Shaft key shall be constructed of corrosion-resistant material.
- M. Shaft bearings shall be contained in the integral hubs of the valve body and shall be the permanently self-lubricated, corrosion resistant, sleeve type of heavy-duty bronze. The valve assembly shall be furnished with a factory set thrust bearing designed to center the valve plug in the valve seat at all times. End cover bolts shall be of stainless steel construction.
- N. A shaft seal shall be provided of the type utilizing a plug shaft stuffing box, four (4) "O" ring seals, a bronze retainer and a corrosion resistant steel lock ring. The "O" ring material shall be BUNA-N rubber, as intended for use with potable water or wastewater.
- O. Manual operators for ball valves 18-inches in diameter or larger shall be the worm gear or travelling nut type conforming to AWWA C507. Manual operators for ball valves mounted above 6 feet from the operating floor shall be equipped with worm gear chainwheel

actuators. Operators shall be equipped with adjustable AWWA limit stops and shall require a minimum of 15 turns for 90 degrees or full stem valve travel. The capacity of the manual operator shall be adequate to drive the valve under the differential pressure of 150 psi and maximum anticipated flow, unless otherwise indicated in the appropriate valve schedule. Electric motor operators shall be as specified elsewhere in this Section.

- P. The torque unit (valve operating mechanism) shall be of the traveling-nut type and shall be the product of the valve manufacturer. The assembly shall be mounted, and attached to the valve body. The torque unit shall be designed to accept a manual, cylinder or electric motor actuator. The torque unit housing shall employ the following:
1. A traveling crosshead to impart positive rotary movement to the plug which will move transversely to the valve shaft.
 2. A cylinder piston rod or stainless steel Type 416 threaded leadscrew (reach rod or stem) with the crosshead directly attached thereto.
 3. A rotator lever (of cast steel construction).
 4. A matched set of interconnecting links (of cast steel construction) connecting the traveling crosshead to the rotator lever.
- Q. The traveling crosshead shall be confined to permit linear motion only and to prevent it from any tendency to rotate due to linkage reaction. A plug shaft support bearing shall be supplied on the cover.
- R. The torque unit shall be so designed that during the first 50 percent of stroke in closing the flow area is reduced by approximately 81 percent. The remaining 19 percent of flow area shall be gradually reduced to a complete shutoff throughout the last 50 percent of the closing stroke.
- S. The torque unit shall be totally enclosed in a suitable housing with a removable cover and shall be capable of being inspected, lubricated, adjusted and repaired without interfering with or removing the valve from the line and shall be permanently lubricated. All parts shall be of first class workmanship, easily replaceable and manufactured of the best materials suited for the purpose. All parts subject to rubbing shall be of significantly different hardness to prevent galling and shall be sized to result in a maximum bearing stress at full load of 2,000 psi. The main shaft shall be replaceable without removing the torque unit housing and while the valve is in the line under pressure.
- T. The manufacturer shall certify that the ball valves are capable of operating in continuous duty service under these pressures and flow conditions.
- U. Each valve shall be hydrostatically tested and tested for bubble tightness after the operator has been mounted and adjusted. Copies of the hydrostatic and leakage test certification and certification of conformance shall be submitted to the Engineer prior to shipment.
- V. All internal and external ferrous components and surfaces of the valves, with the exception of stainless steel and finished or bearing surfaces, shall be shop painted with two coats (10 mils min. dry film thickness) of the manufacturer's premium epoxy for corrosion

resistance. Damaged surfaces shall be repaired in accordance with the manufacturer's recommendations.

2.02 BALL VALVES (PVC/CPVC)

- A. Ball valves (PVC/CPVC) shall be of self-lubricating normal impact Class 12454-B PVC or Class 23447-B CPVC construction with renewable Teflon seat, EPDM "O" rings and removable handle. Valves intended for chemical service shall be constructed of materials suitable for the intended service. Valves shall be manufactured by Chemtrol Products Division of NIBCO, Inc., or equal, and shall have 125 psi minimum non-stock cold water pressure rating and integral unions with screwed ends or flanged ends as required.

2.03 BALL VALVES (SERVICE AIR)

- A. Ball valves (service air) shall be manufactured by Apollo Ball Valve Division of Conbraco Industries, Inc., Pageland, SC., or equal. The body materials shall be cast bronze rated at 600 psi WOG, 150 psi saturated steam. Valves shall be tested by the manufacturer to MSS SP-72, 100 psi air under water, in the opened and closed position. The valve shall provide a port diameter equal to or exceeding the mating pipe size. Valves 2-1/2 inches in diameter and smaller shall have lever operators, unless otherwise specified herein or noted on the Drawings. Levers shall be cadmium plated steel covered with a vinyl grip and attached with a nut and have a hole for tagging purposes. The stem gland shall be adjustable and independent of the lever to compensate for wear. Bottom loaded stems shall be designed to be blow-out proof. The stuffing box seals and ball seats shall be composed of glass-reinforced TFE. The ball and stem shall be 316 stainless. Ball valves shall have NPT ends.

2.04 BALL VALVES (BALL CHECK FOR CAUSTIC SERVICE)

- A. Ball check valves installed in carbon steel caustic solution piping shall be constructed of Type 304 or 316 stainless steel. Valves shall have a 200 psi minimum pressure rating and a maximum temperature rating not less than 300°F. Valves shall be flanged and equipped with unions as necessary to expedite removal and servicing.

- END OF SECTION -

SECTION 15105

CHECK VALVES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Reference Section 15000, Basic Mechanical Requirements.
- B. Valves intended for chemical service shall be constructed of materials suitable for the intended service.

PART 2 -- PRODUCTS

2.01 SWING CHECK VALVES (WATER/WASTEWATER SERVICE)

- A. Unless otherwise specified, check valves 3-inches and less shall be bronze, Y-pattern, swing check valves of the regrinding type. Valves shall have a minimum 200 psi non-shock cold water pressure rating and shall be as manufactured by Jenkins Bros. Corp., Crane Company, or equal.
- B. Check valves larger than 3-inches shall be cushioned swing check valves rated for a minimum working pressure of 200 psi and shall be of the "Shockless Swing-Check" type as manufactured by G.A. Industries, or equal.
- C. Valve closure shall be controlled by an external weighted lever arm, the action of which is cushioned by a hydraulic oil or pneumatic cylinder. Counterweights and cushion cylinders shall be designed so that adjustments can be made in the field to minimize surge and to prevent backflow and hammering noises during actual service conditions. The hydraulic oil or pneumatic cushion system shall be completely self-contained.
- D. Valve bodies, cover discs, levers, and disc arms shall be constructed of heavy cast iron or cast steel fully conforming to the latest revision of ASTM A-126 Class B or Class WCB, respectively. Valve ends shall be Standard American 125 pound flat-faced flanged, in accordance with ANSI B16.1. Each valve disc shall be suspended from a noncorrosive shaft which shall pass through a stuffing box and be connected on the outside of the valve to the cushion and counterweight mechanism.
- E. Valve seating shall be rubber-to-metal designed for drop-tight shutoff. The body seat ring shall be made of bronze or stainless steel and the disc seat ring of 80 Durometer rubber. Body and disc seats shall be renewable.
- F. With the exception of the valve body and seat, all parts in contact with water shall be manufactured from noncorrosive materials. Internal corrosive surfaces shall be shop painted with two coats of epoxy for corrosion resistance. Exterior surfaces shall be painted in accordance with the requirements of Section 09900, Painting.

2.02 CHECK VALVES (PROCESS AIR)

- A. Check valves (process air) shall be provided on the discharge of each of the new blower units. Check valves shall be as manufactured by TRW Mission, APCO, or equal, and shall be double-door type with cast iron bodies, ASTM A 126, Class B, and 125-pound standard flanged connections, or insert Type ANSI B16.34. Discs shall be ductile iron, electroless nickel coated, ASTM A 395, and shall be spring-loaded, normally closed, by means of two (2) 316 stainless steel springs which act independently, one on each of two hinged discs. Maximum spring deflection from neutral position for full open valve shall be 140. Valve seating shall be Butyl or Viton A, and shall provide a zero leakage at 5 to 25 psig at a work temperature of 225°F.

2.03 SWING CHECK VALVES (PVC/CPVC)

- A. Swing check valves (PVC/CPVC) shall be constructed of solid Class 12454-B PVC or Class 23447-B CPVC with EPDM or Teflon seats and seals. Valves shall have an external lever and weight. Check valves shall have flanged ends. Valves shall be capable of top entry to facilitate cleaning and repair without removal from the line. Valve shall incorporate a single disc design. Check valves shall be as manufactured by ASAHI/AMERICA, or equal.

2.04 BALL CHECK VALVES (PVC/CPVC)

- A. Ball check valves (PVC/CPVC) shall be constructed of Class 12454-B PVC or Class 23447-B CPVC with EPDM seals and seats, as manufactured by Chemtrol Products Division of NIBCO, Inc., or equal. Valves shall have 150 psi minimum non-shock cold water pressure rating and integral union with screwed ends or as specified otherwise.

2.05 BALL CHECK VALVES (CAUSTIC SERVICE)

- A. Ball check valves for caustic services installed in carbon steel caustic solution piping shall be constructed of Type 304 or 316 stainless steel. Valves shall have a 200 psi minimum pressure rating and a maximum temperature rating not less than 300°F. Valves shall be flanged and equipped with unions as necessary to expedite removal and servicing.

2.06 FLANGE INSERT CHECK VALVES - FIV

- A. The Contractor shall provide FIVs for the bulk storage and day tanks. The FIVs shall be installed on the overflow lines complete with unions, liquid trap, and flanges. The valves shall be flanged check valve type inserted between two mating flanges. The valves shall be 3-inch. The material of the valves shall be Teflon or PVC with Teflon O-ring seats. Each valve shall have a cracking pressure of 1/8 psig. The springs shall be Type 316 stainless steel completely encapsulated in Teflon. The valves shall be Model FIV-300-T(P)-T-1/8T as manufactured by Check-All Valves Manufacturing Company.

- END OF SECTION -

SECTION 15108

GATE VALVES (INCLUDING KNIFE GATE VALVES)

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Reference Section 15000, Basic Mechanical Requirements.

PART 2 -- PRODUCTS

2.01 GATE VALVES

- A. All gate valves between 2 inches and less than 4 inches shall be iron body, bronze trimmed, wedge disc, and minimum 150 psi non-shock cold water pressure rating. Exposed valves shall be of the outside screw and yoke (OS&Y), ANSI B-16.1, 125 pound flanges and shall be as manufactured by the Crane Company, Jenkins Bros. Corp., or equal.
- B. Valves less than 2 inches shall be of bronze body, rising stem, wedge disc and minimum 300 psi non-shock cold water pressure rating. Valves shall have screwed ends or as specified otherwise.
- C. Gate valves 4 inches through 16 inches shall be of the non-rising stem design, shall fully comply with the requirements of AWWA C509 for resilient-seated gate valves and shall be the Metroseal 250 as manufactured by U.S. Pipe and Foundry Co., or equal. Gate valves shall be designed for a minimum working pressure of 250 psi and a test pressure of 500 psi.
- D. Gate valve body and bonnet shall be cast iron conforming to ASTM A126, Class B with resilient seat gate and O-ring seals. The gate shall be cast iron with a vulcanized rubber coating with no metal to metal contact when in the fully closed position and a smooth unobstructed waterway when in the fully opened position. Gate valves 18 inches and larger shall fully comply with the requirements of AWWA C500 and shall be double disc parallel seat with bypass and inside screw spur geared operator, unless otherwise specified or shown on the Drawings. Valves shall be American Darling Series 50, Mueller, or equal.
- E. Valves shall be flanged mechanical joint as shown on the Drawings, with non-rising stems, and with a 2-inch square standard AWWA operating nuts unless otherwise shown on the Drawings or specified herein.
- F. All internal ferrous components and surfaces of the valves, with the exception of stainless steel and finished or bearing surfaces, shall be shop painted with two coats (10 mils min. dry film thickness) of the manufacturer's premium epoxy for corrosion resistance. Damaged surfaces shall be repaired in accordance with the manufacturer's recommendations.

2.02 KNIFE GATE VALES

- A. Knife gate valves shall be cast iron conforming to ASTM A126, Class B with resilient ring seal seat. The gate shall be stainless steel with a beveled, knife-like edge. The knife gate valve shall be flanged in accordance with ANSI B-16.1, 125 pound flange with a handwheel operator as manufactured by DeZurik, or equal.

- END OF SECTION -

SECTION 15109

PLUG VALVES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Reference Section 15000, Basic Mechanical Requirements.

PART 2 -- PRODUCTS

2.01 PLUG VALVES

- A. Plug valves shall be of the non-lubricated, eccentric seating plug type with synthetic rubber-faced plugs as manufactured by DeZurik Company, Pratt, or equal. All valves shall be provided with limit stops and rotate 90° from fully open to fully shut. The minimum working pressure for all valves shall be 150 psi, and the test pressure shall be at least 270 psi for valves up through 12-inch and at least 230 psi for valves 14-inch and larger. The port area of valves shall be at least 80 percent of full pipe area for valves less than 24-inches and 70 percent for valves 24-inches and larger, unless otherwise specified herein or indicated in the appropriate Valve Schedule in Section 15390, Schedules. The body materials shall be of epoxy coated cast iron or semi-steel, unless specified otherwise. Seats shall have a welded overlay of 90 percent pure nickel and machined to a finish containing no stress cracks. Plug facings shall be of Hycar, or equal and completely suitable for use with domestic sewage.
- B. The shaft seal shall be either the bronze cartridge type with at least two O-Rings, monolithic V-Type, or pull down packing type. If monolithic V-Type or pull down packings are utilized, it shall be self-adjusting, self-compensating type. Packing shall be as manufactured by Chevron, or equal. Plug valves with pull down packings shall be designed with an extension bonnet so that repacking can be done without removal of the actuator.
- C. All buried valves shall have mechanical joint ends (unless otherwise shown), conforming to ANSI A21.11. (AWWA C 111), and shall be operated with a standard AWWA 2-inch square nut through a totally enclosed worm gear actuator. Valve boxes shall be installed with all buried plug valves and shall be as specified herein.
- D. Unless otherwise shown, all exposed valves 4-inches in diameter and larger shall have flanged ends conforming to ANSI B16.1-125/150 pound standard with face-to-face dimensions of standard plug valves. Valves smaller than 4-inches in diameter shall have screwed ends, unless otherwise noted.
- E. Valves 8-inches in diameter and larger shall be handwheel or floorstand operated where required or indicated on the Drawings through totally enclosed worm gear actuators, unless otherwise specified or shown on the Drawings. Valves 6-inches in diameter and smaller shall have lever operators, unless otherwise specified or noted on the Drawings. Manual

operators for plug valves mounted above 6 feet from the operating floor shall be equipped with worm gear chainwheel actuators.

- F. The manufacturer shall certify that the plug valves are capable of operating in continuous duty service under these pressures and flow conditions.
- G. Each valve shall be hydrostatically tested and tested for bubble tightness after the operator has been mounted and adjusted. Copies of the hydrostatic and leakage test certification and certification of conformance shall be submitted to the Engineer prior to shipment.
- H. All internal and external ferrous components and surfaces of the valves, with the exception of stainless steel and finished or bearing surfaces, shall be shop painted with two coats (10 mils min. dry film thickness) of the manufacturer's premium epoxy for corrosion resistance. Damaged surfaces shall be repaired in accordance with the manufacturer's recommendations.

- END OF SECTION -

SECTION 15170
ELECTRIC MOTORS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish all labor, materials, tools and equipment necessary for furnishing, installing, connecting, testing and placing into satisfactory operation all electric motors as shown on the Drawings and specified herein. All motors required for this Contract shall comply with this Section unless otherwise noted.

1.02 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop Drawings.
 - 2. Spare Parts List.
 - 3. Special Tools List.
 - 4. Proposed Testing Methods and Reports of Certified Shop and Field Tests.
- B. Each submittal shall be identified by the applicable specification section.

1.03 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Individual shop drawings for electric motors shall be submitted in accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, unless submitted as a part of the shop drawings for the driven equipment.
- D. Shop drawings for electric motors shall include motor data sheets, dimensioned drawings, wiring diagrams (space heaters, temperature devices, etc.) identifying electric characteristics and design, mechanical construction, manufacturer's name, type and pertinent specifications for the use intended, along with the name of the equipment to be driven. For motors rated 50 horsepower or more, submittal of motor data for acceptance shall include, as a minimum, the following:
 - a. Manufacturer's type and frame designation

- b. Horsepower rating
- c. Time rating (per NEMA Standards)
- d. Ambient temperature rating
- e. Insulation system designation (see Item r. for full description)
- f. RPM at rated load
- g. Frequency
- h. Number of phases
- i. Rated-load amperes
- j. Voltage
- k. Code letter (starting KVA per horsepower)
- l. Design letter for integral horsepower induction motors (per NEMA Standards)
- m. Service factor
- n. Temperature rise at full load and at service factor load
- o. Efficiency at 1/4, 1/2, 3/4 and full load
- p. Power factor at 1/4, 1/2, 3/4 and full load
- q. Motor outline, dimensions and weight
- r. Insulation system description
- s. Horsepower required by connected machine at specified conditions (load curves) shall be supplied for all compressors, propeller and positive displacement pumps.

The foregoing data shall also be verified after manufacture and shall be included with the information to be furnished in the operation and maintenance manuals specified.

- E. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.
- B. Electric motors shall be manufactured by Reliance Electric Company; U.S. Motors Division, Emerson Electric Company; Toshiba Industrial and Power Systems, Inc.; Siemens Energy & Automation, Inc.; General Electric Company; or equal.

2.02 MATERIALS AND CONSTRUCTION

- A. Motors shall be built in accordance with the latest standards of NEMA, including, but not limited to MG-1 and MG-2, IEEE, ANSI and to the requirements specified herein.
- B. Type

1. Unless otherwise noted, motors specified herein are polyphase squirrel cage, NEMA Design B, or single phase capacitor or repulsion start induction motors. Special equipment requiring a motor drive with unusual characteristics shall be equipped with a definite purpose motor to meet the necessary requirements.
2. Unless otherwise shown or specified, all motors 1/2 horsepower or larger shall be three- phase, 60 Hertz, NEMA Design B, squirrel cage induction motors designed for operation at 480 volts or greater as specified herein or shown on the Drawings.
3. Unless otherwise specified in the individual motor specification for the driven equipment, or as required by the dynamic characteristics of the load as determined by the manufacturer of the machine to be driven, all polyphase squirrel cage motors shall be designed to withstand the starting voltage shown on the Drawings and shall have torque and locked rotor current characteristics as specified for NEMA Design B motors.
4. All motors 2 horsepower and smaller shall have windings encapsulated with a flexible epoxy compound, or insulated with a flexible epoxy compound, or insulated with the manufacturer's premium quality system which shall be subject to acceptance by the Engineer.
5. All motors above 3 horsepower shall have stator windings vacuum impregnated with a polyester insulation compound.
6. Unless otherwise noted, all motors smaller than 1/2 horsepower shall be standard single-phase capacitor start or repulsion start induction type designed for operation on 120 volts or 208 volts, 60 Hz alternating current. The motor shall deliver rated load without exceeding a 80 degrees C temperature rise while operating in a 40 degrees C ambient temperature. Small fan motors less than 1/4 HP may be split-phase or shaded pole type as standard with the drive. Shaded pole motors rated more than 1/4 horsepower will not be approved. Fractional horsepower motors shall be completely equipped with all necessary auxiliary components for starting and labeled as "Thermally Protected". Insulation shall be Class B, except that submersible motors shall have epoxy encapsulation. Unless otherwise noted, the motors shall be totally enclosed. Small fan motors may be of the open type where they are suitably protected from moisture dripping and lint accumulation. Motors shall be provided with sealed ball bearings lubricated for 10 years normal use.
7. Where specified, vertical hollowshaft motors shall be designed to carry the motors', pumps', and associated equipment's full thrust. The motors shall be equipped with grease lubricated spherical roller thrust bearings and lower radial guide bearings. Vertical hollowshaft motors shall be fitted with nonreversing ratchet assemblies where specified. Vertical adjustment shall be provided by means of a lockable nut at the top of the shaft.
8. Vertical hollowshaft motors shall have adequate thrust bearings to carry all motor loads and any other operating equipment loads. Horizontal motors shall not be installed where subjected to external thrust loads except where special motor construction is approved by the Engineer.

C. Rating

1. Each motor shall develop ample torque for its required service through its acceleration range and throughout its rated load range. The rating of the motors offered shall in no case be less than the horsepower shown on the Drawings or elsewhere specified. It should be noted that the motor sizes indicated on the Drawings or as otherwise specified herein, are motor sizes required to operate the specific equipment which is specified. Higher rated motor sizes may be determined from the actual equipment submitted, approved, purchased, and installed. Overload protection, starters, disconnect switches, and other necessary equipment shall be furnished and installed for the actual motor sizes required at no additional cost.
2. Motor ratings shall be based on continuous operation in an ambient temperature. The maximum temperature rise for open and drip proof type motors shall not exceed 90 degrees C, and for totally enclosed type motors shall not exceed 80 degrees C.

D. Insulation

1. Insulation shall be as specified for each particular type or class of motor. The insulation system shall provide a high dielectric strength, long life covering for the windings which may be required to operate in a continually damp and chemically contaminated environment. The insulation shall be resistant to attack by moisture, acids, alkalis, abrasives, and mechanical and thermal shock. Leads shall be sealed with a non-wicking, non-hygroscopic insulation material.
2. Motor insulation resistance may be checked at any time after delivery to the job site or during the warranty period. Encapsulated motor stators may be subjected to insulation testing while completely submerged in water. Any motor not meeting the requirements specified herein will be rejected and shall be promptly replaced at no cost to the Owner.
3. Torque and locked rotor current characteristics for three phase motors shall be NEMA Design B. The locked rotor KVA/HP input at full voltage for 10 horsepower. motors and larger shall not exceed that permitted for Code Letter "J", except for specialized equipment requiring a motor drive with special definite characteristics.
4. Unless otherwise specified, non-inverter duty motors shall be furnished with a Class F insulation system. Unless otherwise specified, inverter duty motors shall be furnished with a Class H insulation system. In either case, temperature rise shall be limited to that for Class B insulation. Output torque and speed characteristics of each motor shall be suitable to operate the driven equipment through the full range of acceleration and operating load conditions without exceeding the nameplates current rating, and/or temperature rise.

E. Nameplates

1. The motor manufacturer's nameplates shall be engraved or stamped on stainless steel and fastened to the motor frame with No. 4 or larger oval head stainless steel screws or drive pins. Nameplates shall include as a minimum, Items a through m as listed in Article 1.03 in addition to that required by NEMA standards. The nameplate

shall be positioned so as to be readily visible for inspection in the completed machine.

F. Design

1. Motors shall be designed to accelerate and drive the connected equipment under all normal operating conditions without exceeding nameplate ratings.
2. Motors specified for operation with variable frequency drives shall be inverter duty and shall be designed to output 100 percent of nameplate horsepower under continuous duty service without exceeding the temperature rise specified herein when controlled by the actual drives furnished. Inverter duty motors shall be designed to operate down to 10% of full load speed without the need for a line powered cooling fan.
3. Unless otherwise specified, electric motors shall be furnished with service factors in accordance with NEMA MG-1 as follows:

Type of Motor	Service Factor
Non-inverter Duty	1.15
Inverter Duty	1.0

4. Design selection with respect to the driven machine shall be such that the requirements do not exceed 85 percent of the motors' maximum rating modified by service factor, ambient temperature, enclosure, altitude and electrical service. The electrical service conditions shall be assumed to be 10 percent undervoltage, 5 percent underfrequency, and 3 percent voltage unbalance. Altitude shall be assumed to be the plant elevation plus 10 percent. Ambient temperature shall be assumed to be 95 degrees F in exterior locations, 104 degrees F (40 degrees C) in interior locations, and 122 degrees F (50 degrees C) within housings or enclosures; except where higher temperatures may be encountered within or on individual items of equipment. The applicable paragraphs of NEMA MG-1 shall be used in making the design selection.
5. Motors used with belt drives shall have sliding bases to provide for belt take up.
6. Terminal boxes shall be of sufficient size to accommodate the required quantity and size of conduits. Gasketed terminal boxes shall be furnished with all splash-proof and totally enclosed motors. NEMA ratings of the terminal boxes shall be suited for the application. Motors located in hazardous locations shall be furnished with terminal boxes suitable for the specific Class, Division, and Group suitable for the application. Terminal boxes shall be sized to accommodate accessory equipment such as motor differential current transformers.
7. Terminal boxes for horizontal motors shall be located on the left-hand side when viewing the motor from the drive shaft end and shall be so designed that conduit entrance can be made from above, below, or either side of the terminal box.
8. Motors larger than 250hp shall be manufactured with the six stator coil leads wired to the motor junction box for application in a differential relay scheme. Current

transformers shall be provided by the motor manufacturer and installed in the factory. All ground connections and current transformer connections shall be made in the factory.

G. Construction

1. Frames, mounting means, and shafts shall meet NEMA Standards for the horsepower, RPM, and enclosure selected. Enclosures shall be selected according to the degree of mechanical protection required and shall not be of aluminum construction. All motors shall have a manufacturer's standard shop machinery finish, consisting of a rust-resisting priming coat of zinc chromate and a finish coat of alkyd machinery enamel. Reference Section 09900, Painting.
2. Motors shall have cast iron frames and a heavy gauge steel terminal box, with neoprene gaskets between the frame and the box and between the box and its cover. A grounding lug(s) shall be provided inside the terminal box.
3. Motors weighing more than 50 pounds shall be equipped with at least one lifting eye. All hardware shall be corrosion resistant.
4. Motors located in hazardous locations as defined by the NEC shall be totally enclosed and suitable for the specific Class, Division, and Group suitable for the application.
5. Motors located in Class I or II, Division 1 hazardous locations shall bear the U.L. label and shall be provided with a breather/drain approved for the hazardous location. The U.L. listed breather/drain shall prevent the entrance of contaminants while allowing moisture to drain out of the motor.
6. When located outdoors, or elsewhere if specified, motors shall be totally enclosed, non-ventilated (TENV) or totally enclosed, fan-cooled (TEFC) machines, unless otherwise noted. Totally enclosed motors shall be provided with two (2) 1/4 inch drain holes drilled through the bottom of the frame, which allows complete drainage of the frame. Where specified, TEFC motors controlled by a variable frequency drive shall be provided with a separately powered cooling fan motor that runs at 60HZ to ensure proper cooling of the motor at low speeds. Cooling fan motor shall be suitable for 120VAC, single phase operation.
7. Unless otherwise specified in the equipment specifications, motors rated 100 horsepower or greater located outdoors, in unheated structures, in below grade areas, or as otherwise indicated, shall be furnished with space heaters and embedded motor winding high temperature switches with leads brought out of the motor terminal box. Space heaters shall be suitable for 120VAC operation and for a maximum surface temperature of less than 200 degrees C. Spare heaters shall be of sufficient wattage to maintain the internal temperature of the motor at approximately 10 degrees C above the ambient temperature when the motor is not running.

Embedded motor winding temperature switches shall operate at temperatures well below the temperature rating of the motor winding insulation system. Motor winding

temperature switches are not required where other temperature monitoring devices (e.g. RTD's) are required.

8. Unless otherwise specified in the equipment specifications, motors rated 200HP or greater that are controlled by a VFD shall be furnished with resistance thermal detectors (RTD's) embedded in the stator windings, two per phase. RTD's shall be pre-wired to terminal blocks located in a separate terminal box as specified herein.
9. Unless otherwise specified in the equipment specifications, motors rated less than 200HP that are controlled by a VFD shall be furnished with motor winding high temperature switches embedded in the stator windings with the leads brought out to the motor terminal box.
10. If so specified and when located in indoor areas which are heated and weatherproof, motors shall be open drip-proof machines. Ventilation openings shall be arranged to prevent the entrance of drops of liquid or solid particles at any angle from zero to 15 degrees downward from vertical.
11. Unless otherwise specified, or required, motors rated less than 200 horsepower shall be furnished with bearings of the grease lubricated, antifriction ball type with conveniently located grease fittings and drain plugs. A means of preventing bearings from becoming overgreased shall be provided. Bearings shall have a minimum B-10 life of 20,000 hours.
12. Rotors shall be statically and dynamically balanced. Rotor windings shall be one-piece cast aluminum. Where applicable, rotors shall be constructed with integral fins.

H. Power Factor and Efficiency

1. All motors, including vertical hollowshaft motors, in the range of 1-500 horsepower, inclusive, shall be designed specifically for energy efficiency and high power factor. The motor efficiency and power factor shall meet or exceed the values listed in the table below when the motors are tested in accordance with the NEMA preferred test method IEEE 112A, Method B, Dynamometer. Each motor shall meet the minimum guaranteed efficiency value indicated in the table below. All tests shall be performed in accordance with the procedures contained in NEMA Standard MG1-12.58.

TABLE 12-11 FULL-LOAD EFFICIENCIES OF ENERGY EFFICIENT MOTORS ENCLOSED MOTORS								
HP	2 POLE		4 POLE		6 POLE		8 POLE	
	Nominal Efficiency	Minimum Efficiency						
1	75.5	72	82.5	80	80	77	74	70
1.5	82.5	80	84	81.5	85.5	82.5	77	74
2	84	81.5	84	81.5	86.5	84	82.5	80
3	85.5	82.5	87.5	85.5	87.5	85.5	84	81.5
5	87.5	85.5	87.5	85.5	87.5	85.5	85.5	82.5

TABLE 12-11 FULL-LOAD EFFICIENCIES OF ENERGY EFFICIENT MOTORS ENCLOSED MOTORS								
HP	2 POLE		4 POLE		6 POLE		8 POLE	
	Nominal Efficiency	Minimum Efficiency						
7.5	88.5	86.5	89.5	87.5	89.5	87.5	85.5	82.5
10	89.5	87.5	89.5	87.5	89.5	87.5	88.5	86.5
15	90.2	88.5	91	89.5	90.2	88.5	88.5	86.5
20	90.2	88.5	91	89.5	90.2	88.5	89.5	87.5
25	91	89.5	92.4	91	91.7	90.2	89.5	87.5
30	91	89.5	92.4	91	91.7	90.2	91	89.5
40	91.7	90.2	93	91.7	93	91.7	91	89.5
50	92.4	91	93	91.7	93	91.7	91.7	90.2
60	93	91.7	93.6	92.4	93.6	92.4	91.7	90.2
75	93	91.7	94.1	93	93.6	92.4	93	91.7
100	93.6	92.4	94.5	93.6	94.1	93	93	91.7
125	94.5	93.6	94.5	93.6	94.1	93	93.6	92.4
150	94.5	93.6	95	94.1	95	94.1	93.6	92.4
200	95	94.1	95	94.1	95	94.1	94.1	93
250	95.4	94.5	95	94.1	95	94.1	94.5	93.6
300	95.4	94.5	95.4	94.5	95	94.1		
350	95.4	94.5	95.4	94.5	95	94.1		
400	95.4	94.5	95.4	94.5				
450	95.4	94.5	95.4	94.5				
500	95.4	94.5	95.8	95				

TABLE 12-12 FULL-LOAD EFFICIENCIES FOR NEMA PREMIUM™ EFFICIENCY ELECTRIC MOTORS RATED 600 VOLTS OR LESS (RANDOM WOUND) OPEN MOTORS						
HP	2 POLE		4 POLE		6 POLE	
	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
	77	74	85.5	82.5	82.5	80
1.5	84	81.5	86.5	84	86.5	81.5
2	85.5	82.5	86.5	84	87.5	81.5
3	85.5	82.5	89.5	84	88.5	86.5
5	86.5	84	89.5	84	89.5	87.5
7.5	88.5	86.5	91	89.5	90.2	88.5
10	89.5	87.5	91.7	90.2	91.7	90.2
15	90.2	88.5	93	91.7	91.7	90.2
20	91	89.5	93	91.7	92.4	91
25	91.7	90.2	93.6	92.4	93	91.7
30	91.7	90.2	94.1	93	93.6	92.4

**TABLE 12-12
FULL-LOAD EFFICIENCIES FOR NEMA PREMIUM™ EFFICIENCY ELECTRIC MOTORS
RATED 600 VOLTS OR LESS (RANDOM WOUND)
OPEN MOTORS**

	2 POLE		4 POLE		6 POLE	
40	92.4	91	94.1	93	94.1	93
50	93	91.7	94.5	93.6	94.1	93
60	93.6	92.4	95	94.1	94.5	93.6
75	93.6	92.4	95	94.1	94.5	93.6
100	93.6	92.4	95.4	94.5	95	94.1
125	94.1	93	95.4	94.5	95	94.1
150	94.1	93	95.8	95	95.4	94.5
200	95	94.1	95.8	95	95.4	94.5
250	95	94.1	95.8	95	95.4	94.5
300	95.4	94.5	95.8	95	95.4	94.5
350	95.4	94.5	95.8	95	95.4	94.5
400	95.8	95	95.8	95	95.8	95
450	95.8	95	96.2	95.4	96.2	95.4
500	95.8	95	96.2	95.4	96.2	95.4

NOTES:

(1) Motor data for continuous duty, NEMA Design B, 1.15 service factor, 40 degrees Celsius ambient, Class F insulation, 3 phase, 460 volt, at listed speed rating.

(2) TEFC efficiencies apply to both horizontal and vertical motors.

2. Motors rated 50 horsepower or greater shall be individually tested at the factory before shipment, with a copy of test results provided for the Engineer, to assure compliance with the efficiency and power factor specifications.

I. Power Factor Correction

1. The power factor shall be corrected as necessary to achieve 85% (minimum) with capacitors sized and installed per manufacturer's recommendations. Capacitors shall be installed such that the motor shall not be damaged by overvoltage or excessive transient electrical torque. The capacitor(s) shall be connected as close as possible or directly to the motor terminals. Any power factor corrections shall not decrease the motor efficiency below the stated minimum requirement of this Specification. All power factor corrections shall be noted on the Shop Drawings submitted to the Engineer for approval. **POWER FACTOR CORRECTION, TO ACHIEVE 85%, SHALL BE PROVIDED ON ALL MOTORS ABOVE 15 HORSEPOWER EXCEPT FOR THOSE MOTORS CONTROLLED BY VARIABLE FREQUENCY DRIVES (VFD'S).**

2. When required, power factor correction capacitors shall be connected on the line side of any type of reduced voltage starting motor controller (e.g. RVAT, RVSS, Part-Winding, Wye-Delta, etc.).

2.03 TOOLS, SUPPLIES AND SPARE PARTS

- A. Each motor shall be furnished with all special tools necessary to disassemble, service, repair, and adjust the equipment. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Motors shall be installed as shown on the Drawings and in accordance with the manufacturer's installation instructions.

3.02 DELIVERY, STORAGE, AND HANDLING

- A. Motors shall be properly protected from weather hazards. Motors shall not be allowed to be wrapped tightly in plastic while outdoors. Motors delivered to the site which will not be put in service for a time in excess of 30 calendar days, whether in storage or installed, shall have the shafts rotated a minimum of five (5) rotations every 30 days.
- B. Motors provided with space heaters shall have temporary power applied to the heaters no later than 30 calendar days after delivery to the site until permanent power can be applied to the heaters.
- C. Motors that, in the opinion of the Engineer, have not been properly protected shall be inspected by the manufacturer's representative. Any required electrical corrections for testing shall be made at the Contractor's expense prior to acceptance and/or use.
- D. All motors shall operate without any undue noise or vibration and shall show no signs of phase unbalance.

3.03 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:
 1. Witnessed Shop Tests
 - a. All motors shall be shop tested and inspected in accordance with the equipment manufacturer's standard procedures. Shop tests for motors 100 horsepower and larger may be witnessed by the Engineer. The manufacturer's testing and inspection procedures shall demonstrate that the equipment tested conforms to the requirements specified, all other

applicable requirements, and shall be approved by the Engineer. At least 10 days notice shall be given the Engineer prior to tests and inspection dates.

b. In addition to the efficiency and power factor testing specified herein, each motor shall be tested to determine compliance with the applicable requirements of the IEEE, ANSI and NEMA. Tests shall be as follows:

(1) Motors less than 50 HP

(a) Each motor shall be subjected to a standard, short commercial test including the following:

- i) Running current, no load
- ii) Locked rotor current
- iii) High potential
- iv) Winding resistance
- v) Bearing inspection

(2) Motors between 50 and 100 HP

(a) Each motor shall be subjected to the above tests and shall be furnished with certified test results.

(3) Motors larger than 100 HP

(a) Each motor shall be furnished with certified test results. Each motor shall be subjected to a complete test consisting of full load heat run, percent slip, running load current, locked rotor current, breakdown torque (calculated), starting torque, winding resistance, high potential, secondary current and voltage at collector rings (wound rotor), efficiencies at 100, 75 and 50 percent of full load, power factors at 100, 75 and 50 percent of full load and bearing inspection. Tests will be witnessed by the Engineer where specifically indicated.

(4) Test Reports

(a) All test results for motors over 100 horsepower shall be submitted to the Engineer for approval. Copies of witnessed test raw data shall be submitted to the Engineer immediately upon completion of such tests.

2. Field Tests

a. Field tests shall be performed in accordance with the requirements specified in the General Conditions, Division 1, and Section 16000, Basic Electrical Requirements.

b. All electric motors furnished for this project one (1) horsepower or larger shall have the information required in the following tabulation completed. See Exhibit "A" on following page.

- c. All field testing shall be witnessed by the Engineer.

- END OF SECTION -

(EXHIBIT A)

MOTOR TEST RECORD					
Motor Identification Remarks	Location	Specified Horsepower	Nameplate Horsepower	Nameplate Amperage (FLA)	Measured Amperage Under Normal Operating Conditions

SECTION 16000

BASIC ELECTRICAL REQUIREMENTS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish all labor, materials, tools, and equipment, and perform all work and services necessary for, or incidental, to the furnishing and installation of all electrical work as shown on the Drawings, and as specified in accordance with the provisions of the Contract Documents and completely coordinate with the work of other trades involved in the general construction. Although such work is not specifically shown or specified, all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation shall be furnished and installed as part of this work. The Contractor shall obtain approved Shop Drawings showing wiring diagrams, connection diagrams, roughing-in and hook up details for all equipment and comply therewith. All electrical work shall be complete and left in operating condition in accordance with the intent of the Drawings and the Specifications for the electrical work.
- B. Where the word "Contractor" appears in these Technical Specifications it shall be construed to mean the Electrical Contractor.
- C. THE CONTRACTOR SHALL REFERENCE THE FUNCTIONAL DESCRIPTIONS AND OTHER REQUIREMENTS FOUND IN DIVISION 17, CONTROL AND INFORMATION SYSTEMS, FOR ADDITIONAL REQUIREMENTS PERTAINING TO WORK UNDER THIS CONTRACT. THE FUNCTIONAL DESCRIPTIONS REFERENCED HEREIN SHALL BE CONSIDERED AS PART OF THE WORK REQUIRED UNDER THIS CONTRACT.
- D. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL INTERCONNECTING DEVICES, CONDUIT, WIRE, AND APPURTENANCES NOT FURNISHED BY OTHERS BUT REQUIRED FOR THE OPERATION OF EQUIPMENT AS DESCRIBED IN THE FUNCTIONAL DESCRIPTIONS WHETHER SPECIFICALLY SHOWN ON THE DRAWINGS OR NOT.
- E. All electrical equipment shall conform to the applicable NEMA specifications. All electrical equipment shall be properly identified in accordance with these Specifications and Contract Drawings. Nameplates shall be engraved high pressure plastic laminate, black with white lettering for 120/208 or 120/240V equipment, and red with white lettering for 277/480 or 480V equipment. The nameplates shall be attached to the equipment cabinets with two (2) stainless steel sheet metal screws for nameplates up to 2-inch wide. For nameplates over 2-inch wide, four (4) stainless steel sheet metal screws shall be used, one (1) in each corner of the nameplate. All panelboards, starters, control panels, cabinet enclosures, and equipment switches shall be labeled in the manner described, or in an equally approved manner.
- F. All materials, equipment, sizes and capacities of electrical equipment incorporated in the project shall conform to the latest requirements of the current National Electric Code, the

National Electrical Manufacturer's Association, the State and local electrical codes, and to applicable rules and regulations of the local electrical utility serving the project.

- G. All material and equipment must be the product of an established and reputable manufacturer; must be new and of first class construction; must be designed and guaranteed to perform the service required; and must bear the label of approval of the Underwriters Laboratories, Inc., where such approval is available for the product of the listed manufacturer as approved by the Engineer.
- H. When a specified or indicated item has been superseded or is no longer available, the manufacturer's latest equivalent type or model of material or equipment as approved by the Engineer shall be furnished and installed at no additional cost to the Owner.
- I. Where the Contractor's selection of equipment of specified manufacturers or additionally approved manufacturers requires changes or additions to the system design, the Contractor shall be responsible in all respects for the modifications to all system designs, subject to approval of the Engineer. The Contractor's bid shall include all costs for all work of the Contract for all trades made necessary by such changes, additions or modifications or resulting from any approved substitution.
- J. Furnish and install controls for each piece of equipment requiring the controls under this Contract. The controls shall be the size and type recommended by the manufacturer for the application and as otherwise specified or indicated on the Drawings. Refer to Divisions 1 and 17 of the Specifications for control, connection and coordination descriptions and requirements.
- K. Furnish and install all stands, racks, brackets, supports, and similar equipment required to properly serve the equipment which is furnished under this Contract, or equipment otherwise specified or indicated on the Drawings.

1.02 DRAWINGS

- A. The Contractor shall furnish, install, and place in satisfactory condition ready for operation, all conduits, cables, and all other material needed for the complete lighting, power, control and other electrical systems shown or indicated in the Contract Drawings. Additional conduits and the required wiring shall be installed by the Contractor wherever needed to complete the installation of the specific equipment furnished.

1.03 EQUIPMENT LOCATION

- A. The Drawings show the general location of feeders, transformers, outlets, conduits, and circuit arrangements. Because of the small scale of the Drawings, it is not possible to indicate all of the details involved. The Contractor shall carefully investigate the structural and finish conditions affecting all of his work and shall arrange such work accordingly; furnishing such fittings, junction boxes, and accessories as may be required to meet such conditions. The Contractor shall refer to the entire Drawing set to verify openings, special surfaces, and location of other equipment, or other special equipment prior to roughing-in for panels, switches, and other outlets. The Contractor shall verify all equipment dimensions to insure that proposed equipment will fit properly in spaces indicated.

1.04 LOCAL CONDITIONS

- A. The Contractor shall examine the site and become familiar with conditions affecting the work. The Contractor shall investigate, determine, and verify locations of any overhead or buried utilities on or near the site, and shall determine such locations in conjunction with all public and/or private utility companies and with all authorities having jurisdiction. All costs, both temporary and permanent to connect all utilities, shall be included in the Bid. Costs for connecting the electrical service include, but are not limited to, meter base, CT cabinet, and underground conduits. Coordination with the serving utility is required prior to the Bid to ensure these items have been adequately accounted for in the Bid. The Contractor shall be responsible for scheduling and coordinating with the local utility for temporary and permanent services.
- B. In addition, the Contractor shall relocate all duct banks, lighting fixtures, receptacles, switches, boxes, and other electrical equipment as necessary to facilitate the Work included in this project at no additional cost to the Owner.
- C. The Contractor is responsible for coordinating all electric utility equipment installations with the serving electric utility. The Contractor shall furnish and install all electric utility equipment required by the electric utility to be installed by the Contractor whether specifically shown of the Drawings or not. The Contractor shall furnish and install the following electrical utility equipment as a minimum:
1. Concrete transformer pads constructed as instructed by the electric utility.
 2. Primary and or secondary ductbank and manholes
 3. Metering equipment cabinets and/or bases
 4. Conduit and wire required from metering cabinet to metering current transformers and potential transformers.
 5. Secondary conductors
 6. Secondary terminations

The electric utility will furnish and install the following equipment:

1. Primary conductors and terminations

The Contractor is responsible for ensuring all electric utility equipment and construction installed by the Contractor is furnished and installed in accordance with the electric utility's design specifications and requirements. The Contractor is fully responsible for coordinating his scope of work with the electric utility. Any additional required electric utility construction or equipment not specified herein or shown on the Drawings shall be supplied by the Contractor at no additional cost to the Owner.

The contact person at the serving electrical utility is:

(name of the contact and title)
(name of electric utility)

(street address)
(telephone number)
(email address)

1.05 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions, Section 01300, Submittals and the requirements of the individual specification sections, the Contractor shall obtain from the equipment manufacturer and submit the following:
1. Shop Drawings
 2. Operation and Maintenance Manuals
 3. Spare Parts List
 4. Special Tools List
 5. Proposed Testing Methods and Reports of Certified Shop Tests.
 6. Reports of Certified Field Tests.
 7. Manufacturer's Representative's Certification.
- B. Submittals shall be sufficiently complete in detail to enable the Engineer to determine compliance with Contract requirements.
- C. Submittals will be approved only to the extent of the information shown. Approval of an item of equipment shall not be construed to mean approval for components of that item for which the Contractor has provided no information.

1.06 APPLICABLE CODES AND REQUIREMENTS

- A. Conformance
1. All work, equipment and materials furnished shall conform with the existing rules, requirements and specifications of the Insurance Rating Organization having jurisdiction, the serving electrical utility company, the latest edition of the National Electrical Code (NEC), the National Electric Manufacturers Association (NEMA), the Institute of Electrical and Electronic Engineers (IEEE), the Insulated Cable Engineers Association (ICEA), the American Society of Testing Materials (ASTM), the American National Standards Institute (ANSI), the requirements of the Occupational Safety Hazards Act (OSHA), and all other applicable Federal, State and local laws and/or ordinances.
 2. All material and equipment shall bear the inspection labels of Underwriters Laboratories, Inc., if the material and equipment is of the class inspected by said laboratories.
 3. All work shall be in accordance with local codes.

B. Nonconformance

1. Any paragraph of requirements in these Specifications, or Drawings, deviating from the rules, requirements and Specifications of the above organizations shall be invalid and their (the above organizations) requirements shall hold precedent thereto. The Contractor shall be held responsible for adherence to all rules, requirements and specifications as set forth above. Any additional work or material necessary for adherence will not be allowed as an extra, but shall be included in the Bid. Ignorance of any rule, requirement, or Specification shall not be allowed as an excuse for nonconformity. Acceptance by the Engineer does not relieve the Contractor from the expense involved for the correction of any errors which may exist in the drawings submitted or in the satisfactory operation of any equipment.

C. Certification

1. Upon completion of the work, the Contractor shall obtain certificate(s) of inspection and approval from the National Board of Fire Underwriters or similar inspection organization having jurisdiction and shall deliver same to the Engineer and the Owner.

1.07 PERMITS AND INSPECTIONS

- A. The Contractor shall reference the General Conditions and Section 01010, Summary of Work.

1.08 TEMPORARY LIGHTING AND POWER

- A. The Contractor shall reference the General Conditions and Section 01510, Temporary Utilities.

1.09 TESTS

- A. Upon completion of the installation, the Contractor shall perform tests for operation, load (Phase) balance overloads, and short circuits. Tests shall be made with and to the satisfaction of the Owner and Engineer.
- B. The Contractor shall perform all field tests and shall provide all labor, equipment, and incidentals required for testing and shall pay for electric power required for the tests. All defective material and workmanship disclosed shall be corrected by the Contractor at no cost to the Owner. The Contractor shall show by demonstration in service that all circuits and devices are in good operating condition. Test shall be such that each item of control equipment will function not less than five (5) times.
- C. The grounding system shall be tested to assure continuity and compliance with the requirement that ground resistances do not exceed 5 ohms when measured by a megohmmeter or equivalent device. Ground resistance measurements of each grounding electrode shall be taken and certified by the Contractor. Upon completion of the Project, the Contractor shall submit to the Engineer the measured ground resistance of each ground rod and grounding system, indicating the location of the rod and grounding system as well as the resistance and soil conditions at the time the measurements were made. Ground resistance measurements shall be made in normally dry weather not less than 48 hours

after rainfall and with the ground under test isolated from other grounds. Ground resistance shall also be measured from each piece of equipment to the grounding electrode. Reference Section 16170, Grounding and Bonding, for additional requirements.

- D. Each lighting and power distribution panelboard shall be tested with main circuit breaker disconnected from the feeder, branches connected, branch circuit breakers closed, all fixtures in place and permanently connected, lamps removed or omitted from the fixtures, and all wall switches closed.
- E. Insulation resistance testing of all incoming and outgoing cables for switchgear, motor control centers, lighting and power distribution panelboards, and similar equipment shall be done after the cables are in place and just prior to final terminations. All data shall be recorded, as per Exhibit "A", attached to the end of this Section.
- F. Feeder circuits shall be tested with the feeder conductors disconnected from the supplied equipment. Each individual power circuit shall be tested at the panel or motor control center with the power equipment connected for proper operation.
- G. Megohmmeter tests of the insulation resistance of rotating machines and power feeders shall be conducted. The results will be accepted when the megger shows the insulation resistance to be not less than one megohm per 100 volts at 10°C using a 1,000-volt megger.
- H. All transformers shall be Megohmmeter tested in accordance with the manufacturer's recommendations.
- I. The Contractor shall furnish all equipment and personnel as required for testing.

1.10 DOCUMENTATION

- A. The work requirements of this Section is in addition to and does not supersede testing and adjusting specified in other portions of the Contract Documents. The Contractor shall submit to the Engineer test records and reports for all testing.

1.11 FIELD TEST OF EQUIPMENT

- A. The equipment to be tested shall include, but not be limited to, the following:

- Medium Voltage Circuit Breaker Switchgear
- Medium Voltage Load Interrupter Switchgear
- Medium Voltage Motor Control Equipment
- Liquid-Filled Pad Mount Transformers
- Low Voltage Circuit Breaker Switchgear
- Motor Control Centers
- Variable Frequency Drives and Related Motor Control Equipment
- Panelboards
- Conduit System
- Cable and Wire
- Grounding System
- General Purpose Dry Type Transformers
- Lighting Fixtures (Indoor and Outdoor)

- Packaged Engine Generator Systems
- Automatic Transfer Switches

B. Refer to each specific specification section for detailed field tests.

1.12 FINAL FIELD TEST OF SYSTEM

- A. The Contractor shall complete the installation and testing of the electrical installation at least two (2) months prior to the start-up and testing of all other equipment. During the period between the completion of electrical installation and the start-up and testing of all other equipment, the Contractor shall make all components of the Work available as it is completed for their use in performing Preliminary and Final Field Tests.
- B. Before each test commences, the Contractor shall submit a detailed test procedure, and also provide test engineer resume, manpower and scheduling information for the approval by the Engineer. In addition, the Contractor shall furnish detailed test procedures for any of his equipment required as part of the field tests of other systems.
- C. The Contractor shall perform an infrared inspection to locate and correct all heating problems associated with electrical equipment. The infrared inspection shall apply to all new equipment and existing equipment that is in any way modified under this Contract.

1.13 PROTECTIVE DEVICE SETTING AND TESTING

- A. The Contractor shall provide the services of a qualified testing company using N.E.T.A. certified technicians to adjust, set, calibrate and test all protective devices in the electrical system. The qualifications of the testing company and resumes of the technicians as well as all data forms to be used for the field testing shall be submitted.
- B. All protective devices in the electrical equipment shall be set, adjusted, calibrated and tested in accordance with the manufacturers' recommendations, the coordination study, and best industry practice.
- C. Proper operation of all equipment associated with the device under test and its compartment shall be verified, as well as complete resistance, continuity and polarity tests of power, protective and metering circuits. Any minor adjustments, repairs and/or lubrication necessary to achieve proper operation shall be considered part of this Contract.
- D. All solid state trip devices shall be checked and tested for setting and operation using manufacturers recommended test devices and procedures.
- E. Circuit breakers and/or contactors associated with the above devices shall be tested for trip and close functions with their protective device.
- F. When completed, the Contractor shall provide a comprehensive report for all equipment tested indicating condition, readings, faults and/or deficiencies in same. Inoperative or defective equipment shall be brought immediately to the attention of the Engineer.
- G. Prior to placing any equipment in service, correct operation of all protective devices associated with this equipment shall be demonstrated by field testing under simulated load conditions.

1.14 SCHEDULES AND PLANT OPERATIONS

- A. Since the testing required in Article 1.12 above shall require that certain pieces of equipment be taken out of service, all testing procedures and schedules must be submitted to the Engineer for review and approval one (1) month prior to any work beginning. When testing has been scheduled, the Engineer must be notified 48 hours prior to any work to allow time for load switching and/or alternation of equipment. In addition, all testing that requires temporary shutdown of plant equipment must be coordinated with the Owner/Engineer so as not to affect proper plant operations.
- B. At the end of the workday, all equipment shall be back in place and ready for immediate use should a plant emergency arise. In addition, should an emergency condition occur during testing, at the request of the Owner, the equipment shall be placed back in service immediately and turned over to plant personnel.
- C. In the event of accidental shutdown of plant equipment, the Contractor shall notify plant personnel immediately to allow for an orderly restart of affected equipment.

(EXHIBIT A)
 TEST DATA - MEGOHMS
 TEST NO. ____

Date:			Company:				
Time:			Location:				
Circuit:	Circuit Length:	Aerial:	Duct:	Buried:	No. of Conductors	Size:	AMG MCM Shld:
Insulation Material:			Insulation Thickness:		Voltage Rating:		Age:
Type: ____ Pothead ____ Terminal					Location: Indoors____ Outdoors____		
Number and Type of Joints:							
Recent Operating History:							
Manufacturer:							
State if Potheads or Terminals were grounded during test:							
List associated equipment included in test:							
Miscellaneous Information:							

(EXHIBIT A)
 TEST DATA - MEGOHMS
 TEST NO. ____

Part Tested: Test Made: _____
 Hours/Days: _____
 After Shutdown: _____

Grounding Time: Dry Bulb Temperature: _____
 Wet Bulb Temperature: _____

Test Voltage: _____	Equipment Temperature: _____
	How Obtained: _____
	Relative Humidity: _____
	Absolute Humidity: _____
	Dew Point: _____

Megohmmeter: Serial Number: _____ Range: _____
 Voltage: _____ Calibration Date: _____

Test Connections	To Line To Earth To Ground	To Line To Earth To Ground	To Line To Earth To Ground	Test Connections	To Line To Earth To Ground	To Line To Earth To Ground	To Line To Earth To Ground
□ Minute				5 Minutes			
□ Minute				6 Minutes			
3/4 Minute				7 Minutes			
1 Minute				8 Minutes			
2 Minutes				9 Minutes			
3 Minutes				10 Minutes			
4 Minutes				10/1 Minutes			
				Ratio			

Remarks:

1.15 MATERIALS HANDLING

- A. Materials arriving on the job site shall be stored in such a manner as to keep material free of rust and dirt and so as to keep material properly aligned and true to shape. Rusty, dirty, or misaligned material shall be rejected. Electrical conduit shall be stored to provide protection from the weather and accidental damage. Rigid non-metallic conduit shall be stored on even supports and in locations not subject to direct sun rays or excessive heat. Cables shall be sealed, stored, and handled carefully to avoid damage to the outer covering or insulation and damage from moisture and weather. Adequate protection shall be required at all times for electrical equipment and accessories until installed and accepted. Materials damaged during shipment, storage, installation, or testing shall be replaced or repaired in a manner meeting with the approval of the Engineer. The Contractor shall store equipment and materials in accordance with Section 01550, Site Access and Storage.

1.16 POWER SYSTEM STUDIES

A. General

- 1. The Engineer will provide the Power System studies to the firm providing the protective device setting and testing services. The Contractor shall notify the Engineer six (6) weeks in advance of the scheduled date for the protective device setting and testing. The testing firm shall submit to the Engineer a tabulated listing of all protective devices requiring setting six (6) weeks prior to the setting and testing date. This table shall include the protective device manufacturer, model number, ampere rating (if applicable), instrument transformer ratios, and all other required information.

PART 2 -- PRODUCTS

2.01 PRODUCT REQUIREMENTS

- A. Unless otherwise indicated, the materials to be provided under this Specification shall be the products of manufacturers regularly engaged in the production of all such items and shall be the manufacturer's latest design. The products shall conform to the applicable standards of UL and NEMA, unless specified otherwise. International Electrotechnical Commission (IEC) standards are not recognized. Equipment designed, manufactured, and labeled in compliance with IEC standards is not acceptable.
- B. All items of the same type or ratings shall be identical. This shall be further understood to include products with the accessories indicated.
- C. All equipment and materials shall be new, unless indicated or specified otherwise.
- D. The Contractor shall submit proof if requested by the Engineer that the materials, appliances, equipment, or devices that are provided under this Contract meet the requirements of Underwriters Laboratories, Inc., in regard to fire and casualty hazards. The label of or listing by the Underwriters Laboratories, Inc., will be accepted as conforming with this requirement.

2.02 SUBSTITUTIONS

- A. Any reference in the Specifications or on the Drawings to any article, service, product, material, fixture, or item of equipment by name, make, or catalog number shall be interpreted as establishing the type, function, and standard of quality and shall not be construed as limiting competition. The Contractor, in such cases may, at his option use any article, device, product, material, fixture, or item of equipment which in the judgment of the Engineer, expressed in writing, is equal to that specified.

2.03 CONCRETE

- A. The Contractor shall furnish all concrete required for the installation of all electrical work, Concrete shall be Class A unless otherwise specified. Concrete and reinforcing steel shall meet the appropriate requirements of Division 3 of the Specifications.
- B. The Contractor shall provide concrete equipment pads for all free standing electrical apparatus and equipment located on floors or slabs that exist or provided by others. The Contractor shall provide all necessary anchor bolts, channel iron sills, and other materials as required. The exact location and dimensions shall be coordinated for each piece of equipment well in advance of the scheduled placing of these pads. Equipment pads shall be 4 inches high unless otherwise indicated on the Drawings and shall conform to standard detail for equipment pads shown on the Contract Drawings.
- C. The Contractor shall provide concrete foundations for all free standing electrical apparatus and equipment located outdoors or where floors or slabs do not exist or provided by others. The Contractor shall provide all necessary anchor bolts, channel iron sills, and other materials as required. The location and dimensions shall be coordinated for each piece of equipment well in advance of the scheduled placing of the foundations. Equipment foundations shall be constructed as detailed on the Drawings or if not detailed on the Drawings shall be 6 inches thick minimum reinforced with #4 bars at 12-inch centers each way placed mid-depth. Concrete shall extend 6 inches minimum beyond the extreme of the equipment base and be placed on a compacted stone bed (#57 stone or ABC) 6 inches thick minimum.

PART 3 -- EXECUTION

3.01 CUTTING AND PATCHING

- A. Coordination
 1. The Work shall be coordinated between all trades to avoid delays and unnecessary cutting, channeling and drilling. Sleeves shall be placed in concrete for passage of conduit wherever possible.
- B. Damage
 1. The Contractor shall perform all chasing, channeling, drilling and patching necessary to the proper execution of his Contract. Any damage to the building, structure, or any equipment shall be repaired by qualified mechanics of the trades involved at the Contractor's expense. If, in the Engineer's judgment, the repair of

damaged equipment would not be satisfactory, then the Contractor shall replace damaged equipment at his own expense.

3.02 EXCAVATION AND BACKFILLING

- A. The Contractor shall perform all excavation and backfill required for the installation of all electrical work. All excavation and backfilling shall be in complete accordance with the applicable requirements of Division 2.

3.03 CORROSION PROTECTION

- A. Wherever dissimilar metals, except conduit and conduit fittings, come into contact, the Contractor shall isolate these metals as required with neoprene washers, nine (9) mil polyethylene tape, or gaskets.

- END OF SECTION -

SECTION 16123

BUILDING WIRE AND CABLE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, connect, test, and place in satisfactory operating condition, ready for service, all cables and wires indicated on the Drawings and as specified herein or required for proper operation of the installation, with the exception of internal wiring provided by electrical equipment manufacturers. The work of connecting cables to equipment, machinery, and devices shall be considered a part of this Section. All hardware, junction boxes, bolts, clamps, insulators, and fittings required for the installation of cable and wire systems shall be furnished and installed by the Contractor.
- B. The Contractor shall submit Shop Drawings and other material required to substantiate conformance with the requirements set forth on the Drawings and in Section 16000, Basic Electrical Requirements, and Section 01300, Submittals. Shop drawings shall include, but not be limited to, detailed specifications and product data sheets for the power, control, and instrumentation cable required for this project.
- C. The wire and cable to be furnished and installed for this project shall be the product of manufacturers who have been in the business of manufacturing wire and cable for a minimum of ten (10) years.
- D. Reference Section 16000, Basic Electrical Requirements.

1.02 TESTING

- A. All testing shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:
 1. Witness Shop Tests
 - a. Not required.
 2. Shop Test
 - a. Prior to the first shipment of each size of power, control, and instrumentation cable to be furnished and installed under this Contract, samples of each size of cable shall be subjected to complete physical and electrical factory production tests at the manufacturer's plant. Other cable and wiring shall be tested in accordance with the applicable ICEA Standards. Six copies of certified test data sheets shall be submitted to the Engineer for approval prior to installation at the site. Subsequent shipment of each size of wire shall be covered by certificates of compliance which shall list Contractor's name, point of delivery, reel numbers, size of wire, length of wire, and date of shipment. Certificates shall attest the wires and cables comply with

specification requirements and that wires and cables are equal in every respect to wires and cables which have been successfully tested.

b. All test data or certificates shall be submitted.

3. Field Tests

a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and Section 16000, Basic Electrical Requirements.

b. After installation, all wires and cables shall be tested for insulation levels and continuity. Insulation resistance between conductors of the same circuit and between conductor and ground shall be tested. Testing for insulation levels shall be as follows:

1. For 600V power and control cable, apply 1,000 VDC from a Megaohmmeter for all 600V wires and cables installed in lighting, control, power, indication, alarm and motor feeder circuits. Testing for continuity shall be "test light" or "buzzer".

2. 600V instrumentation signal cable shall be tested from conductor to conductor, conductor to shield, and conductor to ground using a Simpson No. 260 volt-ohmmeter, or approved equal. The resistance value shall be 200 Megaohms or greater.

B. Low voltage wires and cables shall be tested before being connected to motors, devices or terminal blocks.

C. Voltage tests shall be made successively between each conductor of a circuit and all other conductors of the circuit grounded.

D. If tests reveal defects or deficiencies, the Contractor shall make the necessary repairs or shall replace the cable as directed by the Engineer, without additional cost to the Owner.

E. All tests shall be made by and at the expense of the Contractor who shall supply all testing equipment.

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the wire and cable manufacturer and submit the following:

1. Shop Drawings

2. Reports of Certified Shop and Field Tests

3. Wiring Identification Methods

B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed material's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible Submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets.
 - 2. Cable pulling calculations.
 - 3. Wiring identification methods and materials.

1.05 IDENTIFICATION

- A. Each cable shall be identified as specified in Part 3, Execution, of this Specification.

1.06 CABLE PULLING LUBRICANTS

- A. The Contractor shall submit a list with a minimum of four manufacturer's standard lubricants which may be used interchangeably for each type of lubricant required. Lubricant shall be non-hardening type.

1.07 CABLE PULL CALCULATIONS

- A. The Contractor shall submit cable pulling calculations. These calculations, to be performed by a currently registered professional engineer in the State of Georgia, shall define pulling tension and sidewall loading (sidewall bearing pressure values) for all installations of 600VAC, #1/0 conductors and larger greater than 200 feet in length. Calculations for straight horizontal installations of 600VAC, #1/0 conductors and larger greater than 200 feet are not required.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The wire and cable covered by this Specification is intended to be standard equipment of proven performance as manufactured by the Okonite Company, Rome Cable Corporation, Southwire Company, or equal. Wire and cable shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and shown on the Drawings. Only one manufacturer for each wire and cable type shall be permitted.

2.02 600 VOLT POWER WIRE AND CABLE

- A. 600 volt cable and wire shall consist of stranded, copper conductor with insulation rated THHN, 90°C for dry locations and THWN, 75°C for wet locations.
- B. Conductors shall be tin or alloy coated (if available), stranded copper per ASTM-B8 and B-33, and Class B or C stranding contingent on the size unless otherwise specified. Minimum size wire shall be No. 12 AWG.
- C. Uncoated conductors shall only be allowed if specifically accepted by the Engineer.
- D. 600 volt individual power wire and cable shall be Okoseal-N as manufactured by the Okonite Company, Rome Cable Corporation equivalent, Southwire Company equivalent, or equal. Multi-conductor power cables shall be Okoseal-N Type TC Cable as manufactured by the Okonite Company, Rome Cable Corporation equivalent, Southwire Company equivalent, or equal.

2.03 600 VOLT CONTROL CABLE

- A. 600 volt control cable shall consist of stranded, copper conductor with insulation rated THHN, 90°C for dry locations and THWN, 75°C for wet locations. The individual conductors of the multiple conductor cable shall be color coded for proper identification. Color coding shall be equal to ICEA S-68-514, Table K-1. Cables shall meet requirements of IEEE-383.
- B. Conductors shall be tin or alloy coated (if available) stranded copper per ASTM B-8 and B-33, and Class B or C stranding contingent on the size unless otherwise specified. Minimum wire size shall be No. 14 AWG.
- C. Uncoated conductors shall only be allowed if specifically accepted by the Engineer.
- D. 600 volt individual conductor control wire shall be Okoseal-N as manufactured by the Okonite Company, Rome Cable Corporation equivalent, Southwire Company equivalent, or equal. Multi-conductor control cable shall be Okoseal-N Type TC Cable as manufactured by the Okonite Company, Rome Cable Corporation equivalent, Southwire Company equivalent, or equal.

2.04 LIGHTING AND RECEPTACLE WIRE AND CABLE

- A. The lighting and receptacle branch circuit wire shall consist of stranded, copper conductors with insulation rated THHN, 90°C for dry locations and THWN, 75°C for wet locations.
- B. Conductors shall be tin or alloy coated (if available), stranded copper per ASTM-B8 and B-33, and Class B or C stranding contingent on the size unless otherwise specified. Minimum size wire shall be No. 12 AWG.
- C. Uncoated conductors shall only be allowed if specifically accepted by the Engineer.
- D. Lighting and receptacle cables and wire shall be Okoseal-N as manufactured by the Okonite Company, Rome Cable Corporation equivalent, Southwire Company equivalent, or equal.

2.05 INSTRUMENTATION CABLE

- A. The instrumentation cable for analog signals shall be single, shielded, twisted pairs or triads with 600 volt insulation and shall have a 90°C insulation rating.
- B. Conductors shall be tin or alloy coated (if available), soft, annealed copper, stranded per ASTM-B8, Class B stranding unless otherwise specified. Minimum size wire shall be No. 16 AWG.
- C. The instrumentation cable shall be Okoseal-N Type P-OS for single pair or triad applications and Okoseal-N Type SP-OS for multiple pair or triad applications as manufactured by the Okonite Company, Rome Cable Corporation equivalent, Southwire Company equivalent, or equal.

PART 3 -- EXECUTION

3.01 600V CABLE INSTALLATION

- A. The cable and wires shall be installed as specified herein and shown on the Drawings.
- B. The cables shall be terminated in accordance with the cable and/or termination product manufacturer's instructions for the particular type of cable.
- C. To minimize oxidation and corrosion, wire and cable shall be terminated using an oxide-inhibiting joint compound recommended for "copper-to-copper" connections. The compound shall be Penetrox E as manufactured by Burndy Electrical, or equal.
- D. Splices shall not be allowed in the underground manhole and handhole systems. If splices are required, the Contractor shall obtain approval in writing from the Engineer prior to splicing. Splicing materials shall be barrel type butt splice connectors and heat shrink tubing as manufactured by 3M, Ideal, or equal. No splicing of instrumentation cable is allowed. The use of screw-on wire connectors (wire nuts) for power or control wiring will only be permitted if specifically accepted by the Engineer. Reference Section 16130 for additional requirements regarding control wiring.
- E. Wire and Cable Sizes
 - 1. The sizes of wire and cable shall be as shown on the Drawings, or if not shown, as approved by the Engineer. If required due to field routing, the size of conductors and respective conduit shall be increased so that the voltage drop does not exceed 2-1/2%.
 - 2. Minimum wire size within control panels, motor control centers, switchboards and similar equipment shall be No. 12 AWG for power and No. 14 AWG for control.
- F. Number of Wires
 - 1. The number of wires indicated on the Drawings for the various control, indication, and metering circuits were determined for general schemes of control and for particular indication and metering systems.

2. The actual number of wires installed for each circuit shall, in no case, be less than the number required; however, the Contractor shall add as many wires as may be required for control and indication of the actual equipment selected for installation at no additional cost to the Owner. The addition of conductors shall be coordinated with and approved by the Engineer to avoid violations of the NEC regarding conduit fill.
3. All spare field conductors shall be terminated on the terminal blocks mounted within the equipment.

G. Wiring Identification

1. All wiring shall be identified at each termination, shall have a unique wire number, and shall be labeled at both ends. Wire numbers shall correspond with the equipment terminal wire numbers as indicated in the accepted Shop Drawings. Where no wire numbers are indicated, the Contractor shall advise the Engineer in writing prior to assigning wire numbers. Wire numbers shall not be duplicated.
2. In addition to color coding, for all 1-phase and 3-phase systems, identify each cable (single or multi-conductor) and conductor at each end, in each manhole, pullbox, cable tray, or other component of the raceway system. This identification is applicable to all power, control, alarm, signal, and instrumentation cables, and conductors.
3. Identify each cable (single or multi-conductor) and groups or bundles of individual single conductors in each manhole, pullbox, cable tray or other component of the raceway system with circuit identification markers. Implement a "from-to" cable/conductor bundle tagging system as part of this identification effort.
4. For instrumentation wiring, the Contractor shall provide, on the Shop Drawings, a schedule indicating the wire number, color code, if applicable, origin and destination devices, and terminals.
5. Wire identification shall be accomplished through the use of a portable printer and white, polyolefin wire marking sleeves. The wire identification system shall be a "Bradymarker" XC Plus Printer with "Bradysleeve" wire marking sleeves, Panduit equivalent, Seton equivalent, or equal.
6. The Contractor shall submit a written description outlining his intended method of wiring identification and supporting information (i.e., product data sheets, etc.) identifying the materials to be used. The Contractor shall meet with the Owner and the Engineer to come to an agreement regarding wire identification prior to the installation of any wiring.

H. Cable Identification Tags

1. The Contractor shall furnish all labor and materials and affix in a permanent way to each cable in manholes, cable compartments and vaults, junction boxes, pull boxes and points of termination, a bronze metal tag, 1/2-inch in diameter, with a 1/8-inch diameter hole, with copper wire through the hole, the cable identification number

approved by the Engineer. The tag shall be attached to the cable by twisting the ends of the copper wires. All cables shall be tagged with its full ID number immediately after it has been pulled.

I. Cable Installation

1. All interior cable not protected by a compartment enclosure shall be run in conduit.

J. Wiring Supplies

1. Only electrical wiring supplies manufactured under high standards of production and meeting the approval of the Engineer shall be used.
2. Rubber insulating tape shall be in accordance with ASTM Des. D119. Friction tape shall be in accordance with ASTM Des. D69.

K. Training of Cable

1. The Contractor shall furnish all labor and material required to train cables around cable vaults within buildings and in manholes and handholes in the outdoor underground duct system. Sufficient length of cable shall be provided in each handhole, manhole, and vault so that the cable can be trained and racked in an approved manner. Instrumentation cable shall be racked separate from all other AC and DC wiring to maintain the required separation specified herein. In training or racking, the radius of bend of any cable shall be not less than the manufacturer's recommendation. All manhole cables shall be arc and fire-protected. The training shall be done in such a manner as to minimize chaffing.

L. Connections at Control Panels, Limit Switches, and Similar Devices

1. Where stranded wires are terminated at panels, and/or devices, connections shall be made by solderless lug, crimp type ferrule, or solder dipped.
2. Where enclosure sizes and sizes of terminals at limit switches, solenoid valves, float switches, pressure switches, temperature switches, and other devices make 7-strand, No. 12 AWG, wire terminations impractical, the Contractor shall terminate external circuits in an adjacent junction box of proper size and complete with terminal strips and shall install No. 14 AWG stranded wires from the device to the junction box in a conduit. The #12 AWG field wiring shall also be terminated in the same junction box to complete the circuit.

M. Pulling Temperature

1. Cable shall not be flexed or pulled when the temperature of the insulation or of the jacket is such that damage will occur due to low temperature embrittlement. When cable will be pulled with an ambient temperature within a three day period prior to pulling of 40°F or lower, cable reels shall be stored during the three day period prior to pulling in a protected storage area with an ambient temperature not lower than 55°F and pulling shall be completed during the work day for which the cable is removed from the protected storage.

N. Color Coding

1. Conductor insulation shall be color coded as follows:

a. 480V AC Power

Phase A - BROWN
Phase B - ORANGE
Phase C - YELLOW
Neutral - WHITE

b. 120/208V or 120/240V AC Power

Phase A - BLACK
Phase B - RED
Phase C - BLUE
Neutral - WHITE

c. DC Power

Positive Lead - RED
Negative Lead - BLACK

d. DC Control

All wiring - BLUE

e. 120VAC Control

Single conductor 120 VAC control wire shall be RED except for a wire entering a motor control center compartment or control panel which is an interlock. This conductor shall be color coded YELLOW.

f. 24VAC Control

All wiring - ORANGE

g. Equipment Grounding Conductor

All wiring - GREEN

2. Conductors No. 2 AWG and smaller shall be factory color coded with a separate color for each phase and neutral, which shall be used consistently throughout the system. Larger cables shall be coded by the use of colored tape.

3.02 INSTRUMENTATION CABLE INSTALLATION

- A. The Contractor shall install all cable or conductors used for instrumentation wiring (4-20 mA DC, etc.) in rigid galvanized steel or PVC coated rigid galvanized steel conduit. The use of asbestos cement or plastic conduit will not be permitted. Analog signal wires shall

exclusively occupy these conduits. No other wiring for AC or digital DC circuits shall be installed in these conduits.

- B. All shielding shall be continuous and shall be grounded in accordance with the instrumentation equipment manufacturer's recommendations, as approved.
- C. A raceway containing instrumentation cable shall be installed to provide the following clearances:
 - 1. Raceway installed parallel to raceway conductors energized at 480 through 208 volts shall be 18 inches and 208/120 volts shall be 12 inches.
 - 2. Raceway installed at right angles to conductors energized at 480 volts or 120/208 volts shall be 6 inches.
- D. Where practical, raceways containing instrumentation cable shall cross raceway containing conductors of other systems at right angles.
- E. Where instrumentation cables are installed in panels, manholes, handholes, and other locations, the Contractor shall arrange wiring to provide maximum clearance between these cables and other conductors. Instrumentation cables shall not be installed in same bundle with conductors of other circuits.
- F. Grounding of cable shield shall be accomplished at one point only, unless otherwise required by instrumentation system's manufacturer.
- G. Additional pullboxes shall be furnished and installed for ease of cable pulling and the cable manufacturer's recommended conduit fill factor shall be followed. Where required for specifically directed by the Engineer, the Contractor shall moisture seal the cables at all connections with OZ Gedney Type "CSB", or equal, sealing bushings.
- H. Special instrument cable shall be as specified or recommended by the vendor of the equipment or instruments requiring such wiring. Installation, storage, terminations, etc., shall be per manufacturer's recommendations.
- I. All cable, insulation and jacket shall have adequate strength to allow for it to be pulled through the conduit systems. Sufficient conductors shall be installed to provide space and serve future equipment where shown and specified. All conductors shall be color coded and all wires shall be suitably tagged with permanent markers at each end.

3.03 FIBER OPTIC CABLE INSTALLATION

- A. The Contractor shall install the fiber optic cable furnished by the General Contractor and/or the Instrumentation and Control Subcontractor. The cable shall be installed in its respective raceway system(s) as specified herein, indicated on the Drawings, and in accordance with the cable manufacturer's instructions. Reference Division 17 for additional information regarding the fiber optic cable.

3.04 SCHEDULES

- A. The conduit and wire schedules on the Drawings list conduit size, wire size, type, and number required.
- B. All conduits and wiring shall be furnished and installed under this Contract.
- C. The definition of the term conduit shall include all types of raceways used on this project.
- D. In all cases where the word "install" or "installed" refers to conduit, it shall mean install all conduit, raceways, fittings, supports, boxes and appurtenances. In addition it shall include all grounding and bonding. Pull cords are to be pulled upon completion of each raceway.
- E. In all cases where the word "install" or "installed" refers to cable, it shall include pulling the cable and testing the cable for insulation resistance, continuity and absence from grounds, as well as terminating all conductors and testing for proper connection.
- F. The conduit and wire schedules do not indicate all of the conduit and wire required for the project. The Contractor is advised to refer to these Specifications and Drawings for the additional conduit and wire requirements. All lighting, receptacle and control circuits may require field routing by the Contractor.
- G. Conduits leaving or entering a building or structure may be shown in a different arrangement as compared to the duct bank. The Contractor shall arrange conduits penetrating the building based on field conditions. The Drawings are not meant to represent actual conduit arrangements required. Furthermore, spare conduits from duct banks into buildings or structures are required and shall be furnished and installed based on field conditions and Engineer approval.
- H. Certain runs of underground duct banks are not detailed, such as site lighting home runs, but all underground ducts shall comply with the requirements of these Specifications.

- END OF SECTION -

SECTION 16130

BOXES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish all labor, materials, tools and equipment necessary for furnishing, installing, connecting, testing and placing into satisfactory operation all pull, junction and outlet boxes for power, lighting and control as required for a complete electrical installation as shown on the Drawings and specified herein.
- B. Coordination
 - 1. The Contractor shall review installation procedures under other Divisions and coordinate them with the Work specified herein.
 - 2. The Contractor shall notify others in advance of the installation of the Work included herein to provide them with sufficient time for the installation and coordination of interrelated items that are included in the Contract and that must be installed in conjunction with the Work included in this Division.
- C. Boxes shall conform to all applicable Federal, UL and NEMA standards. Materials and components shall be new and conform to grades, qualities and standards as specified herein and shown on the Drawings.
- D. Reference Section 16000, Basic Electrical Requirements.

1.02 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:
 - 1. Witnessed Shop Test
 - a. None required.
 - 2. Field Tests
 - a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and Section 16000, Basic Electrical Requirements.

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer(s) and submit the following:

1. Shop Drawings

B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete or illegible Submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets.

2. Complete assembly, layout, and installation drawings for each box with clearly marked dimensions.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 PULL, JUNCTION, AND OUTLET BOXES

A. Exposed Indoor Wet Process and Outdoor Areas

1. Exposed outlet boxes and junction boxes for outdoor and indoor wet process areas used for lighting fixtures, switches, and receptacles shall be of cast, rust-resisting metal provided with rubber or neoprene gasketed covers of similar metal. The completed units shall be of NEMA 4X construction and of ample size to house the required devices.

B. Concealed

1. Outlet boxes for concealed work shall be a minimum of 4 inches square and 2 inches deep consisting of zinc coated pressed steel provided with knockouts for the conduit required. Boxes shall be provided with approved covers or plastic rings where necessary.

2. Boxes for housing receptacles, switches and similar devices shall be of the deep type.

C. Indoors

1. Pull and junction boxes for indoor exposed use in dry locations shall be galvanized sheet steel with neoprene gasketed screwed-on covers and of all welded construction.

D. Miscellaneous

1. The Contractor shall furnish and install enclosures for housing interfacing and transition equipment, or other equipment requiring an enclosure. The Contractor shall be responsible for mounting the enclosure. The enclosures shall be a low profile type, weatherproof, lockable, and securely mounted to a concrete support pad using anchoring devices by Unistrut, Kendorf, B-Line Systems, Inc., or equal. The enclosures shall be furnished and installed in complete compliance with the NEC and with all state and local codes. The single door enclosure shall be finished with light gray epoxy paint and shall be manufactured by Hoffman, Rittal, The Austin Company, or equal.
2. All welded, galvanized, sheet steel boxes with neoprene gasketed screwed-on covers may be used outdoors in non-hazardous areas only where specified herein or indicated on the Drawings.
3. For outdoor and indoor wet process area use, NEMA 4X junction and pull boxes shall be provided. Boxes shall be equipped with neoprene gasketed covers which have been crossed ribbed and checkered. Boxes shall be provided with removable covers. Stainless steel cover screws are required. Boxes shall match the conduit to which attached.
4. For boxes shown or required in hazardous locations, boxes shall be furnished and installed in accordance with the Class, Division, and Group suitable for the application.

E. Galvanizing

1. The inside and outside surface of the boxes and covers shall be hot dipped or electro-galvanized after fabrication.

F. Box Sizes

1. The minimum size of boxes shall be according to the NEC. No box shall be filled to more than 40% of capacity.

G. Barriers

1. Galvanized steel or aluminum barriers shall be provided in junction or pull boxes to isolate conductors of different voltages and functions. Isolation shall be provided between the following groups:
 - a. Power (480 and 120 volts)
 - b. Control wiring

- c. Instrumentation wiring (twisted, shielded pairs or triads)
2. Barriers shall be provided in multi-gang outlet boxes when the voltage between switches exceeds 300 VAC.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Outlet Boxes

1. All outlet boxes required for supporting lighting fixtures shall be provided with fixture studs of sizes suitable for supporting the weight of the fixtures connected thereto. Fixture studs shall not be less than 3/8 inches in diameter and shall be either integral with the box or of the type which is inserted and supported from the back of the box. In no case will the support of a fixture be dependent upon bolts holding the stud to the box.
2. Outlet boxes for concealed work shall be arranged and located so that tile, where required, may be cut in straight lines to fit closely around the boxes, and so placed that the cover or device plate shall fit flush to the finished wall surface.
3. The exteriors of exposed outlet boxes shall be field painted, where required, in accordance with Section 09900, Painting.

B. Junction and Pull Boxes

1. All junction boxes and pull boxes shall be solidly attached to structural members prior to installation of conduit and set true and plumb. Wooden plugs are not permitted for securing boxes to concrete. Sidewalk-type boxes shall be cast into concrete structures and shall be flush with concrete services after installation.
2. Where control wires must be interconnected in a junction box, terminal strips, consisting of an adequate number of screw type terminals shall be installed. Current carrying parts of the terminal blocks shall be of ample capacity to carry the full load current of the circuits connected. Approximately 20 percent of the total amount of terminals provided shall consist of spare terminals. Terminals shall be lettered and/or numbered to conform with the wiring diagrams.
3. All junction boxes and pull boxes shall have identifying nameplates attached, which when installed on sidewalk type boxes shall not extend above the surrounding concrete slabs. All boxes shall be indicated and identified on the as-built drawings.

- END OF SECTION -

SECTION 16170

GROUNDING AND BONDING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install grounding systems complete in accordance with the minimum requirements established by Article 250 of the NEC. Article 250 of the NEC shall be considered as a minimum requirement for compliance with this Specification.
- B. Grounding of all instrumentation and control systems shall be furnished and installed in accordance with the manufacturer/system requirements and IEEE 1100-92, Powering and Grounding of Sensitive Electronic Equipment. Conflicts shall be promptly brought to the attention of the Engineer.
- C. In addition to the NEC requirements, building structural steel columns [and chemical storage tanks] shall be permanently and effectively grounded:
- D. Reference Section 16000, Basic Electrical Requirements.

1.02 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:
 - 1. Witnessed Shop Tests
 - a. None required.
 - 2. Field Tests
 - a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and Section 16000, Basic Electrical Requirements.

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop Drawings
 - 2. Reports of certified field tests.
- B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Equipment specifications and product data sheets.
 - 2. Drawings and written description of how the Contractor intends to furnish and install the grounding system.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by these specifications shall be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 GROUND RODS AND GRID

- A. Ground rods shall be rolled to a commercially round shape from a welded copper-clad steel manufactured by the molten-welding process or by the electro-formed process (molecularly bonded). They shall have an ultimate tensile strength of 75,000 pounds per square inch (psi) and an elastic limit of 49,000 psi. The rods shall be not less than 3/4 inch in diameter by 10 feet in length; and the proportion of copper shall be uniform throughout the length of the rod. The copper shall have a minimum wall thickness of 0.010 inch at any point on the rod.
- B. The maximum resistance to ground of a driven ground rod shall not exceed 5 ohms under normally dry conditions. Where the resistance obtained with one (1) ground rod exceeds 5 ohms, additional ground rods shall be installed not less than 6 feet on centers. Except where specifically indicated otherwise, all exposed non current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductors in nonmetallic raceways and neutral conductors of wiring systems shall be grounded.
- C. The ground connection shall be made at the main service equipment and shall be extended to the point of entrance of the metallic water service. Connection to the water pipe shall be made by a suitable ground clamp or lug connection to a plugged tee. If flanged pipes are encountered, connection shall be made with the lug bolted to the street side of the flanged connection. If there is not suitable metallic water service to the facility, the ground connection shall be made to the driven ground rods on the exterior of the building.

- D. Where ground fault protection is employed, care shall be taken so that the connection of the ground and neutral does not interfere with the correct operation of the ground fault protection system.

2.03 FITTINGS

- A. Grounding connections to equipment shall be bolted. Cable end connections may be made by use of the crucible weld process or bolted type connectors. Bolted type connectors for this application shall consist of corrosion resistant copper alloy with silicone bronze bolts, nuts and lockwashers which are designed for this purpose.

2.04 GROUNDING CONDUCTORS

- A. A green, insulated equipment grounding conductor, which shall be separate from the electrical system neutral conductor, shall be furnished and installed for all circuits. Equipment grounding conductors shall be furnished and installed in all conduits. Use of conduits as the NEC required equipment grounding conductor is not acceptable.

2.05 EQUIPMENT GROUNDS

- A. Equipment grounds shall be solid and continuous from a connection at earth to all distribution panelboards. Ground connections at panelboards, outlets, equipment, and apparatus shall be made in an approved and permanent manner.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Metal surfaces where grounding connections are to be made shall be clean and dry. Steel surfaces shall be ground or filed to remove all scale, rust, grease, and dirt. Copper and galvanized steel shall be cleaned with emery cloth to remove oxide before making connections.
- B. Ground Grid
 - 1. A main ground grid shall be provided for each structure and interconnecting structure grids consisting of driven ground rods. The ground rods shall be driven deep enough to obtain a ground resistance of not more than 5 ohms and shall be interconnected by the use of copper cable bus, welded to the rods by the crucible weld process. The grounding cables shall be installed after the excavations for the building have been completed and prior to the pouring of concrete for the footings, mats, etc. Copper "pigtailes" shall be connected to the ground system and shall enter the buildings and structure from the outside and shall be connected to steel structures, and equipment as described in this Section and as required to provide a complete grounding system.
 - 2. Grounding conductors shall be continuous between points of connection; splices shall not be permitted.

3. Where conductors are exposed and subject to damage from personnel, traffic, etc., conductors shall be installed in metal raceway. The raceway shall be bonded to the grounding system.
4. Connections to ground rods shall be exposed to permit maintenance and inspection for continuity and effectiveness of grounding system.
5. Where subsurface conditions do not permit use of driven ground rods to obtain proper ground resistance, rods shall be installed in a trench or plate electrodes shall be provided, as applicable and necessary to obtain proper values of resistance.

C. Raceways

1. Conduit which enters equipment such as switchgear, motor control centers, transformers, panelboards, variable frequency drives, instrument and control panels, and similar equipment shall be bonded to the ground bus or ground lug, where provided, and as otherwise required by the NEC.

- END OF SECTION -

SECTION 16141

WIRING DEVICES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install all switches and receptacles for lighting and miscellaneous power applications of the type and at the locations as specified herein and as shown on the Drawings.
- B. All switches and receptacles shall be furnished and installed in outlet boxes as specified in Section 16130, Boxes.
- C. Reference Section 16000, Basic Electrical Requirements.

1.02 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:
 - 1. Witnessed Shop Tests
 - a. None required.
 - 2. Field Tests
 - a. All field testing shall be done in accordance with the General Conditions, Division 1, and Section 16000, Basic Electrical Requirements.

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit shop drawings. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include, but not be limited to:

1. Product data sheets.
- 1.05 SUPPLIES AND SPARE PARTS
- A. The Contractor shall furnish 10% (minimum of 1) spare of each receptacle, switch, and plug furnished and installed for this project.
 - B. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.
 - C. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size shall have the same parts number.
- 1.06 IDENTIFICATION
- A. Each switch and receptacle shall be identified with the equipment item number, manufacturer's name or trademark, and such other information as the manufacturer may consider necessary, or as specified, for complete identification.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by these Specifications is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.
- B. The Contractor shall use the products of a single manufacturer for each type of wiring device.
- C. The Contractor shall use the products of a single manufacturer for all device plates. Plate variations are allowed for the following devices:
 1. Where the selected plate manufacturer does not manufacture a suitable finish plate.
 2. For heavy-duty receptacles rated at more than 30A.
 3. Where non-standard plates are required, specified, or shown.
- D. The Contractor shall furnish and install all wiring devices and device plates. Wiring devices as listed herein are intended to indicate type, function, and quality of the products.
- E. The receptacles, switches, device plates, and other appurtenances shall comply with the requirements of these Specifications. Receptacles installed in toilet, locker, and bathrooms shall be of ground fault interrupter type to meet the minimum NEC requirements. Ground fault circuit interrupter receptacles shall also be furnished and installed as specified herein, indicated on the Drawings, and required by the NEC.

- F. The Contractor shall provide specification grade devices which shall be as manufactured by Appleton, Crouse-Hinds, Leviton, Harvey Hubbell Co., General Electric Company, Bryant Electric Company, Pass & Seymour, or equal.

2.02 WIRING DEVICES

- A. Wiring devices shall be in accordance with the following for nonhazardous areas:

1. Wall Switches, Single Pole, 20 A, 120-277V equivalent to Hubbell No. 1221, Pass & Seymour No. 20AC1, Leviton equivalent, or equal. Switches rated 30 A, 120-277V shall be Leviton 3031, Hubbell equivalent, Pass & Seymour equivalent, or equal.
2. Wall Switches, Double Pole, 20 A, 120-277V equivalent to Hubbell No. 1222, Pass & Seymour No. 20AC2, Leviton equivalent, or equal. Switches rated 30 A, 120-277V shall be Leviton 3032, Hubbell equivalent, Pass & Seymour equivalent, or equal.
3. Wall Switches, Three-Way, 20 A, 120-277V equivalent to Hubbell No. 1223, Pass & Seymour No. 20AC3, Leviton equivalent, or equal. Switches rated 30 A, 120-277V shall be Leviton 3033, Hubbell equivalent, Pass & Seymour equivalent, or equal.
4. Wall Switches, Four-Way, 20 A, 120-277V equivalent to Hubbell No. 1224, Pass & Seymour No. 20AC4, Leviton equivalent, or equal.
5. Convenience Receptacles 20 A, 125V, duplex polarized with grounding connection equivalent to Hubbell No. 5362, Pass & Seymour equivalent, Leviton equivalent, or equal.
6. Hubbell Cat. No. GF-5362, Pass & Seymour equivalent, Leviton equivalent, or equal, for 20A, 120V, duplex, ground fault circuit interrupting type.

- B. Special Purpose Receptacles shall be rated to carry, at least where required the full load amperes and voltage of the unit connected thereto. These receptacles shall be provided with grounding poles and shall be equivalent to the following:

1. Hubbell Cat. No. HBL-5661, Pass & Seymour No. 5871, Leviton equivalent, or equal, for 20A, 250VAC, 1-phase service.
2. Hubbell Cat. No. HBL-9330, Pass & Seymour No.3801, Leviton equivalent, or equal, for 30A, 250VAC, 1-phase service.
3. Hubbell Cat. No. 9430, Pass & Seymour No. 5740, Leviton equivalent, or equal, for 30A, 208/120V, 3-phase service.
4. Hubbell Cat. No. 9450, Pass & Seymour No. 5750, Leviton equivalent, or equal, for 50A, 208/120V, 3-phase service.
5. Hubbell Cat. No. 9460, Pass & Seymour No. 5760, Leviton equivalent, or equal, for 60A, 208/120V, 3-phase service.

6. Hubbell Cat. No. 9330, Pass & Seymour No. 5930, Leviton equivalent, or equal, for 30A, 208V, single-phase service.
7. Hubbell Cat. No. 9315, Pass & Seymour equivalent, Leviton equivalent, or equal, for 30A, 277V, single-phase service.
8. Hubbell Cat. No. 23CM10, Pass & Seymour equivalent, Leviton equivalent, or equal, for 20A, single, 125V, polarized with grounding connection, twist lock type. Matching plug shall be Hubbell Cat. No. 23CM11, Pass & Seymour equivalent, Leviton equivalent, or equal.
9. Crouse-Hinds "Arktite" Series, Appleton equivalent, Killark equivalent, or equal, 30A, 3P, 600 Volt, twist lock, weatherproof, power receptacle and box with matching plug.

C. For hazardous areas the following shall be provided:

1. Wall Switches, single pole, 20 A, 120 V equivalent to Crouse Hinds Cat. No. EFD3591 or EFDC3591 (as required); Appleton No. EDS175F1 or EDSC175F1, Killark equivalent, or equal.
2. Convenience Receptacles 20 A, 120-250 VAC, 2 wire, 3 pole equivalent to Crouse Hinds Cat. No. CPS152-201, Appleton No. CPE1-2375, Killark equivalent, or equal.

D. Plugs for hazardous and non-hazardous receptacles shall be provided:

1. One mating plug of the same or better grade for each 10 convenience receptacles, minimum of 2 each.
2. Plugs and respective cable shall be provided for equipment furnished under other Divisions (steam cleaners, welders, etc.) as necessary.

2.03 DEVICE PLATES

- A. Wall plates with gaskets for flush-mounted receptacles and switches shall be made of Type 304 stainless steel, not less than 0.040 of an inch thick, with beveled edges and milled on the rear so as to lie flat against the wall. Wall plates shall be equivalent to Hubbell Series 9600, Pass & Seymour series 93000, Leviton equivalent, or equal.
- B. Device plates for weatherproof and watertight installations shall be Appleton Type FSR, Crouse-Hinds #DS185, or equal for wall switches and Appleton Type FSK, Crouse-Hinds #WLRD, or equal for convenience receptacles. "In-use" weatherproof covers shall be rugged, die-cast aluminum as manufactured by Thomas & Betts "Red Dot," or equal.

2.04 PLUGS

- A. The Contractor shall furnish suitable plugs with equipment furnished under the respective Contract. Plugs shall be black rubber or plastic. For waterproof receptacles, the plugs shall be similar in construction to the receptacles and shall be encased in corrosion resistant yellow housing provided with clamping nuts and stuffing gland cable outlets.

2.05 PROCESS INSTRUMENTS

- A. The Contractor shall furnish and install a local disconnect switch at each process instrument (e.g., level transmitter, flow transmitter, analytical instrument etc.) to disconnect the 120VAC power supply to the instrument. The device shall be a NSSC series manual motor starting switch without overload protection as manufactured by Crouse-Hinds, Appleton equivalent, or equal. For hazardous locations, the device shall be a front operated general use snap switch mounted in an EFS enclosure as manufactured by Crouse-Hinds, Appleton equivalent, or equal.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Switch boxes shall be of unit construction and of sizes as required to adequately house the number of switches required. No sectional type switch boxes shall be permitted.
- B. Where more than one switch occurs at one point, gang plates shall be used.
- C. All device plates shall be set true and plumb, and shall fit tightly against the finished wall surfaces and outlet boxes.
- D. All devices shall be flush-mounted in finished areas, unless otherwise noted. The Contractor shall determine the proper position of every outlet, and relocate any outlet without additional cost to the Owner if same is incorrectly or improperly located. The Engineer reserves the right to change the location of any outlet or connecting equipment up to the time of roughing in without additional cost to the Owner, provided conduit runs are not increased by more than 10 feet.
- E. In all areas where thermal or acoustic insulation is applied to the ceiling or walls, outlet boxes shall be set to finish flush with the finished surface of the insulation.
- F. When indicated height would place any of the equipment at an unsuitable location such as at a molding or break in wall finish, the Engineer shall determine final location.
- G. For the below-named items mounting heights from finish floor, or finish grade to top is applicable. Mounting heights shall be as follows, unless otherwise specified herein, indicated on the Drawings, or required by the Americans with Disability Act (ADA):
 - 1. Single-pole light switches, 48 inches.
 - 2. Duplex receptacles in dry areas, 16 inches
 - 3. Duplex receptacles in pump rooms, 48 inches

3.02 CIRCUITING

- A. Convenience receptacles shall be grouped on circuits separate from the lighting circuits. A maximum of eight (8) convenience outlets are permitted per 20A, 120V circuit.

- END OF SECTION -

SECTION 16161

PLC TERMINATION CABINETS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish all labor, materials, tools and equipment necessary for furnishing, installing, connecting, testing and placing into satisfactory operation all PLC (Programmable Logic Controller) termination cabinets as required for a complete installation as specified herein and indicated on the Drawings.
- B. The termination cabinets shall be furnished with numbered terminals for wiring connections by others between the termination cabinets and the PLC's. The Contractor shall provide all conduit and wire for each input and output (I/O) wiring point as specified in the I/O list, indicated on the Drawings, and as required.
- C. Coordination
 - 1. The Contractor shall review installation procedures under other Divisions and coordinate them with the Work specified herein.
 - 2. The Contractor shall notify others in advance of the installation of the Work included herein to provide them with sufficient time for the coordination and installation of interrelated items that are included in the Contract and that must be installed in conjunction with the Work specified in this Section.
 - 3. The Contractor shall coordinate the work described in this Section with that to be completed by the Instrumentation Subcontractor.
 - 4. The Contractor shall submit the shop drawings specified herein for approval.
- C. The PLC termination cabinets shall conform to all applicable Federal, UL, and NEMA standards. Materials and components shall be new and conform to grades, qualities and standards as specified herein and shown on the Drawings.
- D. Reference Section 16000, Basic Electrical Requirements; Section 16160, Cabinets And Enclosures; Section 16902, Electric Controls and Relays; and the applicable sections of Division 17, Control And Information Systems.

1.02 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:
 - 1. Witnessed Shop Tests
 - a. None required.

2. Certified Shop Tests and Reports

- a. None required.

3. Field Tests

- a. Field testing shall be performed in accordance with the requirements specified in the General Conditions, Division 1, and Section 16000, Basic Electrical Requirements.

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer(s) and submit the following:

1. Shop Drawings

- B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

- B. Partial, incomplete or illegible Submittals will be returned to the Contractor without review for resubmittal.

- C. Shop drawings shall include but not be limited to:

1. Material specifications and product data sheets.

2. Plan, front, and side view drawings, including overall dimensions of each termination cabinet.

3. Complete assembly, layout, and installation drawings for each termination cabinet with clearly marked dimensions.

4. Complete terminal strip wiring diagrams showing terminal strip and individual terminal identification. Diagrams shall indicate the wiring to be connected to each terminal and the wiring's respective device/tag number (e.g. FIT-XXX, PSH-XXX).

5. Approximate total shipping weight.

6. Bill of material list for each termination cabinet.

- D. Shop drawings shall be submitted after approved shop drawings have been received and updated by the Contractor.

- E. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

1.05 IDENTIFICATION

- A. Each termination cabinet shall be identified with the identification number indicated on the Drawings (e.g., TC1, TC2). A nameplate shall be securely affixed in a conspicuous place on each termination cabinet. Nameplates shall be as specified in Section 16195, Electrical - Identification.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 ENCLOSURES

- A. Termination cabinets shall be free standing, double door NEMA 12 (minimum) with back panel. The cabinet shall be fabricated from minimum 12 gauge steel with seams continuously welded and ground smooth. Doors shall overlap to eliminate the center post, and shall be gasketed and be provided with a three point mechanism operated by oil tight key-locking handle. Doors shall have heavy gauge continuous hinges. Latching rods shall have rollers for easier door closing. Enclosures shall be manufactured by Hoffman Engineering Company, Rittal Corporation, The Austin Company, or equal.
- B. Copper ground lug(s)/bus shall be furnished and installed in the cabinet to allow termination of the equipment grounding conductor to effectively ground the cabinet.
- C. Each termination cabinet shall be furnished with a single lamp, open, fluorescent light fixture with respective SPST light switch and one duplex convenience outlet. These loads shall be powered from a separate 120 VAC circuit from the nearest lighting panelboard.
- D. Cabinets shall be 48"(W)X24"(D)X90"(H) (maximum).

2.03 TERMINALS

- A. Terminals shall be as specified in Section 16902, Electric Controls and Relays.

- B. There shall be sufficient numbered terminals for the termination of all spare field conductors as follows:

<u>PLC/TC No.</u>	<u>REQUIRED SPARE CAPACITY (minimum)</u>
6A	10%
10A	10%
80A	10%

2.04 WIRING DUCT

- A. Each cabinet shall be provided with the terminal strips separated by plastic (PVC) wiring duct. Two systems of wiring duct shall be provided, one for field wiring to cabinet terminals and one for wiring from cabinet terminals to the PLC. The wiring duct from cabinet terminals to the PLC shall be left empty for use by others. Plastic wiring duct shall be of the snap in slot design furnished and installed with covers as manufactured by Panduit, or equal.
- B. Each cabinet shall be designed and fabricated to provide separation of analog, discrete, and power wiring. Wiring duct and terminal strips shall be furnished and installed in each cabinet to allow this separation.

2.05 WIRE IDENTIFICATION

- A. All digital and analog signal wires, shall be labeled with their appropriate tag number from the I/O schedule (five digits plus prefix of suffix letter) for ease of identification.
- B. Wire identification shall be accomplished through the use of a portable printer and white, polyolefin wire marking sleeves. The wire identification system shall be a "Bradymarker" XC Plus Printer with "Bradysleeve" wire marking sleeves, Panduit equivalent, or equal.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. The PLC termination cabinets shall be furnished and installed on concrete pads in the locations as indicated on the Drawings.
- B. All spare field conductors routed to the termination cabinet shall be identified and terminated on their respective spare terminals. Coiling of cables left in the bottom of the enclosure is not acceptable.

3.02 PAINTING

- A. Prior to final completion of the work, all metal surfaces of the termination cabinets shall be cleaned thoroughly, and all scratches and abrasions shall be retouched with the same lacquer as used for shop finishing coats.

3.03 DIRECTORIES

- A. Each termination cabinet shall be provided with a minimum of four typed directories indicating tag number, terminal strip and terminal number, I/O point description, point/signal type, and PLC/TC number for each terminal in the cabinet. See Exhibit A included in this Section which includes sample information for reference only.

3.04 I/O SCHEDULE

- A. Reference Section 17900, Schedules And Control Descriptions, General for the I/O schedule for the I/O points included in this project.

SECTION 16195

ELECTRICAL - IDENTIFICATION

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. All electrical equipment shall be properly identified in accordance with these Specifications and the Contract Drawings. All switchgear, switchboards, motor control centers, variable frequency drives, lighting and distribution panelboards, combination starters, control panels, pull/junction boxes, enclosures, disconnect switches, control stations, and similar equipment shall be identified in the manner described, or in an equally approved manner.
- B. The types of electrical identification specified in this section include, but are not limited to, the following:
 - 1. Exposed conduit color banding.
 - 2. Operational instructions and warnings.
 - 3. Danger signs.
 - 4. Equipment/system identification signs.
 - 5. Nameplates.

1.02 SIGNS

- A. "DANGER-HIGH-VOLTAGE" signs shall be securely mounted on the entry doors of all electrical rooms.

1.03 LETTERING AND GRAPHICS

- A. The Contractor shall coordinate names, abbreviations, and other designations used in the electrical identification work with the corresponding designations shown, specified or scheduled. Provide numbers, lettering, and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of the electrical systems and equipment.

1.04 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit shop drawings. Each submittal shall be identified by the applicable specification section.

1.05 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Equipment specifications and product data sheets.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The material covered by these Specifications is intended to be standard material of proven performance as manufactured by reputable concerns. Material shall be fabricated, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and shown on the Drawings.

2.02 NAMEPLATES

- A. Nameplates shall be engraved, high pressure plastic laminate, black with white lettering.

2.03 HIGH VOLTAGE SIGNS

- A. Standard "DANGER" signs shall be of baked enamel finish on 20 gage steel; of standard red, black and white graphics; 14 inches by 10 inches size except where 10 inches by 7 inches is the largest size which can be applied where needed, and except where a larger size is needed for adequate vision.

2.04 CONDUIT MARKERS

- A. All conduits shall be labeled in accordance with the conduit and wire schedules. Color coded conduit markers shall be standard preprinted, flexible permanent, plastic sheet conduit markers, extending 360 degrees around conduits; designed for attachment to conduit by adhesive. Lettering shall indicate the conduit number as indicated in the conduit schedule. Provide 8 inch minimum length for 2 inch and smaller conduit and 12 inch length larger than 2 inch conduit.

PART 3 -- EXECUTION

3.01 NAMEPLATES

- A. Nameplates shall be attached to the equipment enclosures with (2) two stainless steel sheet metal screws for nameplates up to 2-inches wide. For nameplates over 2-inches wide, four

(4) stainless steel sheet metal screws shall be used, one (1) in each corner of the nameplate. The utilization of adhesives is not permitted.

3.02 CONDUIT IDENTIFICATION

- A. Where electrical conduit is exposed in spaces with exposed mechanical piping which is identified by a color-coded method, apply color-coded identification on the electrical conduit in a manner similar to the piping identification. Except as otherwise indicated, use orange as the coded color for conduit marker backgrounds. Conduit identification shall be made after the conduit has been painted.

3.03 OPERATIONAL IDENTIFICATION AND WARNINGS

- A. Wherever reasonably required to ensure safe and efficient operation and maintenance of the electrical systems and electrically connected mechanical systems and general systems and equipment, including prevention of misuse of electrical facilities by unauthorized personnel, install plastic signs or similar equivalent identification, instruction, or warnings on switches, outlets, and other controls, devices, and covers or electrical enclosures. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for the intended purposes. Signs shall be attached as specified above for nameplates.

3.04 POWER SOURCE IDENTIFICATION

- A. After installation of all field equipment (i.e. valves, motors, fans, unit heaters, instruments, etc) install nameplates at each power termination for the field equipment. Nameplate data shall include equipment designation (tag number), power source (MCC number, panelboard, etc), circuit number, conduit number from schedule and voltage/phase.
- B. Contractor to coordinate with the Engineer and the Owner regarding exact nameplate placement during construction.
- C. Nameplates shall be as specified herein.

- END OF SECTION -

SECTION 16481

INDIVIDUAL MOTOR CONTROLLERS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install separately mounted, individual motor controllers for 120 volt single phase, and 208 and 480 volt three phase motors as specified herein and indicated on the Drawings. Individual motor controllers specified in this Section include magnetic motor starters, manual motor starters, and reduced voltage solid state starters (RVSS).
- B. Reference Section 16000, Basic Electrical Requirements and Section 16902, Electric Controls and Relays.

1.02 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:
 - 1. Witnessed Shop Tests
 - a. None required.
 - 2. Field Tests
 - a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and Section 16000, Basic Electrical Requirements.

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop Drawings.
 - 2. Spare Parts List.
- B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets.
 - 2. Complete layout and installation drawings with clearly marked dimensions for each type/size/rating of individual motor controller. For RVSS starters, show stub-up area locations on the Drawings.
 - 3. Custom wiring diagrams for each individual motor controller. Standard wiring diagrams that are not custom created by the manufacturer for the individual motor controllers for this project are not acceptable. One wiring diagram which is typical for an equipment group (e.g. reuse water pump) is not acceptable. Each wiring diagram shall include wire identification and terminal numbers. Indicate all devices, regardless of their physical location, on the diagrams. Identify on each respective wiring diagram specific equipment names and equipment numbers consistent with those indicated on the Drawings.
 - 4. Bill of material list for each individual motor controller.
 - 5. Nameplate schedule for each individual motor controller.
 - 6. Manufacturer's installation instructions.
 - 7. Time-current curves for each type and size protective device if requested by the Engineer.
 - 8. Approximate total shipping weight of each RVSS.
- D. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items that the Contractor intends to provide are acceptable and shall be submitted.
- E. Prior to completion and final acceptance of the project, the Contractor shall furnish and install "as-built" wiring diagrams for individual motor controller. These final drawings shall be plastic laminated and securely placed inside each individual motor controller unit door and included in the O&M manuals.

1.05 OPERATION AND MAINTENANCE MANUALS

- A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1.

1.06 TOOLS, SUPPLIES, AND SPARE PARTS

- A. The equipment shall be furnished with all special tools necessary to disassemble, service, repair and adjust the equipment. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor.
- B. The Contractor shall furnish the following minimum spare parts:
 - 1. One (1) overload relay complete with heater for each type, size, and rating used.
 - 2. One (1) motor circuit protector & motor contactor for each type, size, and rating used.
 - 3. One (1) spare control power transformer for each type and size used.
 - 4. Two (2) spare fuses for each size and type used.
- C. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.
- D. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the Owner.
- E. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.
- F. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

1.08 IDENTIFICATION

- A. Each equipment item shall be identified with a nameplate. The nameplate shall be engraved indicating the circuit number and equipment name with which it is associated. Equipment identification shall be in accordance with Section 16195, Electrical - Identification.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.
- B. Individual motor controllers specified in this section shall be as manufactured by Cutler-Hammer, the General Electric Company, the Square D Company, or Siemens Energy and Automation, Inc.

2.02 INDIVIDUAL MAGNETIC MOTOR STARTERS

- A. Individual magnetic motor starters shall be combination type complete with motor circuit protectors (MCP's). Starters shall be rated 480 VAC, 3-pole, sized for the intended load unless otherwise indicated. In no case shall a starter smaller than a NEMA Size 1 be used. Each starter shall be furnished with a minimum of two spare auxiliary contacts.
- B. Provide starters in NEMA 1A (gasketed) enclosures when located in clean, dry, conditioned spaces only. NEMA 1A (gasketed) enclosures shall be finished with corrosion resistant epoxy or acrylic paint. Starters to be furnished and installed in indoor damp or wet areas shall be in NEMA 4X Type 304 stainless steel enclosures. Starters to be provided in all outdoor locations shall be in NEMA 4X Type 304 stainless steel enclosures. Individual motor starters located in hazardous areas shall be suitable for the Class, Division, and Group to suit the application.
- C. Furnish and install manual reset overload relays in each phase sized in accordance with the NEC. Provide cover mounted overload reset button with metal (not plastic) shaft and pilot devices as indicated and required. Starters shall be provided with all coils and controls for 120 VAC operation, unless otherwise indicated on the Drawings.
- D. A control power transformer shall be furnished and installed for each motor controller. The minimum control power transformer VA requirements are as follows:

Size 1	75 VA
Size 2	75 VA
Size 3	200 VA
Size 4	300 VA
Size 5	500 VA

Additional transformer capacity shall be provided when required. The motor controller manufacturer is advised to review the total Contract Documents for additional requirements for space heaters, power factor correction capacitors, and similar equipment which may not be specified in this Division or shown on the Drawings.

- E. Ambient compensated, thermal, bi-metallic type overload relays shall be furnished and installed providing Class 20 operation. Overload relays shall be equipped with one additional normally open (NO) and normally closed (NC) isolated contact for use as specified herein or indicated on the Drawings. Solid state overload relays shall only be furnished and installed if specifically accepted by the Engineer. The Contractor shall furnish and install correctly sized overload heaters based on the rating of the motor installed.
- F. Unless otherwise indicated, the pilot devices shall be mounted on the covers of the respective enclosures. Pushbuttons, selector switches, and pilot lights shall be 30.5 mm, heavy-duty, oil tight type with provisions to maintain the NEMA ratings of starter enclosures. Legend plates indicating switch positions shall be provided for each pilot device. Pilot lights shall be LED type.
- G. All control wiring shall be No. 14 AWG (minimum) labeled at each end in accordance with the wiring numbers shown on the accepted shop drawings. Power wiring shall be sized to

suit the maximum horsepower rating of unit; No. 12 AWG (minimum). Wiring shall be type MTW rated for 105°C. Wire color coding shall be as specified in Section 16123, Building Wire and Cable.

- H. Each motor starter coil shall be equipped with a surge-suppression device for protection of the solid state equipment (e.g. programmable logic controller) wired as part of the control circuit.
- I. Where specified in these Contract Documents, indicated on the Drawings, or as required, interposing relays shall be furnished for the motor control circuits. Coil voltage shall be as specified, indicated on the Drawings, or as required. The contact ratings of the relays shall be coordinated with the burden of the motor starter coil. If the burden or other electrical requirements exceed the contact rating of general purpose, plug-in relays, machine tool type relays with adequate contact ratings shall be provided.
- J. Individual magnetic motor starters shall be as manufactured by Cutler-Hammer using NEMA rated Freedom Series starters and contactors, the General Electric Company equivalent, the Square D Company equivalent, or Siemens Energy & Automation, Inc. equivalent.

2.03 INDIVIDUAL MANUAL MOTOR STARTERS

- A. Individual manual motor starters in enclosures as specified above shall be furnished and installed for outdoor and indoor exposed work. Furnish and install manual motor starters in outlet boxes with flush wall plates as required for concealed work.
- B. Furnish and install manual motor starters with pilot lights and overload heater elements of correct rating based on motor nameplate data.
- C. Manual motor starters shall be equipped with either a push button or toggle operator with reset device or mechanism accessible without opening the enclosure.
- D. Individual manual motor starters for motors one (1) horsepower and less shall be Cutler-Hammer Type MS, the General Electric Company equivalent, the Square D Company equivalent, or Siemens Energy & Automation, Inc. equivalent.
- E. Individual manual motor starters for integral horsepower motors shall be Cutler-Hammer Type B100 or B101, the General Electric Company equivalents, the Square D Company equivalents, or Siemens Energy and Automation, Inc. equivalents.

2.04 AUXILIARY CONTROL RELAYS

- A. Provide auxiliary control relays as required to suit the application and as shown on the Drawings. Control relays shall be as specified in Section 16902 - Electrical Controls and Relays. The number of contacts shall be as shown and as required to suit the application plus two spare normally open (N.O.) and two spare normally closed (N.C.).

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. All individual motor starters shall be installed as indicated on the Drawings and as recommended by the equipment manufacturer.

- END OF SECTION -

SECTION 16902

ELECTRIC CONTROLS AND RELAYS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, test, and place in satisfactory operation all electric controls and relays as specified herein and indicated on the Drawings.
- B. Electrical control and relay systems shall be assembled using NEMA rated components. Components designed and built to International Electrotechnical Commission (IEC) standards are not recognized. Equipment designed, manufactured and labeled in compliance with IEC standards is not acceptable.
- C. Motor control circuits shall be wired in accordance with the requirements specified herein or indicated on the Drawings.
- D. Reference Section 16000, Basic Electrical Requirements and Section 16195, Electrical Identification.
- E. The Contractor shall furnish and install, as specified herein and indicated on the Drawings, all motor control components and wiring for all motor-operated equipment furnished under this Section and all other Sections as indicated. The Contractor shall review the entire Contract Drawings to be totally familiar with his responsibilities.
- F. The Contractor shall furnish and install all external power and control wiring to control panels of prewired packaged equipment, unless indicated otherwise.
- G. Control wiring requirements are indicated in electrical schematics and descriptions on the Drawings, in control functional descriptions which appear in Section 17900 - Schedules and Control Descriptions, General of these Specifications, and in equipment manufacturer's equipment data. The Contractor shall furnish and install all control wiring in accordance with these Contract Documents. The Contractor shall provide all control circuits and wiring for a particular item of equipment in accordance with requirements as set forth by the manufacturer of the particular item of equipment.
- H. As specified herein and indicated on the Drawings, furnish and install instrumentation wiring and connections to instrumentation equipment furnished under all Contracts of this Specification. Unless indicated otherwise, motor control switches, pilot lights, relays, and other control equipment for mounting in instrumentation panels shall be furnished, installed, and wired by the Contractor.
- I. Where pumps provided by others are furnished with solenoid valves or other devices for control, the Contractor shall wire these valves or devices.

- J. Unless otherwise specified herein or indicated on the Drawings, motor controllers shall be wired to drop out and remain dropped out on loss of power to the line side of the controller. Operator action shall be required to restart the motor unless the motor is intended to automatically restart.
- K. Motor control components and control wiring shall conform to NEMA Specifications ISC-1970 (Revised, 1975), Industrial Controls and Systems.
- L. Where devices are installed on the doors of NEMA 4, 4X, or 3R enclosures, devices shall be selected and installed to maintain the NEMA rating of the enclosure.
- M. Wiring in all starters, panels, junction boxes, and similar equipment shall be brought out to numbered terminal strips for interconnection. The Contractor shall be responsible for documenting terminal numbers for all starters, controls, panels, and similar equipment provided under the Contract. At the completion of the project, the Contractor shall submit a complete set of record drawings showing and/or listing all terminals in boxes, panels, starters, and similar equipment in a single, complete bound package for the equipment and control supplied under the Contract. Reference the General Conditions, Section 01300 - Submittals and Section 01700 - Project Closeout.
- N. The Contractor is responsible for coordinating the electrical work under the Contract with all equipment starters, controls, and instruments provided by others. The Contractor shall verify and coordinate with process equipment power supply and voltage, process equipment control power supply and voltage, and details of installation and interconnection. Coordination shall include distribution of approved electrical shop drawings to the General Contractor's equipment suppliers.
- O. Electrical control schematic diagrams drawn using a ladder-type format in accordance with JIC standards shall be submitted for all electrical equipment which is being provided under the Contract.
- P. Record drawings shall be provided in accordance with requirements in the General Conditions, Section 01300 - Submittals, and Section 01700 - Project Closeout. One complete set of record wiring diagrams encased in plastic or plexiglass envelopes shall be provided for each starter, panel, and similar equipment. The diagrams shall include wire color codes showing connections from numbered terminal blocks to external equipment.
- Q. Where space or strip heaters are provided within the enclosures for electrical equipment, the Contractor shall make connections to these heaters from an appropriate power source and operate the heaters with temperature control as necessary until the equipment is installed and operated according to its intended use.
- R. Control stations shall be furnished and installed at each motor and at all other controlled devices (e.g. solenoid valves) as specified herein and indicated on the Drawings.

1.02 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

1. Witnessed Shop Tests

None required.

2. Field Tests

Field tests shall be performed in accordance with the requirements specified in the General Conditions, Division I, and Section 16000, Basic Electrical Requirements.

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings.
2. Spare Parts List.
3. Operation and Maintenance Manuals.

B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete or illegible submittals will be returned to the Contractor without review for resubmittal. The letter and performance affidavit described above must be included in the first submittal.

C. Shop drawings shall include but not be limited to:

1. Equipment specifications and product data sheets.

D. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

1.05 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1.

1.06 TOOLS, SUPPLIES AND SPARE PARTS

- A. The electrical control and relay systems and accessories shall be furnished with all special tools necessary to disassemble, service, repair, and adjust the equipment. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor.
- B. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.
- C. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the Owner.
- D. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.
- E. Parts shall be completely identified with a numerical system to facilitate parts control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

PART 2 -- PRODUCTS

2.01 CONTROL COMPONENTS

- A. Pushbuttons (PB) and selector switches (SS) shall be Type E34 as manufactured by Cutler-Hammer, Type 3SBO as manufactured by Siemens Energy and Automation Inc., General Electric Company equivalent, or equal. Pushbuttons and selector switches shall be 30.5 mm, heavy-duty, oil tight NEMA 4X corrosion resistant with legend plates as specified herein, indicated on the Drawings, or otherwise directed by the Engineer. Legend plates shall be plastic, black field (background) with white lettering. Pushbuttons and selector switches shall be non-illuminated. Pushbuttons shall include a full guard. Panic stop/alarm pushbuttons shall be red mushroom type with manual-pull release.
- B. Pushbuttons and selector switches for all electrical equipment shall be of the same type and manufacturer unless otherwise specified herein or indicated on the Drawings.
- C. Pushbuttons, selector switches, and other pilot devices for pump control panels shall be as specified herein and in the control functional descriptions which appear in Section 17900 - Schedules and Control Descriptions, General, and as shown on the Drawings.
- D. Engraved nameplates shall be securely fastened to the front of each pushbutton station, disconnect switch, and motor starter remotely located from the motor control center. If adequate space is not available, the nameplate shall be mounted below the push button station. Nameplates shall be as specified in Section 16195, Electrical Identification. Identify all switches, control stations, and motor controllers as to their respective equipment.

- E. Pilot lights shall be Type E34 as manufactured by Cutler- Hammer, Type 3SBO as manufactured by Siemens Energy and Automation Inc., General Electric Company equivalent, or equal. Pilot lights shall be of the proper control voltage, LED type, heavy-duty, corrosion-resistant NEMA 4X with legend plates as specified herein, indicated on the Drawings, or otherwise directed by the Engineer. Legend plates shall be plastic, black field (background) with white lettering. Pilot light lens colors shall be as follows:

Red	-	"Run", "On", "Open"
Green	-	"Off", "Closed"
Amber	-	"Alarm", "Fail"
White	-	"Control Power On"

- F. Pilot lights for all electrical panels shall be of the same type and manufacturer unless otherwise specified herein or indicated on the Drawings.
- G. Pilot lights for pump control panels shall be round with custom engraved legend plates for each pilot light.
- H. Control Relays (CR) shall be Type D3 as manufactured by Cutler-Hammer, Potter-Brumfield equivalent, Allen-Bradley equivalent, Siemens Energy and Automation Inc. equivalent, or equal. Relays shall be general purpose plug-in type with coil voltage as shown on the Drawings and sealed 10 ampere contacts. All relays shall have three SPDT contacts rated 120/240 VAC and 28 VDC minimum. Machine tool relays shall be provided when the contact burden exceeds 10 amperes. Miniature type or "ice cube" relays are not acceptable.
- I. Timing Relays (TR) shall be the general purpose plug-in type, Type TR as manufactured by Cutler-Hammer, Allen-Bradley equivalent, Siemens Energy and Automation Inc. equivalent, or equal. Timing relays shall be electronic type with 120 VAC coils unless otherwise specified or indicated on the Drawings. Timers shall be provided with two SPDT timed output contacts. Contact ratings shall be the same as for control relays as specified above.
- J. Control Stations (CS) shall be as manufactured by Cutler-Hammer, General Electric Company, Siemens Energy and Automation Inc., or equal. Control stations shall be furnished and installed complete with pushbuttons, selector switches, and other pilot devices as specified herein or indicated on the Drawings. Stop pushbuttons shall be furnished with a lock-out device as specified herein and indicated on the Drawings.

Control station enclosures shall be cast aluminum with gasketed cover for all indoor dry areas. Control station enclosures shall be NEMA 4X stainless steel with gasketed cover for all indoor damp/wet process areas. Control station enclosures shall be NEMA 4X stainless steel with gasketed cover for all outdoor applications.

Control stations located in hazardous locations shall be suitable for the Class, Division, and Group to suit the application. The pilot devices shall be the factory sealed type mounted in enclosures as specified above.

- K. Open type motor starters shall be rated 480 VAC, 3-pole, sized for the intended load unless otherwise indicated. In no case shall a starter smaller than a NEMA Size 1 be used. Each starter shall be able to withstand 20 million operations. Each starter shall be furnished with a minimum of two spare auxiliary contacts in addition to the hold-in contact.

The motor starters shall conform to NEMA Standard IC1 and shall be for across-the-line starting, unless otherwise indicated. IEC rated equipment is not acceptable and shall be used as a basis for rejection of the equipment.

Starters shall be furnished with manual reset overload relays in each phase sized in accordance with the NEC. Provide door mounted overload reset button with metal (not plastic) shaft. Starters shall be provided with coils for 120 VAC operation, unless otherwise indicated on the Drawings.

Ambient compensated, thermal, bi-metallic type overload relays shall be furnished and installed providing Class 20 operation. Overload relays shall be equipped with one additional normally open (NO) and normally closed (NC) isolated contact for use as specified herein or indicated on the Drawings. Solid state overload relays shall only be furnished and installed if specifically accepted by the Engineer. The Contractor shall furnish and install correctly sized overload heaters based on the rating of the motor installed.

Open type magnetic motor starters shall be Cutler-Hammer Type AN16 or AN56 using NEMA rated Freedom Series contactors, General Electric Company equivalents, Siemens Energy and Automation Inc. equivalents, or equal.

- L. Selected motors are indicted as requiring elapsed time indicators. Provide Eagle Signal Type HK210A6, General Time Catalog #ED27NR, Allen-Bradley equivalent, or equal, elapsed time indicators for 120 VAC volt operation mounted flush in the respective motor starter compartment door. Where clearance is not obtainable for compartment door closing, mount timers in a separately mounted enclosure, with each timer nameplated. Wire elapsed time indicator to operate when the respective motor operates.
- M. Terminal blocks shall be assembled on non-current carrying galvanized steel DIN mounting rails securely bolted to the enclosure or cabinet subpanel. Terminals shall be tubular screw type with pressure plate for wire size #22 - #8 AWG.

Power terminal blocks shall be single tier with a minimum rating of 600 volts, 30A. Signal terminal blocks shall be single tier with a minimum rating of 600 volts, 20A. Separate terminal strips shall be provided for each type of power and signal used within each cabinet. There shall be a sufficient quantity of terminals for the termination of all spare field conductors.

Terminals shall be marked with a permanent, continuous marking strip. One side of each terminal shall be reserved exclusively for incoming field conductors. Common connections and jumpers required for internal wiring shall not be made on the field side of the terminal. Subject to the approval of the Engineer, a vendor's pre-engineered and prefabricated wiring termination system may be acceptable.

The terminal blocks shall be as manufactured by Phoenix Contact, Inc., Wieland, Inc., or equal.

- N. Alarm horns shall be as manufactured by Federal Signal Corporation, Edwards Signaling Company, EST (Edwards Systems Tech) or equal. Alarm horns shall be made for surface, flush, or semi-flush mounting on walls, panels, enclosures, or on square outlet boxes. Alarm horn sound output level shall be of 100 dB (nominal) at 10 feet.

PART 3 -- EXECUTION

3.01 CONFIGURATION OF CONTROLS AND EQUIPMENT

- A. All controls including wiring, control switches, pushbuttons, indicating lights, control interlocks and similar devices, shall be provided at the control voltages specified herein or indicated on the Drawings. Each motor starter shall be provided with a control power transformer mounted in the starter unit. Primary wiring to the control power transformer shall be tapped to two (2) poles on the load side of the circuit breaker or fusible switch. Both primary wires shall be fused with 10- ampere, slow-blow fuses. The fuse on the ungrounded secondary side shall be capable of handling 100 percent to 125 percent of the rated control transformer secondary current. Control power transformers shall be provided with volt-ampere (VA) ratings equal to a minimum of 125 percent of the volt-ampere (VA) load connected to the transformer.
- B. All equipment, cabinets, and devices furnished under the Contract shall be heavy-duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer, insofar as possible, and shall consist of equipment models which are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion.
- C. All equipment shall be designed to operate on a 60 Hz alternating current power source at a nominal 117 volts, plus or minus 10 percent, except where specifically noted. All regulators and power supplies required for compliance with the above shall be provided.
- D. All switches shall have double-pole, double-throw, contacts rated at a minimum of 600 VA, unless specifically noted otherwise.
- E. Materials and equipment used shall bear a U.L. label wherever such labeling of equipment and materials are available.
- F. Unless otherwise specified or indicated on the Drawings, all equipment shall be designed, furnished, and installed so that in the event of a power interruption, the equipment must be restarted manually after a power failure.
- G. All power terminals shall be insulated and identified.
- H. All instruments shall operate at 10 to 125 degrees F unless otherwise specified.
- I. Internal wiring within all starters, panels, instruments, junction boxes and similar equipment, shall be brought out to numbered terminal strips for interconnection and field wiring.
- J. All control components shall be mounted in a manner that will permit servicing, adjustment, testing, and removal without disconnecting, moving, or removing any other component. Components mounted on the inside of panels shall be mounted on removable plates and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required otherwise by the manufacturer to protect equipment from vibration. Component's mounting shall be oriented in accordance with the component manufacturer's and industries' standard practices. All internal components shall be identified with suitable plastic or metal

engraved tags attached with drive pins adjacent to (not on) each component identifying the component in accordance with the Drawings, Specifications, and supplier's data.

- K. The control functional descriptions which appear in Section 17900 - Schedules and Control Descriptions, General indicate interconnections between panels, instruments, and similar equipment. Unless otherwise noted, the Contractor shall provide all interconnecting wiring and conduit for complete control systems. The Contractor shall make all connections to equipment devices, instruments, and all components requiring electrical connection.
- L. The shield on each instrumentation cable shall be continuous from source to destination and shall be grounded as directed by the manufacturer of the instrumentation equipment. In no case shall more than one ground point be employed for each shield. The ground point shall be as specified in Division 17. All analog control functions shall utilize 4-20 mA DC control signals, unless otherwise specified. All analog transmission shall take place within shielded twisted cables which are not susceptible to interference or noise.
- M. Lightning/surge protection shall be provided to protect the instrumentation and control 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 shall be maintenance free and self-restoring. Equipment shall be housed in a suitable metallic case, properly grounded. Ground wires for all surge protectors 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 enclosure or in a separate NEMA 4 junction box coupled to the enclosure.
- N. Reference Division 17 - Control and Information Systems for additional information regarding lightning/surge protection requirements.

3.02 FIELD TESTS

- A. The Contractor shall conduct field tests prior to operation of the equipment. The Engineer shall witness all field testing. Field testing shall be conducted at a time approved by the Engineer. Field tests shall be conducted for all hardware components and shall include a functional check of all items. Field tests shall include a functional check of all instruments and control equipment. All equipment shall be connected and fully operational for field testing. Field tests shall demonstrate that the controls perform according to the Contract requirements and that all equipment, valves, switches, controls, alarms, interlocks, indicating lights, and similar equipment function properly. Based on the results of field tests, the Contractor shall make any required corrections to equipment and controls and shall make any adjustments required to the control logic and control settings to achieve the specified operation or operation otherwise directed by the Engineer. Field tests shall be conducted for the full range of operating modes and conditions specified and as directed by the Engineer. The Contractor shall make modifications and adjustments to the controls as directed by the Engineer for optimizing operation of the overall system. All costs in connection with field tests of equipment provided under the Contract, shall be borne by the Contractor. The Contractor shall be fully responsible for the proper operation of all motor starters and controls during the tests.

- END OF SECTION -

SECTION 17000

CONTROL AND INFORMATION SYSTEM
SCOPE AND GENERAL REQUIREMENTS

PART 1 -- GENERAL

1.01 SCOPE

- A. The Contractor shall provide, through the services of an instrumentation and control system subcontractor, all components, system installation services, as well as all required and specified ancillary services in connection with the Instrumentation, Control and Information System. The System includes all materials, labor, tools, fees, charges and documentation required to furnish, install, test and place in operation a complete and operable instrumentation, control and information system as shown and/or specified. The system shall include all measuring elements, signal converters, transmitters, local control panels, digital hardware and software, operator workstations, remote telemetry units, signal and data transmission systems, interconnecting wiring and such accessories as shown, specified, and/or required to provide the functions indicated.
- B. The scope of the work to be performed under this Division includes but is not limited to the following:
1. The Contractor shall retain overall responsibility for the instrumentation and control system as specified herein.
 2. Furnish and install process instrumentation and associated taps and supports as scheduled or shown on the Drawings, unless otherwise noted or supplied by equipment vendors.
 3. Furnish and install local control panels, field panels and associated cabinets and panels as shown on the Drawings and as specified in Division 17.
 4. Furnish and install digital control system hardware and software as specified in Division 17.
 5. Final termination and testing of all instrumentation and control system signal wiring and power supply wiring at equipment furnished under Division 17.
 6. Furnish, install and terminate all special cables (instruments, printers, telemetry, etc.) and operator workstation network cables; and furnish and terminate data highway network cables.
 7. Furnish and install surge protection devices for all digital equipment, local control panels, remote telemetry units, and instrumentation provided under this Division, including connections to grounding system(s) provided under Division 16.

8. Coordinate grounding requirements with the electrical subcontractor for all digital equipment, local control panels, remote telemetry units, and instrumentation provided under this Division. Terminate grounding system cables at all equipment provided under this Division.
 9. Provide system testing, calibration, training and startup services as specified herein and as required to make all systems fully operational.
- C. It is the intent of the Contract Documents to construct a complete and working installation. Items of equipment or materials that may reasonably be assumed as necessary to accomplish this end shall be supplied whether or not they are specifically stated herein.

1.02 RELATED ITEMS

- A. Field mounted switches, torque switches, limit switches, gauges, valve and gate operator position transmitters, sump pump controls and other instrumentation and controls furnished with mechanical or electrical equipment not listed in the instrument schedule shall be furnished, installed, tested and calibrated as specified under other Divisions.
- B. Additional and related work performed under Division 16 includes the following:
1. Instrument A.C. power source and disconnect switch for process instrumentation, A.C. grounding systems, and A.C. power supplies for all equipment, control panels and accessories furnished under Division 17.
 2. Conduit and raceways for all instrumentation and control system signal wiring, grounding systems, special cables and data highway cables.
 3. Instrumentation and control system signal wiring.
 4. Install data highway network cables.
 5. Furnish and install grounding systems for all digital equipment, local control panels, remote telemetry units, and instrumentation provided under Division 17. Grounding systems shall be complete to the equipment provided under Division 17, ready for termination by the instrumentation subcontractor.
 6. Termination of all instrumentation and control system signal wiring at all equipment furnished under other divisions of the Specifications.
 7. Final wiring and termination to A.C. grounding systems and to A.C. power sources (e.g. panelboards, motor control centers, and other sources of electrical power).

1.03 GENERAL INFORMATION AND DESCRIPTION

- A. Where manufacturers are named for a particular item of equipment, it is intended as a guide to acceptable quality and performance and does not exempt such equipment from the requirements of these Specifications or Drawings.

- B. In order to centralize responsibility, it is required that all equipment (including field instrumentation and control system hardware and software) offered under this Division shall be furnished and installed by the instrumentation subcontractor, or under the supervision of the instrumentation subcontractor, who shall assume complete responsibility for proper operation of the instrumentation and control system equipment, including that of coordinating all signals, and furnishing all appurtenant equipment.
- C. The Contractor shall retain total responsibility for the proper detailed design, fabrication, inspection, test, delivery, assembly, installation, activation, checkout, adjustment and operation of the entire instrumentation and control system as well as equipment and controls furnished under other Divisions of the Specifications. The Contractor shall be responsible for the delivery of all detailed drawings, manuals and other documentation required for the complete coordination, installation, activation and operation of mechanical equipment, equipment control panels, local control panels, field instrumentation, control systems and related equipment and/or systems and shall provide for the services of a qualified installation engineer to supervise all activities required to place the completed facility in stable operation under full digital control.
- D. The instrumentation and control system shall be capable of simultaneously implementing all real-time control and information system functions, and servicing all operator service requests as specified, without degrading the data handling and processing capability of any system component. It shall also be possible to simultaneously generate displays on all workstations and print out data on all printers without degradation of system performance.
- E. Control system inputs and outputs are listed in the Input/Output Schedule. This information, together with the control strategy descriptions, process and instrumentation diagrams, and electrical control schematics, describes the real-time monitoring and control functions to be performed. In addition, the system shall provide various man/machine interface and data reporting functions as specified in the software sections of this Specification.
- F. The mechanical, process, and electrical drawings indicate the approximate locations of field instruments, control panels, systems and equipment as well as field-mounted equipment provided by others. The instrumentation subcontractor shall examine the mechanical, process and electrical drawings to determine actual size and locations of process connections and wiring requirements for instrumentation and controls furnished under this Contract. The instrumentation subcontractor shall inspect all equipment, panels, instrumentation, controls and appurtenances either existing or furnished under other Divisions of the Specifications to determine all requirements to interface same with the control and information system. The Contractor shall coordinate the completion of any required modifications with the associated supplier of the item furnished.
- G. The instrumentation subcontractor shall review and approve the size and routing of all instrumentation and control cable and conduit systems furnished by the electrical subcontractor for suitability for use with the associated cable system.
- H. The Contractor shall coordinate the efforts of each supplier to aid in interfacing all systems. This effort shall include, but shall not be limited to, the distribution of approved shop drawings to the electrical subcontractor and to the instrumentation subcontractor furnishing the equipment under this Division.

- I. The Contractor shall be responsible for providing a signal transmission system free from electrical interference that would be detrimental to the proper functioning of the instrumentation and control system equipment.
- J. The Owner shall have the right of access to the subcontractor's facility and the facilities of his equipment suppliers to inspect materials and parts; witness inspections, tests and work in progress; and examine applicable design documents, records and certifications during any stage of design, fabrication and tests. The instrumentation subcontractor and his equipment suppliers shall furnish office space, supplies and services required for these surveillance activities.
- K. The terms "Instrumentation", "Instrumentation and Control System", and "Instrumentation, Control and Information System" shall hereinafter be defined as all equipment, labor, services and documents necessary to meet the intent of the Specifications.

1.04 INSTRUMENTATION AND CONTROL SYSTEM SUBCONTRACTORS

- A. Instrumentation and control system subcontractors shall be regularly engaged in the detailed design, fabrication, installation, and startup of instrumentation and control systems for water and wastewater treatment facilities. Instrumentation and control system subcontractors shall have a minimum of five years of such experience, and shall have completed a minimum of three projects of similar type and size as that specified herein. Where specific manufacturers and/or models of major hardware or software products (PLC, HMI software, LAN, etc.) are specified to be used on this project, the instrumentation and control system subcontractor shall have completed at least one project using that specified hardware or software. As used herein, the term "completed" shall mean that a project has been brought to final completion and final payment has been made. Any instrumentation and control system subcontractor that has been subject to litigation or the assessment of liquidated damages for nonperformance on any project within the last five calendar years shall not be acceptable.
- B. Acceptable instrumentation and control system subcontractors shall be CITI, LLC; GE Automation Services, Inc.; M/R Systems, Inc.; Nix, Purser and Associates, Inc.; Piedmont Automation, Inc.; Revere Control Systems; Systems East, Inc.; Transdyn Controls, Inc.; or equal.

1.05 DEFINITIONS

- A. Solid State: Wherever the term solid state is used to describe circuitry or components in the Specifications, it is intended that the circuitry or components shall be of the type that convey electrons by means of solid materials such as crystals or that work on magnetic principles such as ferrite cores. Vacuum tubes, gas tubes, slide wires, mechanical relays, stepping motors or other devices will not be considered as satisfying the requirements for solid state components of circuitry.
- B. Bit or Data Bit: Whenever the terms bit or data bit are used in the Specification, it is intended that one bit shall be equivalent to one binary digit of information. In specifying data transmission rate, the bit rate or data bit rate shall be the number of binary digits transmitted per second and shall not necessarily be equal to either the maximum pulse rate or average pulse rate.

- C. Integrated Circuit: Integrated circuit shall mean the physical realization of a number of circuit elements inseparably associated on or within a continuous body to perform the function of a circuit.
- D. Mean Time Between Failures (MTBF): The MTBF shall be calculated by taking the number of system operating hours logged during an arbitrary period of not less than six months and dividing by the number of failures experienced during this period plus one.
- E. Mean Time to Repair (MTTR): The MTTR shall be calculated by taking the total system down time for repair over an arbitrary period of not less than six months coinciding with that used for calculation of MTBF and dividing by the number of failures causing down time during the period.
- F. Availability: The availability of a nonredundant device or system shall be related to its MTBF and MTTR by the following formula:

$$A = 100 \times (\text{MTBF}/(\text{MTBF} + \text{MTTR})) \text{ Percent}$$

The availability of a device or system provided with an automatically switched backup device or system shall be determined by the following formula:

$$A = A_2 + 1 - ((1-A_1) \times (1-A_1))$$

where:

A1 = availability of nonredundant device or system

A2 = availability of device or system provided with an automatically switched backup device or system

- G. Abbreviations: Specification abbreviations include the following:

A	-	Availability
ADC	-	Analog to Digital Converter
AI	-	Analog Input
AO	-	Analog Output
AVAIL	-	Available
BCD	-	Binary Coded Decimal
CSMA/CD	-	Carrier Sense Multiple Access/Collision Detect
CPU	-	Central Processing Unit
CRC	-	Cyclic Redundancy Check
CRT	-	Cathode Ray Tube
CS	-	Control Strategy
DAC	-	Digital to Analog Converter
DBMS	-	Data Base Management System
DI	-	Discrete Input

DMA	-	Direct Memory Access
DO	-	Discrete Output
DPDT	-	Double Pole, Double Throw
DVE	-	Digital to Video Electronics
EPROM	-	Erasable, Programmable Read Only Memory
FDM	-	Frequency Division Multiplexing
FSK	-	Frequency Shift Keyed
HMI	-	Human Machine Interface (Software)
I/O	-	Input/Output
LAN	-	Local Area Network
LDFW	-	Lead-Follow
MCC	-	Motor Control Center
MTBF	-	Mean Time Between Failures
MTTR	-	Mean Time To Repair
OS	-	Operating System
PCB	-	Printed Circuit Board
PID	-	Proportional Integral and Derivative Control
PLC	-	Programmable Logic Controller
PROM	-	Programmable Read Only Memory
RAM	-	Random Access Memory
RDY	-	Ready
RMSS	-	Root Mean Square Summation
RNG	-	Running
ROM	-	Read Only Memory
RTU	-	Remote Telemetry Unit
SPDT	-	Single Pole, Double Throw
ST/SP	-	Start/Stop
TDM	-	Time Division Multiplexing
UPS	-	Uninterruptible Power Supply

- H. To minimize the number of characters in words used in textual descriptions on CRT displays, printouts and nameplates, abbreviations may be used subject to the Engineer's approval. If a specified abbreviation does not exist for a particular word, an abbreviation may be generated using the principles of masking and or vowel deletion. Masking involves retaining the first and last letters in a word and deleting one or more characters (usually vowels) from the interior of the word.

1.06 ENVIRONMENTAL CONDITIONS

- A. Instrumentation equipment and enclosures shall be suitable for ambient conditions specified. All system elements shall operate properly in the presence of telephone lines, power lines, and electrical equipment.
- B. Inside control rooms and climate-controlled electrical rooms, the temperature will normally be 20 to 25 degrees C; relative humidity 40 to 80 percent without condensation and the air will be essentially free of corrosive contaminants and moisture. Appropriate air filtering shall be provided to meet environmental conditions (i.e., for dust).
- C. Other indoor areas may not be air conditioned/heated; temperatures may range between 0 and 40 degrees C with relative humidity between 40 and 95 percent.
- D. Field equipment including instrumentation and panels may be subjected to wind, rain, lightning, and corrosives in the environment, with ambient temperatures from -20 to 40 degrees C and relative humidity from 10 to 100 percent. All supports, brackets and interconnecting hardware shall be aluminum or 316 stainless steel as shown on the installation detail drawings.

PART 2 -- PRODUCTS

2.01 NAMEPLATES

- A. All items of equipment listed in the instrument schedule, control panels, and all items of digital hardware shall be identified with nameplates. Each nameplate shall be located so that it is readable from the normal observation position and is clearly associated with the device or devices it identifies. Nameplates shall be positioned so that removal of the device for maintenance and repair shall not disturb the nameplate. Nameplates shall include the equipment identification number and description. Abbreviations of the description shall be subject to the Engineer's approval.
- B. Nameplates shall be made of 1/16-inch thick machine engraved laminated phenolic plastic having white numbers and letters not less than 3/16-inch high on a black background.
- C. Nameplates shall be attached to metal equipment by stainless steel screws and to other surfaces by an epoxy-based adhesive that is resistant to oil and moisture. In cases where the label cannot be attached by the above methods, it shall be drilled and attached to the associated device by means of stainless steel wire.

PART 3 -- EXECUTION

3.01 SCHEDULE OF PAYMENT

- A. Payment to the Contractor for Control and Information System materials, equipment, and labor shall be in accordance with the General and Supplementary Conditions. The schedule of values submitted as required by the General and Supplementary Conditions shall reflect a breakdown of the work required for completion of the Control and Information System. The breakdown shall include sufficient detail to permit the Engineer to administer

payment for the Control and Information System as outlined below.

- B. The following payment schedule defines project milestones that will be used for establishing maximum partial payment amounts for the Control and Information System. Payment for field instruments, field wiring, fiber optic network cable and similar items will be made in addition to the payment for the scopes of services incorporated into the schedule below.

<u>Task Completed</u>	<u>Maximum Cumulative % Request for Payment</u>
Mobilization	3%
Preliminary Design Review	5%
Approved Submittals	20%
Hardware Purchase (excludes field instruments)	40%
Factory Acceptance Test	60%
Loop Checkout	70%
Control System Start-up and Test	80%
Plant Start-up	90%
Final System Acceptance Test	95%
Final Acceptance	100%

- C. Requests for payment for materials and equipment that are not installed on site, but are required for system construction and the factory acceptance test (e.g., digital hardware), or are properly stored as described in the General and Supplementary Conditions and herein, shall be accompanied by invoices from the original supplier to the instrumentation subcontractor substantiating the cost of the materials or equipment.
- D. Any balance remaining within the schedule of values for field instruments and other materials installed on the site, or for other materials for which payment is made by invoice, will be considered due upon completion of the Final Acceptance test.

3.02 CLEANING

- A. The Contractor shall thoroughly clean all soiled surfaces of installed equipment and materials.
- B. Upon completion of the instrumentation and control work, the Contractor shall remove all surplus materials, rubbish, and debris that has accumulated during the construction work. The entire area shall be left neat, clean, and acceptable to the Owner.

3.03 FINAL ACCEPTANCE

- A. Final acceptance of the Instrumentation, Control and Information System will be determined complete by the Engineer, and shall be based upon the following:
1. Receipt of acceptable start up completion and availability reports and other documentation as required by the Contract Documents.

2. Completion of the Availability Demonstration
 3. Completion of all punch-list items that are significant in the opinion of the Engineer.
- B. Final acceptance of the System shall mark the beginning of the extended warranty period.

- END OF SECTION -

SECTION 17030

CONTROL AND INFORMATION SYSTEM SUBMITTALS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall submit for review complete Shop Drawings for all equipment in accordance with the General Conditions and Division 1 of the Specifications. All submittal material shall be complete, legible, and reproducible, and shall apply specifically to this project.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01300 – Submittals
- B. Section 17000 – Control and Information System Scope and General Requirements

1.03 DIGITAL HARDWARE SUBMITTALS

- A. Submit system block diagram(s) showing:
 - 1. All equipment to be provided.
 - 2. All interconnecting cable.
 - 3. Equipment names, manufacturer, and model numbers.
 - 4. Equipment locations.
- B. Submit information for all digital equipment including, but not limited to, the following:
 - 1. Bill of materials with equipment names, manufacturers, complete model numbers and locations.
 - 2. Catalog cuts.
 - 3. Complete technical, material and environmental specifications.
 - 4. Assembly drawings.
 - 5. Mounting requirements.
 - 6. Color samples.
 - 7. Nameplates.
 - 8. Environmental requirements during storage and operation.

1.04 SOFTWARE SUBMITTALS

A. Software submittals shall include the following as a minimum:

1. Bill of materials with software names, vendors, and complete listings of included software modules.
2. Standard manufacturer's literature describing the products.
3. Description of function of software in Control and Information System.
4. Limitations or constraints of software.
5. Minimum system (processor and memory) requirements.
6. Operation and maintenance requirements.

B. Submit information on the following software:

1. Third-party software, including:
 - a. Operating system.
 - b. Operator workstation (SCADA or HMI) software, including all add-in software provided to perform specific functions (alarm dialers, schedulers, backup creation software, etc.).
 - c. Control software (block oriented and/or ladder logic).
 - d. Office-type products, such as spreadsheets, word processors, etc.
 - e. Database management software.
 - f. Communications software, including all applicable local and wide area network software.
 - g. Programmable logic controller programming software (where applicable).
2. Software configuration, including:
 - a. Graphic display organization.
 - b. Database configuration for operator workstations and database management system.
 - c. Trends.
 - d. System security.

- e. Formats for all reports, including all required calculations.
- f. Intercommunications between software products required to implement system functions.
- g. Equipment backup configuration and requirements.

C. Control Strategies

1. Provide control strategy documentation that includes control strategy diagrams (either block oriented logic or ladder logic diagrams, as appropriate) to describe the control of all processes. The written description shall follow the format of the functional control descriptions contained herein. The control strategy submittals shall contain the following as a minimum:
 - a. An overall description of the program structure and how it will meet the specified control requirements.
 - b. A listing of the program.
 - c. Extensive comments in the listings to describe program steps.
 - d. Equation and ladder program derivations for all specified control routines.
 - e. Resource (processor and memory) requirements.
 - f. A listing of inputs and outputs to the control strategy.

D. Application Software

1. Provide application software documentation that contains program descriptions for the operation, modification, and maintenance of all application programs provided for the digital system.
2. Application software includes all custom routines developed specifically for this project, or pre-written routines used for accomplishing specified functions for this project. This shall include VBASIC and C programs, and any other add-in custom software.

E. Graphic Displays

1. Submit all graphic displays required to perform the control and operator interface functions specified herein.
2. Submit graphic displays for review by the Owner and the Engineer at least 60 days prior to commencement of factory testing.
3. The Contractor shall allow for one major cycle of revisions to the displays prior to factory testing and one minor cycle of revisions following factory test. A cycle of revisions shall be defined as all revisions necessary to complete a single set of changes marked by the Engineer. Additional corrections shall be performed during

start-up as required to accommodate changes required by actual field conditions, at no additional cost to the Owner.

4. Two of the required submittals in each revision cycle shall be full color prints of the entire set of displays. Additional sets may be in black-and-white or gray-scale.
5. Displays shall be printouts of actual process graphics implemented in the system.

1.05 CONTROL PANEL SUBMITTALS

A. Submittals shall be provided for all control panels, and shall include:

1. Exterior panel drawings with front and side views, to scale.
2. Interior layout drawings showing the locations and sizes of all equipment and wiring mounted within the cabinet, to scale.
3. Panel area reserved for cable access and conduit entry.
4. Location plans showing each panel in its assigned location.

B. Submit information for all exterior and interior panel mounted equipment including, but not limited to, the following:

1. Bill of materials with equipment names, manufacturers, complete model numbers and locations.
2. Catalog cuts.
3. Complete technical, material and environmental specifications.
4. Assembly drawings.
5. Mounting requirements.
6. Color samples.
7. Nameplates.
8. Environmental requirements during storage and operation.

C. Submit panel wiring diagrams showing power, signal, and control wiring, including surge protection, relays, courtesy receptacles, lighting, wire size and color coding, etc.

1.06 INSTRUMENT SUBMITTALS

A. Submit information on all field instruments, including but not limited to the following:

1. Product (item) name and tag number used herein and on the Contract Drawings.
2. Catalog cuts.

3. Manufacturer's complete model number.
4. Location of the device.
5. Input - output characteristics.
6. Range, size, and graduations.
7. Physical size with dimensions, NEMA enclosure classification and mounting details.
8. Materials of construction of all enclosures, wetted parts and major components.
9. Instrument or control device sizing calculations where applicable.
10. Certified calibration data on all flow metering devices.
11. Environmental requirements during storage and operation.
12. Associated surge protection devices.

1.07 WIRING AND LOOP DIAGRAMS

- A. Submit interconnection wiring and loop diagrams for all panels and signals in the Control and Information System.
- B. Electrical interconnection diagrams shall show all terminations of equipment, including terminations to equipment and controls furnished under other Divisions, complete with equipment and cable designations. Where applicable, interconnection wiring diagrams shall be organized by input/output card. Interconnecting diagrams shall be prepared in a neat and legible manner on 11 X 17-inch reproducible prints.
- C. Loop drawings shall conform to the latest version of ISA Standards and Recommended Practices for Instrumentation and Control. Loop Drawings shall conform to ISA S5.4, Figures 1-3, Minimum Required Items Figures 4-6, Minimum Required Items plus Optional Items.

1.08 PROCESS AND INSTRUMENTATION DIAGRAMS

- A. Submit Process and Instrumentation Diagrams showing all instrumentation and control equipment, and all monitoring and control functions, for the entire Control and Information System as specified herein.
- B. Process and Instrumentation Diagrams shall conform to ISA S5.1 and S5.3, and all applicable ISA standards for symbology, nomenclature, and layout.

1.09 OPERATION AND MAINTENANCE MANUALS

- A. The Contractor shall deliver equipment operation and maintenance manuals in compliance with Section 01300 - Submittals. Operation and maintenance (O&M) manuals shall consist of two basic parts:

1. Manufacturer standard O&M manuals for all equipment and software furnished under this Division.
 2. Custom O&M information describing the specific configuration of equipment and software, and the operation and maintenance requirements for this particular project.
- B. The manuals shall contain all illustrations, detailed drawings, wiring diagrams, and instructions necessary for installing, operating, and maintaining the equipment. The illustrated parts shall be numbered for identification. All modifications to manufacturer standard equipment and/or components shall be clearly identified and shown on the drawings and schematics. All information contained therein shall apply specifically to the equipment furnished and shall only include instructions that are applicable. All such illustrations shall be incorporated within the printing of the page to form a durable and permanent reference book.
- C. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance personnel unfamiliar with such equipment. The maintenance instructions shall include trouble shooting data and full preventive maintenance schedules. The instructions shall be bound in locking 3-D-ring binders with bindings no larger than 3.5 inches. The manuals shall include 15% spare space for the addition of future material. The instructions shall include drawings reduced or folded and shall provide the following as a minimum.
1. A comprehensive index.
 2. A functional description of the entire system, with references to drawings and instructions.
 3. A complete "as-built" set of all approved shop drawings, which shall reflect all work required to achieve final system acceptance.
 4. A complete list of the equipment supplied, including serial numbers, ranges, and pertinent data.
 5. Full specifications on each item.
 6. Detailed service, maintenance, and operation instructions for each item supplied.
 7. Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.
 8. Complete parts lists with stock numbers and name, address, and telephone number of the local supplier.
 9. References to manufacturers' standard literature where applicable.
 10. Warning notes shall be located throughout the manual where such notes are required to prevent accidents or inadvertent misuse of equipment.

- D. The operating instructions shall clearly describe the step-by-step procedures that must be followed to implement all phases of all operating modes. The instructions shall be in terms understandable and usable by operating personnel and maintenance crews and shall be useful in the training of such personnel.
- E. The maintenance instructions shall describe the detailed preventive and corrective procedures required, including environmental requirements during equipment storage and system operation, to keep the System in good operating condition. All hardware maintenance documentation shall make reference to appropriate diagnostics, where applicable, and all necessary wiring diagrams, component drawings and PCB schematic drawings shall be included.
- F. The hardware maintenance documentation shall include, as a minimum, the following information:
 - 1. Operation Information - This information shall include a detailed description of how the equipment operates and a block diagram illustrating each major assembly in the equipment.
 - 2. Preventive-Maintenance Instructions - These instructions shall include all applicable visual examinations, hardware testing and diagnostic routines, and the adjustments necessary for periodic preventive maintenance of the System.
 - 3. Corrective-Maintenance Instructions - These instructions shall include guides for locating malfunctions down to the card-replacement level. These guides shall include adequate details for quickly and efficiently locating the cause of an equipment malfunction and shall state the probable source(s) of trouble, the symptoms, probable cause, and instructions for remedying the malfunction.
 - 4. Parts Information - This information shall include the identification of each replaceable or field-repairable component. All parts shall be identified on a list in a drawing; the identification shall be of a level of detail sufficient for procuring any repairable or replaceable part. Cross-references between equipment numbers and manufacturer's part numbers shall be provided.
- G. Software documentation shall conform to a standard format and shall include, but not be limited to, the following:
 - 1. A program abstract that includes:
 - a. Program Name - The symbolic alphanumeric program name.
 - b. Program Title - English text identification.
 - c. Program Synopsis - A brief text shall be provided that specifies the need for the program, states when it shall be used and functionally describes all inputs, outputs and functions performed. This descriptive text shall be written in a language that is understandable by nonsoftware oriented readers.
 - 2. A program description that shall include, but not be limited to, the following:

- a. Applicable Documents - List all documents (standard manufacturer's literature, other program descriptions, etc.) by section, if practical, that apply to the program. One complete copy of all applicable reference material shall be provided.
- b. Input-Output - Identify each input and output parameter, variable, and software element used by the program. State the purpose of all inputs, outputs, and variables.
- c. Processing - This section shall contain a description of the overall structure and function of the program. Describe the program run stream and present a detailed description of how the program operates. Describe the timing and sequencing of operations of the program relative to other programs. Describe all interactions with other programs. Processing logic that is not readily described without considerable background information shall be handled as a special topic with references to an appendix or to control strategy document that details the necessary information. Reference shall also be made to an appendix or control strategy document for equation and program algorithm derivations.
- d. System Configuration - Describe in detail the system configuration or status required for program implementation, if appropriate.
- e. Limitation and Constraints - Summarize all known or anticipated limitations of the program, if appropriate.
- f. Storage - Define program storage requirements in terms of disk or RAM memory allocation.
- g. Verification - Describe, as a minimum, a test that can be used by the operator to assure proper program operation. Define the required system configuration, input requirements and criteria for successful test completion.
- h. Diagnostics - Describe all program diagnostics, where applicable. Descriptions shall list each error statement, indicate clearly what it means, and specify what appropriate actions should be taken.
- i. Malfunction Procedures - Specify procedures to follow for recovering from a malfunction due to either operator error or other sources.

1.10 FINAL SYSTEM DOCUMENTATION

- A. All documentation shall be delivered to the Owner prior to final system acceptance in accordance with the Contract Documents. As a minimum, final documentation shall contain all information originally part of the control system submittals.
- B. If any documentation or other technical information submitted is considered proprietary, such information shall be designated. Documentation or technical information which is designated as being proprietary will be used only for the construction, operation, or

maintenance of the System and, to the extent permitted by law, will not be published or otherwise disclosed.

- C. Provide a complete set of detailed electrical interconnection diagrams required to define the complete instrumentation and control system. All diagrams shall be 11 X 17-inch original reproducible prints. All diagrams shall be corrected so as to describe final "as-built" hardware configurations and to reflect the system configuration and control methodology adopted to achieve final system acceptance.
- D. Provide system software documentation for the operation and maintenance of all system software programs provided as a part of the digital system. All system software documentation shall be amended as required to delineate all modifications and to accurately reflect the final as-built software configurations.
- E. Provide application software documentation that contains program descriptions for the operation, modification, and maintenance of all application programs provided for the digital system.
- F. Provide control strategy documentation which shall include control strategy (block oriented or ladder logic) diagrams to describe the control of all processes. Control strategy documentation shall reflect the system configuration and control methodology adopted to achieve final system acceptance. Control strategy documentation shall conform to the submittal requirements listed hereinabove.
- G. O&M documentation shall be amended with all final, adjusted values for all setpoints and other operating parameters for Owner reference.
- H. The Owner recognizes the fact that not all possible problems related to real-time events, software interlocks, flags, active tasks, and hardware maintenance and utilization can be discovered during the Acceptance Tests. Therefore, the instrumentation subcontractor through the Contractor shall investigate, diagnose, repair, update, and distribute all pertaining documentation of the deficiencies that become evident during the warranty period. All such documentation shall be submitted in writing to the Owner within 30 days of identifying and solving the problem.

1.11 PROGRAMS AND SOURCE LISTINGS

- A. Provide two copies of all standard, off-the-shelf system and application software (exclusive of firmware resident software) on tape or disk. One copy shall be the original tapes or disks from the manufacturer, with one additional copy for backup purposes.
- B. Provide two copies of source listings on tape or disk for all custom software written specifically for this facility, all database files configured for this facility, and all control strategies. All source listings shall include a program abstract, program linkage and input/output data. Comments describing the program flow shall be frequently interspersed throughout each listing.

1.12 SUBMITTAL/DOCUMENTATION FORMAT

- A. All drawing-type submittals and documentation shall be rendered and submitted in the latest version of AutoCAD.

- B. All textual-type submittals and documentation shall be rendered and submitted in the latest version of Microsoft Word.

1.13 ELECTRONIC O&M MANUALS

- A. Subject to acceptance by the Owner and Engineer, the O&M information may be submitted in part or in whole in an electronic format on optical media.
- B. Electronic O&M manuals shall contain information in standard formats (Adobe, Word, AutoCAD, HTML, etc.) and shall be easily accessible through the use of standard, “off-the-shelf” software such as an Internet browser.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 17040

CONTROL AND INFORMATION SYSTEM TRAINING REQUIREMENTS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. To familiarize the Owner's personnel with the process control system and field instrumentation, training shall be provided as detailed hereunder.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements

1.03 SUBMITTALS

- A. A minimum of 60 days prior to beginning training, submit a detailed training plan describing the following:

1. A listing of all courses to be conducted.
2. Course content.
3. Applicability of each course to management, operations, maintenance, laboratory, etc., personnel.
4. Course schedules.
5. Qualifications and experience of individual(s) providing training.

- B. A minimum of 14 days prior to beginning each training course, submit documentation for use by the Owner's personnel during training. The training documentation shall be specific to the particular course, and shall include the following:

1. A listing of all subjects to be covered.
2. Course schedule.
3. Documentation/lesson plans covering all subjects to be covered during the course instruction. Information shall be in a "how to" format, with sufficient background documentation and references to manufacturer literature to provide a thorough and clear understanding of the materials to be covered.

1.04 GENERAL REQUIREMENTS

- A. All costs of providing the training courses shall be borne by the Contractor.

- B. As used herein, the term "day" shall mean an eight-hour day, and the term "week" shall mean a five-day, 40-hour week.
- C. All training courses shall be conducted under the direction of a training director who shall design a detailed training plan that complements the experience and skill levels of the Owner's personnel.
- D. Training courses shall be structured in order of increasing capability or security levels. The purpose of this requirement is to allow personnel with lesser training requirements or security password levels to drop out of the training at certain times while the training continues for personnel with greater requirements or higher security levels.
- E. All training courses shall include lecture as well as "hands on" experience for each of the attending personnel. The Contractor shall provide sufficient equipment for this to be accomplished. For example, training in which the instructor uses the computer and the Owner's personnel passively observe as the instructor demonstrates system functions shall not be acceptable.
- F. Unless otherwise specified, all training courses shall be conducted in the Owner's facilities.
- G. All training shall be completed prior to system acceptance.
- H. Standard manufacturer training courses are acceptable pending approval by the Engineer and Owner.

1.05 SYSTEM SUPERVISOR/ENGINEER TRAINING

- A. Provide manufacturer standard training in the use and configuration of the specified operator workstation (SCADA) software.
- B. System supervisor/engineer training shall be performed a minimum of 30 days prior to system startup. Total training duration shall be a minimum of five days.
- C. Training shall be provided in the following subjects:
 - 1. System overview and capabilities.
 - 2. Database configuration.
 - 3. Graphic display configuration, including linking of data to displays.
 - 4. Historical data configuration (collection, manipulation, and display).
 - 5. Real-time and historical trending.
 - 6. Report configuration, generation, printing, and customization.
 - 7. Alarm configuration and management.
 - 8. System security.

9. I/O driver use and configuration.
10. System backup and recovery.
11. DDE linking, where applicable.
12. System command language.
13. Troubleshooting.
14. System optimization.
15. System startup and shutdown procedures.
16. LAN and WAN communications, as appropriate.

D. The course shall be structured as follows:

1. Fundamentals - One four-day course (minimum) shall be provided for up to eight persons which shall serve as a digital control system familiarization course for project management personnel, engineers, and key operating/maintenance personnel. This course shall be a prerequisite for the advanced course described below in Item 2.
2. Advanced - One four-day (minimum) digital system configuration and operating course shall be provided for up to four persons. The level of training shall be sufficient to familiarize the Owner's personnel with the configuration and application of all system programs. All essential system operating procedures shall be described as required to enable the Owner's personnel to operate the system via the various workstations and local control panels.
3. Historical – One two-day course to instruct a minimum of four persons in the use and configuration of the historical data archival system. Training shall include creation, viewing, and printing of trends, charts, and reports. Training shall include all database maintenance and archival functions necessary to maintain the facility's data on both short and long term basis, including periodic archival to optical media.

1.06 OPERATOR TRAINING

- A. Two two-week courses comprised of daily half-day (four-hour) sessions for up to ten persons each shall be conducted to provide instruction in the use of the Control and Information System to monitor and control the facility.
- B. Operator training shall include familiarization training covering the Control and Information System. Operators shall be instructed in the names, locations, functions, and basic operation of all items of digital equipment and associated software.
- C. Operator training shall cover process and equipment operation both individually and collectively as an operating system. Normal as well as abnormal operating conditions shall be covered, including the response to failure occurrences and system alarms. All operator/system interactions shall be described.

- D. Operators shall be trained to instruct other operators and shall be provided with all course materials.

1.07 MAINTENANCE TRAINING

- A. A three-day course shall be conducted for at least six persons prior to the start-up of digital equipment at the Owner's plant. Instruction shall be provided in the following:
 - 1. Operating all digital equipment, including system start-up and shutdown procedures.
 - 2. The use of hardware diagnostic routines, test equipment and test procedures as required to enable the Owner's personnel to detect and isolate system faults to the circuit board or module level and to implement repairs by replacing failed circuit boards or modules.
 - 3. Calibration and routine maintenance procedures for all analog and digital equipment.
- B. Step by step written procedures shall be provided for all preventive maintenance tasks and for identifying hardware faults to the circuit board or module level for all items of digital equipment.
- C. All digital equipment preventive and corrective maintenance training activities shall be limited to the use of commercially available off-the-shelf test equipment and to the use of diagnostic routines and hardware items which are the same as those to be provided as part of the system.

1.08 INSTRUMENT TRAINING

- A. A three-day course shall be provided at the Owner's facilities no more than three months prior to system start-up to instruct a minimum of five persons each in the calibration and preventive maintenance of the field instruments provided under this Contract.

1.09 PLC TRAINING

- A. One three-day manufacturer standard training course shall be provided in the programming and use of PLC's to implement monitoring and control functions such as those provided for this project. Training shall cover all aspects of the PLC hardware and software, including specified programming software.
- B. One three-day course of specific training shall be provided by the instrumentation subcontractor in the use and modification of all control strategies provided under this Division.

1.10 GENERAL REFRESHER TRAINING

- A. A one-week general refresher training course shall be provided for up to ten persons 3-6 months after final system acceptance. Instruction shall be given in all aspects of the complete instrumentation and control system. Instructor(s) shall be capable of answering questions related to all aspects and details of the complete system.

1.11 PROPOSED TRAINING AGREEMENT

- A. The instrumentation subcontractor shall submit a proposed training agreement to extend the training services described above for a period of up to five years from the expiration of the guarantee period. The proposed agreement shall include provisions for payment on a cost plus expenses basis and re-negotiation of contract prices based upon changes in recognized economic indicators published by the United States Department of Commerce.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 17050

TOOLS, SUPPLIES AND SPARE PARTS - GENERAL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall provide tools, supplies, and spare parts as specified herein for the operation and maintenance of the Control and Information System.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01300 – Submittals
- B. Section 17000 – Control and Information System Scope and General Requirements

PART 2 -- PRODUCTS

2.01 TOOLS

- A. Provide special tools, other than those normally found in an electronic technician's tool box, required to test, diagnose, calibrate, install, wire, connect, disconnect, assemble and disassemble any digital equipment, instrument, panel, rack, cabinet or console mounted equipment for service and maintenance. This shall include, but not be limited to, the following: connector pin insertion and removal tools, wire crimping tools, special wrenches, special instrument calibrators, indicator lamp insertion and removal tools, etc.
- B. Provide tools and test equipment together with items such as instruction manuals, carrying/storage cases, unit battery charger where applicable, special tools, calibration fixtures, cord extenders, patch cords and test leads, which are not specified but are necessary for checking field operation of equipment supplied under this Division.
- C. One (1) Portable graphical multimeter with rechargeable battery, test leads, industrial lead set, and carrying case, Fluke Model 863, Simpson, or equal.
- D. Furnish one portable 4-20 mA, 24 VDC analog loop signal generator for calibration and testing of analog signal loops. Generator shall be furnished with rechargeable battery pack, test leads, spare battery pack, charger, carrying case and accessories.
- E. Furnish one portable calibrator capable of measuring DC volts, mV, mA, ohms, frequency, T/C, peak detect and trip detect on its input and simultaneously generate on its output all of the preceding signals plus two-wire simulation, ramp functions, up/down stepping and 10 point programmability. The calibrator shall be furnished complete with 24 VDC integral battery pack, spare battery pack, test leads, external charger, fuse pack, carrying case and appurtenances. It shall be possible to store and use automatic instrument calibration procedures that are downloaded from a Windows-based instrument management software.

Calibrator shall be Rochester Instrument Systems AccuPro Diamond CL-9002 with Total IQ instrument management software, or equal.

- F. A complete computer technician kit in an injection molded or high density polyethylene case. The kit shall be Model JTK-2000 Deluxe Computer Technician Kit by Jensen Tool of Phoenix, AZ, or a computer technician kit of equivalent equipment and value.

2.02 SUPPLIES

- A. The Contractor shall provide supplies as needed or as required by the Owner during the specified warranty period. Supplies include items such as printer paper, fuses, ink, ribbon, etc.

2.03 SPARE PARTS

- A. Provide spare parts for items of control and instrumentation equipment as recommended by the manufacturer and in accordance with the Contract Documents.
- B. Furnish all spares in moisture-proof boxes designed to provide ample protection for their contents. Label all boxes to clearly identify contents and purpose.
- C. The Contractor shall replace all spare parts consumed during installation, testing, start-up, the system availability demonstration, and the guarantee period.
- D. Refer to individual digital hardware and instrument sections for additional requirements specific to those devices.

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 17060

SIGNAL COORDINATION REQUIREMENTS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall conform to the signal coordination requirements specified herein.
- B. The Contractor shall be responsible for coordinating signal types and transmission requirements between the various parties providing equipment under this Contract. This shall include, but not be limited to, distribution of appropriate shop drawings among the equipment suppliers and subcontractors.
- C. Analog signals shall be signals for transmitting process variables, etc. from instruments and to and from panels, equipment PLC's and Control System PLC's.
- D. Discrete signals shall consist of contact closures or powered signals for transmitting status/alarm information and control commands between starters, panels, equipment PLC's, the Control System, etc.

1.02 ANALOG SIGNAL TRANSMISSION

- A. Signal transmission between electric or electronic instruments, controllers, and all equipment and control devices shall be individually isolated, linear 4-20 milliamperes and shall operate at 24 volts D.C.
- B. Signal output from all transmitters and controllers shall be current regulated and shall not be affected by changes in load resistance within the unit's rating.
- C. All cable shields shall be grounded at one end only, at the control panel, with terminals bonded to the panel ground bus.
- D. Analog signal isolation and/or conversion shall be provided where necessary to interface with instrumentation, equipment controls, panels, and appurtenances.
- E. Non-standard transmission systems such as pulse duration, pulse rate, and voltage regulated shall not be permitted except where specifically noted in the Contract Documents. Where transmitters with nonstandard outputs do occur, their outputs shall be converted to an isolated, linear, 4-20 milliampere signal.
- F. The Contractor shall provide 24 V power supplies for analog signals and instruments where applicable and as required inside panels, controls, etc.
- G. Where two-wire instruments transmit directly to the Control and Information System, the instrumentation subcontractor shall provide power supplies at the PLC-equipped control panels for those instruments.

- H. Where four-wire instruments with on-board loop power supplies transmit directly to the Control and Information System, the instrumentation subcontractor shall provide necessary signal isolators or shall otherwise isolate the input from the Control and Information System loop power supply. Similar provisions shall be made when a third element such as a recorder, indicator, or single loop controller with integral loop power supply is included in the loop.

1.03 DISCRETE INPUTS

- A. All discrete inputs to equipment and Control and Information System PLC's, from field devices, starters, panels, etc., shall be unpowered (dry) contacts in the field device or equipment, powered from the PLC's, unless specified otherwise.
- B. Sensing power (wetting voltage) supplied by the PLC shall be 24 VDC or 120 VAC.

1.04 DISCRETE OUTPUTS

- A. All discrete outputs from local control panels and Control and Information System PLC's to field devices, starters, panels, etc., shall be 24 VDC powered (sourced) from PLC's dry contact relay outputs.
- B. PLC powered discrete outputs shall energize 24 VDC pilot relay coils in the field devices, starters, panels, etc. which in turn open or close contacts in the associated control circuit. The 24 VDC relay coil, contacts, and associated control circuitry shall be furnished integral with the field device, starter, panel, etc. by the supplier and contractor furnishing the field device, starter, or panel.
- C. Where required or specified herein, discrete outputs from equipment and Control and Information System PLC's to field devices, starters, panels, motor operated valves, etc., shall be dry contact or relay outputs.
- D. Outputs to solenoid valves shall be 120 VAC, powered from the PLC or control panel unless specified or shown otherwise.

1.05 OTHER DISCRETE SIGNALS

- A. Discrete signals between starters, panels, etc. where no 24 VDC power supply is available may be 120 VAC, as long as such contacts are clearly identified in the starter, panel, etc. as being powered from a different power supply than other starter/panel components.
- B. Where applicable, warning signs shall be affixed inside the starter, panel, etc. stating that the panel is energized from multiple sources.
- C. Output contacts in the starter, panel, etc., that are powered from other locations shall be provided with special tags and/or color-coding. Disconnecting terminal strips shall be provided for such contacts.
- D. The above requirements shall apply to all starters and panels, regardless of supplier.

PART 2 -- PRODUCTS

2.01 PILOT RELAYS

- A. Pilot relays shall be supplied with the following:
 - 1. 24 VDC coils.
 - 2. At a minimum, DPDT contacts rated at 5 A, 120 VAC or 28 VDC.
 - 3. Socket of different configuration from 120 VAC relays.
 - 4. Clips for attachment to sockets.
 - 5. Indicator lights that glow when the relay coil is powered.
- B. Pilot relays shall be as manufactured by Square D, Allen Bradley, Potter & Brumfield, or equal.

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 17070

CONTROL AND INFORMATION SYSTEM TESTING - GENERAL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall test the Control and Information System as specified herein to demonstrate compliance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17071 – Factory Acceptance Test
- C. Section 17072 – Field Testing
- D. Section 17073 – Final Acceptance Test

1.03 SUBMITTALS

- A. For each of the specified tests, submit a test plan to the Engineer at least one month in advance of commencement of the tests. The test plan shall contain the following at a minimum:
 - 1. A schedule of all testing to be conducted.
 - 2. A brief description of the testing to be performed
 - 3. Test objectives.
 - 4. Testing criteria per the Specifications.
 - 5. Check lists and procedures for performing each of the specified tests.
 - 6. Sample test result documentation.
 - 7. Requirements for other parties.

1.04 GENERAL REQUIREMENTS

- A. All system start-up and test activities shall follow detailed test procedures; check lists, etc., previously approved by the Engineer. The Engineer shall be notified at least 21 days in advance of any system tests and reserves the right to have his and/or the Owner's representatives in attendance.

- B. The Contractor shall provide the services of experienced factory trained technicians, tools and equipment to field calibrate, test, inspect, and adjust all equipment in accordance with manufacturer's specifications and instructions.
- C. The Contractor (or designee) shall maintain master logbooks for each phase of installation, startup and testing activities specified herein. Each logbook shall include signal, loop or control strategy tag number, equipment identification, description and space for sign-off dates, Contractor signature and Engineer signature. Example test documentation specific to each phase of testing shall be approved prior to initiation of that testing, as specified hereinabove.
- D. All test data shall be recorded on test forms, previously approved by the Engineer. When each test has been successfully completed, a certified copy of all test results shall be furnished to the Engineer together with a clear and unequivocal statement that all specified test requirements have been met and that the system is operating in accordance with the Contract Documents.
- E. The Engineer will review test documentation in accordance with the Contract Documents and will give written notice of the acceptability of the tests within 10 days of receipt of the test results.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 17071

FACTORY ACCEPTANCE TEST

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall perform a Factory Acceptance Test on the Control and Information System as specified herein to demonstrate compliance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17070 – Control and Information System Testing, General
- C. Section 17072 – Field Testing
- D. Section 17073 – Final Acceptance Test

1.03 FACTORY ACCEPTANCE TEST

- A. The Control and Information System equipment shall not be shipped until the Contractor receives notice of acceptability of the factory tests.
- B. Each item of equipment shall be fully factory inspected, calibrated and tested for function, operation and continuity of circuits. Exceptions shall be approved in writing by the Engineer.
- C. Each subsystem shall be fully factory tested for function and operation. As a minimum, all tests shall conform to "Hardware Testing of Digital Process Computers", recommended practice RP55.1. Instrument Society of America.
- D. System performance shall be tested using a fully integrated system, including all software and hardware. To achieve this, the entire control system, including all peripheral devices and all interconnecting cables (field instruments are not included in this requirement), shall be assembled on the factory test floor and the complete operational program loaded and simulated inputs applied.
- E. The instrumentation subcontractor shall perform a 100-hour full system test, during which the entire system shall operate continuously without failure in accordance with the requirements of the Contract Documents. If a system component fails during the test, the 100-hour test period shall be restarted after its operation is restored.
- F. The factory testing shall demonstrate all aspects of system sizing and timing including:
 - 1. Monitoring and control scan times at the PLC level.

2. Response times at the operator workstation level.
- G. The overall system shall be tested at maximum and minimum input power voltage variation. Noise shall be imposed on the lines connected to the equipment to demonstrate that the units can operate in a noisy environment.
- H. Operator Workstation Operation - This demonstration shall provide proof of system operation on an individual subsystem basis first, and then in the expected operating environment. Both normal and abnormal operating modes shall be demonstrated. Operator workstation testing shall include the following:
1. Run all manufacturer's diagnostics (CPUs, disks, CRTs, etc.), to prove reliable subsystem operation. In the case of the CPU, this shall include hardware diagnostics, as well as demonstration of the manufacturer's system software (operating system, communications, database, etc.).
 2. Demonstrate proper operation, under both normal and abnormal conditions of the operator workstation application software (SCADA, remote alarm dial-up, etc.). This shall include demonstration of system on-line diagnostics, fail-over features, reconfiguration operations, system initialization and restart, software fault tolerance, error detection and recovery, communications, and all additional features necessary to assure the successful operation of the system.
 3. Demonstrate the standard features of the system. This shall include proof of operation of the process control database generator, the display generator, data storage and retrieval functions, data acquisition and control, trending functions, and reporting functions.
 4. Demonstrate the configuration of the system to verify conformance with the Contract Documents. This shall include graphic displays and vectoring, operator interface functions, trending, reports, alarm management, security system configuration, etc.
 5. The system shall be operated with data input/output with the PLC's and associated panels to prove operation of all workstation functions.
 6. The testing in Items 3 and 4 above may be performed concurrently (i.e., the standard and configured features of the system may be demonstrated simultaneously).
- I. PLC Operation - All functions comparable to those demonstrated for the operator workstations shall be demonstrated on the PLC's. This shall include the following:
1. On-line and off-line diagnostics.
 2. For redundant units, fail-over operation and reconfiguration.
 3. System initialization and restart.
 4. Peer-to-peer communications.
 5. Non-volatility of memory.

6. Operation of the control logic shall be demonstrated as described herein.
-
- J. Process I/O Simulation - Process input/output simulation for PLC's shall be performed with a manual simulation control panel, a separate programmable logic controller, network-based simulation software, analog signal generators, and/or jumpering of discrete signals between outputs and associated inputs, or some combination of these. Alternate process I/O systems such as plug-in circuit cards or I/O test modules may be utilized subject to approval by the Engineer to provide the specified simulation functions. The simulation system shall provide analog and discrete I/O hardware devices in sufficient quantity to allow complete and thorough testing of the control strategies and functions of the system. The process I/O simulation system shall be used in several ways as follows:
 1. To provide a means of communications checkout from the operator work stations through the various levels of software in the PLC's and to the process, i.e., the simulation panel. Likewise, a discrete or analog input shall be initiated from the simulation panel and the result monitored at the workstations.
 2. Alarm response to discrete status changes or analog value limits shall be verified. Database entries or attributes such as engineering units and conversion equations shall be verified by varying analog inputs.
 3. To provide data for use at all levels of the control system at the time of system integration.
 - K. Control Strategy Testing - Provision shall be made to test all control strategies to prove the integrity of each strategy and the process control language in which it is implemented. For each control strategy, all functions shall be tested individually (where possible) and collectively to verify that the control strategy performs as described herein and as required for overall functionality within the control system.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 17072

FIELD TESTING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall perform field testing on the Control and Information System as specified herein to demonstrate compliance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17070 – Control and Information System Testing, General
- C. Section 17071 – Factory Acceptance Test
- D. Section 17073 – Final Acceptance Test

1.03 GENERAL REQUIREMENTS

- A. Control system start-up and testing shall be performed to ensure that all plant processes shall be systematically and safely placed under digital control in the following order:
 - 1. Primary elements such as transmitters and switch devices shall be calibrated and tested as specified in Sections 17600, 17700, and 17800.
 - 2. Each final control element shall be individually tested as specified hereinafter.
 - 3. Each control loop shall be tested as specified hereinafter.
 - 4. Each control strategy shall be tested under automatic digital control as specified hereinafter.
 - 5. The entire control system shall be tested for overall monitoring, control, communications, and information management functions, and demonstrated for system availability as specified hereinafter.
- B. System start-up and test activities shall include the use of water, if necessary, to establish service conditions that simulate, to the greatest extent possible, normal operating conditions in terms of applied process loads, operating ranges and environmental conditions.
- C. Each phase of testing shall be fully and successfully completed and all associated documentation submitted and approved prior to the next phase being started. Specific exceptions are allowed if written approval has been obtained in advance from the Engineer.

1.04 CONTRACTOR'S RESPONSIBILITIES

- A. The Contractor shall ensure that all mechanical equipment, equipment control panels, local control panels, field instrumentation, control system equipment and related equipment and/or systems are tested for proper installation, adjusted and calibrated on a loop-by-loop basis prior to control system startup to verify that each is ready to function as specified. Each test shall be witnessed, dated and signed off by both the Contractor (or designee) and the Engineer upon satisfactory completion.
- B. The Contractor shall be responsible for coordination of meetings with all affected trades. A meeting shall be held each morning to review the day's test schedule with all affected trades. Similarly, a meeting shall be held each evening to review the day's test results and to review or revise the next day's test schedule as appropriate.
- C. The Contractor shall ensure that the electrical subcontractor conforms with the start-up, test and sign-off procedures specified herein to assure proper function and coordination of all motor control center control and interlock circuitry and the transmission of all discrete and/or analog signals between equipment furnished by the electrical subcontractor and the control system specified herein.
- D. The Contractor shall ensure that the HVAC subcontractor conforms with the start-up, test and sign-off procedures specified herein to assure proper function of all HVAC system control and interlock circuitry and the transmission of all discrete and/or analog signals between HVAC equipment and controls and the control system specified herein.
- E. The Contractor shall coordinate with the Electrical Contractor regarding the start-up, test and sign-off procedures specified herein to assure proper function and coordination of all motor control center control and interlock circuitry and the transmission of all discrete and/or analog signals between equipment furnished by the Electrical Contractor and the control system specified herein.
- F. The Contractor shall coordinate with the HVAC Contractor regarding the start-up, test and sign-off procedures specified herein to assure proper function of all HVAC system control and interlock circuitry and the transmission of all discrete and/or analog signals between HVAC equipment and controls and the control system specified herein.

1.05 FINAL CONTROL ELEMENT TESTING

- A. The proper control of all final control elements shall be verified by tests conducted in accordance with the requirements specified herein.
- B. All modulating final control elements shall be tested for appropriate speed or position response by applying power and input demand signals, and observing the equipment for proper direction and level of reaction. Each final control element shall be tested at 0, 25, 50, 75, and 100 percent of signal input level and the results checked against specified accuracy tolerances. Final control elements, such as VFD's, that require turndown limits shall be initially set during this test.
- C. All non-modulating final control elements shall be tested for appropriate position response by applying and simulating control signals, and observing the equipment for proper reaction.

1.06 LOOP CHECKOUT

- A. Prior to control system startup and testing, each monitoring and control loop shall be tested on an individual basis from the primary element to the final element, including the operator workstation or loop controller level, for continuity and for proper operation and calibration.
- B. Signals from transducers, sensors, and transmitters shall be utilized to verify control responses. Simulated input data signals may be used subject to prior written approval by the Engineer. All modes of control shall be exercised and checked for proper operation.
- C. The accuracy of all DAC's shall be verified by manually entering engineering unit data values at the operator workstation and then reading and recording the resulting analog output data.
- D. The accuracy of all ADC's shall be verified using field inputs or by manually applying input signals at the final controller, and then reading and recording the resulting analog input data at the operator workstation.
- E. Each loop tested shall be witnessed, dated and signed off by both the Contractor (or designee) and the Engineer upon satisfactory completion.

1.07 CONTROL SYSTEM STARTUP AND TESTING

- A. Control system startup and testing shall be performed to demonstrate complete compliance with all specified functional and operational requirements. Testing activities shall include the simulation of both normal and abnormal operating conditions.
- B. All digital hardware shall be fully inspected and tested for function, operation and continuity of circuits. All diagnostic programs shall be run to verify the proper operation of all digital equipment.
- C. Final control elements and ancillary equipment shall be tested under start-up and steady-state operating conditions to verify that proper and stable control is achieved using local area control panels, motor control center circuits, and local field mounted control circuits. All hardwired control circuit interlocks and alarms shall be operational. The control to final control elements and ancillary equipment shall be tested using both manual and automatic (where provided) control circuits.
- D. Signals from transducers, sensors, and transmitters shall be utilized to verify control responses for final control elements. Simulated input data signals may be used subject to prior written approval by the Engineer.
- E. Each control strategy shall be tested to verify the proper operation of all required functions. The control system start-up and test activities shall include procedures for tuning all control loops incorporating PID control modules, and for adjusting and testing all control loops as required to verify specified performance.
- F. The control system start-up and test activities shall include running tests to prove that the Instrumentation, Control and Information System is capable of continuously, safely and reliably regulating processes, as required by the Contract, under service conditions that

simulate, to the greatest extent possible, normal plant operating ranges and environmental conditions.

- G. A witnessed functional acceptance test shall be performed to demonstrate satisfactory performance of individual monitoring and control loops and control strategies. At least one test shall be performed to verify that the control and instrumentation system is capable of simultaneously implementing all specified operations.
- H. Each loop and control strategy test shall be witnessed and signed off by both the Contractor (or designee) and the Engineer upon satisfactory completion.

1.08 FACILITY STARTUP COORDINATION

- A. Facility start-up shall comply with requirements specified in the Contract Documents and those requirements specified herein. Facility start-up shall commence after all previously described start-up and test activities have been successfully completed and shall demonstrate that the Instrumentation, Control and Information System can meet all Contract requirements with equipment operating over full operating ranges under actual operating conditions.
- B. The control system start-up period shall be coordinated with process startup activities and shall be extended as required until all plant processes are fully operational and to satisfy the Engineer that all control system Contract requirements have been fulfilled in accordance with the Contract Documents.
- C. The instrumentation subcontractor's personnel shall be resident at the facility to provide both full time (eight hours/day, five days/week) and 24 hours on call (seven days/week) support of operating and maintenance activities for the duration of the start-up period.
- D. At least one qualified control systems technician shall be provided for control system startup and test activities (at least two when loop checkout is being performed).

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 17073

FINAL ACCEPTANCE TEST

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall perform the Final Acceptance Test on the Control and Information System as specified herein to demonstrate compliance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17070 – Control and Information System Testing, General
- C. Section 17071 – Factory Acceptance Test
- D. Section 17072 – Field Testing

1.03 AVAILABILITY DEMONSTRATION AND FINAL SYSTEM ACCEPTANCE

- A. Upon completion of all control system startup activities and prior to final system acceptance, the Contractor shall demonstrate that the availability of the entire control system, including operation under conditions of digital equipment fail-over, initiated either automatically or manually, shall be not less than 99.8 percent during a 30-day availability test period. The Owner shall be given two (2) weeks notice of the starting date of the 30-day availability test.
- B. For purposes of determining availability figures, downtime of each system or portions of each system resulting from the causes specified hereunder will not be considered system failures.
 - 1. Downtime of any data highway connected device that is automatically backed-up upon failure shall not be considered a system failure provided that the downtime of the failed component does not exceed 24 hours.
 - 2. Downtime of a PLC that is not automatically backed-up shall be considered a system failure if the downtime of the failed controller exceeds one (1) hour.
 - 3. Downtime of a portion of the system resulting from failure of any field sensor shall not be considered a system failure provided that the system operates as specified under this condition.
 - 4. Downtime of the following devices shall not be considered a system failure provided the failed device is repaired within the specified time:
 - a. Floppy disc memory (three days)
 - b. Hard disc and moving head memory (one day)

- c. Workstations, excluding the floppy disc (one day)
 - d. Communications interfaces (eight hours)
 - e. Printer (three days)
 - f. Data Highway LAN (eight hours)
 - g. Magnetic tape and optical storage units (one day)
 - h. UPS Unit (one day)
- 5. Total shutdown of a single PLC resulting from a software fault shall be considered a system failure.
 - 6. An erroneous command to the process that can be specifically related to a software fault shall be considered as one (1) hour of downtime.
 - 7. The inoperability of any subsystem resulting from a software fault shall be considered a system failure.
 - 8. The failure of the same component more than one time during the 30-day test shall be considered a system failure.
- C. If the system fails the 30-day availability test, the 30-day test period shall be restarted after the failed component or software is repaired/replaced and full operation is restored.
 - D. The Contractor shall submit an availability demonstration report that shall state that all system availability requirements have been met.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 17080

QUALITY ASSURANCE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. It is the intent of these Specifications and Drawings to secure high quality in all materials, equipment and workmanship in order to facilitate operations and maintenance of the facility. The Contractor shall provide equipment and services to meet this intent.

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. All work shall be installed in accordance with the National Electric Code, National Electric Safety Code, OSHA, State, local and other applicable codes.

1.03 QUALITY ASSURANCE - GENERAL

- A. All equipment and materials shall be new and the products of reputable recognized suppliers having adequate experience in the manufacture of these particular items.
- B. For uniformity, only one manufacturer will be accepted for each type of product.
- C. All equipment shall be designed for the service intended and shall be of rugged construction, of ample strength for all stresses that may occur during fabrication, transportation, and erection as well as during continuous or intermittent operation. They shall be adequately stayed, braced and anchored and shall be installed in a neat and workmanlike manner. Appearance and safety, as well as utility, shall be given consideration in the design of details.
- D. All components and devices installed shall be standard items of industrial grade, unless otherwise noted, which shall be of sturdy and durable construction and be suitable for long, trouble-free service.
- E. Electronic equipment shall be all solid state construction, utilizing microprocessors, unless otherwise specified. Components shall be de-rated to assure dependability and long-term stability.
- F. Printed circuit boards in field mounted equipment shall be suitable for the specified environmental conditions.
- G. Alignment and adjustments shall be non-critical, stable with temperature changes or aging and accomplished with premium grade potentiometers.
- H. Components of specially selected values shall not be inserted into standard electronic assemblies in order to meet the performance requirements of this specification.

1.05 OPTIONAL EQUIPMENT

- A. Optional or substituted equipment or both requiring changes in details or dimensions required to maintain all structural, mechanical, electrical, control, operating, maintenance or design features incorporated in these Specifications and Drawings shall be made at no additional cost to the Owner. In the event that the changes are necessary, calculations and drawings showing the proposed revisions shall be submitted for approval. The Contractor shall coordinate all changes with other affected trades and contracts and pay all additional charges incurred.

1.06 GUARANTEE

- A. The instrumentation subcontractor through the Contractor shall install, maintain and guarantee the Instrumentation, Control and Information System as specified under the General Conditions and Division 1 of the Specifications. Maintenance personnel provided by the instrumentation subcontractor shall instruct the Owner's personnel in the operation, adjustment, calibration and repair of the equipment being serviced. All preventive and corrective activities shall be documented with service reports, which shall identify the equipment being serviced, state the condition of the equipment, describe all work performed and list materials used. A copy of all service reports shall be delivered to the Owner on the day the work is performed.
- B. The instrumentation subcontractor shall provide the services of factory-trained service technician(s) at least twice during the guarantee period, for the purpose of performing preventive hardware maintenance.
- C. Corrective hardware and software maintenance during the guarantee period shall be performed in accordance with the requirements of Division 1 and, in addition, shall meet the following requirements:
 - 1. Corrective hardware maintenance shall be performed by factory-trained service technician(s) specifically trained to service the digital equipment provided. Technicians possessing suitable training and experience shall be provided to perform corrective maintenance on all other equipment. The hardware service technician(s) shall be available on-site within 24 working hours after notification by the Owner.
 - 2. Corrective software maintenance shall be performed for software provided by the instrumentation subcontractor and incorporated into the system prior to the completion of system commissioning. Software service programmer(s) shall be available for consultation within four business hours and, if required, on-site within 16 business hours after notification by the Owner. Corrective software maintenance shall include the supply, installation and startup of all application software upgrades released during the guarantee period.
 - 3. Corrective hardware and software maintenance performed during the guarantee period shall be performed at no cost to the Owner.
 - 4. As used herein, the term "working hours" shall be defined as those of the treatment facility (seven days per week, 24 hours per day). The term "business hours" shall

be defined as the hours between 8:00 a.m. and 5:00 p.m., local time, Monday through Friday; excluding holidays.

5. The guarantee period shall commence upon final acceptance of the completed treatment facility in accordance with the provisions of the Contract Documents.
- D. The instrumentation subcontractor shall submit to the Owner a proposed maintenance agreement incorporating the following features:
1. Extension of preventive hardware maintenance services as described above for a period of up to five years from the expiration of the warranty period.
 2. Provisions for corrective hardware and/or software maintenance work on a will-call basis for a period of up to five years from the expiration of the warranty period. Corrective maintenance work shall be performed by properly trained personnel as described above.
- E. The proposed agreement shall include provisions for payment based upon an annual fee for preventive maintenance and cost plus expenses for corrective maintenance work. The portion dealing with corrective maintenance shall be written to include corrective maintenance caused by actions of the Owner during the warranty period and shall contain clauses for re-negotiation of contract prices based upon changes in recognized economic indicators published by the United States Department of Commerce.

1.07 SHIPPING HANDLING AND STORAGE

- A. In addition to shipping, handling and storage requirements specified elsewhere in the Contract Documents, air conditioning/heating shall be provided for storage of all field instrumentation, panels, digital equipment and ancillary devices to maintain temperatures between 20 and 25 degrees C and relative humidity 40 to 60 percent without condensation. The air shall be filtered and free of corrosive contaminants and moisture.

1.08 FABRICATION

- A. Fabrication of all equipment shall conform to the codes and standards outlined in this Section, and other portions of the Contract Documents.
- B. The Engineer may inspect the fabricated equipment at the factory before shipment to job site. The Contractor shall provide the Engineer with sufficient prior notice so that an inspection can be arranged at the factory. Inspection of the equipment at the factory by the Engineer will be made after the manufacturer has performed satisfactory checks, adjustments, tests and operations.
- C. Equipment approval at the factory only allows the equipment to be shipped to the project site. The Contractor shall provide for the proper storage, installation and satisfactory start-up and operation of the equipment to the satisfaction of the equipment manufacturer, the instrumentation subcontractor, and the Engineer.

1.09 INSTALLATION

- A. All instrumentation and control system installation work shall conform to the codes and standards outlined in this Section, and other portions of the Contract Documents.
- B. The instrumentation subcontractor shall assign a competent representative who shall provide full time coordination and supervision of all on-site instrumentation and control system construction work from commencement of construction through completion and final acceptance.
- C. All labor shall be performed by qualified craftsmen in accordance with the standards of workmanship in their profession and shall have had a minimum of three years of documented experience on similar projects.
- D. All equipment and materials shall fit properly in their installations. Any required work to correct improperly fit installations shall be performed at no additional expense to the Owner.
- E. Sufficient common-mode and differential-mode noise rejection shall be provided to insure operation of the plant process control system to meet all specification requirements. General practice shall include:
 - 1. Maintaining crossings between noisy wires and signal wires at right angles.
 - 2. Maintaining separation between noisy wires and signal wires as wide as practical.
 - 3. Grounding all signals, shields and power supplies at the process control unit or local control panel.
 - 4. Providing passive filters on signals with time constant compatible with scan intervals and overvoltage protection.
 - 5. Eliminating cable splices. All splices in instrumentation and control system signal and network cables shall be approved in advance by the Engineer.
 - 6. Providing a floating output for transmitters that have their own power sources.
- F. Separate grounding systems shall be provided for the control system AC power and DC circuits within a control system cabinet containing programmable logic controller (PLC) equipment. The AC power system ground shall be connected to the AC power ground system in the associated building. The DC ground shall be a # 6 insulated conductor routed directly from a separate copper ground bus bar in the control system cabinet to a separate DC grounding electrode outside each associated building. DC grounding electrode shall be a separate ground rod driven as specified under Section 16170. The DC ground bus bar inside the control system cabinet shall be isolated from the cabinet chassis using insulated stand-offs. The DC and AC power grounding systems shall be furnished and installed in accordance with the control system manufacturer's recommendations as well as all applicable code requirements.
- G. The case of each field instrument and control panel shall be grounded in compliance with the National Electric Code.

- H. Power wires shall be separated from parallel-running signal wires by the following minimum spacing:

<u>CIRCUIT VOLTAGE (VAC)</u>	<u>MINIMUM SPACING (IN.)</u>
120	12
240	18
480	18
2000 and above	24

- I. The Contractor shall provide all required cutting, drilling, inserts, supports, bolts, and anchors, and shall securely attach all equipment and materials to their supports. Embedded supports for equipment furnished under this Division shall be provided and installed as shown specified herein and shown on the Drawings.
- J. Following acceptance of the factory tests by the Engineer, and in accordance with the construction schedule, the Contractor shall commence installation of the digital control system hardware. Digital system equipment items shall not be installed, however, until all architectural, mechanical, HVAC and electrical work has been completed in the equipment rooms, MCC's, control rooms and all structural and/or mechanical work has been completed within 50 feet of equipment locations.
- K. Upon completion of the above construction work, the Contractor shall request an inspection of the above-named areas. The Engineer will issue a written approval to proceed with delivery and installation only after being satisfied that all work described above has been properly performed. Digital equipment shall remain at the factory site or storage prior to approval for delivery to the project site. Partial shipments may be required to meet construction schedule requirements.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 17100

CONTROL AND INFORMATION SYSTEM HARDWARE, GENERAL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The process control system is physically and functionally distributed between PLC equipped control panels, motor control panels, field panels, operator workstations and appurtenances.
- B. Although manual control facilities shall be provided adjacent to each final control element or in local control panels, such facilities are for testing, maintenance and local monitoring purposes only and shall not be regarded as backup to the PLC based control system.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17120 – Programmable Logic Controllers
- B. Section 17140 – Operator Workstations
- C. Section 17180 – Local Area Network
- D. Section 17185 – Data Highway Network

1.03 DIGITAL HARDWARE CONFIGURATIONS

- A. The digital hardware configuration shown on the Control System Block Diagram depicts overall system configuration requirements. System design shall be based upon this concept and shall provide an overall digital system availability of 99.8 percent under the conditions specified in Section 17073. Unless otherwise specified, designs that vary from this concept will be rejected.
- B. All discrete and analog data acquisition, pre-processing, storage and process control functions shall be performed at the PLC level. Operator workstations shall be fully independent devices, individually connected to the data highway local area network.

PART 2 -- PRODUCTS

2.01 GENERAL SYSTEM HARDWARE REQUIREMENTS

- A. Large scale integrated (LSI) circuit construction shall be employed unless otherwise specified.
- B. Modular construction shall be employed to simplify maintenance and to provide for future hardware expansion. Plug-in, modular PCB's or modules shall be employed for easy removal to permit exposure of circuit wiring, components and test points. Extender boards

shall be provided if necessary to permit PCB's to be completely exposed for testing purposes.

- C. Keying schemes shall be used to prevent PCB misplacement.
- D. Each process control system local area network connected device shall continuously perform on-line diagnostics and failure reporting to the operator workstations.
- E. The temperature inside each enclosure containing digital hardware (i.e., cabinet, panel or console) shall be continuously monitored and shall generate an alarm to the nearest PLC if the temperature rises to an adjustable, preset high temperature.

2.02 DIGITAL SYSTEM FAILURE DETECTION AND FAIL-OVER REQUIREMENTS

- A. No degradation in control system performance shall occur when the system is operating in a partial failure or an equipment fail-over mode. Likewise, no degradation of system performance shall occur while a backed up system component is undergoing preventive or corrective maintenance.
- B. All devices connected to the data highway local area network shall be self-checking and shall report their operational status to the operator workstations as whether "normal" or "failed".

PART 3 -- EXECUTION

3.01 REQUIREMENTS

- A. Refer to Section 17000, Part 3.

- END OF SECTION -

SECTION 17120

PROGRAMMABLE LOGIC CONTROLLERS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation all programmable logic controllers, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17060 – Signal Coordination Requirements
- C. Section 17100 – Control and Information System Hardware - General
- D. Section 17125 – PLC Operator Interface Units
- E. Section 17170 – Portable Notebook Computers
- F. Section 17185 – Data Highway Network
- G. Section 17190 – Uninterruptible Power Systems
- H. Section 17500 – Enclosures, General

1.03 TOOLS, SUPPLIES AND SPARE PARTS

- A. Tools, supplies and spare parts shall be provided as specified in Section 17050 - Tools, Supplies, and Spare Parts. In addition, the following specific spare parts items shall be provided:
 - 1. One of each type of CPU and co-processor module for PLC equipment furnished under this Contract.
 - 2. One of each type of input/output module for PLC equipment furnished under this Contract.
 - 3. One of each type and size of PLC and equipment power supply furnished under this Contract.

PART 2 -- PRODUCTS

2.01 PROGRAMMABLE LOGIC CONTROLLERS - GENERAL

- A. The instrumentation subcontractor shall furnish programmable controllers (PLC's) as specified herein and as shown on the Drawings. PLC's shall be provided complete with rack, power supply, I/O cards, special function cards, instructions, memory, input/output capacity, and appurtenances to provide all features and functions as described herein. PLC I/O cards may be supplied by third party vendors if approved by the PLC manufacturer and the Engineer. No substitutions will be permitted.
- B. All components of the PLC system shall be of the same manufacturer; who shall have fully tested units similar to those being furnished in an industrial environment with associated electrical noise. The PLC system shall have been tested to meet the requirements of NEMA Standard ICS 2-230 (Arc Test) and IEEE C37.90.1 (SWC). 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.
- C. Programmable controllers shall be designed to operate in an industrial environment. The PLC shall operate in an ambient temperature range of 0°-60°C and a relative humidity of 5-95 percent, non-condensing. The PLC shall operate on supply voltages of 90-132 VAC at 47-63 Hz or 24 VDC if provided with a battery backup system. An integral fuse shall be provided on the power supply for short circuit protection and shall be front panel accessible. Integral overcurrent and undervoltage protection shall be provided on the power supply.
- D. The minimum PLC rack size for rack-based PLCs shall be 7 slots, not to include main processor or power supply slots.
- E. System configuration shall be as shown on the Control System Block Diagram. PLC types shall be designated on the Control System Block Diagram and correspond to the specifications herein. Only a single type of processor shall be supplied for all PLC's of a designated type. **Memory and processor shall be adequate for all control functions specified.** PLC's shall be as manufactured or equal to those listed in the following table.

<u>PLC Type</u>	<u>Minimum PLC to be Provided</u>
Large:	GE Fanuc 90-70 with CPX782 processor Allen-Bradley PLC 5 with PLC-5/80E processor Modicon Quantum with 140 CPU 534 14A processor
Mid-Size:	GE Fanuc 90-30 with CPU374 processor Allen-Bradley Compact Logix with L32E or L35E processor Allen-Bradley SLC500 with SLC-5/05 processor Modicon 984-120 Compact with PC-E984-285 processor
Small:	GE Fanuc 90-30 with CPU364 processor GE Fanuc Versamax w/CPUE05 processor Allen-Bradley MicroLogix 1500 processor Allen-Bradley Compact Logix with L31 processor Modicon Momentum processor

2.02 PROCESSORS

- A. The processor and its associated memory shall be enclosed in a modular enclosure. A multiple-position selector switch or equivalent shall be used to select processor operating mode. LED-type indicating lights shall be provided to indicate processor, memory, and battery status. Errors in memory shall be recognized and shall activate the memory error indicating lights. The PLC processor shall monitor the internal operation of the PLC for failure and provide an alarm output. Memory shall consist of battery-backed RAM that shall retain the control program indefinitely as long as AC power is supplied. Lithium batteries shall maintain processor RAM memory for at least one year in the event of power loss. Visual indication shall be provided if battery charge is insufficient to maintain the program in RAM memory for at least two weeks.
- B. The ladder logic instruction set for the PLC shall include the following, as a minimum:
 - 1. Relay type instructions
 - 2. Counter and timer instructions
 - 3. Comparison instructions (equal, greater than, limit tests, etc.)
 - 4. Integer and floating point mathematical instructions
 - 5. Advanced math and trigonometric functions
 - 6. Statistical instructions
 - 7. Matrix and array instructions
 - 8. Logical instructions (and, not, or, etc.)
 - 9. BCD conversion instructions
 - 10. Bit modification, moving, and shift instructions
 - 11. File instructions (search, copy, fill, etc.)
 - 12. Diagnostic instructions
 - 13. Sequencer instructions
 - 14. Program control instructions (jump, goto, subroutine, etc.)
 - 15. PID control loops
 - 16. Block read and write capability
 - 17. Send/receive messages
 - 18. Immediate I/O and communications update instructions
- C. **Additional co-processors or modules may be required to meet the minimum instruction set.**

2.03 COMMUNICATIONS

- A. PLC communications shall be provided as specified in Section 17185 - Data Highway Network and as shown on the Control System Block Diagram.
- B. In addition to a communications port for the data highway network, communication ports shall be provided for any other devices required (i.e., operator interface unit) plus an additional communication port for connection to a notebook computer.

2.04 INPUT/OUTPUT SUBSYSTEMS

- A. Input/output hardware shall be plug-in modules in associated I/O rack or DIN-rail mounting assemblies. Each unit shall handle the required number of process inputs and outputs plus a minimum of 10 percent active pre-wired spares for each I/O type furnished, plus a minimum of 20 percent spare I/O module space for the addition of future circuit cards or modules.
- B. Discrete inputs shall be 24 VDC or 120 VAC signals (integral to the PLC) from dry field contacts. Discrete outputs shall be 24 VDC or 120 VAC outputs sourced from the PLC, or dry relay contacts (2A minimum) as required. Refer to Section 17060 – Signal Coordination Requirements for further details of discrete signal type and voltage requirements. The PLC shall provide momentary and latched outputs as required to interface with motor controls and external devices. Interposing relays shall be provided where required to interface with field equipment. Interposing relays shall be as specified in Section 17550. Electrical isolation shall be provided where required. Maximum density for discrete I/O modules shall be 32 per input module and 16 per output module.
- C. Analog input circuits shall be isolated, minimum 12-bit resolution type. Analog input hardware shall be provided as required for all types of analog inputs being transmitted to the PLC. In general, analog input modules shall be capable of receiving 4-20 mA signals. Where required, RTD input modules shall have a minimum resolution of 0.15°C and be capable of accepting signals from 100-ohm Platinum RTD's. Analog outputs shall be coordinated with the receivers but shall generally be isolated 24 VDC 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 as specified in Section 17560 - Transient Voltage Surge Suppression Devices. Maximum density for analog I/O modules shall be 8 per module.
- D. Input/output modules shall be configured for ease of wiring and maintenance. The modules shall be connected to wiring arms that can be disconnected to permit removal of a module without disturbing field wiring. Covers shall be provided to prevent operator personnel from inadvertently touching the terminals. The process interface modules shall be provided with screw-type terminal blocks with barriers between adjacent terminals for connection of field inputs. Terminals shall be suitable for accepting up to and including No. 14 AWG wire. All DC output circuits to the field shall include fuses, either integral or at the terminal strip. Output failure mode shall be selectable so that upon station or communication system failure all outputs shall be placed either in the non-conducting mode, or remain as were prior to failure. Light-emitting diodes shall be provided for status indication for each input and output point.
- E. External power supplies shall be provided with the PLC as required to meet specified installed I/O power requirements plus spares. Power supplies shall be modular units, shall be fully redundant and shall alarm the PLC upon failure. Power supplies shall have a line regulation of 0.05% and meet the environmental and power requirements specified herein for the PLC.

2.05 REMOTE I/O SUBSYSTEMS

- A. Remote I/O shall be provided as designated on the Control System Block Diagram. Remote I/O shall be either PLC rack type I/O or field modules as manufactured by the PLC manufacturer. Field modules shall meet the requirements of Subsection 2.04, Input/Output Subsystems. Remote I/O processor or communication modules shall be modular and individually replaceable.
- B. Remote I/O shall communicate with the PLC using the PLC manufacturer's standard protocol or an open standard network such as DeviceNet, Ethernet IP, Profibus, Foundation Fieldbus, Modbus, or equal.

2.06 INPUT/OUTPUT CIRCUIT ARRANGEMENT

- A. Signal and control circuitry to individual input/output boards shall be arranged such that board failure shall not disable more than one half of the control loops within any group of controlled equipment (e.g., one pump out of a group of three pumps, two pumps out of four, etc.). Where possible, individual control loops and equipment shall be assigned to individual boards such that failure of the board will disable only one loop or piece of equipment.

2.07 PROGRAMMING SOFTWARE

- A. The PLC programming and configuration software shall be the manufacturer's latest version, Windows-based. The software package shall consist of all programming, configuration, and documentation software needed to place the control and information system in satisfactory operation. The software shall allow on-line and off-line program development and documentation. Programming shall be accomplished through the use of ladder logic and other IEC 1131.3 languages. PLC programming software shall include CD-ROM documentation.
- B. Third-party programming software shall be acceptable if recommended by the manufacturer and if that software exceeds the capabilities of the PLC manufacturer's standard software package.
- C. All configuration and programming software necessary shall be provided on the computer specified in Section 17170 - Portable Notebook Computers for connection to the PLC processor via a communications port. All necessary hardware required to allow the notebook computer to perform PLC configuration and programming shall be provided.
- D. If available, the configuration and programming software shall support communication over the network specified in Section 17185 - Data Highway Network to implement its functions remotely from an operator workstation. All configuration and programming software necessary to implement this functionality shall be provided on the SCADA Server operator workstations specified in Section 17140 - Operator Workstations. All necessary hardware required to have the operator workstation perform PLC configuration and programming shall be provided.

PART 3 - EXECUTION

3.01 REQUIREMENTS

- A. Refer to Section 17000, Part 3.

- END OF SECTION -

SECTION 17125

PLC OPERATOR INTERFACE UNITS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation all operator interface units, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17100 – Digital System Hardware Configuration
- C. Section 17120 – Programmable Logic Controllers

PART 2 -- PRODUCTS

2.01 OPERATOR INTERFACE UNIT – COLORGRAPHIC TOUCH SCREEN

- A. An Operator Interface Unit (OIU) shall be provided to view and change PLC monitoring and control parameters and to display alarm messages using a graphical user interface. The OIU shall provide the following features as a minimum.
 - 1. Minimum of 10.4 inch diagonal display
 - 2. 64-color TFT LCD display of 640 X 480 pixels
 - 3. Resistive film touch screen interface
 - 4. Minimum of 4 MB Flash EPROM application memory
 - 5. Minimum of 256 kB SRAM data backup memory
 - 6. PLC network interface module and driver complete with interface cable
 - 7. Sound and buzzer output
 - 8. Windows-based configuration software complete with download cable
 - 9. Operating Voltage: 120 VAC (internal or via independent power supply)
 - 10. Enclosure Rating: NEMA 12/4X to match the associated PLC cabinet rating
 - 11. Environment: 0-50°C, 20-85% relative humidity, non-condensing
- B. The operator interface unit shall be Pro-Face GP-2500T, or equal.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

- A. The OIU shall be configured to display all PLC I/O, setpoints, and parameters. All equipment failures shall be alarmed. PLC I/O values and operator-entered setpoints shall

be displayed with associated units and service descriptions. Menus shall be provided to navigate between screens of different equipment items. Displays shall be arranged in a hierarchical structure with displays for specific equipment items grouped together. Additional functionality shall be as specified elsewhere in this Division.

- B. All necessary configuration and programming software shall be provided on CD media and turned over to the Owner.
- C. Refer to Section 17000 for additional requirements.

- END OF SECTION -

SECTION 17190

UNINTERRUPTIBLE POWER SYSTEMS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation all uninterruptible power systems, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.
- B. One UPS shall be provided for each operator workstation and its peripherals (i.e. printer, network equipment, radio, etc.) provided under this Contract.
- C. One UPS shall be provided for each programmable logic controller (PLC) or remote telemetry unit (RTU) and its appurtenant equipment provided under this Contract. However, courtesy receptacles in PLC and RTU cabinets shall not be powered by the UPS.
- D. UPS's shall be mounted in or near enclosures containing digital hardware, unless otherwise specified or shown on the Drawings, as follows:
 1. UPS's for operator's consoles shall be mounted within the consoles.
 2. UPS's for control panels containing PLCs shall be mounted either within the cabinet or in an adjacent cabinet of suitable environmental rating.
 3. UPS's for RTUs shall be mounted within the RTU cabinet.
 4. Where the UPS is mounted within a dedicated enclosure, that enclosure shall be properly sized for heat dissipation and all other applicable requirements as specified in Section 17500 and its subordinate Sections.
 5. Where the UPS is mounted within the PLC or RTU cabinet, it shall not interfere with access to other equipment or wiring within the panel (i.e., it shall not be necessary to move or remove the UPS to remove or service other panel-mounted equipment). For floor-mounted PLC cabinets with bottom wiring access (including those cabinets with legs), the UPS shall be placed on a dedicated shelf within the cabinet.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17100 – Control and Information System Hardware, General
- C. Section 17120 – Programmable Logic Controllers
- D. Section 17140 – Operator Workstations

1.03 SUBMITTALS

- A. The Contractor shall submit UPS sizing calculations for all UPS's furnished under this Contract in accordance with Section 17030 - Control and Information System Submittals.

PART 2 -- EQUIPMENT

2.01 UNINTERRUPTIBLE POWER SYSTEMS

- A. Each UPS shall consist of a freestanding UPS module and battery modules as required to meet backup run time requirements.
- B. UPS's shall be true on-line type. Each UPS shall be sized to match the maximum power requirements of the associated digital equipment, control panel power supplies and accessories. Under normal operation, the AC power shall be converted to DC. The DC power from the battery charger shall supply an inverter and maintain the battery module at full charge. The AC output from the inverter shall be fed to the associated digital equipment power supply unit and/or other equipment power supplies as appropriate. Upon loss of the AC supply, the inverter shall continue to supply normal power to the device, drawing DC from the batteries.
- C. An automatic bypass switch shall be provided on UPS's of greater than 2 kVA capacity. The transfer switch shall be of the solid state, make-before-break type and shall automatically transfer load from the inverter to the AC line in the event of an inverter malfunction. The total transfer time shall be 5 milliseconds or less. The transfer switch shall be provided with a manual override.
- D. A manually operated maintenance bypass switch shall be provided for each UPS installation to allow hardware to be powered while the UPS is removed for maintenance. The bypass switch shall be the make-before-break type to ensure continuous power to the associated PLC.
- E. Loss of AC power shall be monitored on the line side of the UPS and reported via normally closed (fail safe) unpowered contacts to the associated PLC/RTU.
- F. Each UPS shall meet the following requirements:
 - 1. Input voltage shall be 117 VAC, single phase, 60 Hz.
 - 2. Voltage regulation shall be +/-5 percent for line and load changes.
 - 3. The output frequency shall be phase-locked to the input AC line on AC operation and shall be 60 hertz +/-0.5 percent when on battery operation.
 - 4. The batteries shall be of the sealed, lead acid or lead calcium gelled electrolyte type, or VRLA absorbed glass mat (AGM) type. The battery modules shall have a minimum full load backup time of 30 minutes for PLC-based control panels, and 45 minutes for remote telemetry units.

5. A status monitoring and control panel shall be provided and shall include the following:
 - a. Status indicating lights for both normal and abnormal conditions.
 - b. Individual alarm contacts that shall close upon loss of the AC line, low battery level or operation of the static transfer switch. Contacts shall be wired to the closest discrete input subsystem. Alternatively, an RS-232 or USB port shall provide UPS status to an operator workstation. All required interface software and hardware shall be provided.
 - c. Circuit breaker for the AC input.
 6. Sound absorbing enclosure.
 7. EMI/RF noise filtering.
 8. Surge protection shall be provided on the AC input circuit, which shall have a UL TVSS clamping voltage rating of 400 V with a <5 ns response time.
- G. UPS systems shall be Model GXT2 as manufactured by Liebert, equivalent by Powerware, MGE UPS Systems, GE Digital Energy, or equal.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

- A. Refer to Section 17000, Part 3 of the Specifications.

- END OF SECTION -

SECTION 17200

CONTROL AND INFORMATION SYSTEM SOFTWARE REQUIREMENTS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation all control and information system software with all required programming and software appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17100 – Digital System Hardware Configuration
- B. Section 17120 – Programmable Logic Controllers
- C. Section 17125 – Operator Interface Units
- D. Section 17170 – Portable Notebook Computers
- E. Section 17240 – Operator Workstation Software

1.03 PRODUCT DELIVERY STORAGE AND HANDLING

- A. All software manuals and magnetic media shall be 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.

PART 2 -- PRODUCTS

2.01 SOFTWARE GENERAL REQUIREMENTS

- A. Information and control system software shall consist of standard off-the-shelf software configurable by the user to conform to the application. Major software items specified in this Division shall include but not be limited to the following:
 - 1. Programmable logic controller software
 - 2. Operator workstation software (operating system, SCADA, etc.)
 - 3. Database management and report writing software
 - 4. Portable notebook computer software
 - 5. Miscellaneous hardware support software

- B. The programmable logic controller software furnished under this Contract shall be as specified under Section 17120 - Programmable Logic Controllers.
- C. The operator workstation software furnished under this Contract shall be as specified under Section 17240 - Operator Workstation Software.

2.02 OVERALL SYSTEM CONFIGURATION

- A. The operator workstation SCADA servers shall be redundant devices with automatic backup capability. If the primary (master) server fails, the backup server shall automatically take over all primary server functions without requiring operator action. All client nodes within the system shall automatically reconfigure to send and receive data to/from the new master server. It shall be possible for the operator to manually force the failover routine and exchange the primary/backup servers at any time. It shall be possible to prioritize the client nodes to allow the most critical clients to connect to the master in the event that the capacity of a single master would be exceeded by a large number of clients.
- B. The database management software and its associated report writing software specified herein shall reside on a historical workstation separate from the primary and backup SCADA servers. All system historical data management and reporting software shall be performed on the historical server to relieve the SCADA servers of the historical workload. System data shall be automatically transmitted to the historical server at regular intervals to maintain the database.
- C. All discrete and analog data acquisition, pre-processing, storage and process control functions shall be performed at the PLC level. The operator workstation software shall not be used for this purpose.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

- A. Software design, implementation and checkout shall satisfy the requirements specified in the various Sections of Division 17.

- END OF SECTION -

SECTION 17303

AIR COMPRESSOR SYSTEMS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the air compressor systems, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17700 - Powered Instruments, General

PART 2 -- PRODUCTS

2.01 AIR COMPRESSOR SYSTEMS

- A. The air compressor system shall include the following:
 - 1. NEMA 1 wall mount or free standing steel enclosure.
 - 2. Duplex air compressors.
 - 3. Air storage tank with drain valve and pressure relief valve.
 - 4. Pneumatic selector switch for normal and purging operations, pressure switch, and alternator for air compressor control and low pressure switch for compressor failure alarm.
 - 5. Manual purge system with two-way and three-way solenoid valves, time delay relay, and a push button.
 - 6. Air filter, pressure regulator, and piping.
 - 7. High- and low-range pressure gages.
 - 8. Pressure switches to provide electrical control contacts (close/open) at three (3) separate adjustable pressures (levels).
 - 9. Appurtenances as necessary.

B. The system shall include all components required to comprise a complete air compressor system to perform the functions indicated herein and in the respective associated Drawings and Specifications.

C. System Operation and Control

1. Power to the system shall be controlled by a fused disconnect switch shall control power to all components within the cabinet. All components requiring power shall operate on a single 120V, 60Hz, single phase power supply.
2. The compressors shall be set up in a lead-lag configuration with automatic alternation through a solid-state alternator to maintain pressure in the air storage tank in the specified range. A low pressure switch shall produce a contact closure for local control of the compressors.
3. The compressed air shall flow through a pressure regulator to produce a constant discharge pressure and then flow through respective control valves.
4. Normal operating and purging mode of the system shall be switchable via a pneumatic selector switch. In normal mode, level is measured continuously and displayed at the level gauge. In "purge" mode, the dip tube shall be purged with air to prevent process material buildup.

D. Installation

The following components shall be housed in the bubbler cabinet and mounted securely within the cabinet in the following order, bottom to top:

1. Air storage tank.
2. Compressors.
3. Disconnect switch, compressor controls, pressure switch, pressure indicating transmitter and alternator.
4. Air filter, pressure regulator, and auxiliary compressed air connection.

E. Cabinet

1. The cabinet shall be of steel construction equivalent to a NEMA 1 single compartment cabinet. The cabinet shall be of minimum 14 gage steel. The front shall be hinged and latched and suitably braced to preclude distortion when open.
2. The cabinet shall be sufficient height and width to house all components, with sufficient space for servicing and repairs.
3. Fluorescent lamps with switches shall be provided in the cabinet.

4. The cabinet shall have a minimum of two filtered ventilation louvers (one near the bottom and one near the top).

F. Air Compressors

1. The duplex air compressors shall be of the oilless type, driven by a 1/3 HP minimum, 120 volts, 1 phase, 60 Hz, capacitor start electric motor. Compressors shall have maintenance free permanent bearings, intake air filter, and thermal overload protection, and shall have a minimum capacity of 0.85 SCFM at 100 psi.
2. The compressors shall be mounted on rubber isolation legs to control vibration transmission into the cabinet and shall have suitable structural support to the cabinet side walls or bottom. They shall be securely bolted.
3. Auxiliary contact closure shall be provided for remote alarm when a compressor fails.

G. Air Storage Tanks

1. The air storage tank shall have a minimum volume of 20.0 gallons and a minimum working pressure of 100 psi. The tank shall have integral welded mounting legs and may be horizontal or vertical. It shall be securely bolted to the cabinet.
2. A drain valve and pipe to the exterior at one side of the cabinet below the door shall be provided. A pressure relief valve set at 100 psi shall be provided on the tank.

H. Compressor Controls

1. The outlet piping of the storage tank shall contain a pressure switch to control the compressors and a pressure switch to produce a low air pressure contact closure for remote alarm. Each pressure switch shall have an adjustable dead band and SPDT contacts, rated 10 amp at 120 VAC, UL/CSA listed. The compressor control pressure switch shall be set initially to start the compressor at 60 psi and stop the compressor at 80 psi. The pressure switches shall be manufactured by ASCO, Ashcroft, or approved equal.
2. The compressor operation shall be alternated by a solid-state alternator, as manufactured by Warrick Controls, Inc., or equal.
3. A fused disconnect switch shall be provided to isolate the system power supply.
4. A 3-position selector switch shall be provided on the bubbler cabinet door to select Compressor 1 Lead – Alternate – Compressor 2 Lead.
5. All components such as relays, switches, etc. shall be provided in the cabinet for the specified controls and alarms.

I. Air Filter, Pressure Regulator and Piping

1. A filter/separator and pressure regulator shall be provided between the air storage tank and the constant differential pressure regulator. The regulator shall have an adjustable pressure range of 0-30 psi minimum and shall be initially set at 20 psi. The filter/separator shall have a metal body, manual drain, reusable filter element for removal of particles 5 microns in size, a capacity greater than the compressor capacity, 1/4-inch NPT connections, and be by Wilkerson Corp., Englewood, CO, or equal.
2. All piping within the cabinet shall be 1/4-inch soft copper tubing with flared or compression connections, except for the flexible connections to the door-mounted level indicators which shall be nylon reinforced PVC tubing with copper connectors. Extended piping from the cabinet shall be 1/2-inch Schedule 80 PVC except where otherwise shown on the Drawings.

J. Pressure Gages

Pressure gages shall be provided on the air storage tank and downstream of the pressure regulator. The gages shall be of the bourdon tube type, be of 2-1/2-inches nominal diameter, have snubbers, and shall be by U.S. Gage, Ashcroft 1009 Series, or equal. The tank gage shall be 0-150 psi, and the regulated gage shall be 0-125 psi.

K. Pressure Indicating Transmitter

A pressure indicating transmitter shall be provided and shall be as specified under Section 17760 of this Division.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

- A. Refer to Section 17700, Part 3 of the specifications.

- END OF SECTION -

SECTION 17500

ENCLOSURES, GENERAL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the control enclosures, with all spare parts, accessories, and appurtenances as specified herein and as shown on the Drawings.
- B. Control enclosures shall be assembled, wired, and tested in the instrumentation subcontractor's own facilities, unless specified otherwise. All components and all necessary accessories such as power supplies, conditioning equipment, mounting hardware, signal input and output terminal blocks, and plug strips that may be required to complete the system shall be provided.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17100 – Control and Information System Hardware, General
- C. Section 17510 – Cabinets and Panels
- D. Section 17520 – Field Panels
- E. Section 17530 – Control System Consoles
- F. Section 17540 – Control System Furniture
- G. Section 17550 – Panel Instruments and Accessories
- H. Section 17560 – Transient Voltage Surge Suppression Devices
- I. Section 17600 – Unpowered Instruments, General
- J. Section 17700 – Powered Instruments, General
- K. Section 17800 – Analytical Instruments, General
- L. Section 17900 – Schedules and Control Descriptions, General
- M. Refer to Division 16 for additional requirements for cable, circuit breakers, disconnect switches, etc.

1.03 GENERAL INFORMATION AND DESCRIPTION

- A. The cabinet itself and all interior and exterior equipment shall be identified with nameplates. The equipment shall be mounted such that service can occur without removal of other equipment. Face mounted equipment shall be flush or semi-flush mounted with flat black escutcheons. All equipment shall be accessible such that adjustments can be made while the equipment is in service and operating. All enclosures shall fit within the allocated space as shown on the Drawings.
- B. Either manufacturer-standard or custom cabinetry may be furnished subject to the requirements of the Contract Documents and favorable review by the Owner.
- C. Due consideration shall be given to installation requirements for enclosures in new and existing structures. The Contractor shall examine plans and/or field inspect new and existing structures as required to determine installation requirements, and shall coordinate the installation of all enclosures with the Owner and all affected contractors. The Contractor shall be responsible for all costs associated with installation of enclosures, including repair of damage to structures (incidental, accidental or unavoidable).

1.04 TOOLS, SUPPLIES AND SPARE PARTS

- A. Tools, supplies and spare parts shall be provided as specified in Section 17050 - Tools, Supplies and Spare Parts. In addition, the spare parts items shall be provided as specified in the individual cabinet and panel specification sections (175XX).

PART 2 -- PRODUCTS

2.01 TERMINAL BLOCKS

- A. Terminal blocks shall be assembled on non-current carrying galvanized steel DIN mounting rails securely bolted to the cabinet subpanel. Terminals shall be of the screw down pressure plate type as manufactured by Phoenix Contact, Wieland, Square D, or equal.
- B. Power terminal blocks shall be single tier with a minimum rating of 600 volts, 30 amps.
- C. Signal terminal blocks shall be single tier with a minimum rating of 600 volts, 20 amps.

PART 3 -- EXECUTION

3.01 FABRICATION

- A. Enclosures 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.
- B. Enclosures shall be sized to adequately dissipate heat generated by equipment mounted inside the panel. If required, one or more of the following shall be provided to facilitate cooling:

1. Louvered openings near the bottom and top (NEMA 12 cabinets only).
 2. Thermostatically controlled, low noise internal air blowers (initial setpoint 75°F) to circulate air within the enclosure, maintaining a uniform internal temperature.
 3. Thermostatically controlled, low-noise cooling fans to circulate outside air into the enclosure, exhausting through louvers near the top of the cabinet (NEMA 12 cabinets only). Air velocities through the enclosure shall be minimized to assure quiet operation.
 4. All openings in cabinets and panels shall be fitted with dust filters.
- C. Enclosures shall be constructed so that no screws or bolt heads are visible when viewed from the front. Punch cutouts for instruments and other devices shall be cut, punched, or drilled and smoothly finished with rounded edges.
- D. The temperature inside each enclosure containing digital hardware (i.e., cabinet, panel or console) shall be continuously monitored and shall generate an alarm to the nearest PLC if the temperature rises to an adjustable, preset high temperature.
- E. Terminals shall be marked with a permanent, continuous marking strip. One side of each terminal shall be reserved exclusively for field incoming conductors. Common connections and jumpers required for internal wiring shall not be made on the field side of the terminal. Subject to the approval of the Engineer, a vendor's pre-engineered and prefabricated wiring termination system will be acceptable.
- F. Wiring shall comply with accepted standard instrumentation and electrical practices. Power, control and signal wiring shall comply with Division 16 of the specifications. For each pair of parallel terminal blocks, the field wiring shall be between the blocks.
- G. Separate terminal strips shall be provided for each type of power and signal used within each cabinet.
- H. All wiring shall be bundled and run open or enclosed in vented plastic wireway as required. Wireways shall be oversized by a minimum of 10%; overfilled wireways shall not be acceptable. 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.
- I. A copper 120 VAC ground bus shall be installed in each cabinet, and shall be connected to the building power ground. A separate, isolated copper ground bus shall be installed in each cabinet for the logic (24 VDC) ground. Both ground buses shall be clearly labeled as to voltage and function.
- J. Interior panel wiring and field wiring shall be tagged at all terminations with machine-printed plastic sleeves. The wire numbering system and identification tags shall be as specified in Section 16123 - Building Wire and Cable. Where applicable, the wire number shall be the ID number listed in the input/output schedules.

- K. Wires shall be color coded as follows:

Equipment Ground - GREEN

120 VAC Power - BLACK

120 VAC Power Neutral - WHITE

120 VAC Control (Internally Powered) - RED

120 VAC Control (Externally Powered) - YELLOW

24 VAC Control - ORANGE

DC Power (+) - RED

DC Power (-) - BLACK

DC Control - BLUE

Analog Signal – BLACK/WHITE or BLACK/RED

- L. Enclosures shall be provided with a main circuit breaker and a circuit breaker on each individual branch circuit distributed from the panel. Main breaker and branch breaker sizes shall be coordinated such that an overload in a branch circuit will trip only the branch breaker but not the main breaker.
- M. Enclosures with any dimension larger than 36 inches shall be provided with 120-volt duplex receptacles for service equipment and fluorescent service lights. Power to these devices shall be independent from the PLC power supply and its associated uninterruptible power system.
- N. Where applicable, enclosures 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 in the word "WARNING" shall be 0.75 inch high, white.
- O. 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.

3.02 PAINTING

- A. All steel enclosures shall be free from dirt, grease, and burrs and shall be treated with a phosphatizing metal conditioner before painting. All surfaces shall be filled, sanded, and finish coated by spraying a 1-2 mil epoxy prime coat and smooth, level, high grade textured finish between flat and semi-gloss shine. The colors shall be selected by the Owner from a minimum of six color samples provided. Refer to Division 9 for additional requirements.
- B. Materials and techniques shall be of types specifically designed to produce a finish of superior quality with respect to adherence, as well as impact and corrosion resistance.
- C. Panels fabricated from stainless steel shall not be painted.

3.03 INSTALLATION

- A. Refer to Section 17000 for additional requirements.

- END OF SECTION -

SECTION 17510
CABINETS AND PANELS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the cabinets and panels, with all spare parts, accessories, and appurtenances as specified herein and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17100 – Control and Information System Hardware, General
- C. Section 17500 – Enclosures, General
- D. Section 17900 – Schedules and Control Descriptions, General

PART 2 -- PRODUCTS

2.01 CABINETS AND PANELS

- A. Cabinets and panels shall be formed or welded construction, reinforced with Unistrut, Powerstrut, or equal to facilitate mounting of internal components or equipment. Sufficient access plates and doors shall be provided to facilitate maintenance and testing of the cabinet's equipment. Doors shall be removable. Cabinets and panels with any dimension 36 inches or greater shall be provided with removable lifting lugs designed to facilitate safe moving and lifting of the panel during installation. All doors shall be fitted with common-keyed locks.
- B. Cabinets and panels shall be minimum 14 USS gauge. Cabinets and panels with any dimension greater than 36 inches shall be 12 USS gauge.
- C. Cabinets and panels located inside buildings, but located in areas other than climate controlled (heated and air conditioned) electrical or control rooms, shall be as a minimum 316 stainless steel NEMA 4X construction, or as specified or shown on the Drawings for hazardous area classification (Class, Division, Group), or submersible (NEMA 6) applications. Epoxy coated cast copper-free aluminum construction shall also be acceptable for NEMA 4, 6 and 7 applications. Cabinets located in chlorine storage/feed areas shall be of non-metallic, FRP construction, rated NEMA 4X.
- D. Cabinets and panels within climate controlled (heated and air-conditioned) electrical or control rooms shall be all steel fully enclosed NEMA 12 units with gasketed doors.

- E. Cabinets and panels shall have doors on the front and shall be designed for front access. NEMA 12 cabinets shall be fitted with three-point door latches. Door latches for NEMA 4X cabinets shall be all stainless steel, fast operating clamp assemblies that do not require bolts or screws to secure. Door hardware on NEMA 4X cabinets located in chlorine storage/feed areas shall be non-corrosive in that environment.
- F. Panels and cabinets located outside fence-secured areas shall be fitted with padlockable latch kits.
- G. All cabinets and panels shall be provided with drawing pockets for as-built panel drawings. One copy of the appropriate panel as-built drawings shall be furnished and left in the pocket of each panel.
- H. Panels with any dimension greater than 36 inches that contain a programmable controller (PLC or DCU) shall be provided with a folding laptop programmer shelf on the inside of the door.
- I. Cabinets and panels shall be prefabricated cabinets and panels by Hoffman or Rittal. The Contractor may optionally provide cabinets that are custom-fabricated by the instrumentation subcontractor or by a reputable panel fabrication shop acceptable to the Engineer.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

- A. Refer to Section 17500 for additional requirements.

- END OF SECTION -

SECTION 17512

CABINET AIR CONDITIONING UNITS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the cabinet air conditioning units, with all spare parts, accessories, and appurtenances as specified herein and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 - Control and Information System Scope and General Requirements
- B. Section 17100 – Control and Information System Hardware, General
- C. Section 17500 - Enclosures, General
- D. Section 17510 - Cabinets and Panels
- E. Section 17900 - Schedules and Control Descriptions, General

PART 2 -- PRODUCTS

2.01 CABINET AIR CONDITIONING UNITS

- A. Where specified or shown on the Drawings, cabinets shall be of insulated 304 stainless steel NEMA 4X construction, and shall be provided with side mounted closed loop air conditioning units and thermostatically controlled space heaters. Power supply shall be 115 VAC, 60 Hz.
- B. Air conditioning units shall both cool and dehumidify the cabinet's internal air. Each air conditioner shall be sized to handle current and future (with specified spare capacity filled) heat loadings from all equipment mounted inside the cabinet.
- C. Air conditioners shall be provided with thermostats which operate the centrifugal evaporator blowers continuously to prevent stratification of air within the cabinet. Compressors shall operate as needed to maintain the temperature set at the thermostat. Compressors shall be provided with space heaters to maintain the compressor at a minimum temperature during cold ambient temperatures.
- D. Ambient air shall be completely separated from the air inside the cabinet. All air conditioner components exposed to the atmosphere outside the cabinets shall be coated to prevent corrosion.
- E. Units shall be provided with EMI/RFI noise suppressors.

- F. Air conditioner enclosures shall be constructed of cold rolled steel which is phosphatized and finished in baked enamel.
- G. Cabinet air conditioners shall be ProAir CR Series as manufactured by McLean Midwest of Brooklyn Park, MN, or equal.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

- A. Refer to Section 17500 for additional requirements.

- END OF SECTION -

SECTION 17520

FIELD PANELS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the field panels, with all spare parts, accessories, and appurtenances as specified herein and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17500 – Enclosures, General
- C. Section 17900 – Schedules and Control Descriptions, General

PART 2 -- PRODUCTS

2.01 FIELD PANELS

- A. Field panels for outdoor service shall be suitable for wall or pipe mounting. Panels shall have the following features:
 - 1. 316L stainless steel NEMA 4X construction.
 - 2. A hinged and gasketed door. Door latches shall be all stainless steel, fast operating clamp assemblies that do not require bolts or screws to secure.
 - 3. Field panels located outside fence-secured areas shall be fitted with padlockable latch kits.
 - 4. Thermal insulation and thermostatically controlled space heaters.
 - 5. External sun shields or shades constructed of the same materials as the associated enclosure, unless otherwise specified.
- B. All external sample/process piping, including valves and appurtenances, shall be insulated with weather-proof insulation and heat-taped to prevent freezing. Heat taping shall be thermostatically controlled and self-regulating, and shall adjust its heat output to the temperature of the lines.
- C. Field panels shall be adequately sized to house instruments, power supplies, surge protection, and appurtenant equipment. Sufficient space shall be provided for servicing instruments without removal of equipment from the enclosure.

D. Field panels shall be as manufactured by Hoffman, Rittal, Hammond, or equal.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

A. Refer to Section 17500 for additional requirements.

- END OF SECTION -

SECTION 17550

PANEL INSTRUMENTS AND ACCESSORIES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the panel instruments and accessories, with all spare parts, accessories, and appurtenances as specified herein and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17100 – Control and Information System Hardware, General
- C. Section 17500 – Enclosures, General
- D. Section 17900 – Schedules and Control Descriptions

1.03 GENERAL INFORMATION AND DESCRIPTION

- A. All equipment mounted on the face of a panel shall conform to the same NEMA rating specified for the panel construction.

PART 2 -- PRODUCTS

2.01 ELECTRONIC INDICATORS

- A. Electronic indicators shall be 3.5 or 6 digit, as appropriate, with 0.56" high red LED display. Indicators shall be provided with nameplate and scale calibrated to match the calibration of the primary element. The unit shall be designed primarily for use with 4-20 mA current loop signal circuits. Indicator operating voltage shall be 115 VAC 10%, 60 Hz. Indicator controls shall include three (3) front-panel pushbuttons for modifying alarm values and other indicator setup. Two (2) form-C relays shall be provided for each indicator. Relay contact outputs shall be rated 5A, 120/240 VAC, resistive load. Where required, a regulated and isolated 24 V excitation power supply shall be provided. Indicators shall be Red Lion Model IMP or APLCL, or equal.

2.02 SIGNAL CONVERTERS

- A. Signal converters shall be provided as required to provide control functions and to interface instrumentation and controls, equipment panels, motor control centers and other instrumentation and controls supplied under other Divisions to the controls provided herein.
- B. General Requirements – Converters shall be of the miniature type, utilizing all solid state circuitry suitable for mounting within new or existing cabinetry. Where sufficient cabinet

space is not available, sub panels or supplemental enclosures shall be provided. Power supply shall be 120V, 60 hertz where required by the converter. Repeatability shall be 0.1% of span, deadband shall be 0.1% span, maximum. Where specific converters are not listed, but are required to interface with the process control system, they shall comply with the general requirements stated herein.

- C. Current to Current Isolators – Current to current isolators shall be furnished where necessary to provide an isolated current loop, calculations or signal amplification between the plant process control system and instrumentation and control loops. Isolators shall be sized such that resistance of existing loops shall not exceed maximum rated resistance. Isolators shall be as manufactured by AGM, Moore Industries, Rochester Instrument Systems (RIS), or equal.
- D. Voltage to Current Transducers – Voltage to current (or current to voltage) transducers shall convert a voltage signal of one magnitude to a 4-20 milliamp DC current signal. The output current shall be directly proportional to the input signal voltage. Transducers shall be sized such that loop resistance does not exceed maximum rated resistance. Transducers shall be as manufactured by AGM, Moore Industries, Rochester Instrument Systems (RIS), or equal.
- E. Frequency to Current Transducers – Frequency to current transducers shall convert pulse-rate and pulse-duration signals to 4-20 mA, 24 VDC analog signals. Converters shall include field-adjustable input frequency range. Converter power shall be 120 VAC, 60 hertz. Transducers shall be sized such that loop resistance does not exceed maximum rated resistance. Transducers shall be suitable for signal transmission via leased telephone lines. Transducers shall be Timeverter as manufactured by AGM, Moore Industries equivalent, Rochester Instrument Systems (RIS) equivalent, or equal.
- F. Current to Frequency Transducers – Current to frequency transducers shall convert 4-20 mA, 24 VDC analog signals to pulse-rate and pulse-duration signals. Converters shall include field-adjustable output frequency range. Converter power shall be 120 VAC, 60 hertz. Transducers shall be sized such that loop resistance does not exceed maximum rated resistance. Transducers shall be suitable for signal transmission via leased telephone lines. Transducers shall be Quantimer as manufactured by AGM, Moore Industries equivalent, Rochester Instrument Systems (RIS) equivalent, or equal.

Integrators – Integrators shall be provided as interchangeable plug-in modules with zero and span adjustment available on the front plate of the units. Output shall range from 0 to 0.1 through 0 to 10 pulses per second. Accuracy shall be $\pm 0.1\%$ of input span. Integrators shall convert linear analog signals to pulse rate and provide a solid-state output. Integrators shall be as manufactured by AGM Electronics, Moore Industries, Rochester Instrument Systems (RIS), or equal.

- G. Electronic Switches (Alarm Relays) – Electronic switches shall be furnished with a calibrated dial for adjusting set points. The input to the switch shall be 4-20 mADC, and the set point shall be adjustable over the full range. Unless otherwise noted, the dead band shall be fixed at less than 2 percent of span. The set point stability shall be $\pm 0.1\%$ per degree F. The repeatability shall be $\pm 0.1\%$ of span. The units shall be furnished with SPDT relays rated at 10 amperes at 115 VAC. Electronic switches shall be as manufactured by AGM, Moore Industries, Rochester Instrument Systems (RIS), or equal.

- H. RTD to Current Signal Converters – RTD to current signal converters shall convert a 3-wire RTD input signal to an isolated 4-20 mA DC output signal. Each converter shall operate from a 120 VAC power source. Accuracy shall be 0.10 percent of span or better. Calibrated span of each converter shall be as indicated on the instrument list. The Contractor shall coordinate calibration of the signal converters with existing RTD elements. The signal converters shall be furnished in the manufacturer's standard enclosure for installation in an existing indoor electrical cabinet. Signal converters shall be as manufactured by AGM, Moore Industries, Rochester Instrument Systems (RIS), or equal.
- I. Interposing Relays – Where required to interface between motor control centers, equipment controls, and control panels, interposing relays and associated control wiring circuitry shall be furnished and installed to provide the monitoring and/or control functions specified herein. Interposing relays shall be miniature type, DPDT, minimum 10 amp, 120 VAC contact rating. Relay coils shall be 120 VAC or 24 VDC as required. Relays shall be Type KU as manufactured by Square D, Potter & Brumfield, Allen-Bradley, or equal.
- J. Timing Relays – Timing Relays (TR) shall be the general purpose plug-in type, Type JCK as manufactured by Square D Company, Cutler-Hammer/Westinghouse Electric Corporation equivalent, Allen-Bradley equivalent, or equal. Timing relays shall be electronic type with 120 VAC coils unless otherwise specified or indicated on the Drawings. Timers shall be provided with a minimum of two SPDT timed output contacts and instantaneous contacts where required. Contact ratings shall be the same as for interposing relays as specified above.
- K. Intrinsically Safe Relays and Barriers – Intrinsically safe relays and barriers shall be provided where required to interface with equipment such as float level switches that are located in NFPA-classified hazardous areas. Intrinsically safe relays and barriers shall be FM approved and shall be manufactured by Pepperl and Fuchs, Crouse Hinds, Square D, or equal.

2.03 TOTALIZERS

- A. Totalizing counters shall be provided for flush panel, spring-clip mounting. Face dimensions of the totalizing counters shall be no larger than 1-1/8-inches high by 2-inches wide. Totalizing counters shall contain eight digits. Height of the digits shall not be less than 5/32-inch. Numerals shall be white on a black background. The counter shall be non-resettable and shall be totally compatible for operation on the pulses supplied by the associated instrument or integrator. The totalizing counter shall be capable of a maximum count rate of 25 counts/second.
- B. Legend plates shall be provided for each of the totalizing counters with white letters on a black background with legends as specified below.
- C. Totalizing counters shall be manufactured by Kessler-Ellis, or equal.

2.04 ACCESSORIES

- A. Control operators such as pushbuttons (PB), selector switches (SS), and pilot lights (PL) shall be Cutler-Hammer/Westinghouse Type E34, Square D Company Type SK, or equal. Control operators shall be 30.5 mm, round, heavy-duty, oil tight NEMA 4X corrosion resistant.

- B. Pushbuttons shall be non-illuminated, spring release type. Pushbuttons shall include a full guard. Panic stop/alarm pushbuttons shall be red mushroom type with manual-pull release. Selector switches shall be non-illuminated, maintained contact type. Pilot lights shall be of the proper control voltage, LED type with light lens colors shall be as specified below.

<u>Color</u>	<u>Function</u>
Red	Running (Open)
Green	Stopped or Off (Closed)
Amber	Fault
White	Other

- C. Control operators shall have legend plates as specified herein, indicated on the Drawings, or otherwise directed by the Engineer. Legend plates shall be plastic, black field (background) with white lettering. Engraved nameplates shall be securely fastened above each control operator. If adequate space is not available, the nameplate shall be mounted below the operator.
- D. Control operators for all equipment shall be as specified herein and of the same type and manufacturer unless otherwise specified or indicated on the Drawings.
- E. Alarm horns shall be general-purpose type, flush panel mount, 115 VAC power supply or 24 VDC power supply, suitable for indoor or weatherproof service, as required. Volume shall be adjustable.

2.05 STRIP CHART RECORDERS

- A. Strip chart recorders shall be of the single pen, null balance, servo-operated, compact strip chart type furnished with disposable fiber tip pens. Systems employing capillary pens are not acceptable. Each pen shall have its own indicator scale, calibrated in engineering units. The charts shall travel at less than 1 inch per hour. Approximately 1 hour of recorded data shall be displayed. Charts shall be 4 inches wide, have time markings at two-hour intervals and shall indicate AM and PM times. An On-Off chart drive switch shall be provided. Recorder input signal circuits shall be electronically isolated. Input signal shall be 4-20 mA, 24 VDC. Zero and span adjustments shall be provided. Accuracy shall be $\pm 0.5\%$ of span, repeatability $\pm 0.25\%$ of span, with a maximum 7-second full-scale travel slew speed. Instruments shall be mounted on pullout chassis. All components shall be integrally mounted in the recorder case. Recorders shall be supplied with panel mounting enclosures. Mounting hardware and umbilical cords and all accessories for connections shall be provided. Power supply shall be 120 VAC, 60 Hertz. Recorders shall be Foxboro Series 760 R, Chessell, ABB/Fischer & Porter, or equal.

2.06 CIRCULAR CHART RECORDERS

- A. Circular chart recorders shall be single pen, servo-operated, circular chart type furnished with solid state plug-in circuit modules and disposable fiber-tip pens. Systems employing capillary pens are not acceptable. Chart drives shall be 7-day, with direct drive synchronous motor. Charts shall be 10 inches in diameter and calibrated in engineering units. Input signal shall be 4-20 mA, 24 VDC. Accuracy shall be 0.5% of span, repeatability 0.25% of span, and sensitivity 0.1% of span. Recorder shall have 40-character digital

fluorescent display. Recorders shall be designed for flush-panel mounting with slide tray for access. All components shall be integrally mounted in the recorder case. Mounting hardware, umbilical cords, and all accessories for connections shall be provided. Power supply shall be 115 VAC, 60 Hz. Recorder shall be Model 1390 as manufactured by ABB/Fischer & Porter, Foxboro, Chessell or equal.

2.07 ELECTRONIC BAR GRAPH INDICATORS

- A. Electronic bar graph indicators shall be solid-state and shall be provided with one input circuit for indication of one process variable. Process variable shall be indicated on a vertical bar graph. Glowing bars consisting of 101 individual segments shall be provided through the use of electronic gas-discharge display units and shall be easily viewed under all types of lighting. The bar color shall be red. The indicator shall not use any electro-mechanical movements, linkage, or other moving parts in its operation. Transparent slip-in scales shall be provided, graduated in engineering units. Scales graduated as 0-100% will not be accepted (except for speed or valve position indication). An electronic digital LED display shall be provided on the face of the indicator, sealed to match the analog bar graph display.
- B. The panel face and background for the indicator shall be black with black case trim. An individual indicator shall have overall panel-mounting dimensions not exceeding 3 inches wide by 6 inches high. Horizontal groupings of indicators shall be self-mounted. The indicator chassis shall be capable of being withdrawn from the case for service without disconnection from the terminals. Connection between the chassis and the case-mounted terminal block shall be accomplished by the use of an "umbilical" cord-type, multiple-conductor flat cable. The "umbilical" connection shall be self-retracting when the chassis is fully plugged in.
- C. Accuracy of the indicator shall be $\pm 0.5\%$ of span with repeatability of 0.1% of span and a resolution of 0.5% of span. Effective indicator scale length shall be nominally 4 inches. The indicator shall remain within $\pm 0.1\%$ of span for a +10% or -15% change from the nominal power supply voltage.
- D. The unit shall be capable of normal operation in an ambient temperature range of 40°F-120°F. Power supply shall be 120 VAC, 60 Hz.
- E. Electronic bar graph indicators shall be Model PC-101 by Weschler Instruments, or equal.

2.08 DIGITAL SINGLE LOOP CONTROLLERS

- A. Digital single loop controllers shall be provided as specified herein and as shown on the Contract Drawings. Controllers shall be microprocessor-based, self contained single loop digital controllers, Model 352B as manufactured by Moore Products Co., or equal.
- B. Controllers shall be front panel mounted and shall have LED bar graph display for process and setpoint values and for valve position. Controller shall have a 4 1/2-digit LED numeric display to monitor process, setpoint, valve position values and two user-defined variables. Pushbuttons shall be provided to select the value being displayed. A four character alphanumeric display shall be included to indicate status and alarm condition. An alarm acknowledge pushbutton shall be provided.

- C. Pushbuttons shall be provided for changing the setpoint or manual output, capable of rapid full-scale changes or precise incremental changes. An integral mode switch shall be included to manually control the loop. Integral keypad switches shall be provided for configuration and operating functions. Controller shall operate on 120-volt single-phase power.
- D. Controllers shall be provided with two analog and two discrete inputs, and with one analog and two discrete outputs. Controllers shall also be provided with a minimum of 23 programmable function blocks, which may be configured by the user to perform control strategies. The instrumentation subcontractor shall perform control strategy configuration for the single loop controllers to enable them to perform all functions specified herein.
- E. Controllers shall be provided with a digital communications network supplied by the controller manufacturer. All controllers shall be provided with all hardware and software required to communicate via this network. Interconnecting cables shall be provided by the instrumentation subcontractor, as recommended by the controller manufacturer. The digital communications network shall employ a global database with peer-to-peer communication over a token passing bus at 500 K bits/sec. The global database shall be updated every 0.5 seconds for every device on the network regardless of plant operating situation. The network shall be self-configuring and shall recognize the addition or removal of any network device without disrupting normal operations. The network shall utilize a passive bus, which shall operate normally following failure of any connected device. Communications protocol shall be HDLC, or equal. The digital communications network shall be the Local Instrument Link by Moore Products, or equal.
- F. Controllers shall be provided with PC-based configuration software capable of running on MS-Windows-based microcomputers. The configuration software shall be capable of creating, editing and storing on disc for later retrieval controller configuration via the controller's digital communications network, and of uploading and downloading these configurations to/from any particular controller on the network. Hardware shall be provided to interface the microcomputer with the digital communications network, including all required communications cables. The configuration software shall be menu-based, with "help" screens for each menu selection. Configuration software shall be Moore Products Mycro 352 Configuration Management Software, with Model 320 Independent Computer Interface, or equal.
- G. Software shall be provided and configured such that the controller's digital communications network is available on-line at the operator workstations through the controller configuration interface hardware. The controller configuration software shall be available through a window on the operator workstations, and all on-line network-based configuration functions shall be executable across the network.

2.09 ANNUNCIATOR SYSTEMS

- A. The annunciator systems shall be installed as specified herein and as shown on the Drawings. Annunciator systems shall be of the all-silicon, solid state type furnished with a separately mounted alarm horn, logic circuitry, a DPDT auxiliary output relay, translucent windows and white lamps. Acknowledge and test switches shall be of the heavy-duty oil-tight type.

- B. The system shall include filter networks on the power supply and each input point. Each point shall be provided with a two-position switch to allow the annunciator to operate with either normally open or normally closed field contact. Maximum field contact interrogation voltage shall be 24 VDC. Each point shall be equipped with a DPDT repeater relay.
- C. The auxiliary output relay shall normally be energized whenever the horn is sounded. When the test circuit is energized, all components except the auxiliary relay shall be energized.
- D. The lamps shall be operated at reduced voltage and shall be rated for 50,000 hours. The lamps shall be easily replaceable as an off-the-shelf item from at least two manufacturers.
- E. The system shall be capable of operation in an ambient temperature of 0 to 150 degrees F, with a line voltage variation of ± 10 percent.
- F. The system shall be capable of operating with a lock-in alarm sequence, as indicated on the following table:

	Field Contact Normal	Field Contact Abnormal	Return to Normal Before Acknowledge	Alarm Acknowledge	Return to Normal
Lamp:	OFF	FLASHING	ON	ON	OFF
Horn:	OFF	ON	OFF	OFF	OFF

- G. The system shall be as manufactured by Ronan Engineering Company, or Panalarm Division of Ametek, Inc., or equal.
- H. Each system shall be furnished with at least 10% but not less than two spare (active) points, with a minimum of 10% but not less than six (boxed) spare lamps.

2.10 OPERATOR INTERFACES

- A. Operator interface control translators shall be provided as specified herein and as shown on the Drawings, to mimic the functions of "traditional" PID loop controllers. Operator interfaces shall provide a transparent interface for local monitoring and control of PID control modules resident in the associated programmable logic controller. Operator interfaces shall be the single loop type with LED bar chart display of process variable and setpoint, manual/auto selector, raise/lower setpoint pushbuttons and key lock to prevent tampering with tuning parameters. Key locks shall be common keyed. Two keys shall be furnished for each interface. In addition to PID loop access capability, the operator interface shall provide access to P I D and bias loop-tuning parameters. Power supply shall be 120 VAC, 60 hertz. Operator interfaces shall be furnished complete with RS232-C serial interface, PLC interface connecting cables, mounting hardware and appurtenances. Operator interfaces shall be as manufactured by Specter Instruments, Austin, Texas, or equal.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

- A. Refer to Section 17500 for additional requirements.

- END OF SECTION -

SECTION 17560

SURGE PROTECTION DEVICES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install and place in satisfactory operation the surge protection devices (SPDs) as specified herein and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17100 – Control and Information System Hardware, General
- C. Section 17500 – Enclosures, General
- D. Section 17900 – Schedules and Control Descriptions, General

1.03 GENERAL INFORMATION AND DESCRIPTION

- A. All surge protectors of each type provided under this Contract shall be furnished by a single manufacturer.

1.04 TOOLS, SUPPLIES AND SPARE PARTS

- A. Tools, supplies and spare parts shall be provided as specified in Section 17050 - Tools, Supplies and Spare Parts. In addition, the following specific spare parts items shall be provided:
 - 1. Five of each type of surge protection device provided under this Contract.

PART 2 -- PRODUCTS

2.01 ELECTRICAL TRANSIENT PROTECTION, GENERAL

- A. All electrical and electronic elements shall be protected against damage due to electrical transients induced in interconnecting lines from lightning discharges and nearby electrical systems.
- B. Manufacturer's Requirements: All surge protection devices shall be manufactured by a company that has been engaged in the design, development, and manufacture of such devices for at least 5 years. Acceptable manufacturers shall be Phoenix Contact, Edco, Transtector, or equal.

- C. Surge protection device installations shall comply with UL 94, the National Electric Code (NEC), and all applicable local codes.
- D. Surge protection devices shall be installed as close to the equipment to be protected as practically possible.
- E. Device Locations: As a minimum, provide surge protection devices at the following locations:
 - 1. At any connections between ac power and electrical and electronic equipment, including panels, assemblies, and field mounted analog transmitters.
 - 2. At both ends of all analog signal circuits that have any portion of the circuit extending outside of a protecting building.
 - 3. At both ends of all copper-based communications cables which extend outside of a building, including at field instruments and the field side of analog valve position signals.
 - 4. On all external telephone communications lines.

2.02 AC POWER PROTECTION

- A. Surge protection device assemblies for connections to AC power supply circuits shall:
 - 1. Be provided with two 3-terminal barrier terminal strips capable of accepting No. 12 AWG solids or stranded copper wire. One terminal strip shall be located on each end of the unit.
 - 2. Have a nonflammable enclosure that meets or exceeds UL 94 V0 flammability requirements. The surge protection device shall be provided with provisions for mounting to interior of equipment racks, cabinets, or to the exterior of freestanding equipment.
 - 3. Be constructed as multistage devices consisting of gas tube arrestors, high energy metal oxide varistors, or silicon avalanche suppression diodes. Assemblies shall automatically recover from surge events, and shall have status indication lights.
 - 4. Comply with all requirements of UL 1449, second edition.
 - 5. Be able to withstand a peak surge current of 10,000 amps based on a test surge waveform with an 8-microsecond rise time and a 20-microsecond exponential decay time, as defined in UL 1449.
 - 6. Have the following characteristics:
 - a. Maximum Continuous Operating Voltage: 150VAC
 - b. Maximum Operating Current: 20 amps
 - c. Ambient Temperature Range: -20 degrees C to +65 degrees C
 - d. Response Time: 5 nanoseconds

2.03 ANALOG SIGNAL CIRCUIT PROTECTION

A. Surge protection device assemblies for analog signal circuits shall:

1. Have four lead devices with a threaded mounting/grounding stud or DIN Rail mounting.
2. Have a nonflammable enclosure that meets or exceeds UL 94 V0 flammability requirements.
3. Be constructed as multistage devices consisting of gas tube arrestors and silicon avalanche suppression diodes. Gas tube arrestors and diodes shall be separated by a series impedance of no more than 20 ohms. Assemblies shall automatically recover from surge events.
4. Comply with all requirements of UL 497B.
5. Be able to withstand a peak surge current of 10,000 amps based on a test surge waveform with an 8-microsecond rise time and a 20-microsecond exponential decay time, as defined in UL 1449.
6. Limit line-to-line voltage to 40 volts on 24VDC circuits.
7. Have the following characteristics:
 - a. Maximum Continuous Operating Voltage: 28VDC
 - b. Ambient Temperature Range: -20 degrees C to +65 degrees C
 - c. Response Time (Line-to-Line): 5 ns

2.04 COMMUNICATION CIRCUIT PROTECTION

A. Surge protection devices for copper-based data communication circuits shall:

1. Be designed for the specific data communication media and protocol to be protected (i.e. telephone, serial, parallel, network, data highway, coax, twinaxial, twisted pair, RF, etc.).
2. Provide protection of equipment to within the equipment's surge withstand levels for applicable standard test wave forms of the following standards:
 - a. IEC 60-1 / DIN VDE 0432 part 2
 - b. CCITT K17 / DIN VDE 0845 part 2
 - c. IEEE C62.31
3. Have a nonflammable enclosure that meets or exceeds UL 94 V0 flammability requirements.
4. Provide automatic recovery.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

- A. Refer to Section 17500 for additional requirements.

- END OF SECTION -

SECTION 17600

UNPOWERED INSTRUMENTS, GENERAL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The instrumentation subcontractor shall furnish, install, test and place in operation process instrumentation (flow elements, pressure switches, etc.) as scheduled herein together with all signal converters, transmitters, isolators, amplifiers, etc. to interface all instrumentation, panels, controls and process equipment control panels with the process controls as shown on the Drawings and as specified. The Contractor may elect to install primary elements (flowmeters, etc.) on process lines provided that the instrumentation subcontractor provides full on-site supervision during installation. Mounting of associated transmitters, indicators, power supplies, brackets and appurtenances shall be provided as specified herein and shown on the Drawings.
- B. It is the intent of the Contract Documents that all process taps, isolation valves, nipples, penetrations, embedded instrumentation supports, conduit, wiring, terminations, and the installation of process instrumentation on process lines shall be provided under this Contract. The instrumentation subcontractor shall supervise installation of equipment provided under this Division where installation is provided by others.
- C. Tapping and connections for primary process sensors shall be sized to suit each individual installation and the requirements of the instrument served. The Contractor shall ensure that the location, supports, orientation and dimensions of the connections and tapping for instrumentation furnished under this Division are such as to provide the proper bracing, the required accuracy of measurement, protection of the sensor from accidental damage and accessibility for maintenance while the plant is in operation. Isolation valves shall be provided at all process taps.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17500 – Enclosures, General
- C. Section 17698 – Instrumentation and Control System Accessories
- D. Section 17700 – Powered Instruments, General
- E. Section 17800 – Analytical Instruments, General
- F. Unpowered instruments furnished with mechanical equipment shall be furnished, installed, tested and calibrated as specified elsewhere in the Contract Documents.

1.03 TOOLS, SUPPLIES AND SPARE PARTS

- A. Tools, supplies and spare parts shall be provided as specified in Section 17050.
- B. In addition to the above requirements, the instrumentation subcontractor shall provide spare parts as specified in individual instrument specification sections.

PART 2 -- PRODUCTS

2.01 GENERAL

- A. Unless otherwise specified, instruments shall be provided with enclosures to suit specified environmental conditions. Field-mounted devices shall be rugged and mounted on walls or pipe stanchions.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Equipment shall be located so that it is accessible for operation and maintenance. The instrumentation subcontractor shall examine the Drawings and Shop Drawings for various items of equipment in order to determine the best arrangement for the work as a whole, and shall supervise the installation of process instrumentation supplied under this Division.
- B. Field equipment shall be wall mounted or mounted on two-inch diameter pipe stands welded to a 10-inch square 1/2-inch thick base plate unless shown adjacent to a wall or otherwise noted. Materials of construction shall be aluminum or 316 stainless steel. Instruments attached directly to concrete shall be spaced out from the mounting surface not less than 1/2-inch by use of phenolic spacers. Expansion anchors in walls shall be used for securing equipment or wall supports to concrete surfaces. Unless otherwise noted, field instruments shall be mounted between 48 and 60 inches above the floor or work platform.
- C. Embedded pipe supports and sleeves shall be Schedule 40, Type 316 stainless steel pipe, ASA B-36.19, with stainless steel blind flange for equipment mounting as shown on the Drawings.
- D. Materials for miscellaneous mounting brackets and supports shall be 316 stainless steel construction.
- E. Pipe stands, miscellaneous mounting brackets and supports shall comply with the requirements of Division 5 of the specifications.

3.02 ADJUSTMENT AND CLEANING

- A. The instrumentation subcontractor shall comply with the requirements of Division 1 of these Specifications and all instrumentation and control system tests, inspection, and calibration requirements for all instrumentation and controls provided under this Contract and specified herein. The Engineer, or his designated representative(s), reserves the right to witness any test, inspection, calibration or start-up activity. Acceptance by the Engineer of any plan,

report or documentation relating to any testing or commissioning activity specified herein shall not relieve the Contractor of his responsibility for meeting all specified requirements.

- B. The instrumentation subcontractor shall provide the services of factory trained technicians, tools and equipment to field calibrate, test, inspect and adjust each instrument to its specified performance requirement in accordance with manufacturer's specifications and instructions. Any instrument which fails to meet any Contract requirements, or any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the discretion of the Engineer, at no cost to the Owner. The Contractor shall bear all costs and provide all personnel, equipment and materials necessary to implement all installation tests and inspection activities for equipment specified herein.
- C. At least 60 days before the anticipated initiation of installation testing, the Contractor shall submit to the Engineer a detailed description, of the installation tests to be conducted to demonstrate the correct operation of the instrumentation and control system.
- D. Field instrument calibration requirements shall conform to the following:
 - 1. The instrumentation subcontractor shall provide the services of factory trained instrumentation technicians, tools and equipment to field calibrate each instrument supplied under this Contract to its specified accuracy in accordance with the manufacturer's specification and instructions for calibration.
 - 2. Each instrument shall be calibrated at 0, 25, 50, 75 and 100 percent of span using test instruments to simulate inputs and read outputs. Test instruments shall be rated to an accuracy of at least five (5) times greater than the specified accuracy of the instrument being calibrated. Where applicable, such test instruments shall have accuracy's as set forth by the National Institute for Standards and Technology (NIST).
 - 3. The instrumentation subcontractor shall provide a written calibration sheet to the Engineer for each instrument, certifying that it has been calibrated to its published specified accuracy. The Contractor shall submit proposed calibration sheets for various types of instruments for Engineer approval prior to the start of calibration. This sheet shall include but not be limited to date, instrument tag numbers, calibration data for the various procedures described herein, name of person performing the calibration, a listing of the published specified accuracy, permissible tolerance at each point of calibration, calibration reading as finally adjusted within tolerance, defect noted, corrective action required and corrections made.
 - 4. If doubt exists as to the correct method for calibrating or checking the calibration of an instrument, the manufacturer's printed recommendations shall be used as an acceptable standard, subject to the approval of the Engineer.
 - 5. Upon completion of calibration, devices shall not be subjected to sudden movements, accelerations, or shocks, and shall be installed in permanent protected positions not subject to moisture, dirt, and excessive temperature variations. Caution shall be exercised to prevent such devices from being subjected to overvoltages, incorrect voltages, overpressure or incorrect air. Damaged equipment shall be replaced and recalibrated at no cost to the Owner.

- END OF SECTION -

SECTION 17635

ROTAMETERS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation all rotameters, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17600 – Unpowered Instruments, General

PART 2 -- PRODUCTS

2.01 ROTAMETERS

- A. Rotameters shall consist of a float chamber, tapered float, and a measuring ring.
- B. Rotameters shall have the following specifications:
 - 1. Process Fluid Temperature: 32° F to 140° F
 - 2. Accuracy: +/- 2.0% of full scale
 - 3. Repeatability: 0.5% of full scale
 - 4. Max. Process Fluid Pressure: 500 psig at 140° F
- C. The body material shall be 316 stainless steel. Wetted parts shall be as follows:
 - 1. Float: 316 stainless steel minimum; or compatible with process fluid
 - 2. Glass Tube: Borosilicate glass
 - 3. O-Rings: Viton minimum; or compatible with process fluid
 - 4. Others: Compatible with process fluid
- D. A graduated metal scale plate shall be provided for flow indication. A graduated metal scale plate shall be provided for flow indication. The indicator shall be large, easy to read, and calibrated in gallons per minute.
- E. Attachment to the pipe shall be by ANSI Class 125/150 stainless steel flanges conforming to ANSI B16.5.
- F. Rotameters shall be as manufactured by Brooks, Fischer & Porter, King Instruments, or equal.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

- A. Refer to Section 17600, Part 3 of the specifications.

- END OF SECTION -

SECTION 17650
PRESSURE GAUGES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the pressure gauges, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17600 – Unpowered Instruments, General
- C. Section 17698 – Instrumentation Accessories

PART 2 -- PRODUCTS

2.01 PRESSURE GAUGES

- A. All gauges shall be designed in accordance with the ASME B40.1 entitled, "Gauges, Pressure, Indicating Dial Type - Elastic Element".
- B. All gauges shall be direct reading type. Snubbers shall be provided on all gauges. Gauge full-scale pressure range shall be selected such that the maximum operating pressure shall not exceed the approximately 75% of the full-scale range.
- C. Features
 - 1. Mounting: ½" NPT, lower stem mount type
 - 2. Accuracy: 0.5% full scale
 - 3. Case: Solid front, black phenolic material
 - 4. Dial: White background and black letters
 - 5. Glass: Shatterproof
 - 6. Blow-out protection: Back
 - 7. Pressure element: stainless steel bourdon tube
 - 8. Movement: Stainless steel, Teflon coated pinion gear and segment
 - 9. Gaskets: Buna-N
- D. Liquid-filled or equivalent mechanically-damped gauges shall be used if the gauges are installed with pumps, or where gauges are subjected to vibrations or pulsation. Filling fluid shall be silicone unless oxidizing agents such as sodium hypochlorite are present, where halocarbon shall be used.

- E. Gauge size shall be 2" for line sizes up to 3" and 4½" for line sizes of 4" or greater.
- F. Diaphragm seals and isolating ring seals shall be furnished in accordance with the requirements specified under Section 17698 - Instrumentation and Control System Accessories.
- G. The complete gauge assembly and appurtenances shall be fully assembled and tested prior to field mounting. A ½" isolation stainless steel ball valve shall be provided for each gauge assembly.
- H. Pressure and vacuum gauges shall be Ashcroft Duragauge Model 1279, Ametek-U.S. Gauge Division, H.O. Trerice Co., WIKA Instrument Corporation, or equal.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

- A. Refer to Section 17600, Part 3.

- END OF SECTION -

SECTION 17660

VANE OPERATED FLOW SWITCHES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation all vane operated flow switches, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 - Control and Information System Scope and General Requirements
- B. Section 17600 - Unpowered Instruments, General

PART 2 -- PRODUCTS

2.01 VANE OPERATED FLOW SWITCHES

- A. Vane operated flow switches shall consist of a paddle or vane, a magnet that moves with the paddle or piston and a reed switch. Motion from the vane shall be passed through a sealed, magnetically coupled mechanism to actuate the switch.
- B. Vane operated flow switches shall have the following specifications:
 - 1. Temperature Limit: 275° F
 - 2. Max. Operating Pressure: 1,000 psig
 - 3. Switch Type: SPDT snap action micro switch
 - 4. Switch Rating: 10 A, 125 VAC; 10⁶ cycle contact life
 - 5. Body Type/Material: Single piece milled, bored brass
 - 6. Enclosure Classification: Class I, Groups C, D
Class II, Groups E, F, G
 - 7. Vane Type/Material: Layered, 316 stainless steel
- C. Manufacturer/Model: Model V4-2-U Flotect by W.E. Anderson, or equal.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

- A. Refer to Section 17600, Part 3 of the Specifications.

- END OF SECTION -

SECTION 17670

LEVEL SWITCHES (SUSPENDED FLOAT TYPE)

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the float level switches, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17600 – Unpowered Instruments, General

PART 2 -- PRODUCTS

2.01 LEVEL SWITCHES (SUSPENDED FLOAT TYPE)

- A. Level switches of the direct acting float-operated design shall be comprised of a hermetically sealed, approximately 5 inch diameter plastic casing float, containing microswitches and flexibly supported by means of a heavy neoprene or PVC jacket, with three conductor cable a minimum of 20 feet in length. Unless otherwise specified, media specific gravity is 0.95 to 1.05. Microswitches shall be one normally open and one normally closed, 5A-115V AC capacity. Float hangers and supports shall be provided as shown on the installation detail drawings. Float switches shall be Model ENM as manufactured by Flygt, or equal.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

- A. Refer to Section 17600, Part 3 of the specifications.

- END OF SECTION -

SECTION 17675

PRESSURE SWITCHES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the pressure switches, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 - Control and Information System Scope and General Requirements
- B. Section 17600 - Unpowered Instruments, General

PART 2 -- PRODUCTS

2.01 PRESSURE SWITCHES

- A. Pressure, vacuum, and differential pressure switches shall be single or dual action with an adjustable setpoint for the process requirement and/or as specified herein. Switches shall be diaphragm or piston operated and activate S.P.D.T. snap action switches on increasing or decreasing pressure. Minimum differential shall be less than 10 percent of the range. Deadband shall be adjustable. Allowable surge pressure shall be a minimum 1.5 times the range. Each pressure switch shall have visible scale.
- B. Pressure switches shall have a contact rating of 10 amperes at 120 volts AC. Pressure switches shall be in NEMA 4X enclosures. Switches shall have a repeatable accuracy of 1 percent of range. Pressure switches shall be isolated from the process fluid by a diaphragm seal or an isolation ring in locations as shown on the Contract Drawings and/or as specified. Wetted parts materials shall be compatible with the process fluid for corrosion resistance. Pressure switches shall be manufactured by ASCO, SOR, Inc., Ashcroft, or equal.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

- A. Refer to Section 17600 Part 3.

- END OF SECTION -

SECTION 17680

TEMPERATURE SWITCHES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the temperature switches, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 - Control and Information System Scope and General Requirements
- B. Section 17600 - Unpowered Instruments, General

PART 2 -- PRODUCTS

2.01 TEMPERATURE SWITCHES

- A. Temperature switches shall be of the close-coupled, liquid filled type utilizing a vapor-pressure thermal system. Temperature changes in the process fluid shall create proportional vapor pressure changes in the temperature sensing bulb. The vapor pressure changes shall act on a diaphragm/piston assembly to actuate and deactuate a snap-action electrical switching element at the setpoint process temperature. The fill fluid shall be chemically and thermally stable, non-flammable, and provide a predictable temperature-vapor pressure curve.
- B. The switching element shall be field adjustable, SPDT, hermetically sealed, and shall be insensitive to vibration. Switch rating shall be not less than 5 A at 125 VAC.
- C. Thermowells shall be provided for each temperature switch assembly.
- D. Switch enclosures shall be NEMA 4X or 7, as required for the application.
- E. Temperature switches shall be as manufactured by SOR, Ashcroft, United Electric, or equal.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

- A. Refer to Section 17600, Part 3 of the specifications.

- END OF SECTION -

SECTION 17698

INSTRUMENTATION AND CONTROL SYSTEM ACCESSORIES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the instrumentation and control system accessories with all spare parts, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17600 – Unpowered Instruments, General
- C. Section 17700 – Powered Instruments, General
- D. Section 16902 – Electric Controls and Relays

PART 2 -- PRODUCTS

2.01 INSTRUMENTATION AND CONTROL SYSTEM ACCESSORIES

- A. General: Accessories include various items of equipment that may be required in the system but are not scheduled. Accessories are shown on details, flow sheets or plans. Accessories are also called out in specifications for scheduled instruments and in the installation specifications. It is not intended, however, that each piece of hardware required will be specifically described herein. This subarticle shall be used as a guide to qualify requirements for miscellaneous hardware whether the specific item is described or not.
- B. Process Tubing: Process tubing shall be 1/2 x 0.065-inch seamless, annealed, ASTM A-269 Type 316L stainless steel with Type 316 - 37 degrees stainless steel flared fittings or Swagelock or Parker-CPI flareless fittings.
- C. Power, Control and Signal Cables: Power, control and signal wiring shall be provided under Division 16 of the Specifications.
- D. Chemical Diaphragm Seals: Diaphragm seals shall be provided for isolation of pressure gauges, switches and transmitters attached to systems containing chemical solutions or corrosive fluids. As a minimum, seals shall be of all 316 stainless steel construction. In general, diaphragms shall be 316L stainless steel for operating pressures at or above 15 psi and elastomers for operating pressures below 15 psi. However, diaphragm material shall be non-reactive with the process fluid in all cases. Refer to the Instrument Schedules for specific materials requirements. Seal shall have fill connection, 1/4-inch NPT valved flush port and capable of disassembly without loss of filler fluid. Where specified, diaphragm

seals shall comply with the above requirements and shall be provided with 316 SS factory filled capillaries. Seals shall be Helicoid Type 100 HA, Mansfield & Green, Ashcroft, or equal.

- E. Isolating Ring Seals: For solids bearing fluids, line pressure shall be sensed by a flexible cylinder lining and transmitted via a captive sensing liquid to the associated pressure sensing instrument(s).
 - 1. Full Line Size Isolating Ring Seals - For all grit/sludge/slurry/scum applications or wherever the associated pressure instrument is used for control purposes, the sensor body shall be full line size wafer design. Except where noted on the Drawings and/or Instrument Schedule, full line size ring seals will not be required for return activated sludge (RAS) lines, but will have tapped ring seals as specified in Item 2, below. Full line size isolating ring seals shall have 316 stainless steel housing and assembly flanges and Buna N flexible cylinder lining for in-line mounting. The wafer shall have through bolt holes or centerline gauge for positive alignment with the associated flanged piping. The captive liquid chamber and associated instrument(s) shall be furnished with threaded drain tap and plug. Isolating ring seals shall be RED Valve Series 40, Ronningen-Petter Iso-Ring, Moyno RKL Series W, Onyx Isolator Ring, or equal.
 - 2. Tapped Isolating Ring Seals - For all other solids bearing fluids, pressure shall be sensed via a minimum 1/2" diameter spool-type isolating ring seal mounted on a 1/2" pipe nipple at 90° from the process piping. An isolation ball valve shall be provided between the process piping and the ring seal, and a cleanout ball valve shall be provided between the ring seal and the atmosphere. The pressure instrument shall be back or side mounted to the ring seal such that the gauge or readout may be viewed normally. Tapped isolating ring seals for solids service shall be Red Valve Series 42/742, Ronningen-Petter Iso-Spool, Onyx Isolator Ring, or equal.
- F. Filling Medium: The filling medium between instruments, isolating ring seals and diaphragm seals shall be a liquid suitable for operation in an ambient temperature ranging from -10°F to +150°F. Filling medium shall be silicone unless oxidizing agents such as sodium hypochlorite are present, where halocarbon shall be used.
- G. Isolation Valves: Isolation valves shall be 1/2 - inch diameter ball valves with 316 stainless steel body, 316 stainless steel ball, except that materials of construction shall be suitable for the associated process fluid where applicable (i.e., chemical service).
- H. Sirens: Sirens shall be UL Listed, heavy duty, AC motor driven, weatherproof type capable of producing a minimum of 111 dBA at 10 feet. Power supply shall be 120 VAC, 60 hertz. Siren shall be McMaster-Carr Model 6392T11, Federal Signal Corporation equivalent, Edwards Signaling Company equivalent, or equal.
- I. Strobe Lights: Strobe lights shall be high profile with Type 304 stainless steel base. Light is rated NEMA 4. Light shall have an outer dome to provide extra lens protection. Lens color shall be as indicated on the Drawings. Surface mount hardware shall be included. Power supply shall be 120 VAC, 60 hertz. Strobe light shall be McMaster-Carr Model 5848T71, Federal Signal Corporation equivalent, Edwards Signaling Company equivalent, or equal.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

- A. Refer to Section 17600, Part 3 of the specifications.

- END OF SECTION -

SECTION 17700

POWERED INSTRUMENTS, GENERAL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The instrumentation subcontractor shall furnish, install, test and place in operation powered process instrumentation (flow elements, level transmitters, etc.) as scheduled herein together with all signal converters, transmitters, isolators, amplifiers, etc. to interface all instrumentation, panels, controls and process equipment control panels with the process control system as shown on the Drawings and as specified. Powered instruments are those instruments that require power (120 VAC or 24 VDC loop power) to operate. The Contractor may elect to install primary elements (flowmeters, etc.) on process lines provided that the instrumentation subcontractor provides full on-site supervision during installation. Mounting of associated transmitters, indicators, power supplies, brackets and appurtenances shall be provided as specified herein and shown on the Drawings.
- B. It is the intent of the Contract Documents that all process taps, isolation valves, nipples, penetrations, embedded instrumentation supports, conduit, wiring, terminations, and the installation of process instrumentation on process lines shall be provided under this Contract. The instrumentation subcontractor shall supervise installation of equipment provided under this Division where installation is provided by others.
- C. Tapping and connections for primary process sensors shall be sized to suit each individual installation and the requirements of the instrument served. The Contractor shall ensure that the location, supports, orientation and dimensions of the connections and tapping for instrumentation furnished under this Division are such as to provide the proper bracing, the required accuracy of measurement, protection of the sensor from accidental damage, and accessibility for maintenance while the plant is in operation. Isolation valves shall be provided at all process taps.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17500 – Enclosures, General
- C. Section 17600 – Unpowered Instruments, General
- D. Section 17698 – Instrumentation and Control System Accessories
- E. Section 17800 – Analytical Instruments, General
- F. Powered instruments furnished with mechanical equipment shall be furnished, installed, tested and calibrated as specified elsewhere in the Contract Documents.

1.03 TOOLS, SUPPLIES AND SPARE PARTS

- A. Tools, supplies and spare parts shall be provided as specified in Section 17050.
- B. In addition to the above requirements, the instrumentation subcontractor shall provide one remote handheld configuration device for communication with all "smart" instruments furnished under this Contract. The devices shall be capable of performing configuration, test, and format functions from anywhere on the 4-20 mA signal loop for a particular transmitter or by direct connection. The configuration device shall be Fischer & Porter Model 50HC1000, Rosemount Model 375, or equal.

PART 2 -- PRODUCTS

2.01 GENERAL

- A. All instrumentation supplied shall be the manufacturer's latest design. Unless otherwise specified, instruments shall be solid state, electronic, using enclosures to suit specified environmental conditions. Microprocessor-based equipment shall be supplied unless otherwise specified. All instruments shall be provided with mounting hardware and floor stands, wall brackets, or instrument racks as shown on the Drawings, or as required.
- B. Equipment installed in a hazardous area shall meet Class, Group, and Division as shown on the Drawings, to comply with the National Electrical Code.
- C. All field instrumentation for outdoor service shall be provided with enclosures which are suitable for outdoor service, as follows:
 - 1. Where the manufacturer's enclosures are suitable for outdoor service, they shall be provided with instrument sunshades. Sunshades shall be Style E as manufactured by O'Brien Corporation, or equal. Where possible, these instruments shall be mounted in a north facing direction.
 - 2. Where the manufacturer's standard enclosures are not suitable for outdoor service, instruments shall be mounted in Field Panels in accordance with Section 17520, Field Panels, or may be furnished with Vipak instrument field enclosures as manufactured by O'Brien Corporation, equivalent by Intertec, or equal. It shall not be necessary to provide the manufacturer's NEMA 4 or 4X enclosures for instruments that will be subsequently mounted in separate field panels.
- D. All instruments shall return to accurate measurement without manual resetting upon restoration of power after a power failure.
- E. Unless otherwise shown or specified, local indicators shall be provided for all instruments. Where instruments are located in inaccessible locations, local indicators shall be provided and shall be mounted as specified in Subsection 3.01 (B) herein. All indicator readouts shall be linear in process units. Readouts of 0-100% shall not be acceptable (except for speed and valve position). Isolated outputs shall be provided for all transmitters.
- F. Unless otherwise specified, field instrument and power supply enclosures shall be 316 stainless steel, fiberglass or PVC coated copper-free cast aluminum NEMA 4X construction.

- G. Where separate elements and transmitters are required, they shall be fully matched, and unless otherwise noted, installed adjacent to the sensor. Special cables or equipment shall be supplied by the associated equipment manufacturer.
- H. Electronic equipment shall utilize printed circuitry and shall be coated (tropicalized) to prevent contamination by dust, moisture and fungus. Solid-state components shall be conservatively rated for long-term performance and dependability over ambient atmosphere fluctuations. Ambient conditions shall be -20 to 50 degrees C and 20 to 100 percent relative humidity, unless otherwise specified. Field mounted equipment and system components shall be designed for installation in dusty, humid, and corrosive service conditions.
- I. All devices furnished hereunder shall be heavy-duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer, insofar as possible, and shall consist of equipment models that are currently in production. All equipment provided, where applicable, shall be of modular construction and shall be capable of field expansion.
- J. All non-loop-powered instruments and equipment shall be designed to operate on a 60 Hz AC power source at a nominal 117 V, plus or minus 10 percent, except where specifically noted. All regulators and power supplies required for compliance with the above shall be provided. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.
- K. All analog transmitter and controller outputs shall be isolated, 4-20 milliamps into a load of 0-750 ohms, unless specifically noted otherwise. All switches shall have double-pole, double-throw contacts rated at a minimum of 600 VA, unless specified otherwise.
- L. Materials and equipment used shall be UL approved wherever such approved equipment and materials are available.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. General

1. Equipment shall be located so that it is accessible for operation and maintenance. The instrumentation subcontractor shall examine the Drawings and shop drawings for various items of equipment in order to determine the best arrangement for the work as a whole, and shall supervise the installation of process instrumentation supplied under this Division.
2. Electrical work shall be performed in compliance with all applicable local codes and practices. Where the Contract Documents do not delineate precise installation procedures, API RP550 shall be used as a guide to installation procedures.

B. Equipment Mounting and Support

1. Field equipment shall be wall mounted or mounted on two-inch diameter pipe stands welded to a 10-inch square by 1/2-inch thick base plate unless shown adjacent to a wall or otherwise noted. Materials of construction shall be aluminum or 316 stainless steel. Instruments attached directly to concrete shall be spaced out from the mounting surface not less than 1/2-inch by use of phenolic spacers. Expansion anchors in walls shall be used for securing equipment or wall supports to concrete surfaces. Unless otherwise noted, field instruments shall be mounted between 48 and 60 inches above the floor or work platform.
2. Embedded pipe supports and sleeves shall be schedule 40, 316 stainless steel pipe, ASA B-36.19, with stainless steel blind flange for equipment mounting as shown on the Drawings.
3. Materials for miscellaneous mounting brackets and supports shall be 316 stainless steel construction.
4. Pipe stands, miscellaneous mounting brackets and supports shall comply with the requirements of Division 5 of the specifications.
5. Transmitters shall be oriented such that output indicators are readily visible.

C. Control and Signal Wiring

1. Electrical, control and signal wiring connections to transmitters and elements mounted on process piping or equipment shall be made through liquid-tight flexible conduit. Conduit seals shall be provided where conduits enter all field instrument enclosures and all cabinetry housing electrical or electronic equipment.

3.02 ADJUSTMENT AND CLEANING

A. General

1. The instrumentation subcontractor shall comply with the requirements of Division 1 of these Specifications and all instrumentation and control system tests, inspection, and calibration requirements for all instrumentation and controls provided under this Contract and specified herein. The Engineer, or his designated representative(s), reserves the right to witness any test, inspection, calibration or start-up activity. Acceptance by the Engineer of any plan, report or documentation relating to any testing or commissioning activity specified herein shall not relieve the Contractor of his responsibility for meeting all specified requirements.
2. The instrumentation subcontractor shall provide the services of factory trained technicians, tools and equipment to field calibrate, test, inspect and adjust each instrument to its specified performance requirement in accordance with manufacturer's specifications and instructions. Any instrument which fails to meet any Contract requirements, or any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the discretion of the Engineer, at no cost to the Owner. The Contractor shall bear all costs and provide all personnel, equipment and materials necessary to

implement all installation tests and inspection activities for equipment specified herein.

3. At least 60 days before the anticipated initiation of installation testing, the Contractor shall submit to the Engineer a detailed description, of the installation tests to be conducted to demonstrate the correct operation of the instrumentation supplied hereunder.

B. Field Instrument Calibration Requirements

1. The instrumentation subcontractor shall provide the services of factory trained instrumentation technicians, tools and equipment to field calibrate each instrument supplied under this Contract to its specified accuracy in accordance with the manufacturer's specification and instructions for calibration.
2. If the manufacturer's recommendations require calibration, each instrument shall be calibrated at 0, 25, 50, 75 and 100 percent of span using test instruments to simulate inputs and read outputs. Test instruments shall be rated to an accuracy of at least five (5) times greater than the specified accuracy of the instrument being calibrated. Where applicable, such test instruments shall have accuracy's as set forth by the National Institute for Standards and Technology (NIST).
3. The instrumentation subcontractor shall provide a written calibration sheet to the Engineer for each instrument, certifying that it has been calibrated to its published specified accuracy. The Contractor shall submit proposed calibration sheets for various types of instruments for Engineer approval prior to the start of calibration. This sheet shall include but not be limited to date, instrument tag numbers, calibration data for the various procedures described herein, name of person performing the calibration, a listing of the published specified accuracy, permissible tolerance at each point of calibration, calibration reading as finally adjusted within tolerance, defect noted, corrective action required and corrections made.
4. If doubt exists as to the correct method for calibrating or checking the calibration of an instrument, the manufacturer's printed recommendations shall be used as an acceptable standard, subject to the approval of the Engineer.
5. Upon completion of calibration, devices calibrated hereunder shall not be subjected to sudden movements, accelerations, or shocks, and shall be installed in permanent protected positions not subject to moisture, dirt, and excessive temperature variations. Caution shall be exercised to prevent such devices from being subjected to overvoltages, incorrect voltages, overpressure or incorrect air. Damaged equipment shall be replaced and recalibrated at no cost to the Owner.
6. After completion of instrumentation installation, the instrumentation subcontractor shall perform a loop check. The Contractor shall submit final loop test results with all instruments listed in the loop. Loop test results shall be signed by all representatives involved for each loop test.

- END OF SECTION -

SECTION 17701

MAGNETIC FLOW METERS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the magnetic flow meters, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17700 – Powered Instruments, General

1.03 TOOLS, SUPPLIES AND SPARE PARTS

- A. Furnish one portable primary head simulator for calibration and testing of magnetic flowmeter signal converters. The calibrator shall be furnished complete with rechargeable battery pack, test leads, spare battery pack, charger, carrying case and accessories. Calibrator shall be furnished by the flowmeter manufacturer, and shall be fully matched to the instrumentation furnished.

PART 2 -- PRODUCTS

2.01 MAGNETIC FLOW METER SYSTEMS

- A. Magnetic flow meter systems shall include a magnetic flow tube and a microprocessor-based "smart" transmitter that is capable of converting and transmitting a signal from the flow tube. Magnetic flow meters shall utilize the characterized field principle of electromagnetic induction, and shall produce DC signals directly proportional to the liquid flow rate.
- B. Each meter shall be furnished with a stainless steel or carbon steel metering tube and carbon steel flanges with a polyurethane, ceramic, neoprene, or Teflon liner as required by the application and/or as specified herein. Liner shall have a minimum thickness of 0.125 inches. The inside diameter of the liner shall be within 0.125 inches of the inside diameter of the adjoining pipe. Liner protectors shall be provided on all flow tubes.
- C. The flow tube shall be provided with flush mounted electrodes. Ultrasonic electrode cleaning shall not be acceptable.
- D. Grounding rings shall be provided for all meters.

- E. All materials of construction for metallic wetted parts (electrodes, grounding rings, etc.) shall be minimum 316 stainless steel, but shall be compatible with the process fluid for each meter in accordance with the recommendations of the manufacturer.
- F. Flow tube shall be rated for pressures up to 1.1 times the flange rating of adjacent piping. System shall be rated for ambient temperatures of -30 to +65°C. Meter and transmitter housings shall meet NEMA 4X requirements as a minimum. When meter and transmitter are located in classified explosion hazard areas, the meter and transmitter housings shall be selected with rating to meet the requirements for use in those areas. Non-metallic transmitter housings shall not be acceptable.
- G. The transmitter shall provide pulsed DC coil drive current to the flow tube and shall convert the returning signal to a linear, isolated 4-20 mA DC signal. The transmitter shall utilize "smart" electronics and shall contain automatic, continuous zero correction, signal processing routines for noise rejection, and an integral LCD readout capable of displaying flow rate and totalized flow. The transmitter shall continuously run self-diagnostic routines and report errors via English language messages.
- H. The transmitter's preamplifier input impedance shall be a minimum of 10^9 - 10^{11} ohms which shall make the system suited for the amplification of low-level input signals and capable of operation with a material build up on the electrodes.
- I. The transmitter shall provide an automatic low flow cutoff below a user configurable low flow condition (0-10%). The transmitter's outputs shall also be capable of being forced to zero by an external contact operation.
- J. Each flow tube shall be factory calibrated and assigned a calibration constant or factor to be entered into the associated transmitter as part of the meter configuration parameters. Manual calibration of the flow meter shall not be required. Meter configuration parameters shall be stored in non-volatile memory in the transmitter. An output hold feature shall be provided to maintain a constant output during configuration changes.
- K. The transmitter shall be capable of communicating digitally with a remote configuration device via a frequency-shift-keyed, high frequency signal superimposed on the 4-20 mA output signal. The remote configuration device shall be capable of being placed anywhere in the 4-20 mA output loop. The remote configuration device shall be as specified under Section 17700. A password-based security lockout feature shall be provided to prevent unauthorized modification of configuration parameters.
- L. Accuracy shall be 0.50% of rate over the flow velocity range of 0.3 to 10.0 m/s. Repeatability shall be 0.1% of rate; minimum turndown shall be 100:1. Minimum required liquid conductivity shall not be greater than 5 uS/cm. Maximum response time shall be adjustable between 1 and 100 seconds as a minimum. Transmitter ambient temperature operating limits shall be -10 to +50°C. Power supply shall be 115 VAC, 60 Hz.
- M. Flow tubes shall be 150-lb flange mounted unless otherwise noted. The cables for interconnecting the meter and transmitter shall be furnished by the manufacturer. Transmitter shall be mounted integrally on flow tube, wall, or 2-inch pipe mounted as shown in the Drawings and/or as specified.

- N. Magnetic flow meter systems shall be as manufactured by Rosemount, ABB/Fischer & Porter, Endress + Hauser, Foxboro, Krohne or equal.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

- A. Ground magnetic flow meter flow tubes and grounding rings in strict accordance with the manufacturer's recommendations.
- B. Refer to Section 17700, Part 3, for further requirements.

- END OF SECTION -

SECTION 17740

ULTRASONIC LIQUID LEVEL MEASUREMENT SYSTEMS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the ultrasonic liquid level measurement systems, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17700 – Powered Instruments, General

1.03 TOOLS, SUPPLIES AND SPARE PARTS

- A. Furnish one hand-held programmer under this Contract to calibrate and configure the level controllers specified herein. The programmer shall be furnished complete with battery plus one spare battery, carrying case and accessories. Programmer shall be furnished by the level instrument manufacturer, and shall be fully matched to the instrument furnished.

PART 2 -- PRODUCTS

2.01 ULTRASONIC LEVEL CONTROLLERS

- A. Each ultrasonic level monitoring system shall include one ultrasonic level sensor and an "intelligent" transmitter (controller). The ultrasonic level monitoring system shall be required to monitor the level of process liquids or solids as shown on the Drawings and/or as specified herein. Location of the sensor and transmitters shall be as shown on the Drawings and/or as specified.
- B. For outdoor installation, the use of approved watertight conduit hub/glands shall be required. Tank mounting applications shall include mounting flange adapter supplied by the manufacturer, which is compatible with the process media and the tank flange connection. Channel or wall mounting applications shall include mounting bracket supplied by the manufacturer and constructed of 316 stainless steel material. Sensor mounting thread shall be 1" NPT.
- C. The level sensor shall be unaffected by moisture droplets on the transducer face and operate on the ultrasonic echo ranging principle. The sensor shall also be fully submersible and resistant to corrosive materials. Sensor accuracy shall be a minimum of 0.25 percent of level measurement range, and include integral temperature compensation with an accuracy of 0.09% of range. Resolution shall be at least 0.1 percent of full range or 0.08 inches, whichever is greater.

- D. The transmitter shall be programmable by using a hand-held programmer. Display shall be LCD with backlighting, shall have the capability to display a minimum of 4 characters at one time, and shall be shielded from direct sunlight. The units shall have as a minimum, the required number of programmable set points to perform the functions specified. Each set point shall operate a set of contacts rated at 5 amps, 250 VAC, non-inductive.
- E. The transmitter shall compensate for changes in temperature and air density. The controller shall be capable of performing the following functions: level monitor, both linear and nonlinear level to flow relationships, volumetric, open channel flow monitoring, differential control, and control of up to 6 pumps, alarms, monitor pump runtime and pump sequencing. Output level signal shall be linear, isolated 4-20 mA DC. Power requirement for the transmitter shall be 120 VAC, 60 Hz. The units shall have a NEMA 4X stainless steel or nonmetallic enclosure.
- F. Ultrasonic level measurement system shall be the HydroRanger 200/Echomax Series Transducers by Siemens/Milltronics, or equal.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

- A. Where two or more ultrasonic level instruments are mounted in close proximity to each other, the transmitters shall coordinate operation to prevent interference from adjacent units. Coordination shall be accomplished via an interconnecting communication cable furnished by the manufacturer.
- B. Where level transducers may become submerged, provide a manufacturer-supplied submergence hood.
- C. Where ultrasonic level systems are used on solids measurement applications, provide a swiveling aiming device to allow easy adjustment of beam direction.
- D. For open channel flow applications where the transducer is subject to direct sunlight, use an externally mounted temperature compensator mounted out of direct sunlight.
- E. Refer to Section 17700, Part 3 of the specifications for additional requirements.

- END OF SECTION -

SECTION 17760

PRESSURE INDICATING TRANSMITTERS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the pressure indicating transmitters, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17700 – Powered Instruments, General

PART 2 -- PRODUCTS

2.01 GAUGE PRESSURE INDICATING TRANSMITTERS

- A. Gauge pressure transmitters shall be of the capacitance type with a process-isolated diaphragm with silicone oil fill, microprocessor-based "smart" electronics, and a field adjustable rangeability of 100:1 input range. Span and zero shall be continuously adjustable externally over the entire range. Span and zero adjustments shall be capable of being disabled internally. Transmitters shall be NEMA 4X weatherproof and corrosion resistant construction with low-copper aluminum body and 316 stainless steel process wetted parts. Accuracy, including nonlinearity, hysteresis and repeatability errors shall be plus or minus 0.065 percent of calibrated span, zero based. The maximum zero elevation and maximum zero suppression shall be adjustable to anywhere within sensor limits. Output shall be linear isolated 4-20 milliamperes 24 VDC. Power supply shall be 24 VDC, two-wire design. Each transmitter shall be furnished with a 4-digit LCD indicator capable of displaying engineering units and/or milliamps and mounting hardware as required. Overload capacity shall be rated at a minimum of 25 MPa. Environmental limits shall be -40 to 85 degrees Celsius at 0-100% relative humidity. Each transmitter shall have a stainless steel tag with calibration data attached to body.
- B. The piezoresistive silicon pressure sensor shall be mechanically, electrically, and thermally isolated from the process and the environment, shall include an integral temperature compensation sensor, and shall provide a digital signal to the transmitter's electronics for further processing. Factory set correction coefficients shall be stored in the sensor's non-volatile memory for correction and linearization of the sensor output in the electronics section. The electronics section shall correct the digital signal from the sensor and convert it into a 4-20 mA analog signal for transmission to receiving devices. The electronics section shall contain configuration parameters and diagnostic data in non-volatile EEPROM memory and shall be capable of communicating, via a digital signal superimposed on the 4-20 mA output signal, with a remote interface device. Output signal damping shall be provided, with an adjustable time constant of 0-36 seconds. Total long term stability (frequency of calibration) shall be not less than 0.125% for five years.

- C. Where scheduled, gauge pressure indicating transmitters shall be calibrated in feet of liquid for liquid level service.
- D. Gauge pressure indicating transmitters shall be Model 3051T as manufactured by Rosemount, or equal.

2.02 DIFFERENTIAL PRESSURE INDICATING TRANSMITTERS

- A. Differential pressure indicating transmitters shall be the same as the gauge pressure transmitters 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.
- B. The electronics sections of differential pressure transmitters shall contain user-selectable square root extractors to provide a linear 4-20 mA DC output proportional to flow, when activated. Square root extractor circuitry shall be activated only for incompressible fluid flow applications (i.e., water). Flow rates for compressible fluids (i.e., air) shall be calculated externally using line temperature and static pressure corrections as specified elsewhere in Division 17. In addition, each flow transmitter shall be furnished with laminated flow versus differential pressure curves wall mounted adjacent to the transmitter.
- C. Differential pressure indicating transmitters shall be Model 3051C as manufactured by Rosemount, or equal.

2.03 FLANGE MOUNTED LEVEL INDICATING TRANSMITTERS

- A. Flange-mounted tank liquid level indicating transmitters shall be the same as gauge pressure transmitters except for body type.
- B. The flange-mounted sensor shall consist of a special non-corrosive isolating diaphragm with fill fluid in a sealed capillary system to transmit liquid pressure to the sensing element. A second isolating diaphragm shall transmit pressure through the fill fluid to the sensing diaphragm in the center of the capacitance cell. An isolating diaphragm and fluid fill shall also be provided on the opposite side of the sensing diaphragm to convey atmospheric or reference pressure.
- C. All mounting flanges, diaphragms, O-rings and materials used in construction shall be non-corroding, compatible with each other, and compatible with the liquid being measured.
- D. Flange-mounted liquid level transmitters shall be as manufactured by Rosemount, Model 3051L.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

- A. Refer to Section 17700, Part 3 of the Specifications.

- END OF SECTION -

SECTION 17770

TEMPERATURE INDICATING TRANSMITTERS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the temperature indicating transmitters, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 - Control and Information System Scope and General Requirements
- B. Section 17700 - Powered Instruments, General

1.03 TOOLS, SUPPLIES AND SPARE PARTS

- A. Furnish one Transmation Model 1074 RTD Calibrator with all accessories.

PART 2 -- PRODUCTS

2.01 TEMPERATURE INDICATING TRANSMITTERS

- A. Temperature indicating-transmitters shall be microprocessor-based with "smart" electronics, capable of accepting direct inputs from 2-, 3-, or 4-wire, platinum, copper, or nickel resistance temperature detectors (RTD) from 10 to 1000 ohms, thermocouple inputs, direct millivolt sources, and resistance/potentiometer devices. The indicating-transmitter shall be a true 2-wire device capable of operating on voltages up to 45 VDC.
- B. The accuracy of the transmitter's Digital-to-Analog converter shall be within 0.02 percent of span. An LCD digital display shall be provided, capable of displaying mA, degrees in any units, ohms, or mV. Digital accuracy (Pt 100 RTD) shall be 0.10 degrees C. The indicator-transmitter shall contain an analog-to-digital converter which shall convert the RTD input to a digital signal and send it to the transmitter's electronics for further processing. Factory set correction coefficients shall be stored in the sensor's non-volatile memory for correction and linearization of the sensor output in the electronics section. The electronics section shall correct the digital signal from the sensor and convert it into a 4-20 mA analog signal for transmission to receiving devices. The electronics section shall contain configuration parameters and diagnostic data in non-volatile EEPROM memory and shall be capable of communicating, via a digital signal superimposed on the 4-20 mA output signal, with a remote interface device. Output signal damping shall be provided, with an adjustable time constant of 0-36 seconds. Long term stability (frequency of calibration) shall be not less than 0.25% of reading or 0.25 degrees C for five years.

- C. The transmitter assembly shall be furnished with all necessary hardware for proper mounting as recommended by the manufacturer. Indicating-transmitter shall be housed in a watertight enclosure meeting NEMA 4X requirements. Enclosure shall be suitable for wall or 2-inch pipe stand mounting.
- D. The transmitter shall provide a linear isolated 4-20 mADC output proportional to temperature.
- E. The transmitter shall constantly monitor all aspects of the input circuitry and diagnose any system failures. If self-diagnostics detect a sensor burnout or transmitter failure, the analog output signal shall be driven either upscale or downscale to alert the user. Upscale and downscale burnout features shall be user-selectable.
- F. Temperature measurement system shall be Model 3144P as manufactured by Rosemount Engineering Co., or equal.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

- A. Refer to Section 17700, Part 3 of the Specifications.

- END OF SECTION -

SECTION 17821

TURBIDITY MONITORING SYSTEMS (LOW RANGE)

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the low range turbidity monitoring systems, with all spare parts, accessories, and appurtenances as specified herein and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17800 – Analytical Instruments, General

1.03 TOOLS, SUPPLIES AND SPARE PARTS

- A. One complete calibration kit shall be provided and shall include a 1-liter calibration cylinder, auto pipette and 1 pint bottle of 4000 NTU Formazin Standard Solution with instructions for use.

PART 2 -- PRODUCTS

2.01 TURBIDITY MONITORS (LOW RANGE)

- A. Turbidity sensors and controllers shall be microprocessor-based, meeting the International Standard for measurement of Turbidity (ISO 7027-1984 (E)) and shall provide continuous monitoring.

B. Features

- 1. Range: 0-100 NTU
- 2. Accuracy: ±2 percent from 0-40 NTU
±5 percent from 40-100 NTU
- 3. Resolution: 0.001 NTU
- 4. Sample Flow: 250-750 mL/min.
- 5. Sample Temperature Range: 0-50°C
- 6. Outputs: Selectable for 0-10mV, 0-100mV, 0-1V or 4-20 mA.
- 7. Diagnostics: Self test diagnostics with alarm indication.
- 8. Alarms: Set point alarms for instrument warning and system fail.
Two 5A, 230 VAC SPDT alarm relays.
- 9. Power Requirements: 115/230 VAC, 50/60 Hz, switch selectable.
- 10. Enclosure: Sensor and controller enclosures shall be rated

11. Manufacturer: NEMA 4X.
Hach Model 1720E, or equal.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

- A. Refer to Section 17800, Part 3 of the specifications.

- END OF SECTION -