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CITY OF AVONDALE

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RANCHO SANTA FE RESERVOIR AND BOOSTER PUMP STATION

CITY PROJECT NO.: 5-6PWEN-2
WCEA PROJECT NO.: 95-416

SPECIFICATIONS

Registered Professional Engineer (Civil)
CERTIFICATE NO.
27807
RONALD L.
ABLIN
Date Signed 6/17/96
ARIZONA, U.S.A.

Troy
Ahwatukee

WILSON & COMPANY

9831 S. 51st Street
Suite C-119
Phoenix, AZ 85044
(602) 893-8860

JUNE, 1996

MESSAGE DISPLAY FOR DICK PERREAULT

To: EAR
PAC
Cc: JSM
GR
DM

Due - Oct 16th.

Bc: Dick Perreault

From: Dick Perreault:TALOS
Postmark: 10/02/96 12:50PM
Status: Previously read Urgent

Host: TALOS
Delivered: 10/02/96 12:50PM

Subject: RANCHO SANTA FE REPORT/PLANS

Message:
ED, I'LL BE PROVIDING A REPORT AND SET OF PLANS TO YOU ON THE RANCHO SANTA FE DEVELOPMENT IN AVONDALE. THEY ARE BUYING R/W FROM MCDOT ALONG THE WEST BANK OF THE AGUA FRIA RIVER, NORTH OF MCDOWELL ROAD. WE HAVE A FOUR BARREL CULVERT IN THE AREA AND ARE CONCERNED ABOUT SIDE DRAINAGE INTO THE CHANNNEL AND OUR FUTURE ACCESS ON TO THE LEVEE. I'VE ADVISED DM THAT MCDOT SHOULD NOT SELL THIS PARCEL UNTIL WE REVIEW THE REPORT AND DETERMINE IF THERE IS ANY IMPACT TO OUR STRUCTURE AND ACCESS. PLEASE REVIEW WITHIN THE NEXT TWO WEEKS, SINCE THE SALE IS SCHEDULED TO HAPPEN VERY SOON. THANKS

RANCHO SANTA FE
RESERVOIR AND BOOSTER PUMP STATION

CITY OF AVONDALE
PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION
1211 South Fourth Street
Avondale, Arizona 85323
(602) 932-1909

BID PACKAGE: Set No.: _____

☐ Instructions to Bidders	6	Sheets
☐ Insurance Requirements	5	Sheets
☐ Unit Price Contract Agreement	5	Sheets
☐ General Conditions	33	Sheets
☐ Bid Proposal	11	Sheets
☐ Technical Specifications	____	Sheets
☐ Plan Drawings: Rancho Santa Fe Well Site No. 10	3	Sheets *(Not Attached)*
☐ Plan Drawings: Rancho Santa Fe Reservoir and Booster Pump Station	23	Sheets *(Not Attached)*

(please verify contents)

BIDDER INFORMATION:

Name: _____
Address: _____
_____
Phone No.: _____
Contact: _____
License No.: _____

CITY OF AVONDALE
INSTRUCTIONS TO BIDDERS

IB 1.0 GENERAL INFORMATION:

IB 1.1 You are invited to submit bid proposals on the RANCHO SANTA FE RESERVOIR AND BOOSTER PUMP STATION, located in the City of Avondale.

The Project will involve the construction of one million gallon water tank and a 4000 GPM booster pump station, pressure sustaining valve, surge anticipator valve, and a chlorination system. Also involved will be the installation of system piping and other associated items.

Sealed bids will be accepted at the office of the City Clerk, City of Avondale, 11923 W. Indian School Road (temporary location at Calmat building), Avondale, Arizona, 85323, until 3:00 P.M. (MST), Thursday, August 22, 1996. Bidders shall submit their bids on the enclosed Bid Schedule forms with all, lump sum prices, and totals completed, typewritten or in ink. Bidders also agrees to furnish all affidavits, certificates, and any other information stipulated to be submitted with the bid proposal. Bidders must use the actual Bid Schedule forms provided by the City. Bids received after the time and date specified shall not be considered and be returned, unopened to the Bidder.

IB 1.2 Sets of the bid documents including the specifications will be available at the City of Avondale Public Works office located at 1211 South Fourth Street, Avondale AZ, 85323, (602) 932-1909, for a refundable deposit fee of $100.00. After the bid opening, the $100.00 deposit can be refunded to the plan holders in return for the bid documents in good condition.

IB 1.3 A **mandatory** pre-bid conference will be held on August 7, 1996, at 3:00 P.M. (MST), at the City of Avondale Public Works office located at 1211 South Fourth Street, Avondale AZ, 85323. Documented attendance at this pre-bid conference is a pre-requisite to submitting a bid for this Project.

IB 1.4 Each bid shall be submitted in a completely sealed, plain envelope, addressed to the City Clerk, City of Avondale, 11923 W. Indian School Road (temporary location at Calmat building), Avondale, Arizona 85323. Each sealed envelope containing a bid shall be plainly marked as follows:

CITY OF AVONDALE CONSTRUCTION PROJECT BID

BID FOR: RANCHO SANTA FE RESERVOIR AND BOOSTER PUMP STATION
PROJECT NO.: 5-6PWEN-2
BID DATE : August 22, 1996
BID TIME : 3:00 P.M. MST
BID SPECS/PLAN SET NO.: _____
BIDDER : _____
CONTRACTOR LICENSE NO.: _____
BIDDER ADDRESS: _____
_____
BIDDER CONTACT PERSON: _____
BIDDER PHONE NUMBER: _____

Each bidder shall submit the Bid Proposal (BP) section only, fully completed, and not the entire Bid Package. The Bid Proposal section includes the actual Bid Schedule, Proposal Guarantee, and other required bidder information, certificates, lists and affidavits.

IB 1.5 If forwarded by mail, the sealed envelope containing the bid must be enclosed inside the sending envelope.

IB 1.6 Any Bidder may withdraw or revise a proposal after it has been deposited with the City provided his request is received by the City, in writing or by telegram, before the bid opening time deadline. Revised bid proposals must be re-deposited before the specified bid opening.

IB 1.7 Each Bidder being an individual, partnership, or corporation under the same or different names can submit only one bid proposal for the same project.

IB 1.8 Bidders agree to abide by the terms of their submitted bid proposals for a period of sixty (60) consecutive days following the date of opening thereof and also agree that their bid may be accepted by the City at any time before the expiration of that period.

IB 1.9 The employment of contractors and subcontractors on public works projects shall be governed by the provisions of Section 34-241 of the Arizona Revised Statutes.

IB 1.10 If applicable, any required minority Contractor regulations and/or specific contract work item percent limitations must be strictly adhered to as outlined by this City or any additional funding agency as required by law.

IB 2.0 OPENING PROCEDURES

IB 2.1 Immediately following the bid submittal closing at City Hall, the received bids shall be opened and read publicly at the City of Avondale Council Chambers located at 521 East Western Avenue, Avondale, AZ, 85323. Bid totals, alternates, required Bidder information, required affidavits, subcontractor/supplier lists, acknowledged receipt of addenda, and bid guarantees shall be checked for attachment at the time of bid opening. Bid proposals which are considered irregular and/or incomplete may be rejected.

IB 2.2 A proposal guarantee (bid bond) in the form of a certified check, cashiers check or surety bond for ten percent (10%) of the amount of the bid will be required for this Project. No bid proposal will be read unless accompanied by a proposal guarantee in the proper amount. The guarantee shall be made payable and acceptable to the City of Avondale.

IB 2.3 The Bidder may be required to submit with his bid proposal a Subcontractor and/or Material Supplier List. The attached form must be filled out completely. Any subcontractor or supplier may be used more than once, provided that the listed party has the required state license to do that specific category of work. The Bidder may list himself to perform one or more of the listed work categories in which he has the proper state license if required. Only one name shall be provided for each listed work category.

IB 2.4 The City reserves the right to accept the lowest and/or most responsible Bidder, or to reject all proposals and to re-advertise for any reason the City determines. As soon as practicable, after the sealed bids have been opened, the City shall review the bid proposals checking the price extensions, addition and totals. In the event of a discrepancy, the unit price bid will govern and the grand total shall be adjusted accordingly. If the apparent low Bidder has made an obvious blunder in his bid proposal, the City may allow that Bidder to withdraw his bid proposal if requested. In which case the second lowest, responsible Bidder would be considered apparent low bid. Any evidence of collusion among Bidders or other recognized acts which are considered unethical, may be considered reason for bid disqualification. The results of the bid opening shall be considered public information.

IB 2.5 The City, through its duly authorized agent will award the contract to the lowest and/or best responsible Bidder, or reject all bid proposals as soon as practicable after the bid opening, up to the sixty (60) days maximum review period. The City reserves the right to cancel the award of any contract at any time before the contract execution by all parties, without any claims against the City.

IB 2.6 In case all of the bid proposals are rejected, or the initial bid date is postponed for some reason, any subsequent changes, additions, addenda, new specifications or new plan sets will be provided to all original plan set holders at no additional charge.

IB 3.0 CONTRACT BOND REQUIREMENTS

IB 3.1 The selected Bidder shall be required to furnish the following contract bonds:

IB 3.1.1 A performance bond in an amount equal to one hundred percent (100%) of the specified contract amount. Purpose being for the faithful performance of the contract in accordance with the plans, specifications and conditions thereof. Such bond shall be solely for the protection of the City.

IB 3.1.2 A payment bond in an amount equal to one hundred percent (100%) of the specified contract amount. Purpose being solely for the protection of claimants supplying labor or materials to the Contractor or his subcontractors in the prosecution of the contract work.

IB 3.2 Each bond shall include a provision allowing the prevailing party in a suit on such bond to recover, as part of the judgement, such reasonable attorney fees as may be fixed by a court of competent jurisdiction.

IB 3.3 Each bond shall be executed by a surety company authorized to do business in the State of Arizona. Each bond shall be made payable and acceptable to the City. The bonds shall be written or countersigned by an authorized representative of the surety who is either a resident of the State of Arizona or whose principal office is maintained in the State, as required by law, the bonds shall have attached thereto a certified copy of Power of Attorney of the signing official.

IB 3.4 The contract bonds shall be executed concurrently with the execution of the contract. The bonds shall become binding upon the award of the contract to the Contractor.

IB 4.0 INSURANCE REQUIREMENTS

IB 4.1 The selected Bidder will be required to carry all insurance which may be required by Federal and State laws, County and City Ordinances, Regulations and Codes. The Contractor shall submit a Certificate of Insurance on a form approved by the City. The Contractor must cover the minimum limits of liability for the specified types of insurance as outlined in detail in the insurance section of these contract documents.

IB 4.2 The complete project as described in the contract must be covered for the entire contract time until final acceptance by the City. Neither the Contractor nor any subcontractor shall commence work under a contract until the City has approved the insurance coverage, company, certificate and requirements as outlined in the contract documents. This is to take place concurrently with execution of the contract.

IB 5.0 CONTRACT AWARD

IB 5.1 A pre-award conference will be held with the selected Bidder to review the scope of work, specifications, contract documents, and schedule.

IB 5.2 The selected Bidder shall have ten (10) calendar days from receipt of the actual Notice of Award to completely and properly execute all required contract documents, obtain and provide the required contract bonds and furnish the necessary insurance certificate to the City. If not previously delivered before the Notice of Award, all the required contract documents will be included with the Notice of Award. If the selected Bidder fails to execute the contract documents and submit the required documents correctly and within the specified time period, the City, at its own option, may consider the Bidder in default, in which case the proposal guarantee for that Bidder will be forfeited.

IB 5.3 The City shall have twenty-one (21) calendar days from receipt of the acceptable contract documents to execute the contract.

IB 5.4 An executed duplicate of the contract will be sent to the Contractor. The City shall have forty five (45) calendar days from the date of contract execution by the agency, to issue a written Notice to Proceed to the Contractor.

IB 5.5 The Contractor shall commence the contract work within fourteen (14) calendar days from the issuance date of the Notice to Proceed unless otherwise directed. The Notice to Proceed shall have the actual contract start date, contract duration and the original contract completion date, stated in the document.

IB 5.6 All specified time periods may be adjusted by mutual agreement between the City and Contractor.

IB 5.7 If the City fails to execute the contract documents or fails to issue a Notice to Proceed within the specified time periods, the Contractor, by written notification, may withdraw and/or terminate the contract without further liability on the part of either party.

IB 6.0 BID CRITERIA

IB 6.1 The City has prepared and/or has had a contracted engineer prepare the plans, special conditions and technical supplemental conditions in accordance with acceptable engineering standards, giving such instruction which any competent contractor should be able to perform and complete satisfactorily.

IB 6.2 The Bidder shall examine the site of the proposed work and review all documents pertaining to the work. It is mutually agreed that the submission of a bid proposal shall be considered prima facie evidence that the Bidder has made adequate examination of the site and is familiar with the character, quality, and quantity of the work to be performed and material to be furnished.

IB 6.3 Soil reports, test hole logs, and ground water levels furnished by the City or by an outside engineering firm for the agency, are furnished for general information only. The existing field conditions as set forth shall not constitute a representation or warranty, expressed or implied, that such conditions actually exist. Bidders shall make their own investigations and form their own estimates of the site conditions.

IB 6.4 Any quantities appearing in the plans or proposal are approximate only and are to be used for comparison of bids. Payment to the Contractor will be made on a unit price basis as accepted by the City in accordance with the contract documents at the bid prices listed in the Bid Proposal submitted by the Contractor and as agreed upon in the contract Agreement. Bid item prices shall include all costs associated with that section of work as outlined in the general, special, technical, and/or supplemental conditions of the contract documents.

IB 6.5 Any questions concerning the project scope of work, bid specifications or contract documents can be directed to Mr. Ron Ablin P.E. at Wilson & Company at (602) 893-8860, before the bid opening. Questions answered over the phone or in person will be for clarification only. Bidders shall submit any questions that they may have regarding the Project via fax to Mr. Ablin at Wilson & Company (Fax No.: (602) 893-8968). Wilson & Company will respond to questions via fax to all plan holders. Bidders shall understand that only changes addressed in a formal written addendum are to be considered.

IB 6.6 Any information provided, other than in an addendum shall be interpreted at the Bidder's risk. The City shall not be held liable for any other information that is not included in an addendum.

IB 6.7 The City, after submission of the bid proposals, will not consider any complaints or claims made by a Bidder for the misunderstanding as to the quantities, conditions, or nature of the contract work.

IB 7.0 BID SPECIFICATIONS AND DOCUMENTS

IB 7.1 The Project Bid Specifications include the Plan Sheet Drawings, Plan Sheet Notes and Details Instructions to Bidders, General Conditions, Special Conditions, Technical Conditions,

special provisions, technical supplements, the Bid Proposal, Insurance Requirements and Certificates, Construction Contract, Payment and Performance Bonds, City Standard notes and details, and the latest MAG Standard Details and Specifications. These Project Bid Specification documents shall become part of the Contract Documents once a construction contract for the Project work is executed.

IB 7.2 Special Conditions, Special Provisions, General Conditions, Technical Conditions, Technical Supplements, City Standard Notes and Details, Title Plan Sheet Notes and Details, Plan Sheet Notes and Details, Plan Sheet Drawings, Instructions to Bidders, Bid Proposal, Construction Contract Agreement and M.A.G. Standard Details and Specifications shall be the descending order of precedence used in determining discrepancies unless the discrepancy is specifically addressed by addendum.

CITY OF AVONDALE

INSURANCE REQUIREMENTS FOR CONTRACTS

IR 1.0 THE CONTRACTOR SHALL AGREE TO THE FOLLOWING:

IR 1.1 Obtain insurance coverage of such types and amounts required in this section and keep such insurance coverage in force throughout the life of this contract. The Contractor will provide satisfactory certificates of the required coverage to the City before beginning work. All policies will contain an endorsement providing that written notice shall be given to the city at least thirty (30) calendar days prior to termination, cancellation, or reduction in coverage in any policy. Insurance policies shall not expire until all work has been completed and the project has been accepted by the City of Avondale. If a policy does expire during life of the contract, a renewal certificate of the required coverage must be sent to the City of Avondale not less than five (5) days prior to expiration date.

IR 1.2 Obtain insurance policies approved by the State of Arizona and acceptable to the City of Avondale. In addition, the City of Avondale will be included as an additional insured except Workers' Compensation and Professional Liability and all insurance policies are primary over any insurance available to the city and as to any claims resulting from this Contract, it being the intention of the parties that the insurance policies so affected shall protect both parties and be primary coverage for any and all losses covered by the described insurance.

IR 1.3 Each certificate shall include the job site and project number or name. Coverage shown on certificate of insurance must coincide with the requirements in the text of the Contract Documents.

IR 1.4 The Contractor agrees to indemnify, defend, and save harmless the City of Avondale, its Mayor and Council, appointed boards and commissions, officials, officers, employees, individually and collectively, from all losses, claims, suits, actions, payments, judgements, demands, expenses, attorney fees, defense costs, or actions of any kind of nature resulting from personal injury to any person, including employees of the contractor or of any subcontractor employed by the contractor (including bodily injury and death) or damages to any property, arising or alleged to have arisen out of the negligent performance of the contractor for the work in fulfillment of the construction of the improvement under the terms of this agreement, or on account of any act or omission by the contractor or his agents, or from any claims or amounts arising or recovered under Workers' Compensation laws or any other law, bylaw, ordinance, order or decree, except any such injury or damages arising out of the sole negligence of the City, its officers, agents or employees.

IR 1.5 If any of the Insurance requirements are not complied with at their renewal dates, payments to the contractor will be withheld until these requirements have been met, or at the option of the City, the City may pay the Renewal Premium and withhold such payments from any monies due to the Contractor.

IR 1.6 All Certificates of Insurance shall be approved by the City of Avondale prior to the start of any work.

IR 1.7 Failure of the Contractor to take out and/or maintain the required insurance shall not relieve the Contractor from any liability under the contract, nor shall the insurance requirements be construed to conflict with or otherwise limit the obligations of the contractor concerning indemnification.

IR 1.8 In the event that claims in excess of the insured amounts provided herein are filed by reason of any operations under the contract, the amount of excess of such claims, or any portion thereof, may be withheld from payment due or to become due the Contractor until such time as the Contractor shall furnish such additional security covering such claims as may be determined by the City of Avondale.

IR 1.9 Any and all deductibles in the insurance policies purchased by the Contractor shall be assumed by and be for the account of and at the sole risk of the Contractor.

IR 1.10 All certificates of insurance submitted by the Contractor shall include or have attached statements and clauses as provided in Schedule "A".

IR 1.11 The Contractor's insurance company shall provide the insurance certificate to the City on a form acceptable to the City and meeting all the requirements described herein.

IR 1.12 Provide and maintain insurance limits as follows:

TYPE OF INSURANCE	MINIMUM LIMITS OF LIABILITY	
GENERAL LIABILITY		
Comprehensive Form	General Aggregate	$ 1,000,000
Premises-Operations	Products-Comp/Ops Aggregate	$ 1,000,000
Explosion and Collapse Hazard	Personal & Advertising Injury	$ 1,000,000
Underground Hazard	Each Occurrences	$ 1,000,000
Products/Completed Operations	Fire Damage (Any one fire)	$ 50,000
Contractual	Medical Expense (Any one person)	$ 5,000
Broad Form Property Damage		
Independent Contractors		
Personal Injury		
AUTOMOBILE LIABILITY		
Any Auto	Combined Single Limit	$ 1,000,000
All Owned Autos	Each Occurrence	$ 1,000,000
Scheduled Autos	Aggregate	$ 1,000,000
Hired Autos		
Non-Owned Autos		
EXCESS LIABILITY	As Required	
Umbrella Form	Each Occurrence	$ 1,000,000
Other than Umbrella Form	Aggregate	$ 1,000,000
WORKER'S COMPENSATION AND EMPLOYER'S LIABILITY	Statutory	
OTHER		
Builders Risk	As Required	

SCHEDULE "A"

CONSTRUCTION CONTRACT
CERTIFICATE OF INSURANCE

It is further certified that the City of Avondale has been named as an additional insured as is required under said contract and that the independent contractor's insurance is primary over any insurance available to the City and to any claims resulting from the contract, it being the intention of both parties and be primary coverage for any and all losses covered by the described insurance.

We understand that the Contractor has agreed that none of these policies will be canceled or changed so as to affect this certificate until (30) days written notice of such cancellation or change has been delivered to the City of Avondale.

We understand that the Contractor has agreed that these policies shall not expire until all work has been completed and the project has been accepted by the City of Avondale. If a policy does expire during the Life of the Contract, a renewal Certificate of the required coverage must be sent to the City of Avondale not less than five (5) days prior to the expiration date.

We understand the Contractor has signed the following statement in the Contract:

> "The Contractor agrees to indemnify, defend, and save harmless the City of Avondale, its Mayor and Council, appointed boards and commission, officials, officers, employees, individually and collectively, from all losses, claims, suits, actions, payments, judgements, demands, expenses, attorney's fees, defense cost, or actions of any kind and nature resulting from personal injury to any person, including employees of the Contractor or of any subcontractor employed by the Contractor (including bodily injury and death) or damages to any property, arising or alleged to have arisen out of the negligent performance of the Contractor for the work done in fulfillment of the construction of the improvement under the terms of this agreement, or on account of any act or omission by The Contractor or his agents, or from any claims or amounts arising or recovered under Workers' Compensation laws or any other law, bylaw, ordinance, order or decree, except any such injury or damages arising out of the sole negligence of the City, its officers, agents or employees."

We understand that the insurance companies issuing the policy or policies shall have no recourse against the City of Avondale including its agents as aforesaid for payment of any premiums or for assessments under any form of policy.

We understand that any and all deductibles in the above described insurance policies shall be assumed by and be for the account, and at the sole risk of the Contractor.

This certificate is not valid unless countersigned by an authorized representative of the Contractor's Insurance Company.

_____
Contractor

_____
Name

_____
Title

_____ _____
Signature Date

COUNTERSIGNED BY:

_____
Contractor's Insurance Co.

_____
Name

_____
Title

_____ _____
Signature Date

UNIT PRICE CONTRACT

THIS AGREEMENT is made and entered into this _____ day of _____ _____, 1996, by and between the City of Avondale, Arizona, a municipal corporation, hereinafter referred to as "CITY", and _____, hereinafter referred to as "CONTRACTOR".

RECITALS

A. The Project is called the RANCHO SANTA FE RESERVOIR AND BOOSTER PUMP STATION, and is located in the City of Avondale, between Rancho Santa Fe Boulevard and The Agua Fria River, on McDowell Road.

B. The Project will involve the construction of one million gallon water storage tank, two 2000 GPM booster pumps, pressure sustaining valve, surge anticipator valve, and a chlorination system. Also involved will be the installation of system piping and other associated items.

C. The CITY agrees to engage the CONTRACTOR to perform work as outlined in this agreement, per the Contract Documents in connection with the PROJECT.

D. The CONTRACTOR is a bonded, insured and licensed _____ contractor, License No. _____ qualified to do business in the State of Arizona.

E. The CONTRACTOR has satisfied itself as to the nature and location of the Work, the general and local requirements of this Contract, the Contract Documents and all other matters which can affect the Work or cost of the Project.

NOW THEREFORE, the parties agree as follows:

1. The CONTRACTOR agrees to perform all of the work described in the Contract per the Contract Documents per the unit prices listed in the Price Schedule in attached Exhibit "A".

2. The CONTRACTOR shall furnish all required materials, labor, equipment, services and tools necessary for the completion of the project described in the Contract Documents and to the satisfaction of the CITY as necessary.

3. The CITY shall pay to the CONTRACTOR an amount, in the manner and at such times as set forth in the General Conditions of the Contract Documents herein. The Contract price is $_____ *and --/100)* **DOLLARS.** Added #1

4. Contract work shall begin within fourteen (14) days from receipt of Notice to Proceed and shall be completed within 180 ( ) consecutive calendar days unless altered by Change Order.

5. The term "Contract Documents" means and includes the following items which are made a part of the Contract and some of which are attached hereto:

   A. Contract Agreement
   B. General Conditions
   C. Technical Conditions and Provisions
   D. Price Schedule (Exhibit "A")
   E. Insurance Certificates
   F. Insurance Affidavit Schedule "A"
   G. Performance Bond
   H. Payment Bond
   I. Notice to Proceed
   J. Change Orders
   K. Letter of Completion and Acceptance
   L. Instructions to Bidders
   M. Insurance Requirements
   N. Bid Proposal
   O. Plan Drawings, Plan Notes and Plan Specifications
   P. Construction Schedule

6. All claims, disputes and other matters in question between the CITY and the CONTRACTOR arising out of, or relating to the Contract Documents or the breach thereof (except for claims which have been waived by the making or acceptance of final payment) shall be resolved by arbitration in accordance with locally accepted industry standards, rules and associations and in accordance with the prevailing law.

7. This agreement shall be binding upon all parties hereto and their respective heirs, executors, administrators, successors and assigns.

IN WITNESS WHEREOF, the CITY and the CONTRACTOR have caused this agreement to be duly executed as of the day, month and year first above written.

CITY OF AVONDALE

By:

_____

Mayor (sign) Date

_____

Attest:

_____

City Clerk (sign) Date

CONTRACTOR:

By:

_____

(sign) Date

Name

_____

Title

~~EXHIBIT "A"~~ Delete per add #1

CITY OF AVONDALE
RANCHO SANTA FE RESERVOIR AND BOOSTER PUMP STATION

PRICE SCHEDULE

TOTAL BID$

ITEM No.	DESCRIPTION	QUANTITY	UN	UNIT PRICE $	TOTAL AMOUNT $
	Base				
1.	General Requirements	1	LS		
2.	Surveying / Staking	1	LS		
3.	Verification of Field Dimensions and Utility Locations	1	LS		
4.	2000 GPM Booster Pump	2	EA		
5.	Chlorination System	1	LS		
6.	1 MG Water Storage Tank	1	LS		
7.	16-inch Flow Meter	1	EA		
8.	Dry Well	1	EA		
9.	Surge Anticipator Valve and Vault	1	EA		
10.	Pressure Sustaining Valve and Vault	1	EA		
11.	Eye Wash and Shower	1	EA		
12.	Pump Station Gravel	52	CY		
13.	Asphaltic Pavement	8800	SF		
14.	Wrought Iron Fence	370	LF		
15.	Pump Station Wall	1	LS		
16.	Chain Link Fence	240	LF		
17.	Fire Hydrant	1	LS		
18.	6-inch Ductile Iron Pipe and Fittings	11	LF		
19.	10-inch Ductile Iron Pipe and Fittings	34	LF		

ITEM No.	DESCRIPTION	QUANTITY	UN	UNIT PRICE $	TOTAL AMOUNT $
20.	12-inch Ductile Iron Pipe and Fittings	36	LF		
21.	16-inch Ductile Iron Pipe and Fittings	90	LF		
22.	20-inch Ductile Iron Pipe and Fittings	76	LF		
23.	24-inch Ductile Iron Pipe and Fittings	226	LF		
24.	8-inch Ductile Iron Pipe and Fittings	8	LF		
25.	8-inch PVC Pipe and Fittings	285	LF		
26.	20-inch PVC Pipe and Fittings	2622	LF		
27.	24-inch PVC Pipe and Fittings	53	LF		
28.	27-inch RCP Pipe and Fittings	265	LF		
29.	1-inch PVC Pipe and Fittings	382	LF		
30.	8-inch Butterfly Valve	2	EA		
31.	10-inch Butterfly Valve	4	EA		
32.	12-inch Butterfly Valve	2	EA		
33.	16-inch Butterfly Valve	3	EA		
34.	20-inch Butterfly Valve	2	EA		
35.	24-inch Butterfly Valve	3	EA		
36.	10-inch Check Valve	2	EA		
37.	Primary Electric	1	LS		
38.	Secondary Electric	1	LS		
39.	Miscellaneous Concrete	12	CY		
40.	Earthwork	1	LS		
41.	Diesel Generator	2	EA		
42.	Rip Rap	15	CY		
43.	PLC Programming	1	LS	$ 5,260	$ 5,260
44.	Catch Basin	1	LS		
45.	4" Air Release Valve	1	EA		
46.	Materials Testing	1	LS		
47.	Clearing and Grubbing	1	LS		
	TOTAL PRICE				$

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DEFINITIONS

1.0 WORDS AND TERMS:

The following words and terms, as used in or pertaining to the Project Specifications and Contract Documents, are defined as follows:

1.1 ADDENDA - Written or graphic instruments issued prior to the opening of Bids which clarify, correct or change the bidding documents or the Contract Documents.

1.2 BID - The offer or proposal of the bidder submitted on the prescribed forms setting forth the prices for the Work to be performed.

1.3 BONDS - Bid, performance and payment bonds and other instruments of security.

1.4 CERTIFICATE OF COMPLETION AND FINAL ACCEPTANCE - The certificate and acceptance by the CITY for the project work when it has been completed in all respects in according with the Contract Documents and any Modifications thereof previously approved. Such acceptance is constituted by a Certificate of Completion and Final Acceptance from the CITY to CONTRACTOR.

1.5 CHANGE ORDER - A written order to the CONTRACTOR from the CITY authorizing a substitution, addition, deletion, alteration, or revision in the Work, and/or an adjustment in the Contract Price or the Contract Time, or both, issued after the effective date of the Contract.

1.6 CHANGE ORDER REQUEST - A written request generated by either the CITY, ENGINEER or CONTRACTOR which states a changed condition in the Work or Contract Documents and asks for an addition, deletion or revision in the Work, and/or an adjustment in the Contract Price or the Contract Time, or both. Approval of a Change Order Request shall result in the execution of a Contract Change Order.

1.7 CITY - The word "CITY" or "OWNER" refers to the City of Avondale.

1.8 CONTRACTOR - The person, firm or corporation with whom the "CITY" has entered in the Contract.

1.9 CONTRACT - The written agreement between the CITY and CONTRACTOR covering the work; other Contract Documents are attached to the Contract and made a part thereof as provide therein.

1.10 CONTRACT DOCUMENTS - Means and Includes the Invitation to Bid and Instruction to Bidders, Bid Proposal and the Bid Schedule, addenda, Proposal Guarantee, Notice of Award, Insurance Requirements & Certificate, Contract Bonds, Contract, Notice to Proceed, Plan Sheet Drawings, General Plan Notes and Details, Standard Notes and Details, General

Conditions, Special Conditions, Technical Conditions, Technical Supplements, Special Provisions, Approved Submittals and Shop Drawings, Change Orders, Written Amendments, Work Directive Changes, Field Orders, Construction Schedules, Permits, and any specific Certificates and Affidavits.

1.11 CONTRACT DATE - The date indicated in the actual document on which the provisions of the contract and contract documents, if applicable, become effective and binding. This date is not to be confused with the project start date.

1.12 CONTRACT PRICE - The monies payable by the CITY to the CONTRACTOR for the Work under the provisions of the Contract Documents.

1.13 CONTRACT TIME - The length of time stated in the Contract Documents for completion of the Work.

1.14 Day - A calendar day of twenty-four hours measured from midnight to the next midnight.

1.15 DEFECTIVE - An adjective which when modifying the word Work refers to Work that is unsatisfactory, faulty or deficient, or does not conform to the Contract Documents, or does not meet the requirements of any inspection, reference standard, test or approval referred to in the Contract Documents, or has been damaged prior to recommendation of final payment.

1.16 DRAWINGS/PLANS - Means and includes Project Drawings, Detail Drawings and Standard Drawings.

1.17 ENGINEER/CONSULTANT - An individual or firm, if any, retained by the CITY to develop the design for the Project, or to provide other services relative to the Project as directed by the CITY District, acting either directly or through proper authorized agents, each agent acting only within the scope of authority delegated to it by the Consultant Engineer.

1.18 EXTRA WORK - Work outside the general scope of the Contract and not necessary to the completion of the Work.

1.19 FIELD ORDER - A written order issued by CITY or ENGINEER which orders minor changes in the Work in accordance with the Contract Documents but which does not involve a change in the Contract Price or the Contract Time.

1.20 NOTICE TO PROCEED - Written notice from the CITY to the CONTRACTOR fixing the project start date on which the Contact time shall commence to run and on which the CONTRACTOR shall start to perform its obligation under the Contract Documents.

1.21 NOTICE OF AWARD - Written notice from CITY to the apparent successful Bidder stating that upon compliance by the apparent successful Bidder with the conditions

precedent enumerated therein including submission by the successful Bidder of all required Contract Documents for approval, within the time specified, CITY will execute and deliver a Contract agreement.

1.22 PROJECT SPECIFICATIONS - Technical portions of the Contract Documents which contain specific clauses that outline conditions or requirements for materials, equipment, construction systems, methods, standards, workmanship, measurement and payment. These sections include but are not limited to; Instruction to Bidders, General Conditions, Special Conditions, Technical Conditions, Technical Supplements, Special Provisions, Approved Submittals and Shop Drawings, Plan Drawings, Plan Notes and Details, Standard Notes and Details, Schedules, and the Bid Proposal.

1.23 PRECONSTRUCTION CONFERENCE - A conference held before CONTRACTOR starts work at the Site, attended by CONTRACTOR, Subcontractor, Engineer and others as appropriate, to discuss schedules, Procedures, traffic control, safety issues, inspections, responsibilities, submittals and to establish a working understanding among the parties as to the Work.

1.24 PROJECT DRAWINGS - The drawings developed by the CITY or Engineer, or both, specifically for the Project which show the character and scope of the Work and are part of the Contract Documents.

1.25 SCHEDULE OF VALUES/BID SCHEDULE - A contract document which is part of the bid proposal reflecting the portions of the Contract Price allotted for the various parts of the Work and used as the basis for reviewing CONTRACTOR's Application for Payment.

1.26 SHOP DRAWINGS - All drawings, diagrams, illustrations, schedules and other data which are specifically prepared by or for CONTRACTOR to illustrate some portion of the Work, samples; and all illustrations, brochures, standard schedules, performance charts, instructions, diagrams, and other information prepared by a Supplier and submitted by CONTRACTOR to illustrate material or equipment for some portion of the Work.

1.27 SITE - The location or locations where the Work is to be accomplished.

1.28 SPECIAL CONDITIONS - Specific clauses setting forth requirements peculiar to the Work and which are supplementary to and take precedence over the General Conditions and the Technical Conditions.

1.29 STANDARD DETAIL DRAWINGS - Details of standard structures, devices, or installations, prepared by the CITY, Engineer or Consultant and referred to on the Project Drawing or in other Contract Documents.

1.30 SUBCONTRACTOR - An individual, firm or corporation having a direct subcontract with CONTRACTOR or with any other Subcontractor for the performance of a portion of the Work at the Site, or for the fabrication and installation of a portion of the Work in

accordance with drawings contained in the Contract or furnished by CONTRACTOR under the Contract.

1.31 SUBSTANTIAL COMPLETION - The Work (or a specified part thereof) has progressed to the point where, in the opinion of the CITY or ENGINEER, as evidenced by a definitive certificate of Substantial Completion, it is sufficiently complete, in accordance with the Contract Documents, so that the Work (or specified part) can be utilized for the purposes for which it is intended; or if there is no such document issued, when final payment is made in accordance with the Contract Documents.

1.32 SUPPLIER - A manufacturer, fabricator, supplier, distributor, materialman or vendor for or to a subcontractor or the CONTRACTOR.

1.33 TECHNICAL CONDITIONS - Sections of the Contract Documents which cover specific details of certain areas of the Work setting forth conditions or requirements for materials, equipment, methods, assembly, service, systems, standards, workmanship, testing, inspections, submittals, start-up, training, warranty, corrective action, acceptance, measurement and payment.

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

1.35 WORK/PROJECT - The entire construction or the total of the separately identifiable parts thereof required to be furnished under the Contract Documents. Work is the result of performing services, furnishing labor and furnishing and incorporating materials and equipment into the construction, all as required by the Contract Documents

1.36 WORK DIRECTIVE CHANGE - A written directive to CONTRACTOR, issued on or after the Contract Date and signed by the CITY and recommended by the ENGINEER, ordering an addition, deletion or revision in the Work or Contract Documents, or responding to differing or unforeseen circumstances or physical conditions under which the Work is to be performed as provided for in the Contract Documents. A Work Directive Change may not change the Contract Price or the Contract Time, but is evidence that the parties expect that the change which is directed or documented by a Work Directive Change will be incorporated into a subsequently issued Change Order, through a Change Order Request if applicable, and following negotiations by the affected parties as to its effect, if any, on the Contract Price and/or the Contract Time as provided for in the Contract Documents.

1.37 WRITTEN AMENDMENT - A written amendment of the Contract Documents, signed by CITY and CONTRACTOR on or after the Effective Date of the Agreement and normally

dealing with the non-engineering or nontechnical rather than strictly Work-related aspects of the Contract Documents.

PRELIMINARY REQUIREMENTS

2.0 SCOPE OF WORK:

2.1 All work performed under this Contract shall be in conformance with the approved project construction plans and specifications and Contract Documents.

2.2 The CONTRACTOR shall furnish all materials, labor, tools, and equipment and perform all operations required to complete the Project Work as described in the approved construction plans and specifications and Contract Documents. The CONTRACTOR shall complete all work items as shown in the Bid Proposal including all non-pay items and incidental work necessary to complete the required construction.

2.3 CONTRACTOR understands that payment shall be in accordance with the Contract Documents and with the prices listed in the Bid Schedule of the Bid Proposal and shall constitute full payment for all Work, including all indirect costs, incidentals, non-pay items, taxes, bonds, assessments, overhead and profit to be included in the appropriate unit price or lump sum for the specific Work item.

2.4 The Contract shall be responsible for obtaining and meeting the requirements of all applicable local, state and federal permits and regulations concerning the specific construction work, materials and methods as inherit and characterized by the project work as provided for in the Contract Documents.

2.5 The CONTRACTOR shall perform all work in accordance with the latest, locally accepted, commonly used, methods and standards of construction. All work shall be performed to the satisfaction of the CITY within reasonable requests. Any work that is substandard, not accepted and required to be redone, shall be at the CONTRACTOR's expense.

3.0 PROPOSAL QUANTITIES:

3.1 It is understood and agreed by the CONTRACTOR that the quantities of the various items of work to be done and material to be furnished under this Contract stated in the Bid Proposal are only approximate and are to be used solely for the purpose of comparison of the proposals offered for the work under this Contract on a consistent basis. The CONTRACTOR further agrees that the CITY shall not be held responsible if any of the quantities are determined by the CONTRACTOR to be found incorrect. The contractor shall not make any claim for damages or for loss of profits because of a difference between the quantities of the various items of work as estimated and the work actually done. Any error, omission, or misstatement in the estimated

quantities shall not invalidate the Contract or release the CONTRACTOR from the execution and completion of the whole or any part of the work in accordance with the Plans, Project Specifications and Contract Documents.

4.0 CONTRACT AWARD:

4.1 After the bid opening and after the bid and bidder are approved, and after the CITY's council approval, within the sixty (60) day time period, the selected Bidder shall have twenty-one (21) calendar days from receipt of the actual written Notice of Award to completely and properly execute all required Contract Documents including the actual construction contract, obtain and provide the required contract bonds, furnish the necessary insurance certificates and submit a construction schedule to the CITY. If not previously delivered before the Notice of Award, all the required contract documents will be included with the Notice of Award.

5.0 CONTRACT BOND REQUIREMENTS:

The CONTRACTOR shall be required to furnish the following contract bonds:

5.1 A performance bond in an amount equal to one hundred percent (100%) of the specified contract amount. Purpose being for the faithful performance of the contract in accordance with the plans, specifications and conditions thereof. Such bond shall be solely for the protection of the CITY.

5.2 A payment bond in an amount equal to one hundred percent (100%) of the specified contract amount. Purpose being for the protection of claimants supplying labor or materials to the CONTRACTOR or his subcontractors in the prosecution of the contract work.

5.3 Each bond shall include a provision allowing the prevailing party in a suit on such bond to recover, as part of the judgement, such reasonable attorney fees as may be fixed by a court of competent jurisdiction. Each bond shall be executed by a surety company authorized to do business in the State of Arizona. Each bond shall be made payable and acceptable to the CITY. The bonds shall be written or countersigned by an authorized representative of the surety who is either a resident of the State of Arizona or whose principal office is maintained in the State, as required by law, the bonds shall have attached thereto a certified copy of Power of Attorney of the signing official. The contract bonds shall be executed concurrently with the execution of the contract. The bonds shall become binding upon the award of the contract to the CONTRACTOR.

6.0 INSURANCE REQUIREMENTS:

6.1 The CONTRACTOR shall be required to submit an Insurance Certificate to the city to keep on file prior to issuance of the Notice to Proceed. The carrier, coverage and certificate must be approved by the CITY prior to start of work. The CONTRACTOR must also execute and submit to the CITY the provided Insurance Requirement Schedule "A".

6.2 The CONTRACTOR will be required to carry all insurance which may be required by Federal

and State laws, County and CITY Ordinances, Regulations and Codes. The contractor shall submit a Certificate of Insurance on a form approved by the CITY. The CONTRACTOR must cover the minimum limits of liability for the specified types of insurance as outlined in detail in the CITY of Avondale Insurance Requirements for Contracts as part of the Contract Documents.

6.3 The complete project as described in the contract must be covered for the entire contract time until final acceptance by the CITY. Neither the CONTRACTOR nor any subcontractor shall commence work under a contract until the CITY has approved the insurance coverage, company, certificate and requirements as outlined in the contract documents. This is to take place concurrently with execution of the contract.

7.0 TAXES:

7.1 CONTRACTOR shall pay all taxes including, but not limited to; sales, privilege, use, contracting, and excise taxes owing in connection with CONTRACTOR's performance of this contract. These costs shall be included in the appropriate unit price for that specific item.

8.0 CONSTRUCTION SCHEDULE:

8.1 The CONTRACTOR shall submit a project work item schedule to the CITY for review and approval by the CITY. The schedule will be required to be submitted after the Notice of Award. The schedule must be approved before a Notice to Proceed will be issued.

8.2 The CONTRACTOR is required to update the construction schedule should there be a change which affects other work activities and/or the specified project completion date. Any contract change order which affect the project time shall require an updated schedule.

9.0 NOTICE TO PROCEED:

9.1 After approval of the CITY's council, a written Notice to Proceed will be issued by the CITY to the CONTRACTOR within forty-five (45) calendar days from the date of contract execution by the CITY. The required contract bonds, securities establishment, insurance certificates, lists and affidavits, schedules and other documents, if required, must also be submitted, reviewed and approved by the CITY prior to issuance of the Notice to Proceed.

9.2 The CONTRACTOR shall commence the contract work within fourteen (14) calendar days from the issuance date of the Notice to Proceed unless otherwise directed. The Notice to Proceed shall have the actual project construction start date, project duration and the original project completion date, stated in the document.

10.0 PRECONSTRUCTION CONFERENCE:

10.1 A preconstruction conference shall be held at a designated place and time after the Notice to Proceed has been issued and before the actual construction work start date. The CONTRACTOR shall be responsible for contacting and scheduling the parties required to be in

attendance. The CONTRACTOR shall give the CITY a minimum of 48 hours notice.

CONTRACT DOCUMENTS

11.0 SPECIFICATIONS:

11.1 The Project Specifications include the plan sheet notes and details, Instructions to Bidders, General Conditions, Special Conditions, Technical Conditions, Bid Proposal, Insurance Requirements and Certificate, Construction Contract, Payment and Performance Bonds, Standard notes and details, special provisions. Technical supplements and the latest MAG Standard Details and Specifications. The Project Specifications shall become part of the Contract Documents once a contract for the project work is executed.

11.2 Special Provisions, Special Conditions, General Conditions, Technical Conditions, Technical Supplements, Approved Submittals and Shop Drawings, Standard Notes and Details, Title Plan Sheet Notes and Details, Plan Sheet Notes and Details, Plan Sheet Drawings, Instructions to Bidders, Bid Proposal and M.A.G. Standard Details and Specifications shall be the descending order of precedence used in determining discrepancies unless the discrepancy is specifically addressed by addendum, change order or amendment.

12.0 DISCREPANCIES AND ADDENDA:

12.1 Bidders shall notify the CITY immediately if any ambiguity, discrepancy, inconsistency or error is found in the Plans or Project Specifications. The CITY shall issue a written addendum to all bidder addressing the correction or clarification if warranted. Any addenda issued by the CITY during the bid time shall be included in the Bid Proposal. All addenda shall become part of the project Specifications and Contract Documents.

13.0 AMENDING AND SUPPLEMENTING CONTRACT DOCUMENTS:

13.1 The Contract Documents may be amended to provide for additions, deletions and revisions in the Work or to modify the terms and conditions thereof in one or more of the following ways; 1) a formal Written Amendment, 2) a Contract Change Order and 4) a Work Directive Change. A Change Order Request or Work Directive Change may be used to generate a Contract Change Order or Written Amendment. Contract Price and Contact Time may only be changed by a Change Order or a Written Amendment.

13.2 In addition, the requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, in one or more of the following ways; 1) a Field Order, 2) ENGINEER's approval of a Shop Drawing or sample or 3) ENGINEER's written interpretation or clarification of the Contract Documents.

PHYSICAL CONDITIONS AND CONTROL

14.0 PHYSICAL CONDITIONS:

14.1 Explorations and Reports - CONTRACTOR may rely upon the accuracy of technical data contained in reports, but not upon nontechnical data, interpretations or opinions contained therein or for the completeness thereof for CONTRACTOR's purpose. CONTRACTOR shall have full responsibility with respect to subsurface conditions at the site.

14.2 Existing Structures - Drawings of physical conditions in or relating to existing surface and subsurface structures (except Underground Facilities referred to in Section 29.0) which are at or contiguous to the site that have been utilized by the ENGINEER in preparation of the Contract Documents. CONTRACTOR may rely upon the accuracy of the technical data contained in such drawings, but not for the completeness thereof for CONTRACTOR's purpose. CONTRACTOR shall have full responsibility with respect to physical conditions in or relating to such structures.

14.3 Report of Differing Conditions - If CONTRACTOR believes that any technical data on which CONTRACTOR is entitled to rely as provided, is inaccurate, or any physical condition uncovered or revealed at the site differs materially from that indicated, reflected or referred to in the Contract Documents, CONTRACTOR shall, promptly after becoming aware thereof and before performing any Work in connection therewith, notify CITY and ENGINEER in writing about the inaccuracy or difference.

14.4 Possible Documents Change - If CITY or ENGINEER concludes that there is a material error in the Contract Documents or that because of newly discovered conditions a change in the Contract Documents is required, a Work Directive Change, Contract Change Order or a Written Amendment will be issued to reflect and document the consequences of the inaccuracy or difference.

14.5 Possible Price and Time Adjustments - In each such case, an increase or decrease in the Contract Price or an extension or shortening of the Contract Time, or any combination thereof, may be allowable to the extent that they are attributable to any such inaccuracy or difference.

15.0 PHYSICAL CONDITIONS-UNDERGROUND FACILITIES:

15.1 Shown or Indicated - The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the site is based on information and data furnished to CITY or ENGINEER by the owners of such Underground Facilities or by others. Unless it is otherwise expressly provided in the Special Conditions. CITY and ENGINEER shall not be responsible for the accuracy or completeness of any such information or data.

15.2 CONTRACTOR shall have full responsibility for reviewing and checking all such information

and data, for locating all Underground Facilities shown or indicated in the Contract Documents, for coordination of the Work with the owners of such Underground Facilities during construction, for the safety and protection thereof and repairing any damage thereto resulting from the Work, the cost of all of which will be considered as having been included in the Contract Price.

15.3 Not Shown or Indicated - If an Underground Facility is uncovered or revealed at or contiguous to the site which was not shown or indicated in the Contract Documents and which CONTRACTOR could not reasonably have been expected to be aware of, CONTRACTOR shall, promptly after becoming aware thereof and before performing any Work affected thereby, identify the owner of such Underground Facility and give written notice thereof to that owner and to CITY and ENGINEER. ENGINEER will promptly review the Underground Facility to determine the extent to which the Contract Documents should be modified to reflect and document the consequences of the existence of the Underground Facility, and the Contract Documents will be amended or supplemented to the extent necessary. During such time, CONTRACTOR shall be responsible for the safety and protection of such Underground Facility. CONTRACTOR may be allowed an increase in the Contract Price or an extension of the Contract Time, or both, to the extent that they are attributable to the existence of any Underground Facility that was not shown or indicated in the Contract Documents and which CONTRACTOR could not reasonably been expected to be aware of.

16.0 CONTROL POINTS:

16.1 CITY or ENGINEER shall provide engineering surveys to establish control points for construction which in ENGINEER's judgement are necessary to enable CONTRACTOR to proceed with the Work. CONTRACTOR shall be responsible for layout and staking of the Work, unless otherwise specified in the Special Conditions, shall protect and preserve the established control points and shall make no changes or relocations without the prior written approval of CITY or ENGINEER. CONTRACTOR shall report to ENGINEER whenever any control point is lost or destroyed or requires relocation because of necessary changes in grade or locations. All re-surveying shall be done by the original party when available and any re-surveying costs due to lost or destroyed control points shall be at the CONTRACTOR's expense.

16.2 When specified and where called for in the Special Conditions, the CITY or ENGINEER shall provide for all construction staking, on a one time basis, of the Work as determined necessary to construct the Work by normally accepted standards and which could be constructed by any competent Contractor. Any re-staking or additional staking requested shall be at the CONTRACTOR's expense. A minimum of 48 hours advance notice is required for staking. Otherwise, if not specified in the Special Conditions, all construction staking and layout shall be the CONTRACTOR's responsibility.

16.3 Unless specified otherwise, all required as-built surveys, record drawings and certifications shall be the responsibility of the party who performs the original construction layout staking, be it the CITY, ENGINEER or CONTRACTOR. The CITY or ENGINEER may, at its option and cost, perform additional or separate as-built surveys to verify compliance of the Work with the Contract Documents.

CONTRACTOR'S RESPONSIBILITIES

17.0 SUPERVISION AND SUPERINTENDENCE:

17.1 CONTRACTOR shall supervise and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. CONTRACTOR shall be solely responsible for the means, methods, techniques, sequences and procedures of construction, but CONTRACTOR shall not be responsible for the negligence of others in the design or selection of a specific means, method, technique, sequence or procedure of construction which is indicated in and required by the Contract Documents. CONTRACTOR shall be responsible to see that the finished Work complies accurately with the Contract Documents.

17.2 CONTRACTOR shall keep on the Work at all times during its progress a competent resident superintendent, who shall not be replaced without written notice to CITY except under extraordinary circumstances. The superintendent will be CONTRACTOR's representative at the site and shall have authority to act on behalf of CONTRACTOR. All communications and information given to the superintendent shall be as binding as if given to CONTRACTOR.

18.0 LABOR, MATERIALS AND EQUIPMENT:

18.1 CONTRACTOR shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. CONTRACTOR shall at all times maintain good discipline and order at the site.

18.2 Unless otherwise specified in the Special Conditions, CONTRACTOR shall furnish and assume full responsibility for all materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities and all other facilities and incidentals necessary for the furnishing, performance, testing, start-up and completion of the Work.

18.3 All materials and equipment shall be of good quality and new, except as otherwise provided in the Contract Documents. If required by CITY, CONTRACTOR shall furnish satisfactory evidence (including reports of required tests) as to the kind and quality of materials and equipment. All materials and equipment shall be applied,installed, connected, erected, used, cleaned and conditioned in accordance with the instructions of the applicable Supplier except as otherwise provided in the Contract Documents.

18.4 The CONTRACTOR shall perform all work in accordance with the latest, locally accepted, commonly used, methods and standards of construction. All work shall be performed to the satisfaction of the CITY within reasonable requests. Any work that is substandard, not accepted and required to be redone, shall be at the CONTRACTOR's expense.

19.0 SUBSTITUTES AND "OR-EQUAL" ITEMS:

19.1 Whenever materials or equipment are specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier the naming of the item is intended to establish the type, function and quality required. Unless the name is followed by words indicating that no substitution is permitted, materials or equipment of other Suppliers may be accepted by ENGINEER if sufficient information is submitted by CONTRACTOR to allow ENGINEER to determine that the material or equipment proposed is equivalent or better to that named. Requests for review of substitute items of material and equipment will not be accepted by ENGINEER from anyone other than CONTRACTOR. If CONTRACTOR wishes to furnish or use a substitute item of material or equipment, CONTRACTOR shall make written application to ENGINEER for acceptance thereof, certifying that the proposed substitute will perform adequately the functions and achieve the results called for by the general design, be similar and of equal substance to that specified and be suited to the same use as that specified.

19.2 If a specific means, method, technique, sequence or procedure of construction is indicated in or required by the Contract Documents, CONTRACTOR may furnish or utilize a substitute means, method, sequence, technique or procedure of construction, acceptable to ENGINEER, if CONTRACTOR submits sufficient information to allow ENGINEER to determine that the substitute proposed is equivalent to that indicated or required by the Contract Documents.

20.0 SUBCONTRACTORS, SUPPLIERS AND OTHERS:

20.1 If the bidding documents or contract documents require the identity of certain Subcontractors, Suppliers or other persons or organizations, including those who are to furnish principle items of materials and equipment, to be submitted to CITY in advance of the specified date prior to the Contract Date for acceptance by the CITY and ENGINEER and if CONTRACTOR has submitted a list thereof in accordance with the Special Conditions, CITY's or ENGINEER's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the bidding documents or the Contract Documents) of any such Subcontractor, Supplier or other person or organization so identified may be revoked on the basis of reasonable objection after due investigation, in which case the CONTRACTOR shall submit an acceptable substitute.

20.2 CONTRACTOR shall be fully responsible to CITY and ENGINEER for all acts and omissions of the Subcontractors, Suppliers and other persons and organizations performing or furnishing any of the Work under a direct or indirect contract with CONTRACTOR just as CONTRACTOR is responsible for CONTRACTOR's own acts and omissions.

20.3 All Work performed for CONTRACTOR by a Subcontractor will be pursuant to an appropriate agreement between CONTRACTOR and the Subcontractor which specifically binds the Subcontractor to the applicable terms and conditions of the Contact Documents for the benefit of CITY.

21.0 DAILY REPORTS:

21.1 The CONTRACTOR shall provide daily reports to the CITY on a form acceptable to the CITY. The reports shall be submitted to the CITY on a weekly basis. The reports shall contain the following information: day, date and year; project title and project location; weather conditions including the temperature; times and hours worked; manpower description and quantity; equipment description and quantity; brief description of the Work performed for that day including quantities and locations (station numbers if applicable); inspections and tests; visitors; accidents and/or delays; working conditions; unexpected events or circumstances; discovery of differing or unforeseen physical conditions; discovery of a discrepancy, error, or omission in the Contract Documents; signed by the CONTRACTOR's representative such as the project superintendent or job foreman.

21.2 This standard daily project Work report is to be considered separate from any other reporting required in the Contract Documents or from other reporting required by other governing bodies or funding agencies.

22.0 CONSTRUCTION SCHEDULE:

22.1 The CONTRACTOR is required to update the construction schedule should there be a change which affects other work activities and/or the specified project completion date. Any contract change order which affect the project time shall require an updated schedule.

23.0 PERMITS:

23.1 The Contract shall be responsible for obtaining and meeting the requirements of all applicable local, state and federal permits and regulations concerning the specific construction work, materials and methods as inherit and characterized by the project work as provided for in the Contract Documents.

23.2 Unless otherwise provided in the Special Conditions, CONTRACTOR shall obtain and pay for all construction permits and licenses. CITY shall assist CONTRACTOR, when necessary, in obtaining such permits and licenses. CONTRACTOR shall pay all governmental charges and inspection fees necessary for the prosecution of the Work.

24.0 LAWS AND REGULATIONS:

24.1 CONTRACTOR shall give all notices and comply with all Laws and Regulations applicable to furnishing and performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither CITY nor ENGINEER shall be responsible for monitoring CONTRACTOR's compliance with any Laws or Regulations.

25.0 TAXES:

25.1 CONTRACTOR shall pay all sales, consumer, use and other similar taxes required to be

paid by CONTRACTOR in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

26.0 USE OF PREMISES:

26.1 CONTRACTOR shall confine construction equipment, the storage of materials and equipment and the operations of workers to the Project site and land and areas identified in and permitted by the Contract Documents and other land and areas permitted by Laws and Regulations, rights-of-way, permits and easements, and shall not unreasonably encumber the premises with construction equipment or other materials or equipment. CONTRACTOR shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof or of any land or areas contiguous thereto, resulting from the performance of the Work.

26.2 During the progress of the Work, CONTRACTOR shall keep the premises free from accumulations of waste materials, rubbish and other debris resulting from the Work. At the completion of the Work, CONTRACTOR shall remove all waste materials, rubbish and debris from and about the premises as well as all tools, appliances, construction equipment and machinery, and surplus materials, and shall leave the site clean and ready for occupancy by CITY. CONTRACTOR shall restore to original condition all property not designated for alteration by the Contract Documents.

27.0 SAFETY AND PROTECTION:

27.1 CONTRACTOR shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. CONTRACTOR shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to its workers, subcontractors and all employees on the Work and other persons and organizations who may be affected thereby; all the Work and materials and equipment to be incorporated therein, whether in storage on or off the site; and other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities and Underground Facilities not designated for removal, relocation or replacement in the course of construction.

27.2 CONTRACTOR shall comply with all applicable Laws and Regulations of any public body having jurisdiction for the safety of persons or property or to protect them from damage, injury or loss; and shall erect and maintain all necessary safeguards for such safety and protection. CONTRACTOR shall notify owners of adjacent property and of Underground Facilities and utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation and replacement of their property. All damage, injury or loss to any property referred to, caused, directly or indirectly, in whole or in part, by CONTRACTOR, any Subcontractor, Supplier or any other person or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, shall be remedied by CONTRACTOR. CONTRACTOR's duties and responsibilities for the safety and protection of the Work shall continue until such time as all the Work is completed and CITY has accepted and taken ownership of or use of the project Work.

27.3 CONTRACTOR shall designate a responsible representative at the site whose duty shall be the prevention of accidents. This person shall be CONTRACTOR's superintendent unless otherwise designated in writing by CONTRACTOR to CITY.

28.0 PROJECT SITE CONTROL REQUIREMENTS:

28.1 CONTRACTOR shall be responsible for dust control related to the project Work construction and shall initiate and continue whatever means and measures necessary to control or eliminate the generation of airborne dust.

28.2 CONTRACTOR shall be responsible for adequate barricading and traffic control, as approved by the CITY or ENGINEER, where the construction of the new facilities is adjacent to or connecting to any existing facilities. The CONTRACTOR is required to submit a traffic control and barricade plan to the CITY or ENGINEER, for approval, before that particular Work can be performed.

28.3 CONTRACTOR shall be responsible for building and maintaining proper and adequate access, including roads, into and throughout the project site or area allowing for inspection and testing accessibility. This is to include but not be limited to; grading, gravel fill, ramps, temporary pavement, planking or boarding, trench plates and dust control.

28.4 CONTRACTOR shall be responsible for daily and final clean-up operations of adjacent existing facilities, including streets, that are used by the CONTRACTOR and other construction traffic related to the project. This work incudes street sweeping, power broom and water as needed.

28.5 CONTRACTOR shall be responsible for providing all necessary security measures for the project site including temporary fencing, lighting, devices and personnel to protect the project, materials, equipment and Work being constructed.

29.0 SHOP DRAWINGS AND SAMPLES:

29.1 After checking and verifying all field measurements and after complying with applicable procedures specified in the General Conditions, CONTRACTOR shall submit to ENGINEER for review and approval in accordance with the accepted schedule of Shop Drawing submissions, or for other appropriate action if so indicated in the Special Conditions, five copies (unless otherwise specified) of all Shop Drawings. All submissions will be identified as ENGINEER may require. The data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials and similar data to enable ENGINEER to review the information as required.

29.2 CONTRACTOR shall also submit to ENGINEER for review and approval with such promptness as to cause no delay in Work, all samples required by the Contract Documents. All samples will have been checked by and accompanied by a specific written indication that CONTRACTOR has satisfied CONTRACTOR's responsibilities under the Contract Documents

with respect to the review of the submission and will be identified clearly as to material, Supplier, pertinent data such as catalog numbers and the use for which intended.

29.3 At the time of each submission, CONTRACTOR shall give ENGINEER specific written notice of each variation that the Shop Drawings or samples may have from the requirements of the Contract Documents, and , in addition, shall cause a specific notation to be made on each Shop Drawing submitted to ENGINEER for review and approval of each such variation.

29.4 ENGINEER will review and approve with reasonable promptness Shop Drawings and samples, but ENGINEER's review and approval will be only for conformance with the design concept of the Project and for compliance with the information given in the Contract Documents and shall not extend to means, methods, techniques, sequences or procedures of construction (except where a specific means, method, technique, sequence, or procedure of construction is indicated in or required by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions. CONTRACTOR shall make corrections required by ENGINEER, and shall return the required number of corrected copies of Shop Drawings and submit as required new samples for review and approval. CONTRACTOR shall direct specific attention in writing to revisions other than the corrections called for by ENGINEER on previous submittals.

29.5 ENGINEER's review and approval of Shop Drawings or samples shall not relieve CONTRACTOR from responsibility for any variation from the requirements of the Contract Documents unless CONTRACTOR has in writing called ENGINEER's attention to each such variation at the time of submission as required and ENGINEER has given written approval of each such variation by a specific written notation thereof incorporated in or accompanying the Shop Drawing or sample approval; nor will any approval by ENGINEER relieve CONTRACTOR from responsibility for errors or omissions in the Shop Drawings.

30.0 RECORD DOCUMENTS:

30.1 CONTRACTOR shall maintain in a safe place at the site one record copy of all Drawings, Specifications, Addenda, Written Amendments, Change Order Requests, Contract Change Orders, Work Directive Changes, Field Orders written interpretations and clarifications, all in good order and annotated to show all changes made during construction. These record documents together with all approved samples and a counterpart of all approved Shop Drawings will be available to ENGINEER for reference. Upon completion of the Work, these record documents, samples and Shop Drawings will be delivered to ENGINEER for CITY.

31.0 CONTINUING THE WORK:

31.1 CONTRACTOR shall carry on the Work and adhere to the progress schedule during all disputes or disagreements with CITY. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except if permitted by the Contract Documents or as

CONTRACTOR and CITY may otherwise agree in writing.

32.0 RELATED WORK AT SITE:

32.1 CITY may perform other work related to the Project at the site by CITY's own forces, have other work performed by utility owners or let other direct contracts therefor which shall contain General Conditions similar to these. If the fact that such other work is to be performed was not noted in the Contract Documents, written notice thereof will be given to CONTRACTOR prior to starting any such other work.

32.2 CONTRACTOR shall afford each utility owner and other contractor who is a party to such a direct contract (or CITY, if CITY is performing the additional work with CITY employees) proper and safe access to the site and a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such Work, and shall properly connect and coordinate the Work with theirs.

32.3 If any part of CONTRACTOR's Work depends for proper execution or results upon the work of any such other contractor or utility owner (or CITY), CONTRACTOR shall inspect and promptly report to ENGINEER in writing any delays, defects or deficiencies in such work that render it unavailable or unsuitable for such proper execution and results. CONTRACTOR's failure to report will constitute an acceptance of the other work as fit and proper for integration with CONTRACTOR's Work except for latent or nonapparent defects and deficiencies in the other work.

32.4 In the event that the CITY, utility company, or other contractor is working in the same or adjacent area, the CONTRACTOR shall perform the Contract work to the best of his ability in cooperation with the other party without claims for delays or hindrances. Persistent hindrances or adverse conditions shall be brought to the CITY's attention.

ENGINEER AND CITY RESPONSIBILITIES

33.0 AVAILABILITY OF LANDS:

33.1 CITY shall furnish, as indicated in the Contract Documents, the lands upon which the Work is to be performed, rights-of-way and easements for access thereto, and such other lands which are designated for use by the CONTRACTOR. Any delay in CITY's furnishing these lands, rights-of-way or easements, will entitle the CONTRACTOR to an extension of the Contract Time.

33.2 CONTRACTOR shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

34.0 VISITS TO SITE:

34.1 ENGINEER or CITY will make visits to the site at intervals appropriate to the various stages of construction to observe the progress and quality of the executed Work and to determine, in general, if the Work is proceeding in accordance with the Contract Documents. ENGINEER or CITY will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work.

35.0 CLARIFICATIONS AND INTERPRETATIONS:

35.1 ENGINEER will issue with reasonable promptness such written clarifications or interpretations of the requirements of the Contract Documents (in the form of Drawings or otherwise) as ENGINEER may determine necessary, which shall be consistent with or reasonably inferable from the overall intent of the Contract Documents.

36.0 REJECTING DEFECTIVE WORK:

36.1 ENGINEER will have authority to disapprove or reject Work which ENGINEER believes to be defective, and will also have authority to require special inspection or testing of the Work.

37.0 LIMITATIONS ON ENGINEERS RESPONSIBILITIES:

37.1 ENGINEER will not be responsible for CONTRACTOR's means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto, and ENGINEER will not be responsible for CONTRACTOR's failure to perform or furnish the Work in accordance with the Contract Documents.

37.2 ENGINEER will not be responsible for the acts or omissions of CONTRACTOR or of any Subcontractor, any Supplier, or of any other person or organization performing or furnishing any of the Work.

CHANGE OF WORK

38.0 CHANGES IN THE WORK:

38.1 Without invalidating the Agreement and without notice to any surety, CITY may, at any time or from time to time, order additions, deletions or revisions in the Work as may be found necessary or desirable.

38.2 CITY and CONTRACTOR shall execute appropriate Contract Change Orders or Written Amendments covering;

38.2.1 changes in the Work which are ordered by CITY and approved by ENGINEER,

38.2.2 extra work which is unexpectedly encountered during progress of the work

that is beyond the original contract scope of work due to subsurface or latent physical conditions at the site of an unusual or unknown nature, differing materially from those ordinarily encountered and generally recognized as inherit in work of the character provided for in the Contract Documents,

38.2.3 changes due to unforeseen conditions or circumstances as delineated in the Contract Documents herein,

38.2.4 changes required because of acceptance of defective Work,

38.2.5 changes required in correcting defective Work, and

38.2.6 changes due to omissions, discrepancies or deficiencies in the Contract Documents which are acknowledged by the ENGINEER and result in a written clarification or decision rendered by the ENGINEER.

These changes will be authorized by a Field Order, Work Directive Change, Change Order Request, Contract Change Order or a Written Amendment.

38.3 ENGINEER shall have fourteen (14) days from date of notice or discovery to address and generate a Change of Work request; or to approve a Change of Work request and submit to CITY for approval.

38.4 CONTRACTOR shall have fourteen (14) days from date of notice to respond to a Change of Work request from CITY or ENGINEER.

38.5 CITY shall have twenty-one (21) days from date of notice or discovery to generate a Change of Work request; or to review and approve a Change of Work request submitted by CONTRACTOR or ENGINEER.

38.6 CITY and CONTRACTOR shall agree as to the extent, if any, of an increase or decrease in the Contract Price or an extension or shortening of the Contract Time that should be allowed as a result of the change of Work.

38.7 CONTRACTOR shall, during the time frames involved in the Change of Work request process stated herein, continue to perform the Work in accordance with the Contract Documents, unless otherwise directed, without claim for delay or additional compensation.

38.8 Any Change of Work document must be properly approved and executed by both CITY and CONTRACTOR to become part of the Contract Documents and part of the Work. Upon receipt of any such document, CONTRACTOR shall promptly proceed with the Work involved which will be performed, unless otherwise directed, under the applicable conditions of the Contract Documents.

38.9 CONTRACTOR shall not be entitled to an increase in the Contract Price or an extension

of the Contract Time with respect to any Work performance that is not required by the Contract Documents as amended, modified and supplemented.

39.0 CHANGE OF CONTRACT PRICE:

39.1 The Contract Price constitutes the total compensation (subject to authorized adjustments) payable to CONTRACTOR for performing the Work. All duties, responsibilities and obligations assigned to or undertaken by CONTRACTOR shall be at his expense without change in the Contract Price.

39.2 The Contract Price may only be changed by a Change Order or by a Written Amendment. Any claim for an increase or decrease in the Contract Price shall be based on written notice delivered by the party making the claim to the other party and to ENGINEER promptly, no later than thirty days after the occurrence of the event giving rise to the claim and stating the general nature of the claim. No claim for an adjustment in the Contract Price will be valid if not submitted within the above stated time frame.

39.3 CONTRACTOR shall submit all back-up documentation and detailed cost breakdowns as may be requested by CITY or ENGINEER. Submitted information shall be incorporated into the Change Order document or Written Amendment as deemed appropriate by the CITY. Approval of requested back-up documentation and cost breakdowns is required prior to CITY execution of the Change of Work document.

39.4 If required, the CITY shall issue a separate, final quantity adjustment Change Order to reflect contract completion at 100%. All quantity overages shall require a Change Order and CITY approval prior to CONTRACTOR submitting a final Application for Payment and subsequent CITY payment.

39.5 The value of any Work covered by a Change Order or of any claim for an increase or decrease in the Contract Price shall be determined in one of the following ways:

39.5.1 Where the Work involved is covered by unit prices contained in the Contract Documents, by application of these unit prices to the quantities of items involved.

39.5.2 By mutual acceptance of a lump sum which may include an allowance for overhead and profit.

39.5.3 Mutually agreed upon work item, quantity and corresponding unit price.

39.5.4 On the basis of the Cost of the Work as listed in Section 49.0 plus a CONTRACTOR's Fee for insurance, bond, overhead, profit and tax.

39.6 CONTRACTOR's Fee:

A. Itemized Breakdown:

1) Cost of Work; By task or by Work item (or)

2) Cost of Work; By labor, material, equipment & subcontract

B. Insurance & Bond on [A.]

C. Overhead: 10% on [A.+ B.]

D. Profit: 5% on [A.+ B.]

E. TAX: 7.0% of 65% of [A.+ B.+ C.+ D.]

F. TOTAL COMPENSATION = Sum of above Items A. through E.

40.0 COST OF THE WORK:

40.1 The term Cost of the Work means the sum of all costs necessarily incurred and paid by CONTRACTOR in the proper performance of the Work. Except as otherwise may be agreed to in writing by CITY or as deemed allowable in the Contract Documents, such costs shall be in amounts no higher than those prevailing in the locality of the Project. These costs shall include only the following items:

40.1.1 Payroll costs for employees in the direct employ of CONTRACTOR in the performance of the Work under schedules of job classifications agreed upon by CITY and CONTRACTOR or as designated in accordance with a governing body, funding agency or labor organization as allowable under Laws and Regulations, if applicable. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work.

40.1.2 Costs of all materials, services and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof.

40.1.3 Payments made by CONTRACTOR to the Subcontractors for Work performed by Subcontractors. If required by CITY, CONTRACTOR shall obtain competitive bids from Subcontractors acceptable to CONTRACTOR and shall deliver such bids to CITY who will then determine, with the advice of ENGINEER, which bids will be accepted. All subcontracts shall be subject to the other provisions of the Contract Documents insofar as applicable.

40.1.4 Costs of engineers, architects, testing laboratories and surveyors, employed for services necessary and specifically related to the Work.

40.1.5 The proportion of necessary transportation, travel and subsistence expenses of CONTRACTOR's employees incurred in the discharge of duties connected with the Work. If applicable, these costs shall be in accordance with a designated governing body, funding agency or labor organization as allowable under Laws and Regulations.

40.1.6 Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office and temporary facilities at the site and hand tools not owned by the workers, which are consumed in the performance of the Work.

40.1.7 Rentals of all construction equipment and machinery and the parts thereof whether rented from CONTRACTOR or others in accordance with rental agreements, and the costs of transportation, loading, unloading, installation, dismantling and removal thereof; all in accordance with terms of said rental agreements.

40.1.8 Sales, consumer, use or similar taxes related to the Work, and for which CONTRACTOR is liable, imposed by Laws and Regulations.

40.1.9 The cost of utilities and hook-ups thereof, fuel, sanitary facilities, and security facilities at the site.

40.1.10 Costs of all additional, associated Work at the site including but not limited to; mobilization, site control maintenance, routine and final clean-up operations, construction water, site access, barricades and traffic control.

40.1.11 All associated, administrative work and tasks directly related and attributable to the project Work including but not limited to; job set-up costs, daily reports, project documentation, progress meetings, special meetings, payroll processing, Application for Payments, scheduling, Change of Work processing, submittals, samples, shop drawings, inspections, "O & M" manuals, training, certifications and testing, as-built work and preparation of record drawings; if required and in accordance with the Contract Documents.

40.1.12 All required permit fees, processing and associated costs thereof.

40.1.13 Minor communication expenses such as 2-way radios, telegrams, telephone service at the site, expressage, facsimile (fax) and printing costs and similar petty cash items in connection with the Work.

40.1.14 Cost of premiums for bonds and insurance required for the performance of the Work.

41.0 CASH ALLOWANCES:

43.2 The Contract Time will be extended in an amount equal to time lost due to delays beyond the control of CONTRACTOR. Such delays shall include, but not be limited to, acts or neglect by CITY or others performing additional work, or to fires, floods, labor disputes, epidemics, abnormal weather conditions or acts of God.

WARRANTY, INSPECTION AND ACCEPTANCE OF WORK

44.0 WARRANTY AND GUARANTEE:

44.1 CONTRACTOR warrants and guarantees to CITY and ENGINEER that all Work will be in accordance with the Contract Documents and will not be defective. Prompt notice of all defects shall be given to CONTRACTOR. All defective Work, whether or not on place, may be rejected, corrected or accepted as provided herein.

45.0 ACCESS TO WORK:

45.1 ENGINEER, ENGINEER's representatives, CITY, CITY's representatives, utility owners, testing agencies and governmental agencies with jurisdictional interests will have access to the Work at reasonable times for their observation, inspecting and testing. CONTRACTOR shall provide proper and safe conditions for such access.

46.0 TESTS AND INSPECTIONS:

46.1 CONTRACTOR shall give ENGINEER and CITY timely notice of readiness of the Work for all required inspections, tests or approvals.

46.2 If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) to specifically be inspected, tested or approved, CONTRACTOR shall assume full responsibility therefor, pay all costs in connection therewith and furnish ENGINEER the required certificates of inspection, testing or approval. CONTRACTOR shall also be responsible for and shall pay all costs in connection with any inspection or testing required in connection with CITY's or ENGINEER's acceptance of a Supplier of materials or equipment proposed to be incorporated in the Work, or of materials or equipment submitted for approval prior to CONTRACTOR's purchase thereof for incorporation in the Work.

46.3 All inspections, tests or approvals other than those required by Laws or Regulations of any public body having jurisdiction shall be performed by organizations acceptable to CITY and CONTRACTOR (or by ENGINEER if so specified).

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

may be prescribed by Laws or Regulations or by the terms of any applicable special guarantee required by the Contract Documents or by any specific provision of the Contract Documents, any Work is found to be defective, CONTRACTOR shall promptly, without cost to CITY and in accordance with CITY's written instructions, either correct such defective Work, or if it has been rejected by CITY, remove it from the site and replace it with non-defective Work. If CONTRACTOR does not promptly comply with the terms of such instructions, or in an emergency where delay would cause serious risk of loss or damage, CITY may have the defective Work corrected or have the rejected Work removed and replaced, and all direct, indirect and consequential costs of such removal and replacement (including but not limited to fees and charges of engineers, architects, attorneys and other professionals) will be paid by CONTRACTOR.

51.0 ACCEPTANCE OF DEFECTIVE WORK:

51.1 If, instead of requiring correction or removal and replacement of defective Work, CITY prefers to accept it, CITY may do so. CONTRACTOR shall bear all direct, indirect and consequential costs attributable to CITY's evaluation of and determination to accept such defective WORK. If any such acceptance occurs prior to ENGINEER's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and CITY shall be entitled to an appropriate decrease in the Contract Price. If the acceptance occurs after such recommendation, an appropriate amount will be paid by CONTRACTOR to CITY.

52.0 CITY MAY CORRECT DEFECTIVE WORK:

52.1 If CONTRACTOR fails within a reasonable time after written notice of CITY to proceed to correct defective Work or to remove and replace rejected Work as required by CITY, or if CONTRACTOR fails to perform the Work in accordance with the Contract Documents, or if CONTRACTOR fails to comply with any other provision of the Contract Documents, CITY may, after seven days' written notice to CONTRACTOR, correct and remedy any such deficiency. In exercising the rights and remedies under this paragraph CITY shall proceed expeditiously. To the extent necessary to complete corrective and remedial action, CITY may exclude CONTRACTOR from all or part of the site, take possession of all or part of the Work, and suspend services related thereto, take possession of CONTRACTOR's tools, appliances, construction equipment and machinery at the site and incorporate in the Work all materials and equipment stored at the site or for which CITY has paid CONTRACTOR but which are stored elsewhere. CONTRACTOR shall allow CITY, CITY's representatives, agents and employees such access to the site as may be necessary to enable CITY to exercise the rights and remedies under this paragraph. All direct, indirect and consequential costs of CITY in exercising such rights and remedies will be charged against CONTRACTOR in an amount approved as to reasonableness by ENGINEER, and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and CITY shall be entitled to an appropriate decrease in the Contract Price. CONTRACTOR shall not be allowed an extension of the Contract Time because of any delay in performance of the Work attributable to the exercise by CITY of CITY's rights and remedies hereunder.

PAYMENT TO CONTRACTOR AND COMPLETION

53.0 PAYMENT SCHEDULES:

53.1 Work item schedules, schedule of values or other types of payment schedules shall be established as provided in the bid documents to serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to CITY. Progress payments on account of Unit Price Work will be based on the number of units completed.

54.0 APPLICATION FOR PROGRESS PAYMENTS:

54.1 On the 25th day of the month, unless otherwise mutually agreed upon, CONTRACTOR shall submit to CITY for review an Application for Payment filled out and signed by CONTRACTOR covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents.

54.2 If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice or other documentation warranting that CITY has received the materials and equipment free and clear of all liens, charges, security interests and encumbrances. In the case of unit price work items; payment amount will be equivalent to a matching work item quantity amount of which the materials or equipment are to be incorporated into.

54.3 CONTRACTOR shall submit, if requested by CITY or as required by Laws and Regulations, beginning with the second Application for Payment, partial lien waivers, releases or certifications of partial payments from CONTRACTOR's Subcontractors and Suppliers, on documents acceptable to the CITY and legally effective.

54.4 CONTRACTOR shall not invoice for any Change Order Work until all required Contract Documents have been approved and executed.

54.5 Ten percent (10%) retention, unless otherwise mutually agreed upon, will be withheld from each progress payment until final acceptance of the Work by the CITY. The CONTRACTOR has the option of using securities in lieu of retention as applicable and available by Laws and Regulations. Upon the CITY's final acceptance of the completed project Work, the CONTRACTOR shall invoice separately for the retention amount withheld or request authorization to release securities.

55.0 REVIEW OF APPLICATIONS FOR PROGRESS PAYMENT:

55.1 ENGINEER will, within seven (7) days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to CITY, or return

the Application to CONTRACTOR indicating in writing ENGINEER's reasons for refusing to recommend payment. In the latter case, CONTRACTOR may make the necessary corrections and resubmit the Application. Seven (7) days after presentation to the CITY of the Application for Payment with ENGINEER's recommendation, the amount recommended will become due and when due will be paid by CITY to CONTRACTOR. If specified in the Special Conditions, Applications for Payment may be submitted directly to the CITY for approval in which case payment will become due from the CITY within fourteen (14) days from the Application approval date. Non-approved Applications will be returned to the CONTRACTOR for corrections and resubmittal.

55.2 ENGINEER's recommendation of any payment requested in an Application for Payment will constitute a representation by ENGINEER to CITY, based on ENGINEER's on-site observations of the Work in progress and the accompanying data and schedules that the Work has progressed to the point indicated; that, to the best of ENGINEER's knowledge, information and belief, the quality of the Work is in accordance with the Contract Documents; and that CONTRACTOR is entitle to payment of the amount recommended. However, by recommending any such payment ENGINEER will not thereby be deemed to have represented that exhaustive or continuous on-site inspections have been made to check the quality or the quantity of the Work beyond the responsibilities specifically assigned to ENGINEER in the Contract Documents or that there may not be other matters or issues between the parties that might entitle CONTRACTOR to be paid additionally by CITY or CITY to withhold payment to CONTRACTOR.

55.3 ENGINEER's recommendation of final payment will constitute an additional representation by ENGINEER to CITY that the conditions precedent to CONTRACTOR's being entitled to final payment have been fulfilled as set forth in the Contract Documents.

55.4 ENGINEER may refuse to recommend the whole or any part of any payment if, in ENGINEER's opinion, it would be incorrect to make such representations to CITY. ENGINEER may also refuse to recommend any such payment, or, because of subsequently discovered evidence or the results of subsequent inspections or tests, nullify any such payment previously recommended, to such extent as may be necessary in ENGINEER's opinion to protect CITY from loss because; 1) the Work is defective, or completed Work has been damaged requiring correction or replacement, 2) the Contract Price has been reduced by Written Amendment or Change Order, or 3) CITY has been required to correct defective or Work complete the Work.

55.5 CITY may refuse to make payment of the full amount recommended by ENGINEER because claims have been made against CITY on account of CONTRACTOR's performance or furnishing of the Work or if Liens have been filed in connection with the Work or if there are other items entitling CITY to a set-off against the amount recommended, but CITY must give CONTRACTOR immediate written notice stating the reasons for such action.

56.0 <u>SUBSTANTIAL COMPLETION</u>:

56.1 When CONTRACTOR considers the entire Work ready for its intended use CONTRACTOR shall notify CITY and ENGINEER in writing that the entire Work is substantially

complete (except for items specifically listed by CONTRACTOR as incomplete) and request that ENGINEER issue a certificate of Substantial Completion. Within a reasonable time thereafter, CITY, CONTRACTOR and ENGINEER shall make an inspection of the Work to determine the status of completion. If ENGINEER does not consider the Work substantially complete, ENGINEER will notify CONTRACTOR in writing giving the reasons therefor. If ENGINEER considers the Work substantially complete, ENGINEER will prepare and deliver to CITY a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before final payment is to be paid.

56.2 If required, the CITY shall issue a separate, final quantity adjustment Change Order to reflect contract completion at 100%. All quantity overages shall require a Change Order and CITY approval prior to CONTRACTOR submitting a final Application for Payment and subsequent CITY payment.

56.3 If applicable and if all project Work is completed, CONTRACTOR shall submit an Application for Payment at Substantial Completion for 100% of the Contract Amount less the required retention amount.

56.4 CONTRACTOR may submit a written request to ENGINEER and CITY asking for release of partial retention. CITY and ENGINEER shall review the request to determine if request is warranted based on the estimated value of any remaining Work to be completed or on the estimated cost of correction and acceptance of any Work, based on the final inspection.

56.5 CITY shall have the right to exclude CONTRACTOR from the Work after the date of Substantial Completion, but CITY shall allow CONTRACTOR reasonable access to complete or correct items on the tentative list.

56.6 CITY at any time may request CONTRACTOR in writing to permit CITY to use any such part of the Work which CITY believes to be ready for its intended use and is substantially complete. If CONTRACTOR agrees, CONTRACTOR will certify to CITY and ENGINEER that said part of the Work is substantially complete and request ENGINEER to issue a certificate of Substantial Completion for that part of the Work. No occupancy or separate operation of part of the Work will be accomplished prior to compliance with the requirements of property insurance.

57.0 FINAL INSPECTION:

57.1 Upon written notice from CONTRACTOR that the entire Work or an agreed portion thereof is complete, ENGINEER will make a final inspection with CITY and CONTRACTOR and will notify CONTRACTOR in writing of all particulars in which this inspection reveals that the Work is incomplete or defective. CONTRACTOR shall immediately take such measures as are necessary to remedy such deficiencies.

58.0 FINAL APPLICATION FOR PAYMENT:

58.1 After CONTRACTOR has completed all such corrections to the satisfaction of ENGINEER and delivered all maintenance and operating instructions, schedules, guarantees, Bonds, certificates of inspection, marked-up record documents and other documents, and after a final quantity Change Order has been approved and executed, if required, all as required by the Contract Documents, and after ENGINEER has indicated that the Work is acceptable, CONTRACTOR may make application for final payment following the procedure for progress payments. The final Application for Payment shall be accompanied by all documentation called for in the Contract Documents, Certificates of Full and Final Payment from CONTRACTOR's Subcontractors and Suppliers, together with complete and legally effective releases or waivers (satisfactory to CITY) of all Liens arising out of or filed in connection with the Work. In lieu thereof and as approved by CITY, CONTRACTOR may furnish receipts or releases in full; an affidavit of CONTRACTOR that the releases and receipts include all labor, services, material and equipment for which a lien could be filed, and that all payrolls, material and equipment bills, and other indebtedness connected with the Work for which CITY or CITY's property might in any way be responsible, have been paid or otherwise satisfied; and consent of the surety, if any, to final payment.

58.2 Where a retention amount has been withheld from previous progress payments, and all Work deficiencies have been corrected and approved by the CITY, and all project Work is complete and final and has been accepted by the CITY, the amount of the Final Application for Payment shall be equal to the retention amount withheld.

59.0 FINAL PAYMENT AND ACCEPTANCE:

59.1 If, on the basis of ENGINEER's observation of the Work during construction and final inspection, and ENGINEER's review of the final Application for Payment and accompanying documentation, all as required by the Contract Documents, ENGINEER is satisfied that the Work has been completed and CONTRACTOR's other obligations under the Contract Documents have been fulfilled, ENGINEER will, within seven (7) days after receipt of the Final Application for Payment, indicate in writing ENGINEER's recommendation of payment and present the approved Application to the CITY for processing and payment. Thereupon ENGINEER will give written notice to CITY and CONTRACTOR that the Work is acceptable subject to any special provisions of the Contract Documents. Otherwise, ENGINEER will return the Application to CONTRACTOR, indicating in writing the reasons for refusing to recommend final payment, in which case CONTRACTOR shall make the necessary corrections and resubmit the Application. Fourteen (14) days after presentation to CITY of the Application and accompanying documentation, in appropriate form and substance, and with ENGINEER's recommendation and notice of acceptability, the amount recommended by ENGINEER will become due and will be paid by CITY to CONTRACTOR.

59.2 If, through no fault of CONTRACTOR, final completion of the Work is significantly delayed and if ENGINEER so confirms, CITY shall, upon receipt of CONTRACTOR's final Application for Payment and recommendation of ENGINEER, and without terminating the Agreement, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by CITY for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if Bonds have been furnished as required, the written

consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by CONTRACTOR to ENGINEER with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of claims.

SUSPENSION OF WORK AND TERMINATION

60.0 CITY MAY SUSPEND WORK:

60.1 CITY may, at any time and without cause, suspend the Work or any portion thereof for a period of not more than ninety days by notice in writing to CONTRACTOR and ENGINEER which will fix the date in which Work will be resumed. CONTRACTOR shall resume the Work on the date so fixed. CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Time, or both, directly attributable to any suspension if CONTRACTOR makes an approved claim therefor as provided in the Contract Documents.

61.0 CITY MAY TERMINATE:

61.1 Should the CONTRACTOR commit any one or more, reoccurring or persistent acts of default, as listed below, and after a seven (7) day notification period from the CITY, the CITY may, without prejudice to any other rights or remedies given the CITY by Laws and Regulations or by the Contract Documents, terminate the services of the CONTRACTOR.

The following acts shall constitute default:

A. If CONTRACTOR is adjudged bankrupt under any chapter of the Bankruptcy Code (Title 11, U.S. Code), as now or hereafter in effect, filed voluntarily by CONTRACTOR; or similar action taken by filing a petition under any other federal or state law in effect at such time relating to bankruptcy or insolvency.

B. If a petition is filed against CONTRACTOR under any chapter of the Bankruptcy Code as now or hereafter in effect at the time of filing; or similar action taken by a petition filed against CONTRACTOR seeking relief under any other federal or state law in effect at such time relating to bankruptcy or insolvency.

C. If CONTRACTOR makes a general assignment for the benefit of creditors.

D. If a trustee, receiver, custodian or agent of CONTRACTOR is appointed under applicable law or under contract, whose appointment or authority to take charge of property of CONTRACTOR is for the purpose of enforcing a lien against such property or for the purpose of general administration of such property for the benefit of CONTRACTOR's creditors.

E. If CONTRACTOR admits in writing an inability to pay its debts generally as they become due.

F. If CONTRACTOR fails to make prompt payments to subcontractors, labor, suppliers, materialmen manufacturers, fabricators, distributors or vendors.

G. If CONTRACTOR persistently refuses or fails, except as provided in a Change of Contract Time, to perform the Work in accordance with the Contract Documents, including but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the progress schedule.

H. If CONTRACTOR persistently disregards Laws or Regulations of the CITY or of any public body or agency having jurisdiction relating to the project Work.

I. If CONTRACTOR disregards the authority of ENGINEER or CITY.

J. Otherwise commit a substantial violation of any provision of the Contract Documents.

61.2 CITY may, after giving CONTRACTOR (and the surety, if there is one) seven (7) day's written notice and to the extent permitted by Laws and Regulations, terminate the services of CONTRACTOR, exclude CONTRACTOR from the site and take possession of the Work and of all CONTRACTOR's tools, appliances, construction equipment and machinery at the site and use the same to the full extent they could be used by CONTRACTOR (without liability to CONTRACTOR for trespass or conversion), incorporate in the Work all materials and equipment stored at the site or for which CITY has paid CONTRACTOR but which are stored elsewhere, and finish the Work as CITY may deem expedient. In such case CONTRACTOR shall not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract Price exceeds the direct, indirect and consequential costs of completing the Work (including by not limited to fees and charges of engineers, architects, attorneys and other professionals and court and arbitration costs) such excess will be paid to CONTRACTOR. If such costs exceed such unpaid balance, CONTRACTOR shall pay the difference to CITY. Such costs incurred by CITY will be approved as to reasonableness by ENGINEER and incorporated in a Change Order, but when exercising any rights or remedies under this paragraph CITY shall not be required to obtain the lowest price for the Work performed.

61.3 Where CONTRACTOR's service have been so terminated by CITY, the termination will not affect any rights or remedies of CITY against CONTRACTOR then existing or which may thereafter accrue. Any retention or payment of moneys due CONTRACTOR by CITY will not release CONTRACTOR from liability.

61.4 Upon seven (7) day's written notice to CONTRACTOR and ENGINEER, CITY may, without cause and without prejudice to any other right or remedy, elect to abandon the Work and terminate the Agreement. In such case, CONTRACTOR shall be paid for all Work executed and any expense sustained plus reasonable termination expense.

62.0 CONTRACTOR MAY STOP WORK OR TERMINATE:

62.1 If, through no act or fault of CONTRACTOR, the Work is suspended for a period of more than ninety (90) days by CITY or under an order of court or other public authority, or ENGINEER fails to act on any Application for Payment within thirty (30) days after it is submitted, or CITY fails for thirty (30) days to pay CONTRACTOR any sum finally determined to be due, then CONTRACTOR may, upon seven (7) day's written notice to CITY and ENGINEER terminate the Agreement and recover from CITY payment for all Work executed and any expense sustained plus reasonable termination expenses. In addition and in lieu of terminating the Agreement, if ENGINEER has failed to act on an Application for Payment or CITY has failed to make any payment as aforesaid, CONTRACTOR may upon seven (7) day's written notice to CITY and ENGINEER stop the Work until payment of all amounts then due. The provisions of this paragraph shall not relieve CONTRACTOR of the obligations to carry on the Work in accordance with the progress schedule and without delay during disputes and disagreements with ENGINEER or CITY, within the ninety (90) day period.

63.0 ARBITRATION:

63.1 No demand for arbitration of any such claim, dispute or other matter will be made until all efforts, as provided by the Contract Documents, have been exhausted by all parties involved, and no later than thirty (30) days after the date on which ENGINEER or CITY has rendered a written decision in respect thereof.

63.2 Notice of the demand for arbitration will be filed in writing with the other party to the Agreement and with the local, governing arbitration association, and copies will be sent to all other affected parties as appropriate.

63.3 The award rendered by the arbitrators will be final, judgment may be entered upon it in any court having jurisdiction thereof, and will not be subject to modification or appeal except to the extent permitted by Sections 10 and 11 of the Federal Arbitration Act.

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SECTION 01010

SUMMARY OF WORK

PART 1 GENERAL

1.01 SUMMARY

A. The work to be accomplished under these Contract Documents includes furnishing all labor, materials and equipment to construct the Rancho Santa Fe Reservoir and Booster Pump Station Project complete and ready for use in accordance with the Contract Documents.

B. The work includes the following principal items:

1. Install a 20" pipeline from an existing pipeline to the reservoir site.

2. Install a 1 MG above ground steel tank with all required appurtenances.

3. Install a chlorine disinfection system complete with a recirculation pump and piping for continuous monitoring of the chlorine residual in the tank.

4. Install a booster pump station complete with 2 pumps and all required appurtenances.

5. Install a 16" flow meter on the discharge line of the booster pumps.

6. Install a 20" pipeline from the booster pump station to the distribution system.

7. Install surge anticipator valve and vault.

8. Install a pressure sustaining valve and vault.

9. Install a standby propane generator for backup power.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 01013

ENGINEERING SERVICES

PART 1 GENERAL

1.01 SUMMARY

A. The work to be accomplished under these Contract Documents has been designed for the OWNER by a registered Professional Engineer retained by the OWNER for this purpose. It is understood that normal engineering for the purpose of interpretation of the contract documents is provided by the ENGINEER. Should any services of the ENGINEER be required to assist in the corrections of errors or omissions in construction by the CONTRACTOR, or services of the ENGINEER be required because of changes in structure or equipment where the CONTRACTOR has requested approval of substitute methods or materials, or any of the items detailed in 3.01, those services will be provided by the ENGINEER at the standard hourly rates previously negotiated with the OWNER and shall be paid for by the CONTRACTOR.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.01 ENGINEERING SERVICES

A. The ENGINEER shall be reimbursed by the CONTRACTOR for the ENGINEER's additional services to the Project through no fault of the ENGINEER including, but not limited to, the following conditions:

1. Additional Shop Drawing review(s) by the ENGINEER as described in Section 01300.

2. Additional site visits, investigations, inspections, design work and/or reports by the ENGINEER which are required due to damages to existing facilities or completed work caused by the CONTRACTOR in his performance, the CONTRACTOR's negligence, or the CONTRACTOR's work which is rejected as defective or as failing to conform to the Contract Documents.

3. Additional time spent by the ENGINEER for Project closeout inspections as described in Section 01700. One inspection for substantial completion and one

inspection for final completion are included in the Project. All additional inspections required to close out the Project will be billed at the previously negotiated rate with the OWNER.

4. Engineering Construction Phase Services rendered on the Project during the time the Project remains incomplete after the contract date of final completion will be billed at the previously negotiated rate with the OWNER. This begins at the end of the contract time plus any extensions.

5. All retesting required due to the failure of the CONTRACTOR's work to meet the requirements of the Contract Documents shall be at the CONTRACTOR's expense.

6. Engineering services rendered for revisions due to deviations as described in Section 01300 - SUBMITTALS.

7. The ENGINEER shall bill the OWNER for additional Engineering Services performed and as described in these Documents. The OWNER shall withhold payment for this from the CONTRACTOR's final payment. A change order shall be executed deleting the amount due from the contract sum and final payment.

END OF SECTION

SECTION 01025

MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.01 SUMMARY

A. Payment for work performed by the CONTRACTOR under these Contract Documents shall be made at the approved contract agreement bid price for each of the principal items as listed in the Bid Form and described in Section 01010 - SUMMARY OF WORK. Such payment shall compensate the CONTRACTOR for all costs in connection with materials stored on site and materials and labor incorporated into the work in accordance with the Drawings and other Contract Documents. All incidental and appurtenant work essential to the completion of the project in a workmanlike manner, including cleanup and disposal of waste or surplus material, shall be accomplished by the CONTRACTOR without additional cost to the OWNER.

1.02 MEASUREMENT

A. Measurements of the completed work will be made in place, with no allowance for waste.

B. Measurements of distances will be made in a horizontal plane, unless otherwise stated.

C. Measurements of areas will be made in a horizontal plane, unless otherwise stated. Widths of pavement removal areas and trenching will be measured based on Maricopa County Association of Governments (MAG) limits, regardless of the construction techniques used.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.01 MEASUREMENT AND PAYMENT

A. Payment shall be made for the actual quantities constructed or installed; said quantities being measured as specified hereinafter. Payment will be made for installed work only. <u>Payment will not be made for stored, uninstalled materials</u>. Work items not specifically identified in the Bid Form, but shown and specified, shall

be considered incidental items. No additional payment will be made for incidental items.

1. Item No. 1 - "General Requirements" shall be paid for at the contract lump sum price and shall include compensation for mobilizing and demobilizing CONTRACTOR's construction equipment and personnel, and shall include compensation for all of the temporary facilities required to complete the project including CONTRACTOR's storage yard, field offices, construction photographs, construction sign, traffic control permits, insurance, bonds, coordination, public relations, utility services, clean-up, record drawings, progress schedules, and all other incidental and appurtenant work not specifically specified in the other paragraphs of this Basis of Payment. Payment shall be based upon the percentage of the total Contract Document work completed.

2. Item No. 2 - "Surveying/Staking" shall be paid for at the contract lump sum price and shall include compensation for the cost of establishing and staking lines and grades for construction, for resetting any monuments, corners or benchmarks disturbed during construction, and all incidental and appurtenant work to complete the item as specified and indicated on the Drawings.

3. Item No. 3 - "Verification of Field Dimensions and Utility Locations" shall be paid for at the contract lump sum price and shall include full compensation for the cost of verifying the depth, location and size of buried utilities and other work shown on the Plans, identified by blue staking or evident from surface features, and all incidental and appurtenant work to complete the item as specified and indicated on the Drawings.

4. Item No. 4 - "2000 GPM Booster Pump" shall be paid for at the contract unit price for each installed pump. This item shall include all costs in connection with manufacturer, delivery, and placement of a horizontal split case centrifugal pump, and all other appurtenant work in accordance with the Specifications.

5. Item No.5 - "Chlorination System" shall be paid for at the lump sum price. This item shall include all costs in connection with the installation of the gas chlorination system, materials and placement of the chlorination structure, piping, valves, chlorine gas

tanks, and all appurtenant work to complete the tasks as specified and indicated on the Drawings in accordance with the Specifications.

6. Item No. 6 - "1 MG Water Storage Tank" shall be paid for at the lump sum price. This item shall include all costs in connection with the fabrication, delivery, and the installation of the water storage tank. The item shall also include the foundation and excavation and earth work associated with the installation and all incidental and appurtenant work to complete the item as specified and indicated on the Drawings in accordance with the Specifications.

7. Item No. 7 - "16-inch Flow Meter" shall be paid for at the contract unit price for each flow meter installed. This item shall include all costs in connection with the delivery and installation of a flowmeter and all appurtenant work to complete the task as specified and indicated on the Drawings in accordance with the Specifications.

8. Item No. 8 - "Dry Well" shall be paid for at the contract unit price for each dry well installation. This item shall include all costs in connection with the complete installation of a new drywell including percolation test, excavation, backfill, disposal of waste material at approved sites, pre-cast concrete liner, pre-cast concrete manhole, piping, screening, and all incidentals and appurtenant work to complete the item as specified and as shown on the Drawings.

9. Item No. 9 - "Surge Anticipator Valve and Vault" shall be paid for at the contract unit price for the installation of each surge anticipator valve and vault installed. This item shall include all costs in connection with the delivery and installation of a surge anticipator valve and vault, excavation, backfill, disposal of waste material at approved sites, pre-cast concrete vault and all appurtenant work to complete the task as specified and indicated on the Drawings.

10. Item No. 10 - "Pressure Sustaining Valve and Vault" shall be paid for at the contract unit price for the installation of each pressure sustaining valve and vault installed. This item shall include all costs in connection with the delivery and installation of a pressure sustaining valve and vault, excavation, backfill, disposal of waste material at approved

sites, pre-cast concrete vault and all appurtenant work to complete the task as specified and indicated on the Drawings.

11. Item No. 11 - "Eye Wash and Shower" shall be paid for at the contract unit price for each emergency eyewash and shower installed including all piping, valves, and appurtenant work in accordance with the Specifications and Drawings.

12. Item No. 12 - "Pump Station Gravel" shall be paid for at the contract unit price per cubic yard. Work shall include delivery and placement of gravel, and all other appurtenant work in accordance with the Specifications and Drawings.

13. Item No. 13 - "Asphaltic Pavement" shall be paid for at the contract unit price per square foot installed. Work shall include subgrade preparation, placement, compaction and all other appurtenant in accordance with the Specifications and Drawings.

14. Item No. 14 - "Wrought Iron Fence" shall be paid at the contract unit price per linear foot installed. Work shall include the installation of foundations, fencing, painting, and all other items required for a complete installation.

15. Item No. 15 - "Pump Station Wall" shall be paid at the contract lump sum price for the construction of the pump station wall, including foundations, walls, gates, and all other items required for a complete installation as specified and indicated on the Drawings and in the Specifications.

16. Item No. 16 - "Chain Link Fence" shall be paid at the contract unit price per linear foot installed. Work shall include the installation of foundations, fencing, and all other items required for a complete installation.

17. Item No. 17 - "Fire Hydrant" shall be paid at the contract lump sum price for each fire hydrant delivered and installed. Work shall include valves, fittings, hydrant and all appurtenant work to complete the task as specified and indicated on the Drawings.

18. Item Nos. 18 through 29 - "Water Pipe" of the respective size and type shall be paid for at the contract unit price per lineal foot as measured along

the centerline of the installed pipe. This item shall include all costs in connection with open trenching, discovery and protection of subsurface obstructions, removal and replacement of subsurface obstructions, shoring and bracing as required, pipe bedding, trench backfill, trench stabilization, over excavation, disposal of surface and waste material at approved locations, furnishing and installing all water pipe, thrust blocks, fittings, connections to existing waterlines, testing, disinfection, pipe supports and all incidental and appurtenant work to complete the item as specified and indicated on the Drawings.

19. Item No. 30 - "1-inch PVC Pipe" shall be paid for at the contract unit price per lineal foot as measured along the centerline of the installed pipe. This item shall include all costs in connection with open trenching, discovery and protection of subsurface obstructions, removal and replacement of subsurface obstructions, shoring and bracing as required, pipe bedding, trench backfill, trench stabilization, over excavation, disposal of surface and waste material at approved locations, furnishing and installing all water pipe, thrust blocks, fittings, connections to existing waterlines, testing, disinfection, pipe supports and all incidental and appurtenant work to complete the item as specified and indicated on the Drawings.

20. Item Nos. 31 through 38 - "Valves" of the respective size and type shall be paid for at the contract unit price for each unit installed. This item shall include all costs associated with the delivery and installation of the valve, valve supports, and all incidental and appurtenant work to complete the item as specified and indicated on the Drawings.

21. Item No. 39 - "Primary Electric" shall be paid for at the contract lump sum price. This item shall include all work required by Arizona Public Service in connection with the installation of the primary power service to the reservoir and pump station.

22. Item No. 40 - "Secondary Electric" shall be paid for at the contract lump sum price for the completed work. This item shall include all costs in connection with secondary power service to the chlorination system, booster pumps, water storage tank, booster pump station, measurement and control systems, all electrical panels, connections and wiring, switches,

and all incidental appurtenant work to complete the item as specified and as shown on the Drawings with the exception of work included in Item No. 37 - "Primary Electric" and Item No. 41 - "Diesel Generator".

23. Item No. 41 - "Miscellaneous Concrete" shall be paid for at the contract unit price per cubic yard installed. This item shall include concrete for the installation of diesel generator pad, pipe supports, and valve supports, concrete pipe encasement and all incidental and appurtenant work to complete the item as specified and indicated on the Drawings.

24. Item No. 42 - "Earth Work" shall be paid for at the contract lump sum price for all the site and earth work specified and indicated on the Drawings.

25. Item No. 43 - "Diesel Generator" shall be paid for at the contract unit price for each standby power unit installed. This item shall include all costs in connection with the installation of the standby diesel generators, above ground storage tanks, piping, valves, materials and placement of the enclosing structures, and all incidental appurtenant work to complete the item as specified and as shown on the Drawings.

26. Item No. 44 - "Rip Rap" shall be paid for at the contract unit price per cubic yard installed. This item shall include all cost in connection with installation of the rip rap and all appurtenant work to complete the item as specified and indicated on the Drawings.

27. Item No. 45 - "PLC Programming" shall be paid for at the contract lump sum price for the completed Work. This item shall include all costs associated with the programming of the pump PLC by the ENGINEER.

28. Item No. 46 - "Catch Basin" shall be paid for at the contract lump sum price for the completed Work. This item shall include all costs associated with the fabrication, delivery, and installation of the catch basin located under the water storage tank drain and over flow structure. The item shall also include all appurtenant work to complete the item as specified and indicated on the Drawings.

29. Item No. 47 - "4-inch Air Release Valve" shall be paid for at the contract unit price per each unit installed. This item shall include the delivery and installation of the air release valve and all appurtenant work involved to complete the item as specified and shown on the Drawings.

30. Item No. 48 - "Materials Testing" shall be paid for at the contract lump sum price for the completed Work. This item shall include all costs associated with the testing of materials and all appurtenant work to complete the item as specified.

31. Item No. 49 - "Clearing and Grubbing" shall be paid for at the contract lump sum price for the completed Work. This item shall include all costs for removing the existing stock piles and all appurtenant Work to complete the item as specified and indicated on the Drawings. The contractor shall be responsible for loading and hauling of materials to the Cal Mat Landfill at Indian School West of the Agua Fria River. The City will incur all tipping costs.

32. Item Nos. 50 through 82 - "Pipe Fittings" of the respective size and type shall be paid for at the contract unit price per each unit installed. This item shall include all costs in connection with the furnishing and installation, testing, disinfection, and all incidental and appurtenant work to complete the item as specified and indicated on the Drawings.

END OF SECTION

SECTION 01040

COORDINATION

PART 1 GENERAL

1.01 SUMMARY

A. The CONTRACTOR will be required to coordinate his activities with the OWNER, the ENGINEER, subcontractors and equipment suppliers in order not to delay the CONTRACTOR's project schedule.

B. Planning: Plan activities in advance to coordinate all aspects of construction:

1. Materials, services and equipment purchasing.

2. Shipping.

3. Receipt and storage at site.

4. Installation, including interface with related items and interference with unrelated items.

5. Inspection and testing, to extent required under Contract Documents.

6. Initial startup of equipment and operational tests.

7. Completion of Work of Contract including final cleaning.

8. Operation during construction.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.01 GENERAL

A. The CONTRACTOR shall coordinate his/her work to ensure that the Work is complete and to ensure efficient and orderly sequence of installation of construction elements.

1. In the event certain parts of work are assigned to subcontractors, the CONTRACTOR shall be responsible to ensure each subcontractor completes work and that all interfaces between trades are properly addressed. All subcontractors shall also coordinate their work with

the OWNER and ENGINEER through the CONTRACTOR.

2. The CONTRACTOR is solely responsible for all assignments of work among subcontractors.

3. The CONTRACTOR shall be responsible for assigning and coordinating work and ensuring that suppliers and installers are familiar with all requirements in Contract Documents relating to each item of work, regardless of location of information in Contract Documents.

3.02 EQUIPMENT

A. The CONTRACTOR shall verify that characteristics or elements of interrelated operating equipment are compatible; coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

1. Spaces: Coordinate space requirements and installation of mechanical and other work which is indicated diagrammatically.

2. Resolve routing and space allocations before work is started in order to prevent interferences and loss of time.

3. Follow routing indicated for pipes and conduits as closely as practicable.

4. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

END OF SECTION

SECTION 01050

FIELD ENGINEERING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Field engineering services required for proper execution and completion of work under this Contract.

1.02 SUBMITTALS

A. Quality Control Submittals

1. Surveyor: Submit name and address of surveyor to be employed by CONTRACTOR for acceptance before beginning work at the site. This submittal shall be in the form of a resume.

2. Documentation and Records: The surveyor shall maintain complete and accurate log of control and survey work as it progresses. On request of the ENGINEER, the CONTRACTOR shall be capable of submitting documentation to verify accuracy of field work.

3. Completion Certificate: Upon completion of the work, the CONTRACTOR shall submit a certificate to the ENGINEER signed by the surveyor certifying that elevations and locations are in conformance with the Contract Documents. Any items of nonconformance shall be noted.

1.03 QUALITY ASSURANCE

A. Qualifications: The CONTRACTOR shall employ a land surveyor registered in the State of Arizona and which is acceptable to the OWNER and ENGINEER.

B. Surveyor: The Surveyor shall be responsible for locating the horizontal and vertical location of structures shown on the plans, and final certification that the work has been completed within tolerances specified.

1.04 PROJECT SURVEY REQUIREMENTS

A. Reference Points: The existing control points are indicated on the Project Drawings. Immediately upon beginning the work, the Surveyor shall locate and maintain bench marks and all other grades, lines, levels and dimensions. Report any errors or inconsistencies to the ENGINEER before commencing work.

B. Batter Boards and Levels: The CONTRACTOR shall stake out the structures and provide and rigidly set batter boards.

1. CONTRACTOR: The CONTRACTOR shall remain responsible for their maintenance and accuracy.

2. From permanent bench marks the Surveyor shall ascertain grades and levels for pipelines and structures as needed.

C. Preservation of Monuments and Stakes: The CONTRACTOR shall carefully preserve monuments, bench marks, property markers, reference points, and stakes.

1. In case of destruction of these, the CONTRACTOR shall be charged with the expense of replacement and shall be responsible for any mistake of loss of time that may be caused. The CONTRACTOR shall tie the new point in with the City datum, both horizontal and vertical.

2. The CONTRACTOR shall protect permanent monuments or bench marks.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 01090

REFERENCE STANDARDS

PART 1 GENERAL

1.01 QUALITY ASSURANCE

A. Reference Standards: For products or workmanship specified or indicated by association, trade or Federal Standards, comply with requirements of standard, except when more rigid requirements are specified or are required by applicable codes.

1. No provision of any referenced standard specification, manual or code (whether or not specifically incorporated by reference in the Contract Documents) shall be effective to change duties and responsibilities of OWNER, CONTRACTOR or any of their consultants, agents or employees from those set forth in Contract Documents, nor shall it be effective to assign to the OWNER or any of the OWNER's consultants, agents or employees any duty or authority to supervise or direct furnishing or performance of work or any duty or authority to undertake responsibilities contrary to provisions of General Conditions and General Requirements.

2. Where wording of referenced standard is permissive, or where requirements of more than one reference standard apply, the CONTRACTOR shall provide under the more restrictive and higher requirement.

3. The CONTRACTOR shall notify the ENGINEER of any conflicts between referenced standards and requirements as specified in Specifications or indicated on Drawings before proceeding with work.

B. Detailed Requirements: The CONTRACTOR shall be familiar with and verify detailed requirements of referenced standards to verify that items and their installation provided under Work of this Contract meet or exceed standard's requirements.

1. Tolerances: Tolerances may vary from standards of different sections. The CONTRACTOR shall make adjustments necessary to assure proper fitting of different elements. Tolerances may be plus or minus as indicated but in sum shall be compensating, not

cumulative.

C. Effective Date: The date of a standard is that in effect as of date of the Invitation to Bid except when specific date is specified or when standard is part of applicable code which includes edition date.

D. Copies: When required by individual sections, the CONTRACTOR shall obtain a copy of the standard and maintain a copy at job site during work.

E. Certificates: The CONTRACTOR shall provide certificates when required by Contract Documents, or when requested in writing by ENGINEER. The CONTRACTOR shall submit Certificate of Compliance or Manufacturer's Certificate in accordance with Section 01300 that materials or workmanship, or both, comply with requirements of referenced standard.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 01200

PROJECT MEETINGS

PART 1 GENERAL

1.01 SUMMARY

A. During the construction period, there shall be weekly project meetings with the OWNER, ENGINEER and the CONTRACTOR, for the purpose of monitoring construction progress and coordinating the work to minimize impacts during construction of the Reservoir and Booster Pump Station.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.01 MEETING REQUIREMENTS

A. Meetings

1. The CONTRACTOR, including project manager and field superintendent, shall attend weekly meetings at the CONTRACTOR's job site field office. Representatives of the OWNER and ENGINEER will be invited to attend.

B. Agenda and Minutes

1. The ENGINEER will establish the agenda and keep and distribute minutes of progress meetings and lists of those present.

C. The Persons Representing Contractor at Meetings

1. The persons who represent the CONTRACTOR at meetings shall have authority to commit the CONTRACTOR to solutions agreed upon in meetings. To the maximum extent possible, the CONTRACTOR shall assign the same person or persons to represent the CONTRACTOR at meetings throughout the progress of work.

D. Coordination Meetings

1. Progress meetings shall in no way be considered a substitute for CONTRACTOR/Subcontractor coordination meetings.

3.02 CONSTRUCTION PROJECT MEETINGS

A. Sample Agenda

1. Review minutes of previous meeting. Provide any pending resolutions.

2. Review work and progress since last meeting.

3. Note field observations, problems, and decisions.

4. Identify problems which will affect planned progress.

5. Review schedule, develop measures and procedures to regain planned schedule.

6. Outline progress and work to be accomplished between this meeting and next.

7. Complete all other current business and establish next meeting date.

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1 GENERAL

1.01 SUMMARY

A. The CONTRACTOR shall include a completed transmittal form for all submittals. Transmittal forms will be furnished to CONTRACTOR by ENGINEER. Submittals shall be sent to the ENGINEER.

1.02 SECTION INCLUDES

A. Shop Drawings

B. Material and Equipment Record

C. Operation & Maintenance Manuals

D. Progress Schedule

E. Progress Reports

F. Daily Reports

G. Testing Results

H. Pre-Construction Video

I. Construction Photographs

J. Record Drawings

1.03 DATA REFERENCE SYMBOLS AND DESCRIPTIONS

A. The submittal data required for shop drawings and operations manuals shall contain, but not necessarily be limited to, that data and material as defined by the coded legend set forth below. The submittal data required shall be as indicated and specified under various headings of the specifications.

LEGEND
DATA REFERENCE SYMBOLS AND DESCRIPTIONS

Symbol	Description
A	Letters of Certification of Compliance on materials, equipment, etc.
B	Samples.
C	Final certified drawings showing outline dimensions, foundation layout or mounting information, and other pertinent dimensions.
D	Field erection instructions, assembly drawings and/or diagrams, detailed reference drawing lists, and lists of erection details.
E	Shop detail drawings showing individual sub-assemblies and fabricated pieces, with material specifications and other applicable data.
F	Installation instructions, operating and/or service manuals and all other data pertinent to operating or servicing the complete apparatus. Preventative maintenance instructions and recommended frequency.
G	Schematic diagrams of power, control and piping systems.
H	General bulletins and catalog cuts describing complete apparatus including operating principles and fundamentals.
I	Service data sheets showing design performance, utility requirements, etc., as applicable to the specific duty for which the equipment is furnished.
J	Head capacity curves for pumps. Impeller size furnished and maximum size available shall be noted on these data.
K	Curves and/or data for overall range of operation from minimum to maximum capacity or load, showing capacity or load, utilities motive medium required, total or incremental differential head, and other pertinent information applicable to the equipment or its component assemblies.

L Materials of construction of all components.

M Renewal parts list with diagrammatic or cross-section drawings showing part identification. Material analysis or trades designation for each significant part is to be noted on parts lists or on a separate sheet.

N Stuffing box sizes; packing sizes; specifications and arrangement; and mechanical seal details, specifications, etc., if furnished in equipment.

O Bearing manufacturer's standard identification and/or interchangeable number for all anti-friction bearings in the equipment proper and its accessory items.

P Material gradation, design mix, job mix formula and/or material analysis.

1.04 SHOP DRAWINGS

A. A minimum of six (6) copies of shop drawings are required for submittal. Disposition of the shop drawings will be in accordance with the following schedule:

Action by ENGINEER	Retained by ENGINEER	Returned to CONTRACTOR	No. Required for Resubmittal
No Exceptions Noted	3	3	0
Exceptions Noted	3	3	0
Revise and Resubmit	1	5	6
Rejected	1	5	6
No Action Taken	1	5	0

B. Only one copy of "Revise and Resubmit" and "Rejected" shop drawings will be stamped.

C. If the CONTRACTOR requires more than three (3) copies of "No Exceptions Noted", "Exceptions Noted", or "No Action Taken" shop drawings, additional copies shall be included in original submittal.

D. The CONTRACTOR may request submittals be reviewed up to 2 times for each equipment or construction material item, regardless of manufacturer or supplier, by the ENGINEER. For additional reviews, CONTRACTOR will reimburse ENGINEER for additional labor as specified in Section 01013 - ENGINEERING SERVICES.

E. The CONTRACTOR will be held responsible for any delay in progress in the work due to resubmittal of shop drawings. Time for completion of the contract will not be extended due to his failure to promptly submit complete and acceptable shop drawings, product data and samples.

F. Do not execute work required by shop drawings until accepted shop drawings are received from ENGINEER.

G. Before submitting shop drawings for review, CONTRACTOR shall check shop drawings for accuracy, ascertain that all work contiguous with and having bearing on other work shown on shop drawings is accurately drawn, and that work shown is in conformity with Contract requirements. The CONTRACTOR is responsible for all submittals from Subcontractors and suppliers.

H. All such drawings and details, when submitted, must bear the stamp of approval of CONTRACTOR, bearing checked data, as evidence that such drawings and details have been checked by him. Said "stamp" shall clearly state that the CONTRACTOR has checked the drawings and, by his signature, he so certifies. Any drawings submitted without such executed stamp of approval, or whenever it is evident (despite the stamp) that the drawings have not been checked, they will be returned to the CONTRACTOR for resubmission and will not be considered. In such event, it will be deemed that CONTRACTOR has not complied with this provision and the CONTRACTOR shall bear risk of all delays to the same extent as if no drawings or details had been submitted.

I. The CONTRACTOR shall prepare composite drawings and installation layouts, when required to solve tight field conditions. Such drawings shall consist of dimensioned plans and elevations, and must give complete information particularly as to size and location of sleeves, inserts, attachments, openings, conduits, ducts, boxes, structural interferences, etc. These composite drawings and installation layouts shall be coordinated in the field by the CONTRACTOR and his subcontractors for proper relationship to the work of other trades, based on field conditions, and shall be checked and approved by them

before submission to the ENGINEER for his final review. The CONTRACTOR shall have competent technical personnel readily available for such coordinating and checking, as well as for supervision of field installation of work as per the drawings and installation layouts, which have been previously determined by him to be correct and carry the ENGINEER's review stamp.

J. Submission of shop drawings (in either original submission or when resubmitted with corrections) constitute evidence that the CONTRACTOR has checked all information thereon, and that he accepts and is willing to perform the work as shown in a workmanlike manner and in accordance with best standard practice.

K. Cost of any changes in construction due to improper checking and coordination by the CONTRACTOR shall be paid for by the CONTRACTOR, and the CONTRACTOR shall be responsible for all additional costs, including coordination.

L. Shop drawings shall clearly delineate the following information:

ENGINEER's name and project number, Project name and address.

Submittal number.

Drawing title, number, date, and scale.

Names of CONTRACTOR, Subcontractor, and Fabricator.

Working and erection dimensions.

Arrangements and sectional views.

Necessary details, including complete information for making connections with other work.

Kinds of materials and finishes.

Show descriptive names of materials and equipment, classified item numbers, and locations at which materials or equipment are to be installed in the work. Use same reference identification as shown on Contract Drawings.

The ENGINEER shall provide the CONTRACTOR with a form to accompany the Shop Drawings.

M. If shop drawings show variations from Contract Documents because of standard shop practice or other reasons, make specific mention of such variations in Transmittal Form.

N. Shop drawing review will be general. It shall not relieve the CONTRACTOR of responsibility for accuracy of such shop drawings, nor proper fitting, construction of work, furnishing of materials, or work required by Contract Documents and not indicated on shop drawings. Shop drawing review shall not be construed as approving departures from Contract Documents.

O. Review of shop drawings and schedules shall not relieve the CONTRACTOR from responsibility for any violation indicated on such drawings or schedules of local, county, state or federal laws, rules, ordinances, or rules and regulations of commissions, boards or other authorities or utilities having jurisdiction.

P. When product data, consisting of manufacturer's printed literature, is required to be submitted to ENGINEER, it shall be submitted in original form. Any fading type of reproduction will not be accepted.

1.05 MATERIAL AND EQUIPMENT RECORD

A. The CONTRACTOR shall maintain an up-to-date record of all materials and equipment furnished by him and any subcontractors to be incorporated in the work.

The ENGINEER will furnish the CONTRACTOR a master of the materials and equipment record furnished by him and any subcontractors to be incorporated in the work.

B. The CONTRACTOR shall provide the following information on these forms:

1. The specification paragraph and section number where material or equipment are called for.

2. Date ordered.

3. Date required.

4. CONTRACTOR's purchase order number.

5. Supplier's purchase order number.

6. Date promised.

7. Date received.

8. Supplier's name and address.

9. Remarks.

10. Shop drawings and samples with approval date.

11. Physical dimensions and ratings.

Other items that shall be submitted with the material and equipment record include performance curves for all pumps. Where submittal sheet describes items in addition to that item being submitted, the submitted item shall be clearly marked on the sheet and superfluous information shall be crossed out.

C. Three copies of the materials and equipment record shall be submitted to the ENGINEER with each application for payment. If the current record has not been submitted, the Application shall not be reviewed and shall be returned to the CONTRACTOR as incomplete.

D. The CONTRACTOR shall permit free access to these records, including information on items recently received and not yet posted to the record, by the ENGINEER or authorized representative of the OWNER at any time.

1.06 OPERATION AND MAINTENANCE MANUALS

A. Five copies of an Operations and Maintenance (O&M) Manual containing the following items, in addition to any instructions packed with the equipment, are required for each individual item of equipment:

1. Specifications

2. Drawings

3. Description of each individual item of equipment

4. Installation instructions

5. Operation and maintenance instructions

6. Parts list

7. Additional data to be included in the manual shall be as required in these Specifications.

These manuals are to be submitted to the ENGINEER upon delivery of the equipment to the site. Overall project substantial completion will not be scheduled until all manuals are approved.

B. The respective manuals for the individual items of equipment shall be combined into bound volumes covering the complete operating installation with individual equipment items tabled separately. Information for equipment subassemblies not manufactured by the major supplier shall also be included with the respective equipment item.

C. The volumes of manuals shall be bound in a substantial three-ring binder with hard back covers, indicating the equipment items addressed, each manufacturer's name, and the year of purchase. Manuals for particular items of equipment which are in the same area should be bound in the same volume where practicable.

1.07 PROGRESS SCHEDULE

A. To assure completion of the Work within the contract times established, all activities of the CONTRACTOR shall be scheduled and monitored by use of a CPM (Critical Path Method) Schedule. The CONTRACTOR shall provide a CPM Schedule for Work done under this Contract in accordance with the requirements of this Section and the General Conditions.

1.08 DAILY REPORTS

A. The CONTRACTOR shall provide daily reports to the City on a form acceptable to the City. The reports shall be submitted to the City on a weekly basis. The reports shall contain the following information: day, date and year; project title and project location; weather conditions including the temperature; times and hours worked; manpower description and quantity; equipment description and quantity; brief description of the Work performed for that day including quantities and locations (station numbers if applicable); inspections and tests; visitors; accidents and/or delays; working conditions; unexpected events or circumstances; discovery of differing or unforeseen physical conditions; discovery of a discrepancy, error, or omission in the Contract Documents; signed by the CONTRACTOR's Representative such as the project superintendent or job foreman.

1.09 TESTING RESULTS

A. CONTRACTOR shall furnish to ENGINEER copies of all testing results for all tests required in the specifications.

1.10 PRE-CONSTRUCTION VIDEO as defined in Section 01380 - CONSTRUCTION PHOTOGRAPHS.

1.11 CONSTRUCTION PHOTOGRAPHS as defined in Section 01380 - CONSTRUCTION PHOTOGRAPHS.

1.12 RECORD DRAWINGS as defined in Section 01700 - CONTRACT CLOSEOUT. CONTRACTOR shall update Record Drawings Monthly and submit updated record drawings to ENGINEER monthly for review with the pay application. An updated schedule must be submitted monthly with the application for payment. The application for payment will not be reviewed and shall be returned to the CONTRACTOR as incomplete if the updated schedule does not accompany it.

1.13 ALL ADDITIONAL SUBMITTALS as required by the Contract Documents.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 01380

CONSTRUCTION PHOTOGRAPHS

PART 1 GENERAL

1.01 SUMMARY

A. Photographer

1. The CONTRACTOR shall furnish progress photographs of the project. The photographer selected by the CONTRACTOR shall be approved by the ENGINEER and shall be either a commercial photographer or an individual experienced and equipped for such photography. The CONTRACTOR shall submit to the ENGINEER three representative prints of color photos taken by the selected photographer for approval of the photographer's qualifications prior to taking the first photographs.

2. The CONTRACTOR shall furnish two pre-construction videos. Prior to performing any construction, the CONTRACTOR shall make the VHS color video tapes showing the existing condition of the pipeline alignment, reservoir and booster pump station site, and well sites 10, 11, and 12. The video shall focus on the areas where construction is to occur. The videos shall be submitted 48 hours prior to construction. The ENGINEER shall be in attendance when the video is taken.

B. Photographs

1. Quantities: The CONTRACTOR shall deliver to the ENGINEER all negatives and three 3-inch by 5-inch color glossy prints of each view with each application for payment and photographs taken during that period.

2. Quality: Processing and reproduction work shall be accomplished in accordance with standard practice to ensure that the negatives and subsequent prints are clear and sharp in detail, of good tonal quality and uniform in range of density. Photos shall be taken by a 35mm camera with a lens sized to accommodate the view of the photograph and shall be protected in appropriate professional enclosures.

3. Labels: The negatives and photographs shall be identified by use of typewritten labels affixed to the negative enclosure and to the back of the photograph. The label shall provide a description of the view, the name of the project, the name of the CONTRACTOR and the date of the photography.

4. Covers: The CONTRACTOR shall furnish adjustable, hard-back photo album covers for each set for storage of the mounted photos. Photo albums shall be labeled as to project title.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.01 PROCEDURES

A. Requirements. Photographic exposures shall be taken during the construction period. The ENGINEER may vary the specified frequency so that significant progress or changes can be recorded on the photographs. The views to be taken will be identified by the ENGINEER. Approximately 6 photographs will be required every 2 weeks through the construction period.

B. The progress photographs shall be of aesthetic composition and shall depict the progress of the work from the beginning of construction through and including the finished product.

C. No money due the CONTRACTOR under any partial payment estimate will be paid until the currently due photographs have been submitted.

END OF SECTION

SECTION 01410

TESTING

PART 1 GENERAL

1.01 SUMMARY

A. Testing

1. See Section 46.0 of the General Conditions for testing requirements and responsibilities. The CONTRACTOR is responsible for all required testing. CONTRACTOR shall coordinate testing with the ENGINEER. Copies of all test reports shall be submitted to the ENGINEER. All retesting required due to the failure of the CONTRACTOR's work to meet the requirements of the contract documents shall be at the CONTRACTOR's expense. All standby and travel time by the testing lab or the ENGINEER due to the CONTRACTOR's inability to be prepared for testing at the agreed upon time or inability of CONTRACTOR to meet performance requirements shall be at the CONTRACTOR's expense.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 01500

CONSTRUCTION FACILITIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Temporary utilities required during construction.

B. Temporary construction facilities including field offices.

C. Requirements for access to the work.

D. Project sign.

1.02 TEMPORARY UTILITIES

A. Water

1. Construction water may be obtained through a fire hydrant from the City of Avondale. A meter may be purchased from the City and shall be drawn on the hydrant where water is being installed. The Contractor shall be responsible for the cost of installing the meter. The cost of the water will be based on the current water rates for the City.

B. Electricity

1. The OWNER will provide a location at the site where the CONTRACTOR can set up temporary power.

2. Temporary electric power installations shall meet construction safety requirements of OSHA, State, and other governing agencies.

C. Sanitation

1. The CONTRACTOR shall provide and maintain sanitary facilities for the CONTRACTOR's employees and Subcontractor's employees that comply with regulations of local and state health departments.

2. The CONTRACTOR shall provide chemical toilets of suitable types and maintain them in a sanitary condition at all times conforming to code requirements and acceptable to health authorities. The toilets shall be of watertight construction so that no

contamination of the area can result from their use. The CONTRACTOR shall make arrangements for frequent emptying of the toilets. Upon completion of the work the CONTRACTOR shall remove the toilets and restore the area to the original condition.

D. Communications

1. The CONTRACTOR shall provide and maintain, at all times during the progress of the Work, not less than one telephone and one fax machine in good working order at the CONTRACTOR's construction field office.

E. Construction Debris

1. The CONTRACTOR shall maintain a clean site. The Contractor shall arrange for the disposal of construction debris, at no additional expense to the OWNER, to an appropriate disposal site.

1.03 TEMPORARY CONSTRUCTION FACILITIES

A. Offices

1. The CONTRACTOR shall provide, maintain and subsequently remove, one field office as specified below for the exclusive use of the OWNER, ENGINEER, CONTRACTOR and their representatives. The field office shall be new or like new in appearance and function.

2. The field office shall be equipped, at a minimum as specified below and shall be available for use within two weeks from the date of the Notice to Proceed.

a. The field office shall be a minimum size of 12'x54' with one office large enough to accommodate an OWNER's or ENGINEER's on-site representative, one break room, and one restroom. The office for the OWNER's or ENGINEER's Representative shall have a separate entrance from the CONTRACTOR's entrance.

b. The ENGINEER's office shall be furnished with two desks each 30 inches by 60 inches, one drafting table 3 feet by 6 feet, two desk chairs, two extra chairs, one four-drawer metal file cabinet with lock, one telephone with 2-line capability, fax machine with a dedicated line, one answering machine, and a wastepaper basket.

c. The break room shall be equipped with a table large enough to accommodate 8 people comfortably, 10 chairs, a 6 cubic-foot refrigerator, microwave oven, bottled drinking water dispenser with hot and cold tap, and a wastepaper basket.

d. The restroom shall have a toilet, sink, paper towel dispenser and a wastepaper basket. The sink shall have hot and cold water and drains.

e. The field office shall have florescent lighting throughout, 110-volt electric wall plugs with maximum spacing between receptacles not to exceed 8'-0", heating, cooling, two entrance doors with railed stairway, first-aid kit, and fire extinguisher. The CONTRACTOR shall provide a set of two keys to the ENGINEER to operate entrance locks.

3. The field office shall be located where directed by the OWNER; leveled, blocked, tied down, and skirted as directed.

1.04 ACCESS ROADS AND PARKING

A. Access Roads

1. The CONTRACTOR shall provide adequate maintenance of all access roads including dust control. The CONTRACTOR shall repair any damage to access roads as a result of construction at no additional cost to the OWNER.

B. Parking

1. The CONTRACTOR shall park all company and private vehicles at a location designated by the OWNER at a location within the site.

1.05 PROJECT SIGN

A. The CONTRACTOR shall furnish and erect one 8' x 16' project sign in a location selected by the OWNER. The project sign shall be approved by the OWNER.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 01640

MATERIALS AND EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. The CONTRACTOR shall furnish all materials and equipment and perform all operations required to completely install and place in operation the various mechanical apparatus and systems indicated on the Drawings and as specified herein. It is not the intent to mention herein each and every item required. However, all installations shall be complete. These general equipment requirements apply, in general, to all equipment. They shall supplement the detailed equipment specifications, but in case of conflict, the equipment specifications shall govern.

PART 2 PRODUCTS

2.01 GENERAL

A. Materials and equipment shall be of new, first quality and best grade, essentially the standard catalog products of reputable manufacturers, and shall be of the type, size and capacity and for the type of service specified. It is the intent of these specifications that the highest quality equipment shall be provided for the intended service. Units proposed shall be carefully matched to the particular hydraulic and mechanical requirements for each installation, and the CONTRACTOR shall submit complete hydraulic and mechanical data for approval by the ENGINEER. Where two or more units of the same class of equipment are required, these units shall be the products of a single manufacturer; however, the component parts of the system need not be the products of the same manufacturer of the complete equipment item, unless otherwise specified.

1. Materials and Workmanship: Materials used in the manufacture of the equipment shall be of the best quality used for the purpose in commercial practice. Materials shall be suitable for service conditions. Iron castings shall be tough, close-grained gray iron free from blowholes, flaws, or excessive shrinkage and shall conform to ASTM A-48. Except where otherwise specified, structural and miscellaneous fabricated steel used in items of equipment shall conform to the

Standards of the American Institute of Steel Construction. All structural members shall be considered as subject to shock or vibratory loads. Unless otherwise specified, all steel which will be submerged, all or in part, during normal operation of the equipment shall have a minimum nominal thickness of 1/4 inch. Equipment shall be installed in accordance with the recommendations of the manufacturer and the best standard practice for each type of equipment.

2. Approval of Materials, Equipment and Shop Drawings: Detailed shop drawings shall be prepared for the equipment to be furnished under this Project. General drawings for equipment will not be acceptable. Approval of equipment under this provision shall not be construed as authorizing any deviations from the specification unless the attention of the ENGINEER has been directed to the specific deviation. Equipment differing from that specified may only be proposed as defined in Section 01300.

   The decision of the ENGINEER on any question concerning the acceptability of materials, equipment or installation shall be final and binding. The shop drawing material required for the various submittals shall be in accordance with the coded legend set forth in Paragraph B - Data Reference Symbols and Descriptions in Section 01300, and as indicated and specified under various headings of these specifications.

3. Nameplates: Equipment shall be furnished with nameplates of bronze, monel, or stainless steel. Aluminum will not be acceptable. Each nameplate shall include pertinent hydraulic and mechanical data. Information shown shall be permanently stamped or cast into each nameplate and shall include the manufacturer's name and model number.

B. Electric Motors

1. General: Unless otherwise required by the detailed equipment specifications, motors furnished with equipment shall be rated for continuous duty of 40 degrees C ambient. Where frequent starting occurs, motors shall be designed for frequent starting duty equivalent to the duty service required by the driven equipment. The horsepower rating of each motor shall be as required to drive the equipment under full load,

including all losses in speed reducers and power transmission, and to be non-overloading over the entire range of equipment head capacity curves without the use of motor service factors. It is the intent of this general specification to allow the manufacturer's standard motor on integrally constructed motor driven equipment such as appliances, hand tools, etc., that is specified by model number in which a redesign of the complete unit would be required for a motor with other features as may be specified herein. All motors furnished under these specifications shall be of recognized manufacture, of adequate capacity for the loads involved, and wound to the current characteristics noted. All motors furnished under these specifications shall be capable of being serviced locally. All motors shall conform to the standards of manufacture and performance of the National Electrical Manufacturers Association as shown in their latest publications.

2. Anchor Bolts: Equipment suppliers shall furnish suitable anchor bolts of specified metallurgy for each item of equipment. Anchor bolts, together with templates or setting drawings, shall be delivered sufficiently early to permit setting the anchor bolts when the structural concrete is placed. Two nuts shall be furnished for each bolt. Unless otherwise shown or specified, anchor bolts for items of equipment mounted on baseplates shall be long enough to permit 1-1/2 inches of grout beneath the baseplate and to provide adequate anchorage into structural concrete.

3. Equipment Bases: A cast iron or welded steel baseplate shall be provided for each pump and other item of equipment which is to be installed on a concrete base. Each baseplate shall support the unit and its drive assembly, and shall be of a neat design with pads for anchoring the units. Baseplates shall be anchored to the concrete base with suitable anchor bolts and grouted in place.

C. Equipment Guards: All belts or chain drives, fan blades, couplings, and other moving or rotating parts shall be covered on all sides by a safety guard. All safety guards in outdoor locations shall be designed to prevent the entrance of rain and dripping water.

D. Special Tools and Accessories: Equipment requiring periodic repair and adjustment shall be furnished complete

with all special tools, instruments, and accessories required for proper maintenance. Equipment requiring special devices for lifting or handling shall be furnished complete with those devices.

E. Standard specifications prepared by recognized organizations mentioned elsewhere shall govern except as provided otherwise by these specifications and/or its accompanying Drawings. Special care shall be exercised in requests for quotations and in orders, to refer to the standard specifications and to all modifications thereof.

F. Standard Codes, Regulations and Specifications: Unless indicated or specified otherwise, all materials and workmanship for the mechanical trades shall conform to the editions of the various standards, codes, manuals, and specifications in effect on the date of advertisement for bids, which are referred to in the various sections herein.

PART 3 EXECUTION

3.01 PROTECTION OF EQUIPMENT

A. General: All equipment shall be boxed, crated or otherwise completely enclosed and protected during shipment, handling and storage. All equipment shall be protected from exposure to the elements and shall be kept thoroughly dry at all times.

B. Painted surfaces shall be protected against impact, abrasion, discoloration and other damage. All painted surfaces which are damaged prior to acceptance of equipment shall be repainted to the satisfaction of the ENGINEER.

C. Electrical equipment, controls and insulation shall be protected against moisture or water damage.

3.02 INSTALLATION

A. Installation of materials and equipment specified herein shall be performed in a workmanlike manner by mechanics skilled in their particular trade. Piping and equipment shall be installed square and plumb and accessible for proper operation and service. Installations shall be consistent in completeness and appearance whether enclosed or exposed. Any item which does not present a neat and workmanlike appearance shall be replaced without additional cost to OWNER. All piping connections to

equipment shall be in accordance with requirements of Section 02600 - PIPED UTILITY MATERIALS.

3.03 GUARANTEE

A. The CONTRACTOR shall guarantee all equipment against:

1. Faulty or inadequate design.

2. Improper assembly or erection.

3. Defective workmanship or materials.

4. Leakage, breakage or other failure.

The guarantee period shall be as defined in the General Conditions.

END OF SECTION

SECTION 01650

STARTING OF SYSTEMS

PART 1 GENERAL (Not Used)

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.01 GENERAL

A. The CONTRACTOR shall place the newly installed equipment and facilities into operation and test, observe and adjust all items for a minimum period of 1 week or until such time as all the units are properly adjusted. The work performed by the CONTRACTOR shall include, but not be limited to, the following items:

1. Labeling equipment as directed herein.

2. Providing operating procedures for equipment. Operating procedures shall be encased in acrylic plastic sheets and provided to staff.

3. Checking all electrical and electronic equipment for proper operation: The CONTRACTOR shall provide water, temporary piping and all other appurtenances required for testing equipment and piping.

4. Adjustments: Making all equipment adjustments required.

B. Supervision of Installation by Manufacturer

1. An experienced, competent, and <u>factory-employed</u> representative of the equipment manufacturer shall visit the site of the work and inspect, check, adjust if necessary, and approve the equipment installation, and shall be present when the equipment is placed in operation. The equipment manufacturer's representative shall revisit the job site as often as necessary until any trouble is corrected and the equipment installation and operation is satisfactory to the OWNER. The equipment manufacturer's representative shall furnish to the ENGINEER, a written report certifying that the equipment:

a. has been properly installed and lubricated.

b. is in accurate alignment.

c. is free from any undue stress imposed by connecting piping or anchor bolts.

d. has been operated under full load conditions and that it operated satisfactorily.

C. Operator Training

1. The CONTRACTOR shall provide a factory-employed manufacturer's representative to train City Staff in operation and maintenance procedures for equipment items specified below during the startup period at no additional cost to the OWNER. The representatives shall present training programs and on-site demonstrations designed to fully acquaint Staff with all equipment features, routine scheduled maintenance procedures, alternative operational modes, spare parts inventories, and all other pertinent information. In addition, the manufacturer's representatives shall remain on-site to observe operation of the equipment and further advise Staff for a minimum number of days as specified in the following table:

Equipment Item	Total Minimum Required Startup Time On-Site (Days)
Booster Pumps	1
Chlorine System	1
Standby Generator	1
Flowmeter	$^1/_2$

2. A complete schedule of representatives and dates for operator training shall be submitted to the ENGINEER prior to commencement of the startup period.

3. The CONTRACTOR shall record all equipment training sessions on VHS color format tapes and provide 2 sets of all tapes to the OWNER. The training tapes shall be indexed and logged.

END OF SECTION

SECTION 01700

CONTRACT CLOSE-OUT

PART 1 GENERAL

1.01 SUMMARY

A. Cleanup and Site Grading

1. After work has been completed, the CONTRACTOR shall remove and dispose of all waste, surplus materials, and illegally dumped materials on the site; shall restore all areas to the condition equal to or better than the original; and perform all site grading to the lines and grades as shown or conforming to adjacent contours.

B. Record Drawings

1. Refer to the General Conditions for Record Drawing requirements. At the completion of the project, the CONTRACTOR shall deliver 2 sets of reproducible mylar record drawings to the OWNER and 3 sets of bluelines of these record drawings. The reproducible mylars will be furnished by the OWNER to the CONTRACTOR.

2. Dimensions shall be given for all underground facilities and they shall be tied to a minimum of 2 fixed points. Two fixed reference points shall be permanently marked and identified by the CONTRACTOR as dimensionally correct. All dimensions given on the drawings must reflect both reference points.

3. The record drawings, to be completed by the CONTRACTOR, shall reflect all changes made by change order, addenda, field order, work directive, and any other changes made and approved during the course of the work. The record drawings shall be signed by a registered engineer at Contractors expense.

4. The quality of drafting performed on the Record Drawings shall meet the engineering industry standard for final reproducible production drawings.

C. Keys

1. Keys shall be tagged and turned over to the OWNER by the CONTRACTOR.

D. Final Pay Request

1. Refer to Sections 58.0 and 59.0 of the General Conditions for Final Payment requirements.

E. CONTRACTOR's Affidavit of Payment of Debts and Claims

1. The CONTRACTOR shall submit an Affidavit of Debts and Claims to the ENGINEER on AIA Form G706.

F. CONTRACTOR's Affidavit of Release of Lien

1. Refer to Section 58.0 of the General Conditions for CONTRACTOR's Affidavit of Release of Lien requirements. The CONTRACTOR shall submit this item to the ENGINEER on AIA Form 706A and attached to AIA Form G706.

G. Consent of Surety

1. Refer to Section 58.0 of the General Conditions for CONTRACTOR's Consent of Surety requirements. This item shall be submitted to the ENGINEER on AIA Form G707.

H. Equipment Manufacturer's Start-Up Reports

1. Refer to Section 01650 - STARTING OF SYSTEMS for equipment manufacturer's Start-Up Report requirements.

I. Labor and Material Lien Waivers

1. Labor and Material Lien Waivers shall be furnished by the CONTRACTOR and all subcontractors (see subcontractor list submitted with bid and all approved substitutes). Lien waivers shall be attached to the CONTRACTOR's Affidavit of Release of Liens, AIA Form 706A.

J. Warranties

1. Copies of written warranties shall be furnished for each individual item of equipment with names, addresses and phone numbers of manufacturer's representative.

K. Operation and Maintenance Manuals

1. Refer to Section 01300 for OPERATION AND MAINTENANCE MANUAL requirements.

L. Close-Out Checklist

1. The CONTRACTOR shall complete and submit the closeout checklist included in Section 01701 with all closeout items.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 01701

CLOSE-OUT CHECKLIST

CONTRACTOR RETENTION RELEASE

PROJECT: _____

FACILITY: _____

CONTRACTOR: _____

Submit the items required by your contract and project specifications as well as special items called for in the specifications not covered by this list.

A. General Requirements: (6 Originals each)

1. Certificate of Substantial Completion - AIA Form G704 _____
2. Final Pay Request _____
3. Affidavit of Payment of Debts & Claims - AIA Form G706 _____
4. Affidavit of Release of Lien - AIA Form G706A _____
5. Consent of Surety - AIA Form G707 _____
6. Letter Certifying All Punch List Items Completed (OWNER'S REPRESENTATIVE to provide) _____
7. Certificate evidencing insurance. _____

B. Lien Waivers:

1. All Subcontractors and Material Suppliers (see List submitted with bid and all approved substitutions) _____
2. All Vendors with Preliminary Notices Files _____

C. Guarantees: (These are minimum warranty periods unless specifications state otherwise)

1. Total project guarantee 1 year _____
2. Pumps 1 year _____
3. Valves 1 year _____
4. Chlorine System 1 year _____
5. Flowmeter 1 year _____
6. Standby Generator 1 year _____

D. Specialty Items:

1. Keys tagged and turned over to Owner _____
2. Testing and Balance Reports as Required by Specifications _____
3. 2 VCR Tapes of all Required Training Programs _____

E. Operation and Maintenance Manuals: In bound hard covers (4 copies)

Tags, Inspection Slips, Instruction Packages, and other information to be removed from equipment, identified and included in Manuals.

1. Electrical _____
2. Pumps _____
3. Valves _____
4. Chlorine System _____
5. Flowmeter _____
6. Standby Generator _____

G. Extra Materials: (These are minimum requirements unless Specifications state otherwise)

1. Hardware (Locks, Closers, Push & Pulls, Hinges, etc.) 1 of each type or 1%, whichever is greater _____
2. Paint - Provide 1 gallon of each color or type with mixing formulas and instructions _____

END OF SECTION

SECTION 02100

SITE PREPARATION

PART 1 GENERAL

1.01 SUMMARY

A. Work under this section consists of preparing the construction sites for new construction and includes stripping, grubbing, removal of existing structures, filling voids resulting from the removal work, disposal of waste materials, and all other miscellaneous items of work required to complete the site preparation.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.01 STRIPPING

A. Grass, weed, and brush growth shall be stripped from the Pump Station and Reservoir Site and the new waterline alignment. All debris and waste materials resulting from these operations shall be removed from the site; no foreign material such as weeds, grass or brush shall be covered by, or incorporated in, fills, embankments or backfills.

3.02 REMOVAL WORK

A. Insofar as is consistent with customary construction practices, all operations shall be performed by such method as shall result in the minimum damage to materials and equipment to be salvaged or to remain intact and in use.

B. Any fencing removed as obstructions shall be restored to match existing as indicated on the drawings and specified herein.

3.03 CLEANUP

A. During construction, the construction sites shall be kept free from all accumulations of trash and debris and, upon completion of construction, the entire site shall be carefully cleaned of all debris and remnants of construction.

END OF SECTION

SECTION 02200

EARTHWORK

PART 1 GENERAL

1.01 SUMMARY

A. This section covers excavating, trenching, backfilling, and grading as indicated on the Project Drawings, together with all incidental work in connection therewith, including subgrade preparation and restoration, legally disposing of surplus and waste materials, and final site grading. Areas disturbed by construction shall be graded and excavated or filled in such a manner that completed items will conform to lines, grades, and elevations of surrounding area.

1.02 REFERENCES

A. ASTM C-131 - Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

B. ASTM C-136 - Sieve Analysis of Fine Coarse Aggregates

C. ASTM D-698 - Moisture - Density Relationship of Soils Using a 5.5 Pound (2.5kg) Rammer and a 12-inch (305mm)Drop

D. ASTM D-2922 - Moisture - Density of Soil and Soil Aggregate In-Place by Nuclear Methods (shallow depth)

E. ASTM D-4318 - Plasticity Index of Soils

F. AASHTO T-85 - Bulk Specific Gravity (SSD) for riprap

1.03 RELATED SECTIONS

A. Section 02600 - PIPED UTILITY MATERIALS

B. Section 03300 - CAST-IN-PLACE CONCRETE

1.04 SUBMITTALS

A. Granular Base and Imported Materials

1. Submit gradation reports, material analysis, and Letter of Certification of Compliance.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.01 EXCAVATION

A. General

1. All excavation shall be unclassified and the CONTRACTOR shall remove all substances encountered in excavating and trenching to the designated limits and grades. No separate or additional payment will be made for classification of materials regardless of the nature, condition, or moisture content.

2. Surface drainage shall be diverted away from site of open excavations and trenches. Surface water which enters or accumulates in open excavations or trenches shall be removed and the subgrade or pipe trench restored to original bearing value and condition at no additional expense to the OWNER.

B. Overdepth Excavation

1. Trenches and excavation shall not be carried below depths required to permit construction to the elevations, grades, and dimensions specified in these Contract Documents. Inadvertent overdepth excavation of pits or trenches occurring through oversight or inattention of the CONTRACTOR shall be corrected as directed and at no additional expense to the OWNER.

2. Overdepth excavation of trenches or structures shall be corrected by backfilling with aggregate base course engineered structure backfill material placed and compacted in 6" maximum lifts to a uniform density of 95 percent as determined by ASTM D-698. Moisture content shall be maintained within ±2 percent of the optimum moisture content.

C. Borrow Excavation

1. Borrow excavation, as required, shall be subsidiary to the total work. The CONTRACTOR shall obtain approved suitable material from an approved source and shall haul, place, and compact material at no additional expense to the OWNER.

D. Excess Excavated Material

1. All excess excavated materials shall be treated as construction debris and shall be removed by the CONTRACTOR at no expense to the OWNER, to an appropriate disposal site.

E. Miscellaneous Excavation

1. The CONTRACTOR shall do such miscellaneous excavating work as may be necessary and directed. Such excavation shall be subject to the same conditions and requirements specified herein.

F. Existing Stock Piles

1. All existing stock piles shall be removed from the site by the CONTRACTOR, at no expense to the OWNER, to an appropriate disposal site.

3.02 TRENCHING

A. General

1. Trenching shall be open cut, with banks kept as nearly vertical as practical. Trenches shall be supported using shoring or trench boxes where required. Particular care shall be used to avoid overdepth excavation except where ordered to remove material considered unstable or otherwise unsuitable as bedding for pipes.

2. Pipe Trenching and Conduit Trenching

a. Width of trench below top of pipe or conduit shall be within the limits recommended by the pipe manufacturer.

b. Trench depth for all pipe and conduit shall be as specified herein and shown on the Drawings.

c. Overwide excavation occurring from any cause shall be corrected by installing additional embedment as directed by the ENGINEER.

d. The CONTRACTOR shall have all trenches closed at the end of each work day, if possible. If not, the CONTRACTOR shall have trenches barricaded and marked.

3.03 BACKFILLING

A. Pipe Embedment

1. Pipe and conduits shall be bedded from bottom of excavation to one-foot above the top of pipe with granular bedding material meeting the requirements of Section 601.4.6 of MAG Uniform Standard Specifications. The initial bedding under the pipe is required for pipe having an inside diameter of 12" or larger, and in all cases where rock larger than 1-1/2" is encountered in the trench bottom.

B. Trench Backfill

1. The backfill material for all trenches except as noted otherwise shall be inorganic soils free of vegetation, debris, organic contaminants and fragments larger than 6-inches in size. The upper portion of all trenches above the pipe embedment shall be backfilled with approved on-site or borrow material and compacted to a uniform minimum density of 95 percent of the maximum density at ± 2 percent of optimum moisture content as determined by ASTM D-698.

C. Standard Fill

1. General: Fill and compact to a uniform minimum density of 95 percent of the maximum density at a moisture content within ± 2 percent of optimum moisture content as determined in ASTM D-698. Backfill material should be free from vegetation, debris, and deleterious material and should contain no particles larger than 6 inches in diameter. Backfill shall be placed in lifts no more than 8 inches measured loose. Moisture content during compaction shall be maintained.

D. Structural Backfill

1. General Structural Fill. Backfill with on-site material and compact to a uniform minimum density of 95 percent of the maximum density as determined by ASTM D-698. Additional backfill material shall be added if required. Fill material should be free from vegetation, debris, and deleterious material, and should contain no particles larger than 6 inches in dimension. The plasticity index shall not exceed 18 as determined by ASTM D4318. Fill shall be placed in lifts no more than 8 inches and compacted to a minimum

of 95% of maximum dry density as determined by ASTM D-698. Moisture content during compaction shall be maintained within 2± percent of the optimum moisture content, as determined by ASTM D698.

2. All fill required to bring the pads up to subgrade elevation and to fill behind structural walls shall meet the requirements specified in this Section.

3. Slab Base. Four inches minimum of granular base shall be placed beneath all concrete slabs. Granular base shall be compacted to a minimum of 95 percent of maximum dry density as determined by ASTM D-698.

   The granular base shall meet the following grading requirements as determined by ASTM C-136:

Size (square openings)	Percent Passing by Weight
1-1/8 inch	100
1/4 inch	35-70
No. 200	0-12

   The plasticity index of the fraction of material passing the No. 40 sieve should be nonplastic when tested by ASTM D-4318. The coarse aggregate should have a percent of wear when subjected to the Los Angeles abrasion test (ASTM C-131) of no greater than 45.

E. Riprap

1. Stone or concrete riprap shall be placed to the indicated depths at the locations shown on the Project Drawings in accordance with applicable requirements of Section 913, ADOT Standard Specifications for dumped riprap, the Drawings and as specified herein.

2. Dumped riprap shall consist of hard sound stone free from earth, cracks, seams, soapstone, shale or other easily disintegrated material that will tend to decrease the durability of the material after placement. Rock shall have a soundness ratio of not less than 0.70 after 25 cycles of freeze and thaw test. Minimum and maximum riprap sizes shall be 4 inches and 12 inches, respectively.

3.04 SUBGRADE PREPARATION

A. General: Subgrades shall not be prepared until after all underground appurtenances have been completed, backfilled, and compacted, and all excavation and fill areas have been brought to proper elevation. Subgrade shall be constructed in layers not over six inches thick after compaction. The material shall be compacted as specified hereinafter for cut and fill areas. The surface of the subgrade shall be struck-off and leveled and, when necessary, scarified and wetted, and finally rolled with the addition of sufficient moisture to prevent drying out prior to placing base course or pavement thereon. Compaction shall be accomplished by power rollers, sheepsfoot rollers, or other equipment.

B. Compaction:

1. Cut Areas. In areas cut from soil, the top of remaining material shall be scarified as required and compacted to a depth of 12 inches below the finished subgrade to within ± 2 percent of optimum moisture content and a density of at least 95 percent of maximum dry density, as determined by ASTM D-698. The CONTRACTOR shall perform the work with approved equipment and methods, shall keep all unnecessary traffic off the area, and shall take all reasonable precautions to disturb the finished surface as little as possible.

2. Fill Areas. In fill areas, the 12 inches below finished subgrade shall be scarified and compacted to within ± 2 percent of optimum moisture content density of at least 95 percent of maximum dry density, as determined by ASTM D-698.

3.05 GRADING

A. General: Excavated areas resulting from removal of obstructions below finish grade shall be backfilled and compacted as specified for the area immediately adjacent. Excavations along edges of structures or base shall be backfilled and compacted as specified.

B. Finish Grading: All debris, excess, and unsuitable materials shall be removed from the site and all ruts, holes, and depressions caused by construction activities shall be filled and graded to match adjacent contours. Waste areas and stockpiles shall be broken down and graded presenting no obstructions to natural drainage, and all

trenching within improved areas shall be finished in a neat and workmanlike manner. Upon completion of backfilling, entire site of the work shall be graded to smooth, uniform slopes, properly shaped and conforming to adjacent contours, providing free drainage without ponding and presenting a neat and finished appearance. Areas which may have been disturbed or affected by construction shall be restored to a graded condition equal or better than the original and graded to drain.

END OF SECTION

SECTION 02511

ASPHALT CONCRETE FOR ROADWAY SURFACES

PART 1 GENERAL

1.01 SUMMARY

A. This section covers the asphalt concrete pavement for roadway surfacing.

B. Removal of existing pavement shall be at locations as shown on the plans and specified in Section 02500 - PAVEMENT REMOVAL AND REPLACEMENT.

1.02 RELATED SECTIONS

A. Section 02200 - EARTHWORK

B. Section 02500 - PAVEMENT REMOVAL AND REPLACEMENT

1.03 SUBMITTALS

A. Descriptive submittals shall be made in accordance with the Data Reference Symbols defined in Section 01300 - SUBMITTALS.

Item	Shop Drawings	O & M Manuals
Asphalt Concrete	A,C,P	A,C,P
Aggregate Base	A,C,P	A,C,P
Tack Coat	A,C,P	A,C,P
Prime Coat	A,C,P	A,C,P

PART 2 PRODUCTS

2.01 ASPHALT CONCRETE

A. Asphalt concrete shall conform to the Arizona Department of Transportation (ADOT) Standard Specifications Section 406 - ASPHALTIC CONCRETE.

B. Asphalt concrete shall be AC-20 Type D-1/2 surface course.

2.02 AGGREGATE BASE

A. Aggregate base shall conform to the ADOT Standard Specifications Section 303 - AGGREGATE SUBBASES AND AGGREGATE BASES.

B. Aggregate base shall be a 4-inch Class 3 aggregate base course with the following gradation:

Sieve Sizes (Square Openings)	Percentage by Weight Passing Sieve (ABC)
1-1/8 Inch	100
No. 4	38-65
No. 8	25-60
No. 30	10-40
No. 200	3-12
P.I. MAX	3

2.03 PRIME COAT

A. The prime coat shall conform to ADOT Standard Specifications Section 404 - BITUMINOUS TREATMENT.

2.04 TACK COAT

A. The tack coat shall be applied as indicated on the Drawings and specified herein.

B. The tack coat shall be Type SS-1H and conform to ADOT Standard Specifications Section 404 - BITUMINOUS TREATMENTS.

PART 3 EXECUTION

3.01 ASPHALT CONCRETE PAVING

A. Asphalt concrete paving shall be constructed per the ADOT Standard Specifications Section 406 - ASPHALTIC CONCRETE.

B. The 2-inch asphalt concrete paving shall be placed in one pass.

3.02 AGGREGATE BASE

A. Aggregate base shall be placed per the ADOT Standard Specifications Section 303 - AGGREGATE SUBBASES AND AGGREGATE BASES.

B. The aggregate base shall be placed in one 4-inch pass.

3.03 TACK COAT

A. The tack coat shall be diluted in the preparation of 50 percent water and 50 percent emulsion and applied at the rate of 0.05 to 0.10 gallons per square yard.

B. The tack coat shall be placed in conformance with ADOT Standard Specifications Section 404 - BITUMINOUS TREATMENTS.

3.04 PRIME COAT

A. The prime coat shall be placed in conformance with ADOT Standard Specifications Section 404 - BITUMINOUS TREATMENTS.

END OF SECTION

SECTION 02520

GRAVEL SURFACING

PART 1 GENERAL

1.01 SUMMARY

A. Gravel surfacing shall consist of the placement of a four inch aggregate surface placed inside the Booster Pump Station walls as shown on the Project Drawings.

PART 2 PRODUCTS

2.01 SUMMARY

A. Gravel surfacing shall be 3/4" to 1½" nominal size aggregate conforming to ASTM D448 consisting of sand and gravel, crushed rock, and/or decomposed granite with a plasticity index not in excess of five (5).

PART 3 EXECUTION

3.01 GENERAL

A. The CONTRACTOR shall use care in placement and during construction activities so as to not damage the gravel roadways once placed. Any additional placement of gravel due to construction activities of the CONTRACTOR will be installed at the CONTRACTOR's expense.

3.02 PLACEMENT

A. The aggregate surface shall be placed in one four-inch layer.

B. The four-inch surface shall conform to grades shown on the Drawings.

C. The layer shall be bladed to a smooth surface conforming to the Plans and shall be watered and thoroughly rolled in a manner satisfactory to obtain a minimum compaction of 95% of maximum density, based on a standard proctor.

D. Laboratory reports showing the gradation and plasticity index shall be submitted to the ENGINEER.

END OF SECTION

SECTION 02600

PIPED UTILITY MATERIALS

PART 1 GENERAL

1.01 SUMMARY

A. Furnish and install smooth solid walled piping of the specified types. Piping shall conform to these specifications and be of the correct size and type as shown on the Plans.

1.02 SECTION INCLUDES

A. Ductile Iron Pipe (DIP) and Fittings

B. Steel and Galvanized Pipe (GSP)

C. Polyvinyl Chloride (PVC) Pipe and Fittings

D. Adapters

E. Piping Wall Seals

F. Thrust Blocks

G. Pipe Joint Restraints

H. Flexible Couplings

I. Corrugated Metal Pipe

J. Copper Pipe

K. Reinforce Concrete Pipe (RCP) and Fittings

1.03 REFERENCES

A. ANSI/AWWA C151/A21.51 - Ductile Iron Pipe Centrifugally Cast, for Water or Other Liquids

B. ANSI/AWWA C115/A21.15 - Flanged Ductile Iron Pipe with Threaded Flanges

C. ANSI/AWWA C111/A21.11 - Rubber Gasket Joints for Ductile Iron and Grey Iron Pressure Pipe and Fittings

D. ANSI/AWWA C110/A21.10 - Ductile Iron and Grey Iron Fittings for Water and Other Liquids

E. ANSI/AWWA C104/A21.4 - Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water

F. ANSI/AWWA C105/A21.5 - Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids

G. ANSI/AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe for Water Distribution

1.04 RELATED SECTIONS

A. Section 02200 - EARTHWORK

1.05 SUBMITTALS

A. Descriptive submittals shall be made in accordance with the Data Reference Symbols defined in Section 01300 - SUBMITTALS.

Item	Shop Drawings
Pipe and Fittings	C,D,F,H,L

PART 2 PRODUCTS

2.01 MATERIALS

A. All materials used in the manufacturing of this equipment shall be new and of the best quality used for the purpose of commercial practice.

2.02 DUCTILE IRON PIPE

A. General

1. Buried Pipe. All buried ductile iron pipe 20" and larger shall be pressure class 250 in accordance with ANSI/AWWA C151/A21.51. All buried ductile iron pipe smaller than 20" shall be pressure class 350 in accordance with ANSI/AWWA C151/A21.51. All joints on buried ductile iron pipe shall be mechanical joint or slip-on joint. All fittings on buried ductile iron pipe shall be mechanical joint ductile iron fittings.

2. Exposed Pipe. All exposed ductile iron pipe shall be special thickness class 53 in accordance with ANSI/AWWA C151/A21.51. All joints and fittings on exposed ductile iron pipe shall be class 150 flanges conformity to ANSI Standard B16.1.

B. Lining

1. All ductile iron pipe and fittings shall be cement mortar lined with a bituminous seal coat in accordance with AWWA C 104.

C. Coating

1. All buried cast and ductile iron pipe and fittings shall be bituminous coated on the exterior in accordance with ANSI/AWWA C 151/A21.51 standards and encased in a polyethylene sleeve for protection against corrosive soils. The polyethylene sleeve for protective wrap shall conform to the requirements of ANSI/ASTM D 1248 and be as manufactured by American Cast Iron Pipe Company or equal. Prior to installation, damaged exterior coatings of ductile iron pipe and fittings shall be repaired with a coat of Rockote Black Mastic No. 612 Medium, or approved equal.

2. All exposed cast and ductile iron pipe and fittings shall be coated as specified in Section 09900 - SPECIAL FINISHES.

2.03 STEEL AND GALVANIZED STEEL PIPE

A. All galvanized steel pipe shall be Schedule 80 conforming to ASTM A53, for seamless pipe galvanized pipe shall conform to ASTM A53. Threaded fittings shall be Class 150 galvanized malleable iron conforming to ASTM A197/ANSI B16.3. All reduction in size shall be made with standard reducing fittings. Bushings shall not be permitted.

B. Joints

1. Joints shall be threaded with malleable iron fittings. Threaded connections shall have ANSI Standard threads, full and cleanly cut with sharp dies. Not more than 3 threads at each connection shall remain exposed after installation. Ends of pipe shall be reamed. Threaded joints shall be made up with a joint compound applied to threads in such manner and quantity that all threads are coated but no compound is forced into the

pipe. Compound shall be suitable for the service and shall be provided maximum protection against corrosion and leakage.

C. Flange Joints

1. Where flanged joints are required, plain faced slip-on or weld neck type flanges shall be furnished and shop welded to the pipe, special or fittings. Flanges shall be 150-pound forged and rolled steel conforming with ANSI B16.5. Flanges shall be back faced or spot faced on the back for bolt heads and nuts. CONTRACTOR shall ensure coordination of dimensions and drilling patterns of all piping, fittings, specials, valves and ancillary items. Flanged bolts for use with steel flanges shall be of carbon steel conforming to ASTM A307, Grade B. Nuts shall be of the cold-pressed type conforming with ASTM A194, Class 1. Bolts and nuts shall be threaded in accordance with ANSI B1.1 for coarse thread series, Class 2 fit. Nuts and bolts shall have hexagonal patterns. Diameters of flange bolts for each size of flange shall conform to ANSI standard specifications and the lengths shall be such that the installed projections are not less than 1/8 inch nor greater than 3/8 inch beyond the outer nut face. Gaskets shall be 1/16 inch compressed ring conforming to ANSI B16.21.

2.04 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

A. General

1. PVC water pipe 14 inches and larger shall conform to AWWA C-905, 165 psi pressure class.

2. PVC water pipe 4 inches to 12 inches shall conform to AWWA C-900, 150 psi pressure class.

3. PVC water pipe 3 inches and smaller shall be Schedule 80 conforming to ASTM D-1785, with a minimum working pressure of 150 psi.

B. Joints

1. Pipe joints for PVC water pipe 4 inches and larger shall be gasketed bell and spigot or gasketed couplings shall conform to ASTM 3139. Joints for pipe indicated on the Drawings to be deflected shall be capable of 2-1/2 degree deflection without leakage.

2. Pipe joints for PVC water pipe 3 inches and smaller shall be solvent welded PVC couplings.

C. Fittings

1. Fittings for PVC water pipe 4 inches and larger shall be mechanical joint ductile iron conforming to 2.02.A of this specification.

2. Fittings for PVC water pipe 3 inches and smaller shall be solvent weld PVC type conforming to ASTM D-2466.

3. Fittings for PVC sewer pipe shall be mechanical joint ductile iron conforming to 2.02.A of this specification.

2.05 ADAPTERS

A. Adapters from one type of pipe to another shall be provided as recommended by manufacturer.

B. Transition couplings and tapping tees shall be provided as recommended by the manufacturer.

2.06 PIPING WALL SEALS (Mechanical Seals)

A. Seals shall be modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and the wall opening. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and nut. Mechanical seals shall be "Link-Seal" as manufactured by Thunderline Corporation, Belleville, MI. Seals shall be installed as recommended by the manufacturer. Wall sleeves for new cast-in-place openings shall be "Link-Seal Wall Sleeves".

2.07 THRUST BLOCKS

A. All underground pipe fittings shall have thrust blocks installed in accordance with the Project Drawings.

2.08 PIPE JOINT RESTRAINERS

A. Pipe joint restrainers shall be installed where shown on the Drawings.

B. All joint restrainers shall be made of ductile iron conforming to ASTM A-536. The restraints shall be configured to be used with standard mechanical joints and standard length bolts per ANSI A21.11 and AWWA C111.

C. Joint restrainers shall be as manufactured by EBAA Iron Inc., American Iron Pipe Company or approved equal.

2.09 FLEXIBLE COUPLINGS

A. Flexible couplings shall be Dresser Style 138 or approved equal. All flexible couplings shall be installed with tie rod and harness joint restraints. Joints restraints shall be Star National Products JR 20-1 or approved equal.

2.10 CORRUGATED METAL PIPE

A. Corrugated metal pipe shall be galvanized steel sheet conforming to the requirements of ASTM A-444. The pipe shall have a minimum gage thickness of 14 and corrugations 2-2/3" by 1/2".

2.11 COPPER PIPE

A. The buried copper pipe shall conform to ASTM B88, Type K or L annealed. The above ground copper pipe shall conform to ASTM B88, Type L, hard drawn. The fittings shall conform to ASME B16.18 cast bronze, ASME B16.24 150 psi flanged. The joints shall conform to ASTM B32, solder, alloy Sn95, Sn94, E, HA, or HB; AWS A5.8, B Cup silver bronze. The above ground unions shall be 150 psi copper, solder type socket ends.

2.12 Reinforced Concrete Pipe (RCP) and Fittings

A. General

1. The CONTRACTOR shall furnish and install new RCP as shown on the plans and specifications herein. RCP shall be Class III ASTM C 76 conforming to the requirements listed in MAG Section 735.

PART 3 EXECUTION

3.01 PIPE WALL AND FLOOR PENETRATIONS/SEALS

A. DIP pipe may be installed through a new cast-in-place wall or floor with cast-in wall pipes of the same material and thickness as the pipe complete with waterstop plates. PVC installed in new walls or floors shall be installed

through a "Link-seal" wall sleeve with a mechanical seal. At the CONTRACTOR's option DIP in new walls or floors may also be installed in this manner. Where new pipes must penetrate existing walls or floors and no opening exists, a new opening must be core drilled, inspected, finished as required, and a mechanical seal installed. Where existing penetrations exist and they are too small to accommodate the new pipe and mechanical seal, or the existing surface is unacceptable to achieve a water-tight seal, a new opening must be core-drilled, inspected, finished as required, and a mechanical seal installed. If the surface and size of existing penetrations meet the mechanical seal manufacturer's requirements for a water-tight seal, the pipe and mechanical seal may be installed.

B. Each core-drilled penetration in existing walls shall be inspected for concrete integrity. CONTRACTOR shall be responsible for evaluating the core surface condition and remediating surfaces as required by the mechanical seal manufacturer to produce a water-tight seal. If the core surface condition shows any small cracks and/ or crevices, the entire surface shall be coated with an epoxy grout as specified in Section 03600 - GROUT. The resultant surface shall meet the mechanical seal manufacturer's requirements for proper surface conditions to assure a water tight seal. Once this remediation has been completed to the manufacturer's requirements, CONTRACTOR shall install the seal.

C. The CONTRACTOR shall be responsible for achieving water-tight seals at all penetrations. If any penetration leaks, the CONTRACTOR shall correct the installation at no additional cost to the OWNER so that the penetrations are water-tight.

3.02 TRENCHING, BACKFILLING AND SUBGRADE PREPARATION

A. Trenching, backfilling and subgrade preparation shall conform to the requirements in Section 02200 - EARTHWORK. Bury depth shall be a minimum of 4 feet to the top of the pipe unless otherwise specified or shown on the Plans.

3.03 PIPE EMBEDMENT shall be as specified in Section 02200 - EARTHWORK.

3.04 TESTING

A. The CONTRACTOR shall be responsible for testing all pipe lines. All testing shall be performed in the presence of

the OWNER's Representative and conform to the following paragraphs.

B. Hydrostatic testing shall be performed on all pressure lines in accordance with ADEQ Administrative Code and AWWA C-600.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Formwork, shoring, bracing, and anchorage.

B. Concrete reinforcement and accessories.

C. Cast-in-place concrete.

1.02 SUBMITTALS

A. Descriptive submittals shall be made in accordance with the Data Reference Symbols defined in Section 01300 - SUBMITTALS.

Item	Shop Drawings	O & M Manuals
Cast-in-Place Concrete	A,C,L,P	A,C,L,P

B. Submit shop drawings under provisions of Section 01300.

C. Submit shop drawings indicating sizes, spacings and locations of reinforcing; bending and cutting schedules; supporting and spacing devices.

D. Prepare shop drawings under seal of professional structural engineer registered in the State of Arizona.

E. Submit test reports under provisions of Section 01400.

F. Submit test reports indicating compliance or non-compliance of concrete materials and concrete mix design.

G. Submit field test reports indicating concrete strength, slump, air content and temperature.

1.03 QUALITY ASSURANCE

A. Perform work in accordance with ACI 301, Specifications of Structural Concrete for Buildings, except as modified by these Contract Documents.

B. Maintain copy of SP-15 on site. SP-15: Specifications for Structural Concrete for Buildings ACI 301 with Selected ACI and ASTM References.

PART 2 PRODUCTS

2.01 FORM MATERIALS

A. In accordance with ACI 301.

B. Form Ties: In liquid containing structures and structures below groundwater level, embedded portion of form tie must not be within 1-1/2 inches of surface and must have waterstops.

2.02 REINFORCEMENT

A. Reinforcing Steel: ASTM A 615, Grade 60, deformed.

1. Threaded dowel splices shall be used for future expansion. The bars shall be forged from ASTM A615 Grade 60 deformed rebar material, free of external welding or machining. It shall be furnished with an integral nailing flange and threaded with UNC thread to a depth equal to 1.0 times the nominal thread diameter plus ¼". The completed splice, shall meet 150% f_y exceeding tensile requirements of American Concrete Institute (ACI) Specification 318, "Building Code Requirements for Reinforced Concrete: and the Corp of Engineers Specification CW-03210, "Civil Works Construction Guide Specification for Steel Bars, Welded Steel Wire Fabric and Accessories for Concrete Reinforcement." Threaded splice bars shall be epoxy coated and include a plastic or brass plug to protect threads.

   Acceptable manufacturers: Richmond Screw Anchor Company, 7214 Burns Street, Fort Worth, Texas, 76118; (817)284-4981; or approved equal.

B. Welded Steel Wire Fabric: Deformed type, ANSI/ASTM A497; uncoated finish.

2.03 CONCRETE MATERIALS

A. Cement: ASTM C 150, Type II Portland, gray color, 0.60 percent or less alkalies when aggregates are alkali reactive.

B. Fine and Coarse Aggregates: ASTM C 33. Coarse material nominal maximum size 3/4 inch.

C. Water: Clean and not detrimental to concrete.

2.04 ADMIXTURES

A. Air Entrainment Admixture: ASTM C 260.

2.05 ACCESSORIES

A. Bonding Agent: Two component epoxy resin; ASTM C 881, Type II; grade, class and special requirements to be determined by supplier and CONTRACTOR for project conditions.

B. Waterstops: Polyvinyl chloride; Corps of Engineers CRD-C572.

1. 6-inch Waterstop - Center bulb 5/8 inch to 3/4 inch O.D. and 1/4 inch to 3/8 inch I.D., 3/8 inch minimum thickness to 3/16 inch minimum thickness at edges.

2. 9-inch Waterstop - Center bulb 5/8 inch to 7/8 inch O.D. and 1/4 inch to 1/2 inch I.D., 3/8 inch minimum thickness to 1/4 inch minimum thickness at edges.

C. Expansion Joint Filler: ASTM D 1751 or ASTM D 1752.

D. Form Release Agent: Colorless material which will not stain concrete, absorb moisture and is non-toxic within 30 days in liquid containing structures.

2.06 CURING MATERIALS

A. In accordance with ACI 301.

2.07 CONCRETE MIX

A. Proportioning: In accordance with ACI 301.

B. Basis for Proportioning: ACI 301 - Section 3.9.

C. When required, sprinkle coarse aggregate stockpiles with water, 12 hours prior to use, to maintain moisture content equivalent to water absorption value determined by ASTM C 127.

D. All Concrete: 4000 psi compressive strength at 28 days.

E. Maximum Water-Cement Ratio: All concrete; 0.45.

F. Add air entraining agent to mix for all concrete.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that site conditions are ready to receive work and field measurements are correct.

B. Beginning of installation means installer accepts existing conditions.

3.02 FORMWORK ERECTION AND REMOVAL

A. Erect and remove formwork in accordance with ACI 301.

B. Hand trim sides and bottom of earth forms; remove loose dirt.

C. Align form joints.

D. Coordinate work of other Sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.

E. Formwork supporting concrete in beams, slabs and other structural members shall remain in place until concrete has reached 70 percent of 28-day specified strength.

F. Non-load carrying form facing material may be removed after the concrete has been cured a minimum of 24 hours at temperatures above 50 degrees F.

3.03 WATERSTOP INSTALLATION

A. Install PVC waterstop with one half of width embedded on each side of joint. Secure waterstops in place using split forms and hog rings crimped between last 2 ribs on 12-inch centers and wire tie to adjacent reinforcing steel. Vibrate concrete around waterstop to insure positive contact.

3.04 REINFORCEMENT PLACEMENT

A. Place, support, and secure reinforcement against displacement in accordance with ACI 301.

B. In slabs on grade, position welded wire fabric 2 inches below surface unless otherwise indicated.

3.05 PLACING CONCRETE

A. Place concrete in accordance with ACI 301.

B. Notify OWNER's Representative minimum 24-hours prior to commencement of concreting operations.

3.06 FIELD QUALITY CONTROL

A. Field testing and analysis of concrete will be performed under provisions of Section 01410 - TESTING.

B. Testing firm will take cylinders and perform slump and air entrainment tests in accordance with ACI 301.

C. One additional test cylinder will be taken and cured on site under same conditions as concrete it represents.

D. Leakage in liquid containing structures must be corrected or replaced to the satisfaction of the OWNER's Representative.

3.07 EXISTING WORK

A. Prepare previously placed concrete by cleaning with steel brush and apply bonding agent in accordance with manufacturer's instructions.

END OF SECTION

SECTION 03420

PRECAST CONCRETE

PART 1 GENERAL

1.01 SUMMARY

A. Furnish and install a precast surge anticipator valve vault as shown on the Project Drawings.

B. Furnish and install a precast pressure sustaining valve vault as shown on the Project Drawings.

1.02 GENERAL

A. Precast concrete construction shall conform to the following specifications, standards and codes, except as modified by these Contract Documents.

1. Section 03300.

2. ACI 318 - Building Code Requirements for Reinforced Concrete.

3. AWS D1.1 - Structural Welding Code.

4. AWS D12-1 - Recommend Practices for Welded Reinforcing Steel, Metal Inserts and Connections in Reinforced Concrete Construction.

5. ASTM C-478-88a.

1.03 QUALITY ASSURANCE

A. Manufacture, transportation and installation shall be by a firm regularly engaged in providing precast, prestressed concrete of quality and scope required in this project. When requested by the ENGINEER, written evidence shall be submitted to show experience qualifications and adequacy of plant capacity and facilities for performance of contract requirements.

B. Design of members shall be prepared by a licensed ENGINEER in accordance with ACI 318 and applicable standards of this division of the specifications, and shall be of the size, shape and details as indicated. Shop Drawings shall be submitted with the seal of a professional structural Engineer registered in the State of Arizona.

C. Members shall be designed to carry the dead and live loads conforming to AASHTO H-20.

D. Deflections shall not exceed the limits stated in ACI 318.

1.04 SUBMITTALS

A. Submit as set forth below in accordance with Section 01300 - SUBMITTALS.

	Shop Drawings
Precast Valve Vault	A,C,D,E,L,P
Vault Steps	A,C,E,L,P

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery and Handling

1. Transport and handle precast units with equipment to protect from dirt or damage.

2. Do not place units in position which will cause overstress, warp or twist.

3. Handle by means of lifting inserts.

B. Storage

1. Store units off ground.

2. Place stored units so that identification marks are discernable.

3. Separate stacked members by battens across full width of each bearing point.

4. Stack so that lifting devices are accessible and undamaged.

5. Do not use upper member of stacked tier as storage area for shorter members or heavy equipment.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Smith Precast, Phoenix, AZ

B. PreCast Manufacturing Co., Phoenix, AZ

C. Hayden Concrete Products, Marana, AZ

D. Utility Vault Company, Inc., Chandler, AZ

2.02 MATERIALS

A. Materials for concrete shall conform to Section 03300 - CAST-IN-PLACE CONCRETE.

B. Steel:

1. Reinforcing steel shall conform to Section 03300 - CAST-IN-PLACE CONCRETE.

2. Prestressing steel - ASTM A416.

3. Cast in Plates - ASTM A36.

C. Bearing Pads:

1. 60 pound roofing felt.

2. Neoprene pads.

D. Rubber gaskets shall be installed between precast concrete members.

E. Vault steps shall be plastic coated steel spaced vertically at 12-inch centers. Plastic coated steps shall be factory fabricated from 3/8-inch steel reinforcing rod encapsulated in molded polypropylene plastic. The steps shall protrude 6-inches from walls and shall provide a minimum 12-inch wide notched tread ridge with retainer lugs on each side of tread ridge to prevent slipping off sides of the step.

2.03 MIXES

A. Mixing procedures shall conform to Section 03300 - CAST-IN-PLACE CONCRETE.

B. Concrete strength shall be as required by design, with the following minimums:

1. At time of strand release	3500 psi
2. At age 28 days	4000 psi

2.04 FABRICATION

A. The manufacturer, quality and dimensional tolerances of all prestressed concrete shall be in general accordance with the requirements of the "Manual for Quality Control for Plants and Production of Precast Prestressed Concrete Products" published by the Prestressed Concrete Institute.

B. All members shall be cast in smooth rigid forms to size and length as shown on the Project Drawings.

C. All members shall have a steel form finish as obtained with a well designed mix and proper vibration.

D. Cast in structural inserts, bolts, plates and frame for lid as detailed in the Project Drawings and as recommended by the manufacturer.

E. All holes for mechanical openings shall be cast in by the manufacturer in accordance with approved plans and specifications.

PART 3 EXECUTION

3.01 INSPECTION

A. Before starting to erect precast units, verify that structure and anchorage inserts are within required tolerances.

B. Check that bearing surfaces are smooth and level for installation of precast members.

C. Determine field conditions by actual measurements.

3.02 INSTALLATION

A. Members shall be installed according to details on approved shop drawings by experienced workmen, in a manner to prevent excessive bending about either axis.

B. All members shall be set accurately into position within allowable tolerances.

C. Any member that has been damaged excessively during erection will be rejected.

3.03 PATCHING

A. Patch damaged units to match adjacent area.

B. Add patch to concrete with bonding agent.

C. Cut off lifting device and coat with grout.

D. Spot paint damaged metal finishes.

END OF SECTION

SECTION 03600

GROUT

PART 1 GENERAL

1.01 SUMMARY

A. All epoxy-based grouting as indicated in the equipment manufacturer's specification and as shown on the drawings shall apply to this section. These products are supplied by the CONTRACTOR installing the grout. Epoxy grouts shall be used for grouting equipment baseplates subject to dynamic and impact loading, in areas subject to chemical attack and for securing anchors in existing concrete unless otherwise noted.

B. All cement-based grouting as indicated in the equipment manufacturer's specification and as shown on the drawings shall apply to this section. These products are supplied by the CONTRACTOR installing the grout. They shall be used for grouting of equipment and column baseplates, and setting precast concrete and anchor bolts that are not epoxy grouted.

1.02 REFERENCES

A. ASTM C109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars

B. ASTM C191 - Standard Test Method for Time of Set of Hydraulic Cement by Vicat Needle

C. ASTM C531 - Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical Resistant Mortars, Grouts and Monolithic Surfacings

D. ASTM C579 - Test Method for Compressive Strength of Chemical Resistant Mortars and Monolithic Surfacings

E. ASTM C827 - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures

F. CPR Creep Test - Test Method for Creep of Epoxy Grouts

G. CRD C621 - Corps of Engineers Specification for Nonshrink Grout

1.03 SUBMITTALS

A. Descriptive submittals shall be made in accordance with the Data Reference Symbols defined in Section 01300 - SUBMITTALS.

Item	Shop Drawings
Grout	A,C,L,P

B. The grout manufacturer must submit, prior to installation, for designer's approval, literature and test data from a laboratory listed in the ASTM Directory of Testing Laboratories that material complies with requirements in Article 1.05, 1.06 and 2.02.

1.04 DELIVERY, STORAGE AND HANDLING

A. All epoxy-based grouts shall be prepackaged, 3-component systems resin, hardener and specially blended aggregate. They shall be delivered to the jobsite in original, unopened package, clearly labeled with the manufacturer's identification and printed instructions. The grout components shall be stored at 70° plus or minus 5°F in a dry environment.

B. All cement-based grouts shall be preblended, prepackaged materials requiring only the addition of water. They must be delivered to the jobsite in original, unopened packages, clearly labeled with the manufacturer's identification and printed instructions. All cement-based materials shall be stored and handled in accordance with the recommendations of the manufacturer and the American Concrete Institute.

1.05 ENVIRONMENTAL CONDITIONS

A. Refer to the manufacturer's literature for any physical or environmental limitations or contact the manufacturer directly.

1.06 WARRANTY

A. The material manufacturer shall warranty that the nonshrink grout shall never go below its initial placement volume when tested in accordance with ASTM C827.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. U.S. Grout Corporation Five Star Grout. A subsidiary of Five Star Products, Inc., Fairfield, CT.

B. Thoro System Products Inc., Miami, FL.

C. Sika Corp., Lyndhurst, NJ.

2.02 MATERIALS

A. Epoxy grouts must meet the following performance requirements. They must be 100 percent solids system and shall not contain any non-reactive diluents.

1. Volume Change

a. The grout shall show no shrinkage (0.0 percent) and a maximum 2.0 percent expansion from time of placement when tested according to ASTM C827, modified to use a ball with a specific gravity between 0.9 and 1.1.

2. Compressive Strength

a. The grout shall show a minimum 7-day compressive strength of 16,000 psi when tested according to ASTM C579.

B. Cement-based grouts must meet the following performance requirements at maximum water. They must not contain expansive cement or metallic particles such as aluminum powder or iron filings.

1. Plastic Volume Change

a. The grout shall show no shrinkage (0.0 percent) and a maximum 4.0 percent expansion from time of placement until final set when tested according to ASTM C827.

2. Hardened Volume Change

a. The grout shall show no shrinkage (0.0 percent) and a maximum 0.2 percent expansion in the hardened state when tested according to CRD C-621.

3. Compressive Strength

a. The grout shall show a minimum 28-day compressive strength of 5,000 psi when tested according to ASTM C109, restrained.

4. Creep

a. The grout shall show creep equal to or less than 0.6 inches/inches times 10^{-3} at 70°F for a minimum of one year when tested according to CPR Creep Test (extrapolated data is not acceptable).

5. Working Time

a. The grout shall show a consistency greater than 125 percent for a minimum 45 minutes when tested according to applicable consistency sections of ASTM C827 at 15 minute intervals.

6. Tests

a. The Cylinder Plate Test shall be run on all field shipments.

PART 3 EXECUTION

3.01 INSPECTION

A. Inspect concrete surfaces to receive grout and verify that they are free of ice, frost, dirt, grease, oil, curing compounds, paints, impregnations and all loose material or foreign matter likely to affect the bond or performance of the grout.

B. Newly placed concrete shall have been placed and cured for 28-days prior to grouting procedures.

C. Inspect baseplates for rust, oil, and other deleterious substances. Clean as required by grout manufacturer.

3.02 PREPARATION

A. Cementitious

1. In order to ensure proper bond to the baseplate and the concrete, all grease, oil, dirt, curing compounds, laitance and other deleterious materials must be completely removed from the concrete and bottom of baseplate.

2. Roughen the surfaces by chipping, sandblasting or other mechanical means to assure bond of the grout to the existing concrete. Loose or broken concrete shall be removed.

3. After concrete surfaces have been washed clean, they shall then be saturated with water for 24 hours prior to placement of cement-based grout.

4. Upon completion of saturation period excess water shall be removed with clean compressed air prior to grouting.

5. Forms to be built as needed.

B. Epoxy

1. Adhesion of epoxy is required, all grease, oil, dirt, curing compounds, laitance and other deleterious materials must be completely removed from the concrete and the mating metal member (bolt, baseplate, etc.).

2. Roughen the surfaces by chipping, sandblasting or other mechanical means to assure bond of the grout to the existing concrete. Loose or broken concrete shall be removed.

3. *Do not wet* concrete substrate.

4. Forming or other leakproof containment is always required with epoxy grout. Forms must be liquid tight. Caulking such as glazier's putty, butyl rubber caulking or duct seal should be used. All forms may be lined with polyethylene for easy grout release.

3.03 INSTALLATION

A. Cementitious

1. Carefully read and understand the manufacturer's instructions as printed on the unit.

2. Mixing - A mortar mixer is recommended. Pre-wet the mixer, empty excess water. Add pre-measured amount of potable water to mixer, then add grout. Mix for at least 3, but not more than 5, minutes, then place.

3. Placing - Grout may be drypacked, flowed, vibrated or pumped into place. All grouting shall take place from

one side of a plate to the other to avoid trapping air.

4. Cutback - Just before the grout has reached its final set, the grout must be cut back to the lower edge of the plate. A 45 degree angle or vertical cutback is recommended.

5. Curing - The grout shall be kept moist for a minimum of 3 days. The method needed to protect the grout will depend on temperature, humidity and wind.

6. Clean-Up - Upon completion of placement, all excess grout shall be removed and discarded before it can set up.

B. Epoxy

1. Carefully read and understand the manufacturer's instructions as printed on the packaging.

2. Mixing

   a. Grout shall be mixed according to the procedures recommended by the manufacturer. For large volume placements, a mortar mixer with moving blades is preferred. For smaller quantities, use an appropriate container and stirer. Do not vary the ratio of components or add solvent to change the consistency of the mix.

3. Placing

   a. Ambient conditions shall be monitored and grout manufacturer contacted for cold weather (50°F) and hot weather (90°F) placement procedures. All grouting should take place from one side to avoid trapping air.

4. Cutback

   a. Epoxy cannot be trimmed after set. It must be left at final placement level with all chamfer strips built into forms.

5. Curing

   a. Consult the owners, designer and grout manufacturer for appropriate cure schedule. In no case should any surface in contact with grout be

allowed to fall below 50°F for a minimum of 48 hours.

6. Cleanup

   a. Upon completion of placement, all excess grout shall be removed before it can set up.

END OF SECTION

SECTION 04220

CONCRETE UNIT MASONRY

PART 1 GENERAL

1.01 SUMMARY

A. All labor, materials, equipment and services necessary to furnish and install all concrete unit masonry work and related items as indicated or specified.

B. All perimeter theme walls shall be in accordance with the "Rancho Santa Fe" style adopted by the City. This includes a solid masonry, free standing wall, using integral color block, no pilaster columns and no stucco finish allowed. Block shall consist of a single scored smooth face finish with different color bands of Sonora split face (vertical square groves) block along the top. Decorative monument columns shall be constructed every 240 ft. and at all corners or change of direction. Color selections may vary. "Dooley" block type walls, 4" interlocking block and post-tensioned column walls are not acceptable. Elevation drops are only allowed at an expansion/construction joint and can only drop one block height (8 inches) at any one time. The CONTRACTOR shall submit drawings, color selections and block samples for review and approval by the City.

1.02 QUALITY ASSURANCE

A. Tolerances for unit masonry work shall conform to ACI-531, except as otherwise noted.

B. It is the intent of this specification to provide unit masonry work of "Standard" quality as defined by the AMG.

1.03 DELIVERY, STORAGE AND HANDLING

A. Transport and handle all masonry units in such manner as to prevent chipping and breakage. Locate storage piles, stacks, or bins to avoid or protect material from heavy and unnecessary traffic.

1.04 PROTECTION

A. Furnish temporary protection for all exposed masonry corners subject to injury.

B. Protect masonry against too rapid drying by hosing down thoroughly twice each day for 5 days including Saturday and Sunday following laying of units. Hosing once each day is sufficient where high temperature for the day does not exceed 80 degrees F. or where masonry is shaded from direct sun rays.

1.05 JOB CONDITIONS

A. Provide all openings in masonry walls where required or indicated. Build in all items specified elsewhere in these Specifications or required for a complete job, including installing reinforcing steel, bolts, anchors, and nailing blocks.

B. Provide temporary bracing for all masonry walls and leave in place until masonry is cured.

PART 2 PRODUCTS

2.01 MATERIALS

A. Concrete masonry units shall be 8"x8"x16" CMU solid masonry block with scored and split face scored block finishes.

B. Concrete masonry units shall be manufactured to meet ASTM C 90, Grade N-1 requirements for hollow load bearing concrete masonry units, using light weight aggregate conforming to ASTM C 331. Unit moisture content shall not exceed 30% of total absorption. Units shall be machine made precast concrete units manufactured by a member of NCMA. Units shall have a maximum linear shrinkage not to exceed .045 of 1 percent from a saturated to oven dry condition. Units to have value of F'm equals 1350 psi. Sizes of units to be as indicated.

C. Re-bar positioners for reinforcing steel shall be AA-239 for vertical steel bars as manufactured by AA Wire Products Co., Chicago, IL.

D. Wall grout shall be 2,000 psi grout.

PART 3 EXECUTION

3.01 WORKMANSHIP

A. Do not lay chipped or cracked (beyond allowable tolerances) or otherwise defective units in the wall where exposed to view. Remove and replace any units that are chipped,

cracked, broken or otherwise defective, whether before or after setting.

B. Where masonry unit cutting is necessary all cuts shall be neat and regular. Do all necessary cutting with a power driven carborundum or diamond disc blade saw.

C. Masonry units shall be clean and free from dirt when laid in the wall. Do not wet masonry units before laying. Keep all masonry work in progress or completed free from mortar droppings or staining.

D. Lay all masonry units in uniform and true courses, level and plumb. Use full mortar bedding for the first course on the foundation and wherever maximum strength is required. Use face shell bedding except where full mortar bedding is required. Butter vertical head joints well for a thickness equal to the face shell of the unit and shove these joints tight so that the mortar bonds well to both units. Solidly fill joints from the face of the unit to the depth of the face shell.

E. Lay masonry units in the wall to the desired height with joints of uniform thickness. Level, plumb and straighten before mortar stiffens. Bond shall be plumb throughout.

F. Lay masonry units in such a way that cracks are not formed at the time the unit is placed in the wall.

G. Adjust masonry units to their final position in the wall while the mortar is still soft and plastic enough to ensure a good bond. If the position of the unit is shifted after the mortar has stiffened, or bond is broken or cracks are formed, re-lay unit in new mortar.

3.02 EXPANSION/CONSTRUCTION JOINTS

A. Expansion/construction joints shall be provided at a maximum spacing of 30 feet.

B. Two greased, smooth steel dowells shall be provided per expansion joint.

3.03 JOINTS

A. Mortar joints shall be straight, clean and uniform in thickness.

B. Unless otherwise specified or detailed, horizontal and vertical mortar joints shall be a nominal 1/3" thick, and course vertically to 8" and horizontally to 16".

3.04 REINFORCING

A. Place vertical reinforcing and bond beam reinforcing as indicated. Lap splices in reinforcing not less than 48 bar diameters for Grade 60 bars; 40 bar diameters for Grade 40 bars. Use re-bar positioners to position reinforcing steel in cells and at all laps in steel bars. Reinforce all walls vertically as indicated. In addition, provide vertical reinforcement at all wall ends, corners, intersections and at jambs of openings. Provide all reinforced bond beams indicated. Grout barrier below bond beams shall be continuous wire lath.

B. Space vertical reinforcing in center of grout at center of wall, continuous full height of wall with one #5 at all corners, intersections, wall ends, jambs and at each side of control joints and at intervals not to exceed 48" o. c. unless otherwise noted. Dowel all vertical reinforcing to foundation with dowels to match vertical wall or column reinforcing.

C. Block wall horizontal steel reinforcing shall be No. 9 gauge wire in the joint at 16" o.c.

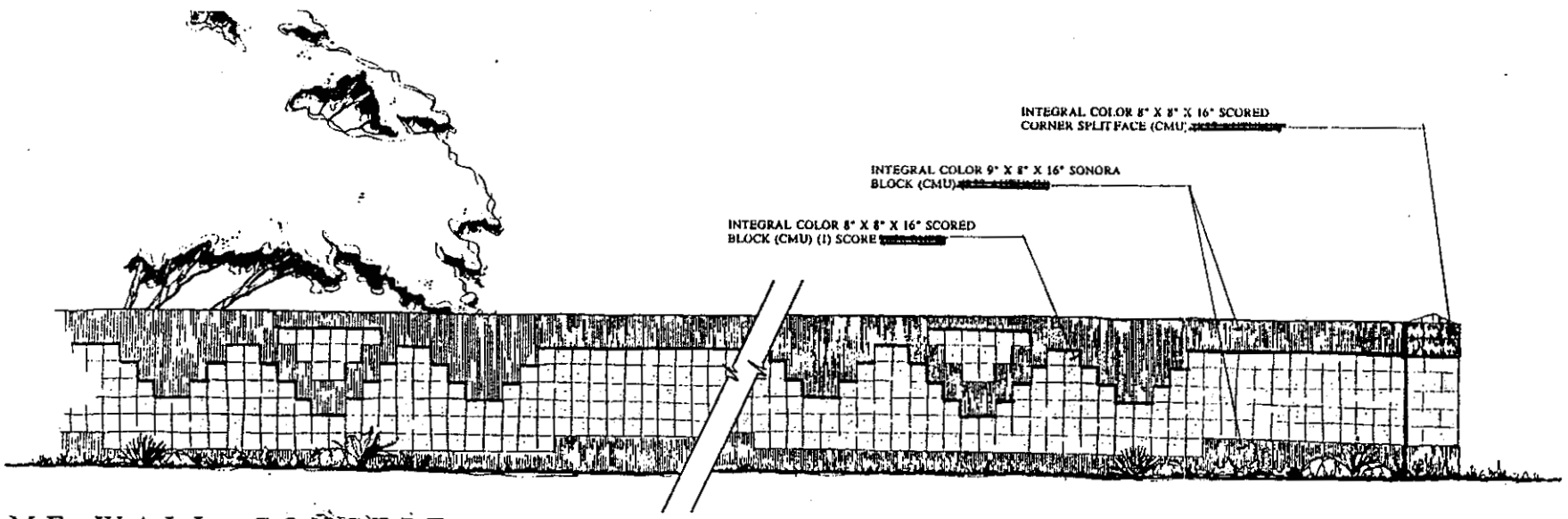
3.05 POINTING AND CLEANING

A. Point and fill holes and cracks in exposed mortar joints. Cut out defective mortar joints, refill solidly with mortar and tool as specified. Pre-hydrate mortar for pointing by mixing dry ingredients with only sufficient water to produce a damp mass of such consistency that it will retain its form when pressed into a ball with the hands, but will not flow under the trowel. Allow mortar to stand for a period of not less than one hour nor more than 2 hours, after which remix with the addition of sufficient water to produce satisfactory workability.

B. Pointing mortars shall be identical to adjacent mortar in similar joints and finish results shall match and be indistinguishable from original mortar used.

C. Upon completion of the masonry work, clean all exposed masonry.

END OF SECTION



THEME WALL CONCEPT

RANCHO SANTA FE

BY CONTINENTAL HOMES

CYL

DATE: 8-2-93
93-008

SECTION 05500

METAL FABRICATIONS

PART 1 GENERAL

1.01 SUMMARY

A. All miscellaneous metal items required to complete the work in accordance with the intent of the Project Drawings and specifications shall be furnished and installed, regardless of whether or not specifically shown or described. Such items include loose or embedded items of structural shapes, plates and bars, welded plate inserts, fabrications and similar items. Bolts, expansion shields, and other fastening devices, which may or may not be provided with the indicated or specified items, shall also be furnished and installed as required for attachment and support.

1.02 SUBMITTALS

A. Descriptive submittals shall be made in accordance with the Data Reference Symbols defined in Section 01300 - SUBMITTALS.

Item	Shop Drawings
Access Hatches	A,C,D,E,H,L,P
Pipe Supports, Hangers & Brackets	A,C,D,E,H,L,P
Anchor Bolts	A,C,D,E,H,L,P
Stainless Steel Rods, Nuts, Bolts & Washers	A,C,D,E,H,L,P
Floor Drains	A,C,D,E,H,L,P
Wrought Iron Fencing	A,C,D,E,H,L,P

B. Shop drawings shall be provided for all metal fabrications and shall indicate all shop and erection details, including cuts, copes, connection, holes, threaded fasteners, rivets and welds.

1. All welds, both shop and field, shall be indicated by AWS Welding Symbols.

2. Show all types of paints.

3. Submit certified copies of the qualifications records of each welder prepared within six months of time of contract award.

C. The CONTRACTOR shall submit shop drawings for all proposed pipe supports, hangers, and brackets.

PART 2 PRODUCTS

2.01 ACCESS HATCHES

A. Access hatches to be installed on the pump station surge anticipator vault and pressure sustaining vault shall be the S2R Series, Model S2R6060 (Double Leaf) access frames and covers as manufactured by Halliday Products, Inc. of Orlando, Florida, or (approved equal) shall have a 1/4-inch thick one-piece, mill finish, extruded aluminum frame, incorporating a continuous concrete anchor. Door panels shall be 1/4-inch aluminum diamond plate, reinforced to withstand a live load of 300 lbs. psf. Doors shall open to 90° and automatically lock with stainless steel hold open arms with aluminum release handles. Doors shall close flush with the frame. Lifting handles, hinges and all fastening hardware shall be stainless steel. Unit shall lock with a non-corrosive locking bar. The lock shall be a cylinder lock with keyway protected by a threaded cover plug. Unit shall be guaranteed against defects in material and/or workmanship for a period of 10 years.

2.02 PROCESS PIPE SUPPORTS, HANGERS AND BRACKETS

A. Process Piping

1. All process piping shall be supported as detailed on the Project Drawings and specified herein. Process piping includes but is not limited to the following:

a. Ductile Iron Pipe

b. PVC Pipe

c. Steel and Galvanized Pipe

2. All process pipe supports, hangers, and brackets shall be as manufactured by B-Line systems, Grinell, or Unistrut as detailed on the Project Drawings.

Supports for stainless steel piping shall be Type 316 stainless steel.

3. All appurtenances required for proper installation of the pipe supports, brackets and hangers shall be supplied by the manufacturer.

4. Anchor bolts for pipe supports, hangers and brackets shall be of the sizes as recommended by the manufacturers of the pipe supports, hangers and brackets. Anchor bolt type and materials shall be as specified under Section 2.03 of this specification.

2.03 ANCHOR BOLTS

A. Cast-In-Place Bolt-Type Anchors

1. Cast-in-place anchor bolts, nuts and washers shall be ANSI Type 304 stainless steel which meet the requirements of ASTM F-593 and ASTM A-666.

2. Cast in place anchor bolts shall have a bent shank or flat plate configuration.

B. Adhesive Anchors

1. Adhesive anchors shall consist of all-thread anchor rod, nut, washer and adhesive capsule. Anchor rods shall be manufactured from ASTM A-666 AISI Type 304 stainless steel which meets the requirements of ASTM F-593. The adhesive capsules shall contain a vinylester resin as supplied in the Hilti HEA adhesive capsules or equal.

2. Anchors shall be installed per manufacturer's recommendations.

2.04 STAINLESS STEEL RODS, NUTS, BOLTS, AND WASHERS

A. Stainless steel rods, nuts, bolts, and washers shall be ASTM A 666, Type 316.

2.05 FLOOR DRAINS

A. Floor drains shall be ductile iron with ductile iron grate sized as indicated on the Project Drawings. The drain shall be as manufactured by Neenah Foundry Company, Model R-4937-B or approved equal.

2.06 WROUGHT IRON FENCING

A. The fencing shall have a nominal height of 8 feet. The top and bottom rails shall be 1½-inch square, 16-gauge, wrought iron fencing. The pickets shall be ¾-inch square, 16-gauge and shall be spaced 6-inches on center apart and welded to each rail. Wrought iron posts shall be 2½-inch square, 11-gauge, wrought iron and shall be spaced 8 feet on center and welded to each rail. Each post shall be embedded into a 1-foot x 1-foot x 2-feet deep concrete post support. The posts shall be embedded at least 2-feet in the ground. The Contractor shall submit design for Owner approval.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. All bolting holes provided in equipment, valves, gates, pipe supports and hangers, handrails, ladders, and other items which require mounting shall be used as specified and intended.

C. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

D. Field weld components indicated on Project Drawings.

E. Perform field welding in accordance with AWS D1.1.

F. ENGINEER approval prior to site cutting or making adjustments not scheduled.

3.02 SHOP PAINTING

A. Shop paint or galvanize all steelwork, except surfaces of steel to be encased in concrete and surfaces to be field welded.

B. Steelwork to be painted shall receive a one coat shop paint system in accordance with Section 09900 - PAINTING.

END OF SECTION

SECTION 09900

PAINTING

PART 1 GENERAL

1.01 SUMMARY

A. The CONTRACTOR shall be responsible for painting items installed under this contract. Field painting will not be required on concrete floors, concrete-unit masonry, or items specified to be completely finished at the factory. Prime coats specified herein will not be required on items delivered with prime or shop coats already applied, except for touch-up of shop coats.

B. Exposed metal surfaces including pumps, meters, piping valves, supports, sample taps, and appurtenances shall be painted to match color coding given later in this section.

1.02 SECTION INCLUDES

A. Surface Preparation and field application of coatings.

B. Surface Finish Application.

C. Surface Finish Schedule.

1.03 COORDINATION

A. Coordinate for compatibility with prime paints in other Sections.

1.04 SUBMITTALS

A. Provide all product data on painting products.

B. Submit manufacturer's application instructions under provisions of Section 01300 - SUBMITTALS.

1.05 QUALIFICATIONS

A. Use qualified installers for mixing and application of coatings on all surfaces. Installers shall have received instructions and approval by coating manufacturer.

1.06 REGULATORY REQUIREMENTS

A. Conform to applicable code(s) for flame/fuel/smoke rating requirements for finishes.

B. Conform to regulations of applicable environmental regulatory organization(s) regarding solvent and lead content.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptance.

B. Container labeling shall include manufacturer's name, type of paint, brand name, brand code, coverage, surface preparation, drying time, cleanup, color designation, and instructions for mixing, reducing and application.

C. Store paint materials at minimum ambient temperature of 45°F and a maximum of 90°F in well ventilated area, unless required otherwise by manufacturer's specifications.

D. Take precautionary measures to prevent fire hazards and spontaneous combustion. All oily rags, waste, etc., shall be placed in a covered material container and removed by the CONTRACTOR at the end of each shift.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Provide continuous ventilation and heating facilities to maintain surface and ambient temperatures above 45°F for 24-hours before, during, and 48-hours after application of finishes, unless required otherwise by manufacturer's instructions.

B. Do not apply exterior coatings during rain, or when relative humidity is above 80 percent, unless required otherwise by manufacturer's instructions.

C. Do not apply materials when surface, materials, and ambient temperatures are outside the temperature ranges required by the coating product manufacturer.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. TNEMEC, Kansas City, MO

B. Approved Equal

2.02 MATERIALS

A. The coatings shall have the following basic properties:

1. Best quality grade regularly manufactured by acceptable manufacturer. All products shall be newly produced coatings fresh from the factory.

2. Ready mixed when delivered, only requiring thorough stirring and thinning as required. The only exception is two-part type coatings which require mixing and reduction immediately prior to application.

3. Good application qualities, capable of curing free of blemishes when thinned.

4. Contain not more than 0.06 percent lead by weight (calculated as lead metal) in the total nonvolatile content of the paint.

B. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified, of commercial quality approved by coating manufacturer.

2.03 FINISHES

A. Refer to schedule at end of Section for surface finish.

B. Provide colors standard with manufacturer, unless directed otherwise.

PART 3 EXECUTION

3.01 EXAMINATION

A. Prior to all work of this Section, examine surfaces scheduled to be finished for conditions which might adversely affect execution, permanence or quality of finish and which cannot be put into acceptable condition through preparatory work described below. Report unsatisfactory conditions.

B. Beginning of installation is defined as the CONTRACTOR's acceptance of existing surfaces.

C. Test shop applied primer for compatibility with subsequent cover materials.

3.02 PROTECTION

A. Protect elements surrounding the work of this Section from damage or disfiguration.

B. Repair damage to other surfaces caused by work of this Section.

C. Furnish drop cloths, shields, and protective methods to prevent spray or droppings from disfiguring other surfaces.

D. Keep all paint containers not in use closed and place all cloths and other wastes in closed metal containers. At the end of each work day remove empty paint containers and all wastes from the project site for proper disposal.

3.03 SURFACE PREPARATION

A. Preparation for all new coating systems shall be accomplished as specified herein and in accordance with the manufacturer's specifications.

B. All new above grade ductile iron piping shall be cleaned per SSPC-SP2 "Hand Tool Cleaning" prior to receiving coating.

C. All new above grade copper and PVC piping shall be cleaned per SSPC-SP1 "solvent cleaning" prior to receiving coating.

D. All new pumps including vertical turbine and chlorination pumps shall be cleaned per SSPC-SP1 "solvent cleaning" prior to receiving finish.

E. All new structural steel and roof decking shall be cleaned per SSPC-SP6 "commercial sand blasting" prior to receiving coating.

3.04 APPLICATION OF COATINGS

A. Prepare surface and apply products in accordance with manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.

B. Touch up's of factory-applied surface coatings shall be in accordance with equipment manufacturer's instructions.

SECTION 16000

GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. It is the intent of this part of the Contract Documents to cover the work and materials necessary for erecting a complete electrical system, tested and ready for continuous use. The system shall be constructed in accordance with the Contract Documents, and Federal, State, and Local codes and regulations.

1.02 RELATED SECTIONS

A. The Contractor shall coordinate the work with other trades, and furnish and install the equipment in accordance with the manufacturers' requirements.

B. The Related Work can be found in other Divisions of these specifications.

1.03 GENERAL PROVISIONS

A. Minimum sizes of equipment, and electrical devices, are indicated but it is not intended to show every offset and fitting, nor every structural or mechanical difficulty that will be encountered during the installation of the work.

B. Work indicated on the Plans is approximately to scale, but actual dimensions and detailed Plans should be followed as closely as field conditions permit. Field verification of scale dimensions on Plans is governed by field conditions. Installation of systems and equipment is subject to clarification as indicated in reviewed shop drawings and field coordination.

C. Discrepancies indicated on different Plans, between Plans and actual field conditions, or between Plans and Contract Documents shall be promptly brought to the attention of the Engineer for clarification, prior to purchasing and installing equipment.

D. The alignment of equipment and conduit shall be adjusted to accommodate architectural changes, or to avoid work of other trades, without extra expense to the Owner.

E. The Contractor shall furnish and install the parts and pieces necessary to the installation of equipment, in accordance with the best practice of the trade, and in conformance with the requirements of these Contract Documents.

F. Items not specifically mentioned in these Contract Documents, or noted on the Plans, or indicated on reviewed shop drawings, but which are obviously necessary to make a complete working installation, shall be deemed to be included herein.

G. The Contractor shall lay out and install electrical work prior to placing floors and walls. Furnish and install sleeves and openings through floors and walls, required for installation of conduits. Sleeves shall be rigidly supported and suitably packed, or sealed, to prevent ingress of wet concrete. Spacers shall be installed in order to prevent conduit movement. Dimensions indicated for electrical equipment and their installation are restrictive dimensions.

H. The Contractor shall furnish and install inserts and hangers required to support conduits and other electrical equipment. If the inserts, hangers, sleeves, or other mounting hardware are improperly placed, or installed, the Contractor shall do necessary work, at their own expense, to rectify the errors.

I. Electrical equipment shall be capable of operating successfully at full-rated load, without failure, at an ambient air temperature of 60 degrees C, and specifically rated for the altitude indicated on the Plans.

J. If any contradictions, contrasts, nonhomogeneity, or inconsistency appears, the most strict criteria noted and the collective requirements in any and all of the project documents shall apply.

K. The Contractor shall perform necessary saw cutting, core drilling, excavating, removal, shoring, backfilling, and other work required for the proper installation of conduits, whether inside, or outside of the buildings and structures. The Contractor shall repair and patch where demolition has taken place in a manner to match existing original structure.

1.04 REGULATIONS, CODES, AND STANDARDS

A. Electrical work, including connection to electrical equipment integral with mechanical equipment, shall be performed in accordance with the latest published regulations, codes, and standards, of the following:

1. National Electrical Code (NEC)
2. State and local codes
3. Institute of Electrical and Electronic Engineers (IEEE)
4. American National Standards Institute (ANSI)
5. American Society for Testing and Materials (ASTM)
6. Insulated Cable Engineers Association (ICEA)
7. National Electrical Manufacturers Association (NEMA) Standards
8. Federal Occupational Safety and Health Act (OSHA)
9. National Fire Protection Association (NFPA)

B. When applicable, the material used in the performance of the electrical work shall be listed by the Underwriters' Laboratories, Inc. (UL) for the class of service for which they are intended.

1.05 SUBMITTALS

A. It is the obligation of the Contractor to organize their work, so that a complete electrical, instrumentation, and control system for the facility will be provided, and will be supported by accurate shop and record drawings, and O&M manuals.

B. The Contractor shall submit detailed shop drawings and data prepared and organized by the suppliers. The quantity of submittal sets required shall be as specified in the Contract Documents.

C. The submittals shall be neatly grouped and organized by specification section number, and sub-section. Related information shall be highlighted, and the specific product shall be marked. All submittals shall be complete, and presented in one package. Incomplete submittals will be returned without review. If a portion of the project requires a fast track schedule, that portion only may be submitted earlier under a separate cover letter. The following shall be submitted to the Engineer and returned, reviewed to the Contractor before fabrication is started.

1. A complete list of the equipment and materials, including the manufacturer's name, product specification, descriptive data, technical literature, performance charts, catalog cuts, installation instructions, and spare part recommendations for each different item of the equipment specified. The above shall clearly show all the specified requirements as described in the Specifications including but not limited to specific U.L. and NEMA rating, technical capabilities, test result verifications, and acceptance letters.
2. Drawings containing complete wiring and schematic diagrams, control diagrams, and any other details required to demonstrate that the system has been coordinated and will operate as intended. Drawings shall show proposed layout, anchoring, support, and appurtenances of equipment, and equipment relationship to other parts of the work including clearances for maintenance and operations.
3. Any exceptions to these specifications, with the reasons for requesting such exceptions, with calculations and drawings for redesign of related components, including detail drawings showing internal and assembly details, with installation instructions. Proposed layout showing any modifications or exceptions to related work made necessary by this work, with calculations and drawings showing such modifications or exceptions.
4. Upon Project acceptance, The Contractor shall submit four sets of "Record Drawings" of the electrical, control, and instrumentation, along with step-by-step procedure manuals for the installation, operation start-up, and maintenance of the equipment. Each set shall include installation, operating, troubleshooting, maintenance and overhaul instructions in complete detail. It shall also include possible breakdowns and repairs, and troubleshooting guides, as well as simplified

ground rods, longer ground rods, or deep-driven sectional rods shall be installed and connected until the specified resistance is obtained, except that not more than three additional ground rods shall be required at any one installation. Ground rods shall be spaced as evenly as possible at least 6 feet apart and connected below grade.

2.03 CONNECTIONS

A. Connections above grade shall be made with bolted solderless connectors, and those below grade shall be made by a fusion-welding process. In lieu of a fusion-welding process, a compression ground grid connector of a type which uses a hydraulic compression tool to provide the correct circumferential pressure may be used. Tools and dies shall be as recommended by the manufacturer. An embossing die code or other standard method shall provide visible indication that a connector has been adequately compressed on the ground wire.

2.04 GROUND WIRES

A. Ground wires shall be sized in accordance with NEC Table 250-94, unless otherwise indicated on the Plans. After being located to provide maximum physical protection, exposed ground wires shall be securely attached to structural supports at not more than 2-foot intervals with suitable fasteners. Bends greater than 45 degrees in ground wires are not permitted. Routing of ground conductors through concrete should be avoided, except where specifically called for in these Documents. When concrete penetration is necessary, nonmetallic conduit shall be cast flush with the points of concrete entrance and exit, so as to provide an opening for the ground wire. The opening shall be sealed with a suitable compound after installation of the ground wire.

2.05 NEUTRAL GROUNDING

A. Neutral conductors shall be grounded where indicated. Ground wires shall be sized in accordance with NEC Table 250-95, unless otherwise indicated. Neutral ground wires shall be protected by conduit where such wires run exposed above grade in nonfence-enclosed areas, or are run through concrete construction. Where concrete penetration is necessary, nonmetallic conduit shall be cast flush with the points of concrete entrance and exit, so as to provide an opening for the ground wire. The opening shall be sealed with a suitable compound after installation of the ground wire. Bends greater than 45 degrees in ground wire connections to the ground rods, or counterpoises are not permitted.

2.06 EQUIPMENT GROUNDING

A. Equipment frames of motor housings, metallic tanks, metallic equipment enclosures, metal splicing boxes, chain-link fencing, and other metallic noncurrent-carrying metal items, shall be grounded. Connections to earth shall be made in the same manner as required for system grounding. Equipment or devices operating at less than 750 volts may be connected to secondary neutral grounding electrodes.

2.07 SURGE ARRESTER GROUNDING

A. Surge arresters shall be grounded. Resistance to ground for intermediate-class arresters shall be not more than 10 ohms and for distribution-class arresters shall be not more than 25 ohms. Ground wire connections shall be not less than No. 4 AWG for distribution arresters and No. 1/0 AWG for intermediate arresters. Connections to earth shall be made in the same manner as required for neutral conductors. Surge arrester grounds may use the same ground wires provided for equipment operating at more than 750 volts. Surge arrester and secondary neutral grounds shall be separate from and independent of each other but both grounds shall be bonded together below grade at the ground rods or may utilize a common counterpoise.

2.08 LIGHTING POLE GROUNDING

A. Base of lighting poles shall be connected to an adjacent ground rod as indicated on Plans. A ground connection from poles back to neutral ground points shall also be provided utilizing equipment grounding conductor.

2.09 METALLIC STRUCTURES

A. Metallic structures and buildings shall be grounded per NEC.

2.10 GROUNDING RINGS

A. When required, grounding rings shall be installed using bare copper cable with ground rods at at least 25 feet intervals using thermoweld connecting means as indicated on Plans in accordance with NEC requirements.

PART 3 - EXECUTION

3.01 INSTALLATION

A. It is the intent of these Contract Documents that all device and equipment grounds shall be run as a separate conductor in the conduit from the equipment to the distribution panels or system ground. Wireways and enclosures shall be properly bonded and grounded, and ground conductors shall be run for all circuits.

B. Equipment cases and devices shall be grounded. Ground rods shall be driven, and concrete encased conduits installed, before a building, or structure is built, and ground conductors brought through the concrete to accessible points for grounding equipment. These systems shall be installed at each structure, where transformers, switchboards, panelboards, and MCCs are installed.

C. Duct banks shall contain a concrete encased system bare copper ground conductor. The system ground conductors shall run continuously in duct banks, through handholes and other raceway boxes. The system ground shall be connected to the structure grounding systems to provide a continuous grounding system. Each metallic raceway, panel, switchboard, and other metallic devices associated with the electrical and control systems shall be bonded to this grounding system.

D. Ground rod shall be installed not less than 6 inches below grade. Equipment, neutral, and surge arrester ground wires shall be connected to the ground grid as indicated.

3.02 TESTS

A. Pre-Energization Tests

Pre-energization tests shall include, but shall not be limited to tests that the equipment engineer is required to perform under paragraph "GENERAL REQUIREMENTS." No part of the electrical system shall be energized until all station grounding system components have been tested and demonstrated to comply with the requirements specified, and until associated test reports have been submitted and approved.

B. Operating Test

After the installation is completed, the Contractor shall conduct an operating test for approval. Equipment shall be demonstrated to operate in accordance with the requirements herein. Tests shall be performed in the presence of the Engineer. The Contractor shall furnish instruments and personnel required for the test.

C. Ground-Resistance Measurements

Ground-resistance measurements of each ground rod shall be taken and certified by the Contractor to the Engineer. No part of the electrical distribution system shall be energized prior to the resistance testing of that system's ground rods and grounding system and submission of test results to the Engineer. Test reports shall indicate the location of the ground rod and grounding system and the resistance and the soil conditions at the time the test was performed. When the building water service is used as a ground or part of the grounding system, ground-resistance measurements shall also be made of this connection. 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. The resistance to ground shall be measured using the fall-of-potential method described in IEEE Std 142 and Std 81.

3.03 TEST RESULTS

A. The Contractor shall perform the above tests and complete the following report:

GROUNDING REPORT

1. Pre-Energization Tests
   a.
   b.
   c.
2. Operating Test
   a.
   b.
   c.
3. Ground-Resistance Measurements
   a.
   b.
   c.

End of Section

SECTION 16190

SUPPORTING DEVICES

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Supports, anchors, sleeves, and seals, are indicated on the Plans, schedules, and specified in other sections of these Specifications.

B. Types of supports, anchors, sleeves and seals specified in this section include the following:
   1. Clevis hangers
   2. Riser clamps
   3. C-clamps
   4. I-beam clamps
   5. One-hole conduit straps
   6. Two-hole conduit straps
   7. Round steel rods
   8. Lead expansion anchors
   9. Toggle bolts
   10. Wall and floor seals

1.02 SUBMITTALS

A. Products shall be submitted in accordance with Section 16000, and elsewhere in the Contract Documents, prior to installation.

PART 2 - PRODUCTS

2.01 GENERAL

A. Provide supporting devices that comply with manufacturers standard materials, design, and construction, in accordance with published product information, and as required for complete installations; and as specified herein.

2.02 SUPPORTS

A. Provide supporting devices of types, sizes, and materials indicated, and having the following construction features:
   1. Clevis Hangers: For supporting 2" rigid metal conduit; galvanized steel; with ½" dia. hole for round steel rod; approximately 54 pounds per 100 units.

2. Riser Clamps: For supporting 5" rigid metal conduit; galvanized steel; with 2 bolts and nuts, and 4" ears; approximately 510 pounds per 100 units.
3. C-Clamps: Black malleable iron; ½" rod size.
4. I-Beam Clamps: Black steel, 1¼" x 3/16" stock; 3/8" cross bolt; flange with 2"; approximately 52 pounds per 100 units.
5. One-Hole Conduit Straps: For supporting ¾" rigid metal conduit; galvanized steel; approximately 7 pounds per 100 units.
6. Two-Hole Conduit Straps: For supporting ¾" rigid metal conduit, galvanized steel; ¾" strap width; and 2-1/8" between center of screw holes.
7. Hexagon Nuts: For ½" rod size; galvanized steel; approximately 4 pounds per 100 units.
8. Round Steel Rod: Black Steel; ½" dia.; approximately 67 pounds per 100 feet.
9. Offset Conduit Clamps: For supporting 2" rigid metal conduit; black steel; approximately 200 pounds per 100 units.

2.02 ANCHORS

A. Provide anchors of types, sizes, and materials indicated, with the following construction features:
   1. Lead Expansion Anchors: ½"; approximately 38 pounds per 100 units.
   2. Toggle Bolts: Springhead; 3/16" x 4"; approximately 5 pounds per 100 units.

B. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following: Abbeon Cal Inc., Ackerman Johnson Fastening Systems Inc., Elcen Metal Products Co., Ideal Industries, Inc., Josyln Mfg and Supply Co., McGraw Edison Co., Rawlplug Co. Inc., Star Expansion Co., and U.S. Expansion Bolt Co.

2.03 SLEEVES AND SEALS

A. Provide sleeves and seals of types, sizes and materials indicated; with the following construction features:
   1. Wall and Floor Seals: Provide factory-assembled watertight wall and floor seals, of types and sized indicated; suitable for sealing around conduit, pipe, or tubing passing through concrete floors and walls. Construct seals with steel sleeves, malleable iron body, neoprene sealing grommets and rings, metal pressure rings, pressure clamps, and cap screws.
   2. Conduit sealing bushings shall be manufactured by O-Z/Gedney, Model CSMI, or equal.
   3. The conductor sealing bushings shall be manufactured by O-Z/Gedney, Model CSBG, or equal.

2.04 CONDUIT CABLE SUPPORTS

A. Provide cable supports with insulating wedging plug for non-armored type electrical cables in risers; construct 2" rigid metal conduit; 3-wires, type wire as indicated; construct body of malleable-iron casting with hot-dip galvanized finish.

2.05 U-CHANNEL STRUT SYSTEM

A. Provide U-channel strut system for supporting electrical equipment, 12-gage hot-dip galvanized steel, of types and sizes indicated; construct with 9/16" dia. holes, 8" o.c. on top surface, with the following fittings that mate and match with U-Channel:
   1. Fixture hangers
   2. Channel hangers
   3. End caps
   4. Beam clamps
   5. Wiring stud
   6. Thinwall conduit clamps
   7. Rigid conduit clamps
   8. Conduit hangers
   9. U-bolts

B. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering channel systems which may be incorporated in the work include, but are not limited to, the following: Allied Tube and Conduit Corp., B-Line Systems, Inc., Elcen Metal Products Co., Greenfield Mfg Co., Inc., Midland-Ross Corp., O-Z/Gedney Div; General Signal Corp., Power-Strut Div.; Van Huffel Tube Corp., and Unistrut Div; GTE Products Corp.

2.06 PIPE SLEEVES

A. Provide pipe sleeves of one of the following:
   1. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe; remove burrs.
   2. Sleeve Seals: Provide modular mechanical type seals, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install hangers, anchors, sleeves and seals as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to insure supporting devices

comply with requirements. Comply with requirements of NECA and NEC for installation of supporting devices.

B. Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.

C. Install hangers, supports, clamps and attachments to support piping properly from building structure. Arrange for grouping of parallel runs of horizontal conduits to be supported together on trapeze type hangers where possible. Install supports with spacings indicated and in compliance with NEC requirements.

D. Torque sleeve seal nuts, complying with manufacturer's recommended values. Ensure that sealing grommets expand to form watertight seal.

End of Section

SECTION 16195

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Electrical identification work specified in this section covers the following:
   1. Buried cable warnings
   2. Electrical power, control and communication conductors
   3. Operational instructions and warnings
   4. Danger signs
   5. Equipment/system identification signs

1.02 SUBMITTALS

A. Submittals to the engineer shall include the following:
   1. Manufacturers data on electrical identification materials and products
   2. Samples of each color, lettering style and other graphic representation required for each identification material or system

1.03 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering electrical identification products maybe incorporated in the work include, but not limited to, the following:
   1. Brady, W.H. Co.
   2. Ideal Industries, Inc.
   3. Panduit Corp.
   4. Equivalent

1.04 QUALITY COMPLIANCE

A. Comply with applicable requirements of UL Std. 969, "Marking and Labeling Systems", pertaining to electrical identification systems.

B. Comply with applicable requirements of NEMA Std. No's WC-1 and WC-2 pertaining to identification of power and control conductors.

PART 2 - PRODUCTS

2.01 GENERAL

A. Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for an application, selection is Installer's option, but provide single selection for each application.

2.02 COLOR-CODED CONDUIT MARKERS

A. Provide manufacturer's standard pre-printed, flexible or semi-rigid, permanent, plastic-sheet conduit markers, extending 360 degrees around conduits; designed for attachment to conduit by adhesive, adhesive lap joint of marker, matching adhesive plastic tape at each end of marker, or pretensioned snap-on. Except as otherwise indicated, provide lettering which indicates voltage of conductor(s) in conduit. Provide 8" minimum length for 2" and smaller conduit, 12" length for larger conduit.

B. Unless otherwise indicated or required by governing regulations, provide white markers with black letters.

2.03 CABLE AND CONDUCTOR WIRE MARKERS

A. Cable and conductor wire markers shall be self laminating vinyl on white background, printed using a BRADY XC PLUS printer, or equal. Handwritten wire markers are not acceptable.

2.04 SELF-ADHESIVE PLASTIC SIGNS

A. Provide manufacturer's standard, self-adhesive or pressure-sensitive, pre-printed, flexible vinyl signs for operational instructions or warnings; of sizes suitable for application areas and adequate for visibility, with proper wording for each application, e.g., 208V, EXHAUST FAN, RECTIFIER.

B. Unless otherwise indicated or required by governing regulations, provide white signs with black lettering.

2.05 LETTERING AND GRAPHICS

A. Coordinate names, abbreviations and other designations used in electrical identification work, with 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 electrical systems and equipment. Comply with ANSI A13.1 pertaining to minimum sizes for letters an numbers.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install electrical identification products as indicated, in accordance with manufacturer's written instructions, and requirements of NEC.

B. Where identification is to be applied to surfaces which require finish, install identification after completion of painting.

C. Comply with governing regulations and requests of governing authorities for identification of electrical work.

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 electrical conduit in manner similar to piping identification. Except as otherwise indicated, use white as coded color for conduit.

3.03 CABLE/CONDUCTOR IDENTIFICATION

A. Apply cable/conductor identification, including voltage, phase and feeder number, on each cable/conductor in each box/enclosure/cabinet where wires of more than one circuit or communication/signal system are present, except where another form of identification (such as color-coded conductors) is provided. Match identification with marking system used in panelboards, shop drawings, contract documents, and similar previously established identification for project's electrical work.

3.04 EQUIPMENT/SYSTEM IDENTIFICATION

A. Install engraved plastic-laminate sign on each major unit of electrical equipment in building; including central or master unit of each electrical system including communication-control-signal systems, unless unit is specified with its own self-explanatory identification or signal system. Except as otherwise indicated, provide single line of text, 1/2" high lettering on 1-1/2" high sign (2" high where 2 lines are required), white lettering in black field. Provide text matching terminology and numbering of the contract documents and shop drawings. Provide signs for each unit of the following categories of electrical work:
   1. Panelboards, electrical cabinets and enclosures.
   2. Access panel/doors to electrical facilities.
   3. Major electrical switchgear.

B. Install signs at locations indicated or, where not otherwise indicated, at location for best convenience of viewing without interference with operation and maintenance of equipment. Secure to substrate with brass or stainless steel screws, except use adhesive where screws should not or cannot penetrate the substrate.

3.05 CIRCUIT IDENTIFICATION

A. The 3-phase wires shall be identified at the switchgear, panelboards and motor control centers as Phases A, B, and C. At 277/480V, Phase A shall be brown, Phase B shall be orange, and Phase C shall be yellow. The neutral shall be grey.

B. In addition to color coding all conductors, each conductor shall be identified in each pull box, manhole, panelboard, cable tray, or termination with circuit identification markers. This identification is applicable to all power, control, alarm, and instrumentation conductors and these markings shall be recorded on the Record Documents. Markers shall be slip-on PVC sleeve type as manufactured by Brady, Seaton, or equal.

C. Markers for other cabling shall be B-292 vinyl as manufactured by Brady, Seaton, or equal.

D. Exposed medium voltage conduits shall be labeled at 50- foot intervals with 1-inch letters stating the voltage - example - "12,470 volts". Labels shall be vinyl plastic as manufactured by Brady, Seton, or equal.

3.06 AUTOMATIC EQUIPMENT WARNING SIGNS

A. Permanent warning signs shall be mounted at all mechanical equipment which may be started automatically or from remote locations. Signs shall be in accordance with OSHA regulations and shall be suitable for exterior use. The warning signs shall be fastened with round head brass screws or bolts, located and mounted in a manner acceptable to the Engineer.

B. Warning signs shall be 7 inches high by 10 inches wide, colored yellow and black, on not less than 18 gauge vitreous enameling stock. Sign shall read:

CAUTION
THIS EQUIPMENT STARTS
AUTOMATICALLY
BY REMOTE CONTROL

3.07 HIGH VOLTAGE WARNING SIGNS

A. Permanent and conspicuous warning signs shall be mounted on all equipment, doorways to equipment rooms, pull boxes, manholes, where the voltage exceeds 600 volts.

B. Signs shall be in accordance with OSHA regulation, and shall be suitable for exterior use. The warning signs shall be fastened with round head brass screws or bolts, located and mounted in a manner acceptable to the Engineer.

C. Signs shall be 7 inches high by 10 inches wide, colored red and white, on not less than 18 gauge vitreous enameling stock. Sign shall read:

WARNING
HIGH VOLTAGE
KEEP OUT

3.08 CONDUCTOR FASTENERS

A. Glue-on type conductor fasteners shall not be used in any panels, panelboards, switchboards, switchgear, motor control centers, or other enclosures containing electrical devices and/or conductors.

End of Section

SECTION 16420

SERVICE ENTRANCE SECTION

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This section covers the service entrance section and related service equipment.

1.02 SUBMITTALS

A. Products shall be submitted in accordance with Section 16000, and elsewhere in the Contract Documents, prior to installation.

B. The contractor shall submit shop drawings, catalog cuts, single line diagrams, component layout drawings and equipment elevation. Shop drawings must indicate all ratings, bus bracing, phasing, and utility requirements.

C. Catalog cuts must be submitted for the service entrance section and components within. Each catalog cut must be properly identified with catalog number and indexed for easy reference.

D. Single line diagrams must be complete with circuit numbers to match the Plans. Components must be sized and shown in a bill of materials.

E. A wiring diagram must be submitted to show connection and control of devices such as ground fault protection, phase protection relays, and other components. Wiring diagram must include component numbers, matching the bill of materials.

F. Service entrance section must be approved for connection by the serving utility company prior to Engineer's review.

G. The SES must be UL listed as a complete assembly suitable for Service Entrance Duty.

PART 2 - PRODUCTS

2.01 SERVICE ENTRANCE SECTION (SES)

A. The SES shall be a single panel, frame or assembly of panels on which shall be mounted on a deadfront mounting plate, circuit breakers or fused switches, metering equipment and any monitoring or protection devices as indicated on the plans.

B. The SES shall be a one-piece enclosure with front accessibility unless otherwise required. The SES shall have a metered distribution section complete with meter socket and factory

installed test blocks, customer metering, and a pull section, overhead or underground, as indicated on the plans; all of which shall comply with the requirements of the serving utility.

C. The enclosure shall be zinc coated steel, minimum 12 gauge thickness. Cabinet shall be protected against corrosion in accordance with U.L. 50, Cabinets and Boxes, Section 13. Exterior covers to be minimum 14 gauge steel, and shall have padlocking provisions. Deadfront shall be a hinged type, 16 gauge minimum, and shall not require the use of a tool to expose interior components for installation or servicing. Factory installed components shall be U.L. listed. Factory installed conductors shall be copper, size and type to conform to NEC and U.L. requirements (minimum size #14 AWG). Construction shall be such to prevent the entry of rodents into the interior. Ventilation openings shall be provided.

D. Unless otherwise indicated on the Plans, the enclosure shall be rated NEMA 3R for outdoor use, or NEMA 1A for indoor use.

E. Bus bars (including neutral and ground) shall be silver, or tin plated solid copper, and braced to withstand short circuit amps as indicated on the Plans.

F. The SES shall have a steel nameplate stamped indicating the equipment voltage, amperage and short circuit withstand rating, mounted on the outside of the enclosure.

G. Padlocking provisions shall be provided to lock the device in the "OFF" position.

H. The overcurrent protection shall be rated as indicated, and as specified elsewhere herein.

I. Metering and instrumentation shall be as indicated, and as specified elsewhere herein.

J. On circuit breakers 800 amps and larger, a trip button shall be provided.

K. The Service Entrance Section shall be as manufactured by Westinghouse, Square D, Allen-Bradley, Siemens, or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The Service Entrance Section shall be installed per manufacturer's instructions, as indicated on the plans, per all applicable NEC and local codes and regulations, and shall comply with serving utility's requirements.

B. Grounding shall be provided as required by the NEC, and as indicated on the Plans.

C. Ground resistance testing shall be performed and report submitted per Section 16170.

End of Section

SECTION 16430

CUSTOMER POWER MONITORING SYSTEM

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This specification covers the customer power monitoring system installed on the service entrance section(s), motor control center(s), and other distribution panel(s) as indicated on Plans.

1.02 SUBMITTALS

A. Products shall be submitted in accordance with Section 16000, and elsewhere in the Contract Documents, prior to installation.

B. Submit manufacturer's catalog cut sheet indicating all options to be supplied as specified herein.

C. Submit shop drawing indicating wiring connection diagram and elevation drawing indicating location of component(s) on the service entrance section.

1.03 MANUFACTURERS

A. Acceptable manufacturers subject to compliance with the specifications herein are as follows:
   1. Westinghouse
   2. Square D
   3. Multilin

PART 2 - PRODUCTS

2.01 GENERAL

A. The system shall consist of electronic circuit monitors as required to obtain signals as specified herein. Components shall include CT's, PT's, CPT, etc. and other devices as required.
   1. The electronic Circuit Monitors shall report metering values such as frequency, temperature, current, voltage, power factor, power, demand current, and real power, and accumulated energy.

2. Each Circuit Monitor shall retain historical circuit data, time and date, setup and configuration values, and diagnostics data in the event of a control power failure without the need for an internal battery.
3. Each Circuit Monitor shall be capable of capturing current and voltage waveforms which may be exported to a personal computer where waveform or other power quality analysis may be performed.
4. The Circuit Monitor shall include an LED readout which will allow local display of the following electrical parameters:
   a. Current, per phase RMS
   b. Voltage, phase-to-phase & phase-to-neutral
   c. Real power, 3-phase total
   d. Reactive power, 3-phase total
   e. Apparent power, 3-phase total
   f. Power factor, 3-phase total & per phase
   g. Frequency
   h. Peak demand current, per phase
   i. Peak demand, real power
   j. Accumulated Energy, (MWH and MVARH)
5. Reset the following electrical parameters shall also be allowed from the front of the Circuit Monitor:
   a. Peak demand current
   b. Peak demand power
   c. Energy (MWH)
   d. Reactive energy (MVARH)
6. Circuit Monitor setup for system requirements shall be allowed from the front of the Circuit Monitor. Setup provisions shall include:
   a. CT rating (xxxx:5)
   b. PT rating (xxxxx:120)
   c. System type (3-wire and 4-wire)
   d. Demand interval (5-60 min.)
7. All reset and functions shall be keyswitch protected to prevent unauthorized/accidental changes.

B. The system shall have System Display units which display data from the Circuit Monitors. The display unit shall contain the following:
1. Each System Display shall provide real-time access to all metering data available for each circuit (present as well as historical data).
2. Each System Display unit shall access and display the data available from selected electronic Circuit Monitors connected on the individual data transfer network.
3. The System Display unit shall utilize a 4 line by 20 character, high contrast LCD technology display with backlighting to provide high reliability and superior readability in all light conditions.
4. The level of backlighting as well as the contrast shall be adjustable.
5. The System Display unit shall allow for easy operation by providing a keypad with large keys for operator selections.

6. The keys shall have a raised perimeter and tactile feedback to ensure a positive response even with gloved hand operation.
7. The keys shall be clearly marked to indicate the function and separated into meaningful groups with display prompting to assist the user in operation.
8. Each System Display unit shall be configured by the manufacturer with all necessary data such as CT ratios, PT ratios, main and feeder device nameplates, demand alarm set points, etc.
9. It shall be possible to change the configuration for each System Display unit using the keypad provided on each display.
10. This capability shall be password protected to prevent unauthorized modification of the configuration.
11. All data with the exception of the captured waveform shall be accessible by the System Display unit.
12. Data shall be displayed in a logically organized manner complete with the proper scaling and units.
13. It shall be possible to sequentially view all available data from a selected Circuit Monitor by single keystroke advancing through the various display pages.
14. It shall be possible to view the same pages of data from other Circuit Monitors by single keystroke advancing back and forth from Circuit Monitor to Circuit Monitor.

C. Software for a personal computer shall be provided as specified herein:
1. The Metering System Software to be supplied shall be suitable for operation on a personal computer.
2. System Software shall be capable of alarm reporting, event logging, data logging, on-line monitoring of instrumentation/status/alarms, waveform analysis, manual control of circuit breakers or other selected devices and shall include sufficient levels of password protection.
3. The software shall be capable of performing background activities such as alarms and automatic logging while the computer is used for other programs such as word processing, spreadsheet, etc.
4. Software shall be supplied by switchgear manufacturer which will display all information available from the Circuit Monitors. This software shall include the following characteristics/capabilities:
   a. MicroSoft windows based with mouse
   b. View & log instrumentation data
   c. View voltage/current waveforms and analyze waveform data
   d. Perform diagnostics/setup
   e. Display tables, charts & graphs
   f. Display meters, meter panels graphically
   g. Event logging
   h. Alarm reporting
   i. Reset energy alarms/historical data
   j. Background data logging
   k. Three level password protection
   l. Manual control of Circuit Monitor outputs

m. Display status (circuit breakers, relays, trip units, etc.)

PART 3 - EXECUTION

3.01 INSTALLATION

A. System Display units shall be installed by the manufacturer in the switchgear as indicated on the plans.

B. The System Display units shall be flush mounted on switchgear door panels.

C. Electronic Circuit Monitors shall be installed by the switchgear manufacturer for all circuits as indicated by the project drawings.

D. All control power, CT, PT, and communications wire shall be factory wired and harnessed within the switchgear lineup.

E. Where external circuit connections are required, terminal blocks shall be provided and the manufacturer's drawings must clearly identify the interconnection requirements including wire type to be used.

F. The metering components included within the service entrance sections shall be factory installed, wired and tested prior to shipment to the job site.

G. All wiring required to externally connect the personal computer shall be installed by the Contractor per manufacturer's requirements and per other portions of these specifications.

H. Contractor interconnection wiring requirements shall be clearly identified on the metering system drawings to be submitted for approval.

3.02 TRAINING

A. On-site start-up and training of the metering system shall be included in the project bid.

B. Start-up shall include a complete working demonstration of the system with simulation of possible operating conditions which may be encountered.

C. Training shall include any documentation and hands-on exercises necessary to enable operations personnel to assume full operating responsibility for the system after completion of the training period.

D. The project bid shall include 2 days start-up assistance and 1 day training.

End of Section

SECTION 16461

TRANSFORMERS - DRY TYPE

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This section covers dry type transformers used for low voltage, single and three phase, power distribution and lighting.

1.02 SUBMITTALS

A. Products shall be submitted in accordance with Section 16000, and elsewhere in the Contract Documents, prior to installation.

1.03 QUALITY ASSURANCE

A. ANSI C57.12.01, dry-type transformers

B. ANSI C89.2, dry-type transformers

C. NEMA ST-20, dry-type transformers

D. UL-506, specialty transformers

PART 2 - PRODUCTS

2.01 DISTRIBUTION - LOW VOLTAGE LIGHTING AND POWER

A. Transformers shall be premium high efficiency quiet type, and shall be installed where indicated on the Plans. The primary winding of the transformers shall have two 2-1/2 percent taps above, and below normal.

B. The transformers shall have a BIL of 10 KV with a temperature class of 185 degrees C for transformers up to 25 KVA, and a temperature class of 220 degrees C for larger transformers.

C. The sound level shall not exceed 44 dBa measured at 5 feet from the transformer after installation. Core and coil assemblies 30 KVA and larger, shall be mounted on rubber vibration isolators, designed to reduce harmonics generated noise.

D. Transformers shall be types manufactured by Westinghouse, Square D, Hevi-Duty, or equal.

2.02 FERRO RESONANT ISOLATION TRANSFORMERS

A. Ferro resonant isolation transformers shall be provided where indicated on the Plans. Regulation shall be +3 percent for an input range of +10 percent. Common mode noise rejection shall be better than 120 dB with transverse mode noise rejection better than 60 dB. Voltage spike attenuation shall be better than 250:1.

B. Isolation transformers shall be as manufactured by Shape Magnetronics, Control Concepts, Inc., or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Transformers shall be installed as indicated on the Plans, and in accordance with the manufacturer's instructions and recommendations. Contractor shall provide painted metal wall brackets, when required.

B. Grounding shall be provided per NEC, and Section 16170.

End of Section

SECTION 16470

PANELBOARDS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This section covers electrical panelboards.

1.02 SUBMITTALS

A. Products shall be submitted in accordance with Section 16000, and the Contract Documents, prior to installation.

B. Panel layout with alphanumeric designation, branch circuit breaker sizes and types, AIC rating, bus sizes, and other characteristics.

1.03 QUALITY ASSURANCE

A. NEMA PB-1, Panelboards

B. NEC

C. UL67, Panelboards

PART 2 - PRODUCTS

2.01 PANELBOARDS

A. Dead-front panelboards, including lighting distribution and control panels, shall be furnished and installed as indicated on the Plans. Buses shall be copper. Mounting and type of enclosures shall be as indicated on the Plans. Where not indicated, indoor enclosures shall be NEMA 12 and outdoor enclosures shall be NEMA 4. The minimum interrupting capacity of any device shall be as indicated on the Plans.

B. Protective devices shall be replaceable without disturbing adjacent units. Wire connectors shall be suitable for wire sizes indicated. Branch circuits shall be numbered as indicated on the Plans, and a complete typed circuit schedule shall be furnished under a transparent cover, and affixed to the panel. Phase busing shall be full height without reduction. Full size neutral bars shall be included, and shall have suitable lug for each outgoing circuit requiring neutral connection. Spaces for future protective devices provided in lighting panels shall be bused for the maximum device that can be fitted into them.

C. Panelboards shall be finished with a primer, rust- resistant phosphate undercoat and two coats of oven-baked enamel with finish ANSI grey. They shall be sized to provide a minimum of 4 inches of gutter space on all sides. Doors shall not uncover any live parts, and shall be hinged and have latches that require no tool to operate. Panelboard doors shall be lockable. Lock and two keys shall be furnished.

D. Each panelboard shall have, on the outside of the door, a lamicoid nameplate with 3/4 inch letters as specified elsewhere in these Contract Documents.

E. Panelboards shall be as manufactured by Square D, Allen-Bradley, Westinghouse, or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Panelboards shall be installed as indicated on the plans and according to manufacturer's instructions.

B. Provide grounding per NEC, and Section 16170.

C. Contractor shall verify all NEC clearance requirements prior to installation.

End of Section

SECTION 16475

MINI POWER CENTERS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This section covers electrical Mini Power Centers.

PART 2 - PRODUCTS

2.01 MINI POWER CENTERS

A. The contractor shall furnish and install Mini Power Centers, as indicated on the Electrical Plans.

B. Single phase transformers shall be 480 volt primary and 240/120 volt secondary. Three phase transformers shall be 480 volt primary and 208 Y/120 volt secondary.

C. All transformers shall have a minimum of 2-5% full capacity primary taps below normal and shall be rated 115 degree temperature rise above 40 degree maximum ambient. All insulating materials are to be in accordance with current ANSI C89.2 and NEMA ST20 standards for a 185 degree UL component recognized insulation system. Transformers are to be encapsulated using a sand-epoxy resin mixture to provide maximum protection against moisture, dust and corrosive environments.

D. Enclosures shall be cleaned, phosphatized and electrostatically powder coated and shall be UL Listed for indoor and outdoor use.

E. Mini Power Center Units shall include integrally mounted and wired primary and secondary main circuit breakers in accordance with National Electrical Code requirement. These breakers and all branch circuit breakers shall be bolt-on type and as specified elsewhere within these specifications. Minimum A/C rating shall be as indicated on Plans.

F. A hinged access door shall be provided which maintains itself in the open position when desired, and which has padlock provisions to prevent unauthorized entry. All live parts are to be fully enclosed for personnel protection when installation is completed. The transformer and panelboards shall be constructed with separate enclosures capable of being assembled or disassembled as independent units.

G. The Mini Power Centers shall be UL Listed for use as service equipment.

H. The Mini Power Centers shall be as manufactured by Square D Company or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Mini Power Centers shall be installed as indicated on the plans and per manufacturer's instruction.

End of Section

SECTION 16476

LOW VOLTAGE CIRCUIT BREAKERS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish and install, low voltage circuit breakers, as indicated on the Plans and specified herein.

1.02 SUBMITTALS

A. Products shall be submitted in accordance with Section 16000, and elsewhere in the Contract Documents, prior to installation.

PART 2 - PRODUCTS

2.01 GENERAL

A. Circuit breakers shall be as manufactured by Square D, Westinghouse, Allen-Bradley, or equal.

B. Circuit breaker frame, trip, short circuit, and interruption ratings shall be as indicated on the Plans, except that they shall be coordinated with the ratings of the equipment actually furnished, and shall be modified where necessary to suit the equipment. Circuit breakers to be used in motor control centers shall be as indicated on the Plans. Where no indication of type is given on the Plans circuit breakers protecting motors shall be motor circuit protectors, and other circuit breakers shall be molded case type.

C. Circuit breaker for mounting in motor control centers, or for separate mounting shall be of the air-break type, quick-make and quick-break, 600 volt, with number of poles as indicated on the Plans.

D. Each pole of the circuit breaker shall provide inverse time delay, and instantaneous circuit protection.

E. The breakers shall be operated by a handle, and shall have a switching mechanism that is mechanically trip free from the handle, so that the contacts cannot be held closed against short circuits, and abnormal currents. Tripping due to overload, or short circuit shall be clearly indicated by the handle automatically assuming a position between the manual ON and OFF positions. Latch surfaces shall be ground and polished. Poles shall be constructed so that they open, close, and trip simultaneously.

F. Breakers must be completely enclosed in a molded case. Non-interchangeable trip breakers shall have their covers sealed; interchangeable trip breakers shall have the trip unit sealed to prevent tampering. Ampere ratings shall be clearly visible. Contacts shall be non-welding silver alloy. Arc extinction must be accomplished by means of arc chutes. The minimum interrupting ratings of the circuit breakers shall be at least equal to the available short circuit current at the line terminals.

G. Circuit breakers shall conform to the applicable requirements of NEMA Standards Publication No. AB1.

H. Molded case circuit breakers shall be ambient temperature compensating that provides inverse time delay overload and instantaneous short circuit protection by means of a thermalmagnetic element. Compensation shall be accomplished by a secondary bi-metal that will allow the breaker to carry rated current between 25 degrees C and 50 degrees C with tripping characteristics that are approximately the same throughout this temperature range.

I. On breakers with interchangeable, thermal, adjustable magnetic trip, the accessibility and position of the adjustment knob shall not be changed from those on the standard breaker.

J. Unless mounted in a switchboard, or panelboard, circuit breakers shall be housed in a NEMA rated enclosure as described elsewhere in these specifications.

K. Provide circuit breakers with shunt trip mechanisms where shown on the Plans.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Circuit breakers shall be installed as indicated on the plans and per manufacturer's instructions.

End of Section

SECTION 16477

FUSES

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Extent of fuse work required by this section is indicated by drawings, and by requirements of this section.

B. Types of fuses specified in this section include the following:
   1. Class L time-delay.
   2. Class L fast-acting.
   3. Class RK1 time-delay.
   4. Class RK1 and Class J current-limiting.
   5. Class RK5 time-delay.
   6. Class K5 time-delay, noncurrent-limiting.
   7. Class T current-limiting.

1.02 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of fuses of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

1.03 CODES AND STANDARDS

A. UL Compliance and Labeling: Comply with applicable provisions of UL 198D, "High-Interrupting-Capacity Class K Fuses". Provide over-current protective devices which are UL-listed and labeled.

B. NEC Compliance: Comply with NEC as applicable to construction and installation of fusible devices.

C. ANSI Compliance: Comply with applicable requirements of ANSI C97.1 "Low-Voltage Cartridge Fuses 600 Volts or Less".

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data on fuses, including specifications, electrical characteristics, installation instructions, furnished specialties and accessories in accordance with Section 16000, and the Contract Documents. In addition,

include voltages and current ratings, interrupting ratings, current limitation ratings, time-current trip characteristic curves, and mounting requirements.

1.05 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering fusible devices which may be incorporated in the work include, but are not limited to, the following: Bussmann, Gould-Shawmut, Reliance, or equal.

PART 2 - PRODUCTS

2.01 GENERAL

A. Except as otherwise indicated, provide fuses of types, sizes, ratings, and average time-current and peak let-through current characteristics indicated, which comply with manufacturer's standard design, materials, and constructed in accordance with published product information, and with industry standards and configurations.

2.02 Class L Time-Delay Fuses

A. Provide UL Class L time-delay fuses rated 600-volts, 60 Hz, with 200,000 RMS symmetrical interrupting current rating for protecting transformers, motors, and circuit-breakers.

2.03 Class L Fast-Acting Fuses

A. Provide UL Class L fast-acting fuses rated 600-volts, 60 Hz, with 200,000 RMS symmetrical interrupting current rating for protecting service entrances and main feeder circuit-breakers.

2.04 Class RK1 Time-Delay Fuses

A. Provide UL Class RK1 time-delay fuses rated 600-volts, 60 Hz, with 200,000 RMS symmetrical interrupting current rating for protecting motors and circuit-breakers.

2.05 Class RK1 Current-Limiting Fuses

A. Provide UL Class RK1 current-limiting fuses rated 250-volts, 60 Hz, with 200,000 RMS symmetrical interrupting current rating for protecting circuit-breakers.

2.06 Class J Current-Limiting Fuses

A. Provide UL Class J current-limiting fuses rated 600-volts, 60 Hz, with 200,000 RMS symmetrical interrupting current rating.

2.07 Class RK5 Time-Delay Fuses

A. Provide UL Class RK5 time-delay fuses rated 600-volts, 60 Hz, with 200,000 RMS symmetrical interrupting current rating for protecting motors.

2.08 Class K5 One-Time Fuses

A. Provide UL Class K5 one-time fuses rated 250-volts, 60 Hz, with 100,000 RMS symmetrical interrupting current rating for protecting non-inductive loads.

2.09 Class T Fuses

A. Provide UL Class T fuses rated 600-volts, 60 Hz, with 200,000 RMS symmetrical interrupting current rating for protection of physically small devices.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Fuse types and sizes shall be as indicated on the Plans. Fuses shall be installed in accordance with the National Electric Code (NEC) requirements and the manufacturer's written instructions.

B. Install fuses in proper fuse holders.

C. Where fuses are installed in the motor starters, fuses shall be sized to match the actual motor full load current.

D. Where fuses are installed in disconnect switches at HVAC units, the fuse sizes shall be sized to meet the HVAC manufacturer's requirements.

E. Fuses for control transformers shall be sized in accordance with the National Electrical Code.

F. Fuses shall be installed with the labels clearly visible.

3.02 FIELD QUALITY CONTROL

A. Prior to energizing fusible devices, test devices for circuit continuity and for short-circuits.

3.03 SPARE PARTS

A. Furnish 3 spare fuses of each size and type.

End of Section

SECTION 16480

MOTOR CONTROLLERS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. A motor controller is any device or group of devices normally used to start and stop a motor by making and breaking the motor circuit current. The motor controller and devices that make up the motor controller shall be governed by items indicated on the Plans, or elsewhere within these specifications.

B. Types of motor controllers specified in this section include the following:
   1. Combination.
   2. Fractional HP manual.
   3. Solid-state reduced voltage.
   4. Autotransformer reduced voltage.
   5. Wye-delta.
   6. Part winding.

C. This section applies to motor controllers rated 480 V and below.

1.02 CODE AND STANDARDS

A. Electrical Code Compliance: Comply with applicable local electrical code requirements of the authority having jurisdiction and NEC Articles 220, 250, and 430, as applicable to installation, and construction of motor controllers.

B. NFPA Compliance: Comply with applicable requirements of NFPA 70E, "Standard for Electrical Safety requirements for Employee Workplaces."

C. UL Compliance: Comply with applicable requirements of UL 486A and B, and UL 508, pertaining to installation of motor controllers. Provide controllers and components which are UL-listed and labeled.

D. IEEE Compliance: Comply with recommended practices contained in IEEE Standard 241, "Recommended Practice for Electrical Power Systems in Commercial Buildings," pertaining to motor controllers.

E. NEMA Compliance: Comply with applicable requirements of NEMA Standard ICS 2, "Industrial Control Devices, Controllers and Assemblies," and Pub No. 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)," pertaining to motor controllers and enclosures.

1.03 MAINTENANCE DATA

A. Submit maintenance data and parts list for each motor controller and component; including troubleshooting maintenance guide. Also, provide product data and shop drawings in a maintenance manual, in accordance with requirements of the Contract Documents.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's data and installation instructions on motor controllers.

B. Shop Drawings: Submit shop drawings of motor controllers showing accurately scaled equipment locations and spatial relationships to associated motors and equipment.

C. Wiring Diagrams: Submit power and control wiring diagrams for motor controllers showing connections to electrical power panels, feeders, and equipment.

D. Submittal documents shall be provided in accordance with Section 16000, and other requirements of the Contract Documents.

PART 2 - PRODUCTS

2.01 GENERAL

A. Except as otherwise indicated, provide motor controllers and ancillary components that comply with manufacturer's standard materials, design and construction in accordance with published product information, and as required for a complete installation.

2.02 COMBINATION CONTROLLERS

A. Provide full-voltage alternating-current combination controllers, consisting of controller and circuit breaker disconnect switch mounted in a common enclosure, of types, sizes, rating, and NEMA sizes indicated on the Plans. Equip controllers with electronic overload relays, control relays, and auxiliary contacts as required on the plans. Provide lockable operating handle for disconnect switch mechanism, mechanically interlocked with enclosure door. Provide NEMA rated enclosure type as shown on the Plans.

B. Circuit breaker disconnect shall be molded case, motor circuit protector type (MCP), sized per NEC.

C. Provide control power transformer sized properly to accommodate device loads. The control power transformer shall have two (2) primary, and one (1) secondary fuse sized according to NEC.

D. Furnish controller with control and indicating devices as indicated on the plans. Auxiliary contacts, and field connections shall be connected to terminal strips for field connection.

E. Controllers shall be as manufactured by Allen-Bradley, Square D, Westinghouse, Furnas, or equal.

2.03 ELECTRONIC OVERLOAD RELAYS

A. Electronic overload relays shall be provided with the motor starters. The overload relay shall be a 3-pole solid state device that monitors all 3 phases of the motor current. The unit shall detect overcurrent and phase current imbalance, and trip after an adjustable time from 3 seconds to 30 seconds.

B. The overload relay shall be Class 10, 600 Volt rated, ambient temperature compensated, and shall have an LED trip indicator. The unit shall have a manual and automatic reset feature, and a normally closed contact for control.

C. Each module shall provide individual trip indication and reset for each trip condition, visible without opening the motor control center compartment door. Provide a normally open auxiliary contact for remote trip indication.

D. Solid state circuits shall be completely protected from damage arising from line transients and voltage spikes.

E. Controllers shall be as manufactured by Allen-Bradley, Square D, Westinghouse, Furnas, or equal.

2.04 MAGNETIC MOTOR STARTERS

A. Starters, Size 2 and larger, shall have arc quenchers on all load breaking contacts. Starters shall be suitable for the horsepower ratings specified. The Contractor shall verify the motor ratings, and coordinate the starter and overload trip ratings with the actual horsepower ratings of the motors installed. Extended overload reset buttons shall be mounted so as to be accessible for operation without opening the door of the enclosure.

B. Magnetic contactors shall be factory adjusted and shall be chatter free. Overload relays shall be electronic, as specified herein.

C. Starters shall be furnished complete with a 120-volt control power transformer. Control circuit fuses shall be furnished both on the primary and secondary of the control circuit transformer. If there is no transformer, all live control power supply wires shall be fused.

D. Starters shall be designed to operate in ambient temperatures up to 60° C.

E. The minimum size starter shall be NEMA Size 1.

F. Controllers shall be as manufactured by Allen-Bradley, Square D, Westinghouse, Furnas, or equal.

2.05 MANUAL STARTERS

A. Manual starters shall be rated for the motor load, and shall be equipped with built-in overloads.

B. Manual starters shall be provided with enclosures as indicated on the Plans, lockable handles that clearly indicate ON, OFF, and TRIPPED positions, pilot light, and positive, quick-make, quick-break mechanisms.

C. Controllers shall be as manufactured by Allen-Bradley, Square D, Westinghouse, Furnas, or equal.

2.06 MOTOR PHASE FAILURE RELAY

A. The relay shall detect voltage values below an adjustable value, loss of phase, and phase reversal. The unit shall automatically de-energize the control circuits of the motors to be protected, when one or all three phase voltages drop below the set point. The unit shall have a nominal trip delay time of two seconds and a reset time of two seconds. The relay shall automatically reset upon restoration of the line voltage. Relays shall be manufactured by Motorsavers, Time Mark Corporation, or equal.

2.07 MOTOR PROTECTION RELAY

A. The motor protection relay shall be capable of the following as a minimum:
   1. Phase loss
   2. Low voltage (adjustable)
   3. Phase reversal
   4. Phase unbalance

B. The motor protection relay shall be equipped with the following as a minimum:
   1. Adjustable trip delay (2 to 20 seconds)
   2. Automatic reset
   3. Transient protection (2500 volts for 10 ms)

C. Motor protection relays shall be set during the project startup according to the individual motor characteristics and application parameters. The motor protection relays for the motors with variable frequency drives shall be set as to prevent low voltage tripping.

D. The motor protection relays shall be Motor saver Model 450, Time Mark Model 264, or equal.

2.08 SOLID STATE REDUCED VOLTAGE STARTER

A. Furnish and install a solid-state reduced voltage starter (SSS) to provide motor soft start and soft stop, where indicated on the Plans. The starter shall be capable of operating with any standard NEMA design motor of the specified horsepower. The unit shall be self contained, house the logic board, power switches, heat sinks, motor overload protection, control power transformer, and any applicable disconnect means in one enclosure.

B. Voltage rating to be 460V, 60Hz, 3 phase, +/- 20%.

C. Operating temperature shall be 0 degrees to 50 degrees C, 5 to 95% relative humidity, non-condensing. Derate 33% for each 10 degrees C over 50 degrees C to a maximum of 70 degrees C.

D. Built in overload protection shall shut down and disable the starter until reset.

E There shall be three pairs of inverse parallel SCRs. Each SCR shall be rated to block 2.5 times the nominal line to line voltage. The SCRs shall be sized to handle locked rotor current (6 times full load current for 10 seconds on a cold start at 50 degrees C).

F. The starter shall be installed as indicted on the Plans, and shall be supplied with properly sized input and bypass contactors, and controls as shown on the Plans.

G. Adjustments and indicators shall be accessible from a digital keypad with LCD panel. Indications shall include control power on, motor on, motor starting, shorted SCR, overload, motor on bypass, and current.

H. Power poles and logic assemblies to be removable as one piece assemblies. One logic assembly shall work in any size unit of a given line voltage. The logic assembly shall be conformal coated. The gate drive circuit shall be optically coupled for noise immunity and long life. The logic assembly and SCRs shall be noise immune per NEMA showering arc test for solid-state contactors.

I. The soft start unit shall be capable of voltage or current control. The voltage limit shall be adjustable from 30% to 80% of line voltage and the current control shall be adjustable from 200% to 600% of FLA. In the voltage control mode, the ramp time shall be adjustable from 1 to 30 seconds, and the unit shall have a soft stop feature, also.

J. The soft start shall have dry contact, form C, outputs available for internal faults, shorted SCR, BYPASS control, and run status.

K. Controllers shall be UL listed under UL508, and manufactured by Toshiba, Square D, Westinghouse, or equal.

PART 3 - EXECUTION

A. Install motor controllers in accordance with equipment manufacturer's written instructions, and with recognized industry practices. Comply with applicable requirements of NEC, UL, and NEMA standards, to insure that products fulfill requirements.

B. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque values for equipment connectors. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and B, and the National Electrical Code.

C. Install fuses, of sizes indicated, in each fusible disconnect switch, if any.

D. Prior to energizing motor controller equipment, check with ground resistance tester, phase-to phase and phase-to-ground insulation resistance levels to ensure requirements are fulfilled.

E. Prior to energizing, check circuitry for electrical continuity, and for short-circuits.

F. Check rotation of each motor for proper direction.

G. Upon completion of installation of motor controller equipment and electrical circuitry, energize controller circuitry and demonstrate functioning of equipment in accordance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and retest to demonstrate compliance.

End of Section

SECTION 16481

MOTOR CONTROL CENTERS (MCC)

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish and install, ready to use, motor control centers for use as indicated on the Plans and specified herein.

B. Circuit breaker ratings, and modifications, shall be as indicated on the Plans.

C. MCP ratings, and modification, shall be as indicated on the Plans.

1.02 SUBMITTALS

A. The motor control centers shall meet the requirements of the latest edition of Standards for Industrial Control No. ICS published by the National Electrical Manufacturers Association. The following minimum information and drawings shall be submitted for review and acceptance by the Engineer:

1. Plan, front, side views and overall dimension of each motor control center.
2. Weight.
3. Internal wiring diagram of each plug-in unit.
4. Internal wiring diagram of the motor control centers.
5. External connection diagram showing the wiring to the external controls and devices associated with the motor control center.
6. A one-line and a schematic diagram for each motor control center.
7. Bill of material list and Manufacturer's Product Data.
8. Installation instructions.
9. Manufacturer's certification that the following items are capable of interrupting and/or withstanding the specified short circuit condition:
   a. Bus bar bracing
   b. Feeder tap units
   c. Starter units

B. Product information shall be submitted in accordance with Section 16000, and elsewhere in the Contract Documents.

PART 2 - PRODUCTS

2.01 MOTOR CONTROL CENTERS (MCC)

A. The motor control center fabricator shall be the manufacturer of the major components therein, such as circuit breakers and starters. Engineered motor control centers shall be by

the component and housing manufacturer. The manufacturer shall comply with equipment specifications contained elsewhere in these Contract Documents.

B. Each component, as well as the complete assembly, shall be constructed and tested in accordance with latest NEMA Standards for Industrial Control. The type of construction of the control centers shall be NEMA Class II, Type B. Lifting eyes shall be provided on each section to facilitate handling.

C. Unit doors shall be mounted on the stationary structure and hinged on the side away from the vertical wireway. They shall be held closed with slotted thumb screws.

D. Unit doors shall have positive action linkage with disconnect operating mechanism. Mechanism shall be designed so that it can be locked in the OFF position with up to 3 padlocks. When the handle is not padlocked, it shall be possible to open the door by releasing the door interlock with a small tool. The control units shall be of the plug-in type.

When doors are closed, the operating mechanism shall clearly indicate whether the disconnect is in the ON or OFF position, and the door interlock mechanism shall engage. The disconnect operating mechanism shall be designed against inadvertent operation when the door is open. Each plug-in unit door shall be provided with a nameplate, specified elsewhere herein, that indicates the circuit number and circuit name. The nameplate shall be attached to the door with brass or stainless screws.

E. It shall be possible to install up to 6 NEMA size one units in one vertical section. Units shall be completely enclosed with sheet steel. A small wireway shall be provided inside the unit, so all wiring can be laid in place without removing barriers or plates. Each vertical section that holds the units shall be rigidly formed of minimum 12 gauge, cold-rolled sheet steel. The vertical front-of-board-construction shall be supplied with minimum 20-inch depth.

F. Continuous horizontal wiring troughs shall be provided at both top and bottom of each section. These troughs shall line up to form a continuous wireway for the full length of the MCC. A large continuous, full-height vertical wiring trough shall be provided in the right side of each section.

G. All starter wiring, control, and power shall be terminated in terminal strips in this trough for size 2 and smaller starters. Size 3 and larger starters shall have control leads terminating on the terminal strips in the trough. Terminal strips shall be split-type to facilitate wiring connections without disconnecting factory or field conductors. Terminal strips shall be rated to accept conductor sizes as indicated on the Plans.

H. Bus bars shall be tin plated copper, and shall be of the ampacity indicated on the Plans. Unit bus bar stabs shall insure high contact pressure. The vertical bus bars shall be effectively isolated from accidental contact by plastic insulating medium. Horizontal bus shall be silver-plated at every joint. The entire vertical bus shall be silver-plated copper.

I. Bus bar supports shall be of high impact strength, non-carbonizing insulating material mounted on padded steel brackets and shall provide adequate dielectric strength and creepage distance. The bus structure shall be capable of withstanding short circuit current in accordance with NEMA standards, and as indicated on the Plans.

J. Horizontal bus amperage rating shall be as indicated on the Plans.

K. Each section shall be equipped with horizontal ground bus that shall be continuous across the MCC.

L. The MCCs shall be supplied as indicated on the Plans, and as specified herein and in accordance with NEMA Standard Pub. IS 1.1, latest edition. The MCCs shall be enclosed in NEMA Type 1 gasketed industrial use enclosures, unless otherwise shown. NEMA 3R enclosures shall provide sufficient depth for air conditioning units to be mounted on the end of the structures. If the MCCs contain VFDs or Solid State Starters that require cooling, their respective sections shall be louvered top and bottom, and fans shall remove heat from within the sections.

M. All metal surfaces and structural parts shall be given a phosphatizing, or equal, treatment prior to painting. The control centers shall then be given a gun-metal gray undercoat which is equal to zinc chromate. The exterior of the enclosure shall be finished in standard ANSI Grey.

N. Spaces for future combination starters shall have all the hardware necessary so that a future plug-in control unit can be installed without having to modify the vertical sections. The number of spaces for future control units shall be as indicated on the Plans.

O. Devices, such as, but not limited to, starters, circuit breaker, relays, timers, conductors, shall conform to other sections of these Contract Documents.

P. Provide customer metering instruments, as indicated on the Plans. Unless otherwise indicated on the Plans, metering units shall be electronic, capable of displaying volts line-to-line and line-to-neutral, and amps per phase.

Q. MCCs shall be as manufactured by Allen-Bradley, Square D, Westinghouse, or equal.

PART 3 - EXECUTION

3.01 GENERAL

A. The MCCs shall be erected in accordance with the recommendations of the manufacturer and with the details specified herein.

B. Cables larger than No. 6 AWG which hang from their vertical connections shall be supported within 2 feet of the connection.

C. The motor overload relays shall be provided and sized based on the actual full load amperes of the motor connected to the starter.

D. The motor circuit protectors shall be adjusted to the lowest settings that do not cause false tripping.

3.02 FIELD TESTS

A. MCCs shall be tested in accordance with Section 16480.

End of Section

SECTION 16495

AUTOMATIC TRANSFER SWITCH

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Automatic transfer switch shall be furnished and installed, as indicated on the Plans, with full load current rating as indicated on the Plans. The switch shall be capable of switching all classes of load, and shall be rated for continuous duty when installed in a non-ventilated enclosure. Withstand current rating shall be as indicated on the Plans.

1.02 SUBMITTALS

A. Contractor shall submit shop drawings, manufacturer's data sheets, and a complete wiring diagram detailing all connections to the electrical system in accordance with Section 16000, and other requirements of the Contract Documents.

PART 2 - PRODUCTS

2.01 AUTOMATIC TRANSFER SWITCH

A. The automatic transfer switch shall be of the time delay neutral, open transition, break-before-make type. The automatic transfer switch shall have the following capabilities:
   1. Adjustable time delay for generator start
   2. Adjustable time delay transfer to generator
   3. Adjustable time delay in "off" position
   4. Adjustable time delay re-transfer to normal power
   5. Adjustable time delay for generator stop
   6. The switches shall be capable of transferring successfully in either direction with 70 percent of rated voltage applied to the terminals.

B. The normal and standby contacts shall be positively interlocked mechanically and electrically to prevent simultaneous closing. Main contacts shall be mechanically locked in position in both the normal and standby positions without the use of hooks, latches, or magnets, and shall be silver alloy protected by arcing contacts, with magnetic blowouts on each pole. Parallel main contacts are not acceptable.

C. The transfer switch shall be equipped with a manual operator that is designed to prevent injury to personnel if the electrical operator should become energized during manual transfer.

D The transfer switch, complete with all accessories, shall be listed by UL under Standard UL-1008.

E. The transfer switch shall be provided by the same fabricator as the standby generator, and shall be supplied with the generator.

2.02 ACCESSORIES

A. The transfer switch shall be equipped with the following:
   1. Nominal 0.5 to 6 second time delay to override momentary outages.
   2. Field adjustable 0 to 31 minutes time delay to retransfer to normal source with 5 minute unloaded running time of standby plant. A switch shall be provided to bypass this feature with transfer to normal source made manually. Time delay shall be nullified if standby power fails and normal power is available.
   3. Differential protection on 3 phases. Dropout and pickup.
   4. Test switch.
   5. Auxiliary contacts which close in normal position. Two sets of Form C contacts shall be provided.
   6. Auxiliary contacts which close in standby position. Two sets of Form C contacts shall be provided.
   7. Pilot lights: indicating normal and standby switch position.
   8. Manual and automatic selector switch.
   9. Manual and automatic pilot lights with push-to-test.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Transfer switch shall be installed, in accordance with the manufacturers recommendations.

3.02 INSTALLATION TESTING

A. When conducting temperature rise tests in accordance with UL-1008, the manufacturer shall include post-endurance temperature rise tests to verify the ability of the switches to carry full rated current after completing the overload and endurance tests.

B. On completion of the installation, start-up shall be performed by a factory-trained service representative in the presence of the Owner and the Engineer.

End of Section

SECTION 16500

LIGHTING

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install lighting fixtures.

1.02 QUALITY ASSURANCE

A. Reference Standards:
   1. National Electrical Code (NEC)
   2. UL Standard #57, Electric Lighting Fixtures
   3. UL Standard #844, Electric Lighting Fixtures for Use in Hazardous Location
   4. UL Standard #1570, Fluorescent Lighting Fixtures
   5. UL Standard #1571, Incandescent Lighting Fixtures
   6. UL Standard #1572, High Intensity Discharge Lighting Fixtures
   7. Illuminating Engineering Society (IES)
   8. All applicable local lighting ordinances

B. Miscellaneous:
   1. Lamps are identified for each luminaire in the Lighting Fixture Schedule on the Plans.
   2. Lighting fixtures and electrical components:
      a. UL labeled, complete with lamps.
      b. Rated for area classification as indicated.
   3. Location of lighting fixtures on Plans are intended to be used as a guide.
      a. Field conditions may affect actual locations.
      b. Coordinate with other trades to avoid conflicts in mounting of fixtures and other equipment.
   4. The quality standard is established by the fixture listed in the Lighting Fixture Schedule.
      a. This quality standard includes, but is not necessarily limited to construction features, materials of construction, finish, and photometrics.

1.03 SUBMITTALS

A. The following shall be submitted to the Engineer for review:
   1. Acknowledgment that products submitted meet requirements of standards referenced.
   2. Manufacturer's technical information on products to be used including photometric performance curves for the fixture and ballast data.

3. Acknowledgment that products submitted are UL or ETL listed.
4. When general data sheets constitute part of the submittal, identify the products to be used on this project.
5. Manufacturer's installation instructions.
6. Identification of fixtures by Lighting Fixture Schedule.
7. UL nameplate data (Voltage, wattage, etc.).
8. Finishes, colors, and mounting type.
9. Pole, fixture, and accessories.
10. Pole wind loading.

B. Contractor shall submit shop drawings, manufacturer's data sheets, and a complete wiring diagram detailing all connections to the electrical system in accordance with Section 16000, and other requirements of the Contract Documents.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Lamps shall be manufactured by General Electric, North American/Phillips, Sylvania, or equal.

B. Lighting fixtures shall be provides as indicated on the Lighting Fixture Schedule on the Plans.

C. Lighting ballasts shall be manufactured by General Electric, Advance, Jefferson, Universal, Bodine, Lithonia, or equal.

D. Light poles shall be as indicated on the Plans. Include base template, anchor bolts, cadmium-plated hardware and pole grounding lug, handhole, anchor base and bolt covers. Pole foundations shall be as indicated on the Plans.

2.02 MATERIALS

A. General:
1. Lamps:
   a. See lighting fixture schedule on Plans for wattage, voltage and number required.
2. All Fixtures:
   a. There shall be no live parts normally exposed to contact.
   b. When intended for use in wet area:
      (1) Mark fixtures "suitable for wet locations."
   c. When intended for use in damp areas:
      (1) Mark fixtures "suitable for damp locations" or "suitable for wet locations."

d. In wet or damp area, install fixtures so that water cannot enter or accumulate in the wiring compartment, lampholder, or other electrical parts.
e. Gasket seals: Urethane foam
f. Diffusers: UV stabilized acrylic plastic

3. Underground wiring:
   a. Provide all wiring runs with separate green grounding conductor.
   b. Ground all pole bases.
4. Pole wiring from base to ballast:
   a. No. 12 type XHHW.
   b. Each phase shall be protected by a 30A, 600V, type Tron waterproof fuseholder, Bussman "Limitron" type fuse, size rating 3-times load current.

B. Incandescent Lamps:
1. Types:
   a. 30-135 watts: Energy efficient
   b. 200-500 watts: Standard
2. Inside frost
3. Base: Aluminum or brass
4. PAR/Halogen

C. Fluorescent Lamps:
1. Rapid start
2. Cool white (F32TB/41K-85CRI and F96T12/41K-70CRI/HO/ES)
3. Energy efficient or standard as noted on the lighting fixture schedule.

D. High-Pressure Sodium Lamps:
1. Bulb finish: Clear
2. Any burning position

E. Metal Halide Lamps:
1. Bulb finish: Clear
2. Any burning position

F. Furnish a minimum of 2 lamps, or ten percent spare lamps of each type and wattage, whichever is greater.

2.03 BALLAST

A. Fluorescent Lighting Fixtures:
1. Ballast:
   a. Rapid start, high power factor type
   b. CBM/ETL certified
   c. Sound rating A
   d. Two internal automatic-resetting thermal switch devices for coil and capacitor

2. Internal wiring: AWM, TFN or THHN
3. Channel and end plates: 22 GA steel
4. Steel door frame and socket track: 20 GA steel
5. Channel cover: 24 GA steel
6. Emergency ballast:
   a. Integral rechargeable nickel-cadmium battery, battery charger, and automatic transfer circuitry.
   b. Charging indicator light.
   c. Test Switch.
   d. Provide a minimum of 900 lumen output for 90 minutes upon loss of normal power.
   e. Mounted integral to the fixture.
   f. UL 924 listed.
9. Provide fixtures with emergency ballasts with permanent caution labels warning that the fixture is fed from an unswitched source.
   a. Provide emergency ballast also with a similar caution label.

B. HID Lighting Fixtures:
1. Ballasts for high pressure sodium lighting fixtures:
   a. Type: Regulating
   b. Ballast design center variance: Maximum 5 percent from rated lamp wattage.
   c. Lamp wattage regulation spread at the lamp voltage: Maximum 10 percent for +/-10 percent line voltage variation.
   d. Ballast primary current during starting not to exceed normal operating current.
   e. Lamp current crest factor: Maximum 1.8 for +/-10 percent line voltage variation at any lamp voltage, from nominal through life.
   f. Power factor shall not drop below 90 percent for +/-10 percent line voltage variations at any lamp voltage, from nominal through life.
   g. Capacitor variance: Tolerance of +/-6 percent which will not cause more than a +/-8 percent variation in regulation throughout rated lamp life for nominal line voltage.
   h. Capable of operation with an open circuit condition for a maximum of 6 months without significant loss of ballast or starting circuitry life.
2. Ballasts for metal halide/mercury vapor lighting fixtures:
   a. Type: Auto-regulator
   b. Voltage input range: +/-10 percent
   c. Lamp regulation spread: 20 percent maximum
   d. Power factor: 90 to 90 percent
   e. Input voltage dip (4sec.): 40 to 50 percent
   f. Crest factor of lamp current: 1.6 to 2.0
3. Ballasts for exterior HID lamps:
   a. UL approved
   b. High power factor designed for -20 Deg F temperature starting

4. Fixtures for non-hazardous locations:
   a. Type: Industrial low bay
   b. Ballast housing: Die-cast
   c. Filter: Activated charcoal
   d. Refractor: UV stabilized molded acrylic

2.04 MISCELLANEOUS ELECTRIC DEVICES

A. PHOTOELECTRIC CONTROL UNITS shall meet the following requirements:
   1. Cadmium sulfide photocell
   2. Aluminum weatherproof enclosure
   3. 30 amp rated contacts
   4. 120-volt AC power

   The Photoelectric control unit shall be Tork Model 2100, or equal.

B. MOTION SENSORS shall meet the following requirements:
   1. 110 degrees field of view, 60 foot range
   2. Adjustable time setting from 15 seconds to 15 minutes
   3. Operating temperature of -20 to + 130 degrees F.
   4. Complete outdoor, weather proof sensor with complete mounting hardware
   5. UL listed

   The motion sensor(s) shall be manufactured by Leviton Model 50500-H or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install lamps in all luminaires.

B. Replace all failed fluorescent, incandescent, metal halide, mercury vapor and high pressure sodium lamps with new lamps prior to final acceptance by Owner.

C. Surface and flush mounted fixtures shall be solidly connected to a junction box. Suspended fixtures shall be hung utilizing pendant mounting or stainless steel chains and hooks. Each suspended fixtures, shall be electrically connected by a length of Type SO flexible cord. 3 conductor No. 14 AWG, minimum, with a twist-lock receptacle mounted in an individual junction box. Plugs and receptacles shall be as manufactured by Hubbell, General Electric Company, or equal.

D. Provide mounting brackets and/or structural mounting support for fixtures.
   1. Do not support fixture from conduit system.
   2. Do not support fixture from outlet boxes.

E. Install with approved mounting hardware following manufacturer's recommendations.

F. Pole mounted fixtures shall be mounted on steel or aluminum poles as indicated on the Plans. All metal poles shall be bonded to the facility ground system. Poles shall have adequate handholes and weatherproof receptacles where indicated.

G. All anchor bolts and nuts shall be stainless steel. Contractor shall paint all steel poles with aluminum paint or other color in accordance with these Contract Documents.

H. Fixture mounting heights and locations indicated on the Plans are approximate and are subject to revision in the field where necessary to avoid conflicts and obstructions.

3.02 ADJUSTING AND CLEANING

A. Wipe all lighting fixture reflectors, lenses, lamps, and trims clean after installation and prior to acceptance of Project by Owner.

End of Section

SECTION 16505

TRANSIENT VOLTAGE SURGE SUPPRESSION SYSTEM

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This section specifies Transient Voltage Surge Suppression (TVSS) System(s).

1 .02 SUBMITTALS

A. Submit manufacturer's data demonstrating compliance with this specification and the Plans. Information shall include, but not be limited to:
   1. An equipment manual with installation, operation, and maintenance instructions for the specified unit.
   2. A list of customer-replaceable spare parts.
   3. Electrical and mechanical drawings which show unit dimensions, weights, mounting provisions, connection details and layout diagram of the unit.
   4. Certification of the MCOV 1-hour burn-in.
   5. Certification from an independent laboratory of single-pulse surge current ratings.
   6. A copy the UL 1449 compliance document showing UL 1449 Suppression Ratings.
   7. Certification of life-expectancy testing.

1.03 QUALITY ASSURANCE

A. Comply to the following Codes and Standards:
   1. ANSI/IEEE (C62.41-1991 and C62.45-1987);
   2. NFPA (70 [NEC], 75 and 78);
   3. NEMA (LS-1-1992);
   4. NEC (240-21 and 110-9);
   5. UL (1283 and 1449).
      a. All units shall be UL 1449 and UL 1283 Listed.

B. The specified system(s) shall be manufactured in the USA by a manufacturer engaged in the design and manufacture of the specified system for a minimum of 5 years.

1.04 WARRANTY

A. The manufacturer shall provide a Limited Five (5) Year Warranty from date of shipment against failure when installed in compliance with applicable national and local electrical codes and the manufacturer's Installation, Operation and Maintenance Instructions.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable.
   1. Current Technology
   2. Liebert
   3. Or Equal.

2.02 ELECTRICAL REQUIREMENTS

A. Provide TVSS units as indicated on the Plans and specified herein.

B. The maximum continuous operating voltage (MCOV) of all suppression components utilized in all units shall not be less than 115 % of the nominal operating voltage.

C. In accordance with NEMA Standard LS 1-1992, the unit shall provide protection in all modes. The primary mode of protection shall be line-to-neutral. The secondary modes of protection shall be line-to-ground and neutral-to-ground.

D. Based on ANSI/IEEE C62.41-1991's 8 x 20 microsecond current waveform, and in accordance with NEMA Standard LS 1-1992, the tested single-pulse surge current capacity for each mode of protection of the units (in amps) shall be no less than as follows:

SURGE CURRENT CAPACITY				
PRODUCT	AMP CLASS (L-N + L-G)	L-N	L-G	N-G
MAIN TVSS	250,000	150,000	100,000	100,000

SURGE CURRENT CAPACITY				
PRODUCT	AMP CLASS (L-N + L-G)	L-N	L-G	N-G
PANELBOARD TVSS	160,000	80,000	80,000	80,000

E. The unit's published performance ratings shall be the UL 1449 Listed suppress ratings. The UL 1449 suppression rating shall be given for the unit, as specified, an Integral Fused Disconnect Switch The UL 1449 suppression rating shall be, for each mode of protection, as follows:

PRODUCT	VOLTAGE	UL 1449 SUPPRESSION RATING		
		L-N	L-G	N-G
MAIN TVSS	277/480	1,000	1,000	800

PRODUCT	VOLTAGE	UL 1449 SUPPRESSION RATING		
		L-N	L-G	N-G
PANELBOARD TVSS	277/480 Three Phase	1,000	1,000	800
PANELBOARD TVSS	120/208 Three Phase	500	500	500
PANELBOARD TVSS	120/240 Single Phase	500	500	500

F. The system shall be tested and capable of protecting against and surviving at least 6,000 ANSI/IEEE C62.41-1991 Category C3 surges without failing or degrading the UL 1449 Surge Suppression Ratings by more than 5%.

2.03 PRODUCT

A. Each unit shall include solid-state suppression system, utilizing a multitude of selenium cells, avalanche diodes, or arrays of fused non-linear voltage dependent metal oxide varistors (MOVs) with similar operating characteristics.

B. The suppression system's components shall optimally share surge currents in a seamless, low-stress manner assuring maximum, non-degrading voltage clamping and surge current diversion performance and proven reliability. The suppression system shall contain field replaceable fuses.

C. The unit shall include a high-frequency extended range tracking filter and shall be UL 1283 Listed as an Electromagnetic Interference Filter. The filter shall reduce fast rise-time, high-frequency, error-producing transients and electrical line noise to harmless level, thus eliminating disturbances which may lead to system upset. Standardized insertion loss data shall be obtained using MIL-STD-E220A 50 ohm insertion loss methodology. The filter shall provide attenuation throughout the frequency spectrum of 100 kHz to 100 MHz.

D. All internal connections associated with the suppression and filter system and subject to surge currents shall be made with compression solderless-type lugs and shall be bolted to the bus bars in order to reduce overall system impedance. No plug-in component modules, quick-disconnect terminals or printed circuit boards shall be used in surge current-carrying paths. Internal wiring associated with the suppression/filter system and subject to surge currents shall utilize low-impedance copper bus bar and #4 AWG copper conductor or larger.

E. Field Connections: The TVSS shall include mechanical lugs for each phase, neutral and ground. The lugs shall accommodate the conductor sized indicated on the Plans.

C. Coatings which have passed the manufacturer's shelf life shall not be used.

3.05 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

A. Paint shop primed equipment.

B. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

C. Prime and paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, except where items are prefinished. Items to be color coded to match the piece of equipment it is attached to.

D. Replace identification markings on mechanical or electrical equipment when painted accidentally.

E. Paint exposed conduit and electrical equipment occurring in finished areas. Conduit to be color coded per NEC and OSHA.

F. Replace electrical plates, hardware, light fixture trim, and fittings removed prior to finishing.

3.06 CLEANING

A. As Work proceeds, promptly remove paint where spilled, splashed, or spattered.

B. Collect cotton waste, cloths, and material which may constitute a fire hazard, place in closed metal containers and remove daily from site.

3.07 PAINTING SCHEDULE

A. Areas and items not to be painted, unless otherwise indicated or specified herein, shall include:

1. Exterior concrete on buildings and structures.

2. Aluminum, bronze, brass, stainless steel, chrome plated items, plastic material, or glass unless specified or indicated otherwise. Equipment nameplates shall not be painted.

3. Factory enamel finished equipment and piping.

4. Factory finished equipment shall be touched up as required.

B. Surfaces to be Painted: Systems are designated below for certain substrates. All items to be painted TNEMEC Desert Sands unless otherwise specified herein. Contractor shall submit color samples for Owners approval.

1. Above grade ductile iron piping, PVC piping, copper piping, all valving, all supports, structural steel, conduit and appurtenances.

a. Primer - one coat epoxy polymide coating TNEMEC Hi-Build Epoxoline Series 66 at 4 mils DFT.

b. Finish - one coat TNEMEC High-Build Acrylic Polyurethane Enamel Series 73 Endurashield III at 3.5 mils DFT.

2. Pumps including booster and chlorination pumps.

a. Finish - Two coats TNEMEC High Build Acrylic Polyurethane Enamel Series 73 Endurashield III at 3.5 mils DFT each coat. Color to match piping it is connected to.

3.08 PIPE PAINTING COLOR SCHEDULE

A. Pipe color shall conform to the following guidelines unless otherwise designated by the ENGINEER.

Exposed Pipe	**Background Colors**	**Color of Letters**	**Labels**
Disinfectants			
Exposed Chlorine - Solution	ANSI Yellow	Black	Chlorine Solution
Exposed Electrical Conduits:			
120V/480V/4160V (no label)	Orange	None	None

B. Pipes above ground shall be color coded as listed above, except pipes less than 3/8" diameter shall be painted the same as the wall or piece of equipment to which it is attached.

C. Positive identification of the contents of a piping system shall be lettered legibly, giving the name of the contents in full or abbreviated form at no greater than 5 foot intervals between markings. Arrows shall be used to indicate direction of flow with locations as shown on Project Drawings. Contents shall be identified by additional details required by the ENGINEER, such as temperature, pressure, etc., as necessary to identify the hazard.

D. Legend shall be brief and applied close to valves or flanges and adjacent to changes in direction, branches, and where pipes pass through walls or floors.

E. Where two or more pipes run parallel, markings shall be applied in the same relative location on each as to be in vertical or horizontal alignment and present a neat appearance.

Minimum Letter Sizes

O.D. of Pipe (Inches)	Height of Letters (Inches)
<3/4"	1/4"
3/4" - 1-1/4"	1/2"
1-1/2" - 2"	3/4"

END OF SECTION

SECTION 11200

FLOWMETER

PART 1 GENERAL

1.01 SUMMARY

A. Furnish and install one 16" flanged, turbo-meter with a radial magnetic drive as shown on the Project Drawings, with all appurtenances required for a complete and operational system.

1.02 SECTION INCLUDES

A. Flanged Turbo-Meter

1.03 SUBMITTALS

A. Descriptive submittals shall be made in accordance with the Data Reference Symbols defined in Section 01300 - SUBMITTALS.

Item	Shop Drawings	O&M Manuals
Flowmeter	C,D,E,F,H,I,L, M,N,O	C,D,E,F,H,I,L, M,N,O

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Flowmeter

1. Rockwell, Model W 10,000 DR

2. Or Approved Equal.

2.02 FLOWMETER

A. The meters furnished under these specifications shall comply with the applicable provisions of American Water Works Association Standard No. C704-91 for cold water meters. Corrosion-resistant materials shall be used throughout the mechanical enclosure. Surfaces of all other parts shall be treated with a fusion-bonded impervious coating. All rotating members, except members in the register assembly, shall be ball bearing mounted.

B. The meter shall consist of two basic assemblies, the main case assembly and the measuring chamber assembly. The main case and flow straightening vane assembly make up the main case assembly. The straightening vanes minimize swirl and jetting from piping arrangements upstream and direct the flow evenly to the rotor. The measuring chamber assembly includes the bronze measuring chamber, rotor, change gears and the permanently hermetically sealed direct reading register.

C. The meter is to be installed with a 16" (DN 400mm) Rockwell Strainer.

D. Flowmeter shall measure flow over a range of 250 to 10,000 gpm. The Flowmeter shall have a low flow capacity of 200 GPM with 95% accuracy.

E. The flow meter shall measure flow with a direct reading. The direct flow reading consists of an HSP Register and Transmitter along with a remote mounted ACT-PAC Model 1000D instrument as manufactured by Sensus. The instrument shall have a six digit totalizer and four lighted digits that display the flow rate through the meter device. The flow rate indicator/totalizer shall have an isolated 4-20 milliamp analog signal proportional to the flow rate.

PART 3 EXECUTION

3.01 INSTALLATION

A. Equipment startup. A factory-employed representative of the manufacturer shall visit the site and provide installation and start-up and training services.

END OF SECTION

SECTION 11210

HORIZONTAL SPLIT CASE CENTRIFUGAL PUMPS

PART 1 GENERAL

1.01 SUMMARY

A. The CONTRACTOR shall furnish materials, equipment and labor to furnish, install and test the pumping system complete with the pumps, motors, mounting bases, piping, valves and appurtenances, as indicated on the contract drawings and as herein specified.

1.02 INSTALLATION

A. The CONTRACTOR shall insure that pumps and motors are properly installed with no pipe strain transmitted to the pump casing.

1.03 RESPONSIBILITY

A. To assure a properly integrated and compatible system, all equipment described in this section shall be furnished by the pump manufacturer, who shall assume full responsibility for the proper operation of the pumps and associated equipment.

1.04 SUPERVISION

A. The CONTRACTOR shall arrange for the pump manufacturer to provide a factory-trained representative as required for the purpose of supervising installation, start-up, final field acceptance testing, and providing instruction to the OWNER's operating personnel in the proper operation and maintenance of the equipment in this Section.

1.05 REFERENCE STANDARDS

A. The Work in this Section is subject to the requirements of applicable portions of the following standards:

1. Hydraulic Institute Standards

2. IEEE Standards

3. NEMA Standards

4. OSHA Rules and Regulations

1.06 SUBMITTALS

A. Descriptive submittals shall be made in accordance with the Data Reference Symbols defined in Section 01300 - SUBMITTALS.

ITEM	SHOP DRAWING	O&M MANUAL
Pump	A,B,C,D,E,F,G,H, H,I,J,K,L,M,N,O	C,D,E,F,G,H,I,J, K,L,M,N,O

PART 2 PRODUCTS

2.01 GENERAL

A. Pumps

Addl. #1

1. The pump shall be a single-stage centrifugal horizontal split case pump, Aurora Pump Model 411 or ~~pre~~-approved equal. Pre-approval must be obtained a minimum of ten days before bid date.

B. Casing

1. The casing will be of the cast iron (ASTM A48) horizontal split case design. The casing shall have tapped and plugged holes for priming, vent and drain. Removal of the upper half of the casing must allow removal of the rotating element without disconnecting the suction or discharge piping. The lower half of the casing shall be furnished with cored passage ways from the high pressure area of the volute to each seal box for positive lubrication without the use of external flushing lines. The bearing arms shall be cast integrally with the lower half of the casing to assure positive bearing alignment. In no case will bolt on bearing arms be acceptable. Each bearing arm will provide a reservoir area for accumulation of weepage from the stuffing box, and a drilled and tapped opening will be provided at the lower portion to allow piping by the CONTRACTOR to the nearest floor drain.

C. Impeller

1. The impeller shall be designed to give the characteristics outlined under "Performance". The impeller shall be constructed of Bronze (ASTM B62). It shall be of the enclosed type, vacuum cast in one piece. It shall be furnished all over, the exterior

being turned and the interior being furnished smooth and cleaned of all burrs, trimmings and irregularities. The impeller will be dynamically balanced. It shall be held securely to the shaft by a key of ample size and shall be locked in place by threaded shaft sleeves.

D. Shaft Sleeves

1. The shaft sleeve shall be constructed of Bronze (ASTM B62). The shaft sleeves shall be extended from the hub of the impeller, through the seal box area, and beyond the gland. They shall be sealed at the impeller hub by a Teflon coated steel gasket to prevent pumped liquid from contacting the shaft. They shall be threaded to hold them securely in place, and designed so as to lock the impeller.

E. Case Wearing Ring

1. The case wearing ring shall be constructed of Bronze (ASTM B62). The pump casing shall be fitted with a case wear ring to minimize abrasive and corrosive wear to the casing. The case wear ring shall be of the radial type, press fitted into the casing.

F. Stuffing Box

1. A stuffing box shall be provided on each size of the pump casing, designed with sufficient area for incorporation of either packing rings or mechanical seals.

G. Packing

1. Each stuffing box shall be fitted with rings of die-cut non-asbestos packing material constructed by interwoven graphited Teflon fiber.

H. Packing Gland

1. Each stuffing box shall be furnished with a two-piece gland to securely hold the packing in place. The gland pieces shall be split to allow access to the packing without disassembly of the unit. Control of weepage shall be accomplished by the use of adjustable swing bolts.

I. Shaft

1. The pump shaft shall be one-piece Carbon Steel (AISI C1045), finished and polished on all sections. The shaft shall be of ample strength and rigidity and the shortest practicable distance between bearings shall be used to keep deflection and vibration to a minimum. The maximum allowable deflection of the shaft is 0.002" at any point of operation on the pump curve.

J. Bearings

1. The pump shall be supplied with a single row inboard bearing primarily for radial loads and a double row outboard bearing primarily for thrust loads. Both bearing shall be regreaseable lubrication ball type, designed for 250,000 hours average life. Each bearing shall be mounted in a machined housing that is moisture and dust proof. The housing shall have registered fits to assure alignment, pinned to prevent rotation, and bolted to the bearing arms. Each housing shall be supplied with a grease fitting and a plugged relief port.

K. Coupling

1. A flexible coupling shall be provided to connect the pump shaft to the motor shaft. The coupling shall be of an all metal type with a flexible rubber insert. The entire rotating coupling element shall be enclosed by a coupling guard.

L. Driprim Base

1. The pump and motor shall be mounted on a groutable steel baseplate with integral drip channels incorporated on each side. Each channel shall include an NPT connection and plug. The base shall be sufficiently rigid to support the pump and motor without the use of additional supports or members.

M. Motor

1. The motor shall be horizontal and in accordance with the latest NEMA standards, and shall have the following characteristics:

a.	Enclosure	Open Drip Proof
b.	Number of Phases	Three
c.	Cycles	60 Hz.
d.	Voltages	460 Volt
e.	Speed	1800 RPM
f.	Horsepower	125 hp

2. Each motor shall have a sufficient horsepower rating to operate the pump at any point on the pump's head-capacity curve without overloading the nameplate horsepower rating of the motor, regardless of service factor. The motor shall have a service factor of at least 1.15. The service factor is reserved for variations in voltage and frequency.

2.02 SPARE PARTS

A. A complete set of spare parts shall be provided for each pump as recommended by the manufacturer. A list if spare parts shall be provided with the Shop Drawings. The spare parts shall consist of but are not limited to the following.

1. 1 Complete Rotating Element with Coatings/Seals
2. 1 Pump Separation Gasket
3. 1 Separate Set of Seals
4. 1 Coupler (Shaft)
5. 1 Set Wear Rings

2.02 SPARE PARTS

A.

PART 3 PERFORMANCE

3.01 CONDITIONS OF SERVICE

A. The following conditions of service shall be strictly adhered to:

1.	Number of Units	2
2.	Type of Drive	Variable
3.	Design Capacity	2000 gpm
4.	Design Head	178 ft.
5.	Efficiency at Design Minimum	83%
6.	Rotative Speed, Maximum	1750 RPM
7.	Shut-Off Head, Minimum	200 ft.
8.	Drive Horsepower, Minimum	100 hp
9.	NPSHR at Design, Maximum	16.4 ft.

3.02 INSPECTION AND FACTORY TESTS

A. Each centrifugal pump furnished under these specifications shall be tested at the factory to verify individual performance (VIP). Certified copies of all test reports shall be submitted to the ENGINEER for approval prior to shipment. Each unit shall be hydrostatically tested in accordance with the Hydraulic Institute Standards.

3.03 INSTALLATION AND ACCEPTANCE TESTS

A. The pumping units shall be installed in accordance with the instructions of the manufacturer and as shown on the Drawings by the CONTRACTOR.

B. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the manufacturer's recommendations.

END OF SECTION

SECTION 11260

CHLORINATION EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Furnish and install a complete chlorination system as shown on the Project Drawings and as specified herein.

B. All chlorination equipment shall comply with the recommendations of the Chlorine Institute, Inc., and the Manufacturing Chemists Association.

C. All materials in construction of the gas handling parts of the chlorination system shall be entirely compatible for corrosive chemical service.

D. All components shall be designed to prevent leakage of chlorine gas to the atmosphere under all conditions.

1.02 SECTION INCLUDES

A. Chlorine Gas Feed System

B. Chlorine Gas Detector

C. Chlorine Cylinder Scale

D. Chlorination House

E. Chlorination Piping

F. Hydraulic Valves

1.03 RELATED SECTIONS

A. Section 02600 - PIPED UTILITY MATERIALS

B. Section 05500 - METAL FABRICATIONS

C. Section 11295 - HYDRAULIC VALVES

D. Division 16 - ELECTRICAL

E. Division 17 - CONTROLS

1.04 SUBMITTALS

A. Descriptive submittals shall be made in accordance with the Data Reference Symbols defined in Section 01300 - SUBMITTALS.

Item	Shop Drawings	O&M Manuals
Ball Valves	C,D,E,F,H,I,L, M,N,O	C,D,E,F,H,I,L, M,N,O
Chlorination Equipment	A,C,D,E,F,G,H,I, J,K,L,M,N,O	C,D,E,F,G,H,I,J, K,L,M,N,O

PART 2 PRODUCTS

2.01 CHLORINE GAS FEED SYSTEM (CHLORINATOR)

A. General

1. The chlorine gas feed system shall be of the vacuum-type solution feed design dispensing a chlorine solution from the ejector. The system shall have a wall-mounted cabinet housing and be automatically controlled. The gas feed system shall be capable of controlling the dosage rate from 0 to 2 mg/1 based on the chlorine residual measured downstream of the chlorine ejector. The chlorine gas feeder shall be the ADVANCE Series 4100 Gas Feeder (Model 4121C) as manufactured by Capital Controls Company, Inc., 3000 Advance Lane, Colmar, Pennsylvania 18915, or approved equal.

B. Gas Feeder Design

1. The chlorine gas feeder shall have a maximum capacity of 50 lbs/day. Gas feeder components shall be panel-mounted and housed in a cabinet. The gas flow indicator with manual rate adjustment and all instruments shall be adjustable from the front of the wall cabinet. The cabinet shall be removable without the use of tools. The internal gas handling components of the chlorine gas feed system shall be designed and arranged to facilitate adjustments, maintenance, and repair. Suitable backflow prevention and drain provisions shall be made to prevent ejector water from entering the gas handling components.

2. The gas feeder design shall permit the entire system to be vacuum checked in the field without using

special tools or manometers. The gas feeder shall be constructed of material suitable for wet and dry gas service. All springs used in the gas feeder shall be of tantalum alloy. The rate valve plug and seat shall be silver.

3. All utility inlets and outlets shall be into the base of the wall cabinet. The chlorine gas feeder shall provide a gas flow indicator and manual rate valve with bypass on the right side of the viewing window. The left side of the viewing window shall be occupied by the controller.

C. Gas Feeder Components

1. Vacuum Regulator. The vacuum regulator with gas vent connection shall be provided with yoke for attachment to a U.S. cylinder valve providing for direct cylinder mounting. A gas supply indicator shall be included on the vacuum regulator, and the vacuum regulator check unit shall shut off the gas supply in the event vacuum is lost for any reason. The vacuum regulator check unit shall be supplied with one complete spare set of all gaskets and O-rings. The gas feeder shall be the Series 200, Advance Gas Feeder as manufactured by Capital Controls Company, Inc., 3000 Advance Lane, Colmar, Pennsylvania 18915, or approved equal.

2. Gas Flow Meter. The gas flow meter shall be equipped with a rate adjustment valve. The flowmeter shall be a 50PPD wall mounted remote meter panel with indicating chlorine gas flowmeter, with 3/8" vacuum tubing connections. The gas flowmeter shall be a Series 200 as manufactured by Capital Controls, 3000 Advance Lane, Colmar, Pennsylvania 18915, or approved equal.

3. Chlorine Ejector. The ejector assembly shall be remotely mounted and designed to completely mix chlorine gas with water under pressure to produce a concentrated solution. The ejector shall function to produce a vacuum by employing a Venturi section which shall draw gas from the chlorinator. The chlorine ejector shall have a capacity of 100 pounds per day with a minimum back pressure of 110 psi at a water flow of 5.5 gpm. The ejector shall be designed to mount directly to the chlorine diffuser.

4. Chlorine Diffuser. Chlorine solution diffuser shall be 100 PPD Corporation cock gas feeder as manufactured

by Capital Controls Company, Inc. The diffuser shall mount on a 6-inch, 90 degree DIP fitting as shown on the plans with a 1-inch NPT.

5. Switchover Module. The switchover module shall be automatic type with a maximum capacity of 100PPD. The switchover module shall be connected to two vacuum regulators by a 3/8" vacuum hose. The system withdraws gas from the first source until that source is empty. When the pressure in the initial gas source approaches zero psig, the vacuum level increases in the system causing the switchover module to automatically switches, sealing the empty source and bringing the full source on-line.

6. Vacuum Shut-Off Valve. The controller shall automatically process the received input signal from the chlorine residual analyzer to turn on or off the gas feed. The valve shall be wall cabinet-mounted. The vacuum shut-off valve shall operate from a 120-VAC, 60-Hz single phase power supply. The vacuum shut-off valve shall be BM-682-1 chlorine gas vacuum line shut-off valve automatic ON/OFF as manufactured by Capital Controls Company, Inc., 2000 Advance Lane, Colmar, Pennsylvania 18915, or approved equal.

D. System Arrangement

1. One remote mounted vacuum regulator shall regulate gas to three automatic ON/OFF gas vacuum line shut-off valves. Each automatic ON/OFF gas vacuum line shut-off valve will be controlled by the operation of each assigned waterwell. The chlorine solution will be distributed to the reservoir supply line by a pressure differential.

E. Power Supply

1. The gas feeder shall operate from a 120-Vac, 60-Hz, single phase power supply.

2. Power and signal wires shall be brought to wall-mounted cabinet terminal strip located in controller.

2.02 CHLORINE GAS DETECTOR

A. General

1. The chlorine gas detector shall be specific to the totally solid-state, non-wet chemistry type specific to chlorine gas. The detector shall have a remote sensor and be seismic and radiation qualified. The chlorine gas detector shall be the Model 1610B Single Point Gas Detector as manufactured by Capital Controls Company, Inc., 3000 Advance Lane, Colmar, Pennsylvania 18915, or approved equal.

B. Gas Detector Design

1. The chlorine gas detector shall be specific to chlorine gas and shall sense chlorine by the use of a totally solid-state sensor. In the presence of chlorine, an electrical current shall flow to the receiver. The receiver shall process and display the incoming signals from the sensor module. The detector shall be capable of operation over a temperature range of 0°F to 150°F.

2. Contact closures shall be provided for the separate warning and alarm circuits to actuate an alarm on site as well as a remote alarm at a 24-hour control station.

3. The sensor shall be a maximum of 6 inches long, 5 inches wide, and 4 inches high. The receiver shall be a maximum of 9 inches wide, 13 inches high, and 4 inches deep.

C. Gas Detector Components

1. Sensor. The sensor shall be solid state and mounted in a corrosion-resistant, wall-mounted NEMA 4X enclosure requiring no chemicals. In the presence of chlorine gas, a current flow will develop and be transmitted through electrical wiring to the receiver. Three-wire, unshielded, 22-gauge cable shall be provided between the sensor and the receiver.

2. Receiver. The receiver shall be housed in a NEMA 4X enclosure suitable for wall mounting and shall contain the following components:

   a. A power switch and LED indicators for POWER and READY shall be provided.

b. The sensor alarm level shall be field set via push button from the front of the receiver. The level shall be displayed on the color bar graph indicator by a flashing bar.

c. An LED ALARM indicator shall illuminate in the event the pre-set level is exceeded and a corresponding contact closure shall be activated at the same time as the alarm. The contact relay shall be rated 10 amps at (240 Vac) (28 Vdc) maximum, resistive or inductive load, SPDT, and be latching or unlatching by jumper selection.

d. An LED MALFUNCTION indicator shall illuminate and activate the jumper selectable latching or unlatching relay contact when the minimum signal, required from the sensor, is not maintained.

e. A RESET button shall be provided for clearing the alarm and malfunction circuits after the conditions have been corrected.

f. A timer shall be provided and activated when the receiver is powered. This will allow the sensor to warm and stabilize. The timer has a selectable range of 1, 2, 4, 8, 16, or 32 minutes via a jumper. Upon completion of stabilization, the READY indicator shall illuminate indicating the ALARM and MALFUNCTION modes are enabled.

g. An LED bar graph indicator shall be visible on the face of the receiver to allow visual reference to the presence of chlorine gas. The bar graph indicator range shall be 0-10 ppm. The alarm level shall be pre-set and displayed by a flashing bar segment along with the number of cumulative bar segments showing the presence of chlorine gas.

h. A 4-20 mAdc output signal shall be provided to transmit the scanned level. The maximum input impedance shall not exceed 900 ohms.

i. An independent, 4-20 mAdc channel input shall be provided.

j. An 18-24 Vdc channel output shall be provided.

k. The minimum detectable concentration of chlorine gas shall be 0.5 ppm by volume.

1. The response time shall be 30 seconds, after stabilization.

3. The receiver shall be completely weather proof and water tight. It shall be constructed for outdoor use and able to withstand elements including but not limited to wind velocity, water spray, dust, sand, and direct sunlight.

D. Power Supply

1. Power shall be provided for 120-vac, 60 Hz single phase.

E. Backup Power Supply

1. Backup power for the gas leak detector shall be provided by a Capital Controls Model 1640 power backup. The backup power shall activate automatically in the event of a power failure. The batteries shall provide six hours of backup operation. The power backup unit shall have an integral charger that will automatically and continuously recharge the batteries under normal conditions.

2.03 CHLORINE CYLINDER SCALE

A. General

1. The chlorine cylinder scale shall be an electronic dual platform cylinder scale. The scale shall have a dual-indicating LCD display with independent tare adjustments. The gross capacity of each platform shall be 350 lbs. and the independent tare shall be 180 lbs. The power requirements for the scale shall be 120 V, 60 Hz, single-phase. Two safety chains shall be supplied to support the cylinders while in operation.

B. Manufacturer

1. The chlorine cylinder scale shall be Model 1361B11 as manufactured by Capital Controls, Inc., 3000 Advance Lane, Colmar, Pennsylvania 18915, or approved equal.

2.04 CHLORINATION HOUSE

A. General

1. The chlorination house shall be completely assembled, ready to install, compact type with all components factory mounted. It shall be Model 7521 as manufactured by Bevco Engineering, Inc., 10605 West Glenbrook Court, Milwaukee, Wisconsin 63224.

B. Chlorination House Design

1. The house shall be constructed of 14 gauge steel, factory finished with three coats of baked enamel, automotive type, desert tan, exterior finish. The steel shall be mill coated with zinc Specification A60 and be rust resistant even when the enamel is scratched. The floor shall be vinyl covered. A recess for a scale(s) shall be built into the floor such that the scale(s) will be flush with the floor. The interior of the house shall be insulated with a 1-inch minimum layer of plastic insulation. The plastic insulation shall meet U.L. specifications for fire resistant SE-1 foam with an R-Value of 7.2. The house shall require no assembly on the job. The roof shall be pitched, provided with a drip lip, and equipped with two removable lifting eyes to facilitate field erection. The side walls shall contain two vents, one for an air inlet and one for exhaust. All vents shall be screened with 40 mesh screen inside the louvers. The house shall be weather proof, non-combustible, with double doors. Each door shall be attached to the house with three full mortise ball-bearing type hinges. The doors shall be provided with three heavy duty, security locking hasps. The doors shall also be supplied with a key lock handle. A gas tight window, 9 inches by 7 inches, shall be provided for inspection of the interior without opening the door.

2. Provisions shall be made to accommodate the mounting, wiring, and piping of all equipment to be installed in the chlorination house as specified and shown on the plans.

C. Chlorination House Components

1. <u>Electrical Fixtures</u>. The chlorination house shall be equipped with electrical fixtures including a light with protective cover, automatic selector switch

internally mounted and interlocked for automatic operation of exhaust fan and light, safety switch (2 pole fused for 30 amps), and wall panel-mounted GFI quad receptacle.

2. Exhaust Fan. The exhaust fan shall have a rating of 100 cubic feet per minute and a capability of providing a complete air change within one minute.

3. Automatic Door Switch. A door actuated microswitch shall be provided to automatically turn on light and fan whenever door is opened.

4. Chlorine Danger Sign. A 20"x 14" "Chlorine Danger" sign made of 0.04-inch thick aluminum shall be mounted on the door. The sign shall be red with 2-inch white letters. In addition to the Chlorine Danger sign, a Chlorine Hazard Identification sign shall be provided. The graphics shall meet Uniform Fire Code Standard No. 79.3 for hazard identification signs.

5. Miscellaneous

   a. Cylinder support chains, vent and vacuum bulkhead fittings, and stainless steel hooks for holding the chlorinator during changing of cylinders shall be provided. A 6" x 6" shelf shall be provided as shown on the Project Drawings.

   b. The Chlorination House shall be completely prewired for all connections for power, status, and instrumentation for Chlorine Gas Detector, Chlorine Residual Analyzer, and Chlorine Gas Feeder. This shall include all interconnections required for the complete operation as a system. The Chlorination House shall require only one (1) power connection (30A, 120V) for all power needs.

   c. The CONTRACTOR shall provide wiring drawings and schematics prior to installation. All work and material shall be suitable for corrosive environment. all electrical equipment shall be UL labeled and the electrical installation shall conform to the National Electrical Code.

D. Power Supply

1. Single-phase, 120-volts, 60-cycle power shall be provided.

2.05 CHLORINATION PIPING

A. Polyvinyl Chloride (PVC) and Fittings

1. This section covers PVC pipe and fittings utilized in the construction of water and chemical pipelines. All PVC pipe fittings shall be as per ASTM D-1784.

2. When PVC pipe is stored outside and exposed to prolonged periods of sunlight, an obvious discoloration of the pipe can occur. This is an indication of reduced pipe impact strength, and any particular length of pipe that is discolored will be rejected. All pipe rejected by the ENGINEER will be removed from the job site.

3. All PVC pipe shall be Schedule 80 meeting the requirements of ASTM D-1784.

4. PVC pipe fittings shall be Schedule 80.

   a. Socket-type fittings shall conform to ASTM D-2467.

   b. Threaded fittings shall conform to ASTM F-437.

   c. Solvent cements shall conform to ASTM F-493.

B. Polyethylene Pipe (PE) and Fittings

1. The CONTRACTOR shall furnish and install 3/8"-inch polyethylene pipe (PE) as specified.

2. All PE pipe shall meet the requirements of ASTM D-3035 PE 3408 CD with an SDR of 17.

3. PE pipe fittings shall conform to ASTM D-2250.

   a. Socket-type fittings shall conform to ASTM D-2683.

   b. Insert fittings shall conform to ASTM D-2609.

   c. Butt heat fusion plastic fittings shall conform to ASTM D-3261 and ASTM D-2513.

   d. PE shall not be solvent cemented under any circumstances.

2.06 HYDRAULIC VALVES

A. Ball Valves

1. Ball valves to be used in the chlorination piping shall be constructed of polyvinyl chloride conforming to ASTM F-439 and ASTM D-1784. Valves shall be true union with Buna N or Viton seals and locked in Teflon seat carrier. Operation shall be 1/4 turn from full open to full closed with the handlever parallel to flow in the full open position. Valves shall be rated at 200 psi at 70°F.

2. PVC ball valves shall be as manufactured by Heflin-Harrington or Ryan Herco.

2.07 SPARE PARTS

A. A complete set of spare parts shall be provided for the chlorination system as recommended by the manufacturer. A list of the spare parts shall be provided with the Shop Drawings. The spate parts shall consist of but are not limited to the following.

1. 1 150 lb CL2 Cylilnder Repair Kit

2. 1 Chlorine Regulator Rebuild Kit

3. 1 Chlorine Ejector Rebuild KIt

PART 3 EXECUTION

3.01 GENERAL

A. The CONTRACTOR shall install and assemble the equipment including all necessary interconnecting piping, utility connections, controls, accessories, and appurtenances to form a complete and workable system that will function as specified. Unless otherwise shown or stated, the equipment shall be anchored to structural systems and shall resist all forces incidental to equipment operation.

B. Interconnecting piping between equipment units shall be field assembled and installed.

C. All chlorination equipment shall be installed, aligned, and tested under the supervision of installation

specialists, factory trained by the equipment manufacturers. Prior to final acceptance of the work, the CONTRACTOR shall furnish the OWNER five (5) copies of the manufacturer's certifications stating that the equipment has been properly installed, aligned and tested, and meets all requirements for satisfactory performance under the conditions specified herein.

D. The CONTRACTOR shall be responsible for all of the equipment until the equipment has been finally accepted by the OWNER.

E. The CONTRACTOR shall properly store, handle, and protect all materials and equipment from injury or damage from any and all causes. Damaged material and equipment will be rejected.

3.02 TEST REPORTS

A. The chlorination equipment shall be individually factory tested by the manufacturer prior to shipment. The manufacturer shall provide five (5) certified copies of the factory test which indicate that the unit passed the test and will perform as specified.

3.03 FINAL ACCEPTANCE

A. After the system is operable and prior to final acceptance, the equipment manufacturer shall provide a qualified engineer to demonstrate that the complete system performance requirements are met. Methods to determine performance shall be subject to review and approval by the City Inspector.

B. Failure of the system to meet performance requirements shall cause the CONTRACTOR to correct any deficiencies at no expense to the City. This provision, however, shall not relieve the CONTRACTOR of his overall responsibility for this portion of the work.

END OF SECTION

SECTION 11295

HYDRAULIC VALVES

PART 1 GENERAL

1.01 SUMMARY

A. Furnish and install all valves and valve accessories as indicated on the plans, and as specified herein including all appurtenances required for a complete and operational installation.

1.02 SECTION INCLUDES

A. Butterfly Valves

B. Check Valves

C. Surge Anticipator Valves

D. Pressure Sustaining Valves

1.03 RELATED SECTIONS

A. Section 01640 - MATERIALS AND EQUIPMENT

B. Section 02600 - PIPED UTILITY MATERIALS

C. Section 05500 - METAL FABRICATIONS

D. Section 09900 - PAINTING

1.04 REFERENCES

A. ANSI/AWWA C504 - Rubber-Seated Butterfly Valve

B. ASTM A-126

C. ASTM A-48

D. ASTM A-536

1.05 SUBMITTALS

A. Descriptive submittals shall be made in accordance with the Data Reference Symbols defined in Section 01300 - SUBMITTALS.

Item	Shop Drawings	O&M Manuals
Butterfly Valves	C,D,E,F,H,I,L, M,N,O	C,D,E,F,H,I,L, M,N,O
Check Valves	C,D,E,F,H,I,L, M,N,O	C,D,E,F,H,I,L, M,N,O
Surge Anticipator Valves	C,D,E,F,H,I,L, M,N,O	C,D,E,F,H,I,L, M,N,O
Pressure Sustaining Valves	C,D,E,F,H,I,L, M,N,O	C,D,E,F,H,I,L, M,N,O

PART 2 PRODUCTS

2.01 BUTTERFLY VALVES

A. Butterfly Valves

1. New butterfly valves shall be AWWA approved, tight-closing, rubber-seat type with rubber seats that are securely fastened to the valve body or valve disc. No metal-to-metal seating surfaces shall be permitted. Valves shall be bubble-tight at rated pressures with flow in either direction and shall be satisfactory for applications involving valve operation after long periods of inactivity. Valve disc shall rotate 90 degrees from the full open position to the tight shut position. Valves shall be equipped with handwheel operators. The handwheel operators shall be traveling nut, self-locking type and shall be designed to hold the valve in any intermediate position between fully open and fully closed without creeping or fluttering. Valve operators shall be equipped with mechanical stop-limiting devices to prevent over-travel of the disc in the open and closed positions and equipped with valve position indicator. Valves shall close with a clockwise rotation. Operators shall conform to the requirements of AWWA C504.

2. Valve bodies shall be constructed of cast iron ASTM A-48 Class 40 or ASTM A-126 Class B. Two trunnions for shaft bearings shall be integral with each valve body. Minimum body shell thicknesses shall be in strict accordance with AWWA Standard C504.

3. Valve disc shall be constructed of ductile iron ASTM A-536 grade 65-45-12.

4. Shafts of all valves shall be turned, ground and polished. Valve shafts shall be constructed of 18-8 Type 304 or Type 316 stainless steel. Shaft diameters must meet minimum requirements established by AWWA Standard C504 for Class 150B.

5. Valve seats shall be Buna N or natural rubber. Valves shall have seats that are bonded or mechanically retained to the valve body or valve disc.

6. Valves shall be fitted with sleeve-type bearings. Bearings shall be corrosion resistant and self-lubricating. Bearing load shall not exceed 20 percent of the compressive strength of the bearing or shaft material.

7. Packing shall be Chevron V-type, non-adjustable wear compensating or O-rings contained in a removable corrosion resistant recess.

8. Valves will be provided with torque tube floorstand assemblies where indicated on the plans. Assemblies shall consist of a torque tube and floorstand. Torque tubes shall be designed for a maximum deflection of no more than 0.75 degrees when measured at the disc edge. The floorstand shall support the full weight of the torque tube by use of corrosion resistant thrust bearings located in the floorstand. Design of a torque tube shall allow plus or minus 2 inches of free movement along the tube longitudinal axis. Floorstand shall have a height of 3 feet above the floor. Torque tube floorstand assemblies shall be factory assembled and shipped as integral units.

9. Certified drawing and material specifications shall be furnished by the manufacturer through the CONTRACTOR covering all items included in Sections 1 and 2 of AWWA C504. Butterfly valves shall be as manufactured by Henry Pratt Company, Mueller or equal.

2.02 CHECK VALVES

A. Check valves shall be globe pattern, ductile iron/bronze trim construction, with 150 lb. flanged end connections, complete opining/closing speed controls and valve position indicator.

B. Check valves shall be Model 81-02 valve as manufactured by CLA-VAL or approved equal.

2.03 SURGE ANTICIPATOR VALVE

A. Function

1. The surge anticipator valve shall control high pressures and power failure surges by bypassing system pressure that exceeds the high pressure control setting and also by opening a preset amount when sensed pressure decreases below a preset minimum in anticipation of a surge.

B. Main Valve

1. The valve shall be hydraulically operated, single diaphragm-actuated and globe or angle pattern. The valve shall consist of three major components: the body with seat installed the cover with bearings installed and the diaphragm assembly. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve separating operating pressure from line pressure. Packing glands and/or stuffing boxes are not permitted and there shall be no pistons operating the main valve or pilot controls. The valve shall be equipped with a valve position indicator.

C. Main Valve Body

1. No separate chambers shall be allowed between the main valve cover and body. Valve body and cover shall be of cast material. The main valve body shall be made of ductile iron. No fabrication or welding shall be used in the manufacturing process.

2. The valve shall contain a resilient, synthetic rubber disc, with a rectangular cross-section contained on three and one-half sides by a disc retainer, forming a tight seal against a single removable seat insert. No O-ring type disc (circular, square, or quad type) shall be permitted as the seating surface. The disc guide shall be of the contoured type to permit smooth transition of flow and shall hold the disc firmly in place. The disc retainer shall be of a sturdy one-piece design capable of withstanding opening and closing chocks. It must have straight edge sides and a radius at the top edge to prevent excessive diaphragm wear as the diaphragm flexes across this surface. No hourglass-shaped disc retainers shall be permitted and no V-type or slotted type disc guides shall be used.

3. The diaphragm assembly containing a non-magnetic 303 stainless steel stem of sufficient diameter to withstand high hydraulic pressures, shall be fully guided at both ends by a bearing in the valve cover and an integral bearing in the valve seat. The seat shall be a solid, one-piece design and shall have a minimum of a five-degree taper on the seating surface for a positive, drip-tight shut off. No center guides shall be permitted. The stem shall be drilled and tapped in the cover end to receive and affix such accessories as may be deemed necessary. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve separating operating pressure from line pressure.

4. The diaphragm shall consist of nylon fabric bonded with synthetic rubber compatible with the operating fluid. The center hole for the main valve stem must be sealed by the vulcanized process or a rubber grommet sealing the center stem hole from the operating pressure. The diaphragm must withstand a Mullins Bust Test of a minimum of 600 psi per layer of nylon fabric and shall be cycle tested 100,000 times to insure longevity. The diaphragm shall not be used as the seating surface. The diaphragm shall be fully supported no less than one-half of the total surface area of the diaphragm in either the fully open or fully closed position.

5. The main valve seat and the stem bearing in the valve cover shall be removable. The cover bearing and seat in 6" and smaller size valves shall be threaded into the cover and body. The valve seat in 8" and larger size valves shall be retained by flat head machine screws for ease of maintenance. The lower bearing of the valve stem shall be contained concentrically within the seat and shall be exposed to the flow on all sides to avoid deposits. To insure proper alignment of the valve stem, the valve body and cover shall be machined with a locating lip. No "pinned" covers to the valve body shall be permitted. Cover bearing, disc retainer, and seat shall be made of the same material. All necessary repairs and/or modifications other than replacement of the main valve body shall be possible without removing the valve from the pipeline. Packing glands and/or stuffing boxes shall not be permitted and components including cast material shall be of North American manufacture.

6. The valve manufacturer shall warrant the valve to be free of defects in materials and workmanship for a period of three years from date of shipment provided the valve is installed and used in accordance with all applicable instructions.

7. Electrical components shall have a one-year warranty.

8. The valve manufacturer shall be able to supply a complete line of equipment from 2 1/2" through 24" sizes and a complete selection of complementary equipment. The valve manufacturer shall also provide a computerized cavitation chart which shows flow rate, differently pressure, percentage of valve opening, Cv factor, system velocity, and if there will be cavitation damage.

D. Material Specification

Valve Size:	8 Inch
Main Valve Body and Cover:	Ductile Iron
Main Valve Trim:	Bronze
End Detail:	DL.150 Flanged
Pressure Rating:	250 PSI Max.
Temperature Range:	180°F Max.
Rubber Material:	BUNA N
Coating:	----
Desired Options:	----

E. Pilot Control System

1. The pressure relief pilot shall be an adjustable, spring-loaded, normally closed diaphragm control designed to permit flow when upstream pressure exceeds the control setting. The low pressure pilot shall be an adjustable, spring-loaded, normally open diaphragm control designed to open when the sensed pressure falls below the control setting and close when pressures are normal. The pilot system shall contain an adjustable hydraulic limiter to limit valve travel during low pressure opening without affecting high pressure relief valve travel. The CONTRACTOR shall connect the sensing/pilot supply connection to the main header with a minimum 3/4" pipe or tubing.

2. A full range of spring settings shall be available in ranges from 0-450 psi.

3. A direct factory representative shall be made available for start-up service, inspection and necessary adjustments.

F. Material Specification for Pilot Control:

Pressure Rating:	300 PSI
Temperature Range:	180°F Max.
Rubber Material:	BUNA N
Coating:	-----
Desired Options:	-----
High Pressure Adjustment Range:	30-300 PSI
Low Wave Adjustment Range:	0-75 PSI
Desired Options:	-----

G. Surge anticipator valve shall be Model 52-03 valve as manufactured by CIA-VAL or approved equal.

2.04 PRESSURE SUSTAINING VALVE

A. Function

1. The valve shall maintain a constant upstream pressure by bypassing or relieving excess pressure and shall maintain close pressure limits without causing surges. If upstream pressure decreases below the spring setting, the valve shall close.

B. Main Valve

1. The valve shall be hydraulically operated, single diaphragm-actuated, globe or angle pattern. The valve shall consist of three major components: the body with seat installed, the cover with bearings installed, and the diaphragm assembly. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure. Packing glands and/or stuffing boxes are not permitted and there shall be no pistons operating the main valve or pilot controls. The valve shall be equipped with a valve position indicator.

C. Main Valve Body

1. No separate chambers shall be allowed between the main valve cover and body. Valve body and cover shall be of cast material. Ductile Iron is standard and other materials shall be available. No fabrication or welding shall be used in the manufacturing process.

2. The valve shall contain a resilient, synthetic rubber disc with a rectangular cross-section contained on three and one-half sides by a disc retainer and forming a tight seal against a single removable seat insert. No O-ring type discs (circular, square, or quad type) shall be permitted as the seating surface. The disc guide shall be of the contoured type to permit smooth transition of flow and shall hold the disc firmly in place. The disc retainer shall be of a sturdy one-piece design capable of withstanding opening and closing chocks. It must have straight edge sides and a radius at the top edge to prevent excessive diaphragm wear as the diaphragm flexes across this surface. No hourglass-shaped disc retainers shall be permitted and no V-type or slotted type disc guides shall be used.

3. The diaphragm assembly containing a non-magnetic 303 stainless steel stem of sufficient diameter to withstand high hydraulic pressures shall be fully guided at both ends by a bearing in the valve cover and an integral bearing in the valve seat. The seat shall be a solid, one-piece design and shall have a minimum of a five-degree taper on the seating surface for a positive, drip-tight shut off. No center guides shall be permitted. The stem shall be drilled and tapped in the cover end to receive and affix such accessories as may be deemed necessary. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve separating operating pressure from line pressure.

4. The flexible, non-wicking, FDA approved diaphragm shall consist of nylon fabric bonded with synthetic rubber compatible with the operating fluid. The center hole for the main valve stem must be sealed by the vulcanized process or a rubber grommet sealing the center stem hole from the operating pressure. The diaphragm must withstand a Mullins Burst Test of a minimum of 600 psi per layer of nylon fabric and shall be cycle tested 100,000 times to insure longevity. The diaphragm shall not be used as the seating surface. The diaphragm shall be fully supported in the valve body and cover by machined surfaces which support no less than one-half of the total surface area of the diaphragm in either the fully open or fully closed position.

5. The main valve seat and the stem bearing in the valve cover shall be removable. the cover bearing and seat

in 6" and smaller size valves shall be threaded into the cover and body. Valve seat in 8" and larger size valves shall be retained by flat head machine screws for ease of maintenance. The lower bearing of the valve stem shall be contained concentrically within the seat and shall be exposed to the flow on all sides to avoid deposits. To insure proper alignment of the valve stem, the valve body and cover shall be machined with a locating lip. No "pinned" covers to the valve body shall be permitted. Cover bearing, disc retainer, and seat shall be made of the same material. All necessary repairs and/or modifications other than replacement of the main valve body shall be possible without removing the valve from the pipeline. Packing glands and/or stuffing boxes shall not be permitted and components including cast material shall be of Norther American manufacture.

6. The valve manufacturer shall warrant the valve to be free of defects in material and workmanship for a period of three years from date of shipment, provided the valve is installed and used in accordance with all applicable instructions. Electrical components shall have a one-year warranty.

D. Material Specification

Valve Size:	20 Inches
Main Valve Body and Cover:	Ductile Iron
Main Valve Trim:	Bronze
End Detail:	CL.150 Flanged
Pressure Rating:	250 PSI Max.
Temperature Range:	180°F Max.
Rubber Material:	BUNA N
Desired Options:	Valve Position Indicator

E. Pilot Control System

1. The pressure relief pilot shall be direct-acting, adjustable spring loaded, diaphragm valve designed to permit flow when controlling pressure exceeds the adjustable spring setting. The pilot control is normally held closed by the force of the compression on the spring above the diaphragm and it opens when the pressure acting on the underside of the diaphragm exceeds the spring setting. Pilot control sensing shall be upstream of the pilot system strainer is partially blocked. A full range of spring settings shall be available in ranged form 0-450 psi.

F. Material Specification for Pilot Control:

Pressure Rating:	300 PSI
Trim:	Stainless Steel
Rubber Material:	BUNA N
Tubing and Fittings:	Copper/Brass
Adjustment Range:	0-85PSI
Operating Fluids:	Water

1. The valve shall be Cla-Val Co. Model 50-01 pressure relief and pressure sustaining valve as manufactured by Cla-Val Co., Newport Beach, California 92659-0325, or approved equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Workmanship shall be of the highest grade throughout and in accordance with the best standard practice for this type of equipment.

B. Valves of the various types and pattern shall be installed at the respective locations as shown on the drawings and specified herein. All appurtenance required for operation and control of the valves shall be included. Joints and connections shall be made in accordance with applicable requirements for pipe line or pipe joints. Valve stems shall be plumb and vertical unless otherwise specifically shown. Each valve shall be adjusted for smooth and easy operation and shall be watertight when placed in operation under maximum working pressure.

END OF SECTION

SECTION 13200

STEEL WATER STORAGE RESERVOIR

PART 1 GENERAL

1.01 SUMMARY

A. This Section covers the one million gallon steel water storage reservoir. The reservoir shall be erected on a concrete ring type foundation designed by the reservoir fabricator.

1.02 GOVERNING STANDARDS

A. Except as otherwise specified herein all Work both in the shop and in the field shall be in accordance with applicable requirements of AWWA D103-87 or D100 and D102, D104, and C652.

1.03 DESCRIPTION AND DESIGN REQUIREMENTS

A. The steel water storage reservoir shall be a flat-bottom tank and have a cone-shaped roof supported on internal structural framing. The reservoir roof shall slope approximately 1/4 inch in 12 inches.

B. The reservoir shall conform to the following requirements:

1. Minimum capacity measured below the overflow, million gallons	1
2. Effective depth, feet	16
3. Pipe connections and diameters, inches	
a. Inlet	24
b. Outlet	24
c. Overflow	16
d. Drain	8

1.04 DRAWINGS AND DATA

A. Complete Drawings and Specifications covering materials to be furnished, dimensions, sizes and thicknesses of plates and members, details of welded or bolted joints,

SECTION 16060

ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Demolition of existing electrical shall be as indicated on the Plans or as indicated elsewhere herein.

B. Demolition information shown on the Plans is based on visual field examination and existing record drawings. The Contractor is responsible for verification of all items indicated or not. All items affected that are not indicated on the plans shall be brought to the Engineer's attention before demolition for direction.

C. The Contractor shall confine demolition work to the item specifically identified on the plans. He shall be liable for any other damage he may inflict to the existing installations.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Care shall be taken in demolition or removal of items as indicated on plans as being returned to the Owner. The Contractor shall notify the Owner prior to removing existing equipment.

B. Whether indicated on the plans or not, the Contractor shall provide patching material to fill voids where demolition has taken place. Patching materials shall match, as nearly as practical, the existing original structure material for each surface being patched.

PART 3 - EXECUTION

3.01 COORDINATION

A. The Contractor shall verify existing field conditions, measurement, circuitry etc. as indicated on Plans prior to performing any demolition.

B. The Contractor shall verify that abandoned or demolished wiring and electrical equipment serve only abandoned facilities. If demolished or abandoned electrical is necessary for proper operation of facilities to remain in service, the Contractor shall immediately notify the Engineer for direction.

C. Demolition shall not be performed without coordinating with new construction to limit down time and ease of switchover. The Contractor must coordinate with the Engineer and the Owner prior to any demolition.

D. Prior to performing any demolition work, the Contractor shall provide temporary wiring and connections to maintain existing systems in service during construction. Temporary wiring shall conform to the National Electrical Code.

3.02 PERFORMANCE

A. General: The means and methods of performing electrical demolition and removal operations are the sole responsibility of the Contractor. However, equipment used, and methods of demolition and removal will be subject to approval of the Engineer.

1. Remove exposed abandoned conduit systems, including abandoned conduit systems in false ceilings.
2. Remove wiring in abandoned conduit systems to source of power supply, where indicated.
3. In exposed through-structure conduit or foundation locations, cut conduits and foundation below the finished structure surfaces in order to perform adequate surface patching.
4. Maintain electrical continuity of existing electrical installations which remain active. Modify installations as necessary to maintain continuity and provide adequate access as required by the National Electrical Code.
5. Extend existing installations using materials and methods compatible with existing electrical installations, and as specified elsewhere herein.
6. Disconnect and leave in place electrical devices and equipment serving utilization equipment that has been removed or demolished.

B. Cutting: Perform cutting work of existing structure materials by such methods as will prevent extensive damage beyond the immediate area of cutting.

C. Unless otherwise indicated existing, electrical equipment, conduit, wire, etc. indicated for demolition shall be removed and disposed of in a lawful manner, off Site.

D. The Contractor shall move existing electrical equipment required to be returned to the Owner, to locations as directed by the Owner. Care shall be taken to ensure existing electrical equipment being returned to the Owner does not become damaged. The Contractor shall provide a means for storing and or stacking of the returned equipment prior to moving to final location, if necessary.

E. Items Abandoned in Place:

1. All items to be abandoned in place shall be de-energized.

fabrication and erection of steel work, and all accessories shall be submitted in accordance with the Submittals Section.

B. Data shall include all horizontal and vertical loadings, anchor bolt (if any) sizes and locations, and maximum loads imparted to the foundation.

C. Data shall also include a table showing capacity of the reservoir in gallons at all levels from empty to full for each 0.10 foot variation in water depth.

PART 2 PRODUCTS

2.01 MATERIALS AND DESIGN

A. Materials shall conform to the requirements of Section 2 and design to the requirements of AWWA D103-87 or Sections 3, 6, 12, and 13 of AWWA D100 except as follows:

1. Design in accordance with Appendix C will be acceptable provided materials are selected from Category 1 or 2. Category 3 materials shall not be used. The design metal temperature shall be 40°F.

2. Corrosion Allowances will not be required.

3. Except where otherwise specified, the minimum metal thickness for any part of the structure shall be the greatest of the following:

a. Design thickness

b. Thickness specified in Section AWWA D100, Section 3.10

c. 1/4 inch

B. Whenever there is a change in thickness greater than 1/16 inch in sidewall plates, the plates shall be joined so that the offset is on the inside and the outside face is flush.

C. The reservoir shall be supported on a concrete ringwall designed by the reservoir fabricator. The maximum allowable soil bearing pressure is 3,000 psf for dead plus live loads and 4,000 psf for total loads including wind and seismic forces. A net allowable soil bearing capacity of 3,000 psf may be used for interior concentrated loads, ignoring the hydraulic load.

D. All design aspects of the concrete ringwall and steel water storage reservoir, including but not limited to the shell, roof structure, bottom plates, and interior columns, shall incorporate pseudodynamic approach in accordance with Section 13 of AWWA D100. It shall not be required that the steel tank be anchored to the foundation.

E. The ringwall shall be designed to resist the contained "at rest" soil lateral pressure due to the reservoir surcharge.

F. The ringwall shall have sufficient compatible stiffness to distribute the wall forces to the reservoir shell without buckling the tank wall selected.

2.02 ACCESSORIES

A. Accessories shall conform to the applicable paragraphs of Section 7 of AWWA D100 and supplementary requirements stipulated herein.

B. Shell Manhole

1. Two 30-inch manholes shall be provided in the sidewall of the reservoir approximately 3-feet above the bottom. Manholes shall provide a watertight seal. The openings shall be suitably reinforced.

C. Pipe Connections

1. The pipe connections shall be provided as indicated on the Project Drawings. Steel pipe for connections shall be at least 1/4-inch thick. Suitable reinforcement shall be provided around each pipe connection.

2. A 2-inch vertical steel pipe shall be welded to the top of the reservoir to permit insertion of probe-type conductance level switches. The pipe shall be fitted with a 2 inch pipe coupling to permit connection of the level switch housing. The 2 inch riser shall be located within 2 feet of the platform for easy access, and a minimum of 3 feet from the reservoir wall.

D. Overflow

1. The overflow shall be equipped with a weir box and shall be capable of discharging the specified overflow rate of 6900 GPM with the water level 12-inches above

the weir.

2. The overflow pipe shall turn and project through the reservoir sidewall near the overflow elevation, then turn and extend down the outside of the reservoir, all as indicated on the Project Drawings. Suitable pipe connection reinforcement and pipe supports shall be provided.

3. Steel pipe for overflows shall be as specified in sections except as modified herein. Steel overflow pipe shall not be mortar lined and shall be painted as specified in this Section.

E. Drain Outlet

1. A valved drain outlet, flush with the reservoir bottom, that runs down and terminates in the overflow box shall be provided as specified and indicated on the Drawings.

F. Outside Ladder and Platform

1. An outside ladder conforming to Section 7.4.1 of AWWA D100 shall be provided. The ladder shall begin at ground level extend to the roof hatch access platform. A ladder cover, extending from 4-inches below the bottom rung to a height of 8 feet, shall be provided to prevent unauthorized access to the ladder. The ladder cover shall be fabricated from 1/8 inch steel with appropriate metal framing and bracing to provide rigid structure. The cover shall be hinged from the reservoir wall with a minimum of three heavy-duty hinges. A suitable hasp shall be attached to the reservoir wall to secure the cover.

2. A suitable fall prevention device shall be provided with two sets of climbing harness. The climbing rail shall extend 4 feet 6-inches above the roof hatch platform. The fall prevention device shall be SAF-T-CLIMB manufactured by Norton Company or equal.

3. A steel safety cage shall be provided beginning 8 feet-above finished grade. The bottom of the safety cage shall be fully blocked by an extension from the ladder cover whenever the ladder cover is in the closed position.

G. Roof Hatch

1. A roof hatch conforming to D100 Section 7.6 complete with cover fabricated from steel at least 3/16-inch thick, shall be provided. The cover shall be hinged and a hasp provided for securing the hatch.

H. Vent

1. A vent of the mushroom type fabricated from steel at least 3/16-inch thick shall be provided. The vent shall be screened with bronze or aluminum 1/2 inch mesh bird screening. The vent shall have a net free area of at least 4,000 square inches. Bird screening shall be designed and installed as to collapse if the screening becomes clogged and is subject to negative or positive pressure from the reservoir.

2.03 Materials

A. All paint shall be delivered to the job in original unopened containers with labels intact. Paint shall be stored inside and shall be protected against freezing. No adulterant, unauthorized thinner, or other material not included in the paint formulation shall be added to the paint for any purpose.

B. Unless otherwise authorized by the ENGINEER, materials shall conform to the following:

Interior Paint System:

Wetted Surfaces, Including Underside of Roof	Total minimum dry film thickness of 10 mils.
Prime Coat	Ameron "Amercoat 395 RT-1805 Blue", Tnemec "20-1255 Pota-Pox Primer", or Valspar "Series 32W3PWR Val-Chem"; dry film thickness of 5 mils.
Finish Coat	Ameron "Amercoat 395 Off-White", Tnemec "20-AA83 Pota-Pox Finish", or Val-spar "Series 32D7PWR Val-Chem"; dry film thickness of 5 mils.

Dry Surfaces	Total minimum dry film thickness of 10 mils.
Prime Coat	Ameron "Amercoat 395 RT-1805 Blue", Tnemec "20-1255 Pota-Pox Primer", or Valspar "Series 32W3PWR Val-Chem"; dry film thickness of 5 mils.
Finish Coat	Ameron "Amercoat 395 Off-White", Tnemec "20-AA83 Pota-Pox Finish", or Valspar "Series 32D7PWR Val-Chem"; dry film thickness of 5 mils.
Exterior Paint System	Three-coat epoxy/aliphatic polyester polyurethane system. Total minimum dry film thickness of 8 mils.
Prime Coat	Ameron "Amercoat 385 P", Tnemec "20-1255 Pota-Pox Primer", or Valspar 13-R-62 Val-Chem Epoxy Primer", dry film thickness of 3 mils.
First Coat	Ameron "Amercoat 385" or Valspar "89 Series Val-Chem Hi-Build Epoxy"; dry film thickness of 3 mils.
Second Coat	Ameron "Amercoat 450 HS" or Valspar "V40 Series Urethane Enamel"; dry film thickness of 2 mils.

C. Product and Color Selection

1. The CONTRACTOR shall submit complete descriptive specifications for all brands of paints proposed for use, together with color cards for all exterior paints, to the ENGINEER for review and color selection. Requests for review submitted directly to the ENGINEER by paint suppliers will not be considered.

D. Coating for Bolted Steel Tanks

1. All metal plates, supports, members, and miscellaneous parts, except bolts, certain accessories, and appurtenances, shall be factory coated in accordance with the provisions of these specifications. Field coating, except for touch-up will not be permitted.

Interior: Thermally cured epoxy equal to Trico-Bond 478 by Columbian Steel Tank Company or equal.

Exterior: Amine Epoxy primer with Trico-Bond 478 setting baked acrylic finish coat or equal.

Option: Amine Epoxy primer with Z-Bond 493 setting baked acrylic finish coat or equal.

PART 3 EXECUTION

3.01 TREATED SAND LAYER

A. Materials

1. A sand layer shall be provided beneath the entire area of the reservoir. The sand layer shall be at least 6 inches thick and shall be graded to slope uniformly upward at one inch per 10 feet to the center of the reservoir.

3.02 PERIMETER SEAL

A. Application

1. A continuous perimeter seal of an inch thick cement-sand grout or 1/2-inch thick asphalt-saturate fiberboard shall be provided between the top of the concrete ringwall foundation and the underside of the reservoir in accordance with Section 12.6.1 of AWWA D100. The perimeter seal shall extend from the inner edge of the concrete foundation to the outer edge of the reservoir. After completion of erection, if fiberboard is used, any projections beyond the outer edge of the reservoir shall be trimmed to a neat line flush with the edge of the bottom and the edge shall be sealed by caulking with asphalt roofing cement.

3.03 TESTING

A. Field Welds

1. The quality of field welding shall be determined in accordance with Section 11.2 of AWWA D100. Weld quality shall be determined by spot radiographs or test segments, or both, of the number and location set forth in Section 11. Tests of field welds shall be made by and at the expense of the CONTRACTOR.

2. At the conclusion of field welding and testing the CONTRACTOR shall submit a written report in accordance with Section 11.2.1. Radiographic film and any test segments shall become the property of the OWNER.

B. Bottom Section

1. After the reservoir bottom has been completely welded and the bottom ring attached, all welded seams in the bottom shall be tested by using strong soap solution or linseed oil and a vacuum box. All leaks shall be repaired.

C. Water Test

1. A "watertightness" test of the reservoir by filling and checking for leaks is not required after erection and prior to field painting. However, any leaks discovered after the reservoir is filled shall be repaired at the expense of the CONTRACTOR by emptying the reservoir, cutting out the defective welds, rewelding, properly restoring and curing the coating system, repeating the entire disinfection and reservoir coating contaminant procedure specified in this Section, and refilling the reservoir.

3.04 PAINTING

A. General

1. Unless otherwise specified herein, all painting work shall be in accordance with the applicable requirements of AWWA D102. Painting materials shall be in accordance with the products listed herein.

2. Unless otherwise authorized by the ENGINEER, all field painting shall be done after erection and testing. If painting is done before testing, paint shall be repaired after all welding repairs have been made.

3. The painting contractor shall submit a satisfactory experience record including application of the specified interior paint systems to steel structures of similar design and complexity.

4. All steel surfaces to be painted with Interior Paint System shall be cleaned by blasting in the field after erection, and all painting of such surfaces shall be done in the field. Other surfaces may be cleaned by pickling or blasting in the shop or by blasting in the field either before or after erection. If pickled or shop blasted, the prime coat for exterior surfaces shall be applied in the shop.

5. Paint used in successive field-applied coats shall be compatible with the previously applied coat. Paint used in successive field-applied exterior coats shall be compatible with and of the same manufacturer as the shop-applied prime coat.

6. An affidavit of compliance with the applicable requirements of AWWA D102 shall be submitted in accordance with Section 1.4 of AWWA D102.

B. Painting Schedule

1. The following schedule lists the paint systems and colors to be used for the parts of the reservoir. Unless otherwise specified, all steel surfaces both inside and outside shall be painted.

Surfaced To Be Painted	Topcoat Color
Interior surfaces, including surfaces of interior accessories.	White
Exterior surfaces of the reservoir, including surfaces of exterior ladders, railings, and accessories.	To be selected by OWNER

2. Painting of the underside of the reservoir bottom plates will not be required. Painting of the top surface of roof purlins which are inaccessible will not be required.

C. Mixing and Thinning

1. Paint shall be thoroughly mixed each time any is withdrawn from the container. Paint containers shall be kept tightly closed except while paint is being withdrawn.

2. Paint shall be factory mixed to proper consistency and viscosity for hot weather application without thinning. Thinning will be permitted only as necessary to obtain recommended coverage at lower application temperatures. In no case shall the wet film thickness of applied paint be reduced, by the addition of paint thinner or otherwise below the thickness recommended by the paint manufacturer.

D. Surface Preparation

1. All surfaces shall be dry when painted and free from dirt, dust, sand, mud, oil, grease, rust, mill scale, and other objectionable substances. All steel surfaces shall be prepared for painting by being thoroughly cleaned by blasting or by pickling. The specified wash or prime coat shall be applied to blasted surfaces immediately after cleaning. In every case, the wash or prime coat shall be applied before visible rust appears. Surface preparation for painting shall be applied before visible rust appears. Surface preparation for painting shall conform to the following Steel Structures Painting Council specifications:

Blasting

Interior Surfaces	SSPC-SP10, Near White Blast Cleaning.
Exterior Surfaces	SSPC-SP6, Commercial Blast Cleaning.

2. Surfaces of welds shall be scraped, chipped, and wire brushed as necessary to remove all slag and weld spatter. The use of chipping tools which produce cuts, burrs, or excessive roughness will not be acceptable. Paint made brittle by heat of welding or paint which has been damaged shall be removed and the edges of undamaged paint feather-edged so that patches will not be noticeable when the painting has been completed. Before any field painting is done, all field-welded seams and joints, together with all

surfaces of plates and structural members not previously painted and surfaces from which damaged paint has been removed, shall be prepared for painting by blasting.

3. The blasting material used shall be a low silica dust inhibiting material, and shall be acceptable to the ENGINEER. Complete data on the blasting material shall be submitted in accordance with the Submittals Section.

4. All blasting operations, including recovery and disposal of blasting materials, shall be performed in accordance with applicable regulations and ordinances. Paint materials used on previously primed or painted surfaces may contain lead, chromate, or other objectionable compounds; blasting materials used in the preparation of such surfaces may become contaminated by the compounds and may be considered as hazardous waste materials, to be handled accordingly.

E. Application

1. Paint shall be applied in a neat manner, with finished surfaces free of runs, sags, ridges, laps, and brush marks. Each coat shall be hard and dry through the entire paint film before the next coat is applied. Each coat shall be applied in a manner that will produce an even film of uniform and proper thickness. In no case shall paint be applied at a rate of coverage which is greater than the maximum rate recommended by the manufacturer.

2. Dry film thicknesses of the paint systems shall be in accordance with the applicable requirements of Sections 2 and 3 and the testing of paint films shall be in accordance with Section 8, of AWWA D102.

3. For the inside and outside paint systems, the color of alternate coats shall provide a contrast to assist in obtaining complete coverage.

4. Paints for the exterior surfaces of the reservoir shall be applied using either hand brushes or rollers. Spray painting of the exterior surfaces will not be permitted.

5. Paint showing sags, checks, blisters, teardrops, or fat edges will not be accepted and shall be entirely removed and the surface repainted.

F. Weather Conditions

1. Paint shall not be applied, except under shelter, during wet, damp, or foggy weather, or when windblown dust, dirt, debris, or insects will collect on freshly applied paint. Paint shall not be applied at an air temperature below 55°F; to surfaces of metals which have a temperature below 55°F, regardless of air temperature; or when metal temperature and atmospheric conditions cause condensation on the surface of the metal.

G. Protection

1. No shop painted materials shall be shipped or otherwise moved from the fabricating shop until paint has become dry and hard.

2. Care shall be taken to prevent paint from being dropped, spilled, or windblown on concrete and masonry surfaces, buildings, structures, cars, or other property or facilities. All surfaces so damaged shall be cleaned, repaired, replaced, or painted to the satisfaction of the ENGINEER.

H. First Anniversary Inspection

1. First anniversary inspection shall be conducted in accordance with Section 9 of AWWA D102.

3.05 DISINFECTION

A. After all other work, including testing and painting, has been completed, the interior of the reservoir shall be thoroughly cleaned and disinfected in accordance with AWWA C652.

B. Prior to starting any disinfection work, the CONTRACTOR shall submit to the ENGINEER a detailed outline of the procedures proposed, the coordination and sequence of operations, and the manner of filling and flushing the reservoir. All procedures shall be acceptable to the ENGINEER.

C. The CONTRACTOR shall furnish all cleaning and disinfecting materials and all equipment and labor necessary for the cleaning and disinfecting operations.

D. All water used in cleaning and disinfecting and the reservoir and which is to be wasted shall be disposed of in a manner acceptable to the OWNER and the appropriate pollution control agency.

3.06 CATHODIC PROTECTION

A. Criteria For Protection

1. The cathodic protection system shall maintain the tank-to-water potential within a range of -0.850 v to -1.050 v relative to a permanent copper-copper sulfate reference electrode. Tank-to-water potentials more electronegative than this range may produce hydrogen gas at the interface between the steel and coating and may cause blistering of the submerged coatings.

2. Potential Measurement. There are two types of automatically controlled, impressed-current cathodic protection systems: Type A-IR Drop-Free System and Type B Current-Applied System. The method of potential measurement for each of these systems shall be as follows:

a. Type A-IR Drop-Free System. The potential shall be measured free of the effect of voltage gradients (IR drops). The long-life reference electrode may be positioned anywhere in the tank electrolyte (water).

b. Type B Current-Applied System. The potential shall be measured with the protective system current activated and include the voltage gradients (IR drops). In order to minimize the IR drop effect, the long-life reference electrode must be positioned within 1 cm of the submerged steel surface of the tank.

B. General Design

1. The cathodic protection system provided under this Section shall achieve and maintain the criteria for protection of the specific tank. The design of an impressed-current system shall include the evaluation of the tank information and criteria for protection.

a. Output Current Capacity. Nominal current capacity of the rectifier shall be determined based on the estimated current density required for cathodic protection. The required current density is

expressed in amps per unit area of total submerged bare surface. The current density shall be determined for each specific tank and depends on the conductivity of the water and the condition of the coatings.

b. Output Voltage Capacity. The output voltage capacity is a function of the protective current requirement and the total circuit resistance in accordance with Ohm's Law. The circuit resistance is governed by the anode-to-water resistance, the electrolyte resistance, and the wiring resistance.

c. Anode Configuration. The anode system shall provide and maintain a uniform distribution of protective current without exceeding the potential limits established. The anode system shall provide and maintain low circuit resistance consistent with the design life of the anode system and be designed to prevent electrical shorting to the tank.

d. Riser Circuit. For an elevated tank riser that is 30 in. (750 mm) in diameter or larger, additional system capacity shall be provided. A separately controlled circuit shall be provided for energizing the riser anode assembly.

C. System Components

1. Automatic Rectifier

a. Rectifier units shall be of the full-wave bridge type using either silicon or selenium rectifying elements. The rectifier shall be capable of varying the current output from 0 to 100 percent of its rated capacity.

b. The rectifier shall be capable of automatically adjusting the current output so as to maintain the tank-to-water potential within ±25 mv of the selected criteria for protection.

c. Proper protection and monitoring devices shall be provided, including disconnect switches; circuit breakers; output voltmeter; ammeters; potential meter; and surge, lightning, and overload protection.

d. The tank-to-water potential used to control the

current output shall be derived from a long-life electrode positioned in the tank electrolyte.

e. Note: An additional control may be used to limit the maximum current output of the rectifier to restrict the tank-to-water potential values for a specified protective coating.

2. Reference Electrode(s)

a. The permanent reference electrode used to measure the tank-to-water potential for controlling the current output of the rectifier shall be designed to remain stable in continuous immersion in the water for a minimum of 10 years with only minimal maintenance as recommended by the supplier. The reference electrode(s) shall have a potential drift of less than 10 mv. To prevent water permeation, the reference electrode lead wire shall be insulated.

3. Anode Materials

a. Seasonal or temporary anodes shall be aluminum allow and shall be of a type that corrodes uniformly.

b. Long-life anode systems shall have an anode design life of at least 10 years. Long-life anodes shall be high silicon cast iron, platinized niobium, platinized titanium, or mixed metal oxides an titanium substrate unless otherwise specified by the purchaser. The material shall be selected based on consumption rate of the material and the current output of the system.

c. To prevent water permeation, the anode lead wire shall be insulated.

4. Anode Suspension Systems

a. Anode suspension systems for tanks not subject to ice formation may be either the vertical or horizontal type. For tanks subject to icing, the suspension system shall be either a buoyant (horizontally submerged), spider-type rope system or an extendable vertical type.

b. For vertically suspended anode systems, hand holes and mounting devices shall be provided so that the

anodes may be replaced or inspected without entering the tank. All hand holes shall have removable, gasketed covers.

c. Horizontally oriented anode systems, which are located below the normal maintained low water level, shall be connected to anchoring devices welded or bolted in place in accordance with the anode configuration.

d. All anode support hardware and wiring shall be designed for at least a 10-year life for the conditions inside the tank.

5. Wiring

a. All wiring on the outside of the tank shall be installed in rigid steel conduit and shall be in accordance with the National Electrical Code, NFPA 70, and all applicable local codes.

3.07 APPLICATION PROCEDURES FOR FACTORY COATING OF BOLTED STEEL TANK

A. Surface Preparation

1. Tank parts are thoroughly washed and rinsed to remove grease, oil and foreign matter.

2. Parts are then immediately oven-dried.

3. Parts are grit-blasted to SSPC-SP10-63T (near white blast cleanings) to 1-2 mil profile.

4. All parts must be coated within 15 minutes after blasting, and no further processing other than coating application shall be done.

B. Interior Coating/Trico-Bond 478 (Includes underneath side of steel bottom)

1. First coat electrostatic application of FDA and NSF approved thermoset epoxy, Technical Coatings Company Epicon 925 as primer, 2.5 mil average dry film thickness.

2. Second coat electrostatic application of FDA and NSF approved thermoset epoxy, Technical Coatings Company Epicon 925 as topcoat, 2.5 mil average dry film thickness.

3. Coating system to have 5.0 mil average dry film thickness.

C. Exterior Coating -- Columbian standard Trico-Bond 478 and acrylic enamel finish.

1. One coat epoxy primer, Technical Coatings Company Epicon 925, 2 mil average dry film thickness, electrostactically applied.

2. One coat high solids acrylic baking enamel, Technical Coatings Company #894-N-006 tan, 1 mil average dry film thickness.

3. Coating system to have 3 mil average total dry film thickness.

D. (Option) Exterior Coating -- Z-Bond 493 optional exterior coating.

1. One coat Technical Coatings Company Epicon R zinc rich primer, 2.5 mils average dry film thickness.

2. One coat electrostatic application of FDA and NSF accepted thermoset epoxy, Technical Coatings Company Epicon 925 as topcoat, 2 mil average dry film thickness.

3. Second coat electrostatic application of FDA and NSF accepted thermoset epoxy, Technical Coatings Company Epicon 925 as topcoat, 2.5 mil average dry film thickness.

4. One coat urethane, Technical Coatings Company Acrothane HF, 1.5 mils average dry film thickness.

5. Coating system to have 8.5 mils average total dry film thickness.

END OF SECTION

SECTION 15430

PLUMBING SPECIALTIES

PART 1 GENERAL

3.01 SECTION INCLUDES

A. Floor drains.

B. Hose bibbs.

3.02 REFERENCES

A. ANSI/ASSE 1011 - Hose Connection Vacuum Breakers.

B. ANSI A112.21.1 - Floor Drains.

3.03 SUBMITTALS

A. Descriptive submittals shall be made in accordance with the data reference symbols defined in Section 01300 - SUBMITTALS.

Item	Shop Drawings
Floor Drains	A,C,D,E,H,L,P
Hose Bibbs	A,C,D,E,H,L,P

PART 2 PRODUCTS

2.01 FLOOR DRAINS

A. FD-1: ANSI A112.21.1; painted cast iron two piece body with flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer; W-1100 series manufactured by Wade; Z-415 manufactured by Zurn; or approved equal.

B. FD-2: ANSI A112-21.1; Painted cast iron two piece body with flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer with 4-inch diameter rough bronze funnel; W-1100 series manufactured by Wade; Z-415 Series manufactured by Zurn; or approved equal.

2.02 HOSE BIBBS

A. Interior: 125 psi WOG, bronze or brass with integral mounting flange, replaceable seal disc, 3/4-inch hose thread spout, with handwheel or T-handle, vacuum breaker in conformance with ANSI/ASSE 1011; Model 102-304 VB manufactured by B & K Industries; or approved equal.

PART 3 EXECUTION

3.01 PREPARATION

A. Coordinate floor construction to receive drains to required invert elevations.

3.02 INSTALLATION

A. Install plumbing specialties in accordance with manufacturer's instructions.

B. Extend cleanouts to finished floor surface. Ensure clearance at cleanout for rodding of drainage system.

C. Encase exterior cleanouts in concrete flush with grade.

D. Install water hammer arrestors complete with accessible isolation valve where shown on Project Drawings.

END OF SECTION

SECTION 15440

PLUMBING FIXTURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Emergency showers and eyewash units.

1.02 REFERENCES

A. ANSI Z358.1 - Emergency Eyewash and Shower Equipment.

1.03 SUBMITTALS

A. Descriptive submittals shall be made in accordance with the data reference symbols defined in Section 01300 - SUBMITTALS.

Item	Shop Drawings
Emergency Showers and Eyewash Units	A,C,D,E,H,L,P

PART 2 PRODUCTS

2.01 EMERGENCY SHOWERS AND EYEWASH UNITS

A. ES-1 (Combination Unit)

1. ANSI Z358.1; Free standing unit with 1-1/4-inch galvanized steel pipe and floor flange, plastic deluge shower head, chrome plated brass 1-inch IPS stay-open ball valve with stainless steel pull rod and triangular handle. Eye wash unit with stainless steel wash receptor, twin eye wash heads with dust covers, chrome plated brass 1/2-inch IPS stay-open ball valve with stainless steel push flag handle. Model 8300 manufactured by Haws; Model S19-310 manufactured by Bradley; or approved equal.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

3.02 PREPARATION

A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install components level and plumb.

3.04 INTERFACE WITH OTHER PRODUCTS

A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.05 ADJUSTING

A. Adjust work under provisions of Section 01700.

B. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.06 CLEANING

A. Clean work under provisions of 01700.

B. At completion clean plumbing fixtures and equipment.

3.07 PROTECTION OF FINISHED WORK

A. Protect finished Work during construction.

B. Do not permit use of fixtures during construction.

END OF SECTION

ELECTRICAL SPECIFICATIONS for

CITY OF AVONDALE

Rancho Santa Fe Reservoir and Booster Pump Station AVONDALE, ARIZONA

Index	Description
16000	General Electrical Requirements
16060	Minor Electrical Demolition
16111	Conduits
16123	600 Volt Class Cable
16124	Instrumentation Class Cable
16140	Outlet, Switch, Pull and Junction Boxes
16141	Lighting Switches & Receptacles
16143	Terminal Blocks
16160	Enclosures
16170	Grounding
16190	Supporting Devices
16195	Electrical Identification
16420	Service Entrance Equipment
16430	Customer Power Monitoring System
16461	Dry Type Transformers
16470	Panelboards
16475	Mini Power Centers
16476	Low Voltage Circuit Breakers
16477	Fuses
16480	Motor Controllers
16481	Motor Control Centers (MCCs)
16495	Automatic Transfer Switch
16500	Lighting
16505	Transient Voltage Surge Suppression System
16622	Outdoor Standby Diesel Electrical Generator
16902	Electric Controls and Relays
16903	Programmable Logic Controllers
16904	Variable Frequency Drive

Registered Professional Engineer (Electrical)
CERTIFICATE NO.
8584
MARC
CIMON
Date Signed JUN 13, 2016
ARIZONA, U.S.A.

wiring and control diagrams of the system installed. This shall provide the Owner with comprehensive information on all systems and components to enable operation, service, maintenance and repair. Exploded, or other detailed views of all equipment, devices, assemblies, and accessory components shall be included, together with complete parts lists and ordering instructions.

5. Record Drawings:
   a. The Contractor shall maintain a marked up set of Contract Document Plans showing actual installed circuit numbers, conduit sizes, cable tray routing, number of conductors, conductor sizes (larger than #12 AWG), and all other deviations from the design Plans.
   b. Underground conduit and concealed items shall be dimensioned on the Plans from permanent, visible, building features.
   c. The Contractor shall provide actual motor size, starter size, and overload heater size, along with all other protective equipment for all 480 V and 4160 V motor circuits as part of the one-line record drawings.
   d. The Contractor shall revise all conductor identification and panel schedules to indicate as-built conditions.

PART 2 - PRODUCTS

2.01 GENERAL MATERIALS AND METHODS

A. Materials, equipment, and parts comprising any unit, or part thereof, specified or indicated on the Plans, shall be new and unused, of current manufacture, and of highest grade consistent with the state of the art. Damaged materials, equipment, and parts, are not considered to be new and unused, and will not be accepted.

B. Field verification of scale dimensions on Plans is directed, since actual locations, distances, and levels will be governed by actual field conditions. The Contractor shall also review architectural, structural, yard, mechanical, and other Plans, and the accepted electrical and mechanical shop drawings, and shall adjust their work to conform to the conditions indicated therein.

C. The fabricator of major components, such as distribution panelboards, switchgear, and motor control centers, shall also be the manufacturer of the major devices therein.

D. Refer to various Division sections for individual equipment manufacturers. Indicated manufacturers are subject to strict compliance with the specifications and complete project documents. The reference to a particular manufacturer does not relieve the Contractor from conforming to the specified requirements.

2.02 NAMEPLATES

A. Where indicated elsewhere in these specifications, or on the Plans, the Contractor shall furnish and install nameplates, which shall be black laminate with white letters. The nameplates shall be fastened to the various devices with round head stainless steel screws. Each disconnect means for service, feeder, branch, or equipment conductors, shall have nameplates indicating its purpose.

2.03 EQUIPMENT ASSEMBLIES

A. Equipment assemblies, such as Service Entrance Sections, Switchgear, Switchboards, Control and Distribution Panels, and other custom fabricated electrical enclosures shall bear a UL label as a complete assembly. The UL label on the individual components making up the assembly will not be considered sufficient to meet the present requirement. Whenever a generic UL label does not apply for the assembly, a serialized UL label shall be affixed to the assembly, and the serial number shall be submitted with the assembly record shop drawings.

B. Custom fabricated electrical control panels, and enclosures, shall bear a UL label affixed by a local UL inspector.

PART 3 - EXECUTION

3.01 UTILITY SERVICE AND EQUIPMENT

A. ELECTRICAL UTILITY

The Contractor shall be responsible for contacting and coordinating the electrical utility work with the electrical utility company. The Contractor shall be responsible for furnishing and installing equipment and material required to bring electrical power service to the service location in conformance with the electrical utility requirements. The Contractor may have to provide the following for the electrical utility company's primary (from utility power line to the utility transformer) and secondary (from utility transformer to the service) electrical lines in accordance with the electrical utility company's specifications and requirements:

1. Conduits (verify quantity and sizes)
2. Trenching, backfill, and compacting (verify trench size(s), backfill material, and compaction percentage requirements)
2. Concrete pad(s) (for pad mounted transformer(s))
3. Cable protection along the vertical drop at the utility company's pole (if pole mounted transformer(s))
4. Other items required by the power utility company's specifications

   The Contractor shall also submit copies of service entrance shop Drawings to the utility, per utility submittal requirements, prior to submittal to the Engineer. The Contractor shall obtain written approval from the power utility company that the

service entrance equipment is acceptable prior to release the order to the supplier for fabrication. A copy of the approval letter from the utility shall be transmitted to the Engineer along with the submittal.

B. TELEPHONE SERVICE

The Contractor shall be responsible for contacting the Telephone Company to coordinate requirements to provide telephone service, as called for on the Plans. The Contractor shall provide trenching, conduit, and backfill for the Telephone Company's communication lines from the Telephone Company's main distribution panel to the telephone company's connection box at this project site, as required by the Telephone Company.

3.02 INSTALLATION OF ELECTRICAL EQUIPMENT

A. Coordinate the installation of electrical equipment with other trades.
   1. Arrange for the building in of equipment during structure construction.
   2. Where equipment cannot be built-in during construction, arrange for sleeves, box-outs, and other openings, as required to allow installation of equipment after structure construction is complete.

B. Verify that equipment will fit support layouts indicated.

C. Equipment Dimensions and Clearances:
   1. Do not use equipment that exceeds the indicated dimensions.
      a. Except as approved in writing by the Engineer.
   2. Do not use equipment or arrangements of equipment that reduce required clearances or exceed the space allocation.

D. Install equipment in accordance with the manufacturer's instructions.

E. Equipment Access:
   1. Install equipment so it is readily accessible for operation and maintenance.
   2. Equipment shall not be blocked or concealed.
   3. Do not install electrical equipment such that it interferes with normal maintenance requirements of other equipment.

F. Equipment shall be installed plumb, square and true with the building construction, and shall be securely fastened.

G. Outdoor wall-mounted equipment, and indoor equipment mounted on earth, or water bearing walls, shall be provided with corrosion-resistant spacers to maintain ¼-inch separation between the equipment and the wall.

H. Screen or seal all openings into outdoor equipment to prevent the entrance of rodents and insects.

I. Equipment fabricated from aluminum shall not be imbedded in earth or concrete.

J. Provide all necessary anchoring devices and supports.
   1. Use supports as detailed on the Plans and as specified.
   2. Supports and anchoring devices shall be rated and sized based on dimensions and weights verified from approved equipment submittals.
   3. Hardware shall be stainless steel.
   4. Do not cut, or weld to, building structural members.
   5. Do not mount safety switches and external equipment to other equipment enclosures, unless enclosure mounting surface is properly braced to accept mounting of external equipment.

K. Contractor shall verify exact rough-in location and dimensions for connection to electrical items furnished by others.
   1. Shop drawings shall be obtained from those furnishing the equipment.
   2. Proceeding without proper information may require the Contractor to remove and replace work that does not meet the conditions imposed by the equipment supplied.
   3. Provide sleeves wherever openings are required through new concrete or masonry members. Place sleeves accurately and coordinate locations with the Engineer.
   4. Should any cutting and patching be required on account of failure of the Contractor to coordinate penetrations, such cutting and patching shall be done at the expense of the Contractor.
      a. The Contractor shall not endanger the stability of any structural member by cutting, digging, chasing, or drilling and shall not, at any time, cut or alter the work without the Engineer's written consent.
         1) Provide additional reinforcing if required.
         2) Cutting shall be done neatly using proper tools and methods.
      b. Subsequent patching to restore walls, ceilings, or floors to their original condition shall be done by the Contractor.

L. Provide concrete foundations or pads required for electrical equipment as indicated or specified.
   1. Floor-mounted equipment shall be mounted on a 4-inch concrete housekeeping pad. Pad shall be poured on top of the finished floor or slab.

3.03 TEMPORARY POWER

A. The Contractor shall furnish, install, and maintain, temporary power and lighting systems needed for construction. This temporary system shall include weatherproof panel(s) for the Contractor's main breakers and distribution system. Ground fault interrupting equipment shall be installed. Connections shall be watertight, with wiring done with Type SO portable cable. After construction is completed, the Contractor shall remove temporary power equipment and devices.

3.04 CUTTING AND REPAIRING

A. Where it becomes necessary to cut into existing work for the purpose of making electrical installations, core drills shall be used for making circular holes. Other demolition methods for cutting or removing shall be reviewed by the Engineer prior to starting the work.

B. The Contractor shall repair damage caused by construction, or demolition work, and restore damaged areas to original condition.

3.05 CORROSION PROTECTION

A. Wherever dissimilar metals, except conduit and conduit fittings, come in contact, the Contractor shall isolate these metals, as required, with neoprene washers, 9 mil polyethylene tape, or gaskets. Where fastening conduit, electro plated, or equivalent fasteners and stainless steel bolts shall be used.

B. Factory finishes damaged during shipping, or construction, shall be restored to original new condition. Rust shall be removed, and bare metal surfaces shall be primed and painted to match the original surrounding finish.

C. Electrical panels, switchgear, motor control centers, and other electrical equipment, shall be shipped in sealed dust and moisture proof plastic sheet enclosures, and the seal maintained until units are installed. Said units shall be new and free of any dirt, dust, water, grease, rust, damaged parts or components. Relays, starters, circuit breakers, switches, contacts, insulators, mechanisms, and buses shall be free of dust, dirt, oil, moisture, metal shavings, and other debris before testing and energizing.

D. Once equipment is installed, it shall be protected at all times with plastic sheet covers until the area is free of dirt, dust, paint spray, water, and other trades. Heat shall be provided to eliminate condensation.

3.06 COORDINATION OF THE ELECTRICAL SYSTEM

A. The Contractor shall verify actual equipment, and motor full-load, and locked-rotor current ratings. The necessary minimum equipment, wire, and conduit sizes are indicated on the Plans. If the Contractor furnishes equipment of different ratings, the Contractor shall coordinate the actual current rating of equipment furnished with the branch circuit conductor size, the overcurrent protection, the controller size, the motor starter, and the branch circuit overcurrent protection. The branch circuit conductors shall have a current carrying capacity of not less than 125 percent of the actual full-load current rating. The size of the branch circuit conductors shall be such that the voltage drop from the overcurrent protection devices, up to the equipment, shall not exceed 2 percent, when the equipment is running at full-load and rated voltage.

3.07 TEST

A. The electrical work shall be free from improper grounds, and from short circuits. The correctness of the wiring shall be verified first by visual comparison of the conductor connections with connection diagrams. Next, individual circuit continuity checks shall be made by using electrical circuit testers. Last, the correctness of the wiring shall be verified by the actual electrical operation of the electrical and mechanical devices. Any deviation from the wiring indicated on the Plans, or accepted Drawings, shall be corrected and indicated on the record drawings.

B. Each conductor shall be identified as required by the Contract Documents. This identification shall be indicated on the record drawings to enable rapid, and accurate circuit tracing by maintenance personnel.

3.08 SINGLE LINE DIAGRAMS

A. Single line diagrams, as indicated on the Drawings, show circuit voltages, circuit protection rating, and other pertinent data. Where conflicts exist on the Drawings, the single line diagrams shall take precedence. Grounding conductors are not necessarily indicated. See grounding requirements specified elsewhere herein.

End of Section

2. Connections shown or otherwise indicated as disconnected shall be removed with lugs left in place and with all conduit and cable openings properly plugged and sealed as required by the NEC.
3. Any abandoned in-place equipment damaged by Contractor shall be repaired and restored to its original condition.

End of Section

SECTION 16111

CONDUITS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Furnish and install conduits as required, and as shown on the Plans. Materials employed shall be as shown on the Plans.

1.02 SUBMITTALS

A. Submit product literature including manufacturer part number, model number, material, size, and specifications. Material shall not be installed until the Engineer has reviewed the submittal data.

B. Shop Drawings shall be submitted for review and acceptance showing routing, conduit size, and number and size of wires in each conduit before installation of conduit and any related work.

C. Proposed routing of conduits buried under floor slabs-on-grade.

D. Identify conduit by tag number of equipment served or by circuit schedule number.

E. Proposed routing and details of construction including conduit and rebar embedded in floor slabs, columns, etc. Identify conduit by tag number of equipment served or by circuit schedule number.

F. Proposed location and details of construction for openings in slabs and walls for raceway runs.

G. Refer to Section 16000 for further submittal requirements.

1.03 REFERENCES

A. American National Standards Institute (ANSI): C80.1, Rigid Steel Conduit - Zinc-Coated.

B. National Electric Manufacturers Association (NEMA): RN-1, Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit.

C. Underwriters Laboratories Inc. (UL):
   1. 1, Flexible Metal Conduit.
   2. 6, Rigid Metal Conduit.

3. 360, Liquid-Tight Flexible Steel Conduit.
4. 467, Grounding and Bonding Equipment.
5. 514, Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers.
6. 651, Schedule 40 and 80 Rigid PVC Conduit.
7. 870, Wireways, Auxiliary Gutters, and Associated Fittings.
8. 884, Underfloor Raceways and Fittings.
9. 886, Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations.

PART 2 - PRODUCTS

2.01 RACEWAYS

A. Exposed conduit in an unclassified or hazardous area shall be galvanized rigid steel (GRS) unless specifically indicated otherwise on the Drawings. Conduits in the corrosive areas shall be PVC coated GRS unless otherwise indicated. Underground and/or concrete encased conduits shall be PVC, unless otherwise indicated. All wiring, except as otherwise noted, shall be in conduit. Conduit size shall not be less than the National Electrical Code (NEC) size required for the conductors therein and shall not be smaller than 3/4-inch. No underground conduit shall be less than one inch.

B. Condulet type fittings shall be Crouse-Hinds, Appleton, or equal with wedge nut covers. All condulets located outdoors or in wet locations shall be weathertight.

C. In unclassified areas, flexible conduit shall be grounding type, weatherproof, corrosion resistant, and watertight.

D. Couplings, connectors, and fittings shall be standard types specifically designed and manufactured for the purpose. They shall be installed to provide a firm mechanical assembly and electrical conductivity throughout.

E. Expansion fittings shall be OZ type AX with jumper for exposed locations and type DX at structural expansion joints, Spring City, or equal. Conduits shall have expansion fittings in accordance with NEC.

F. The conduits and fittings shall be supported per NEC requirements as a minimum.

2.02 GALVANIZED RIGID STEEL (GRS)

A. Conduit and couplings shall be hot-dipped galvanized with zinc coated threads and outer coating of zinc bichromate, in accordance with ANSI C80.1 standards, as manufactured by Jones & Laughlin Steel Corporation, Allied Tube & Conduit Corporation, Triagle PWC, or equal.

B. Steel conduit shall not be buried in earth without concrete encasement and additional corrosion protection. A half lapped rapping of 20 mil PVC based corrosion protection tape shall be used.

2.03 PVC COATED GALVANIZED RIGID STEEL (PVC-GRS)

A. PVC coated GRS conduit shall be installed where shown on the Drawings or elsewhere specified and shall conform to NEMA RN-1 and ANSI C80.1 standards.

B. The zinc surface of the conduit shall remain intact and undisturbed on both the inside and the outside of the conduit throughout the preparation and application processing. A Polyvinyl Chloride (PVC) coating shall be bonded to the galvanized outer surface of the conduit. The bond between the PVC coating and the conduit surface shall be greater than the tensile strength of the plastic. The thickness of the PVC coating shall be a minimum of 0.040-inch (40 mil).

C. A loose coupling shall be furnished with each length of conduit. A PVC coating shall be bonded to the outer surface of the coupling and a PVC sleeve equal to the outside diameter of the uncoated conduit shall extend beyond both ends of the coupling approximately one pipe diameter or 1-1/2 inches, whichever is smaller. The wall thickness of the coating on the coupling and the sleeve shall be a minimum of 0.055-inch (55 mil).

D. A PVC coating shall be bonded to the inner and outer surface of all conduit bodies and fittings and a PVC sleeve shall extend from all hubs. The wall thickness of the coating on conduit bodies and fittings and the sleeve walls shall be identical to those on couplings in length and thickness. The covers on all conduit bodies shall be coated on both sides and shall be designed to be completely interchangeable. The inside of conduit bodies shall remain undisturbed in the processing.

E. Type 304 stainless steel screws shall be furnished and used to attach the cover to the conduit body. All coated material shall be installed and patched according to the manufacturer's recommended installation and patching instructions.

F. Conduit straps shall be PVC coated or stainless steel.

G. PVC coated conduit and fittings shall be as manufactured by Kor Kap Corporation, Occidental Coating Company, Rob-Roy, or equal.

H. PVC coated flexible GRS conduits shall be liquid and vaportight and manufactured in accordance with UL 300 standards.

2.04 RIGID NONMETALLIC - PVC

A. Where specifically indicated on the Drawings, or elsewhere specified, conduit may be high density Schedule 40, 90 degrees C, heavy-duty PVC. The conduit shall be manufactured

from virgin polyvinyl chloride compound which meets ASTM D1784, NEMA TC-2, ANSI C33.91, and UL 651 standards. Smoke emissions shall be limited to less than 6 grams per 100 grams of material tested.

B. Where conduit concrete encasement is indicated on the Drawings, conduit supports shall be installed at five foot intervals. PVC conduit shall be manufactured by Carlon, Triangle Conduit & Cable, or equal.

2.05 INTERMEDIATE METAL CONDUIT

A. Conduit and couplings shall be galvanized intermediate metal conduit manufactured in accordance with UL 1242 and as manufactured by Allied Tube & Conduit Corporation, Jones & Laughlin Steel Corporation, or equal.

B. Intermediate metal conduit shall not be buried without concrete encasement. Threadless couplings and connectors shall not be used.

2.06 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Liquidtight flexible metal conduit shall be liquid and vaportight, oil and ultraviolet ray resistant and manufactured in accordance with UL 300 standards. Liquidtight flexible metal conduit shall be formed of a continuous, spiral wound, galvanized steel core with an extruded PVC jacket. The PVC jacket shall be rated for high ambient heat applications, 90 degrees Celsius.

B. For corrosive locations, liquidtight flexible metal conduit shall be formed of a continuous, spiral wound, aluminum core with an extruded PVC jacket. The PVC jacket shall be impervious to corrosive liquids and vapors.

C. An external bonding conductor shall be required for flexible conduit connections containing circuits rated at 60 amps or greater and for sizes 1 1/2 " or larger. Flexible conduit and connectors for 1 1/4 " and smaller shall be listed for grounding.

D. Connectors for liquidtight flexible conduit shall be galvanized, furnished with a sealing ring and locknut, and suitable for wet locations.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Conduit runs are schematic only, and shall be modified as required to suit field conditions, subject to review and acceptance by the Engineer.

B. Conduit shall run continuously between outlets and shall be provided with junction boxes where connections are made. Couplings, connectors, and fittings shall be acceptable types designed and manufactured for the purpose, and shall provide a firm mechanical assembly, and electrical conductivity throughout.

C. Conduit runs shall be straight and true. Elbows, offsets, and bends shall be uniform and symmetrical. Changes in direction shall be made with long radius bends, or with fittings of the condulet type.

D. Conduit runs in buildings and structures shall be exposed except as specifically noted, or accepted by the Engineer.

E. Conduit runs shall not interfere with the proper and safe operation of equipment, and shall not block or interfere with ingress or egress, including equipment removal hatches.

F. Exposed conduits shall be securely fastened with clamps, or straps, intended for conduit use. All exposed conduit shall be run on the walls and ceiling only and shall be parallel to the planes of the walls or ceiling. No diagonal runs will be permitted. Flexible conduit shall be used only for short lengths required to facilitate connections between rigid conduit to motors from junction boxes, or control equipment. The maximum length of flexible conduit shall be 3 feet.

G. Conduit runs on water-bearing walls shall be supported one inch away from the wall on an accepted channel. When channel galvanizing, or other coating, is cut or otherwise damaged, it shall be field coated to original condition. No conduit shall be run in water-bearing walls, unless specifically designated otherwise.

H. Conduit shall be thoroughly reamed to remove burrs. IMC or GRS shall be reamed during the treading process, and Rigid Nonmetallic PVC shall be reamed before applying fittings. A zinc rich cold galvanizing shall be used to restore corrosion protection on field cut threads. Bushings and lock nuts or hubs shall be used at conduit termination's. The total number of bends in any run between pull points shall not exceed 360 degrees. Junction boxes and pull boxes shall be installed at points acceptable to the Engineer. Conduit ends shall be plugged to prevent the entrance of moisture or debris during construction. All spare conduits shall be adequately capped and shall contain a suitable pull string.

I. Joints shall be set up tight. Hangers and fastenings shall be secure, and of a type appropriate in design, and dimensions, for the particular application.

J. Conduit runs shall be cleaned and internally sized (obstruction tested) so that no foreign objects, or obstructions remain in the conduit prior to pulling in conductors.

K. After installation of complete conduit runs 2 inches and larger, conduits shall be snaked with a conduit cleaner equipped with a cylindrical mandrel of a diameter not less than 85

percent of the nominal diameter of the conduit. Conduits through which the mandrel will not pass shall not be used.

L. Expansion fittings shall be installed across all expansion joints and at other locations where necessary to compensate for thermal expansion and contraction.

M. Provide trenching, backfill, and compaction for conduits installed underground.

End of Section

SECTION 16123

600 VOLT CLASS CABLE

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This section covers the furnishing and installation of 600 Volt Class cables and conductors, terminations and splicing, and pulling lubricants.

1.02 SUBMITTALS

A. Products shall be submitted in accordance with Section 16000, and elsewhere in the Contract Documents, prior to installation.

1.03 REFERENCES

A. Insulated Cable Engineers Association/National Electrical Manufacturers Association (ICEA/NEMA):
   1. S-68-516/WC 8, ethylene-propylene rubber-insulated wire and cable for the transmission and distribution of electrical energy.
   2. S-61-402/WC 5, thermoplastic-insulated wire and cable for the transmission and distribution of electrical energy.
   3. S-66-524/WC 7, cross-linked thermosetting-polyethylene-insulated wire and cable for transmission and distribution of electrical energy.

B. Underwriters Laboratory, Inc.
   1. 44, rubber insulated wires and cables.
   2. 83, thermoplastic-insulated wires and cables.
   3. 486A, wire connectors and soldering lugs for use with copper conductors.
   4. 486B, wire connectors for use with aluminum conductors.
   5. 510, insulating tape.

C. National Electric Code

D. Insulated Cable Engineers Association

PART 2 - PRODUCTS

2.01 ACCEPTED MANUFACTURERS

A. Conductors and Multi Conductor Cables (MCC), subject to compliance with Contract Documents, the following manufacturers are acceptable: American Insulated Wire Corporation, Cablec Corporation, Okonite Company, Southwire Company, or equal.

2.02 CONDUCTORS

A. Wire sizes shall be American Wire Gauge (AWG) sizes with Class B stranded construction. Number 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. Conductors sized No. 1 and larger shall be Type 2, rated for 90 degrees C. All circuit conductors, #6 or smaller shall be "THWN" stranded copper. All other conductors shall be "XHHW" stranded copper.

B. Individual or multiple conductor cables for power, control, and alarm circuits of 480 volts or less shall be insulated for not less than 600 volts and shall have insulation type as indicated on the Plans. "THHW" shall conform to ICEA S-61-402/NEMA WC 5 and UL 83 and "XHHW" shall conform to ICEA S-66-524/NEMA WC 7 and UL 44. Where wire size is not indicated, they shall be of the size required by the NEC, except that no wire external to panels and motor control centers shall be less than No. 12 AWG, unless specifically noted on the Plans. Panel control wiring shall not be less than No. 14 AWG.

C. All wiring shall be as indicated on the Plans. Wires shall be new and shall be soft drawn copper with not less than 97 percent conductivity. The wire and cable shall have size, grade of insulation, voltage, and manufacturer's name permanently marked on the outer covering at not more than 2-foot intervals. All wires shall conform to the latest Standards of the ASTM, and ICEA, and shall be tested for their full length by these Standards. Insulation thickness shall be not less than that specified by the National Electrical Code.

2.03 TERMINATIONS AND SPLICES

A. Cable shall be rated 600 volts. Other parts of cable systems such as splices and terminations shall be rated at not less than 600 volts. Splicing shall join conductors mechanically and electrically to provide a complete circuit prior to installation of insulation.

B. Splices in wires No. 10 AWG and smaller shall be made with an insulated, solderless, pressure type connector, Type I, Class 1, Grade B, Style G, or Type II, Class 1 of FS W-S-610 and conforming to the applicable requirements of UL 486A.

C. Splices in wires No. 8 AWG and larger shall be made with noninsulated, solderless, pressure type connector, Type II, Class 2 of FS W-S-610, conforming to the applicable requirements of UL 486A and UL 486B. They shall then be covered with an insulation and jacket material equivalent to the conductor insulation and jacket.

D. All splices below grade or in wet locations shall be sealed type conforming to ANSI C119.1 or shall be waterproofed by a sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring a thermosetting resin into a mold that surrounds the joined conductors.

E. Conductors, including grounding conductors, of different sizes shall be spliced and then soldered or welded. Splices in wet locations and all splices below grade shall be of the Exothermic type.

2.04 PULLING LUBRICANT

A. All cables shall be properly coated with pulling compound (Aqua Gel, CRC, or equal) before being pulled into conduits so as to prevent mechanical damage to the cables during installation. "Yellow 77" is not acceptable.

B. Other lubricants to be substituted must be accompanied by a statement from the cable manufacturer as to its acceptable use with the cable being installed.

2.05 IDENTIFICATION

A. All conductors shall be numbered with "tube sleeve" type tags with heat impressed letters and numbers.

B. Color code all wiring as follows:

1. Lighting and power wiring:

		120/208 V	480V	24 DC	120 VAC Control/ Power
a.	Phase 1	Black	Brown	Blue	Red
b.	Phase 2	Red	Orange		
c.	Phase 3	Blue	Yellow		
d.	Neutrals	White	White		White
e.	Ground	Green	Green		

2. Color code ends of feeder phase conductors only.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The pulling tension and side-wall pressures, as recommended by the cable manufacturer, shall not be exceeded.

B. As far as practical, all circuits shall be continuous from origin to termination without splices in intermediate pull boxes. Sufficient slack shall be left at the termination to make proper connections. In no case shall a splice be pulled into the conduit. Conductor splicing shall not be permitted without the Engineer's approval.

C. Install all cables in conduit.

D. Each feeder and branch circuit shall be installed in its own individual conduit unless combining feeder and branch circuits is permitted as defined in the following:
   1. As specifically indicated on the Plans.
   2. For lighting, multiple branch circuits may be installed in a conduit as allowed by the NEC and with the wire ampacity derated in accordance with the requirements of the NEC. Conduit fill shall not exceed the limits established by the NEC.
   3. When field conditions dictate and written permission is obtained from the Engineer.

E. Feeder and branch circuits shall be isolated from each other and from all instrumentation and control circuits.

F. Control circuits shall be isolated from all other feeder, branch and instrumentation circuits, except as noted above.
   1. 12 V DC, 24 V DC and 48 V DC control circuits may be combined in common conduit.
   2. 125 V DC control circuits shall be isolated from all other DC and AC control circuits.
   3. 120 V AC control circuits shall be isolated from all DC control circuits.

G. Make splices only at pull or junction boxes.
   1. Crimp or indenter-type connectors are not allowed, except for control circuits landed on terminal strips.
   2. For wire smaller than #6 AWG: Use insulated conical spring type connectors, or "wirenuts".
   3. For #6 AWG and larger wire: Use solderless lugs and screw type connectors.

End of Section

SECTION 16124

INSTRUMENTATION CLASS CABLE

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This section covers cable use for process signal and controls.

1.02 SUBMITTALS

A. Products shall be submitted in accordance with Section 16000, and elsewhere in the Contract Documents, prior to installation.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with Contract Documents, the instrumentation cable shall be as manufactured by Belden, Okonite, or equal.

2.02 INSTRUMENTATION CABLE

A. Instrument cable shall be Type TC, and have the number of individually shielded twisted pairs indicated on the Plans and shall be insulated for not less than 600 volts. Unless otherwise indicated, conductor size shall be No. 18 AWG minimum. Shielded, grounded instrumentation cable shall be used for all analog and low voltage digital signals.

B. The jacket shall be flame retardant with 90 degrees C temperature rating. The cable shield shall be a minimum of 2.3 mil aluminum or copper tape overlapped to provide 100 percent coverage and a tinned copper drain wire.

C. The conductors shall be bare soft annealed copper, Class B, 7 strand minimum concentric lay with 15 mils nominal thickness, nylon jacket, 4 mil nominal thickness, 90 degrees C temperature rating. One conductor within each pair shall be numerically identified.

D. Pairs shall be assembled with a nominal 2-inch lay and shall then be group shielded with a minimum of 1.3 mil aluminum or copper tape overlapped to provide 100 percent coverage. All group shields shall be completely isolated from each other.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Feeder and branch circuits shall be isolated from each other, and from instrumentation and control circuits. Instrumentation cables shall be installed in separate raceways from other cables and wiring. This includes portions running through manholes. Instrumentation cable shall be continuous between instruments or between field devices and instrument enclosures. There shall be no intermediate splices or terminal boards, unless otherwise shown on the Plans..

B. Maintain electrical continuity of the shield when splicing twisted shielded pair conductors. Drain wires shall be terminated inside enclosures at grounded terminal blocks. Only one end of each instrument loop cable drain wire shall be grounded. Ground drain wire of shielded conductors at one end only.

C. Terminate instrumentation and control wiring, including spare wires, at control panels and motor control centers on terminal boards mounted inside the equipment.
   1. Contractor shall supply terminal boards as required.
   2. Do not field wire directly to devices.

End of Section

SECTION 16140

OUTLET, SWITCH, PULL AND JUNCTION BOXES

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This section covers outlets, switches, pulls and junction boxes.

1.02 SUBMITTALS

A. Products shall be submitted in accordance with Section 16000, and elsewhere in the Contract Documents, prior to installation.

PART 2 - PRODUCTS

2.01 Subject to compliance with the Contract Documents, the boxes shall be manufactured by Crouse-Hinds, Appleton, or equal.

2.02 BOXES

A. Pull and junction boxes for non-classified areas shall be 14 GA, galvanized steel with concentric knockouts on all four sides and flat cover fastened with screws. Boxes shall be NEMA 1 classification and UL listed.

B. Pull and junction boxes for wet areas shall be 14 GA steel with polyester power coating inside and out over phosphatized surfaces with seams continuously welded, ground smooth, no knockouts and stainless steel clamps on four sides and flat cover with oil resistant gasket. Boxes shall be NEMA 4 classification and UL listed.

C. Pull and junction boxes for corrosive areas shall be stainless steel with seams continuously welded, ground smooth, no knockouts, rolled lip around all sides, hinged door, captivated stainless steel door screws, and flat door with oil resistant gasket. Boxes shall be NEMA 4X classification and UL listed.

D. Outlet and switch boxes shall be cadmium plated, cast, ferrous, metal, with threaded hubs for exposed wiring. Outlet and switch boxes shall be code gauge, hot-dip galvanized steel with bar hangers for metal stud partition grounding screws, and barriers between switches in boxes with 277 V switches on opposite phases for concealed wiring.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install boxes in accordance with NEC rules and regulations.

End of Section

SECTION 16143

TERMINAL BLOCKS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This section covers terminal blocks for control and other wiring.

1.02 SUBMITTALS

A. Products shall be submitted in accordance with Section 16000, and elsewhere in the Contract Documents, prior to installation.

1.03 MANUFACTURERS

A. Terminal blocks shall be Entrelec, Phoenix Contact, Weidmuller, or equal.

PART 2 - PRODUCTS

2.01 TERMINAL BLOCKS

A. Terminal blocks shall mount on standard DIN rail, and be of the size required for conductors therein. A minimum of 25 percent spares shall be provided in each terminal box. No more than 2 conductors shall be allowed per termination. Jumper bar assemblies shall be installed for interconnecting terminal blocks, distributing power and signal commons. Terminal blocks shall be U.L. rated for 600 Volts, and 30 Amps, minimum.

B. Grounding terminal blocks shall be provided for instrumentation cable shields. The terminal blocks shall have distinctive 2-color bodies, and shall be mounted to the DIN rail with metal screw down type clamps, providing a positive ground connection. One grounding terminal block shall be installed for every 2 instrument cables terminated. Grounding terminal blocks shall be U.L. rated for 600 Volts, and 20 Amps, minimum.

C. Terminal blocks shall be available in a variety of colors, including red, green, blue, gray, black, yellow, and orange.

D. DIN mount fuse holders shall have blown fuse indicators for DC and AC circuits. Fuse holders shall be of the compression clamp type. Fuse holders shall be U.L. listed, and rated for 600 Volts. Fuse sizes shall not exceed the U.L. current rating for the fuse holders.

E. Ground fault circuit interrupter receptacle shall be straight blade, grounding type, specification grade, rated 20 A, 125 V AC, UL listed, with test and reset buttons. Wall plate shall be indoor or weatherproof as required, feed-thru type. Restroom, exterior, and wet areas receptacles shall be GFCI type.

F. Lighting switches for corrosive areas shall be corrosion-resistant NEMA 4X enclosure with switch consisting of fiberglass reinforced polyester enclosure, fiberglass reinforced polyester gasketed wall plate with built-in toggle lever switch with stainless steel shaft, grounding bushing, rated 20 A, 125 V AC, UL listed, and type as indicated on Drawings.

G. Receptacles for corrosive areas shall be corrosion-resistant straight blade, grounding type, specification grade, back and side wired with wrap-around bridge, rated 20 A, 125 V AC, UL listed, yellow, with "FS" or "FD" ridge type cast hub box of copper-free aluminum, neoprene gasket, weatherproof, cast aluminum, UL listed, WDL open or closed, wall plate and type as indicated on Drawings.

H. Lighting switches for explosive areas shall be explosion-proof, UL listed for Class I, Division 1 and 2, Groups B, C, and D; and Class II, Division 1 and 2 areas, Groups E, F, and G, EDS factory sealed, malleable iron body and cover, aluminum sealing chamber, front operated handle with stainless steel shaft, rated 20 A, 125 V AC, and type as indicated on Drawings.

I. Receptacles for Explosive areas shall be explosion-proof, UL listed for Class I, Division 1 and 2, Groups B, C, and D; and Class II, Division 1 and 2, Groups F and G, factory-sealed malleable iron receptacle with spring-loaded cover, malleable iron mounting box, rated 20 A, 125 V AC, "dead-front" construction requiring plug to be inserted and rotated to activate receptacle, and type as indicated on Drawings.

PART 3 - EXECUTION

1.0 INSTALLATION

A. Install switches and receptacles in accordance with NEC rules and regulations (and ADA when applicable).

End of Section

SECTION 16141

LIGHTING SWITCHES AND RECEPTACLES

PART 1 - GENERAL

1.01 SCOPE OF WORK

A This section covers devices for the control and supply of electrical power.

1.02 SUBMITTALS

A. Products shall be submitted in accordance with Section 16000, and elsewhere in the Contract Documents, prior to installation.

1.03 REFERENCES

A. NEC

B. UL

PART 2 - PRODUCTS

2.01 MATERIALS

A. Lighting switches for unclassified areas shall be toggle type, quiet action, specification grade with grounding terminal, back and side wired, solid silver cadmium oxide contacts, one-piece switch arm rated 20 A, 120/277 V AC, UL listed, ivory, type 304 stainless steel cover, and type as indicated on Drawings.

B. Receptacle for unclassified areas shall be straight blade, grounding type, specification grade, back and side wired with wrap-around bridge, rated 20A, 125 V AC, UL listed, ivory, type 304 stainless steel cover, and type as indicated on Drawings.

C. Lighting switches for wet areas shall be press switch type, quiet action, specification grade, with grounding terminal, back and side wired, solid silver cadmium oxide contacts, one-piece switch arm rated 20 A, 120/277 V AC, UL listed, ivory, gray weatherproof press switch type cover, and type as indicated on Drawings.

D. Receptacles for wet areas shall be straight blade, grounding type, specification grade, back and side wired with wrap around bridge, rated 20 A, 125 V AC, UL listed, ivory, weatherproof cover, cast aluminum, UL listed, WDL open and closed and type as indicated on Drawings.

E. DIN rail shall be prepunched, zinc bichromate plated steel. Symmetrical DIN rail shall be 35mmX7.5mm, minimum.

F. Terminal blocks for 4 to 20 milliamp signals shall have knife disconnect switches, and accessible test points for testing and measurement of current loop signals, without the need for removing wire terminations.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Each terminal block and fuse holder shall be identified with the circuit number, or conductor number, corresponding to the identification appearing on the shop Drawings for the equipment, or system.

B. Terminal block and fuse holder markers shall be computer printed plastic-type, with permanent markings.

C. End clamps and end sections shall be installed on each terminal block and fuse holder assembly.

D. Terminal blocks for DC voltages shall be blue, and AC voltages shall be gray.

End of Section

SECTION 16160

ENCLOSURES

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This specification includes enclosures to house electrical controls, instruments, terminal blocks, and serve a junction boxes where shown on the Plans.

1.02 SUBMITTALS

A. Products shall be submitted in accordance with Section 16000, and elsewhere in the Contract Documents, prior to installation.

1.03 MANUFACTURERS

A. Enclosures shall be manufactured by Hoffman, Hammond, Tanco, Rittal, or equal.

PART 2 - PRODUCTS

2.01 STEEL

A. Enclosures shall be fabricated from 14 gauge steel with seams that are continuously welded. Doors shall have full length piano hinges with the door removable by pulling the hinge pin.

B. A rolled lip shall be provided around three sides of the door and around all sides of the enclosure opening. The gasket shall be attached with oil-resistant adhesive and held in place with steel retaining strips. Exterior hardware, such as clamps, screws, and hinge pins, shall be of stainless steel for outdoor installations. A hasp and staple shall be provided for padlocking. Each enclosure shall have a print pocket. All wires entering or leaving the enclosure shall terminate on terminal strips. All wires and terminals shall be clearly identified as specified elsewhere in these specifications.

C. Finish shall be white enamel interior, light grey enamel, ANSI 61 exterior, over phosphatized surfaces. Special finishes and colors shall be furnished for wet locations. Plans should be checked for special conditions.

2.02 NEMA RATING

A. Unless otherwise indicated on the Plans, enclosures shall be NEMA 12 for indoors, NEMA 4X for corrosive areas, and NEMA 4 for outdoor installations. NEMA 4X enclosures shall be stainless steel. NEMA 4 enclosures shall also be used in wet, or wash down areas.

2.03 FIBERGLASS

A. Enclosures shall be heavy-duty, compression molded, fiberglass reinforced polyester, high impact, heat resistant, NEMA 4X.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Enclosures shall be installed as indicated on the Plans, and according to manufacturer's instructions.

B. Enclosures shall be properly grounded, and shall include ground straps connected to hinged doors and accessories.

End of Section

SECTION 16170

GROUNDING

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. A ground grid system consisting of the indicated configuration of copper wires, and ground rods, or concrete encased grounding electrodes ("UFERs") shall be provided to minimize station potential gradient irregularities and drain leakage and fault currents to earth.

B. Whether indicated on the Plans or not, neutral conductors, cable shields, metallic conduits, cable terminations, junction boxes, poles, surge arresters, and other noncurrent-carrying metallic parts of equipment shall be grounded.

1.02 SUBMITTALS

A. Products shall be submitted in accordance with Section 16000, and elsewhere in the Contract Documents, prior to installation.

1.03 REFERENCES

A. National Electrical Code (NEC) Article 250

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

A. A resistance of not greater than 25 ohms shall be provided, unless otherwise specified. Ground resistances shall be measured as herein described. Resistances of systems requiring separate ground rods, rather than a counterpoise, shall be measured separately before bonding below grade. The combined ground resistance of separate systems bonded together below grade may be used to meet the specified ground resistance, but the minimum number of rods indicated must still be provided.

2.02 GROUND RODS

A. Ground rods shall be copper-clad steel conforming to UL 467, 3/4 inch in diameter by 10 feet in length. Unless otherwise indicated, ground rods shall be driven into the ground until tops of rods are approximately 6 inches below finished grade. In counterpoise systems, tops of ground rods shall be approximately at elevations of counterpoises. Where the specified ground resistance cannot be met with the indicated number of ground rods, additional

F. Each unit shall include solid-state, long-life, externally mounted LED visual status indicators that indicate the diagnostic status of the following groups of suppression modules:
   1. Line to Neutral
   2. Line to Ground
   3. Neutral to Ground

G. Each TVSS shall include a disturbance counter for both common mode (L-G) and normal mode (L-N). The Disturbance Counters shall contain-lithium batteries and a reset function.

H. Each unit shall include a lockable_ fused safety disconnect switch, located in the unit enclosure with an externally mounted manual operator. Each switch shall disconnect all ungrounded circuit conductors from the distribution system to enable testing and maintenance without interruption of power to the facility's distribution system. The switch shall be rated for 600 Vac. Each current-carrying ungrounded circuit conductor connected to the facility's distribution system shall be individually fused with 200,000 AIC rated fuses (One 200,000 AIC Fuse Per Phase) in order to provide maximum fault current protection. The unit shall be UL 1449 Listed with the integral fused disconnect switch and the UL 1449 Suppression Rating for this configuration shall be provided.

PART 3 - EXECUTION

3.01 FIELD INSTALLATION

A. Each unit shall be installed adjacent to the electrical equipment as indicated on the Plans, avoiding unnecessary bends, in accordance with applicable national and local electrical codes, and the manufacturer's recommended installation instructions.

3.02 CERTIFICATION OF ON-LINE STATUS AND SUPPRESSION LEVELS

A. The Contractor shall submit the test results to the Engineer.

End of Section

SECTION 16622

OUTDOOR STANDBY DIESEL ELECTRICAL GENERATOR

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. A standby electric generating system shall be rated for standby service at minimum kilowatts as indicated on the Plans.

1.02 SUBMITTALS

A. Products shall be submitted in accordance with Section 16000, and the Contract Documents.

B. Provide a complete list of equipment and material, including manufacturer's descriptive data and technical literature, performance charts, catalog cuts and installation instructions, and spare parts. Submit data for each different item of equipment specified, including but not limited to engine, generator, switchgear, automatic transfer switch, vibration isolators, radiator, and other components. The data shall include a complete list of parts and source of supply.

C. Submit drawings containing actual dimensions, complete wiring and schematic diagrams, control diagrams, and any other details required to demonstrate that the system has been coordinated, and will properly function as a unit. Drawings shall show proposed layout, anchorage, support and appurtenances of equipment and equipment relationship to other parts of the work including clearances for maintenance and operations. Drawings shall show in details all piping connections for fuel.

D. Operation and maintenance manuals shall detail the step-by-step procedure required for system start-up, operation and routine maintenance. They shall include possible breakdowns and repairs, and troubleshooting guides, as well as simplified wiring and control diagrams of the system installed. Instruction manuals containing operation and maintenance procedures shall be supplied prior to acceptance of work.

E. Submit performance test reports in booklet form showing all field tests, and adjustments performed to prove compliance with specified criteria.

F. Miscellaneous:
   1. Manufacturers kilowatts output curve and fuel consumption.
   2. Manufacturers transient response data of the complete engine generator set upon 50%, 75%, and 100% block loads at 1.0 pf. Data shall include maximum voltage dips, maximum frequency dips, and recovery time periods.

3. Engine altitude duration curve.
4. Generator motor starting curves showing the voltage dips versus starting KVA.
5. Prototype test certifications showing all components comply with specifications.
6. The following spare parts for the engine generator shall be supplied to the OWNER prior to acceptance of work.
   a. Two sets of oil filters
   b. Two sets of heavy duty air filters
   c. One dozen spare lamps
   d. Two fuses (for each control circuit)

1.03 MANUFACTURERS

A. Generator set shall be manufactured by Kohler, Onan, Caterpillar, or equal

PART 2 - PRODUCTS

2.01 ENGINE GENERATOR SET

A. The provision of a standby electric generating system shall be rated for standby service as indicated on Plans and as described in these Specifications, delivered at 0.8 power factor, 480 volts, three phase, four wire, 60 hertz, for ambient air temperature of 50 degrees C, and specifically rated for the operating altitude shown on the Plans, without exceeding NEMA MG1 - temperature rise limits.

B. The system shall be a package of:
   1. A diesel engine driven electric plant to provide standby electric power.
   2. Engine mounted control system.
   3. An automatic load transfer switch for switching of the load and control to provide automatic starting and stopping of the engine generator system, as specified in Section 16495 of these Specifications.
   4. Mounted accessories as specified
   5. Integral fuel and exhaust systems.
   6. All other equipment as required to provide a complete and operable system.

C. The engine-generator set and all its accessories shall be constructed for outdoor installation and operation all electrical components shall be housed in NEMA 3R enclosures.

D. All materials, equipment, and parts comprising the units specified herein, shall be new and unused, or current manufacture and of the highest grade.

E. The engine, generator and all major items of auxiliary equipment shall be manufactured in the U.S. by manufacturers currently engaged in the production of such equipment. The unit shall be factory assembled and tested by the engine manufacturer and shipped to the job site by his authorized dealer having a parts and service facility in the area. The performance of

the electric plant shall be certified by manufacturer as to the plant's full power rating, stability and voltage and frequency regulation, and field load tested at site.

F. The units offered under these Contract Documents shall be covered by the manufacturer's standard warranty, or guarantee, on new machines, and shall be a minimum of two years after the date of substantial completion.

2.02 ENGINE

A. The engine shall be water cooled in-line, or Vee-type compression ignition diesel, designed to operate on No. 2 fuel oil. Diesel engines requiring premium fuels will not be considered. The engine shall be equipped with fuel, lube oil, and intake air filters; lube oil coolers, fuel transfer pump, fuel priming pump, and gear driven water pump.

B. The engine governor shall maintain frequency regulation not to exceed 1 percent from no load to full rated load.

C. The unit shall be mounted on a structural steel sub-base and shall be provided with suitable vibration isolators.

D. Safety shut-offs for high water temperature, low oil pressure, overspeed, and engine overcrank shall be provided. An engine-mounted radiator with blower type fan shall be sized to maintain safe operation at specified ambient temperature. The radiator shall be equipped for a duct adapter flange. Air flow restriction from the radiator shall not exceed 0.5 inch of water.

E. The engine cooling system shall be filled with a solution of 30 percent ethylene glycol.

F. Provide a Critical Grade type silencer as manufactured by Kittel, Maxim, or GT Exhaust Systems, including stainless steel flexible exhaust fitting, properly sized and installed, according to the manufacturer's recommendation. Mounting shall be provided as part of the generator set assembly. Silencer shall be mounted so that its weight is not supported by the engine. Exhaust pipe size shall be sufficient to ensure that measured exhaust back pressure does not exceed the maximum limitations specified by the generator set manufacturer. Noise attenuation shall limit the exhaust note to 85dBA within 15 feet of the exhaust stack.

G. Exhaust piping shall have stainless steel automatic exhaust cap, and shall be coated with not less than 6 mils of inorganic zinc after sandblasting to "white metal".

H. The fuel storage tank shall be a subbase type, with integral secondary containment, gauges, piping, fittings, and valves shall be supplied as part of the generator set. The fuel storage tank shall be aboveground and an integral part of the generator. The fuel tank shall be U.L. listed.

I. The tank shall be provided with a level gauge in the primary tank, and leak detection in the secondary tank capable of producing low level and leakage alarm.

J. The tank shall be of sufficient capacity to run the generator set at full load for 12 hours.

K. The level gauges shall be Liquidometer industrial type as manufactured by Hersey Products Company, Petro-Meter Company, or equal.

L. An engine-mounted fuel filter, fuel pressure gauge, and engine fuel priming pump shall be provided.

M. A DC electric starting system with positive engagement drive shall be furnished.

N. Fully automatic generator set start-stop controls in the generator control panel shall be provided. Controls shall provide two auxiliary contacts for activating accessory items. Controls shall include a 30 second cranking cycle limit with lockout. (Three 10 second cranks or a single 30 second crank.)

O. A unit mounted thermal circulation type water heater shall be furnished to maintain engine jacket water to 90 degrees F in an ambient temperature of zero degrees F. The heater shall be single phase, 60 hertz, 120 volts. Heater shall be Chromalox, General Electric, or equal.

P. A lead-acid storage battery set of the heavy-duty diesel starting type shall be provided. The battery set shall be of sufficient capacity to provide for 1-1/2 minutes total cranking time without recharging and shall be rated no less than 220 amp-hours. A battery rack and necessary cables and clamps shall be provided as part of the generator set.

Q. A current limiting battery charger shall be furnished to automatically recharge the batteries. The charger shall float at 2.17 volts per cell and equalize at 2.33 volts per cell. It shall include overload protection, silicon diode full wave rectifiers, voltage surge suppressers, DC ammeter, DC voltmeter and fused AC input. Amperage output shall be no less than 10 amperes.

2.03 GENERATOR

A. The generator shall be a 4-pole or 6-pole revolving field type with static exciter and magnetic amplifier or SCR voltage regulator. No commutator or commutator brushes shall be allowed. Class F insulation shall be used on the stator and rotor, and both shall be further protected with 100 percent epoxy impregnation and an overcoat of resilient insulating material to reduce possible fungus and/or abrasive deterioration. The starter shall be directly connected to the engine flywheel housing, and the rotor shall be driven through a semi-flexible driving flange to insure permanent alignment. Voltage regulation shall be within plus or minus 2 percent of rated voltage, from no load to full-load. The instantaneous voltage dip shall be less than 15 percent of rated voltage when full load and rated power factor is applied to the generator. Recovery to stable operation shall occur within 5 seconds. Stable or steady-state operation is defined as operation with terminal voltage remaining constant within plus or minus one percent of rated voltage. A rheostat shall provide a minimum of plus or minus 5 percent voltage adjustment from rated value. Temperature rise at full-load determined by resistance shall be within rating as defined by NEMA MG-1.

B. The specified standby kW shall be for continuous electrical service during interruption of the normal utility source.

C. These ratings must be substantiated by manufacturer's standard published curves. Special ratings or maximum ratings are not acceptable.

D. A generator mounted vibration isolated 14 gauge steel control panel shall be provided.

E. Control panel shall be microprocessor-based, and shall provide the following features:
   1. Voltmeter, 3-1/2 inch, 2 percent accuracy
   2. Ammeter, 3-1/2 inch, 2 percent accuracy
   3. Voltmeter/Ammeter phase selector switch
   4. Frequency meter, 3-1/2 inch, dial type
   5. Automatic starting controls
   6. Panel illumination lights and switch
   7. Voltage level adjustment rheostat
   8. Engine oil pressure gauge
   9. Engine water temperature gauge
   10. Dry contacts for remote alarms wired to terminal strips
   11. Fault indicators for low oil pressure, high water temperature, overspeed, and overcrank
   12. Four position function switch marked AUTO, MANUAL, OFF/RESET, and STOP
   13. Battery charge rate ammeter if not furnished on separate charger
   14. Running time meter

F. A generator mounted main line molded case circuit breaker shall be installed as a load circuit interrupting and protection device. It shall operate both manually for normal switching function and automatically during overload and short circuit conditions.

G. Generator exciter field circuit breakers do not meet the above electrical standards and are unacceptable for line protection.

H. Provide a sign at the service entrance equipment indicating type and location of standby power generator per NEC.

2.04 PANELBOARD

A. The generator system shall be equipped with a 120/240 volt, single phase, 40 amps minimum distribution panelboard. Higher amperage rated panelboards shall be provided if required by the system. The panelboard shall be UL67 listed. Buses shall be copper.

B. The panelboard shall be mounted where fully accessible. The panelboard enclosures shall be NEMA 3R unless installed inside the generator system's weatherproof housing. The minimum interrupting capacity of any device shall be 10,000 minimum unless indicated otherwise on plans.

C. All devices requiring power inside the generator system shall be prewired to the panelboard in accordance with NEC requirements. Provide grounding per NEC, and Section 16170 of the Specifications.

D. Panelboards shall be as manufactured by Square D, Westinghouse, Siemens, or equal.

PART 3 - EXECUTION

3.01 FACTORY TESTS

A. Before the equipment is installed, a factory certified test log of the generator set showing a minimum of ¾ hour testing with ½ hour at 100 percent rated load, continuously, shall be submitted to the ENGINEER.

3.02 INSTALLATION

A. The generating system shall be installed as indicated on the Plans, per manufacturer's recommendations and shall meet all applicable codes and regulations.

3.03 START-UP

A. On completion of the installation, start-up shall be performed by a factory-trained dealer service representative.

B. This generating system shall be full-load tested at site in the presence of the ENGINEER for a period of 8 hours, with supplier providing necessary resistive load banks. Any defects which become evident during this test shall be corrected by the CONTRACTOR at his own expense.

C. After installation the tank shall be filled with No. 2 fuel oil. The tank shall be refilled after the 8-hour on-site test.

3.04 GROUNDING

A. Provide grounding as shown on the Plans, and as per NEC.

End of Section

SECTION 16902

ELECTRICAL CONTROLS, RELAYS, AND ALARMS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This Section includes the following:
   1. Pushbutton and Selector Switches
   2. Relays
   3. Alarms

1.02 RELATED SECTIONS

A. Section 16160 - Enclosures

1.03 REFERENCES

A. NEMA ICS 1 - General Standards for Industrial Control Systems.

B. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers and Assemblies.

C. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

D. NEMA ST 1 - Standard for Specialty Transformers (Except General purpose Type).

1.04 SUBMITTALS

A. Data - a complete list of equipment and material including manufacturer's descriptive data and technical literature, performance charts, catalog cuts and installation instructions, spare parts data for each different item of equipment specified. The data shall include a complete Bill of Materials.

B. Drawings - containing complete wiring and schematic diagrams, control diagrams, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout, anchorage, support and appurtenances of equipment and equipment relationship to other parts of the work including clearances for maintenance and operations.

C. Submit shop drawings in accordance with the Contract Documents, and NEMA ICS 1 specifications indicating control panel layouts, wiring connections and diagrams, dimensions, support points.

1.05 PROJECT RECORD DOCUMENTS

A. Submit record documents in accordance with the Contract Documents.

B. Accurately record actual locations of control equipment. Revise diagrams included in Drawings to reflect actual control device connections.

1.06 OPERATION AND MAINTENANCE DATA

A. Submit operation data in accordance with the Contract Documents.

B. Include instructions for adjusting and resetting time delay relays, timers, and counters.

C. Submit maintenance data in accordance with the Contract Documents.

D. Include recommended preventative maintenance procedures and materials.

PART 2 - PRODUCTS

2.01 PUSHBUTTONS AND SELECTOR SWITCHES

A. Pushbuttons, pilot lights and selector switches shall be heavy duty industrial, oil tight, 120 volt, with interchangeable pilot lights, plug-in construction, double break silver contacts, and chrome plated lock rings.

B. Nameplates shall be provided for all devices with legends as indicated on the Plans. A list shall be submitted for review and approval.

C. Pilot lights shall be push-to-test type. An extra conductor shall be installed for field mounted pilot lights to accommodate "Push-to-Test" function. Pilot lights shall have clear lenses and LED lamps colored as shown on the Plans.

D. Pushbuttons shall be momentary contact type. Selector switches shall be maintained contact type unless noted otherwise.

E. The above devices shall be manufactured by Allen Bradley, Square D, Westinghouse, or equal.

2.02 RELAYS

A. TIMING RELAYS shall be heavy duty, 300V A.C., 10 amps, solid state design, poles as required per application, -10°C to +60°C, have timing repeatability of ±2.0% of setting, and be UL listed. The range shall be determined from the control descriptions and or schematic

drawings. Provide mounting accessories, as required. The timing relays shall be manufactured by Allen Bradley, Square D, Westinghouse, or equal..

B. CONTROL RELAYS shall be of the plug-in socket base type with dust-proof plastic enclosures, with silver-cadmium oxide contacts rated 300-volt, 10 amperes, with contact arrangement and operating coils of the proper voltage as required by the control circuit sequence. Relays shall have indicating lamp to show energized state. Each relay shall have a minimum of two double pole, double throw contacts, or as required. Control relays shall be Allen Bradley, Square D, Westinghouse, or equal.

C. ALTERNATING RELAYS shall be UL listed, 120 VAC, with contacts rated for 10 amperes at 120 VAC, life expectancy of 100,000 operations, load indicating LEDs, and switch for load locking and load selecting options. Alternating relays shall be manufactured by TimeMark models 261, 271, and 471, and Diversified Electronics model ARA for duplex, triplex, and quadplex alternators.

2.03 ALARMS

A. AUDIBLE ALARMS shall be UL listed, 120 VAC, with solid state circuitry, vibrating horn, non-metallic corrosion resistant housing, with required mounting hardware, suitable for outdoor use capable of producing 100 dB at 10 feet. The audible alarm shall be manufactured by Federal Signal model 350, Edwards model 870-EX, or equal.

B. ROTATING BEACONS for interior and/or exterior locations shall be UL listed, 120 VAC, with motor and cooling fan, rotating lights at 60 times per minute minimum, capable of producing 36000 candlepower with required mounting hardware. Lens color shall be verified at the time of construction. The rotating beacons shall be manufactured by Federal Signal model 371L or equal.

C. ROTATING BEACONS for corrosive and/or hazardous locations shall be UL listed, 120 VAC, with solid state circuitry, rotating lights at 60 times per minute minimum, suitable for outdoor use capable of producing 36000 candlepower with required mounting hardware. Lens color shall be verified at the time of construction. The rotating beacons shall be manufactured by Edwards model 52EX or equal.

D. STROBE BEACONS shall be UL listed, NEMA 4X, 120 VAC, flashing at 80 times per minute minimum, producing peak candlepower of 520,000, effective candlepower of 165, with required mounting hardware. Lens color shall be verified at the time of construction. The rotating beacons shall be manufactured by Federal Signal model 151XST, Edwards model 92EX, or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Fasteners shall be type 304 stainless steel.

B. Install devices in strict accordance with NEC requirements and per manufacturers recommendation.

C. Coordinate with other trades as necessary during installation of these devices.

3.02 ACCEPTANCE

A. All installations are subject to evaluation in accordance with NEC requirements and manufacturers recommendations. Contractor shall remove the unacceptable work and correct work at no charge to Owner.

End of Section

SECTION 16903

PROGRAMMABLE LOGIC CONTROLLERS AND OPERATOR INTERFACE

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This section covers the programmable logic controllers (PLC), and Operator Interface (OI) used for control and monitoring, as indicated on Plans.

B. Contractor shall provide hardware, installation, and terminations of equipment. Owner will provide software configuration and programming.

C. Contractor shall coordinate work with the owner's programmer.

D. The Contractor shall provide the PLC equipment, OI, submittals, and programming software to the programmer no less than 60 days prior to installation of the PLC and OI equipment. The PLC and OI programs will be downloaded and tested, prior to installation of the equipment. The programmer will return the PLC and OI equipment to the Contractor within 30 days of receipt, in time for final installation and wiring of the equipment.

E. Contractor shall provide 40 hours of on-site support during system testing, start-up, validation, and certification.

F. Contractor shall be responsible for hardware and installation during the warranty period. Owner's programmer will be responsible for programming and control logic during warranty period.

1.02 SUBMITTALS

A. Submittals shall include the following:
   1. Manufacturer's data on electrical characteristics, capabilities and physical properties.
   2. Wiring diagrams showing connections to all devices; input and output (I/O), analog and discrete. The wiring diagrams shall indicate I/O module physical slot locations, and the I/O address point to be used in the PLC programs.

B. The owner's programmer shall provide OI screen layouts and configuration. In addition, PLC ladder logic programs complete with I/O memory map and addressing, and cross-referenced list of program elements such as contacts, coils, timers, and other devices. The PLC program shall be documented with symbol names for each program element or device, and comments shall clearly describe the logic for no more than 3 rungs of ladder logic.

1.03 MANUFACTURERS

A. The "MASTER" PLC, at the booster station, shall be manufactured by Modicon Model 984 Compact, Part Number PC-A984-141, or equal, and the Remote PLC at Well 10 shall be a Modicon Model 984 Micro, Part Number 110CPU61200, or equal.

B. The OI manufacturer shall be Total Control Products (TCP) "Quick Panel" 10.5" STN Color Model Number QPI-21100-S29 with Modbus interface, or equal.

PART 2 - PRODUCTS

2.01 PROGRAMMABLE LOGIC CONTROLLER

A. PLCs shall be furnished with hardware and programming software necessary to monitor and control equipment, as listed in the Specifications, and shown on the Plans. Each field input and output shown as an I/O Point shall be connected as per manufacturers recommendations. Additionally, the Contractor shall provide the hardware, programming software, and installation necessary for connecting additional future equipment as indicated on the Plans. The type of field input and output shall be defined as follows:
   1. Analog inputs and outputs (4-20 mA DC).
   2. Discrete inputs (dry contact).
   3. Discrete outputs (24 VDC, form "C" relay)

B. The ladder logic control programs shall reside in the PLCs. The program shall consist of software relay and attendant logic control. Control loop and logic flow diagrams shown on the Plans, or Control Descriptions listed herein, shall be fully implemented.

C. The programmable controllers shall be supplied with extended functions communication interface. No programmable controller shall be accepted unless the programmable controller supplier can document, to the satisfaction of the Engineer, that the supplier has communication interfaces, along with the required software; all of which are standard, off-the-shelf products, that allow full communication between networks of programmable controllers, and personal computers.

D. The programmable controllers shall be able to communicate with each other via Spread Spectrum radio using Modbus RTU Protocol.

2.02 "MASTER" PLC CENTRAL PROCESSING UNIT (CPU)

A. The PLC CPU shall be a microprocessor based industrial controller with a temperature rating of 0 to 60 degrees C, and a humidity rating of 0 to 95 percent non-condensing, minimum. The CPU shall have EEPROM storage for user-programmed instructions. The memory capacity shall be large enough to store the ladder logic program, plus a minimum of 200% extra memory for program expansion. The CPU function block programming shall include PID function blocks.

B. The PLC shall have register memory which shall retain information on power failure. Each location shall be capable of storing 16 bits of data. This information shall represent process set points, timer and counter presets, accumulated values, positions, or other measured process variables. User program memory shall be a minimum of 8K instructions, and 1920 registers.

C. Program control and logic functions shall be solved sequentially during each CPU scan. The scanning tasks shall include, at a minimum:
   1. Update of time reference from a built-in real-time clock.
   2. Diagnostic self-test of PLC to include input and output.
   3. Reset watchdog timer which shall be used to verify correct functioning of the PLC and which shall be preset to 100 to 250 milliseconds.
   4. Scan 1K of logic in 5 millisecond.

D. The CPU shall have a capacity of 256 I/O points in any mix, and be capable of addressing 4 local I/O racks.

E. LED indicators shall display RUN, READY, BATTERY LOW, and RS232 status information.

2.03 INPUT/OUTPUT MODULES

A. Analog inputs and outputs shall have a minimum of 12 bits resolution. Analog modules shall be configurable for 4 to 20 mA DC, or 1 to 5 Volt DC signals. Provide external, or user power, as needed.

B. Each discrete output module shall be fused, with fuse blown indicators on each module. Indicator lights shall also be provided on each I/O point to indicate status of each signal. Each individual input or output point shall be optically isolated to protect the controller I/O circuitry from high voltage transients. External wiring shall terminate on removable terminal strips, or swing arms to allow quick installation, or extraction of I/O modules without disconnecting field wiring. Labels shall be provided on modules, or wiring arms that indicate the I/O address of each termination.

C. The power supply shall provide power for the processor, and I/O modules. The power supply shall have built-in overvoltage and under voltage detection circuitry, protection against overcurrent conditions, and automatic power-up sequence that enables outputs only when proper operating tolerances are reached. Power requirements shall be 120 VAC, or 24 VDC.

D. The I/O rack system shall be field expandable to the maximum I/O capacity of the CPU, without modifications of the processor. Blank, or empty slots shall have covers, or filler plates installed.

E. The PLC system shall be provided with modular remote I/O, connected to the CPU via a dedicated remote I/O port, and be able to communicate over a shielded twisted pair cable at rate of one million bits per second, or greater.

2.04 "REMOTE" PLC CENTRAL PROCESSING UNIT (CPU)

A. PLCs shall be furnished with hardware and software necessary to monitor and control equipment, as listed in the Specifications, and shown on the Plans. Each field input and output shown as an I/O Point shall be connected as per the manufacturers' recommendations. The number and type of field inputs and outputs shall be as follows:
   1. Four Analog inputs, 4-20 mA, 14 bit resolution
   2. Two Analog outputs, 4-20 mA, 12 bit resolution
   3. Sixteen Discrete inputs, 24 VDC, sink or source
   4. Twelve Relay outputs with 6 individual commons

B. The ladder logic control programs shall reside in the PLCs. The program shall consist of software relay and attendant logic control.

C. PLCs shall be expandable by the addition of remote I/O racks in order to reach the CPU's maximum addressable I/O.

D. The PLC CPU shall be a microprocessor based industrial controller with a temperature rating of 0 to 60 degrees C and a humidity rating of 0 to 95 percent non-condensing, minimum. Memory shall be protected by lithium battery backup for at least one year, and capacitor storage for up to 72 hours.

E. The PLC shall have 2k words of user logic, 1820 words of data, scan time shall be 2.5 msecs. per K of logic, or less. The PLC shall be equipped with two configurable RJ-45 comm ports, and an RS-485, 125 Kbps I/O expansion port. The instruction set shall include integer PID control, floating point math, interrupt processing, and a time-of-day clock accurate to with 8 seconds per day.

2.05 STORAGE AND DOWNLOADING OF PLC PROGRAMS

A. The PLC shall be programmable through an RS-232 port, or Network Port, connected to a personal computer through a standard cable. The PLC programming software shall be provided with the user's manuals, original diskettes, and licensing agreement for registration by the Owner. Cables, adapters, connectors, or other hardware required to connect to the PLC shall be provided to the Owner.

B. The PLC programming software shall enable the user to write the PLC program on-line or off-line. The software shall include utilities to manage PLC program files, document and print the programs, configure the programming environment, monitor and force the PLC addresses while on-line, and configure the PLC memory and addressing structure.

2.06 OPERATOR INTERFACE

A. The OI shall have the following features and specifications:
   1. STN Color Liquid crystal display (LCD) with touch screen interface
   2. Flash EPROM for storage of user and operational programs
   3. Display: 640 x 480 pixels, 7.625" wide x 5.75" high
   4. NEMA 4 (water-tight) front panel
   5. Environmental: 32° to 113° F (0° to 45° C), 30% to 85% relative humidity (non-condensing)
   6. Power: 85V - 132V AC or DC, 50-60 Hz power supply,12 watt power consumption

2.07 OPERATOR INTERFACE SOFTWARE

A. OI programming software shall be compatible with IBM-type personal computers (PC). The software shall include communication drivers for the PLC hardware supplied on this project.

B. Provide the programming software to the Owner, complete with original diskettes, manuals, and licensing registration forms filled out in the Owner's name.

2.08 CABLES

A. Provide the necessary communication cables for programming the OI, and connecting the unit to the PLC.

B. Provide power cords, and connect the OI to the power source as shown on the Plans.

PART 3 - EXECUTION

3.01 INSTALLATION

A. PLC and OI shall be installed as indicated on the plans and according to the manufacturer's instructions.

3.02 START UP AND TESTING

A. Upon completion of the installation, start-up shall be performed by a factory-trained manufacturer representative. Operating and maintenance instruction books shall be supplied upon delivery of the unit and procedures explained to operating personnel.

B. The PLC program and I/O shall be thoroughly tested. Each input and output signal shall be tested for correct indication and control function. The Contractor shall assist the

programmer during startup to demonstrate operation of the PLC control logic with simulated inputs, before the entire system is started, and run in automatic mode.

C. Proportional-Integral-Derivative (PID) loops shall be tested and tuned to provide a stable control over the process variable.

3.03 TRAINING

A. The owner's programmer shall provide four (4) hours of training on the control system. Instruction shall include a description of the control system operation. Teach the Operators how to make control system parameter changes (set points, timer values, etc.), and show them how to enter, and change passwords.

3.04 SPARES

A. Contractor shall furnish a minimum of one (1) spare I/O module of each type, and one (1) power supply module.

B. Contractor shall furnish twelve (12) fuses of each type and size, used in the power supply and I/O modules.

End of Section

SECTION 16904

VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.01 SCOPE

A. This section specifies variable frequency drive (VFD) systems for motor sizes to 400 horsepower.

1.02 VFD FEATURES

A. The VFDs shall be provided with the following features:
   1. Fused control circuit transformer.
   2. Provision for 4 to 20 mA input speed reference signal.
   3. Electrically isolated auxiliary contacts for ready, running, and trouble status.
   4. Adjustable minimum/maximum frequency limits.
   5. Independent timed linear acceleration and deceleration.
   6. Adjustable motor slip compensation based on motor current.
   7. Terminal blocks for control and signal wires entering and leaving the controller.
   8. Output transistors shall be insulated gate bipolar transistors (IGBT) type, or Darlington pair.
   9. Current limit.
   10. Programmable automatic restart.
   11. 4 to 20 mA output signal proportional to VFD output frequency.
   12. Digital keypad for configuration, programming, local control, and monitoring.
   13. Microprocessor-based control for system logic sequencing functions.

1.03 FUNCTIONAL REQUIREMENTS

A. SUPPLY POWER: The VFD shall operate continuously with supply power of 460 volts plus or minus 10 percent, 60 hertz plus or minus 3 percent. The VFD shall remain on line and operate without damage to either the VFD or its connected load during a supply power variation of plus 50 percent lasting for a period of up to 0.01 seconds and minus 100 percent lasting for a period of up to 0.5 seconds.

B. AMBIENT CONDITIONS: The VFDs shall operate continuously as specified in an ambient temperature of -5 to +40 degrees C and an ambient humidity of 0 to 90 percent, non-condensing.

C. LOAD: The VFD system shall be capable of 110% continuous current overload. Variable torque inverters shall be capable of delivering 120 percent of the specified load for up to 60

seconds, and constant torque inverters shall deliver 150 percent overload current for 120 seconds.

D. POWER FACTOR: Displacement power factor shall be not less than 0.95 at rated full speed and load. Overall power factor, including harmonic distortion, shall be 0.85, or greater. Contractor shall provide power factor correction components as necessary to meet this requirement.

E. EFFICIENCY: Efficiency of VFD systems shall be at least 96 percent at 60 hertz output driving the specified maximum load.

F. FREQUENCY AND VOLTAGE REGULATION: VFD output frequency shall be regulated to within 0.6 hertz of the frequency set point. VFD output voltage shall be regulated to within ±1.0 percent of that value which will produce minimum motor heating at any operating frequency within the specified range.

G. FREQUENCY RANGE: VFD shall be capable of continuous operation with the specified load at any frequency between 0.1 hertz and 60 hertz.

H. SPACE: VFD system size shall not exceed the size allotments specified on the Plans, nor shall any portion of the VFD system exceed a height of 90 inches. VFD system shall be front accessible and shall not require rear access. The VFD equipment shall be suitable for mounting directly against the wall without any clearance for ventilation or other purposes. VFD units shall be arranged as required for entry of incoming line cables and as required for entry of load cables.

I. AMBIENT NOISE: Free field noise generated by the VFD shall not exceed 85 dBA at 3 feet out from any point on the VFD cabinet under any normal operating condition.

1.04 PROTECTION AND ANNUNCIATION

A. OVERCURRENT PROTECTION: The VFD system shall provide electronic current limit at 150 percent of motor nameplate current. Current limit shall be accurate to within 1.0 percent and shall smoothly limit motor speed at whatever value is necessary to limit motor current to that value.

B. The VFD shall also provide motor running overcurrent protection in compliance with NEC.

C. SHORT CIRCUIT PROTECTION: The VFD shall be fully protected against load faults. Bolted faults, phase to phase, or phase to ground shall not damage the unit. Any impedance or other current limiting necessary to meet this requirement shall be provided as part of the VFD system.

D. LINE VOLTAGE: The VFD shall be protected against high and low line voltage on one or more phases.

E. INTERNAL FAULTS: The VFD shall incorporate an internal fault monitoring system to detect malfunctions. This system shall be designed to protect the VFD from transient and sustained faults, and to limit damage that may be caused by these faults.

F. OVERTEMPERATURE: Overtemperature circuitry shall shut down the VFD upon overheating, and display an overtemperature alarm, or message.

G. DIAGNOSTICS: The VFD shall be provided with a fault diagnostics system that indicates the cause of any shutdown. The system shall store faults in memory and discard the oldest faults as new ones fill the memory. Faults shall be accessible via a digital keypad, also used for local control and programming.

1.05 EXTERNAL CONTROL AND MONITORING

A. SPEED REFERENCE: The VFD shall accept a 4 to 20 milliampere direct current speed reference signal. Speed reference input shall be galvanically isolated and input resistance shall not exceed 250 ohms.

B. READY SIGNAL: The VFD shall provide a contact closure that indicates that the controller line power supply is within acceptable tolerances, the control circuits are normal, and there are no internal or external fault conditions that have not been reset. Presence of this signal indicates that the controller should start normally.

C. RUNNING SIGNAL: The VFD shall provide a contact closure which indicates that the controller is running.

D. SYSTEM TROUBLE: Isolated normally open contacts for remote fault annunciation shall be provided and wired to terminal blocks, which shall be labeled and identified. Contact shall close under fault conditions. Fault conditions that drive the outputs shall be selectable from the digital keypad.

E. The VFD control circuitry shall shutdown the VFD if the motor overheats. Motor winding temperature switches, or RTDs, shall be connected if provided by the motor manufacturer.

1.06 QUALITY ASSURANCE

A. This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
IEEE 519-1992	Guide for Harmonic Control in Electric Power Systems

NEMA 250-85	Enclosures for Industrial Control and Systems
NEMA ICS 2-83	Industrial Control Devices, Controllers and Assemblies
NEMA ICS 3-83	Industrial Systems
NFPA 70-87	National Electrical Code (NEC)
Underwriters Laboratories	UL 508

B. The VFD shall comply with the applicable requirements of NEMA ICS 3 and additional standards referenced by ICS 3.

C. The VFDs specified in this section shall be the product of a single vendor. The Contractor shall be responsible for the adjustable frequency drives in this section. The Contractor shall submit letters of certification with the shop Drawings from the VFD manufacturer, the motor manufacturer, and the driven equipment manufacturer stating that they have reviewed each application and that the combination will satisfy the application duties required, for the actual motor sizes required, regardless of deviations from the scheduled "nominal horsepower".

D. VFD manufacturing facility shall be ISO 9001 classified.

1.07 SUBMITTALS

A. The following information shall be provided in accordance with the Contract Documents:
   1. Catalog and technical data.
   2. Outline dimensions, shipping section dimensions, weight, and foundation requirements for all assemblies.
   3. External connection wiring diagram showing function and identification of all terminals requiring field connections.
   4. Line harmonic distortion calculations and filter design if applicable.

PART 2 - PRODUCTS

2.01 ENCLOSURES

A. Enclosures shall be as shown on the Plans, with force ventilated gasketed enclosures. UL approved Class 1 filters shall be provided on ventilation openings. Cabinets shall be fabricated from 14 gauge minimum thickness sheet steel. Cabinet shall be provided with an interior frame or otherwise formed so as to provide a rigid structure. Doors shall be hung on removable-pin hinges and equipped with vault-type latch capable of accepting a 3/8-inch-shackle padlock. Three-point latch hardware shall be provided. Door width shall not exceed 30 inches.

2.02 INVERTER

A. A padlockable door interlocked circuit breaker shall be provided to protect the inverter against internal faults and as a backup for external load faults. Load faults shall normally be cleared by the inverter assembly.

B. Harmonic filtering shall be provided as shown on the Plans to reduce total harmonic distortion (THD) of the voltage and current power source. Total voltage and current harmonic distortion, including contribution of notching, and with all VFDs in operation shall not exceed the limits set forth for a general system in IEEE 519-1992, Tables 10.2 and 10.3. The voltage THD shall not exceed 5% and the current THD shall not exceed 12%, as measured at the point of common coupling. The point of common coupling (PCC) is defined herein as the circuit breakers feeding each VFD, or where each VFD connects to the bus.

C. AC reactor coils in output circuitry of the VFD shall be provided to limit inductive switching surges such that the measured RMS voltage at the motor terminations does not exceed 480 VAC line to line.

D. Provide EMI/RFI filtering to eliminate radio interference between 10KHZ and 30MHZ.

2.03 CONTROL DEVICES

A. The following control devices shall be front mounted on the VFD enclosure:
   1. Digital keypad.
   2. Manual/remote speed control selector switch.
   3. VFD run light.
   4. Inverter ready light.
   5. Inverter fault light

B. Control devices shall be as specified herein. Indicating lamps shall be high intensity colored LED type with clear lenses.

2.05 MANUFACTURERS

A. The VFDs shall be manufactured by Robicon, Toshiba, Square D, or equal.

B. AC reactors and harmonic filters shall be TCI, MIRUS, Powersmiths, or equal.

PART 3 - EXECUTION

3.01 FIELD INSTALLATION

A. Each VFD shall be installed and tested by the Contractor with the assistance of factory-trained personnel in accordance with the manufacturer's specifications and the Contract Documents. The installation shall be certified on forms provided in the Contract Documents.

3.02 TESTING AND TRAINING

A. Testing and training for this equipment shall be provided in accordance with the Contract Documents. Installation and performance testing shall be conducted as part of the associated pump tests.

B. Four (4) hours of VFD training shall be provided for the Owner's Operations and Maintenance Staff. Training shall be certified on forms provided in the Contract Documents. Training shall cover VFD theory of operation, features and functions available, normal operation, troubleshooting, and routine maintenance. The Contractor shall submit a syllabus for the training session for approval, within 3 weeks of conducting the class. Provide each attendee with a class syllabus detailing each topic to be discussed.

C. Perform voltage and current harmonic tests with each VFD running at minimum and at maximum speed. Submit test results for each VFD. Testing shall be witnessed by the Owner and the Engineer. Measure the voltages on each phase of the motor leads at the load. The measurements shall be taken at 20 Hz, 40 Hz, and 60 Hz. Record all measurements and submit for review prior to Final Acceptance.

3.03 SPARE PARTS

A. The following spare parts shall be supplied with each type, or frame size, of VFD:
   1. Three sets of all replaceable fuses
   2. One of each type of replaceable printed circuit board
   3. Two of each type of output power transistor

B. Provide 3 spare air conditioner filters for each type and size of air conditioner installed.

End of Section

INSTRUMENTATION SPECIFICATIONS for

CITY OF AVONDALE

Rancho Santa Fe Reservoir and Booster Pump Station AVONDALE, ARIZONA

Index	Description
17000	Instrumentation
17120	Pressure Transmitters
17121	Pressure Switches
17123	Ultrasonic Level Transmitter
17410	Automatic Dialer
17450	Radio Communications

Registered Professional Engineer (Electrical)
CERTIFICATE NO.
8584
MARC
CIMON
Date Signed JUNE 13, 1995
ARIZONA, U.S.A.

DIVISION 17000

INSTRUMENTATION

PART 1 - GENERAL

1.01 SCOPE

A. The Contractor shall furnish and install, ready for use, the complete instrumentation and control systems as indicated on the Plans and in each of these Contract Documents. These documents include descriptions of functional operation and performance, as well as standards, but do not necessarily enumerate detailed specifications for all components and devices which are necessary. However, all components and devices shall be furnished and installed as required to provide complete and operable systems for accomplishing the functions and meeting the performance set forth hereinafter.

1.02 GENERAL PROVISIONS

A. Each instrumentation and control system specified shall be separate and distinct and shall be the responsibility of a single manufacturer for the design, construction and furnishing of the desired control hardware, mechanical drawings, interconnection drawings, control piping layout drawings, control conduit layout drawings, internal drawings, installation and start-up supervision and/or calibration of the control equipment. The responsible manufacturer as described in the preceding sentence shall hereinafter be referred to as the "Instrumentation Supplier" and shall bear the responsibility for furnishing a fully complete system operating in a satisfactory manner.

B. The instrumentation and control systems shall be furnished and installed by the Contractor complete and ready to operate, including all necessary interconnections and connections to sources of electrical power, air, water, drains and vents, with all required valves, switches and accessories as specified or as recommended for best operation by the manufacturer of the equipment furnished.

C. All necessary mounting panels, stands, hangers and brackets shall be furnished and installed and shall comply with the relevant sections of these Contract Documents.

D. In general, overall system accuracy shall be within plus or minus two percent of the actual process parameter being controlled (flow, temperature, etc.), unless otherwise specified.

E. Where two or more manufacturers are concerned in furnishing Equipment for a single instrumentation and control system, the Contractor shall supply the Instrumentation Supplier with such information and drawings from other manufacturers, as are needed to fit their equipment into the control and instrumentation system panels.

F. All equipment with interconnects shall be shown together on one coordinated drawing.

G. All equipment to be furnished shall be coordinated, and submittals for the equipment shall be provide in accordance with Section 16000, and as required elsewhere in the Contract Documents.

H. The Contractor shall provide factory-trained personnel to supervise and perform the installation and calibration of the control and instrumentation equipment, until this equipment has been field-tested by the Contractor, and the results of these tests have been reviewed by the Engineer.

I. In addition, factory bench-test data shall be submitted to show that the Manufacturer's proposed equipment has been tested in the specified arrangement and found to achieve specified accuracy.

1.03 SUBMITTALS

A. The Contractor shall coordinate the work specified, and shown on the Plans, such that a complete instrumentation and control system for the facility will be provided, and will be supported by accurate shop and record drawings.

B. The Contractor shall be responsible for providing the submittal documents prepared by subcontractors, and ensuring the accuracy and completeness of the documents, prior to delivery to the Engineer.

C. The Contractor shall ensure that that the electrical, pneumatic, and hydraulic interface between the instruments and the process equipment is clearly shown in the shop drawing submittal.

D. The following shall be submitted to the engineer and returned, reviewed to the contractor before fabrication is started:
   1. Layout drawings of system showing wiring, piping, valves, switches, and control units in schematic form. This includes individual loop drawings and total integrated system
   2. Shop drawings of panels or enclosures showing size, arrangement, color, and nameplates.
   3. Bill of material and catalog data on all equipment, wiring, conduit, tubing, and such other accessories as are needed to properly operate the instrumentation and control system. Data sheets shall show:
      a. Component functional description used herein and on the Plans.
      b. Manufacturer's model number or other product designation.
      c. Project tag number used herein and on the Plans.
      d. Project System or Loop of which the component is a part.
      e. Project location or assembly at which the component is to be installed.
      f. Input and output characteristics.

g. Scale range and units (if any) and multiplier (if any).
h. Requirements for electric supply (if any).
i. Requirements for air supply (if any).
j. Materials of component parts to be in contact with, or otherwise exposed to, process media.
k. Special requirements or features.

4. Wiring diagrams of all electrical work including conduits and piping diagrams of pneumatic/hydraulic systems.
5. Upon acceptance, Contractor shall submit a minimum of 4 sets of "as built" drawings of the instrumentation and control systems, along with manuals for the installation, operation and maintenance of the equipment. Each set shall include installation, operating, troubleshooting, maintenance and overhaul instructions in complete detail. This shall provide the Owner with comprehensive information on all systems and components to enable operation, service, maintenance and repair. Exploded or other detailed views of all instruments, assemblies and accessory components shall be included together with complete parts lists and ordering instructions.
6. A complete index shall appear in the front of each bound submittal volume. A separate technical brochure or bulletin shall be included with each instrument data sheet. The data sheets shall be indexed in the submittal by Systems or Loops, as a separate group for each System or Loop. If, within a single System or Loop, a single instrument is employed more than once, one data sheet with one brochure or bulletin may cover all identical uses of that instrument in that System. Each brochure or bulletin shall include a list of tag numbers for which it applies. System groups shall be separated by labeled tags.
7. Drawings showing both schematic and wiring diagrams for control circuits: Complete details on the circuit interrelationship of all devices within and outside each Control Board shall be submitted first, using schematic control diagrams. Subsequent to return of this first submittal by the Engineer, piping and wiring diagrams shall be prepared and submitted for review by the Engineer; the diagrams shall consist of component layout drawings to scale, showing numbered terminals on components together with the unique number of the wire to be connected to each terminal. Piping and wiring diagrams shall show terminal assignments from all primary measurement devices, such as flow meters, and to all final control devices, such as samplers, pumps, valves and chemical feeders. The Contractor shall furnish all necessary equipment supplier's shop drawings to facilitate inclusion of this information by the Instrumentation Supplier.
8. Assembly and Construction Drawings for each Control Board and for other special enclosed assemblies for field installation. These drawings shall include dimensions, identification of all components, surface preparation and finish data, nameplates, and the like. These drawings also shall include enough other details, including prototype photographs, to define exactly the style and overall appearance of the assembly; a finish treatment sample shall be included.
9. Installation, Mounting, and Anchoring Details for all components and assemblies to be field-mounted, including conduit connection or entry details.

E. The Contractor and suppliers are cautioned regarding the review and compliance with the total Contract Documents. Typical examples are control relays, timers, enclosures, and nameplates. These particular items are sometimes furnished and installed by an instrument supplier. However, they are specified in DIVISION 16 of these Contract Documents.

PART 2 - PRODUCTS

2.01 CONTROL AND INSTRUMENTATION DEVICES

A. Control mechanisms shall be standard devices constructed of corrosion-resistant materials, enclosed in a dust-proof case and mounted as specified in the individual application. Instruments to be mounted outdoors or in basements shall be in weatherproof cases. Corrosion resistant cases shall be furnished where required. Cases shall be finished in manufacturer's standard colors except as otherwise specified. All instrument wires or cables shall be enclosed and not exposed or within reach of the public.

B. Each meter, indicator, totalizer, controller, recorder or other device shall have an identifying engraved laminated plastic nameplate. This includes all primary elements, such as flow meters. The nameplate shall be mounted on the case so that it will identify the equipment as specified on the drawings. Brass or stainless steel mounting screws shall be used.

C. Each receiver and each transmitter shall have an individual cutout, switch and fuse to disconnect the receiver from all sources of power.

D. Straightening vanes, pressure snubbers, or other required accessories, shall be furnished and installed if necessary to meet the accuracy requirements in these Contract Documents.

2.02 INTERCOMPONENT WIRING AND TUBING

A. Intercomponent wiring shall be run in conduit. Minimum permissible signal wiring insulation voltage is 600 volts, with the exception of special cable as required by the manufacturer and accepted by the Engineer.

2.03 POWER SUPPLIES

A. Regulated dc power supplies for instrument loops shall be designed and arranged so that loss of one supply does not affect more than one instrument loop or system. Power supplies shall be suitable for an input voltage variation of plus or minus 10 percent, and the supply output shall be fused or short circuit protected. Output voltage regulation shall be as required by the instrumentation equipment being supplied. Multi-loop, or multi-system power supplies, will be acceptable if backup power supply units are provided which will automatically supply the load upon failure of the primary supply. The backup supply

systems shall be designed so that either the primary or backup supply can be removed, repaired, and returned to service without disrupting the instrument system operation.

B. The power distribution from multi-loop supplies shall be selectively fused such that a fault in one instrument loop will be isolated from the other loops being fed from the same supply. Fuses shall be clearly labeled and located for easy access. Multi-loop supply systems shall be oversized for an additional 10 percent future load. Failure of a multi-loop supply shall be indicated on the respective instrument panel or enclosure.

PART 3 - EXECUTION

3.01 TRAINING

A. The Contractor shall provide 8 hours training of personnel in the operation and maintenance of the furnished control systems.

B. Training shall be provided as required elsewhere in the Contract Documents, but shall consist of at least eight hours, in a single, or multiple sessions, to accommodate the personnel schedules.

C. The Contractor shall coordinate with the Engineer, and the Owner, to schedule the training sessions at least 5 workings days in advance.

End of Section

SECTION 17120

PRESSURE TRANSMITTERS

PART 1 - GENERAL

1.01 SCOPE

A. This section includes furnishing Pressure Transmitters as shown on the Plans and specified herein.

B. Related work specified elsewhere includes, but is not limited to Section 16000, electrical. Also refer to requirements of Contract Documents for testing, adjusting and balancing of systems.

1.02 QUALITY ASSURANCE

A. Equipment to be furnished under this section shall be the product of firms regularly engaged in the design and manufacture of this type of equipment. Manufacturer shall assume responsibility for, and guarantee performance of equipment furnished. However, this shall not be construed as relieving the Contractor from responsibility for the proper installation and functioning of the work.

1.03 SUBMITTALS

A. The following material shall be submitted to the Engineer prior to installation, in accordance with Section 16000, and as required elsewhere in the Contract Documents:
   1. Where applicable, provide complete manufacturer's part number, identifying scaling, operating range, housing and wetted parts materials, NEMA rating, product options, consumable materials, and other pertinent information.
   2. Prior to Final Acceptance of the work, the Contractor shall provide Operations and Maintenance Manuals, in accordance with the Contract Documents.

1.04 MANUFACTURERS

A. Pressure transmitter manufacturers shall be Bristol Babcock, Rosemount, Foxboro, or equal.

PART 2 - PRODUCTS

2.01 PRESSURE TRANSMITTER

A. Provide pressure transmitters with 1/2 inch NPT process connection, block and bleed valve, and local indicator scaled in engineering units.

B. Transmitters shall be of a two-wire type, 24 VDC powered, producing a 4 to 20 mA output proportional to the calibrated pressure range of the instrument. Transmitters shall be capable of driving a 500 ohm loop load.

C. Instrument accuracy shall be within plus or minus 0.5 percent of span, and a 0.2 percent repeatability. Dead band shall be within 0.1 percent of span.

D. Transmitters shall have external zero and span adjustment for field calibration. Instrument enclosure shall be NEMA 4, with 316 stainless steel wetted parts.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Equipment and materials specified in this section shall be installed, connected, and tested in accordance with the manufacturers' recommendations, and as shown on the Plans. Contractor shall coordinate with other trades to insure proper connection to piping and other mechanical equipment.

3.02 ACCEPTANCE

A. Prior to final acceptance of the work, the Contractor shall certify the equipment and installation included under this section to be free of defects, and suitable for trouble-free operation.

End of Section

SECTION 17121

PRESSURE SWITCHES

PART 1 - GENERAL

1.01 SCOPE

A. This section covers Pressure Switches as shown on the Plans.

B. Related work specified elsewhere includes, but is not limited to Section 16000, electrical. Also refer to requirements of General Conditions for testing, adjusting and balancing of systems.

1.02 QUALITY ASSURANCE

A. Equipment to be furnished under this section shall be the product of firms regularly engaged in the design and manufacture of this type of equipment. Manufacturer shall assume responsibility for and guarantee performance of the equipment furnished. However, this shall not be construed as relieving the Contractor from responsibility for the proper installation and functioning of the equipment.

B. Reference standards shall be the latest edition, including addenda, supplements, and revision. Applicable reference publications include the following:

NEC
NEMA

1.03 SUBMITTALS

A. Submit product information cut sheets containing manufacturer's specifications, Operations and maintenance data, instrument enclosure type, installation location, and process pressure range to be supplied. Indicate product part number in full.

B. Provide submittals in accordance with Section 16000, and elsewhere in the Contract Documents.

PART 2 - PRODUCTS

2.01 PRESSURE SWITCHES

A. Pressure switches shall have snap action, single-pole, double-throw switching elements with an electrical rating of at least 10 amperes at 120 VAC. Switches shall be enclosed in a NEMA 4X housing for outdoor use.

B. Operating pressures and set points shall be determined in the field, unless otherwise indicated on the Plans.

C. Set points shall be fully adjustable and shall be in the middle of the working range. Accuracy shall be plus or minus 1/2 of one per cent of adjustable range.

D. For pressures up to 80 PSIG pressure sensing element shall be of the diaphragm or bellows type, and shall have a proof pressure of at least twice the maximum working pressure. Diaphragms or bellows shall be of stainless steel.

E. Pressure switches shall be as manufactured by Barksdale Controls, Mercoid, Union Electric Controls Company, or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Equipment and materials specified in this section shall be installed and connected as specified and shown on the drawings. Contractor shall coordinate with Mechanical and Piping to insure proper connection to piping and/or other mechanical equipment.

3.02 ACCEPTANCE

A. As a condition precedent to final acceptance of the work, the Contractor shall certify the equipment and installation included under this section to be free of defects, and suitable for trouble-free operation under the conditions set forth in these specifications. This requirement is in addition to the manufacturer's guarantee.

End of Section

SECTION 17123

ULTRASONIC LEVEL TRANSMITTER

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This section covers the Ultrasonic Level Transmitters and Controllers to be provided where indicated on the Plans.

B. Related work specified elsewhere includes, but is not limited to section 16000 Electrical. Also, refer to requirements of Contract Documents for testing, adjusting and balancing of systems.

1.02 QUALITY ASSURANCE

A. Equipment to be furnished under this section shall be the product of firms regularly engaged in the design and manufacture of this type of equipment. Manufacturer shall assume responsibility for, and guarantee performance of equipment furnished. However, this shall not be construed as relieving the Contractor from responsibility for the proper installation and functioning of the work.

1.03 SUBMITTALS

A. The following material shall be submitted to the Engineer prior to installation, in accordance with Section 16000, and as required elsewhere in the Contract Documents:
   1. Where applicable, provide complete manufacturer's part number, identifying scaling, operating range, housing and wetted parts materials, NEMA rating, product options, consumable materials, and other pertinent information.
   2. Prior to Final Acceptance of the work, the Contractor shall provide Operations and Maintenance Manuals, in accordance with the Contract Documents.

PART 2 - PRODUCTS

2.01 ULTRASONIC LEVEL CONTROLLER

A. The ultrasonic level controller system shall be comprised of a transmitter in a NEMA 4X housing, an ultrasonic transducer, and cabling. The system shall be of the non-contact type for continuous measurement and control of liquid and solid levels.

B. The transmitter shall include a front panel mounted, 4 digit LCD indicator, scaleable in engineering units. The transmitter shall provide a 4-20 mA DC analog output signal which is proportional to level. The unit shall also have 5 form 'C' SPDT relays assignable for level control, totalizing, sampling, and alarming. The LCD shall provide

messages for loss of echo, and cabling trouble. The transmitter shall be designed to operate from -20 degrees C to +50 degrees C.

C. The transducer shall be encapsulated in chemical and corrosion resistant material, such as Kynar, Teflon, or TEFZEL, and be capable of operating from -40 degrees C to +73 degrees C. The unit shall be ambient temperature compensated. The transducer shall be compatible with the level range as indicated on the Plans, and shall operate with up to 1200 feet of separation from the transmitter.

D. The transducer shall be capable of measuring a span of up to 33 feet. The span and range shall be set in the field. Accuracy shall be +/-0.25 percent of range.

E. The system shall operate on 120 VAC, and shall be Milltronics HydroRanger, or equal. Where more than two ultrasonic level transducers are shown to be connected to one transmitter unit, use the Milltronics Airanger XPL, or equal, with the AO-10 analog output module.

F. Differential level controllers, where indicated on the Plans, shall be Milltronics MultiRanger Plus, or equal.

2.02 ULTRASONIC LEVEL TRANSMITTER

A. Where ultrasonic measurement is indicated on the Plans, but relay control is not required, and the measurement span is less than 16 feet, the Milltronics Probe shall be used.

B. Power requirement shall be 24 VDC, and a 2-wire shielded cable with 600-volt insulation, and 16 AWG conductors with a tinned drain wire shall be provided.

C. The instrument shall have a measurement range of 0.8 to 16.4 feet. Accuracy in air shall be 0.25% of range with built-in temperature compensation. Operating temperature shall be -20 to +60 degrees C.

D. Output shall be 4-20 mA into 750 ohms. A status relay contact shall close on loss of echo, internal failure, or loss of power to the instrument.

E. All mounting hardware shall be 316 stainless steel, and the instrument enclosure shall be rated NEMA 4.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Equipment and materials specified in this section shall be installed and connected as specified, and as shown on the Plans. The Contractor shall coordinate the installation

with the other trades, to insure proper installation of the transducer, transmitter, and associated conduit and cables.

B. The Contractor shall calibrate the instruments to the proper ranges, as required by the Owner and the Engineer. Where analog signals are connected to local, or remote monitoring equipment, the Contractor shall verify that the calibrated ranges and scaling of the local and remote indicators are correct.

3.02 ACCEPTANCE

A. Prior to final acceptance of the work, the Contractor shall certify the equipment and installation included under this section to be free of defects, and suitable for trouble-free operation under the conditions set forth in these specifications. This requirement is in addition to the manufacturer's guarantee.

3.03 SPARE PARTS

A. Provide the Owner with a list of the manufacturers' recommended spare parts.

End of Section

SECTION 17410

AUTOMATIC DIALER

PART 1 - GENERAL

1.01 SCOPE

A. This section covers the automatic dialer to voice annunciate alarm conditions over the telephone lines.

B. Related work specified elsewhere includes, but is not limited to Section 16000, Electrical. Also, refer to requirements of general conditions for testing and adjusting system.

1.02 QUALITY ASSURANCE

A. Equipment to be furnished under this section shall be the product of firms regularly engaged in the design and manufacture of this type of equipment. Manufacturer shall assume responsibility for, and guarantee performance of equipment furnished. However, this shall not be construed as relieving the Contractor from responsibility for the proper installation and functioning of the work.

B. Reference standards. Standards shall be the latest edition, including addenda, supplements, and revision. Applicable reference publications include the following:
   1. NEC
   2. NEMA

1.03 SUBMITTALS

A. Products shall be submitted to the Engineer for review in accordance with Section 16000 of the Specifications, and as required elsewhere in the Contract Documents.
   1. Manufacturer's complete model and part number, product specifications, and installation details.
   2. Detail electrical wiring diagrams showing component designation, and rating.
   3. Operations and maintenance manuals shall be provided for review, prior to Final Acceptance.

PART 2 - PRODUCTS

2.01 AUTOMATIC DIALER

A. Furnish the number of output channels as required on the plans. Each channel shall monitor a normally closed or normally open input contact. Upon alarm, the automatic dialer shall

dial, over standard dial-up telephone line, the telephone number of designated personnel. When the phone call is answered, the automatic dialer shall identify which alarm condition has occurred, and its location. If the phone call is unanswered, the automatic dialer shall cycle indefinitely through the programmed telephone numbers, until the alarm condition is acknowledged.

B. The 16 telephone numbers shall be programmable using an integrally mounted keypad. The dialer shall be capable of dialing 24 digits.

C. The dialer shall have provisions to accept incoming. The dialer shall, during an incoming call, report the status of its monitored points to the caller.

D. The dialer shall be powered by 115 volts, 60 hertz, and shall contain its own integrally mounted and wired battery backup. The battery shall be able to operate the dialer for 24 hours during power failure.

E. The messages transmitted by the dialer shall be electronically recorded, or voice synthesized.

F. The dialer shall be tested and guaranteed for performance in ambient temperatures 20 to 130 degrees F.

G. The dialer shall be equipped with alarm channels as indicated on the P&ID Plans and the schematic diagrams. The dialer shall have 32 alarm channels.

H. Unless specifically indicated otherwise on the Plans, the automatic dialer shall be enclosed in a NEMA 12 enclosure (if installed indoors) and NEMA 4X enclosure (if installed outdoors or in a corrosive area).

I. The automatic dialer shall be a Verbatim model, by Raco Manufacturing Company or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Equipment and materials specified in this section shall be installed and connected as specified herein, indicated on the Plans, and per manufacturer's recommendations.

B. The Contractor shall program the automatic dialer with the messages and phone numbers provided by the Owner.

C. The Contractor shall test and verify all alarms with the Owner.

3.02 ACCEPTANCE

A. Prior to final acceptance of the work, the Contractor shall certify the equipment and installation included under this section to be free of defects, and suitable for trouble-free operation under the conditions set forth in these specifications. This requirement is in addition to the manufacturer's guarantee.

End of Section

SECTION 17450

RADIO COMMUNICATIONS

PART 1 - GENERAL

1.01 SCOPE

A. This section includes requirements for radio communications equipment used in remote telemetry units, Supervisory Control And Data Acquisition (SCADA) systems, and miscellaneous devices associated with radio communications.

B. This specification contains the requirements for two types of radios: licensed and non-licensed. The Contractor shall provide the correct type of radio for this project, as shown on the Plans.

1.02 QUALITY ASSURANCE

A. The radio equipment to be installed shall comply with applicable FCC Rules, Part 94 for Multiple Address Systems (MAS), and FCC Part 15 for spread-spectrum radio operation, where applicable.

1.03 SUBMITTALS

A. The Contractor shall provide a radio survey report, performed by an FCC licensed technician. The report shall contain the following information:
   1. Path profiles
   2. Predicted fade margins in dBs.
   3. In-field radio check of questionable pathways.
   4. Antenna heights and gains necessary for dependable reception.

B. Submit product information, detailing part numbers, manufacturers' specifications, and installation details. Submittal shall also include shop drawings of equipment installations, control panel fabrication and wiring, antenna mast construction and installation. The Contractor shall not proceed with equipment installation without approved submittals.

PART 2 - PRODUCTS

2.01 SPREAD SPECTRUM RADIO-MODEM

A. The spread spectrum radio-modem shall be designed to operate within the 902 to 928 MHz band, employing frequency hopping technology, approved by the FCC, under Part 15 rules. This type of radio will not require an FCC license. The radio-modem shall have a frequency hopping range of 64 frequencies per channel, over the 902 to 928 MHz band, and

13 or 15 MHz of spacing between transmit and receive frequencies. The user shall select from 7 channels, 4 hop patterns, and shall be able to assign up to 255 addresses.

B. The radio shall meet the following specifications:
   1. Operation in a 12.5 KHz channel bandwidth.
   2. Temperature range: -30 to +60 deg. C
   3. Humidity: 95% at 40 deg. C
   4. Shock and Vibration: MIL STD-810E Spec.
   5. Output Power: 1 Watt (+30DBm) max.
   6. Frequency Stability: +/-0.00015% (1.5 PPM)
   7. Spurious and Harmonic Emissions: -65dBc
   8. Transmit frequency range:
      a. Master: 902-915 MHz
      b. Remote: 915-928 MHz
   9. Output Impedance: 50 ohms
   10. Binary CPFSK modulation
   11. Continuous duty cycle
   12. Receiver type: double conversion superheterodyne
   13. Receiver sensitivity at the antenna port for analog models: 12 dB SINAD at 0.3 microvolts (-117 dBm)
   14. Receiver frequency range:
      a. Master: 915-928 MHz
      b. Remote: 902-915 MHz
   15. Bit error rates shall be less than BER $1X10^{-6}$ at -105
   16. Power requirements shall be 13.8 VDC nominal for individual radio-modems, and 120 VAC for packaged systems with battery backup. Packaged radio enclosures shall be NEMA 4X.
   17. N-type female antenna connection
   18. Data rates of 1200 to 4800 bps and an RS232 interface

C. The radio-modem shall have built-in diagnostics and programming through an RS232, DB25 connector. Provide one software package for programming the unit with an IBM compatible personal computer.

D. The radio-modem shall have LED indicators for : RTS, CTS, TXD, DCD, RXD communication signals.

E. The remote telemetry unit (RTU) radio-modem shall operate in the half duplex mode with the transmitter keying to be data activated. Communications protocol shall be transparent and seamless, with a data turnaround time of less than 180 msecs. The spread spectrum radio-modem shall be Microwave Data Systems Model MDS 9310, or equal.

2.02 ANTENNA

A. The remote antenna shall be a broadband Yagi-type, meeting the following specifications:

1.	Frequency Range:	806 to 960 MHz
2.	Gain:	10 dB, minimum
3.	Maximum Input Power:	100 Watts
4.	Lightning Protection:	Direct Grounding to mast
5.	Front to Back Ratio:	15 dB, minimum
6.	Connector:	Type N, Female
7.	Mounting Hardware:	Weatherproof clamp suitable for direct mount to 2 inch SCH 40 steel pipe
8.	VSWR:	1.5:1 or less
9.	Impedance:	50 ohms
10.	Acceptable Manufacturers:	Scala Model TY900, Telewave Model ANT860Y10E, or Decibel Model DB-498

2.03 LIGHTNING ARRESTER

A. The lightning arrester shall meet the following requirements:

1.	Max. Surge:	50KAmps IEEE 8/20 Waveform (based on IEEE Std. 28-1974 and ANSI C62.1)
2.	Turn on VDC:	60 V. Typical
3.	Turn On Time:	7ns after DC Threshhold (based on 1 KV/nS waveform
4.	Impedance:	50 Ohms
5.	Frequency Range:	900 to 1000 MHz.
6.	VSWR:	1.1 to 1 or less over operating Bandwidth
7.	Insertion loss:	0.1 dB or less over operating Bandwidth
8.	Temperature Range:	-30 to +60 degrees C.
9.	Connections:	Type N female for input and output
9.	Manufacturer:	Polyphaser Series IS-50, flange mounted

2.04 ANTENNA CABLE/FEEDLINE

A. The antenna cable shall be 1/2 inch, foam-dielectric, low loss, 50 ohm impedance feedline. Cable attenuation at 1000 MHz shall be 2.34 dB, or less, per 100 feet. Cable outer conductor shall be copper, and the minimum bending radius of 5 inches shall be maintained during and after installation. Cable shall be Andrews Heliax Coaxial Cable, type LDF4-50A, or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Equipment and materials specified in this section shall be installed and connected as specified and shown on the drawings. Contractor shall coordinate with all trades insure proper installation and connection of this equipment.

3.02 GUARANTEE

A. Contractor shall fully guarantee all work under this section for a period of one year from date of final acceptance by the owner against faulty workmanship and failure or malfunction of materials and/or equipment due to faulty of imperfect workmanship. This guarantee shall be given in writing to the owner at the time of issuing final certificate. Work, materials or equipment found to be defective within this period shall be replaced without cost to the owner.

3.03 ACCEPTANCE

A. As a condition precedent to final acceptance of the work, the Contractor shall certify the equipment and installation included under this section to be free of defects, and suitable for trouble-free operation under the conditions set forth in these specifications. This requirement is in addition to the manufacturer's guarantee.

End of Section