MASTER AGREEMENT
FOR WATER SYSTEM CONSTRUCTION, MAINTENANCE, REPAIR, AND IMMEDIATE RESPONSE

City of Anaheim

Contract Documents and Specifications

April 2022
Public Utilities Department
Water Engineering Division
Anaheim, CA

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VOLUME I

MASTER AGREEMENT
FOR WATER SYSTEM CONSTRUCTION, MAINTENANCE, REPAIR, AND IMMEDIATE RESPONSE

PROPOSAL PACKAGE & RELATED INFORMATION

April 2022
Public Utilities Department
Water Engineering Division
Anaheim, CA

CITY OF ANAHEIM

Master Agreement for Water System Construction, Maintenance, Repair, and Immediate Response

INVITATION AND INSTRUCTIONS TO BIDDERS

1. **PROJECT INFORMATION**

ISSUE DATE:	4/21/2022
OWNER:	City of Anaheim 200 S. Anaheim Boulevard Anaheim, California 92805
CONTACTS:	
City of Anaheim	Patrick Kelley (Contract Administration) pkelley@anaheim.net 714 765-5272 Sam Barrera (Utilities Analyst) sbarrera@anaheim.net 714-765-4119

2. **INVITATION**: The City of Anaheim (hereinafter, the "CITY") invites bidders to submit an (ELECTRONIC) sealed Bid for the Work.

3. **WORK DESCRIPTION**: The proposed work for this Master Agreement includes the construction, maintenance, repair, abandonment, and relocation of water distribution and production facilities, and all appurtenant work as shown on the plans and delineated in the specifications.

4. **BID/AWARD PROVISIONS**

   A. **PRE-BID MEETING**: A NON MANDATORY pre-bid meeting will be held at Anaheim West Tower, 201 S. Anaheim Blvd, 6th floor, on April 28, 2022 at 3:00 PM.

   B. **Pre-Bid Questions**: All questions related to the contract documents shall be submitted via Planet Bids no later than 5:00 P.M., May 4, 2022.

   C. **SUBMISSION OF PROPOSALS**: Proposals shall be prepared and submitted in accordance with the following instructions to bidders.

      1. Electronic Bids (Proposals) will be accepted until the following date and time: May 12, 2022 at 2:00 PM. No bids will be accepted thereafter.

      2. Proposals shall be submitted in singular.

      3. All Proposals shall be delivered electronically in accordance with the instructions herein and will not be accepted if delivered later than the date and exact time specified above. A designated clock in the City of Anaheim City Clerk's Office will be used as the official clock for establishing the official time for submission of all accepted proposals and the cutoff time for the rejection of late proposals.

4. Proposals will be opened and publicly read by the City Clerk and City Engineer in the Council Chambers of the City of Anaheim, City Hall, Anaheim, California, May 5, 2022 at 2:00 PM and summary available on-line.

5. The Proposal shall include the following filled out and executed forms as provided in the "Proposal/Submittal Package":

A.	Contractor Pre-Qualification Application	Fill-in, scan and upload
B.	Rate Schedule	Fill-in, scan and upload
C.	Non-Collusion Affidavit	Fill-in, scan and upload
D.	Equal Employment Opportunity Certificates of Compliance	Fill-in, scan and upload
E.	Contact Information Sheet	Fill-in, scan and upload
F.	Addenda, if issued	Signed, scan and upload

6. Bidders shall agree not to withdraw Proposals for a period of ninety (90) days after the date of opening of the Bids.

D. **BID SECURITY**: No Bid Bond Required.

E. **OBTAINING BID SETS**:

1. For bidding purposes, each Bidder **must** obtain an official electronic Bid Set from Planet Bids. Website as indicated on the advertisement for this project.

F. **EXAMINATION OF BID DOCUMENTS**: Bid Documents for the Work may be examined without charge at the following locations:

PlanetBids
https://www.planetbids.com/portal/portal.cfm?CompanyID=14424&BidID=63416

Select Bid Opportunities, Choose Public Works under Department, and then the "Project Name"

G. **ACCEPTANCE AND REJECTION OF PROPOSALS**: The CITY reserves the right to reject any and all proposals, or waive any informalities, irregularities or technicalities if, in its judgment, the interest of the CITY may so require.

END OF SECTION

INSTRUCTIONS TO CONTRACTORS
FOR MASTER CONSTRUCTION AGREEMENT PREQUALIFICATION

General Information

The City of Anaheim ("Anaheim") invites licensed contractors ("Contractor" or "Contractors") to submit electronic proposals for prequalification under the 2022 Master Construction Agreement for as-needed water system construction, maintenance, repair, relocation, and immediate response services ("Master Agreement") and will receive such proposals via PlanetBids – Anaheim's online bidding program -- at the date and time specified in the legal notice.

All Contractors that wish to be prequalified for the Master Agreement must (1) fully complete the Prequalification Application, and (2) provide all documents requested in the Prequalification Package. These two submittals are referred to collectively herein as the "Prequalification Proposal." Upon submission of a complete Prequalification Proposal, Anaheim will review it and determine whether the Contractor applicant is prequalified to bid for work under the Master Agreement as a "Prequalified Contractor."

Status as a Prequalified Contractor remains valid throughout the approximately five-year term of the Master Agreement, which is expected to commence in September 2022 and expire on September 30, 2027. Pursuant to the Master Agreement, Anaheim reserves the right to terminate a particular Master Agreement, and thus a particular Contractor's prequalified status, with or without cause.

Contractors that do not submit fully completed Prequalification Proposals by the closing date and time specified in the legal notice will not be eligible for prequalification in the Anaheim City Council's initial consideration of the Master Agreement, but they may be eligible at a later date if subsequent determinations by staff are authorized.

Prequalification Proposal and Related Documents

The Prequalification Package consists of Volume I and Volume II of the 2022 Master Agreement for Water System Construction, Maintenance, Repair, and Immediate Response. These documents must be obtained from the online bidding program. The Prequalification Proposal shall consist of the Prequalification Application, Rate Schedule and other required documents as specified and contained in Volume I – PROPOSAL PACKAGE & RELATED INFORMATION of the Master Agreement. Volume II consists of other related documents, including the Estoppel Certificate, Sample bonds, General Scope of Work (which defines Work Order Categories), Standard Specification Supplement, Special Provisions, Sample Master Agreement, and specifications. The Prequalification Proposal shall be signed by the prospective Contractor or the Contractor's legal representative, who must have binding authority, and shall include all required information. All entries on the Prequalification Proposal must be in ink or typewritten. A Prequalification Proposal by a corporation must show the names, titles and business addresses of the president, secretary and treasurer, and must be signed by an officer of the corporation. A Prequalification Proposal submitted by an agent shall include evidence of the agent's legal authority to do so.

Bonds are not required to be submitted with the Prequalification Proposal. Faithful Performance and Labor and Material Bonds, in the amounts specified in the Master Agreement shall be furnished by the Contractor concurrently with the execution of the Master Agreement. The Faithful Performance and Labor and Material Bonds shall remain in effect and in the minimum principal amounts specified in the Master Agreement, and any adjustments thereto, throughout the term of the Master Agreement and any extensions.

Interpretation of Documents

Any prospective Contractor may submit a written request to Anaheim for an interpretation of any portion of the Prequalification Package. Requests shall be submitted promptly and must be received by Anaheim prior to the closing date shown on the legal notice. Answers to such requests for interpretation shall be made by Addendum issued by the City Engineer. A copy of each Addendum will be provided via the online bidding system and/or e-mail (at Anaheim's discretion) to each Contractor that obtained a Prequalification Package. The interpretation in the Addendum shall be final in such matters.

Prequalifying Procedure

Upon each Contractor's submission of a Prequalification Proposal, Anaheim will review the submittal to determine whether the Contractor is prequalified for the Master Agreement. If Anaheim determines the Contractor to be prequalified, the Contractor's name, along with a list of other proposed Prequalified Contractors and the proposed Master Agreement documents, will be presented to Anaheim City Council for approval. If approved, the listed Contractors may execute Master Agreements with Anaheim in order to bid on and potentially receive work orders for water system construction, maintenance, repair, relocation and/or immediate response services covered by the Master Agreement. The foregoing construction services shall be referred herein as "Water Work."

Contractor shall indicate the Work Order Category for which it is seeking to prequalify in the Prequalification Proposal. Anaheim will evaluate Prequalification Proposals and Rate Schedules to determine prequalification. The available Water Work under the Master Agreement consists of the following five Work Order Categories:

Work Order Category No. 1 –Abandon, Repair, Relocate, Replace, and install General Water Infrastructure System Components

Work Order Category No. 2 – Abandon, Repair, Relocate, Replace, and Install Water Transmission & Distribution Pipelines

Work Order Category No. 3 – Replace, repair, overhaul, and install water system electric motors, booster pumps, well pumps, treatment process pumps, & diesel engine pumps

Work Order Category No. 4 – Repair, replace, and install water system medium and low voltage electrical conduits, cables, and conductors, motor control center components, electrical panel lineups, plant wiring, SCADA system components, instrumentation, communication system components, and control panels

Work Order Category No. 5 – Welding for transmission mains, distribution mains, and other water system components.

Typical work types for each Work Order Category are described in Exhibit A – General Scope of Work, attached to the sample Master Agreement in Volume II of the Prequalification Package.

In its evaluation of the Prequalification Proposals, Anaheim reserves the right to inspect each Contractor's and/or its subcontractor's business office(s), equipment, and tool storage yard(s). At the end of its evaluation, Anaheim will select qualified Contractors for each Work Order Category. Selections will be based on qualifications rather than competition, and Anaheim may select any number of Contractors for a particular Work Order Category, including zero.

Anaheim will establish lists of prequalified Contractors for each of the above-described Work Order Categories. All listed Contractors will have been determined by Anaheim to be qualified to perform the types of work covered by each Work Order Category. When Anaheim requires Water Work, it provides detailed specifications and drawings, as appropriate, and invites Prequalified Contractors from the appropriate list(s) to bid on specific Water Work projects. Anaheim will select the Contractor to perform the Water Work in the manner set forth in the Master Agreement. As stated in the Master Agreement, no prequalified Contractor is guaranteed to receive any Water Work.

All Water Work shall be planned, executed, and completed in accordance with the WORK ORDER PACKAGE OR REQUEST; WORK ORDER/REQUEST DRAWINGS; Anaheim's Water Services Standard Specifications and its Special Provisions; latest Standard Specifications for Public Works Construction ("Green Book") adopted by ANAHEIM; the Standard Specifications Supplement attached to the Request for Bids; and the Appendices.

<u>Immediate Response Services</u>

A Contractor will be deemed prequalified for an Immediate Response Services "Request" so long as the Contractor is prequalified for a Work Order Category which involves the type of work required by the Request. When Immediate Response Services are required, Anaheim will contact Prequalified Contractors via telephone until the Immediate Response Service requirements have been satisfied. Under this process, Anaheim may or may not contact every qualified Contractor. No prequalified Contractor is guaranteed to receive any Immediate Response Services work.

To facilitate a timely response to emergencies, Anaheim will establish a ranked list of Prequalified Contractors interested in providing Immediate Response Services work in each Work Order Category. The ranking will determine which Prequalified Contractors get called first to respond

to Immediate Response Services work, and it will be established based on the information provided by Contractors in their Prequalification Proposals.

Processing Prequalification Proposals

Anaheim reserves the right to waive minor irregularities and omissions in the Prequalification Proposals.

Note: A Contractor's Prequalification Proposal may be rejected and not considered on the following grounds:

(1) Omission of requested information or documentation,
(2) Untimely submission, or
(3) False information.

Appealing a Prequalification Determination

If Anaheim determines a Contractor to be "not qualified" for purposes of the Master Agreement, the Contractor may appeal that determination by (1) giving notice to Anaheim of its intent to appeal no later than ten business days after receiving notice of Anaheim's determination, and (2) requesting a hearing. If a Contractor fails to file a timely appeal with Anaheim and request a hearing, it waives any and all rights to challenge Anaheim's qualification decision.

If the Contractor gives the required notice of appeal and requests a hearing, the hearing shall be conducted so that it is concluded no later than ten business days after Anaheim's receipt of its notice of appeal. The hearing so provided shall be an informal process conducted by a Hearing Officer to whom the Anaheim City Council has delegated responsibility to hear such appeals. At or prior to the hearing, the Contractor will be advised of the basis for Anaheim's prequalification determination. The Contractor will be given an opportunity to present information and argument in opposition to the prequalification determination. No later than ten business days after completion of the hearing, the Hearing Officer will render his/her decision. The date for approval of the Master Agreement will not be delayed to allow for completion of an appeal process.

MASTER AGREEMENT FOR WATER SYSTEM CONSTRUCTION, MAINTENANCE, REPAIR, AND IMMEDIATE RESPONSE

NON-MANDATORY

PRE-BID

MEETING

DATE: April 28, 2022
TIME: 3:00 p.m.
PLACE: Anaheim West Tower
201 S. Anaheim Blvd.
6th Floor

Questions regarding the meeting location
will be received at (714) 765-5272

Attendees should park in the parking structure upper levels and obtain a ticket which will be validated.

CONTRACTOR PREQUALIFICATION APPLICATION
FOR MASTER CONSTRUCTION AGREEMENT

Entity Name Authorized to Conduct Business in California		Check One:	☐ Corporation ☐ Partnership ☐ Sole Proprietor ☐ Other:_____
Other Company Names Used (For licenses, DBA, etc.)			
Contact Person:			
Title:			
Address:			

Phone:		Fax:	
Email Address:			
If sole proprietorship or partnership, name, title, contact info for owner(s) and managing partner(s):			
If corporation, State of incorporation:			
Name, title, contact info for corporate officers:			

Contractor's CSLB License Number(s) and Class	Date of Expiration
Anaheim Business License Number	Date of Expiration
Department of Industrial Relations Registration Number (DIR Number)	Renewed for 2022-23 (Yes/No)

NOTE: The words "you" and "your" used herein shall mean the applicant company, its corporate officers, partners, principals, owners and/or proprietors.

CONTRACTOR PREQUALIFICATION APPLICATION
FOR MASTER CONSTRUCTION AGREEMENT

Subcontractor(s) ***(List if Prequalification Application Relies on Subcontractor's License or Expertise)[1]***	
1. Subcontractor Company Name/Address:	
Subcontractor Email Address (for DIR input):	
Subcontractor's CSLB License Number(s) and Class	Date of Expiration
Anaheim Business License Number	Date of Expiration
DIR Number	Renewed for 2022-23 (Yes/No)
2. Subcontractor Company Name/Address:	
Subcontractor Email Address (for DIR input):	
Subcontractor's CSLB License Number(s) and Class	Date of Expiration
Anaheim Business License Number	Date of Expiration
DIR Number	Renewed for 2022-23 (Yes/No)
3. Subcontractor Company Name/Address:	
Subcontractor Email Address (for DIR input):	
Subcontractor's CSLB License Number(s) and Class	Date of Expiration
Anaheim Business License Number	Date of Expiration
DIR Number	Renewed for 2022-23 (Yes/No)

[1] Listed Subcontractors are factors in prequalification; use of other Subcontractors in bids may result in review of Contractor's prequalification status.

CONTRACTOR PREQUALIFICATION APPLICATION
FOR MASTER CONSTRUCTION AGREEMENT

Work Order Category[2] Check categories for which Contractor seeks to prequalify. • For each checked Work Order Category, attach copies of current certifications for Cal/OSHA competent persons as appropriate for each Work Order category selected. Updated certifications shall be provided for each Work Order or Immediate Request. • For Work Order Category No. 5, attach copies of welder certifications. Welder certification test shall be in accordance with the requirements of section 4 of ANSI/AWS D1.1, D10.9 Pipe Welder Qualification Structural Steel Welding Code(s). Updated certifications shall be provided for each Work Order or Immediate Response Request.	**Propose on and be Prequalified to perform the Work**	**Propose to be Considered for Immediate Response Work**
Work Order Category No. 1 (Water System Components) • Water system components: Abandon, repair, relocate, replace, and install water system components and other water facilities as needed	☐	☐
Work Order Category No. 2 (Transmission and Distribution Pipelines) • Abandon, repair, relocate, replace, and install water transmission & distribution system mainline pipes, service pipes, hydrants, and others as needed	☐	☐
Work Order Category No.3 (Motors & Pumps) • Replace, repair, overhaul, and install water system electric motors, booster pumps, well pumps, treatment process pumps, & diesel engine pumps	☐	☐
Work Order Category No. 4 (Electrical & Instrumentation) • Replace, repair, and install water system medium and low voltage electrical conduits, cables, and conductors, motor control center components, electrical panel lineups, plant wiring, SCADA system components, instrumentation, communication system components, and control panels	☐	☐
Work Order Category No. 5 (Welding) • Welding for transmission mains, distribution mains, and other water system components.	☐	☐

[2] For typical work types in each Work Order Category, see "General Scope of Work," attached as Exhibit A to the sample Master Agreement in Volume II of the Prequalification Package.

CONTRACTOR PREQUALIFICATION APPLICATION
FOR MASTER CONSTRUCTION AGREEMENT

PART I. ESSENTIAL REQUIREMENTS FOR PREQUALIFICATION

Contractor will be immediately disqualified if the answer to any of questions 1 through 4 is "No" or 5 through 8 is "Yes."

1. Contractor possesses a valid and current California Contractor's license for the Work Order Category or Categories for which it intends to pre-qualify.
☐ Yes ☐ No

2. Contractor can obtain a commercial general liability insurance policy with a policy limit of at least $2,000,000 per occurrence and $4,000,000 aggregate.
☐ Yes ☐ No

3. Contractor has current workers' compensation insurance policy as required by the Labor Code or is legally self-insured pursuant to Labor Code section 3700 et seq.
☐ Yes ☐ No ☐ Contractor is exempt from this requirement, because it has no employees

4. Is your current bonding capacity sufficient to provide the required bonds as set forth in the Master Agreement for which you seek pre-qualification?
☐ Yes ☐ No

5. Has your contractor's license been revoked at any time in the last five years?
☐ Yes ☐ No

6. Has a surety completed a contract on your behalf, or paid for completion because your company was default terminated by the project owner within the last five (5) years?
☐ Yes ☐ No

7. At the time of submitting this pre-qualification form, is your company ineligible to bid on or be awarded a water utility project bid through a public works contract, or perform as a subcontractor on such contract, pursuant to either Labor Code section 1777.1 or Labor Code section 1777.7?
☐ Yes ☐ No
If the answer is "Yes," state the beginning and ending dates of the period of debarment:
_____

8. At any time during the last five years, has your company or any of its owners or officers been convicted of a crime involving the awarding of a contract of a government construction project, or the bidding or performance of a government contract?
☐ Yes ☐ No

CONTRACTOR PREQUALIFICATION APPLICATION
FOR MASTER CONSTRUCTION AGREEMENT

PART II. ORGANIZATION, HISTORY, ORGANIZATIONAL PERFORMANCE, FINANCIAL CONDITION, AND EXPERIENCE

1. ORGANIZATION, HISTORY, AND ORGANIZATIONAL PERFORMANCE

NAMES OF CORPORATE OFFICERS. OFFICERS, PARTNERS, PRINCIPALS, PROPRIETORS:

Name	Position	Percentage of Stock

LIST OF ANY SUBSIDIARIES OR AFFILIATED COMPANIES:

Exact Name	Type of Business	Ownership

A. Contractor License No.: _____ Type _____ Expiration _____

Classification (type) of Specialty Contractor: _____

Have you ever been licensed under a different name or a different license number? _____

If yes, give name and license number: _____

B. How many years has your organization been in business as a contractor under your present business name and license number? _____

C. For each Work Order Category selected above, how many years of related construction experience does your company have?

Total	_____ year(s)
As a general contractor?	_____ year(s)
As a subcontractor?	_____ year(s)

D. Has your company or any of its owners/principals ever petitioned for bankruptcy? _____

If the answer is "YES," enter the date(s): _____

CONTRACTOR PREQUALIFICATION APPLICATION
FOR MASTER CONSTRUCTION AGREEMENT

E. Has your company or any of its principals defaulted so as to cause a loss of surety? If the answer is "YES," enter the date(s), name and address of surety and details:

_____
_____
_____
_____

F. Have you been assessed liquidated damages for your project in the past three years? _____
If yes, explain _____
_____

G. Have you been in litigation on a question relating to your performance on a contract during the past three (3) years? _____
If yes, explain _____
_____
_____

H. Have you failed to complete a contract? _____ If so, give details: _____
_____
_____

I. In what other lines of business pertaining to this Statement do you have financial interest?

_____
_____

J. Name the persons with whom you have associated in business as partners or joint venture in each of the last five (5) years: _____
_____
_____

K. What is the organization experience of the principal individuals of your present organization?

Individual's Name	Present Position In Your Office	Years of Construction Experience Related to Water Works	Magnitude and Type of Work

2. FINANCIAL CONDITION

A. Name, Address of Bank: _____

_____Telephone ( )_____

Total Line of Credit $ _____How Secured? _____ Interest Rate: _____

How much of your line of credit is currently available? _____

Name of Loan Officer: _____

B. Name, Address of Bank: _____

_____Telephone ( )_____

Total Line of Credit $ _____How Secured? _____ Interest Rate: _____

How much of your line of credit is currently available? _____

Name of Loan Officer: _____

3. EXPERIENCE

For each Work Order Category checked above, identify at least five (5) projects your company has completed during the past five years that represent the types of work described in the "General Scope of Work" and Appendices provided in the Prequalification Package. The following form can be used for this purpose. (Copy and/or use supplemental sheets as required to complete your answer.)

☐ Project Name: _____ Work Order Category No. : _____

Project Duration: _____To_____

Superintendent of Job: _____

Project Total Cost:_____Company's Construction Cost: _____

Address: _____

Client Name: _____

Client Phone #: _____

CONTRACTOR PREQUALIFICATION APPLICATION
FOR MASTER CONSTRUCTION AGREEMENT

Description of Work: _____

☐ Project Name: _____ Work Order Category No. : _____

Project Duration: _____To_____

Superintendent of Job: _____

Project Total Cost:_____Company's Construction Cost: _____

Address: _____

Client Name: _____

Client Phone #: _____

Description of Work: _____

☐ Project Name: _____Work Order Category No. : _____

Project Duration: _____To_____

Superintendent of Job: _____

Project Total Cost:_____Company's Construction Cost: _____

Address: _____

Client Name: _____

Client Phone #: _____

Description of Work: _____

CONTRACTOR PREQUALIFICATION APPLICATION
FOR MASTER CONSTRUCTION AGREEMENT

☐ Project Name: _____ Work Order Category No. : _____

Project Duration: _____To_____

Superintendent of Job: _____

Project Total Cost:_____Company's Construction Cost: _____

Address: _____

Client Name: _____

Client Phone #: _____

Description of Work: _____

☐ Project Name: _____ Work Order Category No. : _____

Project Duration: _____To_____

Superintendent of Job: _____

Project Total Cost:_____Company's Construction Cost: _____

Address: _____

Client Name: _____

Client Phone #: _____

Description of Work: _____

CONTRACTOR PREQUALIFICATION APPLICATION
FOR MASTER CONSTRUCTION AGREEMENT

* * * * * * *

I, the undersigned, declare that I have read the foregoing Prequalification Application and have personal knowledge of its contents. The information stated in the Application is true, except as to any matters stated on information and belief, and as to those matters I believe them to be true. I am a resident of the State of California, over the age of 18, and competent to testify to the matters herein stated. I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct.

_____	_____	_____
Signature	Name, Title	Date

Contact for Questions (if different than above):	
Name:	Email:
	Phone:

RATE SCHEDULE FOR MASTER AGREEMENT FOR WATER SYSTEM CONSTRUCTION, MAINTENANCE, REPAIR, AND IMMEDIATE RESPONSE

DATE: _____

NOTE: The straight time and premium rates, and the equipment rates that the contractor provides herein may be used for Time and Material Work, Crew Rate Work, or Immediate Response Work at the sole discretion of the City. Contractor shall provide rates in the areas of work for which he/she wishes to pre-qualify and compete. References to WORK ORDER shall mean either a WORK ORDER PACKAGE or REQUEST.

1. GENERAL
   The compensation and payment set forth in Section 9 of the latest Standard Specifications for Public Works Construction adopted by ANAHEIM (Standard Specifications) and this Rate Schedule shall be for the WORK as directed by the CITY and performed under this MASTER AGREEMENT on a Time and Equipment or Crew Hour Rate basis, as specified in the WORK ORDER which incorporates this MASTER AGREEMENT.

2. LABOR BILLING RATES
   The following schedule for labor billing rates applies for this Rate Schedule.

3. CONTRACTOR OWNED EQUIPMENT RATES:
   _____ Percent (____ %)
   The equipment rates shall be based on the latest edition of the Caltrans "Labor Surcharge and Equipment Rental Rates" book. Enter a percent multiplier to be applied to the Caltrans equipment rates if higher or lower rates are being proposed; otherwise, enter 100 (hundred).

4. CONTRACTOR FURNISHED MATERIAL HANDLING CHARGE:
   _____ Percent (____ %)

5. RENTAL EQUIPMENT HANDLING CHARGE:
   _____ Percent (____ %)
   Rental Equipment is only for equipment not listed under the CONTRACTOR Owned Equipment.

RATE SCHEDULE FOR MASTER AGREEMENT FOR WATER SYSTEM CONSTRUCTION, MAINTENANCE, REPAIR, AND IMMEDIATE RESPONSE

6. DOCUMENTATION OF RATES:

The CONTRACTOR'S rates and schedules are documented in this Rate Schedule. Requests for adjustment of rates shall be submitted to the Water Engineering Division in writing at least forty-five (45) days prior to the effective date of any proposed rate changes; however, no increase in such hourly labor costs sales shall exceed the Consumer Price Index for Urban Wage Earners in the Los Angeles-Riverside-Orange County area for the preceding twelve (12) month period. WORK ORDERS in progress or issued prior to the effective date of a change in the Rate Schedule, shall not be subject to change and shall be completed under the Rate Schedule in effect on the date the WORK ORDER was issued, unless otherwise specified. Only one change of the CONTRACTOR'S rates and schedules shall be allowed during a year's period.

7. COST ACCOUNTING REQUIREMENTS

CITY shall require that the CONTRACTOR provide supporting documents with each invoice for WORK performed under the MASTER AGREEMENT.

RATE SCHEDULE FOR MASTER AGREEMENT FOR WATER SYSTEM CONSTRUCTION, MAINTENANCE, REPAIR, AND IMMEDIATE RESPONSE

The elements of cost invoiced and the support required are as follows:

A. Labor Hours: Copy of time sheets approved by the WATER UTILITY INSPECTOR.

B. Contractor Owned Equipment: Copy of time sheets with equipment identification numbers approved by the WATER UTILITY INSPECTOR.

C. Special Order Material: Copy of respective invoice paid during the billing period and the CITY approved delivery receipt or other amount approved by the WATER UTILITY INSPECTOR.

D. Rentals: Copy of respective invoice paid during the billing period.

E. Subcontractors: Copy of respective invoice paid during the billing period.

F. Invoice Requirements: The CONTRACTOR must prepare and submit separate invoices for each WORK ORDER. All invoices shall reference the appropriate WORK ORDER number.

9. CREW COMPOSITION

Crew Hour Rates shall be adjusted for crewmember classification or amount of basic equipment actually utilized. Unless otherwise specified in the WORK ORDER, the composition of each crew shall be determined by the CONTRACTOR. The CONTRACTOR shall furnish labor with adequate skills to perform the WORK authorized, including supervision, planning and layout. The CITY reserves the right to stipulate the required crew composition. The following items are representative of what shall be included in the Crew hour Rates:

Labor
Small Tools
Consumable Supplies
Expendable Materials
Storeroom
All Forms of Taxes
Insurance
Labor Benefit Payments
Wages in excess of Job Time
Administrative Work
Job Site Water and Electric
Chemical Toilets
Temporary Fencing
Telephone and Radio Expense
Overhead and Profit
Traffic Control

RATE SCHEDULE FOR MASTER AGREEMENT FOR WATER SYSTEM CONSTRUCTION, MAINTENANCE, REPAIR, AND IMMEDIATE RESPONSE

10. BASIC EQUIPMENT DEFINITION

The CONTRACTOR shall furnish all basic equipment necessary to properly perform the WORK. The type of basic equipment utilized shall be at the discretion of the CONTRACTOR. Compensation for the expense of furnishing the following basic equipment will be billed at the applicable hourly rate per Item 3 and Item 5 of Page 1 of the Rate Schedule. Submit a list of Contractor Owned Equipment:

A. Automotive Equipment *(including but not limited to, Contractor may identify their list of equipment)*

1. Crew Truck
2. Pick-Up Truck
3. Foreman Truck
4. Boom Truck
5. Material Truck
6. Support Truck
7. Dump Truck
8. 10-Wheeler Truck/Trailer
9. Water Truck
10. Pipe Trailer

B. Boring and Earth Drilling Equipment
Including power motor, bore pipe, bits, augers and reamers.

C. Buffing, Grinding, Sawcutting, Compaction, and Drilling Equipment
Including sawtruck, sawcutting machine, sheep's foot roller, sandblasting machine, etc.

D. Compressors and Pneumatic Equipment

E. Pumps
Including pumping equipment for testing purposes and water/mud removal, etc.

G. Portable Generators (As Required)

H. Portable Lighting

I. Traffic Control Equipment
Including Flashing Arrowboard, Delineators, Flashing Barricades, Barricades, Cones, Signs, K-Rails, Steel Traffic Plates, etc.

RATE SCHEDULE FOR MASTER AGREEMENT FOR WATER SYSTEM CONSTRUCTION, MAINTENANCE, REPAIR, AND IMMEDIATE RESPONSE

J. Excavation Equipment
Including excavator, backhoe, trencher, bulldozer, loader

K. Welding Equipment
Including accessories

L. Tapping Machine
Including machines and accessories

M. Concrete Equipment
Including formwork, finishing tools and accessories, etc.

N. Paving Equipment
Including Steam roller, vibratory plate, 12-ton AC roller, etc.

O. Hoisting Equipment
Including crane, mast, boom, winch (4-ton capacity), accessories, etc.

P. Cable/Wire Pulling Equipment

Q. Splicing Equipment

RATE SCHEDULE FOR MASTER AGREEMENT FOR WATER SYSTEM CONSTRUCTION, MAINTENANCE, REPAIR, AND IMMEDIATE RESPONSE

LABOR BILLING RATE SHEET

CLASSIFICATION	EFFECTIVE DATE	STRAIGHT TIME $/HR.	PREMIUM TIME $/HR.

PIPELINE WORK
Superintendent (S)
Foreman (F)
Equipment Operator (EO)
Pipe Fitter (PF)
Certified Welder (CW)
Laborer (L)

SERVICE WORK
Foreman (F)
Equipment Operator (EO)
Pipe Fitter (PF)
Laborer (L)

PUMP WORK
General Foreman Service Mechanic (GFSM)
Service Technician (ST)
Service Mechanic (SM)
Equipment Operator (EO)
Millwright (M)
Laborer (L)

WELL WORK
General Foreman Driller Operating Engineer (GFDOE)
Foreman Driller Operating Engineer (FDOE)
Journeyman Driller Operating Engineer (JDOE)
Laborer (L)

MOTOR WORK
General Foreman Service Technician (GFST)
Service Technician (ST)
Service Mechanic (SM)
Equipment Operator (EO)
Millwright (M)

RATE SCHEDULE FOR MASTER AGREEMENT CONTRACTS FOR WATER SYSTEM CONSTRUCTION, MAINTENANCE, REPAIR, AND IMMEDIATE RESPONSE

LABOR BILLING RATE SHEET (*continued*)

CLASSIFICATION	EFFECTIVE DATE	STRAIGHT TIME $/HR.	PREMIUM TIME $/HR.

ELECTRICAL WORK
General Foreman Electrician (GFE)
Foreman Wireman (FW)
Foreman Electrician (FE)
Journeyman Electrician (JE)
Laborer (L)

CONTROL/SCADA/ INSTRUMENTATION WORK
General Foreman Test Technician (GFTT)
Foreman Test Technician (FTT)
Journeyman Test Technician (JTT)
Laborer (L)

CIVIL WORK
Foreman (F)
Equipment Operator (EO)
Laborer (L)

RATE SCHEDULE FOR MASTER AGREEMENT CONTRACTS FOR WATER SYSTEM CONSTRUCTION, MAINTENANCE, REPAIR, AND IMMEDIATE RESPONSE

RATE PER CREW HOUR

Pipeline Work	CREW COMPOSITION	STRAIGHT-TIME	PREMIUM-TIME
1-Man Crew (Inspection)	F		
4-Man Crew	F, PF, L, EO		
5-Man Crew	F, 2PF, L, EO		
6-Man Crew	S, F, PF, CW, L, EO		
Service Work			
3-Man Crew	PF, EO, L		
4-Man Crew	PF, 2L, EO		
Pump Work			
1-Man Crew (Troubleshooter)	SM		
2-Man Crew	GFSM, SM		
3-Man Crew	GFSM, SM, EO		
4-Man Crew	GFSM, SM, ST, EO		
6-Man Crew	GFSM, SM, ST, EO, M, L		
Well Work			
2-Man Crew	FDOE, JDOE		
3-Man Crew	FDOE, JDOE, L		
5-Man Crew	GFDOE, FDOE, JDOE, 2L		
Motor Work			
1-Man Crew (Troubleshooter)	GFST		
2-Man Crew	GFST, SM		
3-Man Crew	GFST, ST, EO		
4-Man Crew	GFST, ST, SM, EO		
6-Man Crew	GFST, ST, SM, EO, M, L		
Electrical Work			
2-Man Crew	GFE, FW		
3-Man Crew	FE, 2JE		
4-Man Crew	FE, FW, 2JE		
5-Man Crew	FE, FW, 2JE, L		
Control/SCADA Instrumentation Work			
1-Man Crew (Troubleshooter)	GFTT		
2-Man Crew	FTT, JTT		
3-Man Crew	FTT, 2JTT		
4-Man Crew	FTT, 2JTT, L		

RATE SCHEDULE FOR MASTER AGREEMENT CONTRACTS FOR WATER SYSTEM CONSTRUCTION, MAINTENANCE, REPAIR, AND IMMEDIATE RESPONSE

RATE PER CREW HOUR (*continued*)

Civil Work	CREW COMPOSITION	STRAIGHT-TIME	PREMIUM-TIME
2-Man Crew	F, L		
3-Man Crew	F, 2L		
4-Man Crew	F, 2L, EO		
5-Man Crew	F, 3L, EO		

NOTES: 1. The CONTRACTOR shall provide a rate per man to increase the crew size above a 6-man crew.
2. The CONTRACTOR shall provide a formula for the CITY to calculate rate for Daily, Weekly, and Monthly usage if required.

NONCOLLUSION AFFIDAVIT TO BE EXECUTED
BY BIDDER AND SUBMITTED WITH BID

State of California)
) ss.
County of Orange)

_____, being first duly sworn, deposes and says that he or she is _____ of _____ the party making the foregoing bid that the bid is not made in the interest of, or on the behalf of, any undisclosed person, partnership, company, association, organization, or corporation; that the bid is genuine and not collusive or sham; that the bidder has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid, and has not directly or indirectly colluded, conspired, connived, or agreed with any bidder or anyone else to put in a sham bid, or that anyone shall refrain from bidding; that the bidder has not in any manner, directly or indirectly, sought by agreement, communication, or conference with anyone to fix the bid price of the bidder or any other bidder, or to fix any overhead, profit, or cost element of the bid price, or of that of any other bidder, or to secure any advantage against the public body awarding the contract of anyone interested in the proposed contract; that all statements contained in the bid are true; and, further, that the bidder has not, directly or indirectly, submitted his or her bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, or paid, and will not pay fee to any corporation, partnership, company, association, organization, bid depository, or to any member or agent thereof to effectuate a collusive or sham bid.

State of California)
) ss
County of _____)

_____
Name of Bidder

Subscribed and sworn to before me this

_____ day of _____ 20 _____

_____
Signature of Bidder

WITNESS my hand and official seal

_____
Notary Public

_____

_____

_____
Address of Bidder

Approved as to form
By City Attorney

By _____

ALL SIGNATURES ON THIS NONCOLLUSION AFFIDAVIT MUST BE WITNESSED BY A NOTARY
(attach appropriate jurats)

EQUAL EMPLOYMENT OPPORTUNITY CERTIFICATES OF COMPLIANCE

As used in this Certificate, the word "Contract" shall mean either "Contract", or "Subcontract". The word "Contractor" shall mean either "Contractor" or "Subcontractor".

The undersigned Contractor certifies the following to the City of Anaheim:

1. COMPLIANCE REPORTS:

   That if the Contractor has participated in a previous Contract subject to the rules and regulations on Equal Opportunity set forth in 41 Code of Federal Regulations Part 60-1, he has filed with the Joint Reporting Committee, the Director of the Office of Federal Contract Compliance of the United States Department of Labor, the appropriate Government Agencies or the Equal Employment Opportunity Commission all reports due under the applicable filing requirements, or if he has not he agrees to do so promptly and before any Contract is awarded.

2. NON-DISCRIMINATION:

   During the performance of any Contract placed with him by the City of Anaheim, the Contractor agrees as follows:

   1. The Contractor will not discriminate against any employee or applicant for employment because of, race, religion, sex, creed, color, or national origin. The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, religion, sex, creed, color, or national origins. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer, recruitment or recruitment advertising, layoff of termination, rates of pay, or other forms of compensation, and selection for training, including apprenticeship.

   2. The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, religion, sex, creed, color, or national origin.

   3. The Contractor will send to each labor union or representative of workers with which he has a Collective Bargaining Agreement or other Contract or understanding, a notice advising the labor union or worker's representative of the Contractors commitments under Section 202 of Executive Order Number 11246 of September 24, 1965, as amended, and shall post copies of the notices in conspicuous places available to employees and to applicants for employment.

4. The Contractor will comply with all provisions of Executive Order Number 11246 of September 24, 1965, as amended, and with the rules, regulations, and relevant orders of the Secretary of Labor.

5. The Contractor will furnish all information and reports required by Executive Order Number 11246 of September 24, 1965, as amended, and by the rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the Contracting Agency and the Secretary of Labor for purposes of investigations to ascertain compliance with such rules, regulations, and orders.

6. In the event of the Contractor's non-compliance with the nondiscrimination clauses of this Contract or with any of such rules, regulations, or orders, this Contract may be canceled, terminated, or suspended in whole or in part and the Contractor may be declared ineligible for further City Executive Order Number 11246 of September 24, 1965, as amended, and such other sanctions may be imposed and remedies invoked as provided in Executive Order Number 11246 of September 24, 1965, as amended, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

3. AFFIRMATIVE ACTION PROGRAM:

Contractor's attention is directed to Section 60-1.40 of Title 41 of the Code of Federal Relations, related to Affirmative Action Compliance Programs, and applying to each Subcontractor with a Subcontract of $50,000 or more and 50 or more employees.

Contractor certifies that he has developed and has on file at each of his establishments a written Affirmative Action Compliance Program, as is called for in section 60-1.40 of and pursuant to part 60-2 of Title 41 of the code of Federal Regulations, and that such Affirmative Action Compliance Program is current, or if it is not, within 120 days after receipt of any order, the undersigned firm agrees to develop and maintain a written Affirmative Action Compliance Program, for each of his facilities unless such firm is not required by law or regulation to develop such program.

4. CERTIFICATION OF NON-SEGREGATED FACILITIES:

The Contractor certifies that it does not maintain or provide for its employees any segregated facilities at any of its establishments, and that it does not permit its employees to perform their services at any locations, under its control, where segregated facilities are maintained. The bidder, offerer, applicant, or Subcontractor agrees that a breach of this Certification is a violation of the Equal Opportunity Clause of any Contract placed with it. As used in this Certification, the term "Segregated Facilities" means any waiting rooms, work areas, restrooms and washrooms, restaurants and other eating areas, time clocks, locker rooms, and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees, which are segregated by explicit directive or in fact segregated on the basis of race, religion, sex, creed, color, or national origin because of habit, local custom or otherwise.

Contractor further certifies that it will obtain identical certifications from proposed Subcontractors prior to the award of Subcontracts exceeding $10,000 covering the procurement if personal property and non-personal services (including construction).

CONTRACTOR'S FIRM NAME_____

ADDRESS_____

SIGNED_____

TITLE_____

DATE_____

MASTER AGREEMENT
FOR WATER SYSTEM CONSTRUCTION, MAINTENANCE, REPAIR, AND IMMEDIATE RESPONSE

Contact Information Sheet
April 2022

Company	
Address	
Point of Contact/PM	
Title	
Phone (Office)	
Phone (Cell)	
Email	

Immediate Response	
Point of Contact	
24 hour Phone	
Email	

All other contacts (if more than one) or in different format (from above), please attach additional sheets.

If information changes, please provide updated sheet.

VOLUME II

MASTER AGREEMENT
FOR WATER SYSTEM CONSTRUCTION, MAINTENANCE, REPAIR, AND IMMEDIATE RESPONSE

OTHER RELATED DOCUMENTS

April 2022
Public Utilities Department
Water Engineering Division
Anaheim, CA

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MASTER AGREEMENT FOR WATER SYSTEM CONSTRUCTION,
MAINTENANCE, REPAIR, AND IMMEDIATE RESPONSE

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1. Invitation to Bidders
2. Instructions to Contractor for Master Agreement Pre-Qualification
3. Pre-proposal Meeting
4. Contractor Pre-Qualification Application (Fill-in, scan, and upload)
5. Rate Schedule (Fill-in, scan, and upload)
6. Non-Collusion Affidavit (Fill-in, scan, and upload)
7. Equal Employment Opportunity Certificate of Compliance
   (Fill-in, scan, and upload)
8. Contact Sheet (Fill-in, scan, and upload)

VOLUME II **OTHER RELATED DOCUMENTS**

9. Standard Specification Supplement
10. Special Provisions
11. Master Agreement (Sample)
    {Includes Agreement and Exhibit A – General Scope of Work}
12. Appendix A – Estoppel Certificate
13. Appendix B – Faithful Performance Bond
14. Appendix C – Labor and Material Bond
15. Appendix D – Equipment Specification
16. Appendix E – Instrumentation & Electrical Specification
17. Appendix F – Civil Work Specification
18. Appendix G – Mechanical Specification

CONTRACT DOCUMENTS

AND

STANDARD SPECIFICATION SUPPLEMENT

PUBLIC WORKS DEPARTMENT

City of Anaheim
California

REVISED 7/01/15

MASTER

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1. PROPOSAL (Enclosed)

2. NON-COLLUSION AFFIDAVIT (Enclosed)

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6. BID BOND

7. FAITHFUL PERFORMANCE BOND

8. LABOR AND MATERIAL BOND

9. STANDARD SPECIFICATIONS SUPPLEMENT

10. SPECIAL PROVISIONS

INSTRUCTIONS TO BIDDERS

General Information

ELECTRONIC proposals, including all documents required to be submitted with the bid, will be received at the office of the Anaheim City Clerk of said City until the date and time specified in the legal notice or addendum to the project documents, whichever occurs latest, for the construction of work described in the project documents or said legal notice. The ELECTRONIC proposals will be opened and publicly read by the City Clerk and City Engineer, or their respective designees, in the Council Chambers, or other designated location, at the City of Anaheim, California, shortly after the bid opening day and time.

In addition to the "ELECTRONIC" uploading of Proposal Documents described in the 'INVITATION TO BIDDERS', the fully executed **original Bid Bond** shall be delivered to the Anaheim City Clerk on or before the actual bid opening day and time.

This project is subject to compliance monitoring and enforcement by the Department of Industrial Relations.

No contractor or subcontractor may be listed on a bid proposal for a Public Works project (submitted on or after March 1, 2015) unless registered with the Department of Industrial Relations pursuant to Labor Code section 1725.5.

No contractor or subcontractor may be awarded a contract for public work on a Public Works project (awarded on or after April 1, 2015) unless registered with the Department of Industrial Relations pursuant to Labor Code section 1725.5.

Proposal

All documents included in the Proposal Packet must be submitted on the unaltered forms obtained, via download from the City's on-line bidding software. All entries on the Proposal must be in ink, or typewritten. If an individual submits the proposal, his or her name and post office address must be shown. If submitted by a corporation, the proposal must show the names, titles, and business addresses of the president, secretary, and treasurer, and be sealed with the corporate seal. Anyone signing a proposal as the agent of another, or others, must file with it legal evidence of his or her authority to do so.

The **Proposal** packet, as detailed in 'INVITATION TO BIDDERS' shall be "uploaded to the City's ELECTRONIC" bidding software and the **line item costs** shall be input on-line in the bidding software on or before the day and hour set for the opening of bids. The original copy of the **Bid Bond forms** shall be delivered to the office of the City Clerk of the City of Anaheim, California, and shall be enclosed in a sealed envelope addressed to the City Council of the City of Anaheim, California, bearing the name and address of the bidder and the name and account number of the project on or before the actual bid opening day and time.

Interpretation of Contract Documents

If any prospective bidder preparing a bid for the proposed contract is in doubt as to the intent or meaning of any part of the plans, specifications, or other proposed contract documents, he or she shall submit to the City or designee Engineer a written request for an interpretation thereof. The person submitting the request shall be responsible for its prompt delivery. Any interpretation of the proposed documents shall be made by addendum only, duly issued by the City, and a copy of each such addendum shall be made available, via download from the City's ELECTRONIC BIDDING software, to each potential bidder who has registered on-line to receive project updates. The City will not be responsible for any other explanation or interpretation of the proposed documents **nor will the City be responsible for the completeness of project documents obtained from other sources.**

After the contract has been awarded, contractor agrees in advance that any ambiguities not submitted to the Engineer pursuant to the above, shall be construed against the Contractor and in favor of the City.

BID SUBMISSION CHECKLIST

1. The **Proposal** includes **all documents, as described in the INVITATION TO BIDDERS,** that are required to be electronically submitted with the bid. The Bid shall be received through the City's electronic bidding process until the date and time specified in the legal notice or addendum to the project documents, whichever occurs latest.

2. **Line Item Values** shall be electronically inputted through the on-line bidding software and shall be received through the City's electronic bidding process until the date and time specified in the legal notice or addendum to the project documents, whichever occurs latest.

3. The fully executed **original Bid Bond** shall be delivered to the Anaheim City Clerk until the date and time specified in the legal notice or addendum to the project documents, whichever occurs latest.

Follow bid submission checklist detailed above, otherwise the bid will be considered non-responsive.

(SAMPLE)
BID BOND

KNOW ALL BY THESE PRESENTS, that we, _____, as Principal, and _____, a corporation organized and existing under the laws of the State of _____ and whose principal office is located in the City of _____, as surety, are jointly and severally bound unto the CITY OF ANAHEIM of Orange County, California, in the sum of _____ DOLLARS ($_____), lawful money of the United States of America to be paid to the said CITY OF ANAHEIM, for which payment well and truly to be made, we bind ourselves, our heirs, successors, executors, administrators and assigns, jointly and severally, by these presents.

THE CONDITION OF THIS OBLIGATION is such that whereas the Principal has submitted the accompanying bid dated _____, 20_____, for the construction of _____ for the CITY OF ANAHEIM, Orange County, California.

NOW, THEREFORE, if the Principal shall not withdraw said bid within thirty (30) days after the opening of same, and shall within twenty-one (21) days after the agreement has been presented to him for execution enter into a written contract with the City in accordance with the bid as accepted, and if the Principal shall give the required bond with good and sufficient sureties, or sureties for the faithful performance and proper fulfillment of such contract and for the protection of laborers and materialmen, or in the event of the withdrawal of said bid within the periods specified, or the failure to enter into said contract and give said bond within the time specified if the Principal shall within sixty (60) days after request by the City, pay the City the difference between the amount specified in said bid and the amount for which the City may procure the required work and/or supplies if the latter amount be in excess of the former, then the above obligation shall be void and of no effect, otherwise to remain in full force and virtue.

IN WITNESS WHEREOF the above-obligated parties have executed this instrument under their several seals this _____ day of _____, 20 _____, the name and corporate seal of each corporate party being affixed hereto and these presents duly signed by its undersigned representative pursuant to authority of its governing body.

_____
PRINCIPAL

Two Witnesses (if individual)

_____ By _____

_____ Title _____

ATTEST (if corporation)

_____ _____
Surety

_____

Title By _____
Title

Corporate Seal
ATTEST (SEAL)

_____
Corporate seal

(SAMPLE)

Premium

FAITHFUL PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS:

WHEREAS, the City of Anaheim, a municipal corporation of the State of, California, in the County of Orange has awarded to _____, License No. _____ (hereinafter called "Principal"), a contract for _____, which said contract is hereby referred to and made a part hereof; and

WHEREAS, said Principal is required under the terms of said contract to furnish a bond for the faithful performance of said contract.

NOW, THEREFORE, we, _____, as Principal, and _____ as Surety, are held and firmly bound unto the City of Anaheim, a municipal corporation (hereinafter called "City"), in the penal sum of _____DOLLARS ($_____), lawful money of the Unites States of America, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, successors, executors, and administrators, jointly and severally, firmly by these presents.

The condition of this obligation is such that, if the above bounded Principal, his or its heirs, executors, administrators, successors or assigns, shall in all things stand to and abide by and well and truly keep and perform all the undertakings, terms, covenants, conditions and provisions in the said contract and any alteration thereof made as therein provided, on his or their part, to be kept and performed at the time and in the manner therein specified, and in all respects according to their true intent and meaning, and shall indemnify and save harmless City, its officers, agents and employees, as therein stipulated, then this obligation shall become null and void; otherwise, it shall be and remain in full force and effect.

As a part of the obligation secured hereby and in addition to the face amount specified therefore, there shall be included costs and reasonable expenses and fees, including reasonable attorneys' fees, incurred by the City in successfully enforcing such obligation, all to be taxed as costs and included in any judgment rendered.

The said Surety hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the contract, or to the work to be performed thereunder or to the specifications accompanying the same shall in any way affect its obligation on this bond, and it does hereby waive notice of any such change, extension of time, alterations or additions to the terms of the contract or to the work or to the specifications.

IN WITNESS WHEREOF, three (3) identical counterparts of this instrument, each of which shall for all purposes be deemed an original thereof, have been duly executed by the Principal and Surety herein named, on the _____ day of _____, 20 _____, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative pursuant to authority of its governing body.

_____
Principal

By _____
President

By _____
Secretary

_____
Surety

_____
Attorney in Fact

CORPORATE ADDRESS OF SURETY:

_____

_____

_____

APPROVED AS TO FORM:

MICHAEL R.W. HOUSTON
CITY ATTORNEY

By: _____

Date: _____

Please note: All signatures must be notarized

(SAMPLE)

LABOR AND MATERIAL BOND

Premium

KNOW ALL MEN BY THESE PRESENTS:

WHEREAS, the City of Anaheim, a municipal corporation of Orange County, California, has awarded to _____, License No. _____ (hereinafter called "Principal"), a contract for _____, which said contract is hereby referred to and made a part hereof: and

WHEREAS, under the terms of said agreement, Principal is required before entering upon the performance of the work, to file a good and sufficient payment bond with the City of Anaheim to secure the claims to which reference is made in Title 15 (commencing with Section 3082) of Part 4 of Division 3 of the Civil Code of the State of California.

NOW, THEREFORE, said Principal and the undersigned as corporate Surety are held firmly bound unto the City of Anaheim and all contractors, subcontractors, laborers, materialmen and other persons employed in the performance of the aforesaid agreement and referred to in Title 15 (commencing with Section 3082) of Part 4 of Division 3 of the Civil Code of the State of California in the sum of _____ DOLLARS ($_____), for materials furnished or labor thereon of any kind, or for amounts due under the Unemployment Insurance Act with respect to such work or labor, that said Surety will pay the same in an amount not exceeding the amount hereinabove set forth, and also in case suit is brought upon this bond, will pay, in addition to the face amount thereof, costs and reasonable expenses and fees, including reasonable attorney's fees, incurred by City in successfully enforcing such obligation, to be awarded and fixed by the court, and to be taxed as costs and to be included in the judgment therein rendered.

It is hereby expressly stipulated and agreed that this bond shall inure to the benefit of any and all persons, companies and corporations entitled to file claims under Title 15 (commencing with Section 3082) of Title 4 of Division 3 of the Civil Code, so as to give a right of action to them or their assigns in any suit brought upon this bond.

Should the condition of this bond be fully performed, then this obligation shall become null and void, otherwise it shall be and remain in full force and effect.

The Surety hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of said agreement or the specifications accompanying the same shall in any manner affect its obligations on this bond, and it does hereby waive notice of any such change, extension, alteration or addition.

IN WITNESS WHEREOF, three (3) identical counterparts of this instrument, each of each of which shall for all purposes be deemed an original thereof, have been duly executed by the Principal and Surety herein named, on the _____ day of _____, 20 _____, in the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative pursuant to authority of its governing body.

_____
Principal

By _____
President

By _____
Secretary

_____
Surety

_____
Attorney in Fact

CORPORATE ADDRESS OF SURETY:

_____

_____

_____

APPROVED AS TO FORM:

MICHAEL R.W. HOUSTON
CITY ATTORNEY

By: _____

Date: _____

Please note: All signatures must be notarized

STANDARD SPECIFICATION SUPPLEMENT
2012 EDITION

The City of Anaheim has adopted the 2012 Edition and subsequent Supplements thereto, of the Standard Specifications for Public Works Construction by Public Works Standards, Inc., as its specification for public works construction projects. All work performed under this contract shall be performed in strict accordance with appropriate provisions of that publication, as designated in the Special Provisions, except as modified in the Standard Specification Supplement and the Special Provisions.

Copies of the SSPWC are available from:
BNI Publications, Inc.
990 Bark Center Drive, Suite E
Vista, CA 92081
Telephone (888) BNI-BOOK; (888) 264-2665
Website: www.bnibooks.com

The SSPWC set forth above will control the General Provisions and construction methods and materials for the contract, except as amended by the plans, special provisions, or other contract documents. The following provisions are intended to supplement the provisions of the SSPWC unless noted otherwise. The section numbers of these provisions coincide with the section numbers of the SSPWC. Only those sections that require additions, deletions, or revisions are included herein.

SECTION 1 – Terms, Definitions, Abbreviations, Units of Measure, and Symbols

1-2 Terms and Definitions

The provisions of Section 1-2 of the Standard Specifications for Public Works Construction's General Provisions, hereafter referred to as General Provisions, are supplemented by the following:

City:	City of Anaheim
Agency:	City of Anaheim
Board:	City Council of the City of Anaheim
County:	Orange, CA
Engineer:	The City Engineer of the City of Anaheim or his authorized representative
Federal:	The United States of America

Completion of Work

The Completion of Work date shall be considered the date upon which all items of work are fully complete, excluding any and all landscape establishment and maintenance.

Final Completion Date

The Final Completion Date shall mean the date at which all work is completed, including any and all landscape establishment and maintenance.

Contract Documents

The Contract Documents shall be considered to also include the Instruction to Bidders, the Proposal, the Bid Bond, the Non-Collusion Affidavit, the Designation of Sub-Contractors, the Agreement which is prepared for execution by the City and the Contractor, Plans Specifications and Special Provisions, Standard Specification Supplement, Contract Bonds, Resolutions adopted by the City Council pertaining to the work, Insurance Policies and Certificates, and any Supplemental Written Agreements or Addenda amending or extending the scope of the work originally contemplated that may be required to complete the work in a substantial and acceptable manner.

This project is subject to compliance monitoring and enforcement by the Department of Industrial Relations.

No contractor or subcontractor may be listed on a bid proposal for a Public Works project (submitted on or after March 1, 2015) unless registered with the Department of Industrial Relations pursuant to Labor Code section 1725.5.

No contractor or subcontractor may be awarded a contract for public work on a Public Works project (awarded on or after April 1, 2015) unless registered with the Department of Industrial Relations pursuant to Labor Code section 1725.5.

SECTION 2 – Scope and Control of the Work

2-1 Award and Execution of the Contract

The provisions of Section 2-1 of the General Provisions are supplemented by the following:

The award of contract, if it were awarded, will be made to the lowest responsible and qualified bidder whose proposal complies with all the prescribed requirements. Such award, if made, will be made within forty-five (45) days after the opening of the proposals and the bidder shall hold his proposal open to the City for said forty-five (45) day period. Until an award is made, the right will be reserved to reject any or all bids, and to waive technical errors or discrepancies, if to do so is deemed to best serve the interest of the City.

No contractor or subcontractor may be awarded a contract for public work on a Public Works project (awarded on or after April 1, 2015) unless registered with the Department of Industrial Relations pursuant to Labor Code section 1725.5.

No proposal will be considered from a Contractor that has not been issued a proposal form by the City of Anaheim.

In selecting the lowest responsible and qualified bidder, consideration will be given to the bidder's financial standing, his general competency for the performance of the work covered by the proposal and the size of previous jobs satisfactorily completed by him, as well as whether he has breached any terms of public works contracts he has entered into in the past. Bidders may be required to present satisfactory evidence that they have been regularly engaged in the business, or are reasonably familiar therewith, and that they are fully prepared with the necessary capital, materials and machinery to complete the work to be contracted for, to the satisfaction of the City Council. Each bidder must be prepared to furnish, at the time of opening bids, a certified copy of his financial statement.

Failure to execute the contract and file acceptable bonds, as specified in Section 2-4 and insurance certificates, as specified in Section 7-3, shall be just cause for the annulment of the award and the forfeiture of the bid bond. Transfers of contract, or of interest in contracts, are prohibited.

The Contractor shall posses any and all Contractor's or other business licenses required by law with respect to the work to be performed under this contract and shall certify to the City that they are properly licensed.

The Contractor shall promptly, and not later than the 21st calendar day after receipt of notice of award, deliver to the City the following fully executed documents:

Three (3) copies of this Agreement fully executed by the Contractor.
All "Insurance Requirements" constituting the insurance policies, endorsements and certificates of insurance to be provided by the Contractor, including, but not limited to: Public Liability, Property Damage and Workman's Compensation.
The "Faithful Performance Bond" to be provided by the Contractor.

The "Labor and Material Bond" to be provided by the Contractor.

Such contract documents, insurance requirements and bonds shall be collectively referred to as the "Contract, Insurance and Bond Documents".

2-2 Assignment

The provisions of Section 2-2 of the General Provisions are supplemented by the following:

2-2.1 Notice to Proceed:

The Contractor agrees to commence the Work and related services provided for in the Contract Documents (hereinafter, the "Related Services") herein immediately upon the receipt of a written Notice to Proceed from the City, to continue performance of the Work and Related Services in a diligent, workmanlike manner without interruption, and to complete the improvements on or before the dates for completion as set forth in these Special Provisions. Delivery by the City of an executed copy of the Agreement to the Contractor shall alternatively be deemed to constitute the Notice to Proceed, and shall occur when an executed copy of the Agreement is either delivered personally, or by overnight express courier, to the Contractor or its authorized agent or representative, or when a copy of the executed Agreement is faxed to the Contractor at its address as shown on the first page of the Agreement and thereafter deposited in the United States mail addressed to Contractor with the postage thereon fully prepaid.

Time is of the Essence

The Contractor acknowledges and agrees that time is of the essence in its completing the Project in the timely manner as set forth in the Contract Documents.

Failure to Deliver by Document Deadline Date

The Contractor further acknowledges and agrees that no Notice to Proceed with the work shall be effective as to the Contractor until such time as the City has received and approved said Contract, Insurance and Bond Documents. In the event said Contract, Insurance and Bond Documents are not received by the City on or before said Document Deadline Date, the Contractor agrees to the deduction of one (1) working day from the number of days available to achieve the Contract completion date set forth in this Section of these Special Provisions for every day of delay in receipt by the City of the Contract, Insurance and Bond Documents beyond the Document Deadline Date. Said deduction shall be in addition to any other remedy available to the City upon the Contractor's failure to timely provide said Contract, Insurance and Bond Documents, including the right of the City to refuse to execute and deliver the Agreement or to take such other action as may be authorized by law. In the event said Contract, Insurance and Bond Documents are received by the City on or before the Document Deadline Date, the subsequent delivery of a fully executed copy of this agreement to the Contractor by the City shall be deemed an election by the City to exercise the deduction of working days to achieve the Contract Completion Dates without further notice to the Contractor being required.

2-3 Subcontracts

This project is subject to compliance monitoring and enforcement by the Department of Industrial Relations.

No contractor or subcontractor may be listed on a bid proposal for a Public Works project (submitted on or after March 1, 2015) unless registered with the Department of Industrial Relations pursuant to Labor Code section 1725.5.

No contractor or subcontractor may be awarded a contract for public work on a Public Works project (awarded on or after April 1, 2015) unless registered with the Department of Industrial Relations pursuant to Labor Code section 1725.5.

2-3.2 Self Performance

This Section is hereby modified as follows:

"The Contractor shall perform, with its own organization, Contract work amounting to at least thirty (30) percent of the Contract Price except that any designated "Specialty Items" may be performed by subcontract and the amount of any such "Specialty Items" so performed may be deducted from the Contract Price before computing the amount required to be performed by the Contractor with its own organization. "Specialty Items" will be identified by the City of Anaheim in the Bid or Proposal. Where an entire item is subcontracted, the value of work subcontracted will be based on the Contract Unit Price set forth in the Contractor's bid documents. When a portion of an item is subcontracted, the value of work subcontracted will be based on the estimated percentage of the Contract Unit Price. This will be determined from information submitted by the Contractor, and subject to approval by the Engineer.

Before the work of any Subcontractor is started, the Contractor shall submit to the Engineer for approval a written statement showing the work to be subcontracted giving the name and business of each Subcontractor and description and value of each portion of the work to be so subcontracted."

Contractor shall certify and provide proof that all subcontractors to be employed under this contract are properly registered with the Department of Industrial Relations as required by California Law. Documentable proof of proper registration with DESIGNATION OF SUB-CONTRACTORS FORM DULY COMPLETED are required to be submitted along with the bid proposal forms and failure to comply with this provision may be deemed sufficient to render the Contractor's bid non-responsive.

2-5 Plans and Specifications

2-5.1 General

The provisions of Section 2-5.1 of the General Provisions shall be supplemented by the following:

Contractor acknowledges that he has satisfied himself as to the nature and location of the work, the general and local conditions, conditions of the site, availability of labor, electric power, water and the kind of surface and subsurface materials on the site, the kind of equipment needed, and

all other matters which may in any way effect the work or the cost. Any failure of the Contractor to acquaint himself with all the available information concerning conditions will not relieve him from responsibility for estimating and bidding properly the difficulties or cost of the work.

2-5.2 Precedence of Contract Documents

Delete the entire subsection and replace with the following:

If it appears that the work to be done or any matter relative thereto is not sufficiently detailed or explained in the plans, specifications and Special Provisions, the Contractor shall apply to the Engineer for such further explanation as may be necessary and shall conform to such explanation or interpretation as part of the Contract.

In the event of any discrepancy between any scaled dimensions on the plans and the figures written thereon, the figures shall be taken as correct.

The specifications, plans, Special Provisions and all supplemental contract documents are essential parts of the Contract and a requirement occurring in one is as binding as though occurring in all. If there should be any inconsistencies in the above documents the order of authority and control shall be as follows:

1. Special Provisions
2. Plans
3. Standard Details
4. City of Anaheim Standard Specifications
5. Reference Specifications

Inconsistencies in Standard Specifications, the order of authority and control shall be as follows:

Sections referenced in the Special Provisions
City of Anaheim Standard Specifications
Standard Specifications for Public Works Construction 2012 Edition and subsequent Supplements thereto, of Standard Specifications
State of California, 2010 as referenced in Special Provisions.

2-5.4 As Built (Added)

The Contractor shall maintain a "Record" set of Drawings and Specifications on the job site at all times, including all executed addenda, change orders, and field orders. This set of “Record Drawings” shall be separate, clean, blueline prints reserved for the purpose of showing a complete picture of the work actually constructed. These drawings shall be kept current with the construction and for the purpose of attaining a correct set of As-Built plans. All final locations determined in the field and any deviations from the Plans and Specifications shall be marked in red on this “Record” set of plans to show the As-Built conditions. Upon completion of all work, and before final payment, these “Record” drawings with all applicable As-Built notes shall be signed by the Contractor, dated, and returned to the Engineer for review and acceptance. Reviewed and accepted “Record” drawings are a condition for final acceptance.

2-6 Work to be done.

The following paragraph shall be added following paragraph one:

All work which is defective in its construction or deficient in any of the requirements of the Plans and Specifications, including but not limited to, conformance to the lines and grades shown on the plans or established by the Engineer, shall be remedied or removed and replaced by the Contractor in an acceptable manner at his own expense. No compensation will be allowed for any work done beyond the lines and grades shown on the Plans or established by the Engineer. Upon failure on the part of the Contractor to comply with any order of the Engineer made under the provisions of this article, the Engineer and City may cause the defective work to be remedied or removed and replaced at the expense of the Contractor.

2-9 Surveying

2-9.1 Permanent Survey Markers

Add the following after the first sentence:

Prior to the start of construction, the Contractor shall contact the City of Anaheim, City Surveyor at (714)-765-5284 to coordinate the transfer of existing bench marks and ties. City of Anaheim survey crews will transfer the benchmarks and ties.

2-10 Authority of the Board and the Engineer

The following sentence shall be added beneath the last paragraph:

No change shall be made to the approved Plans and Specifications, except as directed by the Engineer, in writing.

SECTION 3 – Changes in Work

3-2 Changes Initiated by the Agency

3-2.1 General

The first paragraph of Section 3-2.1 of the General Specifications shall be deleted.

3-2.2 Contract Unit Prices

3-2.2.1 General

The first sentence of Section 3-2.2.1 of the General Specifications shall be modified as follows:

If a change is ordered in an item of work covered by a Contract Unit Price an adjustment in payment will be made. This adjustment will be based upon the increase or decrease in quantity at the Contract Unit Price Bid.

The second and third paragraph of Section 3-2.2.1 of the General Specifications shall be deleted.

3-2.2.2 Increases of More Than 25 Percent.

Delete this entire section.

3-2.2.3 Decreases of More Than 25 Percent.

Delete this entire section.

3-3 Extra Work

3-3.2.2.3 Tool and Equipment Rental

The provisions of Section 3-3.2.2.3 of the General Provisions relating to "Tool and Equipment Rental" shall be deleted and replaced with the following:

Equipment rental rates shall be per Section 9, Sub-section 9-1.04D "Equipment Rental", of Caltrans 2010 Standard Specifications, using the Caltrans current "Labor Surcharge and Equipment Rental Rates" at the time the Extra Work is being performed.

The link to the latest "Labor Surcharge and Equipment Rental Rates" is as follows:
http://www.dot.ca.gov/hq/construc/equipmnt.html

3-3.2.3 Markup

The provisions of Section 3-3.2.3 of the General Provisions relating to markup shall be deleted and replaced with the following:

a) Work by Contractor.

A markup of fifteen (15%) percent, covering all overhead and profits, shall be added to the Contractor's costs as determined under 3-3.2.2 and shall constitute the Contractor's only payment for all overhead of any type and profit on "extra work". There is no compensation for bond costs associated with "extra work".

b) Work by subcontractor.

When a subcontractor performs all or any part of the extra work, the markup established in 3-3.2.3(a) shall be applied to the subcontractor's actual cost of such work, and shall constitute its only payment for all overhead of any type and profit. The Contractor shall receive an additional markup, not to exceed five (5%) percent, for all its overhead and profit on the "extra work" performed by the Subcontractor.

3-5 Disputed Work

The second sentence of Section 3-5 of the General Provisions shall be modified as follows:

Delete all reference to mediation/arbitration.

3-5.1 Claims and Disputes During Performance: (Added)
The following procedures and requirements shall apply and be fully complied with for any claim or dispute to be considered for payment as extra work:

Procedure:

The Contractor and the City shall make good-faith attempts to resolve any and all claims and disputes that may from time to time arise during the performance of the work of this contract. If the Contractor considers any Work required of them to be outside the requirements of the Contract, or if Contractor consider any instruction, meaning, requirement, ruling or decision of the City or its representative to be unauthorized or improper, Contractor shall, within seven (7) calendar days after such demand is made, or instructions given, file a written protest with the City Engineer stating clearly and in detail the objection and reason therefore. The Contractor shall nonetheless perform the

disputed work even though a written protest has been filed. If a written protest is not submitted within seven (7) calendar days of the date that Contractor's claim arose, the Contractor shall waive his right to further claim on the specific issue.

A. If a written protest is filed, the City will review the Contractor's written protest and provide a decision. If the Contractor still considers Anaheim's requirement to be outside of the requirements of the Contract, Contractor shall notify the City, in writing, within seven (7) calendar days after receiving Anaheim's decisions that Contractor will submit formal claim. Any formal claim shall be submitted within thirty (30) calendar days of receiving Anaheim's initial decision. Contractor shall submit its claim and all arguments, justification, cost or estimate, schedule analysis, and detailed documentation supporting their position. Failure to furnish timely notification within seven (7) calendar days and all justifying documentation within thirty (30) calendar days will result in the Contractor waiving his right to submit the claim.

B. Upon receipt of the Contractor's formal claim including all arguments, justification, cost or estimates, schedule analysis, and documentation supporting its position as previously described, the City Engineer or his representative will review the material submitted and any other available facts and within thirty (30) calendar days from receipt of the Contractor's claim, render a final determination.

Certification:

A. With any formal claim, the Contractor shall submit a statement as follows:

1. The claim is made in good faith

2. Supporting data are accurate and complete to the best of the Contractor's knowledge and belief.

3. The amount requested accurately reflects the Contract adjustment for which the Contractor believes the City is liable.

4. If the Contractor is an individual, the certification shall be executed by that individual under penalty of perjury.

5. If the Contractor is not an individual, the certification shall be executed by an officer or general partner of the Contractor having overall responsibility for the conduct of the Contractor's affairs under penalty of perjury.

6. If a false claim is submitted, the Contractor will be subject to appropriate legal action.

B. In regard to any claim or portion of a claim for Subcontractor work, the Contractor shall fully review said claim and certify said claim, under penalty of perjury, to have been made in good faith.

C. Failure to furnish certification as required hereinbefore will result in Contractor's waiving its right to the subject claim.

D. Nothing in this procedure shall deprive contractor of any rights or remedies required by state statute.

Claim Format

A. The Contractor shall submit the claim justification in the following format:

Summary of claim merit and quantum plus clause under which the claim is made.
List of documents related to claim:

a. Specifications
b. Drawings
c. Clarifications/Requests for information
d. Schedules
e. Other

Chronology of events and correspondence
Analysis of claim merit.
Analysis of claim cost.

Refusal by Contractor to Perform Requested Change Order or Disputed Work

Contractor acknowledges that all work associated with the original project scope as well as any work change ordered into this project is vital to the satisfactory completion of the project and its intended use or purpose. Furthermore, Contractor acknowledges that the consequences to Agency for refusing to proceed with work under the change order or disputed work provisions set forth herein will cause the Agency incalculable damage and that said damage could vary so widely that actual costs are inestimable and a monetary equivalent is not easily ascertainable. Therefore, Agency and Contractor agree that *Liquidated Damage in the amount of $10,000 or 15% of the actual quote for the subject work, received from a replacement Contractor, whichever is greater*, will be assessed against the Contractor for refusing to diligently pursue and perform the requested change order and/or the disputed work associated with the dispute. The total liquidated damage assessment under this provision will be deducted by the Agency from monies due or becoming due to contractor, not excluding retention proceeds, for each refusal to proceed with work under the change order or disputed work provisions.

SECTION 4 – Control of Materials

4-1 Materials and Workmanship

4-1.1 General

After the second paragraph add the following:

The Contractor shall defend (at City's option), hold harmless, and indemnify the City of Anaheim, the Consultant Engineer, and City's officers, agents, employees, representatives, and volunteers from and against and from all claims and liability arising from damage and injury due to said defects. The Contractor shall make all repairs and replacements promptly upon receipt of written order from the Engineer. If the Contractor fails to make the repairs and replacements

promptly the City may do the work and the Contractor and his surety shall be liable to the City for the cost of the work.

4-1.4 Test of Materials

The provisions of Section 4-1.4 of the General Provisions shall be supplemented by the following:
Delete the portion of the third sentence of the first paragraph that refers to retesting and delete the entire fourth sentence of the first paragraph and replace it with:

The costs of all other tests, including the retesting of material or workmanship that fails to pass the first test, shall be paid for by the Contractor.

The cost of compaction retesting in excess of ten percent (10%) of the number of initial compaction tests required by the Engineer may be assessed to the Contractor at the City's discretion.

4-1.5 Certificate of Compliance

Insert the following after the first paragraph:
The Contractor shall submit Certificates of Compliance prior to the use of materials for which these specifications or the Special Provisions require that such a Certificate be furnished by the contractor. A Certificate of Compliance shall not relieve the Contractor of the responsibility of incorporating material in the work which conforms to the requirements of the Plans and Specifications and any such material not conforming to such requirements will be subject to rejection whether in place or not.

The City reserves the right to refuse to permit the use of materials on the basis of a Certificate of Compliance.

The form and disposition of the Certificate of Compliance shall be as directed by the Engineer.

4-1.6 Trade Names or Equals

The first paragraph of Section 4-1.6 is modified as follows:
Request for substitution shall be submitted within 10 days after award of contract.

SECTION 5 – Utilities

5-1 Location

The following is added to the Fourth paragraph of Section 5.1 in the General Provisions:

The failure of the California Department of Transportation to promptly or accurately identify the location of its subsurface installations, to either the City or the Contractor, shall not be the City's responsibility. The Contractor shall be responsible for locating these subsurface installations even though the California Department of Transportation has not accurately identified such installations. If no pay item is provided in the contract for this work, full compensation for such work shall be considered as included in the prices bid for other items of work.

Contractor further acknowledges that Government Code Section 4215 states in pertinent part that"…Nothing contained herein shall be deemed to require the public agency to indicate the presence of existing service laterals or appurtenances whenever the presence of such utilities on the site of the construction project can be inferred from the presence of other visible facilities such as buildings, meter and junction boxes, on or adjacent to the site of the construction;…".

5-1.1 Underground Service Alert (Added)

The Contractor will be required to contact Underground Service Alert and obtain an Identification Number. The notification must be made a minimum of two (2) working days prior to doing any excavation on this project.

The Identification Number must be given to the Engineer and/or Inspector prior to the start of any work on this project. If the Contractor fails to obtain this number, the City reserves the right to stop all work on the project. No additional compensation or extension or working days shall be allowed for this stoppage.

5-4 Relocation

Add the following at the end of the subsection:

Any facilities to be relocated by the Contractor, as indicated on the plans, shall be relocated in a workmanlike manner. All such work shall be done only at such times which are acceptable to the owner. The Contractor shall schedule his relocation work in cooperation with the owner and shall be responsible for any costs resulting from the Contractor's failure to do the work at times which are acceptable to the owner. The Contractor shall notify owners at least two (2) working days in advance of any work on any of their utilities.

5-5 Delays

In Section 5-5 of the General Provisions the last paragraph is deleted and the following submitted in its place:

If the Contractor sustains loss due to delays attributable to interferences, relocations, or alterations not covered by 5-1, or 3-3, it may submit a claim pursuant to 6-6.

5-7 Utility Connection (Added)

Upon installing utility connections to City owned facilities, the Contractor shall see that said utilities are put in the City's name.

SECTION 6 – Prosecution Progress and Acceptance of the Work

6-1 Construction Schedule and Commencement of the Work

6-1.1 Construction Schedule

The provisions of Section 6-1.1 of the General Provisions shall be supplemented by the following:

Insert the following after the first sentence in the paragraph:

The Contractor shall submit to the Engineer/Contract Administrator, within five (5) working days prior to the issuance of the Notice to Proceed, a detailed schedule for the items of works to be done.

The following paragraphs shall be added at the end of this subsection:

Prior to the commencement of construction, arrangements will be made by the City for a meeting between the Contractor, The Engineer, Utility Representatives, designers and others as may be involved with the project. The purpose of the meeting is to coordinate the activities of the Contractor within the limits of this contract, review utility conflicts, review scheduling, discuss construction methods and clarify inspection procedures.

The Contractor shall submit updated Progress Reports to the Engineer at monthly intervals after the date of the Notice to Proceed. The report shall include an updated Construction schedule. Any deviations from the original schedule shall be explained. Progress payments will be withheld pending receipt of any outstanding reports.

6-1.2 Commencement of the Work

The following paragraph shall be added at the end of this Sub-section:

In the event a Notice to Proceed has not been issued within ninety (90) days from the award of the Contract due to failure of the Contractor to submit the required documents, the Contract time shall commence on the 91st day after award and each day thereafter will be charged against the Contract time in accordance with Section 6-7.3.

6-2 Prosecution of the Work

The provisions of Section 6-2 shall be supplemented by the following:

Insert the following between paragraphs 1 and 2:

The Contractor, and any and all Subcontractors, shall limit all construction activity and operations to the new City Right-of-Way. The Contractor shall, prior to conducting work on any occupied property within the project area, confirm with the City's inspector the location of the City's right of way, and the extent of any applicable temporary construction easements, which serve as the permissible bounds of construction activity. No person, or construction activity, shall pass beyond or engage in any construction-related activity outside of the defined temporary construction easements, and the Contractor shall monitor its personnel, and the personnel of its subcontractors, to assure compliance with this provision. The prohibition on construction-related activity beyond the defined City Right of Way and Temporary Construction Easements includes work for the sidewalk, landscaping and slough walls, etc., and extends to prohibit storage of materials or vehicles, including parking or storage of vehicles of employees, and any utilization of private property for staging, storage, or any other purpose.

6-3 Suspension of the Work

6-3.1 General

The following is added to Section 6-3.1 of the General Provisions:

It is understood that the City may require temporary omissions and "leap frogging" of portions of the work at locations to be designated by the Engineer. All fill-in and "come back" required for those previously omitted areas or openings shall be completed at the direction of the Engineer and all costs are to be included in the various item of work and no additional payment shall be allowed therefore.

6-6 Delays and Extensions of Time

6-6.1 General

The provisions of Section 6-6.1 in the General Provisions shall be deleted and replaced with the following:

If delays are caused by unforeseen events beyond the control of the Contractor, such delays will entitle the Contractor to an extension of time as provided herein, but the Contractor will not be entitled to damages or additional payment due to such delays except as provided in 6-6.3 and 6-6.4.

No extension of time will be granted for a delay caused by the Contractor's inability to obtain materials unless the Contractor furnishes to the Engineer documentary proof. The proof must be provided in a timely manner in accordance with the sequence of the Contractor's operations and the approved construction schedule.

If delays beyond the Contractors control are caused solely by action or inaction by the City, such delays will entitle the Contractor to an extension of time as provided in 6-6.2.

6-6.2 Extensions of Time

Section 6-6.2 of the General Provisions is changed to be as follows:

Extensions of time, when granted, will be based upon the effect of delays to the critical path of the work. They will not be granted for non-controlling delays to minor portions of the work unless it can be shown through a Critical Path Method (CPM) schedule that such delays did or will delay the critical path of the work.

6-6.3 Payment for Delays

Section 6-6.3 of the General Provisions is changed to be as follows:

The Contractor will only be compensated for damages incurred due to delays for which the City is solely responsible, and which delays are unreasonable under the circumstances involved, and not within the contemplation of the parties. The damages recoverable by the Contractor are only those actual costs incurred by the Contractor due to the delay. The City will not be liable for damages which the Contractor could have avoided by any reasonable means, such as judicious handling of forces, equipment, or plant. The determination of what damages the Contractor could have avoided will be made by the Engineer.

6-6.4 Written Notice and Report

Section 6-6.4 of the General Provisions is changed to be as follows:

(a) If the Contractor desires an extension of time, it shall file with the City a written time extension notice within three (3) days after the beginning of the delay. Time extensions related to the delay, shall be determined by the Engineer based on the impact on the critical path of the project.

Within fifteen (15) days of the Contractor's first time extension notice, the Contractor shall submit to the City a full and written detailed change order request, which fully documents the amount of time to be claimed. The change order for time extensions shall include an "impacted" schedule showing the effect of the claimed delay event on the critical path and contract completion dates. Any change order for extension of time shall fully document the Contractor's request for time extensions pursuant to the requirements of the contract documents. The Contractor's failure to submit the above described written change order request, to the City within eighteen (18) days of the original commencement of the delay, shall constitute a waiver of the Contractor's claim for a time extension.

(b) If the Contractor desires a payment for delay as specified in 6-6.3, it shall file with the City a written notice of its intent to make a claim for such payment within three (3) days after the beginning of the delay.

Any payment for the delay will be as set forth in 6-6.3.

Additionally, within three (3) days after the beginning of the delay, the Contractor shall submit to the City a written notice containing a good faith estimate of the payment it will seek for each day of delay. If the Contractor cannot make a good faith estimate of the payment it will seek for each day of delay, it shall submit within three (3) days after the beginning of the delay a full explanation as to why it cannot make a good faith estimate of the payment it will seek for each day of delay.

If Contractor fails to submit a timely notice of its intent to claim payment for delay, or its notice with an estimate of the payment it will seek per day of delay, or its explanation why such estimate cannot be made, as required above, the Contractor expressly waives and releases the City from any and all damages caused by the delay.

6-7 Time of Completion

6-7.1.1 Overtime Inspection Costs (Added)

The Contractor is hereby notified that he/she is responsible for all overtime inspection costs incurred by the City for all work performed at the discretion of the Contractor outside normal working hours.

Authorized overtime work by the Contractor as part of this contract required by these Special Provisions or by City obtained permits or by other City Departments will not be subject to overtime inspection costs.

The Contractor will be notified in writing of all overtime inspection costs incurred by the City.

Payment for overtime inspection costs will be withheld from progress payments to the Contractor.

6-9 Liquidated Damages

The provisions of Section 6-9 of the General Provisions shall be modified to read as follows:

Failure of the Contractor to complete the work within the time allowed will result in damages being sustained by the City. Such damages are, and will continue to be, impracticable and difficult to determine. For each day in excess of the time specified for completion of the work (as adjusted by any Change Orders), the Contractor shall be liable to the City for the sum stated as liquidated damages in the special provisions.

Execution of the contract by the City and the Contractor shall constitute agreement:

(a) That the sum stated in the Special Provisions as liquidated damages is the minimum amount of the costs and actual damage caused the City by failure of the Contractor to complete the work within the allotted time.

(b) That such sum constitutes liquidated damages and shall not be construed as a penalty.

(c) That such sum may be deducted from payments due the Contractor.
Nothing contained in this provision or in the contract shall be construed to limit or defeat the right of the City to recover for any and all actual damages sustained as a result of the untimely completion of the work.

6-9.1 Final Submittals (Added)

The Contractor within thirty (30) Calendar days from the FINAL COMPLETION DATE, (as defined in Section 6-8) shall submit all outstanding certified payrolls, the final invoice, and any other outstanding documentation. In the event there are deficiencies in the documents submitted, the Contractor shall be responsible for correcting all deficiencies and providing complete and accurate documentation within fourteen (14) calendar days of the correction notice from the Engineer. Contractor also acknowledges and agrees that satisfactory submission of the final paper work is part of the labor on the work of improvement and that the labor on the project is not completed until such documentation obligations are satisfied.

Failure to comply with these provisions will result in assessment of Liquidated Damages in the amount of $250.00 per day. The City will deduct the total amount of these Liquidated Damages from the Contractor's final progress payment or project retention monies without further notification to the Contractor.

Payment for conformance to the requirements of this section shall be deemed to be included in the price bid for the various items of work.

SECTION 7 – Responsibilities of the Contractor

7-1 The Contractor's Equipment and Facilities

7-1.1 General

7-1.2 Temporary Utility Services

Insert the following after the first paragraph:

The Contractor shall be responsible for payment of all billings for water and electrical service for the planting and maintenance of the landscaping of the various areas shown on the plans until such time as the City accepts the Landscaping and Irrigation Systems.

7-2 Labor

7-2.1 General

The first sentence of Section 7-2.1 of the General Provisions shall be supplemented as follows:

Add the words – "and employment of apprentices".

7-2.2 Prevailing Wages

The first sentence of this Section shall be modified to read as follows:

In accordance with the provisions of Section 1773.2 of the Labor Code, copies of the current prevailing rate of per diem wages at the time of the Bid as determined by the Director of the Department of Industrial Relations (DIR) are available on the website as follows: (http://www.dir.ca.gov/dlsr/statistics_research.html).

The Federal Department of Labor will not accept lower State wage rates not specifically included in the Federal minimum wage determinations. This includes "helper" (or other classifications based on hours of experience) or any other classification not appearing in the Federal wage determinations.

7-2.3 Payroll Records

The following paragraph shall be added following the first paragraph:

The Contractor, and all subcontractors, suppliers and vendors, shall comply with all City, State, and Federal orders regarding affirmative action to ensure equal employment opportunities and fair employment practices. Failure to file any report due under said orders will result in suspension of progress payments.

The Prime Contractor shall be responsible for the submittal of bi-weekly certified payrolls for its own forces as well as all subcontractors.

Contractors and subcontractors on all Public Works projects will be required to submit certified payroll records (CPRs) to the Labor Commissioner unless excused from this requirement.

The Contractor and each of his subcontractors shall prepare payrolls on forms prescribed and in accordance with instructions furnished by the City. Within seven (7) days after the regular payment date of the payroll, the Contractor shall deliver to the City a certified and legible copy

of each payroll. Such payroll shall be stated under penalty of perjury to in accordance with the federal regulations made pursuant to the "Anti-Kick-Back Statute (41 U.S.C. Sec.51)".

Such copies of payrolls shall be accompanied by substantial proof that all bills for services rendered and materials supplied have been duly paid for. The Contractor shall not carry on his payroll any person not employed by him. Employees of a subcontractor must be carried on the rules of the employing subcontractor.

Each Contractor or subcontractor shall preserve its weekly payroll records for a period of three (3) years from the date of the contract. The payroll records shall set out accurately and completely the name, address, social security number, occupational classification, and hourly wage rate of each employee, hours worked by him during the payroll period, and full weekly wages earned by him, any deductions made from such weekly wages and the actual weekly wages paid. Such payroll records shall be made available at all times for inspection by the City or its authorized representatives.

The Contractor agrees that, in case of underpayment of wages to any worker on the project under this contract by the Contractor or any subcontractor, the City shall withhold from the Contractor out of payments due, an amount sufficient to pay such worker the difference between the wages required to be paid under this contract and the wages actually paid such worker for the total number of hours worked and that the City may disburse such amount so withheld by it for and on account of the Contractor to the employee to whom such amount is due. The Contractor further agrees that the amount to be withheld pursuant to this paragraph may be in addition to the percentages to be retained by the City pursuant to other provisions of this contract.

The contractor shall provide unlimited access to the job site for all equal employment opportunity compliance officers.

7-2.4 Hours of Labor

7-3 Liability Insurance

The provisions of Section 7-3 of the General Provisions shall be modified to read as follows:

The agency shall be given thirty (30) days notice prior to cancellation or termination of required insurance policies.

The Contractor shall not commence work under this contract until he has obtained all insurance required hereunder with a company or companies acceptable to the City, nor shall the Contractor allow any subcontractor to commence work in his subcontract until all insurance required of the subcontractor has been obtained.

The provisions of Section 7-3 of the General Provisions relating to minimum insurance amounts shall be modified as follows:

The Insurance policy shall provide the following minimum limits:

Bodily injury including	$1,000,000 each person
Accidental death	$1,000,000 each accident
Property damage and	

Public liability	$1,000,000 each person
(including coverage of	
vehicles used by the	$1,000,000 each accident
Contractor on or off the premises)	$1,000,000 property damage

Each of the above policies shall specify that it acts as the primary insurance and that no insurance held or owned by the designated additional insured shall be called upon to cover a loss under said policy.

7-5 Permits

Replace the entire first paragraph with the following:

Prior to start of any work the Contractor shall obtain the applicable City permits and make arrangements for City inspections. The City will issue the permits at no charge to the Contractor. The Contractor and all subcontractors shall each obtain a City business license, and shall be licensed in accordance with State Business and Professions Code. The contractor shall also obtain and pay for any and all other permits, licenses, inspections, certificates, or authorizations required by any governing body or entity.

It is understood by the bidder and Subcontractors that The City of Anaheim, per Anaheim Municipal Code Section 3.04.050, does impose upon the businesses, trades, professions, calling, and occupations specified in the code, license taxes in the amounts prescribed in the code. It is unlawful for any person to transact and carry on any business, trade, profession, calling, or occupation without first having procured a license from the City and then complying with any and all applicable provisions of the code. Contractor license fees shall be as prescribed by the Anaheim Municipal Code Section 3.24.010.

The Contractor shall obtain all necessary permits for the discharge or disposal of any ground or surface waters in accordance with the California Regional Water Quality Control Board Regulations.

7-6 The Contractor's Representative

The following paragraphs shall be added following the first paragraph:

The Contractor shall file with the Engineer the addresses and telephone numbers where he or his representative may be reached during hours when the work is not in progress, so that twenty-four (24) hour, seven (7) day a week contact can be maintained.

7-7 Cooperation and Collateral Work

Add the following paragraphs following the second paragraph:

The Contractor shall cooperate with property owners, various utility companies, and other interested parties within or adjacent to the limits of the work specified herein.

It shall be the responsibility of the Contractor to schedule his work and that of his subcontractors to produce a smooth flow of work in a competent manner. All Contractors on this project shall cooperate with each other scheduling their work.

7-8 Work Site Maintenance

7-8.1 Cleanup, Marking Removal and Dust Control

The second paragraph is amended as follows:

The Contractor shall perform all cleanup work (including the use of a motorized sweeper with vacuum to sweep and clean the street) at the end of each working day during the construction. The cost of all clean up shall be included in the price bid for the various items of work and no additional payment will be made for the cleanup measures.

The following shall be inserted after the first paragraph:

Materials and equipment shall be removed from the site as soon as they are no longer necessary. Before the final inspection, the site shall be cleared of equipment, unused materials, rubbish, and all markings placed by the Contractor, the City, Underground Service Alert (USA), or other agent(s)' markings necessary for the performance of various items of work. These markings shall include, but not limited to paint, stakes, and metal tags.

Before the final inspection, the site shall also be cleared of all detour traffic signs and equipment(s), including all detour signs posted or attached to power poles, street light structures, utility poles or structures, etc., all inclusive of the project. All detour traffic signs installed and posted by others and are not a part of the contracted work shall remain and shall be protected in place.

The last paragraph is amended as follows:

Failure of the Contractor to comply with the Engineer's cleanup orders, including removal of markings and associated detour signs and equipment(s) shall result in the assessment of liquidated damages in the amount of $500 per day. It shall also result in an order by the City to suspend work until all areas impacted by the construction site have been cleaned and all conditions corrected, to the satisfaction of the Engineer or Inspector.

Payment for *Cleanup, Marking Removal and Dust Control* shall be included in the price bid for other various items of work and no additional compensation shall be allowed therefore.

7-8.2 Air Pollution Control

7-8.2.1 Smog Control

Extreme precautions shall be exercised by the Contractor to minimize the escaping of smoke into the air by either the machine or the burning of the pavement during the heater-planning process, in the event that the smoke problem becomes excessive, it may be necessary to add an additional blower system to reduce the problem. No additional compensation will be made for any necessary steps required to reduce the smoke.

7-8.4 Storage of Equipment and Materials in Public Streets

The number of days is amended to two (2) working days. In addition, the last paragraph is amended as follows:

All excess material from excavation not used shall be removed from the site within one (1) working day.

No equipment/material storage will be allowed within the project area during non-working hours for the duration of the construction. Unused equipment or material (including the displaced material) shall be removed and stored offsite (to a fenced and screened area) daily. Only equipment and materials to be used and installed on the next working day may be stored at the construction site.

Payment for conformance to the requirements of this section shall be deemed to be included in the price bid for the various items of work. No additional compensation will be allowed therefore.

7-8.5 Sanitary Sewers

7-8.5.1 General

The second to the last sentence of the first paragraph shall be replaced with the following:

All sewage flows shall be conveyed in closed conduits and disposed of in a sanitary sewer system, including pumping if required

The following shall be added to the last paragraph:

Full compensation for all work associated with maintaining sewage flow shall be included in the unit price bid for various items of work. No additional compensation will be allowed therefore.

7-8.6 Water Pollution Control

7-8.6.1 General

7-8.6.2 Best Management Practices (BMPs)

Sub-section 7-8.6.2 of the General Provisions shall be amended as follows:

WATER POLLUTION PREVENTION AND BEST MANAGEMENT PRACTICES (BMP'S)

Description – Construction activates at City construction sites (less than 1 acre) are currently governed by the City's NPDES Permit. In order to ensure that appropriate measures are taken to prevent construction related pollutants (dirt, and construction materials) from being washed, blown, tracked or otherwise carried, unintended and uncontrolled, offsite, the Permit requires conformance with Orange County's Construction Runoff Guidance Manual, found at: http://ocwatersheds.com/documents/bmp/constructionactivities

City and Locally Funded Projects
If this project disturbs less than 1 acre of land or is related to routine maintenance of an existing linear facility, the project falls outside the coverage requirements of the General Construction Permit. Therefore a SWPPP is not required. However Permit requirements still prescribe that

appropriate BMPs shall be implemented in accordance with the Construction Runoff Guidance Manual. Therefore, the Contractor shall develop, implement and maintain an Erosion and Sediment Control Plan. This Plan shall use the construction plans as a basis for identifying the location and type of BMP that will be implemented on and off-site, based upon the anticipated construction activities, equipment and materials that will be used in the project, for review and approval by the Department of Public Works.

Since construction activities are highly variable throughout the phases and term of the project and may even include work not originally anticipated, the approved Erosion and Sediment Control Plan does not relieve the contractor from the responsibility to implement and maintain the appropriate BMPs, which may not have been identified, to prevent storm water pollution resulting from the at all times during the contract period.

State and Federally Funded Projects

If this project disturbs less than 1 acre of land or is related to routine maintenance of an existing linear facility, the project falls outside the coverage requirements of the General Construction Permit. Therefore a SWPPP is not required. However Permit requirements still prescribe that appropriate BMPs shall be implemented in accordance with the both the Construction Runoff Guidance Manual. Therefore, the Contractor shall develop, implement and maintain Water Pollution Control Program (WPCP), approved by the Department of Public Works and conforming with the requirements of Caltrans Specifications Section 7-1.10G, Water Pollution.

Since construction activities are highly variable throughout the phases and term of the project and may even include work not originally anticipated, the approved WPCP does not relieve the contractor from the responsibility to implement and maintain the appropriate BMPs, which may not have been identified, to prevent storm water pollution resulting from the at all times during the contract period.

The following shall apply to all projects regardless of the type of "Stormwater Plan" developed or funding source

The contractor shall routinely inspect the construction site, staging areas, and any impacted areas offsite to evaluate the applicability and effectives of the BMPs that are or should be in place. These inspections shall be conducted at a minimum, within 48 hours prior to anticipated storm events, during rainfall (if occurring during business hours) and after any storm event. The outcome of these inspections shall identify any deficiencies identified and corrective actions anticipated or taken and shall be documented by the contractor and made available to the City's representative, the same day, upon request.

Payment to develop and maintain the Erosion and Sediment Control Plan, WPCP and all related or required BMPs shall be considered included in the contract unit price paid for other items of work and shall be considered incidental for accomplishing the work and no additional compensation will be allowed therefore.

Failure of the Contractor to comply with the Engineer's requested corrective actions may result in an order to suspend work until the condition is corrected. No additional compensation will be allowed as a result of such suspension.

7-8.6.2.1 Catch Basin Labeling (Added)

On all catch basin construction, the following shall be stenciled on top of the curb at the catch basin:

NO DUMPING – DRAINS TO OCEAN

The lettering shall be three inch (3") high and applied with black paint.

Payment for conformance to the requirements of this section shall be deemed to be included in the price bid for the various item of work and no additional compensation will be allowed therefore.

7-8.6.3 Storm Water Pollution Prevention Plan (SWPPP)

Add the following after the first paragraph:

The Contractor shall be responsible for complying with all requirements of the State NPDES General Construction Storm Water Permit (trigger for compliance currently set at disturbance of 1 acre or more of land) and for development and implementation of the Storm Water Pollution Prevention Plan (SWPPP), PRDs (Permit Registration Documents), and Monitoring Plan (MP) (only if Risk Level 2 or 3). The one exception to this responsibility is the uploading online of PRDs into State SMARTS, which is performed by City Staff. However, the contractor is responsible for providing – in a timely manner – PRDs and any other information required in order to complete these submittals as required by the General Construction Permit, and as may be required by the administering agency (e.g., Caltrans).

At the pre construction meeting, the Contractor is required to submit a SWPPP to the City that has been completed by a Qualified SWPPP Developer (QSD) along with PRDs. The Notice to Proceed will not be issued until the approval of SWPPP by the City and successful uploading of SWPPP and PRDs to SMARTS System by the City.

The Contractor shall be responsible for conducting all required monitoring inspections and shall file copies of the inspections and all other reports, certifications or records, as required by the SWPPP, with the Public Works Department. All fines levied against the City, as a result of the Contractor's failure to comply with the requirements of the Permit, shall be the Contractor's sole responsibility and will be withheld from monies due or becoming due to Contractor.

Submitting Annual Reports: Based on current General Construction Permit deadlines, the Contractor must submit all information to the City required for completion of the Annual Report, one (1) month prior to the deadline for Annual Report Submittal, thus allowing the City to review, request any missing information, and submit then through the SMARTS System.

Time extensions will not be allowed for any delays or suspension of work as a result of the Contractor's noncompliance with the Permit or SWPPP.

Payment for complying with the Permit Provisions, completing the SWPPP, implementation of the SWPPP, providing the necessary information to the City for filing of Annual Reports and Notice of Termination, and any incidental work, shall be deemed to be included in the lump sum price bid for SWPPP.

All information related to the Final Reports (including the Annual Report, which must be

completed and submitted before the Final Report) must be submitted to the City within 30 days of substantial completion of the project, for the City to upload to the SMARTS System.

The contractor shall comply with the Permit and SWPPP requirements, such as implementation, modification, onsite maintenance, monitoring of SWPPP, submittal of required information or documentation for such forms, including but not limited to the NOI, weekly inspection reports, rain event reports, annual reports, NOT and any other SWPPP related forms as required by the Provisions of the General Construction Permit in effect, throughout the project.

In the case that the contractor fails to comply with the aforementioned requirements and deadlines set forth under this section, the City reserves the right to withhold progress payments, or if the final progress payment has been issued, withhold the release of retention monies remaining under the contract, until the contractor's full compliance, with all provisions satisfied.

7-9 Protection and Restoration of Existing Improvements

Delete the second paragraph and replace it with the following:

The Contractor shall relocate, repair, replace or re-establish all existing improvements within the project limits which are not designated for removal (e.g. curbs, gutters, sidewalks, driveways, fences, walls, irrigated systems, signs, utility installations, pavements, structures, landscaping, etc.) which are damaged or removed as a result of his operations or as required by the Plans and Specifications. Damaged or removed traffic signal detector loops and or irrigations systems shall be replaced or repaired and returned to service within seventy (72) hours, unless otherwise directed by the Engineer. Where existing traffic striping, pavement markings, and curb markings are damaged or the reflectivity reduced by the Contractor's operations, such striping or marking shall also be considered as existing improvements and the Contractor shall repaint or replace such improvements.

Relocations, repairs, replacements or re-establishments shall be at least equal to the existing improvements and shall match such improvements in finish and dimensions unless otherwise specified.

The last paragraph of this subsection is replaced with the following:

All costs to the Contractor for protecting, removing, restoring, relocating, repairing, replacing, re-establishing and/or supporting existing improvements shall be included in the Bid.

7-10 Public Convenience and Safety

Insert the following:

When construction occurs within a developed residential area and/or through a school site, the Contractor shall take all necessary precautions to protect the public, especially children, from the hazards of open excavations. Trenches shall either be covered or adequately fenced and lighted at night and on weekends or whenever operations are not in actual process.

Unusual conditions may arise on the work which will require that immediate and unusual provisions be made to protect the public from danger or loss or damage to life and property, due directly or indirectly to the prosecution of the work. It is part of the service required of the contractor to make such provisions and to furnish such protection.

The Contractor shall use such foresight and shall take such steps and precautions as his operations make necessary to protect the public from danger or damage, loss of life or property, which could result from the interruption or contamination of public water supply, irrigation or other public service or from the failure of partly completed work.

Whenever, in the opinion of the City, an emergency exists against which the Contractor has not taken sufficient precaution for the safety of the public or the protection of the utilities or of adjacent structures or property which may, in the opinion of the City, require immediate action in order to protect public or private or personnel or property interest or prevent likely loss of human life or damage on account of the operations under the contract, then and in that event the City may provide suitable protection to said interest by causing such work to be done and material to be furnished, as, in the opinion of the City, may seem reasonable and necessary.

The cost and expense of said labor and material together with the cost and expense of such repairs as may be deemed necessary shall be borne by the Contractor, and if he shall not pay said cost and expense upon presentation of the bills therefore, duly certified by the Engineer, then said cost and expense will be paid by the City and shall therefore be deducted from any amounts due, or which may become due to said Contractor. Failure of the City, however, to take such precautionary measure, shall not relieve the Contractor of his full responsibility for public safety.

The foregoing provisions are in addition to and not in limitation of any other rights or remedies available to the City.

7-10.1 Access

7-10.1.1 General

The following paragraphs shall be inserted after the second paragraph:

The Contractor shall prepare a permit application for street closure and shall attach two copies of the proposed traffic control signing, barricading, and/or detour routing. The permit application and accompanying attachments shall be submitted to the Engineer for review. Upon approval from the Engineer, a no-fee Street Closure Permit will be issued. No Street Closure, Lane Closure, Detour or other work requiring traffic control shall commence prior to issuance of said permit

The Contractor shall provide and install barricades, delineators, warning devices and construction signs in accordance with the current Caltrans Manual of Traffic Controls for Construction and Maintenance Work Zones, and maintain them in new or like new condition for the duration of the construction project, unless otherwise approved by the Engineer. During adverse weather or unusual traffic or working conditions, additional traffic devices shall be placed as directed by the Engineer.

The Contractor shall notify the Engineer a minimum of 5 working days prior to closing or restricting left-turn movements. A minimum of 48 hours prior to restricting left-turn movements and/or closing left-turn pockets, the Contractor shall post sign in advance of and in the area of

the closure or restriction. The signs, as a minimum, shall notify the public of the date(s) of the closure and the duration.

Judgment as to adequate or sufficient barricading and signing shall be that which is sufficient and adequate in the opinion of the Engineer.

The Contractor shall relocate, preserve and maintain the visibility of all existing signs within the project limits which affect the flow of traffic, as directed by the Engineer. Any signs which are damaged or found to be missing during the course of construction shall be replaced by the Contractor at his expense as directed by the Engineer. All other signs that interfere with the course of work and are not necessary for the safe flow of traffic will be removed and replaced by the City. Traffic control signs include Stop Signs, Speed Limit, Parking Restriction and other regulatory signs.

Payment for conformance to the requirements of this section shall be deemed to be included in the price bid for various item of work and no additional compensation will be allowed therefore.

7-10.1.1.1 Vehicular Access

Insert the following after the first paragraph:

Temporary AC shall be placed at all approaches to form a smooth transition between the street and drive approach. The Contractor shall maintain the temporary AC until such time the permanent pavement is constructed.

7-10.1.1.2 Pedestrian Access

Contractor is responsible in providing, developing and maintaining pedestrian access. Contractor shall route pedestrian access and shall be incorporated in the approved construction drawings; this pedestrian access route(s) shall be incorporated in both Phasing Plan (if project requires work to be installed/constructed in different phases) and Traffic Control Plans.

7-10.2 Work Area Traffic Control

7-10.2.1 General

Insert the following:

The Contractor shall notify the occupants of all affected properties at least forty eight (48) hours prior to any temporary obstruction of access. No overnight closure of any driveway will be allowed except as permitted by the Engineer.

The Contractor shall maintain reasonable access to all businesses and residents at all times.

At least one (1) twelve foot (12') wide traffic lane shall be provided for each direction of travel on all streets at all times, except as permitted by the Engineer. The traffic lanes shall be maintained on pavement, and shall remain unobstructed.

The Contractor shall install detour signs per approved Traffic Control Plans. Detour signs posted or attached to power poles, street light structures, utility poles or structures, etc., shall bear the Project Name and Contractor's Name written legibly on the back of each

sign posted or installed. At the completion of the project, these detour signs shall be cleared off the area and shall comply with all the provisions of Section 7-8.1.

Drive approaches shall be opened at the end of the normal recommended concrete curing time.

A minimum of seven (7) days prior to the start of construction, the Contractor shall install informational signs for the project, as directed by the Resident Engineer. As a minimum, the information on the sign shall include the following:

a. Start date of construction
b. Completion date
c. Lane restrictions
d. Information phone number (714) 765 5079

7-10.4 Safety

7-10.4.2 Safety Orders

Insert the following paragraph:

The Contractor shall comply with "Construction Safety Orders" of the State Division of Industrial Safety except where "Federal Safety and Health" regulations are more stringent, in which case such federal rules shall apply.

7-10.5.3 Steel Plate Covers

Insert the following after the first paragraph:

Excavations or trenching shall not be left open during non-working hours. They shall be backfilled, plated over with traffic bearing steel plates (when opened to traffic) or securely fenced and lighted with 6 foot high chain link fencing or equivalent, with temporary lighting as appropriate.

Open trenches that are required to be opened to traffic shall be backfilled, plated over with traffic bearing steel plates recessed, flush with adjacent roadway surfaces, unless otherwise directed by the Engineer. The Contractor shall comply with the following in installing the recessed trench plates:

a. Provide a minimum 12" lap of steel plate on each side of trench to assure no slipping of plate or collapsing of trench wall. Where 12" lap cannot be met, engineering design is required and shall be approved by the City Engineer. Trench shoring including overlap must be based on shoring calculations.
b. Steel plate must fit snug within the recessed area and installed to operate with minimum noise.
c. The pavement shall be cold planed to a depth equal to the thickness of the plate and to a width and length equal to the dimensions of the plate.
d. Multiple plates must be tack welded as needed to secure plates, 6" minimum.
e. All plates must meet required traffic loads, and be skid-resistant. The Contractor shall be responsible for the appropriate selection and maintenance of the steel plates.
f. Steel plates must be removed and permanent pavement shall be placed within fifteen (15) working days or as approved by the Engineer.

g. Advance warning signs "steel plates ahead" shall be placed.

7-13 Laws to be Observed

The following paragraph shall be added after paragraph one:

If a discrepancy or inconsistency is discovered in the plans, Drawing Specifications or contract for the work in relation to any such law, ordinance, regulation, order or decree, the contractor shall forthwith report the same to the Engineer in writing, otherwise the provisions of Section 2-5.1 shall govern.

SECTION 8 – Facilities for Agency Personnel

SECTION 9 – Measurement and Payment

9-3 Payment

9-3.1 General

The following paragraph shall be added at the end of the subsection:

Whenever the Contractor is required to perform work or furnish equipment, labor, tools and materials of any class of work contained in the plans and specifications for which no price is fixed in the proposal, it shall be understood that such work, equipment, labor, tools, and material shall be provided without extra charge, allowance, or direct payment of any kind. The cost of performing such work or furnishing such equipment, labor, tools, and materials shall be included in the unit bid prices in the proposal and no additional compensation will be made therefore.

9-3.2 Partial and Final Payment

The second paragraph is amended as follows:

On the workday following the designated closure date for preparation of progress estimates, the Contractor shall submit to the Engineer a written progress estimate based on the contract unit prices or as provided for as in Subsection 9-2 of the work that has been satisfactorily completed. The Engineer will review the estimate and approve it or notify the Contractor of any exceptions. The Engineer will determine and prepare the partial and final payments. If the Contractor fails to submit a written progress estimate, the Engineer will determine the quantity of work performed. No such progress estimate will be required, nor payment be made when the total number of working days is twenty-five (25) or less or when the value of the work totals less than $500.00. Progress payment will, when properly completed as specified, be paid within thirty (30) calendar days of submittal, and it is understood that any delay in the preparation, approval and payment of these demands will not constitute a breach of contract on the City.

9-3.2.1 Progress Billings (Anaheim Resort Area Projects Only) (Added)

All progress billings are to be submitted by the Contractor to the Engineer by the 15th of each month. The Public Works Department will process billings received by the 15th of each month and payment will be made not later than the end of the following month. Progress billings received after the 15th of the month will be processed with the next progress billing.

The Contractor is hereby notified that this project is funded with funds other than Anaheim Resort Area (ARA) funds. As a result, two separate checks may be issued per progress payment. One check will be for the ARA portion of the work and the other check will be for the non-ARA work. The two checks may not be issued on the same date.

9-3.3 Delivered Materials

The text of this subsection shall be deleted and replaced with the following:
Materials and equipment delivered but not incorporated into the work will not be included in the estimates for progress payment.

PART 2 CONSTRUCTION MATERIALS

SECTION 200 Rock Materials

200-2 Untreated Base Materials

See Section 400-2

SECTION 203 Bituminous Materials

203-6 Asphalt Concrete

See Section 400-4

SECTION 208 Pipe Joint Types and Materials

208-1 General

Insert the following after the first sentence of the section:

Only the following types of joint materials will be permitted for vitrified clay pipe: “D” and “G”. All other provisions of this section apply.

PART 3 CONSTRUCTION METHODS

SECTION 300 Earthwork

The provisions of Section 300 of the Construction Methods shall be as supplemented and provided for in the project’s Special Provisions.

SECTION 301 Treated Soil, Subgrade Preparation and Placement of Base Materials

301-1.3 Relative Compaction

The provisions of Section 301-1.3 of the Construction Methods shall be modified as follows:

Within the width of the roadway the top six (6) inches of the subgrade material shall be compacted to a minimum relative compaction of 95%. In shoulder areas and the subgrade material upon which curb, gutter, driveway and sidewalk are to be placed, the sub-grade shall be compacted to a minimum relative compaction of 90%.

After compaction and trimming, the subgrade shall be firm, hard, and unyielding.

301-1.6 Adjustment of Manhole Frame and Cover Sets to Grade

The provisions of Section 301-1.6 of the Construction Methods are supplemented by the following:

Unless noted otherwise on the plans or in the Special Provisions, water valve boxes, manholes and survey monuments within the area to be paved or graded shall be set to finished grade in the manner herein specified and as indicated in the City of Anaheim Standard Details.

302-5.5 Distribution and Spreading

The provisions of Section 302-5.5 of the Construction Methods shall be amended per the following:
The final or surface layer of asphalt concrete shall not be placed until all on-site improvements, including all grading, and all off-site P.C.C. improvements are substantially complete, as determined by the Engineer.

Asphalt concrete of 61 mm (0.20 foot) thickness or less may be placed in one lift. Asphalt concrete of greater than 61 mm (0.20 foot) thickness shall be placed in a minimum of two lifts. When placed in two lifts, the compacted thickness of the final surface course of asphalt concrete shall not be greater than 61 mm (0.20 foot) or less than 30 mm (0.10 foot).

Fog Seal Coat

A fog seal coat shall be applied over all join strips where asphalt constructed under this project abuts existing pavement and as directed by the Engineer. The fog seal coat shall conform to the provisions of Section 203.

Fog seal coat shall be an SS1 type asphaltic emulsion applied at a rate of 0.25 L/m2 (0.05 gallons per square yard) or as determined by the Engineer. Payment for the fog seal coat shall be included in the unit price bid per ton for "Asphalt Concrete" and shall include full compensation for furnishing all labor, materials, tools, equipment and appurtenances necessary to do the work, complete in place, as shown on the plans, and as specified in the Specifications and Special Provisions and as directed by the Engineer. No additional compensation will be allowed therefore.

302-5.8 Manholes (and other structures)

The first paragraph of 302-5.8 is hereby changed to read as follows:

Sewer and storm drain structures, water valve boxes, survey monuments and electrical vaults extending above the new subgrade, profile surface or cold mill surface shall be removed by the Contractor to the new subgrade, profile surface or cold mill surface before placement of base

material or paving. The owners shall lower other structures. All debris and foreign material shall be removed per 301-1.6. The top of reset manholes and other structures shall meet the smoothness requirement as specified in 302-5.6.2.

303-5 Concrete Curbs, Walks, Gutters, Alley Intersections, Access Ramps, and Driveways

303-5.5.2 Curb

The last sentence of the second paragraph of Section 303-5.5.2 of the Construction Methods shall be modified as follows:

The name of the Contractor and the year in which the improvement is constructed shall not be stamped in the completed work.

SECTION 306 Underground Conduit Construction

The provisions of Section 306 of the construction Methods are supplemented by the following:

306-1 Open Trench Operations

306-1.1 Trench Excavation

306-1.1.6 Bracing Excavations

The last paragraph of the section shall be replaced with the following:

All material used for protection (including sheeting) shall be removed from the project unless it has been approved to remain in place by the Engineer.

306-1.1.7 Protection (Added)

This Section is added to include the following:

Any excavation greater than 305 mm (1') in depth but less than 0.9 m (3') which will be left open after the completion of the normal work day shall be protected by a fence or barricade. Any excavation over 0.9 m (3') in depth will be fenced.

Prior to the start of construction the Contractor shall submit to the Engineer, for approval, the method of protection to be used.

All excavations less than or equal to 305 mm (1') in depth which will be left open over night shall have material bladed up and compacted against all vertical cuts within 1.5 m (5') of the traveled way.

Payment for compliance with this section shall be deemed to be included in the price bid for the various items of work for which excavation is necessary. No additional compensation will be allowed therefore.

306-1.2 Installation of Pipe

306-1.2.1 Bedding

306-1.2.1.1 General

The second paragraph of this sub-section is amended as follows:

Bedding shall conform to the following provision of the Construction Methods and as shown on the plans:

The cost of providing and installing said bedding material shall be included in the price bid for pipe and no additional allowance will be made therefore. In any case, where rock bedding under the pipe is required by the Engineer for stabilizing unstable subgrade due to existing ground conditions (not attributable to Contractors' operations or methods), such rock bedding material shall be paid for at the job site delivered price.

306-1.2.3 Field Jointing of Clay Pipe

This section is amended as follows:

Type "G" joints shall be used on all mains and six inch (6") or larger laterals. Type "D" joints may be used on 4" laterals.

306-1.3 Backfill and Densification

The provisions of this section are supplemented by the following:

All backfill for pipe or conduit shall be densified to a relative compaction of 90% minimum by water densification, mechanical tampers or rollers or other mechanical means.

306-1.5.1 Temporary Resurfacing

The first sentence of the last paragraph is revised as follows:

Payment for temporary trench resurfacing shall be included in the various items of work and no additional payment will be allowed.

SECTION 307 – Street Lighting and Traffic Signal Systems

When applicable, the Traffic Engineering Specifications for Traffic Signals and Safety Lighting Facilities will be found at the end of this Standard Specification Supplement. This document shall replace "Section 307, Street Lighting and Traffic Signal Systems," of the Greenbook, Standard Specifications for Public Works Construction, Latest Edition.

Detectors

Traffic signal detection shall not be interrupted for a period longer than fourteen (14) calendar days. Any project, public or private, which renders the vehicle loop detectors inoperative during the course of construction activities, the CONTRACTOR shall replace the loops or install video detection capabilities at all effected project intersection(s) by the end of the fourteen (14) calendar days. The CONTRACTOR will be assessed "Liquidated Damages" in accordance with the Special Provisions for each additional day traffic signal detection is interrupted. Any proposed video detection system shall comply with the City Specifications and approved by the City Engineer, or his representative, prior to installation by the CONTRACTOR. Compensation for the loop detectors or video detection system shall be paid for the item of work, no additional compensation shall be allowed. The CONTRACTOR shall contact Traffic Systems Maintenance

Operations at 714-765-6908 seven (7) days prior to start of work to arrange for installation of video detection.

Inductive loop detectors and detector amplifier units shall conform to the provisions of Section 86-5.01, "Vehicle Detectors" of the State of California Department of Transportation (Caltrans) Standard Specifications and Standard Plans, 2010 Edition; City Standard Details except as amended herein and in the Traffic Engineering Specifications for Traffic Signals and Safety Lighting Facilities and Special Provisions.

The term “inductive loop detector” applies to a complete vehicle detection installation consisting of a conductor loop or group of loops installed in the roadway, steel conduit, pull boxes, lead-in cable (DLC), and detector (amplifier) unit and power supply installed in a traffic signal controller cabinet.

Inductive loop detectors shall be Type “E” and consist of three turns of type 2 loop wire. Preformed inductive loops hall not be used unless otherwise shown on the PLANS. Loop detector configuration and location shall be installed in accordance with City Standard Detail No. 410, and as shown on the plans. Loop detector layout shall be approved by the ENGINEER prior to installation by the CONTRACTOR. Header loops shall straddle the limit line or stop bar.

Loop detector lead-in cable shall be “Type B”. All detector loop wires shall be joined as specified in Section 86-2.09C, "Connectors and Terminals," of the Standard Specifications or as approved by the ENGINEER. Splices in pull boxes shall be insulated as specified in Section 86-2.09E, "Splice Insulation," of the Standard Specifications. Each DLC shall be tagged with a plastic or aluminum label that specifies the phase. Each loop shall be identified in the pull box as to number and lane assignment. Tags will be furnished by the CONTRACTOR.

Loop conductors and sealant shall be installed on the same day as the loop slots are cut. All for filling slots shall conform to State Specifications. The sealant for filling slots in asphalt concrete shall be Hot-Melt Rubberized Asphalt Sealant. Elastomeric sealant shall be used only for filling slots in portland concrete.

Holes larger than 4-inches across left in the pavement due to loop installation shall be filled with asphalt concrete hot mix.

Where existing interconnect conduit is to be used for advanced/system loop detectors, the CONTRACTOR shall use extreme care not to damage the existing cables (i.e. twisted pair, fiber optic, sign control cable) when installing new lead-in cable. Any existing cable damaged by the CONTRACTOR shall be replaced at his/her expense.

All detector loops in a travel lane shall be series connected and all travel lanes shall be series connected up to a maximum of three (3) lanes per sensor unit, unless otherwise directed by the ENGINEER.

Detectors units shall be two channel, rack mounted, inductive loop type with external timing switches conforming to EDI Model #LM 602t, or approved equivalent. Detector unit power supplies shall be rack mounted. The power supply pin out configuration shall be identical to EDI Model #PS-175 (24 volt) power supply. All detector power supplies shall be interchangeable.

Unless otherwise provided for in the contract documents, compensation for installation of loop detectors shall be deemed to be included in the contract price bid for the item of work, and no additional payment will be made therefore.

SECTION 400 – Alternate Rock Products, Asphalt Concrete, Portland Cement Concrete and Untreated Base Material

Portland cement concrete shall meet the requirements of Section 400 and these Special Provisions.

For 2500 class concrete, a pre-qualified mix design may be used in accordance with the provisions of ACI 318-71, Section 4.2.2.1, in which $f'_{c = 17}$ mpa (2500 psi).

The cement type requirement, Section 201-1.2.1, shall be Type II or Type V as determined by the Engineer. Type II or Type V cement shall conform to ASTM C 150 and the low alkali requirements of Table 2 therein.

The Cleanness Value requirement of Section 200-1.4 shall be replaced with the following:

Tests	Test Method No.	Requirements
Cleanness Value	California 227	
Individual Test		70 Min*
Moving Average		75 Min*

The sand equivalent requirement of Section 200-1.5.3 shall be replaced with the following:

Tests	Test Method No.	Requirements
Sand Equivalent	California 217	
Individual Test		70 Min*
Moving Average		75 Min*

* For 2500 or less class concrete, except concrete pavement, a minimum 65 Individual Test Result and a minimum 70 Moving Average will be acceptable if 17 mpa (2500 psi) 28-day strength criteria of Section 201-1.1.4 are met, at 150 mm (6") slump or greater. The EMA Materials Laboratory will make the testing and acceptance determination. Evaluation of Sand Equivalent and Cleanness Value shall conform to the provisions of Subsection 400-1.1.3.

SECTION 400-2 – Untreated Base Materials

Base materials shall conform to the provisions of Section 400-2 of the Standard Specifications and the following supplement:

In lieu of the 2nd sentence of Section 200-2.4.1 at least 65%, by weight, of the material retained on the No. 4 sieve shall be a crushed particle as determined by Test Method No. California 205.

Evaluation of gradation and sand equivalent test results shall conform to the provisions of Subsection 400-2. The gradation and sand equivalent requirements of Subsections 200-2.2, 200-2.4, 200-2.5 and 200-2.6 shall be the moving average requirements.

Individual test requirements for gradation and sand equivalent shall be as determined by the Engineer.

SECTION 400-4 – Asphalt Concrete

Asphalt concrete shall conform to the provisions of Section 400-4 of the Standard Specifications and the following supplement:

Coarse aggregate shall consist of material of which at least 75% by weight shall be crushed particles in lieu of the requirements of Section 400-4.2.3.

The gradation of combined aggregate and the asphalt content shall be as follows:

Arterial Highways, Collector, and Interior Streets	Max
19 mm (3/4") (III-B2-PG 64-10) Base Course	5.7%
13 mm (1/2") (III-C3-PG 64-10) Base and Surface Course	6.0%

Surface course shall not consist of reclaimed asphalt pavement (RAP).

Base course shall be per SSPWC, 2012 Edition and any supplement therein.

Performance Graded (PG) asphalt binder shall conform with Section 92 of the State of California, Department of Transportation Standard Specifications (2010 Edition and subsequent supplements).

MASTER AGREEMENT
SPECIAL PROVISIONS

WATER SERVICES

PUBLIC UTILITIES DEPARTMENT

CITY OF ANAHEIM

CALIFORNIA

GENERAL

The following Special Provisions are supplementary and in addition to the latest Water Services Standard Specifications (WSSS). The section numbers of these Special Provisions coincide with those of the WSSS, and only those sections requiring elaboration, amendments, specifying of options or additions are called out.

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SECTION 1 SUPPLEMENTAL GENERAL PROVISIONS

1-01 PLANS AND SPECIFICATIONS

1-01.01 GENERAL

Subsection 1-01.01 is hereby added to Section 1-01.

The work to be done under the Master Agreement requires the completion of all work in accordance with the Contract Documents, including the Special Provisions contained herein and the Special Provisions contained in a Work Order Package or a Request (if Special Provisions contained in a Work Order Package or a Request conflict with the Special Provisions contained herein, then the Special Provisions contained in the Work Order Package or Request, shall control), Construction Drawings, other related documents included in the Work Order Package or Request.

All water improvement work in this Contract shall conform to the following: Work Order Package or Request; ANAHEIM Public Utilities latest Water Services Standard Specifications (WSSS) and these Special Provisions; the latest Standard Specifications for Public Works Construction adopted by ANAHEIM (Standard Specifications); the Standard Specifications Supplement; and the Appendices included in Volume II of the Master Construction Agreement Pre-qualification Package. Unless otherwise indicated, any references to plans or drawings with these Special Provisions shall be those plans or drawings attached to Work Order Package or Request.

WSSS may be downloaded from the City's website at the following address:

http://www.anaheim.net/767/Business-Developers-Contractors

Copies of Standard Specifications are available from Building News, Inc., 1612 S. Clementine Street, Anaheim, California, 92802, telephone (888) BNI-BOOK.

SECTION 1 - SUPPLEMENTAL GENERAL PROVISIONS

1-02 DEFINITIONS

The definitions in the City of Anaheim Water Services Standard Specifications (WSSS) and the Standard Specifications shall be supplemented by the following:

A. OWNER/CITY/CITY WATER REPRESENTATIVE: The words "Owner," "City," or “City Water Representative” used in the Contract Documents refer to City of Anaheim, California.

B. AGENCY: Whenever the term "Agency" appears in the Standard Specifications for Public Works Construction it shall mean the City of Anaheim.

C. PROPOSAL: The offer of the bidder for the work when made out and submitted on the prescribed proposal form, properly signed and with proposal guarantee.

D. ENGINEER: The word "Engineer" shall mean the City staff, individual, or firm authorized by the City to oversee the completion of the work, acting either directly or through properly authorized agents.

SECTION 1 - SUPPLEMENTAL GENERAL PROVISIONS

1-03 ABBREVIATIONS

The abbreviations in the City of Anaheim Water Services Standard Specifications (WSSS) and the Standard Specifications shall be supplemented by the following:

ACI	American Concrete Institute
AGA	American Gas Association
AI	The Asphalt Institute
AIA	American Institute of Architects
AISI	American Iron & Steel Institute
AMC	City of Anaheim Municipal Code
ASA	American Steel Association
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
CRSI	Concrete Reinforcement and Steel Institute
HI	Hydraulic Institute
IEEE	Institute of Electrical and Electronics Engineers
IPCEA	Insulated Power Cable Engineer's Association
ISO	Insurance Services Office
NEC	National Electrical Code
NEMA	National Electric Manufacturers' Association
NIST	National Institute of Standards and Technology
OSHA	Occupational Safety and Health Act of 1970
PCA	Portland Cement Association
UL	Underwriters' Laboratory
WRRR	Water Rates, Rules and Regulations (City of Anaheim)

SECTION 1 - SUPPLEMENTAL GENERAL PROVISIONS

1-04 SCOPE OF WORK

The following shall be added to Section 1 – General Provisions:

1-04.01 LOCATION OF WORK

The projects will be located within the service area boundaries of the City of Anaheim Public Utilities Department.

1-04.02 DESCRIPTION OF WORK

The Contractor shall be responsible for construction and completion of the work as set forth in a WORK ORDER PACKGE or a REQUEST. The Contractor shall furnish all labor, materials, methods or processes, implements, tools, and machinery necessary for the construction, testing, and completion of the work in accordance with the WORK ORDER PACKAGE or REQUEST, and leave the construction site in a neat, clean, and orderly condition. Each Phase of work shall be coordinated, scheduled, and pursued so the work is not delayed and the time duration for the work is not extended.

1-04.03 COMPLETION OF WORK

The Contractor shall complete all of the work under the Master Agreement as specified in a WORK ORDER PACKAGE or a REQUEST in every detail within the days specified therein after the issuance of the Notice to Proceed for the WORK ORDER PACKAGES or after the Contractor is selected for the Request. The Notice of Completion will be recorded only after successful testing and final project walk through is completed and accepted by the Engineer.

1-05 CONTROL OF WORK

The following shall be added to Section 1 – General Provisions:

1-05.01 NOTICE OF AWARD AND NOTICE TO PROCEED

The City will notify the successful Contractor with a Notice of Award for the work other than Immediate Response Services. **Upon receipt of the Notice of Award, the Contractor shall complete all required documents with the City and submit a detailed construction schedule as outlined in section 1-05.02.**

No work can be done by the Contractor until the Notice to Proceed is received from the City and as further specified in the following sections.

1-05.02 PRE-JOB CONFERENCE

The City will schedule a Pre-Job Conference shortly after the Notice of Award is received by the Contractor. The Contractor shall bring its schedule and proposed sequence of work to the pre-job conference. The Pre-Job Conference will address the following items:

A. Discussion to clarify any questions about the work as exists in the field, detailed on the plans, or specified within the Contract Documents, including, if desirable to the parties present, a visit to the project site.

B. Review of the project construction schedule and discussion of the details of the schedule. The schedule shall include all construction tasks and disciplines required to construct the project facilities, from the Notice to Proceed through completion of construction. During the pre-job conference the Contractor may be asked to make adjustments to its schedule to suit the needs of the City.

C. Introductions of the key project personnel.

1. The City will furnish the Contractor a list of the various representatives, and any other personnel who will have direct responsibilities with the project.

2. Contractor is expected to be represented at the meeting by its assigned superintendent and foreman. Attendance by representatives of the various major sub-contracted portions of this project will also be required.

The Contractor shall proceed with the work only after the pre-job conference, approval of the Contractor detailed construction schedule, approval of shop drawings, and receiving of the Notice to Proceed.

1-05.03 EXAMINATION OF THE SITE

Examination of the site shall be made by the Contractor, who, shall be satisfied as to the conditions under which the work is to be performed. The Contractor shall include the impact, if any, of the conditions on the site under which the work is to be performed. The Contractor shall at such time ascertain and check the locations of any existing structures or equipment which may affect the work. No allowance shall subsequently be made for any extra expense incurred due to failure or neglect to make such examination. The Contractor is solely responsible for inspecting the project locations during the preparation of its Bid Proposal or response to a Request and fully understanding the physical conditions and constraints of the site.

SECTION 1 - SUPPLEMENTAL GENERAL PROVISIONS

1-05.04 WORK HOURS

Normal work hours shall be performed Monday – Friday: 7:00 A.M. – 3:30 P.M. or as required by the City.

If the Contractor elects to perform work at times other than the normal work hours, it must obtain approval from the City. No additional payment will be made by the City if the Contractor elects to work outside the normal work hours.

1-05.05 CONSTRUCTION SCHEDULING

The Contractor shall provide the City with the proposed construction schedule in sufficient detailed bar chart form indicating various activities, time, and location of work. The detailed construction schedule shall be submitted at the pre-job conference and approved by the City before any work commences.

The Contractor bid price shall include coordination with the City's schedules. The Contractor shall be responsible for scheduling the construction of the work so that the impact to the existing City's water system is minimized.

The contract completion date shall be based on the Contract Completion Days designated in the Work Order Package or Request and not on a proposed early completion shown in the schedule.

The Contractor shall be responsible for assuring that all work sequences are logical and the schedule shows a coordinated plan for complete performance of the work.

1-05.06 SCHEDULING SEQUENCE

The Contractor shall perform its work in such a manner that all disruption of water service and main shutdowns will be kept at an absolute minimum. The exact time and day of each shutdown shall be closely coordinated with the City's Utilities Operation Division to reduce interruption of their activities. The Contractor shall coordinate all consumer service shutdowns with the affected consumer and the City's Water Representative.

Payment for conformance to the requirements of this section shall be deemed to be included in the bid price for the various items of work and no additional compensation will be allowed.

If in the opinion of the water inspector, certain portions of the water improvements are required to be performed at times other than the

normal work hours defined in Section 1-05.04, the Contractor shall comply with that scheduling requirement.

Payment for the conformance to the discretionary requirements of this section shall be accommodated via the extra work order process.

1-05.07 REQUIREMENTS DURING CONSTRUCTION

The Contractor shall not commence any work until the Engineer has been furnished with proof that all necessary materials and equipment have been provided, and the Contractor is ready to proceed and is able to complete the portion of work proposed within the time frame described within these Special Provisions.

1-06 CONTROL OF WORKMANSHIP AND MATERIALS

The following shall be added to Section 1 - General Provisions:

1-06.01 GENERAL

All materials installed under a Work Order Package or Request, unless indicated otherwise, shall be furnished by the Contractor. These materials shall be new and conform to the latest revision of the WSSS, these Special Provisions, or other Contract Documents.

1-06.02 "OR EQUAL" ITEMS

In compliance with the provisions of Section 4380 of the Government Code of the State of California, the Contractor will have ten (10) calendar days after award of the Work Order Package or Request to submit data substantiating a request for substitution of any "or equal" items, when allowed. Substitution(s) may be used after written approval is received by the Contractor from the Engineer.

1-06.03 SALVAGING OF MATERIALS & EQUIPMENT

All materials, equipment and appurtenances, except those specified to be salvaged herein or in the Plans, shall become the property of the Contractor and shall be removed from the site as a part of this Contract. All salvaged materials shall be transported by the Contractor and stored for disposal by the City at the City's Utilities Service Center at 901 East Vermont Avenue, Anaheim, or as noted on the plans or directed by the City. Salvaged water facilities have no salvage value to the City.

1-06.04 TESTINGS

The testing of equipment and materials, or of any portion of the job under construction, shall be in accordance with these Special Specifications and as directed by the Engineer. The Contractor shall

furnish, without additional costs to the City, all equipment, materials, labor and other incidentals requested for testing in accordance with Section 4 of the Standard Specifications. The Contractor shall also provide access to any area of the job for testing purposes and shall furnish, without cost, any assistance necessary to perform the testing. Soil density and concrete cylinder testing shall be performed by a private laboratory, selected and paid for by the City. Extra testing required, due to test failures, will be at the Contractor's expense, either as a billing by the City or as a deduction from contract payment.

The Contractor shall notify the City's field representative of the readiness of any phase of construction to be tested and shall not proceed with any subsequent phase of work until the results of the test are known and approved.

1-06.05 DISPUTES

On all questions related to the quantities, the acceptability of material, equipment, or workmanship, the execution, progress or sequence of work, the interpretation of Contract Documents and the acceptable fulfillment of a Work Order Package or Request on the part of the Contractor, the decision of the Engineer shall govern and shall be precedent to any payment under a Work Order Package or Request. The progress and completion of the work shall not be impaired or delayed by virtue of any question or dispute arising out of or related to the foregoing matters and the instructions of the Engineer.

1-06.05.1 AB 626/PUBLIC CONTRACT CODE SECTION 9204

If the Contractor has a "claim" as defined in Public Contract Code Section 9204, the Contractor and City shall abide by the procedures set forth in that section and the City of Anaheim Water Services Standard Specifications. Any submission of a Section 9204 claim by the Contractor does not constitute a submission of a claim under the Government Tort Claims Act or any other law and as such the Contractor will be required to comply with those statutes as applicable. Section 9204 is included, in full, as Appendix H in the 20222~~19~~-2722~~2~~ APU Water Master Agreement Bid Documents.

1-06.06 GENERAL SUPERVISION

Direction of the work by the Engineer shall in no way imply that the Engineer or Engineer's representatives are in any way responsible for the safety of the Contractor or its employees, or that the Engineer or Engineer's representatives will maintain supervision over the Contractor's construction methods or personnel other than to ensure

that the quality of the finished work is in accordance with the Contract Documents.

1-06.07 QUALITY OF MATERIALS AND SOURCE OF SUPPLY

At the option of the Engineer, the source of supply of each of the materials shall be approved by him or her before delivery is started. All materials proposed for use may be inspected or tested at any time during their preparation and use. If, after trial, it is found that sources of supply which have been approved do not furnish a uniform product or if the product from any source proves unacceptable at any time, the Contractor shall furnish approved material from other approved sources. After approval, any material which becomes unfit for use due to improper storage, handling or any other reason shall be rejected.

SECTION 1 - SUPPLEMENTAL GENERAL PROVISIONS

1-07 UTILITIES

The following shall be added to Section 1 – General Provisions:

1-07.01 UTILITY LOCATIONS AND NOTIFICATIONS

The Contractor is required to contact the Underground Service Alert organization at telephone number 811 a minimum of two (2) working days prior to performing any ground-disturbing construction on the project. The Contractor shall contact the Underground Service Alert at additional times a minimum of two (2) working days prior to performing construction at each different construction location.

The Contractor shall locate, verify and protect all existing utility facilities in the immediate vicinity of the work as stated in Section 3 of the Standard Specifications.

Existing utilities have been shown on the plans using the best information available. It is the Contractor's responsibility to verify by potholing all utility crossings and potential conflicts with the proposed water project. The cost of additional potholing required to verify utility locations or the conditions of the existing water facilities shall be included in the cost of the various items of work and no additional compensation will be allowed.

Contractor shall contact the respective field representative first, then pothole and expose all communication, fuel lines, and utility systems within the area of water construction.

Nothing contained herein shall be deemed to require the public agency to indicate the presence of existing service laterals or appurtenances whenever the presence of such utilities on the site of the construction project can be inferred from the presence of other visible facilities, such as buildings, meter and junction boxes, on or adjacent to the site of the construction.

Damage to any existing facility, due to the operations of the Contractor, shall be repaired by the Contractor, at its own expense, to the satisfaction of the Engineer or the representative of the facility damaged.

1-07.02 POTHOLING AND LOCATING EXISTING UNDERGROUND UTILITIES

The Contractor shall pothole and locate existing underground utilities at the locations shown on the drawings, or where connection to an existing utility is required, prior to submitting shop drawings for the construction. An effort has been made to locate all underground utilities within the project site; however, numerous utilities may be installed

concurrent with the Contractor's operations. Accurate information as to the location and time of completion for the other utilities was previously not available and it shall be the Contractor's responsibility to coordinate its operations and construction with the location and/or construction of other utilities.

The Contractor shall be responsible for coordinating the potholing with the City's surveyor to obtain necessary survey information regarding the locations of the existing utilities.

The Engineer will not review any of the pipeline shop drawings until the potholing is completed. No extension of time or additional compensation will be made for delays caused by the failure of the Contractor to complete the potholing in a timely manner.

The Contractor shall notify Underground Service Alert at least 48 hours in advance of any construction or potholing and make arrangements for the existing utilities to be marked by the affected utility companies.

The City's surveyor will provide the required survey services to locate the exposed utilities potholed by the Contractor. The Contractor shall notify the City a minimum of five (5) working days in advance of survey requirements.

All costs incurred in exposing and locating the existing utilities including all labor (except the survey services outlined above), tools, equipment for excavation, backfill, restoring existing surface and site improvements, shall be included in the unit price bid for the corresponding water facility construction.

The Contractor shall bear the cost of repairing or replacing any existing utility damaged by its potholing work to the satisfaction of the owner of the affected utility.

1-07.03 WATER AND POWER FOR CONSTRUCTION

The Contractor shall provide power needed for construction of all items under this Contract. The Contractor shall, at its own expense, convey the construction water and power, in each case, to the point of use. Construction water shall be fresh potable water only and the source of supply shall be approved by the Engineer prior to its use.

The Contractor shall make its own provisions for obtaining and providing water necessary to perform the work. If the Contractor plans to use City water, it shall make arrangements for water purchases by contacting the City's Water Utility Customer Service section at phone (714) 765-4201, extension 5006, and complete an application for temporary water service.

All on-site power shall be maintained in proper working order so as to execute the construction in a safe and timely manner. If the Contractor plans to use City power, it shall make arrangements for a temporary electrical service by contacting the City's electrical Utility, phone number (714) 765-5156.

All work conducted at night or under any other conditions of deficient daylight shall be lighted with suitable lighting sufficient to insure proper safety, work, and inspection. At places where work is going on, or where construction monitoring is to be made, adequate special illumination shall be provided, as directed by the Engineer. Lighting shall be utilized to minimize nuisance to residences in the neighborhood.

1-08 PROJECT OBSERVATION AND ACCEPTANCE OF WORK

The following shall be added to Section 1 – General Provisions:

1-08.01 CONSTRUCTION PROJECT OBSERVATION

The City shall have access to the work and shall be furnished with every reasonable facility for ascertaining full knowledge of the progress, material, and workmanship used to complete the work. The City shall be given twenty-four (24) hours advance notice of any phases of construction for purposes of project observation. All material and equipment and their manufacturer's certification shall be reviewed prior to placement and all workmanship shall be visually inspected prior to backfilling the trench.

The observation of the work by the City shall not relieve the Contractor of any obligation to complete the work as prescribed by the Contract Documents. The City shall have the authority to suspend the work wholly, or in part, for such time as it may deem necessary due to the failure of the Contractor to perform any provisions of the Contract Documents. The work can only continue when the defective material or method of work has been corrected and is accepted by the City.

1-08.02 DEFECTIVE AND UNAUTHORIZED WORK

All work which is defective in its construction or deficient in any of the requirements of the Contract Documents shall be remedied or removed and replaced by the Contractor in an acceptable manner at its own expense. Defective work shall be corrected, and unsuitable materials may be rejected notwithstanding the fact that such defective work and unsuitable materials have been previously accepted by the City.

No compensation will be allowed for any work done beyond the lines and grades shown on the Plans or established by the Engineer. If the Contractor fails to comply with any order of the Engineer made under the provisions of this article, the Engineer may cause the defective work to be remedied or removed and replaced at the expense of the Contractor.

1-08.03 COMPLETION OF PORTIONS OF THE WORK

The Contractor may finish portions of the work and relinquish jurisdictional control of portions of the work completed to the City as may be specified in these Special Provisions. This relinquishment of completed work does not relieve the Contractor of the final acceptance of all the work covered in the Work Order Package or Request.

1-08.04 FINAL REVIEW OF THE WORK & ACCEPTANCE

The Contractor shall notify the Engineer a minimum of five (5) working days in advance when it desires a final inspection of the work. The Engineer will, as soon thereafter as possible, make the necessary examinations. No final acceptance of the work will be allowed until all check lists items to be rectified have been corrected and any subsequent final review have been performed. Partial payment for materials delivered on the site does not in any way relieve the Contractor of its responsibility to insure the materials are installed correctly and they perform to the requirements of the Contract Documents.

1-09 RESPONSIBILITIES OF THE CONTRACTOR

The following shall be added to Section 1 – General Provisions:

1-09.01 QUALIFICATIONS OF THE CONTRACTOR

The Contractor, in order to qualify for award of the Work Order Package or Request, shall have been engaged in construction of similar projects, and shall have engaged in the construction of projects of similar nature for a period of not less than 3 years.

1-09.02 EQUIPMENT

The Contractor must furnish adequate equipment to properly perform the work in accordance with the WSSS. All equipment must be in a good working condition and maintained in such state during the progress of the work. No worn or obsolete equipment shall be used, and in no case shall the maker's rating of capacity for any equipment be exceeded.

SECTION 1 - SUPPLEMENTAL GENERAL PROVISIONS

1-09.03 CHARACTER OF WORKMEN

The Contractor shall employ none but competent foremen, laborers, and mechanics. If any person employed on the work by the Contractor fails or refuses to carry out the direction of the Engineer, or shall appear to the Engineer to be incompetent, troublesome, or otherwise undesirable, it shall be discharged from the project immediately upon the request of the Engineer, and such person shall not again be employed on the work. The Contractor shall furnish the services of a competent and experienced foreman who shall be capable of doing this work.

1-09.04 SUBCONTRACTORS

At the Engineer's discretion, certain subcontractors may be permitted, if shown to be necessary or advantageous to the Contractor in the completion of the work and without injury to the interests of the City of Anaheim. Each subcontractor shall be properly licensed for the type of work which it is to perform and shall be approved in advance by the Engineer. The Contractor shall be responsible to the Engineer and the City of Anaheim for the acts and omissions of its subcontractor(s) and their employees to the same extent the Contractor is responsible for its own employees. Nothing contained in this Section shall create any contractual relationship between any subcontractor and the Engineer or the City of Anaheim or relieve the Contractor of any liability or obligation under the Prime Contract.

1-09.05 CONSTRUCTION SUPERVISION AND COOPERATION

The Contractor shall provide competent supervision of the work. Unless personally present on the premises where the work is done, the Contractor shall designate an authorized representative who shall have the authority to represent and act for the Contractor, and any written or verbal directions or requests of the City's Representative delivered to such representative shall have the same force and effect as if delivered to the Contractor.

Said authorized representative shall be present at the site of the work at all times while work is actually in progress on a Work Order Package or Request. When work is not in progress and during periods when work is suspended, arrangements acceptable to the City's Representative shall be made for any emergency work required.

Whenever the Contractor or its authorized representative is not present on any particular part of the work where it may be desired to give direction, orders will be given by the City's Representative which shall

be received and obeyed by the superintendent who is in charge of the particular work in reference to which the orders are given.

During the course of work to be performed under a Work Order Package or Request, other contractors may be performing work in the immediate vicinity of this work. The Contractor under a Work Order Package or Request shall schedule its work and coordinate its operations with those so as to minimize conflicts and interference between its operation and those of other contractors. Contractor may be required to work on overtime hours, holidays, and weekends to fulfill the requirements of the businesses and residents in the area, however, except as noted in section 1-05.04, Contractor shall not be required to work outside of the times specified herein barring any emergency. No additional payment shall be made to the Contractor for compliance with this requirement.

1-09.06 SAFETY

In accordance with generally accepted construction practice, the Contractor shall be solely and completely responsible for conditions of the job site, including safety of all persons and property during performance of the work, and the Contractor shall fully comply with all State, federal and other laws, rules, regulations, and orders relating to safety of public and workers. It will be the Contractor's responsibility to acquaint itself with and abide by these regulations during all phases of construction. The Contractor will hold harmless and indemnify the City and its agents for any damages caused by any failure to abide by said regulations.

The City will make periodic observations of materials and completed work to determine their compliance with plans, specifications, and design and planning concepts, but in doing so the City is not responsible for the maintenance of a safe place to work or any safety in, on, or about the site of the work. Nevertheless, the City may suspend operations if it determines that an imminent safety hazard exists. No additional time or compensation will be allowed for suspension of operations resulting from an unsafe condition or act.

In any emergency affecting the safety of life, work, or adjoining property, the Contractor shall, at its discretion and without special instructions from the City, immediately act to prevent threatened loss or injury.

Upon request, the Contractor shall immediately provide safe access for observation by the Engineer or Engineer's designee to all parts of the work and to the job site where the work is in preparation.

The Contractor shall provide and install all safety equipment, signs,

guards, lighted barricades and any devices necessary for the prevention of accidents and injury in compliance with this section. Installation and application of temporary safety equipment, and/or material shall be included in the Work Order Lump Sum or Unit Price Proposal. No additional compensation will be allowed.

The Contractor shall make arrangements for first aid at the job site and for the transportation of injured persons for medical attention as required.

The Contractor shall within one day (24 hours), report in writing to the Engineer all injuries and property damage arising out of, or in connection with, the performance of the work, giving full details and statements of witnesses. If death, serious injuries or serious damages are caused, the accident shall be reported immediately by telephone, radio, or messenger to the Engineer. If requested by the City, the Contractor shall meet with the Engineer City Representatives to present a Safety Action Plan outlining steps the Contractor will take to avoid future occurrences of similar injuries and/or property damage.

The Contractor shall submit, prior to being issued a Notice to Proceed on any Work Order, a written safety program, with procedures, detailing how it intends to comply with this section. The Contractor's safety program shall also indicate the scheduled days and times of safety meetings and daily tailgate briefings.

Unacceptable types and numbers of injuries or property damage, failure to comply with state, federal and other laws, rules, regulations, and orders relating to safety, and/or failure to follow safety plans or programs applicable to the work may constitute grounds for termination of a specific Work Order or the Master Agreement.

1-09.07 JOBSITE SAFETY

Contractor acknowledges responsibility for jobsite safety and acknowledges further that the Engineer will not have any such responsibility.

The City may require in the Request for Work Order Proposal ("RFWOP") that the Contractor designate a Safety Representative for the work prior to the issuance of a Notice to Proceed. The City may also require in the RFWOP that the Contractor provide a Site Specific Safety Plan for the work prior to the issuance of a Notice to Proceed. Any anticipated costs due to compliance with these safety requirements shall be included in Contractor's Work Order Proposal.

The Safety Representative, if required, shall have the necessary qualifications and experience to supervise the implementation and

monitoring of all safety precautions and programs related to the Work Order. The Safety Representative shall be an individual stationed at the job site and may have other responsibilities in addition to safety. The Safety Representative shall make routine daily inspections of the work and hold weekly safety meetings with Contractor's personnel, subcontractors and other as applicable. The weekly safety meetings shall be open to the Engineer or Engineer's designee, with attendance subject to the Engineer's discretion.

1-09.08 INDEMNIFICATION

To the fullest extent permitted by law the Contractor shall indemnify, defend and hold harmless Owner, Engineer and their employees from and against all claims, damages, losses and expenses, including but not limited to attorney fees and claim costs, arising out of or resulting from performance of work by the Contractor, its subcontractors, or their agents and employees, which results in damage to persons or property including wrongful death regardless of whether or not such claim, damage, loss or expense is caused in whole or in part by the negligence, active or passive, of Owner, Engineer, and their employees, excepting only the sole negligence of Owner, Engineer, and employees.

1-09.09 OPERATION AND MAINTENANCE MANUALS

Upon completion and before making application for acceptance of the work, the Contractor shall submit to the Engineer four (4) copies of operation and maintenance manuals if required by the City.

The manuals shall include the items and be in the form as outlined in APPENDIX A, as applicable.

1-09.10 WARRANTY

The Contractor shall execute and submit a completed Warranty Form for the work in the format shown in APPENDIX B.

SECTION 1 - SUPPLEMENTAL GENERAL PROVISIONS

1-10 PROJECT SITE MAINTENANCE

The following shall be added to Section 1 – General Provisions:

1-10.01 PROTECTION OF THE PUBLIC

It is part of the services required of the Contractor to make provisions as necessary to protect the public. The Contractor shall use foresight and shall take such steps and precautions as its operations warrant to protect the public from danger, loss of life, and loss of property, which would result from interruption or contamination of public water supply, interruption of other public services, or from the failure of partially completed work or partially removed facilities. Unusual conditions may arise during the work which will require that immediate and unusual provisions be made to protect the public from danger, loss, or damage to life and property, due directly or indirectly to prosecution of work under any Work Order or Request.

Whenever, in the opinion of the Engineer, an emergency exists against which the Contractor has not taken sufficient precaution for the public safety, protection of utilities, and protection of adjacent structures or property that may be damaged by the Contractor's operations, or when, in the opinion of the Engineer, immediate action is considered necessary in order to protect the public or property due to the Contractor's operations under any Work Order or Request, the Engineer may request that the Contractor provide a remedy for any unsafe condition. If the Contractor fails to act on the situation within a reasonable time period, the City may provide suitable protection to said interest by causing such work to be done and material to be furnished as, in the opinion of the Engineer, may seem reasonable and necessary. The cost and expense of said labor and material, together with the cost and expense of such repairs as are deemed necessary, shall be borne by the Contractor.

All expenses incurred by the City for emergency repairs will be deducted from the progress payments and the final payment due to the Contractor. However, if the City does not take such remedial measures, the Contractor is in no way relieved of the full responsibility for public safety.

1-10.02 CONSTRUCTION SITE WORK OPERATIONS

The Contractor shall exercise appropriate measures whenever and as often as required to prevent its construction operations from producing dust, dirt, and mud that will cause a traffic hazard or nuisance to persons living nearby or occupying buildings in the vicinity of the work. Extreme care shall be taken by the Contractor during the main draining

and flushing operations to avoid erosion of unprotected subgrade and embankment areas.

The Contractor will be required to comply with the requirements for the Clean Water Act. This act prohibits certain discharges to the storm water drainage system. Any discharge, which is not comprised entirely of storm water or which contains any pollutant (including chlorine), shall not be discharged to the storm water drainage system or any upstream flow which is tributary to the storm water drainage system.

Only clean potable water, with no detectable chlorine residual, can be dumped onto the street or into the gutter. Any work that creates a slurry of asphalt or cement, such as saw cutting, must be picked up by vacuum and disposed of other than in the street or gutter. If a water truck is required to clean the street, the Contractor will be required to collect the corresponding water and either convey it into local sewage facilities, pick it up by a vacuum, or place sand bags at the catch basins and desilt/filter the runoff until it meets the Clean Water Act requirements. Additional requirements are described in Section 3-02-01.1 and Section 3-10.05.

1-10.03 SITE ACCESS

The Contractor shall, at all times, provide adequate access to existing valves, hydrants and other utility facilities in or near the construction site. The Contractor shall maintain the site so that there is sufficient access by the Contractor's personnel and other authorized personnel to all areas of the site. The Contractor shall coordinate its efforts with any representatives of the City or other contractors who may be on the sites performing work for the City.

1-10.04 CONSTRUCTION SITE SAFETY, FENCING AND STEEL PLATES

Open trenches shall be backfilled or covered with steel traffic plating when not attended by the Contractor's personnel. The Engineer will require trench excavations to be closed by backfill or steel traffic plating at the close of the work period during the construction stage depending upon the location of the trench, traffic conditions, and the total non-working hours the trench would be left open. If a trench must remain open, steel plates of adequate thickness to support traffic may be placed over the excavations.

Contractor shall make the following provisions to prevent steel plates from moving: All steel plates shall be properly secured with asphaltic concrete around all four edges, steel plates shall be welded together and nailed to the street or the AC surface around the plate location shall be

ground down to the thickness of the plate such that the top of the plate is flush with the surface of the street.

All other open excavations shall be protected from both pedestrian and vehicular traffic by fencing, or any other means in a manner approved by the Engineer. The Contractor shall provide temporary chain link fencing at least 6 feet high along all open excavations not attended by its personnel.

1-10.05 SITE CLEANING

The Contractor shall remove dirt, debris, waste, and rubbish from the working area and the construction site to the satisfaction of the City Inspector at the end of each day or as directed by the City Inspector. Unattended construction materials, equipment, and trash shall be left in a manner such that they do not constitute fire hazards or become or cause nuisance or dangers due to forces of nature, such as rain or wind. Care should be taken to prevent spillage, and any such spillage, or debris due to the Contractor's operations shall be immediately cleaned up. Final cleanup and site restoration requirements are referred to in Section 1-10.06.

Any hazardous waste generated during the project must be stored, handled, and disposed of in accordance with state, federal, and local requirements. Unless otherwise approved by Environmental Services, any hazardous waste must be removed from the site within 90 days of generation. The Contractor shall be responsible for labeling and securing any hazardous waste containers. Hazardous waste must be disposed of at a facility approved by Environmental Services. All hazardous waste manifests must be signed by Environmental Services.

1-10.06 FINAL CLEAN UP AND SITE RESTORATION

Upon completion and before making application for acceptance of the work, the Contractor shall provide, at its own expense, final clean-up of the construction site and all ground occupied by the Contractor in connection with the work. All rubbish, excess materials and equipment shall be removed and all parts of the work shall be left in a neat and presentable condition.

The Contractor after the completion of the work shall restore the site to an acceptable manner to the Engineer. Sidewalks, driveways, concrete pavement shall be replaced in a manner compatible with the individual site. Landscaping material shall be replaced or replanted to the original places, in accordance with proper, acceptable procedures for the trade. Dirt areas shall be uniformly graded to the satisfaction of the Engineer.

1-10.07 NOISE CONTROL

The work shall be done as quietly as possible to prevent any annoyance to adjacent properties. The Contractor shall install noise suppression and shielding devices on all equipment until compliance with the requirements of all City's anti-noise ordinances is achieved.

In accordance with AMC 6.70, the Contractor is generally limited to construction efforts between the hours specified in these Special Provisions.

1-10.08 DUST AND SMOKE CONTROL

The Contractor will conduct operations and activities in a manner that will provide dust and smoke control as follows:

A. No fuel shall be used nor shall any operation be conducted that will emit into the atmosphere any smoke that is equal to Ringelmann No. 2 or darker.
B. No operation shall be conducted that emit into the atmosphere any flying dust or dirt that is noticeable or that might constitute a nuisance to persons living nearby or occupying buildings in the vicinity of the work.
C. Dust control operations shall be performed to prevent construction operations from producing dust in amounts harmful to, or causing a nuisance to, persons living nearby or occupying buildings in the vicinity of the work.
D. Dry materials and rubbish shall be wet down to prevent blowing dust.
E. Excavated material leaving the site, or material being imported, shall be covered or wet down to prevent excessive dust from being created.
F. Contractor shall conduct all work in accordance with South Coast Air Quality Management District (SCAQMD) Rule 403.

1-10.09 AIR POLLUTION CONTROL

Pursuant to Title 13 of the California Code of Regulations (CCR), Section 2449(d)(2)(A), Contractor shall ensure that all self-propelled diesel-fueled vehicles, 25 horsepower and up and not designed to be driven on public roads, limit idling to no more than five (5) minutes, except under the following conditions:

A. idling when queuing;

B. idling to verify the vehicle is in safe operating condition;
C. idling for testing, servicing, repairing, or diagnostic purposes;
D. idling necessary to accomplish work for which the vehicle was designed (such as operating a crane)
E. idling required to bring the machine system to operating temperature; and
F. idling necessary to ensure safe operation of the vehicle.

1-11 MEASUREMENT AND PAYMENT

The following shall be added to Section 1- General Provisions:

1-11.01 PAYMENT FOR PROPOSAL ITEMS

The unit price or lump sum price for each proposal item shall include all labor, materials, and equipment necessary to construct such items in an operative condition, complete in place, including all submittals, shop drawings, field performance/ efficiency tests, "As-Built" drawings, and operation and maintenance manuals.

The Contractor shall submit a detailed payment schedule on all lump sum items as specified in Part 1, General Provision, Subsection 9-2 of the. This schedule shall be submitted to the Engineer within 14 calendar days of receipt of the Notice of Award.

Payment for all incidental items of work not separately provided for in the proposal shall be included in the price bid for other related items of work and no additional payments will be made for these incidental items.

1-11.02 PROGRESS PAYMENTS FOR DELIVERED MATERIALS

The City will make a proportionate progress payment up to, but not to exceed, 50% of the value of all materials received on the construction site but not yet installed by the Contractor. In order to provide an allowance to make this proportionate progress payment, the City will require the Contractor to furnish certified invoices paid by the Contractor for all delivered materials. The Engineer will verify the quantities of materials received at the construction site. The Contractor will not be allowed to remove from the site any said materials and shall replace any said materials lost or damaged prior to installation or construction at its sole expense.

1-11.03 MOBILIZATION AND DEMOBILIZATION

Mobilization shall consist of construction mobilization and demobilization, temporary construction utilities, fences, job trailers, permits, construction surveys, photographs and testing, traffic control, bonds and insurance, site maintenance and clean up, removal and reinstallation of existing site facilities, and all other items not specifically covered under the other bid items. Payment for mobilization will be made after the completion of that work and will constitute 75% of the lump sum bid item. Payment for demobilization will be made after completion of that work and will constitute the remaining 25% of the lump sum bid item.

--- END OF SECTION 1 ---

SECTION 2 SUPPLEMENTAL MATERIALS

2-01 DUCTILE IRON PIPE

2-01.01 GENERAL

Add the following to subsection 2-01.01:
The cost of all pipe materials including pipes, fittings, fitting joint restraints, couplings, tie-bolts, steel rods, appurtenances and anchor blocks except valves, will be included in the applicable unit price for pipe stated in the Proposal.

2-05 MAIN LINE VALVES

2-05.01 GENERAL

Add the following to subsection 2-05.01:

The Contractor shall provide and install all valves in conformance with the manufacturer's recommendations and the Contract Documents. The valves shall be true to the alignment of the pipe they are to be installed in. Valves shall have mechanical ends or flanged ends, or a combination of both. Mechanical joints shall utilize a single rubber gasket conforming to AWWA Standard C111. Flanged joints shall utilize a 3.2 mm (1/8-inch) thick rubber (SBR or neoprene) ring or full face gasket. Ring type gaskets shall be used for 14-inch and larger sizes. The ferrous interior of all valves shall be protected with fusion bonded epoxy per AWWA C550.

All buried valves and fittings are to be back filled with clean sand. The sand shall be installed in such a manner that after compaction no earth or other backfill will be less than 6-inches (150 mm) from any part of the valve, fitting, flanges, bolts, or nuts. The sand shall be compacted as specified for other backfill.

2-08 MAIN LINE PIPE FITTINGS

2-08.02 END CONNECTIONS

2-08.02.2 FLANGED FITTINGS

Add the following to sub section 2-08.02.2:

SECTION 2 - SUPPLEMENTAL MATERIALS

All flanged fittings shall be rated for a working pressure of not less than 250 psi. All flanges shall be made of ductile iron, except where otherwise noted on the drawings.

SECTION 2 - SUPPLEMENTAL MATERIALS

2-13 SHOP DRAWING AND MATERIAL SUBMITTALS

2-13.01 SHOP DRAWINGS AND DATA DEFINED

Subsection 2-13.01 is hereby added to Section 2-13.

Working drawings include without limitation, shop detail drawings, fabrication drawings, falsework and formwork drawings, pipe layouts, and steel reinforcement. They shall contain all required details and information, at a reasonable scale.

The Contractor is required to submit to the Engineer all technical data and specifications of the various components, parts or items indicated on the shop drawings which shall include, without limitation, data on materials and equipment proposed to be utilized, including materials and equipment lists, catalog data sheets, cuts, performance curves, diagrams and similar descriptive lists. Materials and equipment lists shall give, for each item thereon, the name and location of the supplier or manufacturer, trade name, catalog reference, size, finish and all other pertinent data. **If more than one size, type, model, etc. are listed on a cut sheet, the specific item(s) shall be highlighted with a yellow felt tip marker or clearly identified.**

2-13.02 REVIEW AND REVISION

Subsection 2-13.02 is hereby added to Section 2-13.

The Contractor shall furnish to the Engineer for review a minimum of four (4) prints of each shop drawing. The Contractor shall properly check and correct all working drawings and data before their submission, whether they are prepared within its organization or by a subcontractor or supplier. The shop drawings shall be submitted at least ten (10) working days before such drawings will be required for commencing the work. Within ten (10) working days of receipt of said prints, the Engineer will return two prints of each drawing to the Contractor with its comments noted thereon.

If the drawing is returned to the Contractor marked "NO EXCEPTIONS TAKEN," a revision of said drawings will not be required.

If the drawing is returned to the Contractor marked "MAKE CORRECTIONS NOTED," formal revision of said drawing will not be required and the Contractor shall immediately submit two corrected copies to the Engineer.

If the drawing is returned to the Contractor marked "AMEND AND RESUBMIT," the Contractor shall revise said drawing and shall resubmit four copies of said revised drawing to the Engineer, as in the case of an original submittal, including the time frame above for review.

The fabrication and/or installation of any materials or equipment shall not be permitted before the Engineer has reviewed the pertinent shop drawings and returned copies of same to the Contractor without rejection.

Revisions indicated on shop drawings shall be considered as changes necessary to meet the requirements of the contract plans and specifications, and the Contractor shall have no claim for damages or extension of time due to any delay resulting from making required revisions to shop drawings. The review of said drawings by the Engineer shall apply to general design concept only and shall in no way relieve the Contractor of responsibility for errors or omissions contained therein, nor shall such review operate to waive or modify any provisions of requirements contained in contract drawings or these specifications.

2-13.03 CHARGES FOR MULTIPLE SHOP DRAWING REVIEWS

Subsection 2-13.03 is hereby added to Section 2-13.

The Contractor is responsible to properly review, correct, and ensure that all shop drawings and equipment data submitted are in compliance with and conform to contract plans and specifications. The Contractor will be charged for the costs of City engineering time expended to review shop drawings that are not approved within two reviews by City staff or its representative. A statement covering such charges will be submitted to the Contractor by the City after all shop drawings have been reviewed, and payment shall be due within 10 days after receipt of any such statement. The City will not impose any charges to the Contractor if the submitted shop drawings are approved within two reviews.

2-16 SUBSTITUTION OF MATERIALS

Section 2.16 is hereby added to Section 2.

2-16.01 GENERAL REQUIREMENTS

A. Where products or processes are specified by trade, patent or proprietary name, said specification, unless marked "no substitution", shall be deemed to be followed by the words "or equal as accepted in writing by

the City." In such case substitution of similar products as “approved equals” will be considered under this section.

B. Selection of Proprietary Product - Where more than one proprietary name is specified, the Vendor/Contractor may provide any one of the products specified. Only one manufacturer shall be used for each specific application throughout the work notwithstanding that similar materials or equipment of two or more manufacturers or producers may be specified for the same application.

C. Substitution Request Procedure - Submit a written request for proposed substitutions to the City in accordance with this section and in the forms outlined in APPENDIX C.

D. Vendor/Contractor's Responsibility for Construction Modifications - If a proposed substitute product is accepted by the City, the Vendor/Contractor shall assume both the responsibility for construction modifications and additional costs required by reason of this acceptance.

E. Systems of Like Manufacture - Where products are specified in groups to be furnished by one manufacturer, no substitution will be considered that is not similarly furnished by one manufacturer. Where the Vendor/Contractor proposes to use a system of equipment other than that shown in the Contract Documents and/or Standard Specifications the substitution shall be proposed as a complete system.

F. No time extension or project delays will be allowed for substitution of materials.

2-16.02 SUBMITTALS

A. Contractor shall furnish the following submittals:

SUBMITTAL	DESCRIPTION	
Substitution Request Form	Submit Substitution Request on form furnished below.	
Dimensional Data	Required for Product Substitutions	
Product Information	Submit technical product information as needed to substantiate Product Substitutions	
Material Samples	Required as needed to substantiate Product Substitutions	
Manufacturer’s Statement of Responsibility	Required at City’s discretion for Product Substitutions	
Foundry or Test Record Transcripts	Required as needed to substantiate Product Substitutions	
Material List and Ratings	Required as needed to substantiate Product Substitutions	
Warranty	Furnish warranty equal to or better than warranty required for specified product.	

B. Determination of Equality - The burden of proof of equality of the substituted item shall be on the Vendor/Contractor. Acceptance of such substitutions is entirely at the discretion of the City.

C. List of Approved Substitutions - The City will issue to the Vendor/Contractor a list setting forth those substitutions that have been approved. No products proposed for substitution shall be ordered before they are approved in writing by the City.

D. Products to be considered as "approved equals" shall, in City's opinion, meet the following minimum requirements:

1. Products shall be of equal quality, substance, function and color to those listed.
2. Products shall be standard products of a reputable manufacturer having regularly been engaged for 5 years in manufacture of products furnished.
3. Products shall have a reputation for assuring long-lasting trouble-free service.
4. Factory-authorized, factory-trained and competent service personnel and stocked service parts shall be readily available.
5. The manufacturer shall be capable of certifying compliance with listed reference standards.

E. The City reserves the right to reject product substitutions solely on the basis of maintenance economies of scale available to the City through standardizing on manufacturers and minimizing spare parts inventories.

F. Denial of Substitution - If, in the opinion of the City the proposed substitution is not equal to or better in every respect to that of the specified product, or was not submitted for acceptance in the manner outlined above, the Vendor/Contractor shall furnish the specified products.

G. Responsibility for Coordinating Substitutions with Construction Trades – Vendor/Contractor shall inform all other trades, vendors, and subcontractors of the effects of substitutions on their work or products. Failure to notify shall not relieve Vendor/Contractor of its duty to make payments arising from alterations in specified products or methods needed to complete the work in an approved and acceptable manner.

2-16.03 RESPONSIBILITY FOR SPARE PART INVENTORIES

A. Spare parts inventory for two years' typical maintenance may be required for products not presently in use in the City's facilities.

2-17 CHEMICAL USE, INCLUDING COATINGS, SOLVENTS, AND ADHESIVES

Add the following section 2-17:

SECTION 2 - SUPPLEMENTAL MATERIALS

Any paints, coatings, solvents, and other chemical compounds used shall comply with California Air Resources Board (CARB) and SCAQMD rules, including, but not limited to:

A. SCAQMD Rule 1113 (Architectural Coatings)
B. SCAQMD Rule 1143 (Consumer Paint Thinners & Multi-Purpose Solvents)
C. SCAQMD Rule 1168 (Adhesive and Sealant Applications)
D. SCAQMD Rule 1171 (Solvent Cleaning Operations)

Chemical use must be submitted to and approved by the Engineer prior to beginning work. Safety Data Sheets for each chemical must be readily available on site at all times a chemical is being used or stored on site. Unless requested by the City, any unused chemicals must be removed from the site upon completion of the work.

--- END OF SECTION ---

SECTION 3 SUPPLEMENTAL CONSTRUCTION METHODS AND CONTROLS

3-01 INSPECTION

Add the following to section 3-01:

Should the Contractor elect at any time, or from time to time, to conduct its operation on any regular shift more than eight (8) hours, on a Saturday, Sunday, or on a holiday, and if in the opinion of the Engineer it is necessary for the inspector or inspectors, as a consequence of such operations, to be present, the Contractor shall pay premium or overtime pay.

Premium or overtime pay shall be that portion which is in addition to their regular pay on a straight time hourly basis. The Contractor will be notified in writing of all overtime inspection costs incurred by the City. Payment for overtime inspection costs will be withheld from the progress payments to the Contractor.

3-02 PRE-CONSTRUCTION DETAILS

3-02.01 PERMITS AND LICENSES

Add the following to subsection 3-02.01:

The Contractor shall obtain the necessary applicable permits as required by other agencies for construction within their respective jurisdictional areas. The permits must be kept at the job site at all times. All provisions of these permits will apply as though stated in the WSSS and will have authority over any conditions herein. Any costs incurred due to compliance with these permits, license, etc., shall be included in the contract cost. No additional payment will be made.

3-02.01.1 NPDES PERMIT

Subsection 3-02.01.1 is hereby added to subsection 3-02.01.

City is a co-permittee operating under the permit conditions established by the National Pollution Discharge Elimination System (NPDES) Permit from California Regional Water Quality Control Board – Santa Ana Region pertaining to water discharges to the municipal separate storm sewer system resulting from various municipal activities. For reference, the current permit order number is R8-2009-0030, NPDES No. CAS618030. Water drained or flushed from pipelines and other water system features, including test water shall be accomplished per Section 3-10.05.

3-02.01.2 CITY REQUIREMENTS

Subsection 3-02.01.2 is hereby added to subsection 3-02.01.

The following is a brief summary of the main requirements for the work within the City of Anaheim. These requirements shall govern over the City's general permit requirements unless the City's requirements are more stringent than these.

1. Contractor shall submit traffic control plans to the Field Engineering Division for approval fourteen days prior to beginning of construction. See Traffic Control Section 3-02.02.
2. The Contractor shall make all requests in writing for connection to and/or shut down of existing water facilities, a minimum of four (4) working days before the shutdown is required. Contractor shall comply with Section 3-04.04 for particular requirements associated with shutdowns.
3. Contractor shall provide the following customer notifications:
    - One (1) week before work starts, Contractor shall post Project Signs per section 3-02.05.
    - One (1) week prior to moving into the area, Contractor shall distribute to all residents within the affected area a notice of construction. The City will draft the notice; however it is the Contractor's responsibility to copy and distribute it.
    - All notices of service interruption shall be delivered to the affected customers a minimum of 72 hours prior to any shutdown. The City will draft any service interruption notices, but it is the Contractor's responsibility to copy and distribute to the affected customers.
    - Contractor shall provide at least a two (2) day advanced notice to coordinate trash pick-up and street sweeping within the area of its work operation.

    All notifications shall be reviewed by the Engineer prior to distribution or fabrication as in the case of the project sign.
4. Contractor will be required to obtain a permit from the City Department of Public Works (standard City Right of Way Construction Permit). Permits may also be required from the Building, Electric, and other City Divisions.

SECTION 3 SUPPLEMENTAL CONSTRUCTION METHODS AND CONTROLS

3-02.01.3 STATE LICENSE REQUIREMENTS

Subsection 3-02.01.3 is hereby added to subsection 3-02.01.

All Contractors submitting bids for this project shall have a Class "C-34" or Engineering "A" Contractor's License valid in the State of California. Contractors who install, destroy, or modify water wells shall have a Class "C-57" Contractor's license. All Contractors shall maintain these licenses throughout the duration of the Master Agreement.

No bid shall be considered from a Contractor who, at the time the bid is submitted, is not licensed to contract for this project in accordance with the law under provisions of Division III, Chapter 9, of the Business & Professions Code of the State of California. In the event of a dispute as to the classification of license required, the opinion of the Contractor's State License Board shall prevail.

The Contractor shall submit with the bid proposal the Contractor's license number and expiration date, and a statement indicating the representations made are made under penalty of perjury. Any bid not containing this information or information which is subsequently proven false shall be considered non-responsive and rejected by City.

3-02.02 TRAFFIC CONTROL

3-02.02.1 PROTECTION OF CONSTRUCTION SITE

Subsection 3-02.02.1 is hereby added to subsection 3-02.02.

The Contractor shall conduct its work in such a manner as to minimize the disruption of traffic flow. Contractor shall submit to and have approved by the City's Field Engineer a Traffic Control Plan, prepared and stamped by a registered traffic engineer, fourteen (14) days prior to the start of construction.

All traffic control methods shall conform to the "California Manual on Uniform Traffic Control Devices." Flag persons shall be stationed at each end of the construction location where it is necessary to temporarily stop or detour traffic for the movement of materials and equipment; such flag persons shall be equipped with radio or cell phone to maintain communication with one another. During the construction activity hours, flagmen and workers shall wear high-visibility garments prescribed in Title 8 CCR, Section 1598. Traffic stoppages shall be limited to time periods approved by the City Engineer.

Construction in major public streets shall only be performed between the hours as outlined per General Provisions Section 1-05.04 of the WSSS. At all times during these hours, left turn lanes and at least one lane of traffic open each way must be maintained by the Contractor.

Within a minimum period of seven (7) working days prior to any construction at any major street intersection, the Contractor shall post advance notification signs. The signs shall be visible to all motorists entering the intersection from all four directions informing them of the proposed construction to be performed at the location of the intersection.

Pedestrian traffic must be maintained in a safe manner during the construction period. Pedestrian and emergency vehicular access shall be maintained to all residences, businesses, and manufacturing establishments within the construction area.

3-02.02.2 TEMPORARY NO PARKING

Subsection 3-02.02.2 is hereby added to subsection 3-02.02

The Contractor shall post "Temporary No Parking" signs where required only after notifying and receiving approval from the Engineer. Type of sign and method and location of posting shall also be subject to the Engineer's approval. The Contractor shall notify all affected residences and business establishments at least forty-eight (48) hours prior to the posting of signs.

3-02.02.3 OPENING WORK AREAS TO VEHICLE TRAFFIC

Subsection 3-02.02.3 is hereby added to subsection 3-02.02

The Contractor shall backfill the trench with suitable material to support temporary traffic loading immediately following the abandonment of pipe or valves to maintain access to all driveways and traffic lanes affected by the trenching operation. Adequate signing, barricading and delineation shall be utilized unless the roadway is completely opened to traffic by backfilling the trench and restoring pavement. Trench backfill and hot mix temporary AC pavement over trench shall be made within two (2) days of trench excavation and shall be installed / maintained flush with existing street surface. Repairs to temporary AC pavement shall be performed as determined by the Inspector.

3-02.02.4 RESTORATION OF PAVEMENT MARKINGS, TRAFFIC LOOPS, AND ROADWAY SIGNS

Subsection 3-02.02.4 is hereby added to subsection 3-02.02

Upon completion of the excavation, trenching, backfilling, compaction, and final repaving operation the Contractor shall restore all pavements, striping, traffic loops, pavement legends, raised pavement markers and roadway signs within the limits of the work to their original conditions within five (5) working days. In order to return the roadway to a uniform condition in appearance, this condition means all stripes, raised pavement markers and legends will be repainted, including pavement cleaning as necessary. This condition refers to all lane lines within the limits of work area, not solely those lane lines or legends actually disturbed by trenching or detouring operations. All materials and workmanship shall comply with City's standards and shall be approved by the Engineer.

3-02.03 SURVEYING

Add the following to subsection 3-02.03:

The City of Anaheim Survey Section is responsible for providing construction surveys to establish "control stakes," also known as "grade stakes" for line and grade as shown on the approved Plans, for project construction. From these "control stakes" the Contractor provides and sets, when needed supplemental "working stakes." The City's basic policy regarding City of Anaheim Survey Section-furnished construction survey is to provide the necessary control stakes and information to establish the lines and grades as shown on the approved Plans required for the completion of the work.

The Contractor shall submit a survey request to the Water Capital Improvement Project Manager a minimum of 48 hours in advance of any required staking. The Contractor shall provide a clear, safe area as required by the City Surveyor including any required traffic control required to provide sufficient access for all requested offsets. The City's Surveyor, or designated representative, will be solely responsible for determining the limits required for any traffic control implementation. The Contractor's failure to provide a sufficiently safe work zone will result in the City Surveyor canceling the survey request. If a survey request is canceled due to an unsafe work zone, the Contractor shall be required to submit a new survey request and abide by the minimum 48 hour notice for any required staking. The Contractor shall submit suitable requests for City-furnished "control stakes," ensuring that the requested staking area is ready for stakes and that the stakes will begin

to be used within 5 days of staking. The Contractor shall preserve construction survey stakes and marks for the duration of their usefulness. If any construction survey stakes are lost or disturbed and need to be replaced, such replacement shall be at the expense of the Contractor. Working stakes used by the Contractor in actually performing the work are the Contractor's responsibility and are to be set by the Contractor's forces from City-furnished "control stakes."

Construction survey stakes must be set under the responsible charge of a person who is authorized to practice land surveying in the State of California, as defined in Section 8726 of the Professional Land Surveyors Act.

All water improvements shall be staked (Lath or Pin) per plan at a maximum of 50' intervals, at all proposed fittings, all proposed service stations, all changes in alignment and elevation (Grade Breaks), angle points (AP), beginning curve (BC) and end curve (EC), beginning casing, end casing, etc. with the pins/hubs at an offset of the contactors choosing (normally between 6' – 10'). At the Water Utility Inspectors discretion, "staking" at 25' intervals may be required depending on circumstances.

3-02.04 STORAGE AREA

Subsection 3-02.04 is hereby added to section 3-02:

The Contractor shall secure a storage area to protect its property from vandalism and loss and to protect the public from possible injury.

The Contractor is responsible for any fines, damages, and restoration costs associated with the storage area. The Contractor shall demobilize, leaving this storage area in a neat and clean condition prior to filing the Notice of Completion.

3-02.05 PROJECT SIGNS

Subsection 3-02.05 is hereby added to section 3-02:

Prior to sign fabrication, the Contractor shall provide, for review and approval by the City, a scaled project sign mock up submittal per WSSS Standard W-050 and project specific verbiage provided by City.

The Contractor shall, two weeks before work starts, post four (4) project signs within the limits of each construction site, indicating that the work is being done for the City of Anaheim. The Contractor shall coordinate the location of the signs with the project Water Inspector and the City's Public Works Department. Upon completion of the project and no later than one week after completion, the Contractor shall remove the project signs, and restore the site to its original condition and to the satisfaction of the City. All cost for the fabrication, installation, anchoring and

removal of the signs shall be included in the bid price and without any additional compensation from the City.

SECTION 3 SUPPLEMENTAL CONSTRUCTION METHODS AND CONTROLS

3-03 REMOVALS AND TRENCH EXCAVATION

3-03.02 REMOVAL OF UTILITIES

3-03.02.1 REMOVAL OF OBSTRUCTIONS

Subsection 3-03.02.1 is hereby added to subsection 3-03.02

The Contractor shall remove and dispose of all debris or other obstructions to the construction of the work. In the case that the obstruction consists of an improvement not required by law to be removed by the City, the improvement shall be removed, maintained, and replaced by the Contractor at its expense.

Permanent improvements shall be protected in place and shall be provided with adequate access. Contractor shall, at its own expense, repair, replace or restore to the satisfaction of the Engineer, all property of any type or nature which has been moved, damaged or altered in any way by its operations, and shall return all landscape, roadway and adjoining surfaces to their original conditions and appearance.

3-03.02.2 REMOVAL OF HAZARDOUS MATERIAL

Subsection 3-03.02.2 is hereby added to subsection 3-03.02

Asbestos Cement Pipe

1. During the performance of any asbestos abatement work, it is the responsibility of the Contractor to ensure that the work is in full conformance with the requirements of all applicable Federal, State, and Local regulations, standards, and codes governing asbestos abatement including but not limited to: The SCAQMD Rule 1403-Asbestos Emissions from Demolition/Renovation Activities; Cal-OSHA Standards 1529 and 5208; and Contractor registration requirements outlined in Cal-OSHA Standard 341.6. The Contractor shall obtain a California contractor's license Certification, Cal-OSHA Registration, and any necessary permits required for asbestos removal.
2. The Contractor shall notify Cal-OSHA of any asbestos abatement action exceeding 100 square feet of surface area of asbestos-containing material.
3. The Contractor shall be responsible for all aspects of compliance with SCAQMD Rule 1403 including, but not limited to, conducting asbestos facility surveys, submitting notifications to SCAQMD, and preparing

Procedure 5 Approved Alternative Plans (if required by SCAQMD).

4. All asbestos waste is to be properly transported to and disposed of at Azusa Land Reclamation in Azusa, California. Alternative facilities must be approved by Environmental Services. The City must sign all hazardous waste manifests.
5. The Contractor shall submit written plans for asbestos abatement to the City for review and comments prior to commencing asbestos work.

Lead Paint Removal

Contractor shall adhere to the Cal/OSHA Lead in Construction Standard (Title 8 CCR Section 1532.1) in all construction activities where lead is disturbed and a potential for employee exposure exists.

3-03.03 TRENCH EXCAVATION

3-03.03.1 WATER IN TRENCH

Subsection 3-03.03.1 is hereby added to subsection 3-03.03

Water, if encountered, shall be removed from excavations as soon as it accumulates. The Contractor shall have on-site sufficient pumping capacity to keep the trench dewatered. The Contractor shall provide and maintain adequate operating pumping capacity plus additional standby pumping capabilities to cope with emergencies. The Contractor shall demonstrate to the construction observer that it has sufficient pumping capacity on-site prior to starting construction. The City cannot guarantee a complete shutdown of the main because of the age and condition of the existing valves.

Contractor agrees that delays to system shutdown and isolation are not reimbursable. The City will make a concerted effort to isolate the system as planned with the Contractor, but the Contractor shall be prepared to employ pumping equipment if a water tight shutdown cannot be achieved. Water discharged to the street, storm drain system, or other water way must not contain any pollutants (including sediment) in excess of the water quality criteria established by the City's NPDES permit conditions, and outlined in Section 3-10.05.

SECTION 3 SUPPLEMENTAL CONSTRUCTION METHODS AND CONTROLS

3-04 CONNECTION TO EXISTING FACILITIES

3-04.04 PROPOSED WATER SERVICE INTERRUPTIONS AND SHUTDOWNS

Subsection 3-04.04 is hereby added to Section 3-04.

Prior to temporarily shutting down any water main and the abandonment of pipe or valves, the Contractor is responsible for the following:

- The Contractor shall perform at each work location all excavations, verifications of the size, type and features of existing water main facilities, to be assured that all new caps, connections and appurtenances to be installed will be compatible with the existing water facilities, so that the connection and/or shutdown will be held to a minimum duration.

- All water mains, fire lines and water services shall be maintained in active uninterrupted service during the course of Work Order Package or Request.

- The Contractor shall adhere to the approved Construction Schedule for notifying all affected parties of any unforeseen schedule alterations that may occur.

- In case of a necessary shutdown of any portion of the existing utility system for the purposes of abandonment of pipe and valves, the Contractor shall request through the Engineer a schedule for such shutdown of portions of the City's water system, which will be developed and approved by the City.

- The Contractor shall make all requests in writing for connection to and/or shut down of existing water facilities, a minimum of four (4) working days before the shutdown is required. After receiving the advance request from the Contractor, and approving the temporary shutdown of the affected water facilities, the City's Field Division personnel will operate all valves necessary to isolate each pipeline to be joined or relocated from the rest of the water system.

Contractor recognizes that the unauthorized operation of City's water system is likely to cause City and/or third parties damage or injury. Contractor is not allowed to operate any portions of the City's current operating water system without prior written approval of City's authorized representative(s). In the event the Contractor operates any portion of the City water system, including but not limited to valves and controls, without written permission previously scheduled and approved by the City, Contractor agrees to pay City a sum equal to the amount of damages sustained by City resulting from the unauthorized operation.

SECTION 3 SUPPLEMENTAL CONSTRUCTION METHODS AND CONTROLS

3-05 LAYING OF DUCTILE IRON PIPE WATER MAIN

3-05.02 THRUST RESTRAINT

Add the following to subsection 3-05.02:

Where anchor blocks are called for on the Construction Drawings, the Contractor may either use an anchor block or a reverse tie anchor block depending on the site conditions. The City's field representative will determine the acceptability of either of these alternatives on a case-by-case basis.

Restrained joints, anchor blocks, or other thrust restraining devices shall be installed at every horizontal and vertical bend that is equal to or greater than 5 degrees. The City's field inspector will verify that the thrust restraint device proposed by the Contractor will be acceptable for the site conditions.

3-05.07 EXISTING PIPE AND VALVES

Subsection 3-05.07 is hereby added to Section 3-05.

The connecting joints between existing pipe and between existing pipe and existing valves are not known. The Contractor shall exercise due caution during tie-ins with and the abandonment of existing pipe and valves, including any temporary bracing until permanent restraints are serviceable.

Permanent restraints shall follow the details shown on the plans and as called for by the water inspector after a field determination can be made. The City's water inspector will verify that the thrust restraint device proposed by the Contractor will be acceptable for the site conditions.

SECTION 3 SUPPLEMENTAL CONSTRUCTION METHODS AND CONTROLS

3-08 PIPE BEDDING AND BACKFILLING OF TRENCH

Add the following to Section 3-08:

All select material utilized as bedding and backfill to a minimum of 12 inches (0.30 m) over the pipe shall have a minimum sand equivalent (SE) of 30 or shall be sand conforming to Sections 200-1.5.1 and 200-1.5.5 of the Standard Specifications . Backfill, bedding and compaction for all excavation shall conform to Section 306 of the Standard Specifications or as modified by Construction Plans. Relative compaction shall be as specified in Section 301-1.3 of the Standard Specifications as modified by WSSS or Construction Plans.

Excess trench excavation and debris from the work shall become the property of the Contractor and shall immediately be removed from the job site in a manner and at a location acceptable to all pertinent agencies. The Contractor shall be responsible for removing and disposing of all excess materials at its expense resulting from the installation of the water facilities included in a Work Order Package and Request. Excess materials include valve boxes, pipe and appurtenances found in the pipe trench. The cost of disposal shall be included in the cost of the various items of work and no additional compensation will be approved.

3-09 REPAVING AND FINISHING

3-09.01 REPAVEMENT

Subsection 3-09.01 is hereby added to Section 3-09.

The Contractor shall furnish and install temporary pavement and permanent pavement replacement, where required, and per the following:

1. Temporary AC pavement over trench shall be completed within five (5) days of the trench excavation. All temporary pavement repairs shall be performed with hot mix asphaltic concrete, (AC) and shall be 4 inch minimum thickness.
2. Both temporary and permanent pavement surface through the trench shall be rolled smooth and flush with existing pavement and shall be maintained in this condition.
3. Permanent AC pavement replacement shall be in accordance with City Trench Replacement standard 132-A.
4. Permanent pavement replacement shall be completed within seven calendar days of damage or removals and / or excavation.
5. Full depth base paving per standard 132-A shall be performed on all trenches within major multiple lane roadways within the same day of trench opening unless otherwise approved by the Engineer. Grinding and capping per standard 132-A, including replacement of impacted stripping and traffic loops, shall be completed within two (2) weeks following successful pipeline pressure testing and shall not be allowed to exceed 30 days from the date of the start of trench work.

SECTION 3 SUPPLEMENTAL CONSTRUCTION METHODS AND CONTROLS

3-10 TESTING, DISINFECTION, AND FLUSHING

3-10.05 WATER SYSTEM DISCHARGES.

Subsection 3-10.05 is hereby added to section 3-10.

All water drained or flushed from pipelines, or used to disinfect or test portions of a pipeline or water system component, shall be disposed of by the Contractor at its sole expense. All water discharged to the City of Anaheim storm drain system shall be carried out in compliance with the water quality objectives and discharge permit restrictions established by the California Regional Water Quality Control Board - Santa Ana Region, 3737 Main Street, Suite 500, Riverside, California 92501, (909) 782-4130.

For contracts administered by the City of Anaheim Public Utilities Department, the Contractor will be authorized to discharge water to the storm drain under the City's Municipal Separate Storm Sewer National Pollution Discharge Elimination System (NPDES) Permit, also known as the MS4 Permit, if the water meets the prescribed discharge criteria. For all work not administered by the City, the Contractor shall be responsible for obtaining a discharge permit directly from the California Regional Water Quality Control Board - Santa Ana Region. All permit conditions and discharge limitations must be met. Water system discharges are authorized by the City's MS4 permit when they also comply with R8-2015-0004, NPDES No. CAG998001 pertaining to water discharges that pose an insignificant (de-minimis) threat to water quality. In addition to other requirements, this specifies that wastewater shall not contain constituent concentrations in excess of the following limits:

Constituent	Maximum Concentration
Oil & Grease	, No visible sign
Sulfides	0.4 mg/L
Total Residual Chlorine	0.1 mg/L
Total Suspended Solids	75 mg/L
Total Petroleum Hydrocarbons	100 µg/L
pH	Within 6.5 to 8.5

Disposal of test water or other chlorinated water will require the Contractor to apply a reducing agent (i.e. sodium thiosulfate, or ascorbic acid, etc.) to neutralize residual chlorine or chloramines to meet the residual chlorine discharge limit (< 0.1 mg/l).

The Contractor must conduct all discharges in accordance with the latest edition of the American Water Works Association California-Nevada Section Best Management Practice (BMP) Manual for Drinking Water System Releases. In addition, the Contractor shall ensure that all applicable NPDES permit conditions are met. The Contractor is responsible for all costs, equipment, maintenance, etc. associated with

permit compliance. The Contractor shall coordinate any and all construction, maintenance, and discharge activities with the Department's Water Engineering and Environmental Services personnel. To assure compliance, the Contractor is also required to meet the following:

1. At least 5 days prior to discharging water to the storm drain system, the Contractor shall complete and submit a Work Plan for Discharges to the Storm Drain System (see Appendix D) to Environmental Services identifying the type and location of the expected discharge, date(s), anticipated volume, treatment technology, and sampling methodology. If there are changes required to the work plan, the Contractor must notify Environmental Services prior to the discharge. The plan shall be submitted in writing to environmental@anaheim.net.

2. During the discharge, water sampling and testing must be completed to assure that permit conditions are met. The Contractor is responsible for sample collection, laboratory analyses and ensuring that the water effluent limits are met.

3. Following each discharge, the Contractor shall complete the Department's Monitoring Report for Water Discharges (see Appendix D). The completed form shall be submitted to the Department's project inspector with the attached laboratory analyses. The Contractor is to submit all laboratory analyses to the project inspector *within one business day* of receipt of the laboratory data.

4. If a discharge occurs that is not in compliance with the permit conditions or the Master Agreement, the Contractor shall *immediately* notify the Engineer and Environmental Services, and shall submit a plan to bring the discharge into full compliance with a timetable for correction.

Water samples for total chlorine are to be collected at the beginning of the discharge. Samples collected for total suspended solids (TSS) analyses are to be collected within the first 30 minutes of *each* discharge. For continuous discharges, weekly samples are to be collected thereafter. Total residual chlorine testing may be conducted at the site by qualified personnel using a US EPA accepted DPD colorimetric chlorine test kit. All effluent TSS analyses shall be conducted by a state certified laboratory.

Note that water discharges directly from the City's potable water system will not require laboratory testing for TSS. TSS analysis is only required for new well construction, or well development, or other

activities that may result in elevated concentrations of TSS. TSS analysis is not required for routine line flushing of potable water mains or wells. Since the laboratory test method for TSS cannot provide instantaneous results, the use of a field TSS colorimeter is required at the time of discharging water to the storm drain system. Where elevated TSS is observed, equipment to remove TSS may be needed to achieve TSS discharge limits.

If dechlorinating chemicals are placed inside a well or water system component, the Contractor must contact this Department's Water Quality staff who will conduct tests to confirm the absence of dechlorinating chemical residuals in the system prior to sampling for bacteriological analysis and placing the system component in service.

Testing for total residual chlorine and TSS is not required for discharges to dry streambeds or trenches where the discharge completely percolates before reaching any flowing streams. If the Contractor intends to discharge to dry streambeds, this must be indicated in the work plan submitted to Environmental Services.

Additionally, the flow of water from the work location shall be controlled to prevent erosion of surrounding soil, damage to vegetation, and/or altering of ecological conditions in the area. Under no circumstances shall the flow contribute to silt, mud, debris, or other contaminants entering the storm drains or other waterway.

SECTION 3 SUPPLEMENTAL CONSTRUCTION METHODS AND CONTROLS

3-13 AS-BUILT DRAWINGS

Add the following to Section 3-13:

Contractor shall clearly record, in red pencil, all differences between the location or arrangements indicated on the original Contract Drawings and those of the actual installation, as well as references to equipment manufacturers' drawings numbers. All conceptual or major design changes shall be approved by the City before implementing the change in the construction contract. Failure to receive prior approval may result in termination of service.

At the end of the project and prior to final payment, the Contractor shall sign and date each sheet of the "As-Built" Contract Drawings as being a correct and accurate record of the installation and submit a complete package to the City to be transferred to the record drawings. Facilities and items to be located and verified on the record drawings shall include the following:

A. Location of bends, angle points, valves, solid sleeves and tees.

B. Other related facilities, as specified by the City.

E. Valve Location/ Information per Valve As-Built Table located on the plans or last page of Appendix herein.

Changes and dimensions shall be recorded by the Contractor in a neat, legible manner. Record construction drawings shall be maintained at the jobsite during construction.

SECTION 3 SUPPLEMENTAL CONSTRUCTION METHODS AND CONTROLS

3-14 WATER POLLUTION PREVENTION AND BEST MANAGEMENT PRACTICES (BMP's)

The following shall be added to Section 3 – Construction methods and Controls:

Description – Storm water and non-storm water discharges resulting from municipal construction activities (less than 1 acre) are currently governed by the Santa Ana Regional Water Quality Board NPDES Permit No. CAS618030. The permit applies to activities within the County of Orange and is available from the City of Anaheim, Department of Public Works. Also available from the Department of Public Works is the Local Implementation Plan which provides specific guidance and sets requirements regarding proper pollution control practices and includes a list of Best Management Practices which must be implemented where applicable. This list can be found on line at http://www.cabmphandbooks.com and the Local Implementation Plan is available at the Public Works Records Office, located on the second floor City Hall, 200 North Anaheim Boulevard, Anaheim, CA 92805.

The Contractor shall develop, implement and maintain an Erosion and Sediment Control Plan for all ground-disturbing projects less than one (1) acre. The plan shall prevent all non-stormwater pollutants from entering any water body (including the City's storm drain system), and shall be approved by the Field Engineer.

The Contractor shall develop, implement, and maintain a Stormwater Pollution Prevention Plan (SWPPP) for all ground-disturbing projects greater or equal to one (1) acre. The SWPPP shall be prepared by a Qualified SWPPP Developer (QSD). The SWPPP shall be reviewed and approved by Environmental Services prior to beginning work. After approval, the Contractor shall submit the SWPPP electronically to the State Water Resources Control Board SMARTS Portal. The Contractor shall be responsible for complying with all portions of the adopted Construction General Permit (currently Order 2009-009-DWQ), This shall include setting and maintaining appropriate best management practices (BMPs), conducting required inspections, monitoring weather, maintaining records, sampling runoff, and preparing reports.

If projects will take place on Caltrans property, the Contractor shall develop, implement, and maintain a Water Pollution Control Program (WPCP) conforming to the requirements of Caltrans Specifications Section 7-1-.01G, "Water Pollution Control," as approved by the Field Engineer. Copies of the Construction Contractor's Guide and Specifications of the Caltrans Storm Water Quality Handbook may be obtained from the Department of Transportation, Material Operations Branch, Publication Distribution Unit, 1900 Royal Oaks Drive, Sacramento, California 95815, Telephone Number (916) 445-3520. Electronic copies can be found at http://www.dot.ca.gov/hq/construc/stormwater.html.

The Contractor shall implement and maintain the appropriate BMPs to prevent storm water pollution within the project site at all times during the contract period.

A Municipal Activities Procedures Manual has been developed by the County of Orange to assist with permit implementation. Specifically, the Municipal Activities

Procedures Manual contains Model Maintenance Procedures with BMPs that the Contractor shall adhere to.

The City reserves the right to inspect the construction site at any time to evaluate compliance with this section. Payment to provide and maintain stormwater plans and BMPs shall be considered included in the contract unit price paid for other items of work and shall be considered incidental to accomplishing the work and no additional compensation will be allowed therefore.

Failure of the Contractor to comply with the Engineer's requested corrective actions may result in an order to suspend work until the condition is corrected. No additional compensation will be allowed as a result of such suspension.

APPENDIX A

OPERATION & MAINTENANCE MANUAL REQUIREMENTS

OPERATION & MAINTENANCE MANUAL REQUIREMENTS

Operation & Maintenance Manuals, when required, shall be submitted in the following format and organization:

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Project Record Documents.

B. Operation and Maintenance Data.

C. Preventive Maintenance and Operating Requirements.

D. Warranties and bonds.

1.2 RELATED REQUIREMENTS

A. Volume I of the Technical Specifications, General Conditions: Performance bond and labor and material payment bonds, warranty, and correction of work.

B. Section 01300 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.

C. Section 01750 – Starting and Adjusting

D. Section 01787 – Product Warranties

E. Section 01820 – Demonstration and Training

1.3 SUBMITTALS

A. Submittals shall include:

a. List of equipment furnished for project with name, address, and telephone number of each vendor.

b. List of serial numbers of equipment furnished.

c. A copy of shop drawings for mechanical, electrical, and instrument equipment in final form.

d. Manufacturer's operation and maintenance instructions and parts lists.

e. Tabulation of motor nameplate horsepower, nameplate current, field-measured current, overload relay setting, and catalog number for polyphase motors.

f. List of fuses, lamps, seals, and other expendable equipment and devices. Specify size, type, and ordering description. List name, address, e-mail address, fax number, and telephone number of vendor.

B. Provide manuals for each piece of equipment including individual components and subsystems of complete assemblies. Line out non-applicable text and illustrations. The section of the manual on operation shall describe the functions and limitations of each component and its relationship to the system of which it is a part. Where several models, options, or styles are described, the manual shall identify the items actually provided.

C. Each manual shall contain the following:

a. Manufacturer's identification, including order number, model, and serial number.

b. Blue line prints or reviewed shop drawings and diagrams of all systems.

c. Certified equipment drawings or reviewed shop drawing data clearly marked for equipment furnished.

d. Complete operating and maintenance instructions for each and every item of equipment, setting forth in detail and step-by-step the procedure for starting, stopping, operating, and maintaining the entire system as installed. Include a schedule of recommended maintenance intervals.

e. Complete parts list of replaceable parts, their part numbers, and the name and address of their nearest vendor.

f. Any special emergency operating instruction and a list of service organizations (including addresses and telephone numbers) capable of rendering emergency service to the various parts of the system.

g. Copy of manufacturer's equipment guarantees and warranties.

D. Brochures shall be loose leaf with durable plastic or fiberboard covers. Each sheet shall be reinforced to prevent tearing from continued use, and each brochure shall have the following information clearly printed on its cover:

a. Project name, name of Owner, and address.

b. Name and address of Owner's Representative.

c. Name and addresses of Contractors and subcontractors and department to contact.

d. Telephone number of Contractors, including night and emergency numbers.

e. Major equipment vendors' names and telephone numbers.

E. Submit complete manuals at least four weeks before the date of the instructions required by the subsections on "Manufacturer's Services" in the various specification sections.

F. Operation and maintenance manuals specified herein are in addition to any operation, maintenance, or installation instructions required by the Contractor to install, test, and start up equipment.

1.4 EQUIPMENT DATA SHEETS

Provide three sets of equipment data sheets, bound in three-ring binders, and one electronic copy in Word format summarizing the equipment manufacturer's maintenance instructions and recommendations. See the blank data sheet and example data sheets below.

Preventive Maintenance and Operating Requirement Sheets

Preventive Maintenance Program	Equipment Record Number	
EQUIPMENT DESCRIPTION	ELECTRICAL OR MECHANICAL DATA	
Name:	Size:	
Serial No.:	Model:	
Vendor:		
Vendor Address:	Type:	
	Mfr.:	
Vendor Rep:	Voltage:	Amps:
Phone:	Phase:	rpm:
Maintenance Work to be Done		Frequency*
OPERATING REQUIREMENTS AND REFERENCE		

*D - Daily; W - Weekly; B - Biweekly; M - Monthly; Q - Quarterly;
S - Semiannually; A - Annually.

Preventive Maintenance and Operating Requirement Sheets

Preventive Maintenance Program	Equipment Record Number	
EQUIPMENT DESCRIPTION	ELECTRICAL OR MECHANICAL DATA	
Name: Influent Pump No. 1 Tag No.: P01-1	Size: 15 hp	
Serial No.: 123456ABC Vendor: ABC Pump Co.	Model: 140T Frame Serial No. 987654ZY Class F Insulation W/Space Heater	
Vendor Address: 1111 Pump Circle Newport Beach, CA 92663	Type: Mfr.: DEF Motors, Inc.	
Vendor Rep: XYZ Equipment, Inc.	Voltage: 460	Amps: 20
Phone: (714) 752-0505	Phase: 3	rpm: 1,800
Maintenance Work to be Done		Frequency*
1. Operate all valves and check such things as a) bearing temperature, b) changs in running sound, c) suction and discharge gauge readings, d) pump discharge rate, and e) general condition of the drive equipment. 2. Check packing. 3. Checking pumping unit for any dust, dirt, or debris. (Continued on attached sheet)		D D W
OPERATING REQUIREMENTS AND REFERENCE		
For manufacturer's instructions regarding installation, operation, maintenance, and trouble shooting of this equipment, see Volume ____, Section _____.		

*D - Daily; W - Weekly; B - Biweekly; M - Monthly; Q - Quarterly;
S - Semiannually; A - Annually.

Preventive Maintenance Program	Equipment Record Number	
EQUIPMENT DESCRIPTION	ELECTRICAL OR MECHANICAL DATA	
Name:	Size:	
Serial No.:	Model:	
Vendor:		
Vendor Address:	Type:	
	Mfr.:	
Vendor Rep:	Voltage:	Amps:
Phone:	Phase:	rpm:
Maintenance Work to be Done		Frequency*
4. Lubricate bearing frame and motor bearings (consult manufacturer's instructions for type of grease or oil).		Q
5. Disassemble and change or repair the following: a) impeller, b) shafts, c) shaft sleeve, d) rotary seals, and e) sleeve bearings.		A
OPERATING REQUIREMENTS AND REFERENCE		

*D - Daily; W - Weekly; B - Biweekly; M - Monthly; Q - Quarterly;
S - Semiannually; A - Annually.

PART 2 - PRODUCTS - NOT USED

PART 3- EXECUTION

3.1 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the work:

a. Drawings.

b. Specifications.

c. Addenda.

d. Change Orders and other modifications to the Contract.

e. Reviewed shop drawings, product data, and samples.

f. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress.

E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:

a. Manufacturer's name and product model and number.

b. Product substitutions or alternates utilized.

c. Changes made by Addenda and modifications.

F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:

a. Measured depths of foundations in relation to finish first floor datum.

b. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.

c. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the work.

d. Field changes of dimension and detail.

e. Details not on original Contract drawings.

G. The Contractor shall provide a final set of record drawings marked in red to the Water Inspector as soon as the work is complete. The Contractor shall present the up to date record drawings to the Water Inspector prior to approval of any payment request.

3.2 OPERATION AND MAINTENANCE DATA

A. For each Product or System: List names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.

B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project

Record Documents as maintenance drawings.

D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.3 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

A. For Each Product, Applied Material, and Finish:

   a. Product data, with catalog number, size, composition, and color and texture designations.

   b. Information for re-ordering custom manufactured products.

B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.

C. Moisture protection and weather-exposed products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.

D. Additional information as specified in individual product specification sections.

E. Provide a listing in Table of Contents for design data, with tabbed fly sheet and space for insertion of data.

3.4 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

A. For Each Item of Equipment and Each System:

   a. Description of unit or system, and component parts.

   b. Identify function, normal operating characteristics, and limiting conditions.

   c. Include performance curves, with engineering data and tests.

   d. Complete nomenclature and model number of replaceable parts.

B. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.

C. Include color coded wiring diagrams as installed.

D. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

E. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

F. Provide servicing and lubrication schedule, and list of lubricants required.

G. Include manufacturer's printed operation and maintenance instructions.

H. Include sequence of operation by controls manufacturer.

I. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

J. Provide control diagrams by controls manufacturer as installed.

K. Provide General Contractor's coordination drawings, with color coded piping diagrams as installed.

L. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

M. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

N. Include test and balancing reports.

O. Additional Requirements: As specified in individual product specification sections.

3.5 OPERATION AND MAINTENANCE MANUALS

A. Prepare instructions and data by personnel experienced in maintenance and operation of described products.

B. Submit three hard copies and one electronic copy of all manufacturer's operations and maintenance manuals and data pertinent to equipment supplied for the project. Prepare data in the form of an instructional manual. All hard copies shall be organized in three ring binders.

C. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.

D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.

E. Provide tabbed dividers for each separate product and system, with typed description of product and major component parts of equipment.

F. Text: Manufacturer's printed data, or typewritten data on 24 pound paper.

G. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

H. Arrange content by systems under section numbers and sequence of Table of Contents of this Project Manual.

I. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, in three parts as follows:

a. Part 1: Directory, listing names, addresses, and telephone numbers of Owner's Designated Representative, General Contractor, Subcontractors, and major equipment suppliers.

b. Part 2: Operation and Maintenance Instructions arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:

i. Significant design criteria.
ii. List of equipment.
iii. Parts list for each component.
iv. Operating instructions.
v. Maintenance instructions for equipment and systems.
vi. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.

c. Part 3: Project documents and certificates, including the following:

i. Shop drawings and product data.
ii. Air and water balance reports.

iii. Certificates.
iv. Photocopies of warranties and bonds.

J. Provide a listing in Table of Contents for design data, with tabbed dividers and space for insertion of data.

K. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of Owner's Designated Representative, Consultants, and General Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.

APPENDIX B

WARRANTY FORM

WARRANTY FORM

Warranty Form (Project / Component)

(Location)

We hereby guarantee the (Project/Component) that we have constructed for a period of one (1) year from (Date) the date of acceptance by the _____ of the work/substantial completion.

The following are excluded from the provisions of this warranty:

We agree that if any of the equipment should fail due to any reason other than improper maintenance or improper operation, if any pipe or appurtenances should develop leakage, or if any settlement of fill or backfill occurs, or should any portion of the work fail to fulfill any of the requirements of the specifications, we will, within five (5) days after receipt of written notice of such defects, provide on-site troubleshooting services, and within ten (10) days after receipt of written notice, commence to repair or replace the same together with any other work which may be damaged or displaced in so doing.

In the event of our failure to comply with the above mentioned conditions, or should the exigencies of the case require repairs or replacements to be made before we can be notified or respond to notification, we do hereby authorize the _____ to proceed to have the defect repaired and made good at our expense, and we will pay the cost therefore upon demand.

The warranty provided herein shall not be in lieu of, but shall be in addition to any warranties or other obligations otherwise imposed by the Contract Documents and by law.

CONTRACTOR:

Signed:

Title:

Date:

APPENDIX C

MATERIAL SUBSTITUTION REQUEST FORMS

CITY OF ANAHEIM
PUBLIC UTILITIES DEPARTMENT

SUBSTITUTION REQUEST FORM

- This form provides information required by the City to determine if your product should be considered an "or equal" per the Standard Specifications. The Standard Specifications are used by City contractors, developers, and others to construct improvements for the City.

- Please fill out the form completely and attached additional information as specified in 1.2.A herein. Incomplete forms will not be considered.

- No obligations on the part of the City are either inferred or implied by receipt of this form.

- Use a separate form for each product to be considered. Separate forms are not required for various sizes of the same product, as long as the product's components are similar.

- If the proposed product substitutions are in reference to a specific project, submit copies of plans showing in red each location where the product substitution is proposed.

Submit completed forms to:

Water Engineering WEngineering@anaheim.net
Water Engineering
Anaheim Public Utilities Department
201 S. Anaheim Blvd, Suite 601
Anaheim, CA. 92805
Fax: 714.765.4199

CITY OF ANAHEIM
PUBLIC UTILITIES DEPARTMENT

SUBSTITUTION REQUEST FORM

GENERAL INFORMATION

Drawing or Section Number: _____

Specified Item(s): _____

Proposed Product Make/Model: _____

Proposed Product Description: _____

Sizes: _____

Submitted by:

Representative: _____

Company: _____

Phone: _____

Email: _____

MANUFACTURER INFORMATION

Manufacturer: _____

Headquarters Address: _____

City/State/Zip: _____ Phone: _____

Website: _____

Local Office Address: _____

City/State/Zip: _____ Phone: _____

How long has the manufacturer been producing the specified product?_____

_____

How long has the manufacturer been producing related product? _____

_____

What related products? _____

_____

CITY OF ANAHEIM
PUBLIC UTILITIES DEPARTMENT

SUBSTITUTION REQUEST FORM

PRODUCT INFORMATION

What are the appropriate ANSI, ASTM, and/or AWWA standards? _____

_____

Does the product meet these standards? If not, why not? _____

_____

What laboratories, if any, have tested and approved the product? _____

_____

What material options (if any) are available for the product components? _____

_____

What other agencies in Southern California are using the product?

Agency	How long?	Contact Person	Phone

Who are the local suppliers that stock the product?

Supplier	City

CITY OF ANAHEIM
PUBLIC UTILITIES DEPARTMENT

SUBSTITUTION REQUEST FORM

How available is the product (i.e., What is the delivery lead time)? _____

_____

What specifically does the written warranty cover and for how long? _____

_____

Additional Remarks

_____

_____

_____

_____

CERTIFICATION OF PERFORMANCE AND ASSUMPTION OF LIABILITY FOR EQUAL PERFORMANCE

I certify that the proposed substitution is equal to or better in all respects to the product specified and that the proposed substitution will, in all respects perform the function for which it is intended.

_____
Signature Date

_____
Name

_____
Title

_____
Company

_____
Address

_____
Telephone

Signature must be by person having authority to legally bind his or her firm to the above terms. Failure to provide legally binding signature will result in retraction of approval.

APPENDIX D

NPDES DISCHARGE NOTIFICATION AND REPORT FORMS

CITY OF ANAHEIM – PUBLIC UTILITIES DEPARTMENT

WORK PLAN FOR
DISCHARGES TO THE STORM DRAIN SYSTEM

Contractor information (company name, address, telephone number, contact person):

_____

_____

_____

_____

Location of discharge (include site address and location of nearby storm drain):

_____

_____

_____

_____

Type of discharge (water main, well site, etc.):

_____

_____

_____

Expected discharge date(s):

_____

_____

_____

Anticipated volume of discharge:

_____

_____

_____

_____

Treatment technology and sampling methodology:

_____

_____

_____

_____

CITY OF ANAHEIM - PUBLIC UTILITIES DEPARTMENT

MONITORING REPORT FOR
DISCHARGES TO STORM DRAIN SYSTEMS

Site location: _____

Date and time of sampling: _____

Start time of pumping: _____

End time of pumping: _____

Flow rate: _____

Company and name of person who performed sampling or measurements:

_____

_____

Date analyses were performed: _____

Company who performed analyses: _____

CONSTITUENT	**TYPE OF SAMPLE**	**UNITS**	**MINIMUM FREQUENCY OF ANALYSIS**	**LABORATORY ANALYSIS**
* Flow		gpd	Daily	_____ (List measured flow rate)
Total Suspended Solids (TSS)	Grab	mg/l	During first 30 minutes of *each* discharge and weekly thereafter for continuous discharges.	_____
Total Residual Chlorine	Grab	mg/l	During first 30 minutes of *each* discharge and weekly thereafter for continuous discharges.	_____

* Flow rate is to be determined using a calibrated flow meter

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ANAHEIM, CA 92805
(714) 765-5169
FAX (714) 765-5123

CITY OF ANAHEIM MASTER CONSTRUCTION AGREEMENT – WATER

THIS AGREEMENT ("Master Agreement"), dated for purposes of identification only this _____ day of _____, 2022, is made by the CITY OF ANAHEIM, a municipal corporation, hereafter referred to as "ANAHEIM," and _____, a _____ **[type of business, i.e., an individual, a partnership, a joint venture, a California corporation or some other business entity]**, hereafter referred to as "CONTRACTOR."

ANAHEIM and CONTRACTOR are sometimes individually referred to herein as "Party" and collectively as "Parties."

RECITALS

WHEREAS, ANAHEIM desires to obtain construction, maintenance, repair, abandonment, relocation, and immediate response services (collectively, the "Work") in connection with its water production, transmission and distribution systems (collectively, the "Water System") from time to time on an as-needed basis as requested by ANAHEIM; and

WHEREAS, ANAHEIM has issued a request for prequalification proposals dated _____, 2022, to perform the Work ("Request for Prequalification"); and

WHEREAS, in response to the Request for Prequalification, CONTRACTOR submitted a prequalification proposal dated _____, 2022 ("Proposal"), and ANAHEIM evaluated the Proposal and determined CONTRACTOR to be prequalified to perform the Work; and

WHEREAS, the Proposal is incorporated herein by reference and is applicable to the Work unless otherwise set forth herein; and

WHEREAS, the public interest, economy and general welfare will be served by this Master Agreement.

NOW, THEREFORE, IN CONSIDERATION OF THE MUTUAL PROMISES, COVENANTS AND CONDITIONS HEREIN CONTAINED, THE PARTIES AGREE AS FOLLOWS:

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PART I - WORK TO BE PERFORMED BY CONTRACTOR

A. References. Except as otherwise indicated, all references to ANAHEIM include its elected officials, officers, directors, employees, agents, and volunteers. Except as otherwise indicated, all references to CONTRACTOR include its personnel, employees, agents, and subcontractors.

B. Scope of Work.

1. CONTRACTOR agrees to perform the Work and supply all materials required for the Work in connection with ANAHEIM's Water System from time to time on an as-needed basis as requested by ANAHEIM. The Work is generally described in the "General Scope of Work," attached hereto as Exhibit A and incorporated herein by this reference. The specific Work to be provided by CONTRACTOR shall be specified in an individual work order package ("Work Order Package") to be prepared and issued by ANAHEIM or, for services that become necessary with little or no notice that are determined by the Director of Public Works or the Anaheim Public Utilities General Manager ("General Manager"), as applicable, or their respective designees, at their sole discretion, to require an immediate response ("Immediate Response Services"), in a request for Immediate Response Services ("Request"). By entering into this Master Agreement, ANAHEIM does not give any guarantee to CONTRACTOR that ANAHEIM will award CONTRACTOR any Work Order Packages or Requests.

2. Each Work Order Package and Request shall contain a specific Work description, plans, bid list, scheduled start and Work completion date, and bond requirements. The terms and conditions in this Master Agreement shall govern performance under, and shall apply to, all Work Order Packages and Requests received from ANAHEIM.

3. Any preprinted or other CONTRACTOR-inserted provisions on CONTRACTOR's acknowledgment or other submittals that purport to set forth general terms and conditions shall not govern or have any application to transactions between the Parties involving any Work Order Package or Request that references this Master Agreement.

4. CONTRACTOR shall provide the Work in accordance with this Master Agreement, the applicable Work Order Package or Request received from ANAHEIM's

Representative, as defined herein, Appendices A through G hereto ("Appendices"), the latest Standard Specifications for Public Works Construction adopted by ANAHEIM ("Standard Specifications"), the Standard Specifications Supplement ("Standard Specifications Supplement"), ANAHEIM's Water Services Standard Specifications ("Water Standard Specifications"), and the Special Provisions of ANAHEIM's Water Services Standard Specifications ("Special Provisions").

5. In the event of conflicting provisions among the contract documents, including a Change Order, the terms of these documents shall control in the following order of priority:

1) Change Order, Faithful Performance Bond, and Labor and Material Bond;
2) Work Order Package or Request;
3) Master Agreement;
4) Special Provisions when applicable;
5) Water Standard Specifications;
6) the Appendices hereto, except for the Faithful Performance Bond, and Labor and Material Bond;
7) the Standard Specifications Supplement;
8) the Standard Specifications;
9) General Scope of Work, Exhibit A to this Master Construction Agreement; and
10) Proposal.

6. In entering into this Master Agreement, CONTRACTOR offers and agrees to assign to ANAHEIM all rights, title, and interest in and to all causes of action it may have under Section 4 of the Clayton Act (15 U.S.C. Sec. 15) or under the Cartwright Act (Cal. Bus & Prof. Code, Sec. 16700-16728), arising from purchases of goods, services, or materials pursuant to this Master Agreement. This assignment shall be made and become effective at the time

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ANAHEIM tenders final payment to CONTRACTOR on a Work Order Package or Request, without further acknowledgment by the Parties.

C. Representatives of CONTRACTOR.

1. Prior to commencing the Work under any Work Order Package or Request, CONTRACTOR shall designate for each Work Order Package or Request a representative ("Representative" or "CONTRACTOR's Representative") with whom all contacts concerning that Work Order Package or Request shall be made. CONTRACTOR's Representative or designee shall be on the job site at all times during performance of the Work.

2. ANAHEIM shall have the right but not the obligation to approve CONTRACTOR's designation of a Representative for each Work Order Package or Request. If ANAHEIM disapproves CONTRACTOR's Representative for a Work Order Package or Request, CONTRACTOR shall promptly designate another Representative acceptable to ANAHEIM. Failure by ANAHEIM to object to CONTRACTOR's designation of a Representative at any time before or during performance of the Work shall not be a waiver of ANAHEIM's right to require CONTRACTOR to replace Representative at any time during performance of the Work.

3. Other than as set forth above, CONTRACTOR shall give a minimum of thirty (30) days advance notice and receive ANAHEIM's written approval prior to substitution of any Representative(s) designated for Work Order Packages or Requests pursuant to this section, prior to assignment to the Work or during the performance of the Work.

4. CONTRACTOR shall assign additional staff as needed to perform the Work in a timely and expeditious manner.

PART II - ANAHEIM

A. Documents. ANAHEIM will, upon request, make available to CONTRACTOR original or copies of existing drawings, maps, and other existing information relevant to the Work to be performed as may be readily available to ANAHEIM.

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B. Representative of ANAHEIM.

1. For Work defined as public works pursuant to state law and/or municipal ordinance and so identified in the applicable Work Order Package, the Director of Public Works of ANAHEIM or designee shall serve as "ANAHEIM's Representative" in all matters pertaining to Work to be performed under this Master Agreement. CONTRACTOR shall, in the performance of this Master Agreement, consult with the Director of Public Works or designee and other ANAHEIM employees as the Director of Public Works or designee may direct.

2. For the Work defined as maintenance, operation, inspection, and/or repair of the Water System pursuant to ANAHEIM's municipal code or as Immediate Response Services, and so identified in the applicable Work Order Package or Request, the General Manager or designee shall serve as ANAHEIM's Representative in all matters pertaining to Work to be rendered under this Master Agreement, including without limitation, termination of this Master Agreement and giving any notices required under this Master Agreement on behalf of ANAHEIM. CONTRACTOR shall, in the performance of this Master Agreement for Work, consult with the General Manager or designee and such other ANAHEIM employees as the General Manager or designee may direct.

C. Research of ANAHEIM Records. ANAHEIM's Water Engineering Division will assist CONTRACTOR in researching ANAHEIM's record data pertaining to ANAHEIM's facilities. For Critical Infrastructure Information, CONTRACTOR shall execute all confidentiality and/or nondisclosure agreements required by ANAHEIM for access to that information. If CONTRACTOR fails to execute such agreements, ANAHEIM may treat this failure as a breach of this Master Agreement.

D. Inspection. ANAHEIM may, at any time and from time to time, inspect the Work prior to its completion to see that the Work is or has been performed in accordance with the Work Order Package or Request. Such inspections will be conducted at reasonable times. Notwithstanding the above, ANAHEIM may inspect the Work at any time if the Public Works Director or General Manager, as applicable, or their respective designees, determine, at their sole discretion, that an inspection is necessary for health and safety reasons. Inspections

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conducted by ANAHEIM, irrespective of outcome, shall not waive ANAHEIM's right to inspect and/or reject the Work at a later time, and shall not relieve CONTRACTOR from its obligation to complete the Work in accordance with the applicable Work Order Package or Request.

PART III - TERMS OF AGREEMENT

A. Term of Agreement.

1. The term of this Master Agreement ("Term") shall commence on the Effective Date, as defined herein, and shall terminate on September 30, 2027, unless terminated earlier as provided herein. The General Manager or designee is authorized to extend the Term of the Master Agreement for such a time period necessary for completion of outstanding Work Order Packages or Requests in progress at the end of the Term. In no event, however, shall the extension exceed twelve (12) months.

2. All Parties recognize that the continuation of this Master Agreement after the close of any fiscal year of ANAHEIM, which fiscal year ends on June 30 of each year, shall be subject to budget approval providing for or covering contract items as an expenditure in the budget. ANAHEIM does not represent that the budget or any particular budget item will be adopted, since budget determinations are made by the ANAHEIM City Council at the time of the consideration of each budget. No penalty shall accrue to ANAHEIM in the event this provision shall be exercised. Should termination be accomplished in accordance with this Section, a settlement shall be negotiated by the Parties based on items delivered, Work provided, monies paid and monies due.

B. Commencement and Completion of Performance.

1. When Work under this Master Agreement other than Immediate Response Services is required, ANAHEIM will send a written or electronic Work Order Package to all prequalified contractors, including the CONTRACTOR so long as CONTRACTOR is also prequalified for the Work. If interested in performing the Work, CONTRACTOR, along with other prequalified contractors, shall submit a sealed bid indicating cost and other information requested. In the alternative, CONTRACTOR shall submit an electronic sealed bid when it is

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required by a Work Order Package, and CONTRACTOR shall abide by all Work Order Package's electronic proposal requirements. ANAHEIM will be open either written or electronic bids at the pre-established time and place as set forth in the Work Order Package.

2. Water Engineering Division will administer the bidding process and bid opening. The Water Engineering Division will select the qualified contractor based on the lowest responsive total price bid to complete the Work within the time frame established in the Work Order Package.

3. When Immediate Response Services are required, ANAHEIM will contact via telephone prequalified contractors until the Immediate Response Service requirements have been satisfied. Under this Immediate Response Service process, ANAHEIM may or may not contact CONTRACTOR. The Water Engineering Division will administer the Immediate Response Service process. If awarded, CONTRACTOR shall commence performance of the Work as may be requested by the Water Engineering Division in a timely and expeditious manner until either (1) final completion and acceptance by ANAHEIM of the Work or (2) earlier suspension or termination of the Work in accordance with the provisions of this Master Agreement.

4. If CONTRACTOR receives a Work Order Package or Request from ANAHEIM but is unable or unwilling to provide the Work, CONTRACTOR shall promptly notify ANAHEIM of this fact.

5. The nature of the Work makes timely performance critical to the orderly progress of related work and to the operating schedule of ANAHEIM. CONTRACTOR shall, if required under the applicable Work Order Package or Request, provide a proposed construction schedule in its sealed bid that sets forth, at a minimum, each phase of the Work, the number of personnel to be utilized for each phase, and the specific time required to complete each phase. CONTRACTOR shall revised the construction schedule as requested by ANAHEIM, which has final approval.

6. If performance of the Work falls behind the schedule agreed upon by the Parties, CONTRACTOR shall, upon request by ANAHEIM's Representative, make reasonable

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efforts to accelerate its performance of the Work at no additional cost to ANAHEIM until performance of the Work conforms to the agreed-upon schedule.

7. For both Work Order Packages and Requests, CONTRACTOR shall obtain approval from ANAHEIM's Representative prior to expenditure of any overtime which would result in extra cost to ANAHEIM. ANAHEIM reserves the right to refuse to pay overtime premiums when CONTRACTOR has the option to provide the Work at straight-time by utilizing additional personnel, consecutive shifts or other methods approved by ANAHEIM.

8. The time period(s) specified for performance of the Work Order Package or Request may be extended for force majeure events. This Part III.B.8 is applicable to a Request only when ANAHEIM has specified a time period for completion of Work within the Request. Force majeure events include unforeseeable causes beyond the control and without the fault or negligence of CONTRACTOR, including, but not limited to, acts of God or of the public enemy, unusually severe weather, fires, earthquakes, floods, pestilence, and other natural catastrophes, epidemics, quarantine restrictions, riots, strikes, freight embargoes, wars, litigation, civil disturbance or disobedience, labor dispute, labor or material shortage, sabotage, government priorities, restraint by court order or public authority and action or non-action by or inability to obtain the necessary authorization or approvals from any governmental agency or authority, and/or acts of any governmental agency, including ANAHEIM, which by the exercise of due diligence CONTRACTOR could not reasonably have been expected to avoid and which by exercise of due diligence has been unable to overcome, if CONTRACTOR immediately notifies ANAHEIM's Representative in writing of the causes of the delay and the anticipated length of the delay. ANAHEIM's Representative shall ascertain the facts and the extent of delay, and may extend the time for performing the Work Order Package or Request for the period of the enforced delay if, in the judgment of ANAHEIM's Representative, the delay is justified. The determination of ANAHEIM's Representative shall be final and conclusive upon the Parties to this Master Agreement. In the event of delay, however caused, CONTRACTOR's sole remedy shall be an extension of the time of performance of the Work Order Package or Request, pursuant to this Section, and CONTRACTOR shall not be entitled to recover damages against

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ANAHEIM. Any change to the Work completion date shall be documented by a written Change Order to the Work Order Package or Request.

9. The Parties agree that time is of the essence in obtaining the Work and that it is essential that CONTRACTOR provide the Work by the date specified in each Work Order Package or Request. The Parties agree that in the event that the Work is not provided by this date, actual damages to ANAHEIM as a result of that failure would be impractical or extremely difficult to ascertain. In the event of CONTRACTOR's failure to complete the Work by the date specified in the Work Order Package or Request, CONTRACTOR agrees to pay ANAHEIM liquidated damages for every calendar day's delay beyond the completion date specified in the Work Order Package or Request an amount equal to either (a) Five Hundred Dollars ($500.00) per calendar day; or (b) the liquidated damages amount, if any, specified in an applicable Work Order Package or Request. The foregoing sentence shall be subject to Part III.B.8 above.

10. A written statement requesting acceptance of the Work shall be submitted to ANAHEIM's Representative by CONTRACTOR, with a request for acknowledgment. The acknowledgment shall be executed by ANAHEIM within thirty (30) days after (1) ANAHEIM determines after final inspection that the Work has been satisfactorily completed, and (2) ANAHEIM has accepted the Work. Execution of the acknowledgment shall constitute final acceptance by ANAHEIM.

C. Compensation and Payment.

1. Limits.

a. Per Project. The Parties understand and agree that full and complete payment for Work performed for a single Work Order Package or Request in accordance with this Master Agreement shall not exceed the sum of Five Hundred Thousand Dollars ($500,000.00), excluding change orders but inclusive of hiring incentives, if any. CONTRACTOR's performance of the Work shall be compensated either on a lump sum basis in an amount not to exceed the amount set forth in the applicable Work Order Package or Request

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or on a Unit Price, Crew Hour Rate or Time and Equipment basis as set forth in the Proposal, at ANAHEIM's election.

b. Per Fiscal Year. The Parties understand and agree that the combined cumulative value of all Work Order Packages and Requests awarded to Contractor during each fiscal year (July 1 through June 30) during the Term of the Agreement shall not exceed the sum of Three Million Dollars ($3,000,000.00), excluding change orders. Any unused portion of this annual limit shall expire and not carry over to increase the dollar limit of Work that may be awarded in the subsequent fiscal year.

2. Contractor's Labor Rates. Unless otherwise stated in the applicable Work Order Package or Request, CONTRACTOR's performance of the Work on a Time, Material and Equipment basis shall be paid at the hourly rates for the respective classifications as set forth in the Proposal. CONTRACTOR's performance of the Work on a Crew Hour Rate basis shall be paid at the hourly rate for the respective crew composition as set forth in the Proposal. Billing rates shall include (a) all labor-related costs including, but not limited to, payroll costs, benefits, payroll taxes, Workers Compensation Insurance, Liability Insurance, (b) small tools, personal and consumable supplies, (c) home office and field overhead, and (d) profit. All shift differentials shall be paid as direct reimbursables.

3. Contractor Furnished Material Costs. All material reimbursement costs as invoiced to CONTRACTOR by its suppliers (including freight charges and all applicable discounts and taxes) plus a fixed percentage as specified in the Proposal for all applicable overhead and handling costs. Charges for materials shall be separately stated on all invoices. No profit shall be paid by ANAHEIM to CONTRACTOR for material costs.

4. Subcontractors. Costs for subcontracted Work shall be paid as invoiced by subcontractors plus five percent (5%) markup for administrative costs.

5. Rental Costs.

a. Contractor-Owned Equipment. Costs for CONTRACTOR's own equipment at rates as set forth in the Proposal or CONTRACTOR's bid, as applicable.

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b. Third-Party Rentals. Reasonable costs for rental of equipment including insurance, as invoiced by its suppliers to CONTRACTOR as specified in the Standard Specifications Supplement.

c. Rental Period. Rental period shall begin when equipment is received at jobsite or the Work is initiated, whichever occurs later. Rental period shall end when equipment leaves the jobsite or Work is essentially completed, whichever occurs first. Rental period shall not include time for which equipment is unusable due to unsafe conditions, is inoperative or is in transit.

d. Rental Rates. The lowest combination of monthly, weekly, daily and hourly rates shall apply. Rates shall include (1) any routine maintenance, parts and supplies, (2) all applicable insurance, and (3) fuel and transportation costs, as specified in the Proposal or CONTRACTOR's bid, as applicable.

6. Other Costs. Costs for other items as set forth in the Work Order Package or Request.

7. Pricing Basis. The Pricing Basis for Work performed on Work Order Packages or Requests which reference this Master Agreement, shall be Lump-sum, Unit Price, Crew Hour Rate, or Time, Material and Equipment as set forth in the bid applicable to a specific Work Order Package or Request.

8. Taxes. CONTRACTOR assumes exclusive liability for, and shall pay before delinquency, all Federal, State or Local sales, use, excise and other taxes, charges or contributions of any kind now or hereafter imposed on, or with respect to, or measured by, the equipment, materials, supplies or labor furnished hereunder or the wages, salaries, or other remunerations paid to individuals employed in connection with the performance of the Work.

9. Incentives. For eligible projects, as identified in the Work Order Package or Request, CONTRACTOR may earn an incentive payment for meeting certain hiring goals during the course of the project. To apply, CONTRACTOR must submit a hiring report for the eligible project at the same time the request for final payment is submitted pursuant to Part III.C.10.g. below ("Hiring Report"). The Hiring Report shall list, for the CONTRACTOR and

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any subcontractor(s), individual employees who worked on the project and reside in the City of Anaheim ("Local Hire") and/or qualify as veterans under 5 United States Code section 2108 ("Veterans"). The Hiring Report shall state the names of all Local Hires and/or Veterans who worked on the project and shall also state the total number of employees who worked on the project for the CONTRACTOR and any subcontractor(s). If, upon ANAHEIM's review and acceptance of the Hiring Report, CONTRACTOR has achieved a Local Hire and Veterans hiring goal of 25% for the eligible project, CONTRACTOR will be entitled to an incentive payment equal to 1% of the bid award amount for the Work Order Package or Request. ANAHEIM reserves all rights to request documentary evidence in support of the Hiring Report.

10. Method of Payment.

a. No payment shall be made under any Work Order Package or Request until ANAHEIM has received the executed acknowledgment of the Work Order Package or Request, any current required certificate(s) of insurance, and bond(s) from CONTRACTOR.

b. For Time, Material and Equipment Work, CONTRACTOR shall submit a copy of time sheets daily, for approval and retention by ANAHEIM's Representative, listing: employee name, classification, hours worked straight time and overtime, and identification of equipment and materials utilization and materials used. Each monthly invoice shall be supported with sufficient detail to allow ANAHEIM to evaluate the invoiced costs, including hours for each classification, with sheets and approved time sheets and applicable rates, invoiced costs from suppliers and subcontractors, and equipment rental charges.

c. For Crew Hour Rate Work, CONTRACTOR shall submit a copy of the time sheets daily, for approval and retention by ANAHEIM's Representative listing: crew composition, hours worked straight time and overtime, and additional equipment not covered by the crew hour rate (if applicable). Each monthly invoice shall be supported with sufficient detail data to allow ANAHEIM to evaluate the invoiced costs, including crew hours for each crew composition, with approved time sheets and applicable rates, invoiced costs from suppliers and subcontractors, and equipment rental charges. CONTRACTOR shall submit a separate invoice

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for each ANAHEIM Work Order Package.

d. For Lump sum or Unit Price Work, CONTRACTOR shall submit invoices in accordance with the progress payment schedule outlined in the applicable Work Order Package, Request, or as approved by ANAHEIM's Representative in accordance with the Work completion schedule.

e. As part of CONTRACTOR's application for payment CONTRACTOR shall (1) certify that the portion of the Work for which compensation is claimed has been completed in accordance with the terms and conditions and specifications of this Master Agreement, (2) state CONTRACTOR's estimate of the percentage of construction completed to date and the actual construction costs incurred to date, (3) state that the amount claimed has not been the subject of a prior application for payment, and (4) provide an estimate of the time required for completion of the Work. Each application for payment shall be accompanied by an executed Estoppel Certificate in the form set forth in Appendix A hereto. Each Estoppel Certificate shall identify the Work Order Package or Request to which it applies and shall be signed by an authorized officer of CONTRACTOR and must be attached to the application for payment.

f. CONTRACTOR shall submit invoices in a format approved by ANAHEIM and as set forth in this Article to:

City of Anaheim
Public Utilities Department
Attention: Project Manager
Master Agreement No. xx
Water Engineering
201 S. Anaheim Blvd, Suite 601
Anaheim, California 92805

g. When requesting final payment following final acceptance of all Work by ANAHEIM, CONTRACTOR shall execute a "Conditional Waiver and Release Upon Final Payment" pursuant to California Civil Code Section 8136 or successor statute in a form approved by ANAHEIM. If requested, CONTRACTOR shall provide further assurances

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reasonably required by ANAHEIM that all subcontractors, suppliers and employees have been paid. No final payment shall be made to CONTRACTOR without full compliance with this requirement.

h. ANAHEIM may withhold payment of the whole or part of any amount due or claimed by CONTRACTOR to the extent necessary to protect ANAHEIM from losses, including, but not limited to, the following: (1) defective Work not remedied; (2) third-party claims filed or reasonable evidence indicating probable filing of third-party claims; (3) failure of CONTRACTOR to make payment promptly to its employees, suppliers or subcontractors; (4) damage caused by CONTRACTOR to another contractor to ANAHEIM; (5) failure of CONTRACTOR to diligently prosecute the Work and maintain satisfactory progress required to meet the Work completion schedule; or (6) any other material breach by CONTRACTOR of its obligations under the Work Order Package, Request, or Master Agreement.

i. Subject to the above, ANAHEIM shall make payment within thirty (30) days after receipt and approval of invoice.

D. Warranty.

1. CONTRACTOR expressly warrants that all the Work performed by it and any subcontractors shall be in conformance with this Master Agreement and the Work Order Package or Request, and shall be free from defects in workmanship. CONTRACTOR further warrants that the Work shall be performed in a manner consistent with prudent construction and utility industry practices.

2. CONTRACTOR represents to ANAHEIM that it and its subcontractors are properly licensed, fully experienced and properly qualified to perform the class and type of the Work outlined in the Work Order Package or Request, in addition to being properly equipped, organized, staffed and financed to handle such Work. CONTRACTOR shall perform the Work in an orderly and workmanlike manner and shall not employ on the Work any individuals unskilled in the duties they are assigned.

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3. CONTRACTOR agrees that upon receipt of written notice from ANAHEIM's Representative that any Work performed is not in conformance with the Work Order Package or Request, CONTRACTOR shall forthwith correct all nonconforming Work at CONTRACTOR's sole expense. If CONTRACTOR refuses or neglects to comply promptly with the provisions of this subparagraph, ANAHEIM may, at its option, take all steps necessary to carry out the corrective actions and charge all costs to CONTRACTOR. CONTRACTOR hereby agrees it will promptly pay all costs or ANAHEIM may deduct the cost amounts from future monies owed or becoming due to CONTRACTOR.

4. CONTRACTOR further agrees that if any fault, break or defect due to workmanship, fabrication or installation occurs in any of the Work performed under this Master Agreement within one (1) year from the final acceptance date as set forth in Section III.B., CONTRACTOR shall repair the same promptly, as requested by ANAHEIM's Representative, without cost to ANAHEIM, so as to fully comply with the Work Order Package or Request.

5. In the event any Work performed by CONTRACTOR does not comply with the terms of this Master Agreement or the Work Order Package or Request, and ANAHEIM's Representative deems it necessary that this non-conforming Work shall be temporarily utilized, CONTRACTOR agrees that such Work may be utilized by ANAHEIM until the Work is corrected in accordance with this Master Agreement. CONTRACTOR shall not claim any compensation from ANAHEIM for such temporary utilization.

6. If ANAHEIM's Representative deems it inexpedient to correct any instance of nonconforming Work, ANAHEIM shall have the right to deduct from any amounts then due or which shall thereafter become due to CONTRACTOR under this Master Agreement, or CONTRACTOR shall refund to ANAHEIM, a sum of money determined by ANAHEIM's Representative to represent the difference in value between the Work as performed and that specified in the Work Order Package or Request, as well as damages resulting from the nonconforming Work. CONTRACTOR may appeal the determination by Anaheim's Representative to either the Director of Public Works or General Manager, as applicable, and

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may recover sums that are determined to have been improperly deducted. Decisions of the Director of Public Works or General Manager in these matters shall be final.

7. All Work performed, and any and all measurements of the Work performed, under the Work Order Package or Request shall be made to the satisfaction of the Director of Public Works or the General Manager, as applicable, or their respective designees, whose sole judgment shall determine whether the quality of the Work shall satisfy the requirements of the Work Order Package or Request.

8. This Article shall not be construed as a limitation of CONTRACTOR's liability. The remedies provided for herein are supplemental and in addition to all other remedies ANAHEIM may have for CONTRACTOR's negligence, breach of contract, or defective performance.

E. Title.

1. Title to materials furnished by ANAHEIM for the performance of the Work shall remain with ANAHEIM at all times.

2. Title to the Work as passed through to ANAHEIM from CONTRACTOR shall be free and clear of all liens and encumbrances.

3. All sketches, documents, drawings, tracing, field survey notes, computations, detail, data diskettes, photographs, and/or computer software developed specifically pursuant to the Master Agreement and other materials prepared by CONTRACTOR are recognized by ANAHEIM to be instruments of CONTRACTOR's Work and shall become the property of ANAHEIM at the time of payment to CONTRACTOR for such Work, and CONTRACTOR shall promptly deliver them to ANAHEIM at the request of ANAHEIM. CONTRACTOR agrees not to use these documents and other materials for any purpose other than the performance of Work required by this Master Agreement without the prior written authorization of ANAHEIM.

F. Changes and Extra Work.

1. CONTRACTOR may request a change in scope of a Work Order Package or Request by advising ANAHEIM in writing of the change believed to be necessary.

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ANAHEIM may initiate a request for extra Work by written notification to CONTRACTOR. As soon as practicable after written notice, CONTRACTOR shall prepare and forward to ANAHEIM the price for the change or extra Work in accordance with the Proposal and any required adjustment to the schedule. The price shall include all costs associated with performing the additional or changed Work, including the impact on original contract Work, inefficiencies created by the additional or changed Work, and overhead associated with the additional or changed Work. All extra Work shall be billed at the rates shown in the Proposal or at a lump sum price approved by ANAHEIM's Representative.

2. If CONTRACTOR's price is not accepted, CONTRACTOR shall provide ANAHEIM's Representative with the details of its price estimate. If the Parties fail to agree on the price, ANAHEIM's Representative may authorize the changes or extra Work to be performed on a Time, Equipment and Material or Crew Hour Rate basis, while reserving the option to obtain the services of other contractors, or ANAHEIM's own employees, to perform the Work in dispute.

3. Should changes or extra Work be authorized by ANAHEIM, CONTRACTOR shall furnish the necessary labor with requisite tools and/or materials required for performing such additional Work. All authorized changes and extra Work and the agreed-to price shall be confirmed and directed through a Change Order to the Work Order Package or Request.

4. CONTRACTOR shall implement a change or extra Work only after it has received a written copy of an authorized Change Order. All changes or extra Work shall be performed under the terms and conditions of this Master Agreement, except as specified in the Change Order. All Change Orders shall be signed by Representatives of both Parties prior to commencing the specified Work.

5. CONTRACTOR hereby expressly waives any compensation for any change or extra Work not authorized by an executed Change Order to the Work Order Package or Request. No compensation for labor or schedule impacts from changes or extra Work shall be considered, except as specified in the Change Order.

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6. In no event shall the dollar amount of an individual Change Order exceed the sum of Ten Thousand Dollars ($10,000.00) or ten percent (10%) of the original cost specified in the Work Order Package or Request, whichever is greater. In no event shall the combination of Change Orders for a single Work Order Package or Request exceed the sum of One Hundred Thousand Dollars ($100,000.00).

G. Other Work.

1. CONTRACTOR acknowledges that this Master Agreement is not exclusive, and that ANAHEIM reserves the right to employ or contract with other entities for the performance of the Work outlined in the General Scope of Work (Exhibit A hereto). CONTRACTOR further acknowledges that its Work will be requested on an as-needed basis, and that no promises or guarantees have been made that a particular amount of Work will be requested by ANAHEIM or that any level of compensation may be earned by CONTRACTOR hereunder.

2. If any part of CONTRACTOR's Work depends upon the work of another contractor or of the employees of ANAHEIM, CONTRACTOR shall inspect the other contactor's work and promptly report to ANAHEIM's Representative any defects that render it unsuitable for its intended role in the proper execution and results of CONTRACTOR's Work. Failure to so inspect and report any defective Work shall constitute an acceptance of the same by CONTRACTOR as being fit and suitable for the proper execution and results of the Work.

3. CONTRACTOR further agrees that during the performance of the Work, CONTRACTOR shall not hinder or interfere with any individual or business entity ANAHEIM may employ to do any Work. CONTRACTOR shall suspend any part of the Work, or shall carry on the same, as directed by ANAHEIM's Representative, so as to afford all reasonable facilities for the performance of the other Work. CONTRACTOR shall not claim any extra compensation for delays in the Work. CONTRACTOR's sole recourse shall be an extension of time for performance as ANAHEIM may grant in accordance with the provisions hereof.

H. Reports. CONTRACTOR shall provide status reports as requested by ANAHEIM's Representative. Reports shall compare expended labor hours, recorded costs

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and actual performance to estimated labor hours, estimated costs and scheduled performance for the Work. Reports shall also include projections of estimated Work completion date, explanation of any significant variations, and identification of any potential or known developments which may affect the cost to ANAHEIM or the Work completion date.

I. Protective Measures. CONTRACTOR shall be responsible for the proper care and protection of all equipment and materials delivered and the Work performed until final acceptance of the Work and issuance of a notice of completion for that Work Order Package or Request by ANAHEIM. CONTRACTOR shall also adequately protect adjacent property as provided by law and by this Master Agreement, including, but not limited to, protection of any Work existing in public property. CONTRACTOR shall take all necessary precautions for the safety of its employees and the employees of its contractors, subcontractors, or others working on its behalf on the Work and prevent accidents or injury to individuals on, about, or adjacent to the premises where the Work is being performed. In addition, CONTRACTOR shall erect and properly maintain at all times, as required by the conditions and progress of the Work, all necessary safeguards and warnings for the protection of its employees and the employees of its contractors, subcontractors, and others working on its behalf, as well as the public, including, but not limited to, temporary covering on all equipment pads.

J. Risk of Loss and Damage. CONTRACTOR shall be responsible for any loss or damage to the Work, or material furnished by ANAHEIM for the Work, until final acceptance of the Work and issuance of a notice of completion by ANAHEIM for a specific Work Order Package or Request. In the event of loss or damage, if it should become necessary to replace materials furnished by ANAHEIM, the cost of replacement shall be paid by CONTRACTOR to ANAHEIM. ANAHEIM may deduct replacement costs from any amounts due or to become due CONTRACTOR.

K. ANAHEIM-Furnished Tools and Equipment. Should ANAHEIM furnish any tools or equipment to CONTRACTOR to perform any Work, any tools or equipment shall be provided solely as a convenience to CONTRACTOR, and only under the following conditions:

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1. CONTRACTOR shall ensure that any employee using any loaned tool or equipment is adequately and properly trained in its correct, intended, and safe use, and shall actively supervise, with trained personnel, all employees using any ANAHEIM loaned tool or equipment in order to ensure that, at all times, the use of the tool or equipment is correct, safe, in accordance with the intended use, and creates no risk of injury or damage to individuals and/or property.

2. The Comprehensive General Liability Insurance required by this Master Agreement shall include coverage for liability assumed by CONTRACTOR associated with the use of, supervision of, and training of any employee using any ANAHEIM loaned equipment or tools.

3. CONTRACTOR shall be responsible for thoroughly inspecting all ANAHEIM loaned tools and equipment for defects. Any loaned tools or equipment found by CONTRACTOR to be defective in any way shall immediately be returned to ANAHEIM and not utilized by CONTRACTOR.

4. Any tools or equipment loaned to CONTRACTOR by ANAHEIM shall be promptly returned to ANAHEIM's upon request by ANAHEIM's Representative. If CONTRACTOR fails to promptly return any tools or equipment, ANAHEIM may at its option replace them at CONTRACTOR's expense.

L. Suspension of Work.

1. ANAHEIM may at any time suspend the entire Work, or any portion thereof, upon written notice to CONTRACTOR, who shall thereupon discontinue and suspend the Work except for operations that may be necessary to prevent damage to property or to the Work already accomplished. CONTRACTOR shall resume the Work after ANAHEIM gives written notice lifting the suspension.

2. For all Work satisfactorily performed by CONTRACTOR prior to suspension of Work, CONTRACTOR shall be paid in accordance with the Work Order Package or Request, as applicable. If the Work shall be delayed due to any suspension of Work, CONTRACTOR shall also be entitled to an equitable extension of time within which to complete

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the Work. ANAHEIM shall pay additional reasonable costs actually incurred by CONTRACTOR in deactivating and reactivating the Work caused by an ANAHEIM-ordered suspension. This shall be CONTRACTOR's sole compensation for suspension of the Work by ANAHEIM.

3. This Subpart L shall be construed as applying only to suspension of Work Order Package or Request by ANAHEIM and caused by conditions that cannot be reasonably anticipated. The provisions of this Subpart L shall not apply to any conditions or suspension of the Work cited in the Work Order Package or Request or suspension because of inclement weather, or nature of the Work, or operating requirements of ANAHEIM, or termination as defined herein.

M. Termination. ANAHEIM may terminate this Master Agreement with or without cause upon giving CONTRACTOR fifteen (15) days prior written notice. ANAHEIM may terminate any specific Work order issued pursuant to a Work Order Package or Request with or without cause upon giving CONTRACTOR five (5) days prior notice. If this Master Agreement or any Work order is terminated without cause, CONTRACTOR will be paid for costs incurred and actual Work satisfactorily performed for ANAHEIM up to and including the date of termination. Termination of this Master Agreement, with or without cause, shall result in (1) immediate suspension of the CONTRACTOR's pre-qualified status, (2) immediate prohibition of further bids and proposals by CONTRACTOR under this Master Agreement, and (3) immediate termination of all pending Work Order Packages and Requests awarded to CONTRACTOR under this Master Agreement, except such operations as may be necessary to prevent damage to property or to the Work already accomplished, and those operations shall be terminated as soon as practicable. Such termination shall be duly noticed and provide the CONTRACTOR an opportunity for appeal and a hearing consistent with ANAHEIM's pre-qualification procedures.

The General Manager or designee is authorized to terminate the Master Agreement as stated herein.

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N. Disputes. Any dispute that cannot be resolved between the Representatives of the Parties shall be referred to the General Manager or his/her designee, whose decision shall be final. CONTRACTOR shall have no cause of action for any alleged breach of this Master Agreement by ANAHEIM until after ANAHEIM has made final payment for all Work provided hereunder.

O. Liens. CONTRACTOR shall hold harmless, indemnify and defend ANAHEIM from any mechanic's liens or stop notice claims against ANAHEIM by CONTRACTOR, subcontractors, employees or agents pertaining to the Work specified in any Work Order Package or Request referencing this Master Agreement.

P. Fiscal Records and Audits.

1. CONTRACTOR shall keep a correct and current accounting of payroll costs, travel, subsistence, field and incidental expenses. CONTRACTOR shall use recognized accounting methods in preparing invoices and reports. ANAHEIM reserves the right to designate its own employee representative(s) or its contracted representative(s) with a certified public accounting firm who shall have the right to audit CONTRACTOR's accounting procedures and internal controls of CONTRACTOR's financial systems and to examine any cost, revenue, payment, claim, other records or supporting documentation resulting from any items set forth in this Master Agreement. If CONTRACTOR fails to provide supporting documentation satisfactory to ANAHEIM for any costs charged ANAHEIM, then CONTRACTOR agrees that ANAHEIM may delete such items from the invoice or CONTRACTOR shall reimburse ANAHEIM for those costs. Any audit(s) shall be undertaken by ANAHEIM or its representative(s) at reasonable times and in conformance with generally accepted auditing standards. CONTRACTOR agrees to fully cooperate with all audit(s).

2. This right to audit shall extend during the length of this Master Agreement and for a period of three (3) years, or longer if required by law, following the date of final payment of the last Work Order Package or Request performed by CONTRACTOR. CONTRACTOR agrees to retain all necessary records/documentation for the entire length of this audit period.

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3. CONTRACTOR will be notified in writing of any exception taken as a result of an audit or pre-payment review of an invoice. Any adjustments and/or payments which must be made as a result of any audit or inspection of CONTRACTOR's invoices and/or records shall be made within thirty (30) days from presentation of ANAHEIM's findings to CONTRACTOR. If CONTRACTOR fails to make a required adjustment or payment, CONTRACTOR agrees to pay interest, accruing monthly, at a rate of ten percent (10%) per annum unless another part of this Master Agreement specifies a higher rate of interest, then the higher rate will prevail. Interest will be computed from the date of written notification of exception(s) to the date CONTRACTOR reimburses ANAHEIM for any exception(s). If an audit inspection or examination in accordance with this article discloses overcharges (of any nature) by CONTRACTOR to ANAHEIM in excess of one percent (1%) of the value of that portion of the contract that was audited, the actual cost of ANAHEIM's audit shall be reimbursed to ANAHEIM by CONTRACTOR. CONTRACTOR reserves the right to contest any exception.

4. CONTRACTOR shall include a similar clause in its agreements with subcontractors reserving the right to designate its own employee representatives from a certified public accounting firm, and/or representative(s) from ANAHEIM, who shall have the right to audit and to examine any cost, payment, settlement or other supporting documentation resulting from any item set forth in its agreements.

Q. Indemnity and Insurance.

1. Indemnity. CONTRACTOR agrees to indemnify, defend, and hold harmless ANAHEIM, its officials, agents, employees, and representatives, from and against any and all claims, demands, defense costs and liability of any kind or nature (collectively referred to hereinafter as "Claims") arising out of or in connection with CONTRACTOR's (or CONTRACTOR's subcontractors', if any) performance or failure to perform work performed by or on behalf of CONTRACTOR, or goods or services provided by or on behalf of CONTRACTOR under the terms of this contract; except for those Claims which arise out of the sole negligence or willful misconduct of ANAHEIM. Such agreement shall be in effect without regard to whether or not ANAHEIM, CONTRACTOR, or any other person or entity maintains or

fails to maintain insurance coverage for any such Claims. The obligations set forth in this indemnification/defense provision shall survive the termination of this Master Agreement. ANAHEIM's Risk Manager is hereby authorized to amend the requirements set forth herein in the event that such amendment is in ANAHEIM's best interest.

2. Insurance. Without limiting ANAHEIM's right to indemnification, the Parties agree that CONTRACTOR shall secure, prior to commencing any activities under this Master Agreement, and maintain, during the Term of this Master Agreement, insurance coverage as follows:

Workers' Compensation Insurance as required by California law and Employers Liability Insurance in an amount not less than $1,000,000.00 per occurrence.

Commercial General Liability Insurance, including coverage for Premises and Operations, Contractual Liability, Personal Injury Liability, Products/Completed Operations Liability, and Independent Contractors' Liability (if applicable), in an amount of not less than Two Million Dollars ($2,000,000.00) per occurrence, Four Million Dollars ($4,000,000.00) annual aggregate, written on an occurrence form.

Comprehensive Automobile Liability coverage; including, as applicable, owned, non-owned and hired autos, in an amount of not less than Two Million Dollars ($2,000,000.00) per occurrence, combined single limit, written on an occurrence form.

The General Liability and Auto Liability Insurance required herein shall include coverage insuring against CONTRACTOR's indemnification obligations set forth herein, provided that this provision shall not diminish any rights ANAHEIM may have as an additional insured under this insurance.

If CONTRACTOR maintains broader coverage and/or higher limits than the minimums shown above, ANAHEIM requires and shall be entitled to the broader coverage and/or the higher limits maintained by CONTRACTOR. Any available insurance proceeds in excess of the specified minimum limits of insurance and coverage shall be available to ANAHEIM.

The Worker's Compensation and Liability Insurance policies required herein shall

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each provide for a waiver of subrogation in favor of ANAHEIM.

ANAHEIM's Risk Manager is hereby authorized to reduce the requirements set forth herein in the event he/she determines that such reduction is in ANAHEIM's best interest.

Each insurance policy required by this Master Agreement shall contain the following clause or shall otherwise provide for the following conditions:

> "This insurance shall not be canceled, limited in scope or coverage, or non-renewed until after thirty (30) days prior written notice has been given to the City Clerk, City of Anaheim, 200 S. Anaheim Blvd., Anaheim, CA 92805, except in the event of cancellation for non-payment of premium which shall provide for not less than ten (10) days notice."

Each insurance policy required by this Master Agreement, except policies for Workers' Compensation, shall contain the following clauses or shall otherwise provide for the following conditions:

> "It is agreed that any insurance maintained by CONTRACTOR pursuant to this Master Agreement shall be primary to, and not contribute with, any insurance or self-insurance maintained by the City of Anaheim."
>
> "The City of Anaheim, its officers, agents, employees, representatives and volunteers are added as additional insureds as respects acts, omissions, operations, goods or work provided, or activities of, or on behalf of, the named insured under an agreement or contract with the City of Anaheim."

Prior to commencing any Work under this Master Agreement, CONTRACTOR shall deliver to ANAHEIM insurance certificates confirming the existence of the insurance required by this Master Agreement, and including the applicable clauses referenced above. Also, within thirty (30) days of the execution date of this Master Agreement, CONTRACTOR shall provide to ANAHEIM (i) endorsements to the insurance policies which add to these policies the

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applicable clauses referenced above, or (ii) in lieu of said endorsements, documentation acceptable ANAHEIM evidencing that the coverage, terms, and conditions set forth in the above-referenced clauses are otherwise included in said insurance policies. Should it be deemed necessary by ANAHEIM, it shall be CONTRACTOR's responsibility to see that ANAHEIM receives documentation acceptable to ANAHEIM which sustains that the individual signing said endorsements is indeed authorized to do so by the insurance company. Insurance required hereunder shall be placed with insurers (i) admitted to write insurance in California, (ii) possessing A.M. Best's rating of A VII or higher, or (iii) otherwise acceptable to ANAHEIM, with prior written permission from ANAHEIM. In the event that (i) a claim or other legal action is filed against ANAHEIM, and ANAHEIM, in its good faith opinion, believes it may have coverage under any of the insurance required herein, and (ii) the issuer of any such insurance has failed to fully accept, without reservation, ANAHEIM's submission of said claim or legal action, then ANAHEIM has the right to demand, and to receive within a reasonable time period, copies of the insurance policies related to such required insurance; provided, however, that this provision shall not apply if the Parties agree that CONTRACTOR shall fully defend, hold harmless, and indemnify ANAHEIM against any such claim or other legal action.

3. Remedies. In addition to any other remedies ANAHEIM may have if CONTRACTOR fails to provide or maintain any insurance policies or policy endorsements to the extent and within the time herein required, ANAHEIM may, at its sole option:

a. Order CONTRACTOR to stop Work under this Master Agreement and/or withhold any payment(s) which become due to CONTRACTOR hereunder until CONTRACTOR demonstrates compliance with the requirements hereof;

b. Terminate this Master Agreement.

Exercise of any of the above remedies, however, is an alternative to other remedies ANAHEIM may have and is not the exclusive remedy for CONTRACTOR's failure to maintain insurance or secure appropriate endorsements.

4. Subcontractors.

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a. Nothing herein contained shall be construed as limiting in any way the extent to which CONTRACTOR may be held responsible for payment of damages to persons or property resulting from CONTRACTOR's, or CONTRACTOR's contractors/subcontractor's, if any, performance of the Work covered under this Master Agreement.

b. In the event CONTRACTOR hires other persons or firms to perform some of the Work related to this Master Agreement, CONTRACTOR shall ensure (i) that the acts or omissions of such persons or firms are covered under the above-referenced liability insurance, or (ii) that such firms maintain insurance equal to or better than and subject to the same limits, terms and conditions as, the insurance required of CONTRACTOR under this Master Agreement; and in either instance, CONTRACTOR shall provide, or cause to be provided, evidence of such insurance coverage, reasonably acceptable to ANAHEIM.

R. Required Bonds. At the execution of this Master Agreement, CONTRACTOR shall provide both a performance bond and a bond for payment for labor and material to secure its performance of Work under this Master Agreement. CONTRACTOR shall maintain these bonds for the entire Term of this Master Agreement. Each bond shall be written in the principal amount of not less than One Hundred and Fifty Thousand Dollars ($150,000.00) and in the form set forth in the Sample Faithful Performance Bond attached hereto as Appendix B and Sample Labor and Material Bond attached hereto as Appendix C. However, should the total value of all Work awarded to CONTRACTOR but not yet completed by CONTRACTOR and accepted by ANAHEIM exceed $150,000.00 at any time, CONTRACTOR agrees to increase the principal amount of its bonds to an amount not less than the total value of CONTRACTOR's outstanding Work Order Packages and/or Requests. CONTRACTOR shall not commence any Work unless and until CONTRACTOR has complied with the foregoing. This higher bond amount shall be maintained until one or more outstanding Work Orders Packages or Requests have been completed and a corresponding portion of the bond has been released by ANAHEIM. At that time the total principal amount of the bonds may be reduced to the new total amount of all Work Orders or Requests then awarded but not yet completed and accepted by ANAHEIM. Notwithstanding the above, in no event shall the principal amount of

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each of the bonds be less than One Hundred and Fifty Thousand Dollars ($150,000.00) at any time during the Term of this Master Agreement, including any extensions. All bonds shall be written with surety (i) authorized to do business in the State of California by the California Department of Insurance, and (ii) listed on the most current version of the Department of Treasury's Circular 570. Bonds shall be in the form set forth in Appendices B and C, attached hereto, and any bond riders issued to increase or decrease the principal amount shall be on forms acceptable to ANAHEIM. All signatures by principals and sureties on bonds and any bond riders shall be notarized. ANAHEIM will not reimburse CONTRACTOR for the premium of the initial principal bond amount of One Hundred and Fifty Thousand Dollars ($150,000.00); however, CONTRACTOR will be allowed to include a bond fee, in the cost of each Work Order or Request, corresponding to the value of the awarded Work Order Package or Request.

S. Breach of Agreement. CONTRACTOR shall not be relieved of liability to ANAHEIM for damages sustained by ANAHEIM by virtue of any breach of this Master Agreement by CONTRACTOR, and ANAHEIM may withhold any payments to CONTRACTOR for the purpose of set-off until the exact amount of damages due ANAHEIM from CONTRACTOR is determined. In addition, ANAHEIM may pursue all remedies available under law for breach of this Master Agreement. The waiver by either Party of any breach to this Master Agreement shall not constitute a waiver as to any succeeding breach.

T. Compliance with Laws.

1. In the performance of this Master Agreement, CONTRACTOR shall abide by and conform to (and shall ensure that CONTRACTOR's contractors and/or subcontractors, if any, shall abide by and conform to) any and all applicable laws, statutes, safety rules, and practices of the United States, the State of California, the Charter, Ordinances, and Operating Orders of the City of Anaheim, and any other applicable local laws (collectively, Laws and Practices). Further, CONTRACTOR warrants that all Work done under this Master Agreement shall be in strict compliance with all Laws and Practices, including, but not limited to, Cal/OSHA, AQMD and EPA regulations.

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2. ANAHEIM's Representative may enter the jobsite to make reasonable inspections to monitor compliance with the Laws and Practices and with the terms of this Master Agreement. CONTRACTOR shall at all times maintain proper facilities and provide safe access for inspection by ANAHEIM's Representative to all parts of the jobsite. When specifications in a Work Order Package or Request require Work to be specially tested or approved, it shall not be tested or approved without timely advance notice to ANAHEIM's Representative of its readiness for testing and approval and without prior written consent by ANAHEIM's Representative.

3. If ANAHEIM's Representative identifies an occurrence of noncompliance with Laws and Practices, he or she may inform CONTRACTOR's Representative of the occurrence and require that CONTRACTOR's Representative promptly bring the jobsite into compliance with Laws and Practices.

4. If ANAHEIM's Representative identifies a situation which, in the opinion of the Representative, constitutes an immediate potential for bodily harm or significant property damage, he or she may contact CONTRACTOR's Representative and recommend that Work be stopped until the situation is rectified to the satisfaction of ANAHEIM's Representative.

5. If ANAHEIM's Representative identifies a noncompliance situation which, in his/her opinion, constitutes an imminent danger of serious bodily harm or death, ANAHEIM's Representative may contact CONTRACTOR's Representative and request that the situation be rectified to the satisfaction of ANAHEIM's Representative.

6. The election of ANAHEIM to exercise or not exercise its rights under these provisions shall impose no liability on ANAHEIM nor shall it relieve CONTRACTOR of any duties or obligations under the terms of this Master Agreement, provided that ANAHEIM's Representative acted in good faith in the exercise or non-exercise of such rights.

7. CONTRACTOR shall dispose of all materials used in conjunction with the performance of this Master Agreement in strict compliance with all Laws and Practices.

8. CONTRACTOR shall not discriminate against handicapped persons in the provision of services and shall provide accessibility for handicapped persons to the services provided under this Master Agreement. CONTRACTOR shall comply with all applicable

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requirements of the Americans with Disabilities Act of 1990 and implementing regulations (28 CFR Parts 35-36) in order to provide handicapped accessibility to the extent readily achievable.

9. CONTRACTOR certifies and agrees that all persons employed or applying for employment by it, its affiliates, or holding companies, and all subcontractors, bidders and vendors, are and will be treated equally by it without regard to, or because of race, color, religion, sex, marital status, national origin or ancestry, pregnancy, childbirth or related medical condition, medical condition (cancer related) in compliance with all anti-discrimination laws and regulations of the United States, the State of California and ANAHEIM as they now exist or may hereafter be amended.

10. CONTRACTOR shall allow representatives of ANAHEIM access to CONTRACTOR's employment records related to this Master Agreement during regular business hours to verify compliance with these provisions when so requested by ANAHEIM.

U. Labor Code.

1. ANAHEIM and CONTRACTOR acknowledge that this Master Agreement is subject to the provisions of Division 2, Part 7, Chapter 1 (commencing with Section 1720) of the California Labor Code relating to public works and public agencies and agree to be bound by all the provisions thereof as though set forth fully herein. Full compensation for conforming to the requirements of the Labor Code and with other Federal, State and local laws related to labor, and rules, regulations and ordinances which apply to any Work performed pursuant to this Master Agreement shall be considered as included in the price for all contract items of Work involved.

2. This Master Agreement is further subject to prevailing wage law, including, but not limited to, the following:

a. The CONTRACTOR shall pay the prevailing wage rates for all Work performed under the Master Agreement. When any craft or classification is omitted from the general prevailing wage determinations, the CONTRACTOR shall pay the wage rate of the craft or classification most closely related to the omitted classification. The CONTRACTOR shall forfeit as a penalty to ANAHEIM the amount of $50.00 or any greater penalty as provided

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in the Labor Code for each Calendar Day, or portion thereof, for each worker paid less than the prevailing wage rates for any Work done under the Master Agreement employed in the execution of the Work by CONTRACTOR or by any subcontractor under CONTRACTOR in violation of the provisions of the Labor Code. In addition, the difference between applicable prevailing wage rates and the amount paid to each worker for each Calendar Day, or portion thereof, for which each worker was paid less than the prevailing wage rate shall be paid to each worker by the CONTRACTOR.

b. CONTRACTOR shall comply with the provisions of Labor Code Section 1777.5 concerning the employment of apprentices on public works projects, and further agrees that CONTRACTOR is responsible for compliance with Section 1777.5 by all of its subcontractors.

c. Pursuant to Labor Code Section 1776, CONTRACTOR and any subcontractor shall keep accurate payroll records, showing the name, address, social security number, work classification, straight time and overtime hours worked each day and week, and the actual per diem wages paid to each journeyman, apprentice, worker, or other employee employed by CONTRACTOR or any subcontractor in connection with this Master Agreement. Each payroll record shall contain or be verified by a written declaration that it is made under penalty of perjury, stating both of the following: (1) the information contained in the payroll record is true and correct; and (2) the employer has complied with the requirements of Labor Code Sections 1811 and 1815 for any work performed by its employees on any portion of the Work. The payroll records enumerated under this Subpart shall be certified and shall be available for inspection at all reasonable hours as required by Labor Code Section 1776.

d. This Master Agreement is further subject to 8-hour work day and wage and hour penalty law, including, but not limited to, Labor Code Sections 1810 and 1813, as well as California nondiscrimination laws, as follows: CONTRACTOR shall strictly adhere to the provisions of the Labor Code regarding the 8-hour day and the 40-hour week, overtime, Saturday, Sunday and holiday work and nondiscrimination on the basis of race, religious creed, color, national origin, ancestry, physical disability, mental disability, medical condition, marital

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status, sex or sexual orientation, except as provided in Section 12940 of the Government Code. Pursuant to the provisions of the Labor Code, eight hours' labor shall constitute a legal day's work. Work performed by CONTRACTOR's employees in excess of eight hours per day, and 40 hours during any one week, must include compensation for all hours worked in excess of eight hours per day, or 40 hours during any one week, at not less than one and one-half times the basic rate of pay. CONTRACTOR shall forfeit as a penalty to ANAHEIM an amount of $25.00 or any greater penalty set forth in the Labor Code for each worker employed in the execution of the Work by CONTRACTOR or by any subcontractor of CONTRACTOR, for each Calendar Day during which such worker is required or permitted to Work more than eight (8) hours in one Calendar Day or more than 40 hours in any one calendar week in violation of the provisions of the Labor Code.

e. CONTRACTOR shall at all times comply with the express requirements of Labor Code Sections 1725.5, 1771.1, 1771.4 and 1776, including but not limited to the contractor and subcontractor registration and requirements related to certified payroll records.

f. This Master Agreement is subject to Public Contract Code Section 6109: CONTRACTOR shall be prohibited from performing Work subject to this Master Agreement with a subcontractor who is ineligible to perform the Work pursuant to Sections 1777.1 or 1777.7 of the Labor Code.

V. Confidentiality.

1. "Confidential Information" means, with respect to a Party hereto, all information or material which either (1) is marked or identified as "Confidential," "Restricted," or "Proprietary Information" or other similar marking or identification, or (2) the other Party knew, as recipient, or under the circumstances, should have known, was considered confidential or proprietary by the Disclosing Party (as defined below). Confidential Information shall consist of all information, whether in written, oral, electronic, or other form, furnished in connection with this Agreement by the Disclosing Party or its Representatives ("Representative" is defined as any elected and appointed officials, affiliate, director, officer, employee, agent, advisor or

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consultant of a Party or any of its subsidiaries or affiliates) to the Receiving Party (as defined below) or to its Representatives, and specifically includes but is not limited to ANAHEIM's individually identifiable customer information, and ANAHEIM's customer usage data and financial data.

2. CONTRACTOR and ANAHEIM shall each hold the other's Confidential Information in confidence. Neither Party shall make the other's Confidential Information available in any form to any third party or use the other's Confidential Information for any purpose other than as specified in this Agreement. The Party providing Confidential Information ("Disclosing Party") to the other Party ("Receiving Party") shall remain the sole owner of such information. Except as provided elsewhere within this Agreement, nothing contained in this Agreement shall be construed as granting or conferring any right or license in any Confidential Information or in any patents, copyrights, software or other technology, either expressly or by implication to the Receiving Party, or to its Representatives or to others. The term Confidential Information shall not include any of the following: (1) information already in possession of, or already known to, the Receiving Party as of the Effective Date without an obligation of confidentiality; (2) information in the public domain at the time of the disclosure, or which, after such disclosure, enters into the public domain through no breach of this Agreement by the Receiving Party or its Representative(s); (3) information lawfully furnished or disclosed to the Receiving Party by a non-party to this Agreement without any obligation of confidentiality and through no breach of this Agreement by the Receiving Party or its Representative(s); (4) information independently developed by the Receiving Party without use of any Confidential Information of the Disclosing Party; or (5) information authorized in writing by the Disclosing Party to be released from the confidentiality obligations herein.

3. By virtue of this Agreement, each Party hereto may disclose to the other Party information that is Confidential Information. This Agreement does not diminish, revoke or supersede any existing confidentiality, non-disclosure or similar agreement between the Parties that does not pertain to the subject matter of this Agreement. However, any Confidential Information, whether or not previously disclosed, that pertains to the subject matter of this

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Agreement shall be governed by the terms of this Section V, which shall supersede any such previous agreement with respect to such Confidential Information and any Confidential Information relating to the subject matter of this Agreement that was exchanged under such previous agreement it shall be treated as though it was exchanged under this Agreement as of the date of such exchange.

4. The Receiving Party will treat all Confidential Information of the Disclosing Party, no matter written, electronic, or oral, as confidential and proprietary, and the Receiving Party shall only use such information in furtherance of this Agreement. As such, the Receiving Party shall hold in confidence the Confidential Information of the Disclosing Party, and ensure that such Confidential Information is not disclosed to any other person or entity, except as expressly permitted by this Agreement or as authorized in writing by the Disclosing Party. Receiving Party shall not disclose Confidential Information of the Disclosing Party received under this Agreement to any person other than its Representatives who require knowledge of such Confidential Information in furtherance of this Agreement. The Receiving Party shall inform its Representatives of the confidential nature of the Confidential Information of the Disclosing Party and advise such Representatives of the limitations on the use and disclosure and prohibition on making copies or summaries of such Confidential Information. The Receiving Party shall be responsible for any breach of this Agreement by its Representatives. Neither Party shall use the Confidential Information of the other Party for any commercial purpose.

5. If the Receiving Party becomes legally compelled (by oral questions, interrogatories, request for information or documents, subpoena, civil investigative demand, or similar process) to disclose any Confidential Information of the Disclosing Party or is asked for Confidential Information pursuant to the California Public Records Act or similar law, the Receiving Party will provide the Disclosing Party with written notice of such an occurrence (if so permitted) as soon as possible. Thereafter, at its sole costs and expense, the Disclosing Party may seek a protective order or other appropriate remedy, or waive compliance with the provisions of this Agreement. So long as it is consistent with applicable law, the Receiving Party

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will not oppose action by, and the Receiving Party will cooperate with, the Disclosing Party, at the Disclosing Party's sole cost and expense, to obtain an appropriate protective order or other reliable assurance that confidential treatment will be accorded the Confidential Information. If the Disclosing Party fails to obtain such protective order or other remedy, or if the Disclosing Party waives compliance with the requirements of the preceding sentence, the Receiving Party will disclose only Confidential Information that it is legally required to disclose, and will exercise commercially reasonable efforts, at Disclosing Party's expense, to obtain reliable assurance that confidential treatment will be accorded the Confidential Information so disclosed.

6. In the event the Receiving Party discloses, disseminates or releases any Confidential Information, except as expressly permitted by this Agreement, such disclosure, dissemination or release will be deemed a material breach of this Agreement and the Disclosing Party may demand prompt return of all Confidential Information previously provided to the Receiving Party. As soon as the Receiving Party becomes aware that it has made an unauthorized disclosure of Confidential Information, the Receiving Party shall take any and all necessary actions to recover the improperly disclosed Confidential Information and immediately notify Disclosing Party regarding the nature of the unauthorized disclosure and the corrective measures being taken. Each Party agrees that any breach of their confidentiality obligations could cause irreparable harm to the other Party, the amount of which would be extremely difficult to estimate. Accordingly, it is understood and agreed that monetary damages would not be a sufficient remedy for any material breach of this Agreement and that specific performance and injunctive relief in addition to monetary damages shall be appropriate remedies for any breach or any threat of such breach. The provisions of this Paragraph are in addition to any other legal rights or remedies the Disclosing Party may have.

7. Within two (2) weeks of the termination of this Agreement, CONTRACTOR will return to ANAHEIM or destroy, to the extent permitted by law, any and all Confidential Information, including all originals, copies, translations, transcriptions or any other form of material, without retaining any copy or duplicate thereof; provided that CONTRACTOR may retain Confidential Information contained on backup media created in the ordinary course of

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business provided further that there is no effort to access such Confidential Information and CONTRACTOR's confidential obligations with respect to such information shall continue so long as such information is retained. CONTRACTOR shall certify in writing the destruction of the Confidential Information. ANAHEIM may perform an audit of CONTRACTOR's records to confirm the return or destruction of the Confidential Information. ANAHEIM shall have this audit right for three (3) years after the termination of this Agreement.

8. Notwithstanding the termination of this Agreement, this Confidentiality Section shall survive the expiration or earlier termination of this Agreement.

PART IV - GENERAL PROVISIONS

A. Notification.

1. Any notice may be served upon ANAHEIM by personal delivery in writing, or by facsimile, confirmed by mail, or by telegram, or by depositing it in a United States mail deposit box with the postage thereon, fully prepaid and addressed to ANAHEIM at the address hereinafter set forth; and in the case of CONTRACTOR, may be served upon CONTRACTOR by personal delivery in writing, or by facsimile, or by telegram, or by depositing it in a United States mail deposit box with the postage thereon fully prepaid, and addressed to CONTRACTOR at the address hereinafter set forth:

ANAHEIM:	City of Anaheim Attention: City Clerk 200 S. Anaheim Boulevard, Suite 217 Anaheim, CA 92805 Telephone: (714) 765-5166 Facsimile: (714) 765-4105
WITH COPIES TO:	City of Anaheim Attention: Public Utilities General Manager 201 South Anaheim Boulevard, Suite 1101 Anaheim, CA 92805 Telephone: (714) 765-4157 Facsimile: (714) 765-4138
AND	

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City of Anaheim
Attention: Director of Public Works
200 South Anaheim Boulevard, Suite 276
Anaheim, CA 92805
Telephone: (714) 765-5700
Facsimile: (714) 765-5225

CONTRACTOR: **[INSERT NAME, ADDRESS, TELE/FAX]**

2. Upon written notice to each Party concerned, served by means provided in the above paragraph, either Party may change the above addresses. The General Manager is authorized to give the notices required herein to be given on behalf of ANAHEIM.

B. Independent Contractor.

1. The performance of CONTRACTOR's Work hereunder shall be in the capacity of an independent contractor and not as an officer, agent, or employee of ANAHEIM. In consideration for the compensation paid to CONTRACTOR by ANAHEIM, CONTRACTOR agrees that ANAHEIM shall not be liable or responsible for any benefits, including, but not limited to, worker's compensation, disability, retirement, life, unemployment, health or any other benefits and CONTRACTOR agrees that it shall not sue or file a claim, petition or application therefor against ANAHEIM or any of its officers, employees, agents, representatives, or sureties.

2. CONTRACTOR shall at all times be responsible for the acts and omissions of subcontractors and individuals directly or indirectly employed by it. CONTRACTOR is responsible for performance of all the Work, whether performed by CONTRACTOR or its subcontractors. The Work Order Package and/or Request shall not give rise to any contractual relationship between ANAHEIM and a subcontractor. ANAHEIM shall not undertake any obligation to pay or to be responsible for the payment of any sums to any subcontractor.

C. Successors and Assigns. All of the terms, conditions and provisions hereof shall inure to the benefit of and be binding upon the Parties hereto and their respective successors and assigns, provided, however, that no assignment of this Master Agreement shall be

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made without the prior written consent of the Parties to this Master Agreement, which consent shall not be unreasonably withheld.

D. Laws Governing Construction of Terms. This Master Agreement shall be governed by the laws of the State of California. Any legal action concerning or arising out of this Master Agreement shall be filed in a court of the State of California having jurisdiction of the subject matter, and venue shall be in the County of Orange, State of California.

E. Service of Process. CONTRACTOR hereby designates the City Clerk of the City of Anaheim as its local agent for service of process in any legal action or proceeding that may arise out of or in connection with this Master Agreement. ANAHEIM shall transmit to CONTRACTOR a copy of any legal process served on the Anaheim City Clerk on the same date as service is made, in the manner set forth above.

F. Complete Agreement. This Master Agreement constitutes the complete and entire agreement between the Parties and supersedes any previous communications, representations or agreements, whether oral or written, with respect to the subject matter hereof. There are no additions to, or deletions from, or changes in any of the provisions hereof, and no understandings, representations or agreements concerning any of the same, which are not expressed herein, unless stated below. No modification or revision shall be of any force or effect, unless the same is in writing and executed by the Parties hereto. THE PARTIES HEREBY AGREE THAT NO TRADE USAGE, PRIOR COURSE OF DEALING OR COURSE OF PERFORMANCE UNDER THIS MASTER AGREEMENT SHALL BE A PART OF THIS MASTER AGREEMENT OR SHALL BE USED IN THE INTERPRETATION OR CONSTRUCTION OF THIS MASTER AGREEMENT. ANAHEIM has provided the following Appendices to CONTRACTOR, which are incorporated herein by this reference:

Appendix A - Estoppel Certificate

Appendix B - Sample Faithful Performance Bond

Appendix C - Sample Labor and Material Bond

Appendix D - Equipment Specifications

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Appendix E - Instrumentation and Electrical Specifications

Appendix F - Civil Work Specifications

Appendix G - Mechanical Specifications

CONTRACTOR acknowledges receipt of these Appendices. In addition to the Appendices, the following contract documents are incorporated into this Master Agreement by reference as if fully set forth herein: the Non-collusion Affidavit, Equal Employment Opportunity Certificates of Compliance, Special Provisions, Water System Standard Specifications, the Standard Specifications Supplement, the Standard Specifications, the Proposal, and the General Scope of Work (Exhibit A hereto). ANAHEIM has provided the foregoing documents to CONTRACTOR, and CONTRACTOR acknowledges receipt of these incorporated documents. If any provision of this Master Agreement shall be held invalid, the invalidity shall not affect the other provisions hereof, and to this extent, the provisions of this Master Agreement are intended to be and shall be deemed severable.

G. Counterparts. This Master Agreement may be executed in any number of counterparts, each of which shall be deemed an original, but all of which shall constitute one and the same instrument.

H. Headings. The headings herein set out are for convenience of reference only and shall not be deemed a part of this Master Agreement.

I. Time of Essence. Time is expressly agreed to be of the essence of this Master Agreement, a Work Order Package and/or Request, and each, every and all of the terms, conditions and provisions herein.

J. Effective Date and Authority. The effective date of this Master Agreement shall be the date of ANAHEIM's execution herein. In the event CONTRACTOR fails to set forth a date of execution opposite the name(s) of CONTRACTOR's signator(s), CONTRACTOR hereby authorizes ANAHEIM, by and through its representative, to insert the date of execution by CONTRACTOR's signator(s) as the date this Master Agreement, as executed by CONTRACTOR, is received by ANAHEIM.

OFFICE OF THE CITY ATTORNEY
CITY OF ANAHEIM
200 S. ANAHEIM BOULEVARD, SUITE 356
ANAHEIM, CA 92805
(714) 765-5169
FAX (714) 765-5123

CONTRACTOR and CONTRACTOR's signators represent that the signators hold the positions set forth below their signatures and that the signators are authorized to execute this Master Agreement on behalf of CONTRACTOR and to bind CONTRACTOR hereto.

IN WITNESS WHEREOF, the Parties hereto have caused this Master Agreement to be executed on the dates hereinafter respectively set forth.

DATE: _____

CITY OF ANAHEIM,
a municipal corporation

By:_____
Dukku Lee,
Public Utilities General Manager

DATE:_____

ATTEST

By:_____
Theresa Bass, City Clerk

Contractor's Legal Name, Type of Entity (e.g. a corporation)

DATE:_____

By:_____

Printed Name:_____

Title:_____

"CONTRACTOR"

APPROVED AS TO FORM:
ROBERT FABELA, CITY ATTORNEY

By:_____
Daniel J. Payne
Deputy City Attorney

OFFICE OF THE CITY ATTORNEY
CITY OF ANAHEIM
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EXHIBIT A

GENERAL SCOPE OF WORK

[ATTACHED BEHIND THIS PAGE]

OFFICE OF THE CITY ATTORNEY
CITY OF ANAHEIM
200 S. ANAHEIM BOULEVARD, SUITE 356
ANAHEIM, CA 92805
(714) 765-5169
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EXHIBIT A

GENERAL SCOPE OF WORK

PART A: CONSTRUCTION, MAINTENANCE SERVICES

The City of Anaheim ("ANAHEIM") requires the services of CONTRACTOR, on an as-needed basis, for the construction, maintenance, repair, abandonment, relocation and immediate response services ("WORK") in connection with its water production, transmission, and distribution systems ("Water System"). Except for Immediate Response Services, which are defined and addressed below in Part B, typical WORK will include, but not be limited to, the following:

1. Work Order Categories

a. **WORK ORDER CATEGORY NO. 1 (Water System Components)** WORK will consist of, abandoning, repairing, relocating, extending, replacing, and installing water infrastructure system components, including, but not limited to vaults, valves, meter vaults, meter vault lids, conduits, substructures, welding, inspecting and evaluating damages and restoring service to water distribution, production, and/or communication facilities, and other water facilities as needed. WORK may further consist of earthwork, excavation, trenching, backfilling, landscaping, and slope maintenance as needed.

b. **WORK ORDER CATEGORY NO. 2 (Transmission & Distribution Pipelines)** WORK will consist of, abandoning, repairing, relocating, extending, replacing, and installing water infrastructure system components, including, but not limited, water mains at any depth and associated appurtenances including, but not limited to, fire hydrants, large services (3" and above), small services (below 3"), linestops, valves, conduits, substructures, welding, inspecting and evaluating damages and restoring service to water distribution, production, and/or communication facilities, and other water facilities as needed. WORK may further consist of earthwork, excavation, trenching, backfilling, landscaping, and slope maintenance as needed.

c. **WORK ORDER CATEGORY NO. 3 (Motors & Pumps)** –

- WORK will consist of, but not be limited to pulling, inspecting, testing, dismantling, rewinding, cleaning, repairing, overhauling, replacing parts, balancing, reassembling, resistance testing, performing running tests, painting, replacing, and installing (i) horizontal and vertical induction motors for municipal Water System pumps, (ii) split-case horizontal, end-suction, axial and mixed flow, and vertical turbine centrifugal pumps, and (iii) diesel engine pumps for ANAHEIM water supply booster stations, deep wells, and treatment plants.
- All WORK shall be done in accordance with Model Repair Specifications for Low Voltage Induction Motors, latest edition, including all supplements, as written and promulgated by the U.S. Department of Energy's Office of Industrial Technologies (OIT). Copies of the Model Repair Specifications for Low Voltage Induction Motors specifications may be obtained from Office of Industrial Technologies Energy Efficiency and Renewable Energy, U.S. Department of Energy, Washington, D.C. 20585, telephone (800) 862-2086.

d. **WORK ORDER CATEGORY NO. 4 (Electrical & Instrumentation)** –

- WORK will consist of, but not be limited to, repairing, replacing, and installing medium and low voltage electrical conduits, cables and conductors, motor control center components, electrical panel lineups, plant wiring, Supervisory Control and Data Acquisition (SCADA) system components, instrumentation, communication system components, security cameras, door/gate access controls, and main control panels for ANAHEIM Water System.
- WORK will include, but not be limited to, trenching for conduits; constructing concrete pads for meter pedestals, junction boxes, cabinets, and panels; wiring terminations; primary and secondary conductor installations; replacing and installing conduits; pulling wires; meter and panel installations; pump motor starter installations and pump wiring hook ups; circuit breaker repairs, replacements, and installations; transformer repairs, replacements, and

installations; troubleshooting and repairing failed and tripped circuits; bringing power to remote valves, pumps, water pressure regulating stations, wells, water storage tanks, water reservoirs, water pump stations, and other water facilities; electrical panel lineups repairs, replacements, and installations; troubleshooting and testing damaged system components; repairing and replacing communication and power conduit and wiring; repairing, replacing, and calibrating instrumentation equipment such as, pressure transmitters, flow transmitters, vibration transmitters, level transmitters, alarm switches, solenoid valves, limit switches, pilot systems, analyzers, valve actuators, and etc.; replacing control panels; installing variable frequency drives and solid state reduced voltage (soft) starters and associated components; installing and mounting equipment hardware in new and existing systems and panels such as, programmable logic controllers (PLCs), human-machine interfaces (HMIs), radios and antennas, uninterrupted power supplies (UPSs), servers and desktop personal computers (PCs), networking equipment and switches, alarm devices, sensors, closed circuit television and surveillance cameras, and meters; and performing final wire and communication terminations, testing and start-up of systems; and other related work.

e. **WORK ORDER CATEGORY NO. 5 (Welding)** –

- WORK will consist of, but not be limited to, the welding for repair of water transmission mains, distribution mains, vault hatches/covers and other Water System components as needed.

2. Conditions Common to All Work Order Categories

a. WORK will also include, but not be limited to, setting up traffic control, excavating within the limits specified on the plans or as directed by the Engineer, potholing existing underground water facilities, utilities, conduits and/or substructures, coordinating the surveying of the construction staking, and backfilling, compacting, and replacing pavement or concrete within the limits specified.

b. CONTRACTOR shall provide traffic control per the current Manual on Uniform Traffic Control Devices, subject to modifications by ANAHEIM's Public Works Construction Services Division and Traffic & Transportation Services as needed to accommodate field conditions. CONTRACTOR shall submit a traffic control plan at least fourteen (14) days prior to the start of construction to ensure approval by Construction Services Division and Traffic & Transportation Services. CONTRACTOR shall set up required traffic control, and access shall comply with Section 7-10 of the latest edition of the "Standard Specifications for Public Works Construction" at the time of the Work Order Package, and any supplements (collectively, "Standard Specifications").

c. CONTRACTOR shall provide shoring or bracing per Subsection 306-1.1.6 of the Standard Specifications and shall meet all Cal OSHA requirements. Trench excavations shall be closed by backfill or steel traffic plating at the close of the WORK period during the construction stage, depending upon the location of the trench, traffic conditions, and the total non-working hours the trench would be left open. If a trench must remain open, steel plates of adequate thickness to support traffic may be placed over the excavations. All other open excavations shall be protected from pedestrian and vehicular traffic and all public access by fencing or other effective means in a manner approved by the Engineer. CONTRACTOR shall provide temporary chain link fencing at least 6 feet (1.8 meters) high along all open excavations not attended by its personnel.

d. CONTRACTOR shall notify Underground Service Alert at least 48 hours in advance of potholing and make arrangements for the existing utilities to be marked by the affected utility companies.

e. CONTRACTOR shall provide all labor (except survey services), materials, tools, equipment and permits required to complete the WORK as per the Work Order Package or Immediate Response Services Request ("REQUEST").

f. CONTRACTOR is responsible for protecting in place all existing substructures and utilities (e.g., electrical, telephone ducts and cables, water, sewer, storm drain, gas, oil, fiber optic ducts and cable, irrigation lines, laterals, and manholes). CONTRACTOR shall, at its own expense, repair, replace or restore to the satisfaction of the Engineer, all property of any type or nature which has been moved, damaged or altered in any way by its operations.

g. Upon completion of the excavation, trenching, backfilling and compaction operation the CONTRACTOR shall restore to their original condition all pavements, sidewalks, curbs, gutters to the nearest joint, landscaping, fencing, irrigation, striping, traffic loops, pavement legends, raised pavement markers and roadway signs within the limits of the WORK.

h. CONTRACTOR shall maintain safe construction work areas in accordance with local, State and Federal laws, orders and regulations.

i. CONTRACTOR shall pay for all testing, except soil density and concrete cylinders, required as part of the WORK, and also arrange for and perform all testing in the presence of the "Water Utilities Inspector" designated by ANAHEIM.

j. CONTRACTOR shall coordinate with the Water Utilities Inspector to arrange for Water System shut downs, tie-ins, and activations.

k. The CONTRACTOR agrees that it is solely and completely responsible for job site conditions during the course of construction of the Project, including safety of all persons and property, that this requirement shall apply continuously, and that the CONTRACTOR shall defend, indemnify and hold harmless ANAHEIM and its officials, agents, employees and representatives from any and all liability, claims and damages, real and alleged, in connection with the performance of WORK,

excepting any liability arising from the sole negligence or willful misconduct of ANAHEIM.

l. Materials shall be furnished by ANAHEIM and/or CONTRACTOR for completion of WORK as specified in Work Order Packages prepared by the Water Engineering Division. All WORK shall be planned, executed, and completed in accordance with the Work Order Package; Work Order Drawings; ANAHEIM's Water Services Standard Specifications and applicable Special Provisions; latest edition of the Standard Specifications adopted by ANAHEIM at the time the Work Order Package is issued; the Standard Specifications Supplement and the Appendices included in Volume II of the Master Construction Agreement Proposal Package.

m. CONTRACTOR shall operate in and around active or energized equipment and shall therefore conduct itself in accordance with all applicable federal, state, and local laws, orders and regulations. CONTRACTOR shall follow ANAHEIM's Water Services Standard Specifications and applicable Special Provisions in the testing and activation of new and existing Water System components. Required System Outages shall be scheduled with and approved by ANAHEIM through the Water Utilities Inspector five (5) working days before the required date. The requirements for installing water facilities to complete the WORK shall be described in the individual Work Order Package and REQUEST.

PART B: IMMEDIATE RESPONSE SERVICES

ANAHEIM also requires the services of CONTRACTOR, on an as-needed basis, to provide expedited or emergency WORK in the form of "Immediate Response Services," which are defined by ANAHEIM to mean reporting to a job site with required resources within two (2) hours of telephone notification. Immediate Response Services WORK can be from any of the Work Order Categories described above and may include, but not be limited to, the following:

1. Inspect and evaluate damages and restore service to water distribution, production, and/or communication facilities.
2. Repair and/or replace water mains, valves, fire hydrants, services, meters, line stops, vaults, sampling stations, conduits, and substructures.
3. Weld water mains, vault hatches/covers, etc.
4. Clean up environmental/hazardous spills and by-products of combustion and/or disinfection.
5. Repair and/or replace water well, booster station, and treatment plant equipment, including but not limited to pumps, electric motors, diesel engine pumps, motor control center components, electrical panel lineups, wiring, control panel components, etc.
6. Repair and/or replace other ANAHEIM incidental utilities such as electric, sewer, storm drain, etc.
7. Repair and/or replace associated curb, gutter, sidewalk, roadway, drive approaches, etc.
8. Repair and/or replace communication, telecommunications, and SCADA facilities.
9. Earthwork, excavation, trenching, backfilling, landscaping, and slope maintenance as needed.

Materials shall be furnished by CONTRACTOR for completion of WORK. All WORK shall be planned, executed, and completed in accordance with the REQUEST; REQUEST DRAWINGS; ANAHEIM's Water Services Standard Specifications and applicable Special Provisions; latest edition of the Standard Specifications adopted by ANAHEIM at the time the REQUEST is issued; the Standard Specifications Supplement and the Appendices included in Volume II of the Master Construction Agreement Proposal Package.

CITY OF ANAHEIM

APPENDIX A

ESTOPPEL CERTIFICATE

Appendix A

Estoppel Certificate

Work Order #: _____

Work Order Title: _____

CONTRACTOR has systematically interviewed its Representative and other key personnel for the Work and all of its Subcontractors who have performed any of the Work called for by the Work Order regarding conditions encountered during performance of the Work since submission of the last application for payment and has compared such information with the Master Agreement. Based on that review, and exception for the prior unresolved claims listed below (if any) and the new claims listed below which are being submitted to ANAHEIM concurrently herewith, CONTRACTOR is not aware of any basis for claim by CONTRACTOR that it or any of its Subcontractors should receive any additional compensation or additional time for completing the Work, over and above that provided by the Work Order (as modified by amendments and Change Orders thereto issued prior to this date), and CONTRACTOR is not aware of any facts that make the expected date of Final Acceptance of the Work set forth on the most recent Schedule inaccurate. CONTRACTOR has delivered all documents and submittals required under the terms of the Master Agreement to be delivered to ANAHEIM on or prior to this date.

Executed this _____ day of _____, 200___ at _____.

CONTRACTOR'S Name

By _____

Printed Name _____

Title _____

Premium

FAITHFUL PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS:

WHEREAS, the City of Anaheim, a municipal corporation of the State of California in the County of Orange, has entered into with ___, a California corporation, License No. _____ (hereinafter called "Principal") the **2022 Five-Year Anaheim Public Utilities "CITY OF ANAHEIM MASTER CONSTRUCTION AGREEMENT -- WATER" approved by the Anaheim City Council on or around July 2022**, which said contract is hereby referred to and made a part hereof; and

WHEREAS, said Principal is required under the terms of said contract to furnish a bond for the faithful performance of said contract.

NOW, THEREFORE, we, _____, a California corporation, as Principal, and_____ _____ as Surety, are held and firmly bound unto the City of Anaheim, a municipal corporation (hereinafter called "City"), in the penal sum of **ONE HUNDRED FIFTY THOUSAND DOLLARS ($150,000.00)**, lawful money of the United States of America, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, successors, executors, and administrators, jointly and severally, firmly by these presents.

The condition of this obligation is such that, if the above bounded Principal, his, her or its heirs, executors, administrators, successors or assigns, shall in all things stand to and abide by and well and truly keep and perform all the undertakings, terms, covenants, conditions and provisions in the said contract and any alteration thereof made as therein provided, on his, her or their part, to be kept and performed at the time and in the manner therein specified, and in all respects according to their true intent and meaning, and shall indemnify and save harmless City, its officers, agents and employees, as therein stipulated, then this obligation shall become null and void; otherwise, it shall be and remain in full force and effect.

As a part of the obligation secured hereby and in addition to the face amount specified therefor, there shall be included costs and reasonable expenses and fees, including reasonable attorneys' fees, incurred by City in successfully enforcing such obligation, all to be taxed as costs and included in any judgment rendered.

The said Surety hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the contract, or to the work to be performed hereunder or to the specifications accompanying the same shall in any way affect its obligation on this bond, and it does hereby waive notice of any such change, extension of time, alterations or additions to the terms of the contract or to the work or to the specifications.

/ / /
/ / /

IN WITNESS WHEREOF, three (3) identical counterparts of this instrument, each of which shall for all purposes be deemed an original thereof, have been duly executed by the Principal and Surety, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative pursuant to authority of its governing body.

Note: Except for City Attorney, all signatures must be notarized.

PRINCIPAL

_____, a California corporation

By: _____

Dated: _____

By: _____

Dated: _____

SURETY

By:_____
Attorney in Fact

Dated:_____

CORPORATE ADDRESS OF SURETY:

_____

_____

_____

APPROVED AS TO FORM:

ROBERT FABELA
ANAHEIM CITY ATTORNEY

By:_____
Daniel J. Payne
Deputy City Attorney

Dated:_____

Premium

LABOR AND MATERIAL BOND

KNOW ALL MEN BY THESE PRESENTS:

WHEREAS, the City of Anaheim, a municipal corporation of the State of California in the County of Orange, has entered into with _____, a California corporation, License No. _____ (hereinafter called "Principal") the **2022 Five-Year Anaheim Public Utilities "CITY OF ANAHEIM MASTER CONSTRUCTION AGREEMENT -- WATER" approved by the Anaheim City Council on or around July 2022**, which said contract is hereby referred to and made a part hereof; and

WHEREAS, under the terms of said contract, Principal is required before entering upon the performance of the work, to file a good and sufficient payment bond with the City of Anaheim to secure the claims to which reference is made in Part 6 of Division 4 of the Civil Code of the State of California (commencing with Section 8000).

NOW, THEREFORE, said Principal and the undersigned as corporate Surety are held firmly bound unto the City of Anaheim and all contractors, subcontractors, laborers, material men and other persons employed in the performance of the aforesaid contract and referred to in Part 6 of Division 4 of the Civil Code of the State of California (commencing with Section 8000) in the sum of **One Hundred Fifty Thousand Dollars ($150,000.00)**, for materials furnished or labor thereon of any kind, or for amounts due under the Unemployment Insurance Act with respect to such work or labor, that said Surety will pay the same in an amount not exceeding the amount hereinabove set forth, and also in case suit is brought upon this bond, will pay, in addition to the face amount thereof, costs and reasonable expenses and fees, including reasonable attorney's fees, incurred by City in successfully enforcing such obligation, to be awarded and fixed by the court, and to be taxed as costs and to be included in the judgment therein rendered.

It is hereby expressly stipulated and agreed that this bond shall inure to the benefit of any and all persons, companies and corporations entitled to file claims under Part 6 of Division 4 of the Civil Code of the State of California (commencing with Section 8000), so as to give a right of action to them or their assigns in any suit brought upon this bond.

Should the condition of this bond be fully performed, then this obligation shall become null and void, otherwise it shall be and remain in full force and effect.

The Surety hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of said contract or the specifications accompanying the same shall in any manner affect its obligations on this bond, and it does hereby waive notice of any such change, extension, alteration or addition.

/ / /
/ / /

IN WITNESS WHEREOF, three (3) identical counterparts of this instrument, each of which shall for all purposes be deemed an original thereof, have been duly executed by the Principal and Surety, the

name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative pursuant to authority of its governing body.

Note: Except for City Attorney, all signatures must be notarized.

PRINCIPAL

_____, a California corporation

By: _____

Dated: _____

By: _____

Dated: _____

SURETY

By:_____
Attorney in Fact

Dated:_____

CORPORATE ADDRESS OF SURETY:

_____

_____

_____

APPROVED AS TO FORM:

ROBERT FABELA
ANAHEIM CITY ATTORNEY

By:_____
Daniel J. Payne
Deputy City Attorney

Dated:_____

CITY OF ANAHEIM

APPENDIX D

EQUIPMENT SPECIFICATION

EQUIPMENT SPECIFICATION

TABLE OF CONTENTS
APPENDIX D

DIVISION 11 - EQUIPMENT

11005 General Mechanical and Equipment Provisions
11060 Pumping Equipment: General Requirements
11071 Pumping Equipment: Vertical Hollow Shaft Deep Well Pump Motors
11145 Vertical Turbine Pumps
11181 Vertical Wet-Pit Centrifugal Pumps

DIVISION 16 - ELECTRICAL

16150 Induction Motors

SECTION 11005

GENERAL MECHANICAL AND EQUIPMENT PROVISIONS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Requirements of this Section apply to all equipment provided on the Project including that found in Divisions 11, 13, and 16, even if not specifically referenced in individual "Equipment" articles of those Specifications.

B. Related Sections include but are not necessarily limited to:

1. Section 09900 - Painting and Protective Coatings.
2. Section 13442 - Primary Elements and Transmitters.
3. Section 16010 - Electrical: General Requirements.

1.02 QUALITY ASSURANCE

A. Referenced Standards:

1. Anti-Friction Bearing Manufacturers Association (AFBMA).
2. American Gear Manufacturers Association (AGMA).
3. American Society for Testing and Materials (ASTM):
   a. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
4. Institute of Electrical and Electronics Engineers (IEEE):
   a. 112, Standard Test Procedure for Polyphase Induction Motors and Generators.
5. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment.
   b. ICS 6, Enclosures for Industrial Control and System.
   c. MG1, Motors and Generators.
6. National Fire Protection Association (NFPA):
   a. 70, 1993 National Electrical Code (NEC).

B. Miscellaneous:

1. A single manufacturer of a "product" to be selected and utilized uniformly throughout Project even though:

a. More than one manufacturer is listed for a given "product" in Specifications.

b. No manufacturer is listed.

2. Equipment, electrical assemblies, related electrical wiring, instrumentation, controls, and system components shall FULLY comply with specific NEC area and NEMA 250 and ICS-6 designations shown on Electrical Drawings and defined in Section 16010.

1.03 DEFINITIONS

A. Product: Manufactured materials and equipment.

B. Major Equipment Supports - Supports for Equipment:

1. Located on slab-on-grade or earth supported with equipment weighing 5000 LBS or more.

C. Equipment: One or more assemblies capable of performing a complete function. Mechanical, electrical, instrumentation or other devices requiring an electrical, pneumatic, electronic or hydraulic connection. Not limited to items listed under "Equipment" article within specifications.

D. Installer or Applicator: Installer or applicator is the person actually installing or applying the product in the field at the Project site.

1. Installer or applicator are synonymous.

1.04 SUBMITTALS

A. Shop Drawings:

1. General for all equipment:

a. Acknowledgement that products submitted comply with the requirements of the standards referenced.

b. Manufacturer's delivery, storage, handling, and installation instructions.

c. Equipment identification utilizing numbering system and name utilized in Drawings.

d. Equipment installation details:

1) Location of anchorage.

2) Type, size, and materials of construction of anchorage.

3) Anchorage setting templates.
4) Manufacturer's installation instructions.

f. Equipment area classification rating.

g. Shipping and operating weight.

h. Equipment physical characteristics:
1) Dimensions (both horizontal and vertical).
2) Materials of construction and construction details.

i. Equipment factory primer and paint data.

j. Manufacturer's recommended spare parts list.

k. Equipment lining and coatings.

l. Equipment utility requirements include air, natural gas, electricity, and water.

2. Mechanical and process equipment:
a. Operating characteristics:
1) Technical information including applicable performance curves showing specified equipment capacity, rangeability, and efficiencies.
2) Brake horsepower requirements.
3) Copies of equipment data plates.

b. Piping and duct connection size, type and location.

c. Equipment bearing life certification.

d. Equipment foundation data:
1) Equipment center of gravity.
2) Criteria for designing vibration, special or unbalanced forces resulting from equipment operation.

3. Electrical and control equipment:
a. Electric motor information:
1) Nameplate data.
2) Service factor on motors 1/2 HP and above.
3) Motor enclosure type.
4) NEMA frame size, if applicable.
5) NEMA design code, if applicable.
6) Insulation type.
7) Locked rotor current on motors 10 HP and above.
8) Efficiency and power factor at full load, 3/4 load, 1/2 load and 1/4 load.
9) Stall time (hot and cold) for motors 125 HP and larger.

10) For electric motors greater than 75 HP, submit the following additional information.

a) Motor current, efficiency and power factor at:

(1) Full load, 3/4 load, 1/2 load and no load.

(2) Locked rotor current.

(3) Stall time damage point.

(4) Overload damage curve.

b) Motor test reports demonstrating motor capabilities equal to or in excess of the following standard defined criteria.

(1) Overspeed by NEMA MG1-12.48.

(2) Noise by NEMA MGI-12.49.

(3) Number of starts by NEMA MG1-12.50.

(4) Routine tests by NEMA MG1-12.51.

b. Control panels:

1) Panel construction.

2) Point-to-point wiring diagrams.

3) Scaled panel face and subpanel layout.

4) Technical product data on panel components.

5) Panel and subpanel dimensions and weights.

6) Panel access openings.

7) Nameplate test.

8) Panel anchorage.

B. Operation and Maintenance Manuals:

As required by Engineer.

C. Miscellaneous Submittals:

1. Sample form letter for equipment field certification.
2. Certification that equipment has been installed properly, has been initially started up, has been calibrated and/or adjusted as required, and is ready for operation.
3. Certification for major equipment supports that equipment foundation design loads shown on the Drawings or specified have been compared to actual loads exhibited by equipment provided for this Project and that said design loadings are equal to or greater than the loads produced by the equipment provided.
4. Field Noise testing reports if such testing is specified in narrow scope sections.
5. Field Vibration testing reports if vibration testing is specified in narrow scope sections.

6. Notification, at least one week in advance, that motor testing will be conducted at factory.
7. Certification from equipment manufacturer that all manufacturer-supplied control panels that interface in any way with other controls or panels have been submitted to and coordinated with the supplier/installer of those interfacing systems.
8. Motor test reports.
9. Certification prior to Project closeout that electrical panel drawings for manufacturer-supplied control panels truly represent panel wiring including any field-made modifications.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

B. Motors:

a. U.S. Electric Motors.

b. IEM.

B. Siemens.

C. Westinghouse.

D. Louis Allis.

E. Baldor.

F. Reliance.

G. Marathon.

B. Submit requests for substitution in accordance with Special Provisions Section 1-06.02.

2.02 MANUFACTURED UNITS

A. Electric Motors:

1. Provide motors designed and applied in compliance with NEMA, IEEE, and the NEC for specific duty imposed by driven equipment.
2. Where frequent starting applications are specified, design for frequent starting duty equivalent to duty service required by driven equipment.
3. Rate for continuous duty at 40 DegC ambient. Design in accordance with the NEMA Standards for Class F insulation with Class B temperature rise above 40 DegC ambient on continuous operation or intermittent duty at nameplate horsepower.

4. Design for full voltage across the line starting regardless of the starting method.
5. Design bearing life based upon actual operating load conditions imposed by driven equipment.
6. Size for altitude of Project.
7. Size motors so that, under maximum continuous load imposed by driven equipment, motor nameplate horsepower for continuous operation is minimum of 15 percent more than driven load or provide motor with 1.15 service factor in which case maximum continuous load imposed shall not exceed nameplate horsepower rating of motor.
8. Furnish with clamp-type grounding terminals inside motor conduit box.
9. Furnish with oversized external conduit boxes.
10. Furnish with stainless steel nameplates with information to include all data as required by paragraph 430-7 of the National Electric Code, NFPA 70.
11. Use of manufacturer's standard motor will be permitted on integrally constructed motor driven equipment such as appliances and hand tools specified by model number in which a redesign of complete unit would be required in order to provide a motor with other features as may be specified herein.
12. Electrical motors greater than 100 HP.
    a. 230/460 V, 60 HZ, 3 pH supply voltage.
    b. Weather protected 1 (WP1) or Totally Enclosed Fan Cooled (TEFC) with 1.15 service factor.
    c. Specially insulated for use in damp locations below 20 DegC.
    d. Oil or grease lubricated antifriction bearings conforming to AFBMA Standards. Design bearing life for 90 percent survival rating at 50,000 HRS or at 100,000 HRS of operation for motors greater than 100 HP.
    e. Thermal protection:

       Two (2) non-linear, 100 OHM, platinum, resistance temperature detectors shall be embedded in each of the stator windings. One (1) non-linear 100 OHM, platinum resistance temperature detector shall be embedded in each of the motor bearings. The temperature sensors shall be compatible with the solid-state motor protection relay in the motor starters. The supplier of the motors shall coordinate with the supplier of the motor control centers.
    f. For vertical motors, provide 15 YR average life thrust bearings conforming to AFBMA Standards.
13. Motors 100 HP and above having a locked rotor inrush KVA greater than 6.3 times motor horsepower are not acceptable.
14. Motor efficiencies:
    a. Provide motors having the minimum efficiency:

       95.4 full load.

15. Motor accessories:
    a. Space heaters, 120 volt, 1 phase, and adequately sized to raise temperature inside the motor to a minimum of 6 degrees above ambient. Provide Thermistors on motor windings.
    b. Vibration Transmitter. Provide one two-wire vibration transmitter with 4-20 mA analog signal output over 24 VDC external excitation voltages. The vibration transmitter shall be suitably mounted on motor and properly selected to monitor and protect the pump assembly from excessive vibration level. Vibration transmitter shall be PMC-BETA Model 162VTS or equal. Field calibrate the vibration transmitter system with the supervision of the vibration monitor vendor's representative.
16. Measure efficiencies by IEEE 112 - Method B (Method E may be used for vertical motors 50 HP and larger. Vertical motors may eliminate thrust-bearing losses for efficiency measurements).

2.03 COMPONENTS

A. Gear Drives and Drive Components:
    1. Size drive equipment capable of supporting full load including losses in speed reducers and power transmission.
    2. Provide nominal input horsepower rating of each gear or speed reducer at least equal to nameplate horsepower of drive motor.
    3. Design drive units for 24 HR continuous service, constructed so oil leakage around shafts is precluded.
    4. Utilize gears, gear lubrication systems, gear drives, speed reducers, speed increasers and flexible couplings meeting applicable standards of American Gear Manufacturers Association.
    5. Gear reducers:
        a. Provide gear reducer totally enclosed and oil lubricated.
        b. Utilize antifriction bearings throughout.
        c. Provide worm gear reducers having a service factor of at least 1.20.
        d. Furnish other helical, spiral bevel, and combination bevel-helical gear reducers with a service factor of at least 1.50.

2.04 ACCESSORIES

A. Guards:
    1. Provide each piece of equipment having exposed moving parts with full length, easily removable guards, and meeting OSHA requirements.

a. Construct from 16 GA stainless steel or aluminum.
b. Construct to preclude entrance of rain, snow, or moisture.
c. Roll to conform to shaft or coupling surface.
d. Connect to equipment frame with stainless steel bolts and wing nuts.

B. Equipment Anchorage:
1. Cast-in-place anchorage:
a. Provide ASTM F593, Type 316 stainless steel anchorage for all equipment.
b. Configuration and number of anchor bolts shall be per manufacturer's recommendations.
c. Provide two nuts for each bolt.
2. Drilled anchorage:
a. Threaded rods same as cast-in-place.

C. Data Plate:
1. Attach a stainless steel data plate to each piece of rotary or reciprocating equipment.
2. Permanently stamp information on data plate including manufacturer's name, equipment operating parameters, serial number and speed.

D. Gages:
1. Provide gages in accordance with Section 13442 and where indicated on drawings.
2. Utilize tapping sleeves for mounting per Section 15060.

E. Lifting Eye Bolts or Lugs:
1. Provide on all equipment 50 LBS or greater.
2. Provide on other equipment or products as specified in the narrow specifications.

2.05 FABRICATION

A. Design, fabricate and assemble equipment in accordance with modern engineering and shop practices.

B. Manufacture individual parts to standard sizes and gages so that repair parts, furnished at any time, can be installed in field.

C. Furnish like parts of duplicate units to be interchangeable.

D. Ensure that equipment has not been in service at any time prior to delivery, except as required by tests.

E. Furnish equipment that requires periodic internal inspection or adjustment with access panels that will not require disassembly of guards, dismantling of piping or

equipment or similar major efforts. Quick opening but sound, securable access ports or windows shall be provided for inspection of chains, belts, or similar items.

F. Provide common, lipped base plate mounting for equipment and equipment motor where said mounting is a manufacturer's standard option. Provide drain connection for 3/4 IN PVC tubing.

G. Machine the mounting feet of rotating equipment.

2.06 SHOP OR FACTORY PAINT FINISHES

A. Electrical Equipment:

1. The standard factory-applied paint coating system(s) of the approved manufacturers of the following equipment are acceptable:
    a. Panel boards.
    b. Electrical panels.
    c. Switchboards.
    d. Switchgear.
    e. Safety switches.
    f. Motor starter equipment.
    g. Motor control centers.
    h. Busways.
    i. Raceways and cable trays.
    j. Transformers.
    k. Power circuit breakers.
2. As an alternate to the acceptable standard factory-applied paint coating systems, a manufacturer may provide a Paint coating system in accordance with Section 09900.

B. Other Equipment: In accordance with Section 09900.

2.07 SOURCE QUALITY CONTROL

A. Motor Tests:

1. Test motors in accordance with NEMA and IEEE procedures. Include the following:
    a. Routine test:
        1) Running no-load amperes.
        2) Locked rotor amperes.

3) Winding resistance, DC.

4) High-potential test at twice rated voltage plus 1000 V, with a minimum of 2200 V for 1 minute, winding to ground.

5) Vibration check.

b. Complete test:

1) Rated load temperature rise.

2) Slip in percent.

3) Locked rotor amperes (3 pH, full voltage).

4) Locked rotor torque.

5) Breakdown torque.

6) High potential test; see paragraph 4) above.

7) Efficiencies tabulated at 100, 75, and 50 percent of full load.

8) Power factor tabulated at 100, 75, and 50 percent of full load.

2. Provide routine and complete test for motors 100 HP and larger. Commercial test will be acceptable if test results can be compared to results from identical motors and projected to the results for a complete test.

3. The Owner reserves the right to, at any time, select and have tested any motor included within the Project. If motor passes testing requirements, Owner will be responsible for any shipping and testing costs incurred. Costs shall be determined by current freight rates and manufacturer's published rates at the time of the test. If motor fails test, Contractor shall be responsible for all costs incurred. If two successive motors fail the test, the Owner has the right to reject any or all motors from that manufacturer. The Owner also reserves the right to witness any routine or complete tests at Owner's expense.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install equipment as shown on Drawings and in accordance with manufacturer's directions.

B. Utilize templates for anchorage placement for slab-mounted equipment.

C. For equipment having drainage requirements such as seal water, provide 3/4 IN PVC or clear plastic tubing from equipment base to nearest floor or equipment drain. Route clear of major traffic areas and as approved by Engineer.

D. DO NOT construct foundations until major equipment supports are approved.

E. Extend all non-accessible grease fittings using stainless steel tubing to a location that allows easy access of fittings.

F. Construct sub-bases; either concrete, steel or cast iron, level in both directions. Particular care shall be taken at hold-down bolt locations so these areas are flat and level.

G. Machine Base:

1. Mount machine bases of rotating equipment on sub-bases in manner that they are level in both directions according to machined surfaces on base. Use machinist level for this procedure.
2. Level machine bases on sub-bases and align couplings between driver and driven unit using steel blocks and shims.
    a. Size blocks and shims to provide solid support at each anchor bolt location. Area size of blocks and shims shall be approximately 1-1/2 times area support surface at each anchor bolt point.
    b. Provide blocks and shims at each anchor bolt. Blocks and shims that are square shape with "U" cut out to allow blocks and shims to be centered on anchor bolts.
    c. After all leveling and alignment has been completed and before grouting, tighten anchor bolts to proper torque value.
    d. Do not use nuts below the machine base on anchor bolts for base leveling.

H. Couplings:

1. Align in the annular and parallel positions.
    a. For equipment rotating at 1200 rpm or less, align both annular and parallel within 0.001 IN tolerance for couplings 4 IN size and smaller. Couplings larger than 4 IN size: Increase tolerance 0.0005 IN per inches of coupling diameter, i.e., allow 6 IN coupling 0.002 IN tolerance, and allow a 10 IN coupling 0.004 IN tolerance.
    b. For equipment rotating at speeds greater than 1200 rpm allow both annular and parallel positions within a tolerance rate of 0.00025 IN per inch coupling diameter.
2. If equipment is delivered as a mounted unit from factory, verify factory alignment on site after installation and realigned if necessary.
3. Check surfaces for run-out before attempting to trim or align units.

I. Grouting:

1. After machine base has been shimmed, leveled, couplings aligned and anchor bolts tightened to correct torque value, a dam or formwork shall be placed around base to contain grouting. Extend dam or formwork at least 1/2 IN above the top of leveling shims and blocks.
2. Saturate top of roughened concrete sub-base with water before grouting. Add grout until entire space under machine base is filled to the top of the base

underside. Puddle grout by working a stiff wire through the grout and vent holes to work grout in place and release any entrained air in the grout or base cavity.

3. When the grout has sufficiently hardened, remove dam or formwork and finish the exposed grout surface to fine, smooth surface. Cover exposed grout surfaces with wet burlap and keep covering sufficiently wet to prevent too rapid evaporation of water from the grout. When the grout has fully hardened (after a minimum of 7 days) tighten all anchor bolts and recheck driver-driven unit for proper alignment.

3.02 INSTALLATION CHECKS

A. For all equipment specifically required in detailed specifications, secure services of experienced, competent, and authorized representatives) of equipment manufacturer to visit site of work and inspect, check, adjust and approve equipment installation. In each case, representatives) shall be present during placement and startup of equipment and as often as necessary to resolve any operational issues which may arise.

B. Secure from equipment manufacturer's representatives) a written report certifying that equipment:

1. Has been properly installed and lubricated.
2. Is in accurate alignment.
3. Is free from any undue stress imposed by connecting piping or anchor bolts.
4. Has been operated under full load conditions and that it operated satisfactorily. Secure and deliver a field written report to Owner immediately prior to leaving jobsite.

C. No separate payment shall be made for installation checks. All or any time expended during installation check does not qualify as O&M training or instruction time when specified.

3.03 FIELD PAINTING AND PROTECTIVE COATINGS

A. For required field painting and protective coatings, comply with Section 09900.

3.04 WIRING CONNECTIONS AND TERMINATION

A. Clean wires before installing lugs and connectors.

B. Coat connection with oxidation eliminating compound for aluminum wire.

C. Terminate motor circuit conductors with copper lugs bolted to motor leads.

D. Tape un-insulated conductors and connectors with electrical VW tape, 150 percent of insulation value of conductor.

E. Connections to carry full ampacity of conductors without temperature rise.

F. Terminate spare conductors with electrical tape.

3.05 FIELD QUALITY CONTROL

A. Furnish equipment manufacturer services as specified in the individual equipment specifications.

B. Inspect wire and connections for physical damage and proper connection.

C. For motor 50 HP and above, conduct insulation resistance (megger) test on each motor before energized. Conduct test with 500 or 1000 V DC megger. Test each phase separately and follow procedures listed below:

1. Disconnect voltage sources, lightning arrestors, capacitors, and other potential low insulation sources from motor before connecting megger to motor.
2. When testing a phase, connect phases not under test to ground.
3. Apply test voltage, phase to ground, on each phase being tested. Record resistance reading at 30 seconds and at one minute after test voltage is applied. Divide one minute reading by 30 second reading to obtain dielectric absorption ratio (DAR). DAR must be 1.25 or greater for phase to pass test.
4. If phases have a DAR of 1.25 or greater, attach a tag to the motor and mark tag "Insulation Resistance Test OK" and sign.
5. Connect equipment removed in paragraph I above.

D. Check rotation of motor before connection to driven equipment, before couplings are bolted or belts installed. Before motor is started to check rotation, determine that motor is lubricated.

E. Sub-base that supports the equipment base and that is made in the form of a cast iron or steel structure that has supporting beams, legs and cross member that are cast welded or bolted, shall be tested for a natural frequency of vibration after equipment is mounted. Keep the ratio of the natural frequency of the structure to the frequency of the disturbing force out of the range from 0.5 to 1.5.

3.06 EQUIPMENT BASES AND BEDPLATES

Mount equipment assemblies on a single, welded steel bedplate unless otherwise shown or specified. Provide bases and bedplates with machined support pads, tapered dowels for alignment or mating of adjacent items, adequate openings to facilitate grouting, and openings for electrical conduits. Continuously weld seams and contact edges between steel plates and shapes, and grind welds smooth. Do not support machinery or piping on bedplates other than that which is factory installed. Provide jacking screws in equipment bases and bedplates to aid in leveling prior to grouting. Unless specified or shown otherwise, provide plates of minimum thickness of

one inch. Pump bedplates shall include a drip lip and provisions for directing gland leakage to a single point.

3.07 EARTHQUAKE DESIGN AND RESTRAINT

All tanks and equipment shall be designed, constructed and attached to resist stresses produced by seismic forces specified in this Section. Equipment that does not vibrate during normal operation shall be rigidly attached. Equipment that vibrates during normal operation shall be attached by means of isolators with mechanical stops that limit movement in all directions unless it can be demonstrated by calculations that such stops are not required. Equipment or portions of equipment that move during normal operation shall be restrained with mechanical devices that prevent displacement unless it can be demonstrated by calculations that such restraints are not required.

A. Minimum Earthquake Forces. Except as provided herein the minimum earthquake forces shall be those prescribed for Essential Facilities by the current Edition of the Uniform Building Code as published by the International Conference of Building Officials, 5360 South Workman Mill Road, Whittier, California 90601.

B. Contractor shall make submittals of Shop Drawings, details and data specified in Paragraph 1.04, entitled “Submittals”, signed, by a Registered California Professional Engineer with demonstrated proficiency in Structural or Civil Engineering.

END OF SECTION 11005

SECTION 11060

PUMPING EQUIPMENT: GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Pumping equipment.

B. Related Sections include but are not necessarily limited to:
   1. Section 09900 - Painting and Protective Coatings.
   2. Section 11005 - General Mechanical and Equipment Provisions.
   3. Section 11145 - Vertical Turbine Pumps.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. Hydraulic Institute (HI):
      a. Standards for centrifugal, rotary and reciprocating pumps.

B. Fully coordinate all mechanical seal systems specified to ensure pump and seal compatibility.

1.03 DEFINITIONS

A. The abbreviations are defined as follows:
   1. IPS: Iron Pipe Size.
   2. NPSHR: Net Positive Suction Head Required.
   3. TDH: Total Differential Head.
   4. TEFC: Totally Enclosed Fan Cooled.
   5. WP1: Weather Protected Type 1.

B. Pump Service Category - Pump or pumps having identical names (not tag numbers) used for specific pumping service.

1.04 SUBMITTALS

A. Shop Drawings:
   1. See Section 11005.
   2. Product technical data including:
      a. Performance data and curves with flow (gpm), head (FT), horsepower, efficiency, NPSH requirements, submergence requirement.
      b. Pump accessory data.

c. Bearing supports, shafting details and lubrication provisions.
d. Solids passage information.

3. Certifications;
   a. Certified pump performance curves as described in section 2.04.
   b. Statement relative to installation and start-up per section 3.02-A.4.
4. Test reports:
   a. Factory hydrostatic test.

B. Operation and maintenance Manuals:
As required by Engineer.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Mechanical seals:
   a. Chesterton.
   b. Garlock.

B. Submit requests for substitution in accordance with Special Provisions Section 1-06.02.

2.02 ACCESSORIES

A. See Section 11005.

B. Each Unit:
1. Lifting eye bolts or lugs.
2. Plugged gage cock connection at suction and discharge nozzles.
3. Tapped and plugged openings for casing and bearing housing vents and drains.
4. Fittings for properly adding flushing lubricant.
5. Pressure relief fittings for grease lubrication.

C. Packing Seal:
1. Provide packing seal unless another seal specified in individual pump specification sections.
2. Minimum of five rings graphite impregnated synthetic packing.
3. Provide minimum 1/4 IN DIA supply tap and 1/2 IN DIA minimum drain tap.
4. Provide split teflon or bronze water seal ring.
5. Adjustable split follower cast iron or bronze gland.

2.03 FABRICATION

A. Pump Support:
   1. Design base to support weight of drive, shafting and pump.
   2. Comply with HI vibration limitations.
   3. Mount vertical pumps on single piece pedestal baseplate.
   4. Fabricate to withstand all operating loads transmitted from the pump and drive.

2.04 SOURCE QUALITY CONTROL

A. If specifically required in the individual pump specification sections, provide factory tests.
   1. All-units:
      a. Hydrostatic test at 150 percent of shutoff head for a minimum of 5 minutes.
   2. Adjustable speed units:
      a. Head (FT) versus flow (gpm) pump curves:
         1) Maximum, minimum and two equally spaced intermittent speeds.
         2) Efficiencies along each curve.
         3) Brake horsepower along each curve.
   3. Constant speed units:
      a. Head (FT) versus flow (gpm) pump curves:
         1) Efficiencies along curve.
         2) Brake horsepower along each curve.
         3) Hydraulic thrust along each curve.
   4. Results certified by a registered professional engineer.

B. Statically and dynamically balance each pump per HI standards.

PART 3 - EXECUTION

3.01 INSTALLATION

A. See Section 11005.

B. Floor or Pad-Mounted Units (Non-Submersible):
   1. Align vertically and horizontally level, wedge and plumb units to match piping interfaces.
   2. Assure no unnecessary stresses are transmitted to equipment flanges.
   3. Tighten flange bolts at uniform rate and manufacturer's recommended torque for uniform gasket compression.
   4. Support and match flange faces to uniform contact over entire face area prior to bolting pipe flange and equipment.

5. Permit piping connecting to equipment to freely move in directions parallel to longitudinal centerline when and while bolts in connection flange are tightened.
6. Grout equipment into place prior to final bolting of piping but not before initial fitting and alignment.
7. Assemble connecting piping with gaskets in place and minimum of four bolts per joint installed and tightened. Test alignment by loosening flange bolts to see if there is any change in relationship of piping flange with equipment connecting flange. Realign as necessary, install flange bolts and make equipment connection.
8. Field paint units as defined in Section 09900.
9. Provide pressure gage on discharge of all pumps.

3.02 FIELD QUALITY CONTROL

A. Provide services of equipment manufacturer's field service representatives to:

1. Inspect equipment covered by these Specifications.
2. Supervise pre-start adjustments and installation checks.
3. Conduct initial startup of equipment and perform operational checks.
4. Provide a written statement that manufacturer's equipment has been installed properly, started up and is ready for operation by Owner's personnel.
5. Instruct Owner's personnel for the specified minimum number of hours at jobsite on operation and maintenance of each of the following for pumping equipment:
    a. Vertical Turbine Pump and Motor.
        1) Two sessions on pump at 4 hours minimum per session.
        2) Two sessions on motor at 4 hours minimum per session.

END OF SECTION 11060

SECTION 11071
PUMPING EQUIPMENT: VERTICAL HOLLOW SHAFT DEEP WELL PUMP MOTORS

PART 1 - GENERAL

1.1 SUMMARY

This section provides guidelines for design and manufacture of low and medium voltage vertical squirrel cage induction motors on NEMA size frames and larger. Work governed by these specifications includes manufacture, testing, delivery, and installation of equipment constructed in accordance with the requirements presented herein.

A. Section Includes:
   1. Vertical Hollow Shaft Motors for Deep Wells.

B. Related Sections include but are not necessarily limited to:
   1. Section 11005 – General Mechanical and Equipment Provisions.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Iron and Steel Institute (AISI).
   2. American National Standard Institute (ANSI):
      a. B16.1, Cast-Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
   3. American Society for Testing and Materials (ASTM):
      a. A48, Standard Specification for Gray Iron Castings.
      b. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
      c. A108, Standard Specification for Steel Bars, Carbon, Cold Finished, Standard Quality.
      d. A276, Standard Specification for Stainless Steel Bars and Shapes.
      e. B505, Standard Specification for Copper-Base Alloy Continuous Castings.
   4. American Water Works Association (AWWA):
      a. E101, Deep Well Vertical Turbine Pumps - Line Shaft Type.
   5. Hydraulic Institute Standards (HI).
   6. Institute of Electrical and Electronic Engineers (IEEE)
   7. National Electrical Manufacturers' Association (NEMA)
   8. Anti-Friction Bearing Manufacturers' Association (AFBMA)
   9. Society of Automotive Engineers (SAE).

All materials and equipment shall be labeled or listed as being approved by the Underwriters Laboratories (UL) , whenever applicable.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Dimensional data and calculations:
      a. Sketch showing the “BD” and “CD” dimensions, head shaft material type and diameter of each well pump motor.
      b. Proposed new motor data including manufacturer, rated horsepower, motor current, efficiency, speed, dimensional data, weight, and power factor.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Schematic drawing of all equipment, with dimensions of each piece.
      d. Equipment weight, materials of construction, factory primer and paint data, lining and coating data, motor utility requirements (e.g. oil, water, air, and power requirements), and other project specific information.
      e. Performance and operating characteristics, capacities, test data, installation drawings, anchoring details, wiring diagrams, installation, storage and handling instructions, and dimensional data.
      f. Equipment bearing life certification.
      g. Nameplate data and certification of premium efficiency units.
      h. Motor service factor, enclosure type, NEMA frame size, NEMA design code, insulation type and temperature rise, locked rotor current, full, ¾, and ½ loads.
      i. Stall time (hot and cold) for motors.
      j. Test data including sound level by NEMA MG 1-12.53, number of starts by NEMA MG 1-12.54, and routine tests by NEMA MG 1-12.55.
      k. Motor high thrust capacity.

B. Operation and Maintenance Manuals:
   1. O&M manuals shall include the following:
      a. Equipment function, normal operating characteristics, limiting operations.
      b. Assembly, disassembly, installation, alignment, adjustment, and checking instructions.
      c. Copies of equipment data plates and all equipment serial numbers.
      d. Operating instructions for start up, routine operation, regulation and control, shut down, and emergency conditions.
      e. Lubrication and maintenance conditions.
      f. Guide to troubleshooting
      g. Parts list and predicted life of parts subject to wear.

h. Outline, cross-section, and assembly drawings, engineering data, and connection diagrams.
i. Factory motor test reports, including USEM tests (complete initial test) per IEEE 112 method B, dynomometer test.
j. Equipment manufacturer's certifications.
k. Certification that equipment has been installed properly, has been initially started up, has been calibrated, balanced, and/or adjusted as required, and is ready for operation.
l. Number of turns required on pump impeller adjusting nut and required operation and maintenance to maintain pump efficiency.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. US Electric Motors.
2. IEM.
3. Marathon.
4. Siemens.
5. Westinghouse.
6. Louis Allis.
7. Baldor.
8. Byron Jackson Submersible.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

Provide NEMA electric motors, designed for specific duty imposed by driven equipment, outdoor installation, frequent starting duty and to operate continuously at rated load at an ambient temperature of 40 degrees Centigrade (40 Deg C) at a maximum altitude of 1,000 meters.

a. Motors shall be suitable for continuous operation on a three-phase, sixty-hertz system rated 460 volts.
b. Motors shall be capable of withstanding all normal (including hydraulic) forces which may be imposed upon them during the course of normal operation, including starting and stopping.
c. Motors shall be suitable for across-the-line starting or electronic soft starting and shall be able to start and accelerate the connected load to full load speed with 90% of rated voltage at the motor terminals.
d. Motors shall be capable of continuous operation at full load and rated frequency with a voltage variation of +10%.
e. Motors shall be capable of continuous operation at full load and rated voltage with a frequency variation of +5%.

f. Motor starting current shall not exceed a value equal to 650% of the motor full load current.
g. Motor installation in hostile environments subject to dust, moisture and/or corrosive atmospheric conditions shall have all parts given protective treatment.

A. Performance Parameters:
   a. Speed: 4-pole speed or 6-pole speed
   b. Horsepower: per Contract Documents
   c. Enclosure: WP1 or TEFC
   d. Minimum guaranteed full load efficiency: per Contract Documents
   e. Hydraulic Down thrust @ Shutoff condition: Based on pump data
   f. Hydraulic Down thrust @ Normal Operating condition: Based on pump data
   g. Provide Non-Reverse Ratchet Assembly

B. Motor enclosures. Shall be of fabricated steel or cast iron construction in accordance with the manufacturer's standard design. Canopy caps shall be of aluminum, cast iron or sheet metal and shall be easily removable for maintenance purposes. Motors to be installed in locations where moisture may collect shall be furnished with drain openings and plugs. In the case of Explosion-proof motors, drains and breathers shall be furnished and shall be of the type approved by UL.

C. Stator construction. Stator laminations shall be of fully processed steel. Each lamination surface shall be given the necessary treatment so as to have core plate type C-5 insulation. Stator windings for system voltages above 600 volts shall be form wound of rectangular copper magnet wire. Aluminum magnet wire is not acceptable. Individual coils shall be insulated with mica bearing tape prior to insertion. Coil extensions shall be blocked and braced sufficiently to minimize movement during normal starting and running conditions at full rated voltage.

D. Insulation. Unless otherwise indicated, insulation system shall be Class F or better. Insulation system shall meet Class F temperature rise when motor load is at 1.15 service factor. Insulation systems shall receive a minimum of two vacuum pressure impregnation treatments using a 100% solids epoxy resin. Provide a completely sealed insulation system. This system shall be capable of passing the NEMA MG1-20.48 water immersion test. Provide encapsulated windings using an epoxy seal after the windings have dried to less then 1-percent moisture. For variable frequency drive motors, insulation system shall be Inverter Grade® insulation system, as manufactured by US Motors, and shall meet the requirements of NEMA MG-1 Part 31.

E. Rotor Construction. Rotors shall be of cast or fabricated aluminum in accordance with manufacturer's standard design, unless otherwise indicated.

F. Bearings. Bearings supplied shall be of type and size sufficient to satisfy thrust loading requirements for each motor in accordance with manufacturer's standard design. Bearings shall be rated per Section 11005.

G. Thrust Bearings. Motors shall be designed and constructed with thrust bearings to allow inspection and/or replacement without requiring complete disassembly of motor. Thrust bearings shall be designed and constructed of adequate capacity to handle all operating conditions of the well pump and motor, including the worst case down thrust condition and momentary up thrust condition.

H. Sound attenuation. Motors shall be of sound attenuation construction such that the maximum sound decibel level at the well site property line, with the well pump motor operating at full load, is 60 dbA or less.

I. Low Voltage Contact Relay. WP1 motors shall be furnished with Allen – Bradley Bulletin 1410 Motor Winding Heater, or equal. The low voltage contact relay shall be installed on one leg (phase) of the motor leads.

2.3 ACCESSORIES

A. See Section 11005.

2.4 COMPONENTS

A. General:
   1. Furnish units consisting of a vertical hollow shaft motor (to be direct connected to an existing vertical shaft turbine well pump). Design unit with non-reversing ratchets.
   2. Weight of revolving parts of pump including unbalanced hydraulic thrust of impeller is carried by thrust bearing in driver.
   3. Make provision at driver shaft for adjusting impeller with reference to pump bowls.
   4. Provide thrust bearing capable of handling both the mechanical and hydraulic thrust loads of the existing pump assembly.

B. Data Plates:
   1. Provide stainless steel data plate securely attached to motor.
   2. Include manufacturer's name, horsepower, serial number, speed, service factor, and other pertinent data.

C. Head Shaft, Motor Clutch / Coupling:
   1. Provide new head shaft and motor clutch/coupling to mate new motor to well pump assembly and discharge head. Match material.
   2. Material is either 416 stainless steel or 1045 carbon steel.
   3. Provide Non-Reverse Ratchet Assembly.

D. Motors:
   1. Reduce voltage starting, vertical hollow shaft, squirrel cage, induction type.
   2. 460 V, 60 HZ, 3 PH.
   3. Size motor to drive pump continuously over the complete head - capacity range without the load exceeding the nameplate rating or entering into the service factor.
   4. Premium efficiency motor.
   5. Design motor for 120 ^{o}F ambient.
   6. Provide motor space heaters (120 V rating), drain, breather elements.
   7. Provide motor thermistors (winding protection).
   8. Provide stainless steel data plate securely attached to motor.
   9. Comply with Section 11005.
   10. Factory test.

2.5 SOURCE QUALITY CONTROL

E. See Section 11005.

F. Provide the following factory tests:
   1. All motors shall be given a standard commercial test as defined by NEMA MG 1-12.51 and IEEE 112 a and b.
   2. Conduct megger test and record reading of all motor windings just prior to connecting the motor to its feeder to determine if accumulation of moisture has occurred in the motor during storage. The reading shall be documented, submitted to the Engineer for review, and included in the final O&M manuals.
   3. Conduct noise tests in accordance with the latest revision of IEEE-85, Test Procedure for Air Borne Noise Measurements and Rotating Electrical Machinery. The motor shall be operating during test on rubber at no load with rated voltage and frequency.
   4. Conduct vibration tests per NEMA MG 1-12.07 for small and medium motors and MG 1-20.54 for large motors, except 3600-rpm motors greater than 250 HP and motors with sleeve bearings shall be tested at full nameplate horsepower load and temperature.
   5. All testing, other than locked rotor conditions shall be at full voltage +/-5 percent.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

3.2 FIELD QUALITY CONTROL

A. See Section 11005.

B. Conduct field noise level measurements with the new installed motor running at full load, rated voltage, and frequency and with the well pumping. Noise level measurements shall be taken at the property lines and shall be less than or equal to 60 dBA. Should the new motor produce more than 60 dBA sound pressure at the property line, the Contractor shall install additional sound attenuation materials around the motor to reduce the sound pressures to the 60 dBA requirement. No additional compensation will be made to the Contractor to comply with this requirement.

C. Conduct field efficiency tests on the new installed motor at ½, ¾, and full load, and conduct an overall plant efficiency pump test.

D. Clean and disinfect all components entering the well, per the WSSS.

END OF SECTION

SECTION 11145

VERTICAL TURBINE PUMPS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Vertical turbine pumps.
      a. Vertical turbine deep well pump.

B. Related Sections include but are not necessarily limited to:
   1. Section 11005 - General Mechanical and Equipment Provisions.
   2. Section 11060 - Pumping Equipment: General Requirements.
   3. Section 13440 - Instrumentation for Process Control: General Requirements.
   4. Section 16150 – Induction Motors

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Iron and Steel Institute (AISI):
   2. American National Standard Institute (ANSI):
      a. B16.1, Cast-Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
   3. American Society for Testing and Materials (ASTM):
      a. A48, Gray Iron Castings (Class 35 Minimum).
      b. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
      c. A1O8, Standard Specification for Steel Bars, Carbon, Cold Finished, Standard Quality.
      d. A120, Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless for Ordinary Uses.
      e. A276, Specification for Stainless and Heat-Resisting Steel Bars and Shapes.
      f. B505, Standard Specification for Copper-Base Alloy Continuous Castings.
      g. B584, Standard Specification for Copper Alloy Sand Castings for General Applications.
   4. American Water Works Association (AWWA):
      a. E101, Vertical Turbine Pumps - Line Shaft and Submersible Types.
   5. Hydraulic Institute Standards (HI).
   6. Society of Automotive Engineers (SAE).

1.03 SUBMITTALS

A. Shop Drawings:

1. Product technical data including:

a. Acknowledgment that products submitted meet requirements of standards referenced.

b. Manufacturer's installation instructions.

c. See Section 11060.

d. Schematic elevation showing dimensions of pump base, column, shaft, bowl assembly, cone strainer, discharge head and motor

B. Operation and Maintenance Manuals:

1. See Special Provisions Section 1-09.09

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The pump manufacturer shall be responsible for the entire pump and motor assembly. Subject to compliance with the Contract Documents, the following pump manufacturers are acceptable:

1. Byron Jackson.

2. Ingersoll Rand.

3. Johnston

B. Submit requests for substitution in accordance with Specification Section 13.02 and Article 2.02.A.1.

2.02 PERFORMANCE AND DESIGN REQUIREMENTS

A. Performance Parameters:

i. Pump Bowl Assembly: shall consist of discharge case, intermediate bowls, suction case, impellers, impeller shafting and bearings. Bearings shall be located above and below the impellers. The bowls shall be designed to produce the specified gallons per minute at the specified feet total dynamic head and specified efficiency. City of Anaheim shall determine bowl assembly equivalency based on experience, efficiency, capacity, and construction.

ii. Pump Impellers: shall be bronze, meeting ASTM Standard B-145; of the enclosed type; and statically and dynamically balanced. Impellers shall be accurately machined to fit the contour of the bowl, hand filed in the waterways. Impellers shall be attached to the shaft so that they cannot become loose under any operating condition or under reverse rotation. Provisions in the shaft for axial adjustment of the impellers shall be made so that proper clearance between bowls and impellers may be maintained.

The Contractor is cautioned to ensure that the bowl lateral is sufficient for proper operation. The impeller skirt and series throat case shall be thick enough to allow for machining and installation of wear ring at time of repair.

iii. Bowls: suction case, intermediate bowls, and discharge case shall be cast iron, conforming to ASTM Standard A48, Class 30, coated with porcelain enamel and shall have sufficient stiffness to prevent adverse changes in bearing alignment and to maintain the running clearance of the seal rings. Bowls shall be flanged with male and female rabbet fits including top and bottom flanges as required. Bottom bowl shall be furnished with a 10-foot long steel suction pipe and stainless steel cone strainer. The top bowl shall fit T&C water lube column pipe.

iv. Pump Shaft: shall be one piece and shall be turned and polished stainless steel, conforming to ASTM A-276, Type 410 or 416. It shall be supported above and below each impeller. The suction case bearing is to be bronze, grease packed and protected against entrance of sand or other abrasives. Intermediate bowl bearings are to be lubricated by the water being pumped and shall also be of bronze. Pump shaft minimum diameter shall be sized to handle worst case down thrust condition and maximum loads of the motor and bowl assembly

v. Column Diameter: Size such that column velocity is equal to or less than 5 feet per second, but not less than 2.5 feet per second.

B. Provide pumps with increasing head characteristics from secondary design conditions to shutoff condition. Provide pumps with net positive suction head requirements (NPSHR) less than the net positive suction head available (NPSHA) at all operating conditions.

2.03 ACCESSORIES

A. See Sections 11005 and 13442.

2.04 COMPONENTS

A. General:

1. Furnish unit consisting of a vertical shaft turbine pump, direct connected to a vertical hollow shaft motor. Design unit with non-reversing ratchets.
2. Weight of revolving parts of pump including unbalanced hydraulic thrust of impeller is carried by thrust bearing in driver.
3. Make provision at driver shaft for adjusting impeller with reference to bowls.

B. Column:

1. Construct discharge column pipe of steel standard butt joint column pipe and threaded sleeve type couplings. The column sections shall include a bronze water lubricated bearing retainer at each column joint.

2. Provide top and bottom sections of column pipes to 5-foot lengths.
3. Provide intermediate column sections not exceeding 10 feet in length.
4. Provide 10-feet of suction pipe of same diameter and material as pump column with cone shaped Type 316 Stainless Steel Strainer. Strainer to have minimum inlet open area of not less than 4 times the suction pipe size.
5. Sandblast column and coat inside and out with a minimum 15 mils dry film thickness fusion bonded epoxy at the factory that is FDA approved for use with potable water.

BB. Water Level Cable and Transducer:

1. Length (feet) and material of cable to be furnished for water level transducer.
2. Furnish water level pressure transducer/transmitter: Rottmeyer Model MPOTRN.100, with J-box termination enclosure MPZAD.002, with vented cable.

C. Open Line Shaft:

1. Line shafts and couplings shall be ASTM A276 Type 416 Stainless Steel and shall be field replaceable.
2. Maximum length: 10 Feet.
3. Furnish renewable shaft sleeves constructed from 416 stainless steel at each bearing location.
4. Undercutting of shafting at sleeve locations is not permitted.
5. Line shaft bearings shall be removable self-flushing rubber type supported by retainers butted between machined faces of discharge column located on 10-ft centers.
6. Provide complete line shaft pre-lubrication system to water lubricate line shaft bearings prior to pump startup.

D. Pump Bowl:

1. Provide bowl constructed of close grained cast iron, free from imperfections and accurately machined and fitted.
2. Coat pump bowl water passages with an abrasion-resistant baked enamel, phenolic or epoxy.
3. Provide coating FDA approved for potable water service.
4. Design to ensure easy removal of bearings and impeller.
5. Furnish heavy duty 316 SS cone strainer.
6. Plug discharge case bypass ports.

E. Bearings:

1. Provide units with sleeve bearings of SAE 660 bronze in each bowl.
2. In bowl, provide main bronze bearing immediately above impeller and a lower bronze bearing immediately below impeller.

3. Provide for lubrication of bowl bearings continuously with water from system pressure.

F. Pump Shaft and Impeller:

1. Provide pump unit shaft constructed of rolled and ground 416 stainless steel.
2. Furnish enclosed type impellers constructed of bronze and securely attached to impeller shaft.
3. Ensure impeller is accurately fitted and statically and dynamically balanced.
4. Provide bronze replacement wear rings in each bowl to prevent wear on bowls.

G. Discharge Head Assemblies:

1. Design discharge head assembly for 150 psi working pressure and 250 psi test pressure.
2. Provide contamination-free design head base plate.
3. Provide discharge head for above ground mounting constructed of close-grained cast iron or fabricated steel with integral discharge flange.
4. Construct discharge nozzle with a vertical vane to minimize turbulence.
5. Furnish ANSI B16.1 125/150 LB discharge flange.
6. Mount discharge head on fabricated steel base plate, which is of sufficient size to span opening in support structure. The fabricated steel base plate shall have tapped holes for bolting down pump discharge head, complete with all bolts, nuts, washers, and anchor bolts. The top of the fabricated steel base plate shall be machined to mate with the pump discharge head base plate. The dimensions and thickness of the fabricated steel base plate shall be determined by the pump manufacturer.
7. Supply discharge head with lifting lugs capable of supporting weight of entire unit.
8. Furnish high pressure stuffing box constructed of cast iron and containing not less than five rings of graphite impregnated teflon packing (Crane C1065) or Kevlar Aramid fiber. Compress packing around shaft with adjustable gland. Furnish grease fitting to provide additional lubrication to bronze upper shaft bearing. Stuffing box must be located and accessible above pump base plates. The entire unit, including the stuffing box, shall be designed to withstand the pump shut-off head condition. Provide connections for grease inlet and pressure relief. Provide 416 stainless steel shaft at top section of line shaft where it passes through stuffing box. Provide bronze upper shaft bearing directly below stuffing box, in the head, to eliminate any shaft whip which could damage the seal. Hard pipe with 3/8 inch 316 SS piping from stuffing box bleed off to floor drain near pump.
9. Provide drain connection and pre-lubricating product water connection and piping.
10. Provide tapped and plugged openings for casing and bearing housing vents and drains.

H. Data Plates:

1. Provide stainless steel data plate securely attached to pump.
2. Include manufacturer's name, pump size and type, serial number, speed, impeller diameter, capacity and head rating, and other pertinent data.

I. Motors:

1. Soft starting vertical hollow shaft, speed as specified, squirrel cage, induction type motor, with enclosure as specified.
2. Size motor to drive pump continuously over the complete head - capacity curve of the pump without entering into the service factor at any point or exceeding the nameplate rating.
3. Design motor for 40 DegC ambient, with 1.15 service factor.
4. Premium efficiency motor, guaranteed minimum efficiency = 95.4%.
5. Comply with Section 11005, Paragraph 2.02 and Section 16150.
6. Provide thrust bearing capable of handling both the mechanical and hydraulic thrust loads of the pump.

2.05 MAINTENANCE MATERIALS

A. Extra Materials:

1. Furnish the Owner the following extra parts for each pump service category:
   a. Lower bearing assembly: One set.
   b. Upper bowl bearing: One set.
   c. Line shaft bearing assemblies: One set.
   d. Packing, gland follower, studs and nuts: One set.
   e. Lantern ring: One.
   f. Wearing rings: One set.

2.06 FACTORY TEST

A. Provide factory test in accordance with Section 11060 and HI Standards with project motor and pump. Certified test results shall be provided to the Engineer. To allow the Owner/Engineer to witness this test, the Owner and Engineer shall be advised 48 hours in advance of the test. If the test is conducted at a location more than 30 miles distance from the City of Anaheim, the Contractor shall pay for the time and expense expended by the Owner/Engineer to witness the test. This cost shall be included in the contractor’s bid price.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

3.02 FIELD QUALITY CONTROL

A. See Section 11060.

END OF SECTION 11145

SECTION 11181

VERTICAL WET-PIT CENTRIFUGAL PUMPS

PART 1 - GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Society for Testing and Materials (ASTM):
    a. A48, Gray Iron Castings.
    b. A276, Stainless and Heat-Resisting Steel Bars and Shapes.
    c. A436, Austenitic Gray Iron Castings.
    d. A532, Abrasion-Resistant Cast Irons.
    e. A743, Castings, Iron-Chromium, Iron-Chromium-Nickel, Nickel-Base, Corrosion Resistant, for General Application.
    f. B62, Composition Bronze or Ounce Metal Castings.
    g. B148, Aluminum-Bronze Sand Castings.
2. National Electrical Manufacturer's Association (NEMA): MG 1, Motors and Generators

1.02 DEFINITIONS

A. Terminology pertaining to pumping unit performance and construction shall conform to the ratings and nomenclature of the Hydraulic Institute Standards.

1.03 SUBMITTALS

A. Shop Drawings:

1. Make, model, weight, and horsepower of each equipment assembly.
2. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
3. Performance data curves showing head, capacity, horsepower demand, and pump efficiency over the entire operating range of the pump, from shutoff to maximum capacity. Indicate separately the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at the guarantee point.
4. Detailed structural, mechanical, and electrical drawings showing the equipment dimensions, size, and locations of connections and weights of associated equipment.
5. Power and control wiring diagrams, including terminals and numbers.

6. Control panel construction drawings including detailed bill-of-material information.
7. Complete motor nameplate data, as defined by NEMA, motor manufacturer, and including any motor modifications.
8. Factory finish system.

B. Quality Control Submittals:
1. Factory Functional and Performance Test Reports.
2. Manufacturer's Certification of Compliance that the factory finish system is identical to the requirements specified herein.
3. Special shipping, storage and protection, and handling instructions.
4. Manufacturer's printed installation instructions.
5. Manufacturer's Certificate of Proper Installation.
6. Suggested spare parts list to maintain the equipment in service for a period of one year. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
7. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
8. Operation and maintenance manual.

1.04 EXTRA MATERIALS

A. Furnish for this set of pumps:
1. Complete set gaskets and O-ring seals.
2. Complete set keys, dowels, pins, etc.
3. Impeller.
4. One complete set of any special tools required to dismantle pump.

PART 2 - PRODUCTS

2.01 GENERAL

A. The pump manufacturer shall be responsible for the complete pump and motor assembly and for compliance with the pump and drive requirements.

2.02 PUMP CONSTRUCTION DETAILS

A. Pump Type: Heavy-duty vertical wet-pit, suspended column, single suction centrifugal type, Vanton Model SGC-PY200 or equal. All wetted parts of the pump shall be nonmetallic and resistant to the pumped fluids. The pumped fluids will be water and sodium hypochlorite (up to 15% solution strength). Pump shall be provided with a suction strainer with 1/4-inch holes.

B. Materials: All wetted parts of the pump shall be polypropylene unless otherwise hereinafter specified. AISI, ASTM, etc., numbers, types, and grades specified are typical of material composition and quality. Equivalent materials will be considered if demonstrated to be resistant to pumped fluid.

C. Depth of Setting: Length from bottom of mounting plate to bottom of pump strainer shall be 2'-10". An extension pipe is not allowed. Verify dimensions with CONTRACTOR prior to fabrication.

D. Impeller: Enclosed or semi-open type, constructed from polypropylene. Secure to shaft by key and capscrew and washer, impeller nut, or thread-on construction.

E. Shaft: Stainless steel, hardened, ASTM A276, Type 316 shaft completely encased in thick-sectioned polypropylene plastic.

F. Shaft Sleeve: Sleeve shall be securely locked against shaft rotation. Sleeve shall extend beyond gland.

G. Discharge Pipe: Schedule 80 polypropylene discharge pipe extending through the cover plate and terminating in the 120 psig ANSI Standard flanged discharge connection.

H. Thrust Bearing: Regreasable steel ball or roller type with addition and relief fittings rated for 25,000 hours as defined by AFBMA Standards.

I. Lineshaft Bearing: Ultra pure ceramic on filled Teflon.

J. Baseplate: Polypropylene, adequately sized to span and mount over opening as shown on the Drawings; CONTRACTOR shall coordinate. Factory mount pump and discharge pipe on baseplate.

K. Motor Support Frame: Cast iron or fabricated steel, designed to permit access to pump bearing(s) and flexible coupling. Motor mounting surface shall be designed for standard NEMA P flange motor.

L. Shaft Seal: A V-ring vapor seal to prevent escape of corrosive vapors up the pump shaft shall be affixed to the plastic portion of the shaft sleeve where it penetrates the mounting plate. The V-ring shall run against a stationary ceramic seat on the mounting plate.

M. Shaft Column: The pump's centrifugal pump head shall be mounted to a thick wall PVC column.

N. Casing: Pump casing shall be centrifugal bottom suction, radically split, single volute design constructed entirely of PVC.

2.03 DRIVE MOTOR

A. The pump and motor shall be flexibly coupled with a Woods Sureflex coupling, with OSHA coupling guard. Couplings requiring lubrication are not acceptable. Designs which use rigid coupling or carry the thrust in the motor bearings are not acceptable.

B. Motors shall be standard C-face, NEMA Design B, squirrel-cage induction type, rated 120 volts, single-phase, 60-Hz, 3/4-hp, 1,800 rpm, vertical, TEFC, Chem-Duty design, with a 1.15 service factor. Guaranteed rated load efficiency shall be 79.3 percent minimum, and guaranteed rated load power factor shall be 65 percent minimum. Load on any motor shall not exceed the nameplate horsepower rating at any point on the pump performance curve, not including service factor. Motors shall be General Electric Severe Duty or Reliance XT.

2.04 ACCESSORIES

A. Equipment Identification Plate: 16-gauge stainless steel with 1/4-inch die-stamped equipment tag number securely mounted in a readily visible location.

B. Lifting Lugs: Equipment weighing over 100 pounds.

C. Anchor Bolts: Type 316 stainless steel, sized by equipment manufacturer

D. Cable: Provide manufacturer's standard cable, length as required for connection between pump and control panel.

2.05 FACTORY FINISHING

A. Prepare and finish coat in accordance with Section 09900, Painting and Protective Coatings.

2.06 SOURCE QUALITY CONTROL

A. Factory Inspections: Inspect control panels for required construction, electrical connection, and intended function.

B. Factory Tests and Adjustments: Test all equipment and control panels actually furnished.

C. Factory Test Report: Include test data sheets, curve test results, performance test logs.

D. Functional Test: Perform manufacturer's standard test on equipment.

E. Performance Test:

1. Conduct on each pump.
2. Perform under simulated operating conditions.

3. Test for a continuous 3-hour period without malfunction.
4. Furnish test log.
5. Adjust, realign, or modify units and retest in accordance with Hydraulic Institute Standards.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's printed instructions.

B. Level base by means of steel wedges (steel plates and steel shims). Wedge taper not greater than 1/4 inch per foot. Use double wedges to provide a level bearing surface for the pump and driver base. Accomplish wedging so that there is no change of level or springing of the baseplate when the anchor bolts are tightened.

C. Adjust pump assemblies such that the driving units are properly aligned, plumb, and level with the driven units and all interconnecting shafts and couplings. Do not compensate for misalignment by use of flexible couplings.

D. After the pump and driver have been set in position, aligned, and shimmed to the proper elevation, grout the space between the bottom of the baseplate and the concrete foundation with a poured, nonshrinking grout. Remove wedges after grout is set and pack void with grout.

E. Connect suction and discharge piping without imposing strain to pump flanges.

F. Anchor Bolts: Accurately place using equipment templates and as specified in Section 05500, Miscellaneous Metals.

3.02 FIELD FINISHING

A. Equipment as specified in Section 09900, Painting and Protective Coatings.

3.03 FIELD QUALITY CONTROL

A. Functional Tests: Conduct on each pump.
   1. Alignment: Test complete assemblies for correct rotation, proper alignment and connection, and quiet operation.
   2. Vibration Test:
      a. Test with units installed and in normal operation, and discharging through temporarily connected hoses to the exterior chemical fill location sump at rates between the low discharge head and high discharge head conditions specified.
      b. If units exhibit vibration in excess of the limits adjust or modify as necessary. Units which cannot be adjusted or modified to conform as specified shall be replaced.

3.04 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Present at site or classroom designated by OWNER, for minimum person-days listed below, travel time excluded:

1. One person-day for installation assistance, system startup, testing, jobsite training, and inspection.

END OF SECTION 11181

SECTION 16150

INDUCTION MOTORS

PART 1 - GENERAL

1.01 DESCRIPTION

Requirements specified in Conditions of the Contract, Division 1, Section 16010 and Section 16100 form a part of this Section. This Section outlines the electrical requirements for squirrel-cage induction motors.

1.02 SUBMITTALS

Submit for the Owner's approval shop drawings, factory test reports, manufacturers' certified reports and technical data for motors supplied with driven equipment to the extent required in this Section, Section 16010 and the Specification Sections for mechanical equipment.

A. Shop Drawings. In addition to information to be included in the shop drawings as specified in Section 16010, shop drawings shall include the following:

1. Motor locked rotor and full load currents.
2. Power factors and efficiencies at full load, three quarters load and half load.
3. Motor housing material, winding material, NEMA Design letter, NEMA Code Letter, ambient temperatures and maximum elevations in which motor is designed to operate continuously, service factor, NEMA insulation Class, temperature rise, type of enclosure, voltage, bearing life and dynamic balance; all of which shall comply to the requirements of the specifications.
4. Nameplate data.
5. Dimensions and weights of motors.
6. Motor construction details.
7. Speed torque/current at 100 percent volts.
8. Wiring diagrams, internal and typical external connections.
9. Letter or standard motor manufacturer’s literature confirming that motor (or motors) are designed for use with adjustable frequency drives/SCR drives.
10. Time-current damage curves, plotted on full size log-log paper for motors 100 horsepower and larger.

B. Current Data. Submit eight copies to the Owner of field recorded current data. The data shall indicate the full load current for each motor, and current rating for the overload relay in each motor starter and controller.

PART 2 - PRODUCTS

2.01 GENERAL

Motors shall be supplied by the manufacturer of the driven equipment as specified in this section, and specifically outlined in the driven equipment specifications. The Motors shall be completely fabricated, assembled, checked and tested at the factory in accordance with NEMA MG-1. The induction motors shall be Baldor, Louis Allis, Reliance, Siemens, U.S. Electrical Motors, Westinghouse, Marathon, IEM or equal.

A. Motor Ratings.

1. Torque and slip characteristics shall be as recommended by the manufacturer of the driven equipment and as specified. Motor manufacturer shall confirm motor capability to the specifications.
2. Motors shall have a continuous rating and shall operate continuously and satisfactorily in ambient temperatures from minus 10 degrees celsius to plus 50 degrees celsius at a maximum elevation of 3,300 feet without exceeding nameplate horsepower rating.
3. The motors shall have high power factor and the minimum power factor shall be 80 percent at full load.
4. Motors shall be designed for premium efficiency. Motors with the following minimum efficiencies, at full load, shall be provided:
    a. 84 percent minimum efficiency shall be provided for motors through 5 horsepower.
    b. 87.5 percent minimum efficiency shall be provided for motors 7-1/2 through 15 horsepower.
    c. 91 percent minimum efficiency shall be provided for motors 20 through 40 horsepower.
    d. 95 percent minimum efficiency shall be provided for motors 50 through 125 horsepower.
    e. 96 percent minimum efficiency shall be provided for motors 150 to 400 horsepower.
5. The motors shall be sized so that the maximum BHP of the load does not exceed 90 percent of the full load nameplate horsepower of the motor unless otherwise indicated in the driven equipment specifications.
6. The motor must be able to accelerate the driven machine from zero to top speed at 90 percent of rated voltage without overheating.
7. The maximum locked rotor KVA/HP code letter for motors smaller than 15 HP shall not exceed the requirements for NEMA Design B motors. The maximum locked rotor KVA/HP code letter shall be Code G for motors 15 HP through 250 HP unless otherwise indicated. The maximum locked rotor KVA/HP code letter shall be Code F for motors 300 horsepower and larger unless otherwise indicated.

8. All motors shall be insulated and braced for full voltage across the line starting regardless of the starting method used.
9. Motors 1/2 HP and larger shall be NEMA MG1-1.16 Design B and shall have NEMA MG1-1.66 Class F insulation, minimum, unless otherwise indicated.
10. The temperature rise by resistance above the temperature of the cooling medium, for each of the various parts of the motor shall not exceed the values of the NEMA MG1-1.66 Class B insulation system as indicated in NEMA MG 1-12.43, unless otherwise indicated.
11. Motors for variable frequency drive operation shall be equipped with Inverter Grade® insulation system, as manufactured by US Motors, and shall meet the requirements of NEMA MG-1 Part 31.
11. All motors shall have a 1.15 service factor at the specified maximum ambient temperature
13. Motors 1/2 HP and larger shall be 460 volts, 3 phase, 60 Hertz unless otherwise indicated.
14. Motors smaller than 1/2 HP shall be 115/230 volts, 1 phase, 60 Hertz unless otherwise indicated.

B. Motor Construction.
1. Enclosures for induction motors shall be approved for the installations and as indicated. The enclosure types shall be one of the following as outlined in the driven equipment specifications unless otherwise indicated.
   a. Weather Protected 1.
   b. Totally-enclosed fan cooled.
2. Housing, end brackets and all outside components shall be cast iron.
3. A condensate drain hole shall be provided on all non explosion- proof enclosed motors. The drain hole shall be provided in each end bracket on horizontal motors. A single drain hole shall be provided in the lower bracket of vertical motors.
4. The motors shall be equipped with terminal boxes for all conduit and wire connections as required.
   a. The terminal boxes shall be properly sized, diagonally split, cast iron, and rotatable in 90 degree steps. Provide a gasket between the box and motor frame and between the box and the cover. Terminal boxes shall be attached to the motor frame with grade 5 zinc plated and chromated steel bolts or cap screws. All terminal boxes shall have threaded holes for conduit entrance.
5. The castings shall be coated with a red-oxide zinc-chromate primer, and finished with a corrosion resistant epoxy coating. All fabricated steel enclosures shall be coated on all inside and outside surfaces except shafts and register fits.

6. Provide stainless steel nameplates of ample size with clear numerals and letters.
    a. Nameplates shall indicate the manufacturer, serial number, model number, type, horsepower, phase, hertz, volts, design, full load amperes, locked rotor code letter, service factor, speed, insulation class, temperature rating, information required by NEMA MG 1-10.39, NEMA MG 1-10.40 and other essential data.
    b. Nameplate data shall be in the English language and units.
    c. Nameplates shall be secured to the motor frame with corrosion resisting pins in accessible locations.
7. Ground lugs shall be provided in all main motor terminal boxes for grounding.
8. All motors shall have copper windings.
9. Antifriction bearings shall be grease lubricated except for vertical, high thrust motors which may require oil lubrication.
    a. Grease lubricated bearings shall include accessible fittings for in-service, periodic relubrication.
    b. Oil lubricated bearings shall be a reservoir type with a sump for settling foreign matter, accessible and exterior fill and drain plugs and a visual oil level indicator with maximum and minimum indicator levels.
    c. Horizontal, direct connected motor bearings shall be designed for 1 year minimum B-10 bearing life at NEMA minimum V-belt criteria for the rating.
    d. Horizontal, V-belt connected motor bearings shall be designed for 3 year minimum B-10 bearing life for the application V-belt drive or 1 year minimum B-10 bearing life at NEMA minimum V-belt criteria whichever is more restrictive.
    e. Vertical motor bearings shall be designed for 2 year minimum B-10 bearing life at design operating thrust. At maximum operating thrust, B-10 life shall not be less than one year. Transient (shut-off) thrust shall not exceed 30% of the static deformation limit. Motor shall be designed for 30% momentary upthrust capacity except 3600 RPM units which must have 30% continuous upthrust capacity. Any system which exceeds 30% upthrust must be designed for continuous upthrust at one year B-10 bearing life.
    f. Pre-lubricated, double shield bearings are acceptable only on single phase and 56 frame motors.
10. The dynamic balance of motors built in frame size 143 and larger shall be 0.001 inches total amplitude or peak to peak displacement.

11. Accessories shall include the following:
    a. Space heater shall be provided for well pump motor. The space heater shall be 120 volt, 1 phase, and adequately sized to raise the temperature inside the motor to a minimum of 6 degrees Farenheit above ambient and provide thermistols on the windings.
    b. Provide temperature sensors in stator windings of well pump motor. Six (6) RTD type temperature sensors shall be provided. RTD sensors shall be suitable for connection to GE's Multilin 269 plus motor protector.
    c. Provide temperature sensors in well pump motor's bearings. Two (2) RTD type temperature sensors shall be provided. RTD sensors shall be suitable for connection to GE's Multilin 269 plus motor protector.
12. Motors shall have a guaranteed maximum noise level in accordance with NEMA MG1-12.49 for integral horsepower motors and NEMA MG1-20.50 for large motors, except where more restrictive requirements are outlined in other Sections of the Specifications.
13. Well Pump Motor shall be designed for solid state (soft) starter operation.
14. Booster Pump Motor shall be designed for variable frequency drive/inverterduty operation.

PART 3 - EXECUTION

3.01 GENERAL

Provide all the equipment installations and wiring installations, including connections as indicated, specified and required. Assure proper fits for all equipment and materials in the spaces as shown on the Drawings.

A. Motors.
    1. Provide power, control, alarm, and grounding installations for all motors as indicated and required.
    2. Check the connections and provide correct rotation for all motors.
    3. Record the full load current to each motor, and the overload relay rating in each motor starter for the certified data submittal.
    4. Provide the wiring for heaters in the motor frames and the required controls to deenergize the heater when the motor operates.
    5. Provide the required wiring for all control equipment that shall be furnished and installed by other Sections of the Specifications.
    6. Install the motor control stations as shown on the Drawings.
    7. Field damaged factory finish on equipment shall be touched-up with paint that is equal in quality and color to the original factory finish.

3.02 FACTORY TESTS

A. All Motors shall be given a standard commercial test as defined by NEMA MG 1-12.51 and IEEE 112 a and b.

B. Conduct megger test and record reading of all motor windings just prior to connecting the motor to its feeder to determine if accumulation of moisture has occurred in the motor during storage. The reading shall be documented, submitted to the engineer for review, and included in the final O&M manuals.

C. Noise Tests shall be determined by measurement in accordance with the latest revision of IEEE-85, Test Procedure for Air Borne Noise Measurements and Rotating Electrical Machinery. The motor shall be operating during test on rubber at no load with rated voltage and frequency.

D. Vibration Tests shall be per NEMA MG 1-12.07 for small and medium motors and MG 1-20.54 for large motors, except 3600 RPM motors greater than 250 horsepower and motors with sleeve bearings shall be tested at full nameplate horsepower load and temperature.

E. All Testing, other than locked rotor conditions shall be at full voltage $\pm$5 percent.

3.03 FIELD CHECKS

A. Motor Installations shall be complete and correct.

B. Operation Tests shall be performed to observe that motors start, run and stop satisfactorily under design load.

END OF SECTION 16150

CITY OF ANAHEIM

APPENDIX E

INSTRUMENTATION AND ELECTRICAL SPECIFICATION

INSTRUMENTATION AND ELECTRICAL SPECIFICATION

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SECTION 13440

INSTRUMENTATION FOR PROCESS CONTROL: GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. General requirements for complete instrumentation system for process control.

1.02 QUALITY ASSURANCE

A. Referenced Standards:

1. American Society of Mechanical Engineer (ASME):
   a. B31.1, Power Piping.
   b. SEC II-A SA-182, Specification for Forged or Rolled Alloy Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature.
   c. SEC II-A SA-479, Specification for Stainless and Heat-Resisting Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels.
2. American Society for Testing and Materials (ASTM):
   a. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
   b. A276, Specification for Stainless and Heat-Resisting Steel Bars and Shapes.
   c. A479, Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes for use in Boilers and other Pressure Vessels.
   d. B16, Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines.
   e. B68, Standard Specification for Seamless Copper Tube, Bright Annealed.
   f. B75, Standard Specification for Seamless Copper Tube.
   g. B124, Standard Specification for Copper and Copper-Alloy Forging Rod, Bar, and Shapes.
   h. B283, Standard Specification for Copper and Copper-Alloy Die Forgings (Hot-Pressed).
   i. B453, Standard Specification for Copper-Zinc-Lead Alloy (Leaded-Brass) Rod.
3. Institute of Electrical and Electronic Engineers (IEEE):

a. 518, Guide for the Installation of Electrical Equipment to Minimize Electrical Noise Inputs to Controllers from External Sources.

b. C62.41, IEEE Guide for Surge Voltages in Low-Voltage AC Power Circuits.

4. Instrument Society of America (ISA):

a. S5.1, Instrumentation Symbols and Identification.

b. S5.2, Binary Logic Diagrams for Process Operations.

c. S5.3, Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic and Computer Systems.

d. S5.4, Standard instrument Loop Diagrams.

e. S20, Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.

f. RP7.1-56, Pneumatic Control Circuit Pressure Test.

5. National Institute of Standards and Technology (NIST).

B. Qualifications:

1. Instrumentation subcontractor:

a. Financial capability to carry out work.

b. Maintain a qualified technical staff.

c. Have design capability.

d. Have competent service, startup, and authorized training personnel.

C. Contractor to obtain copy of City of Anaheim "Standard Specifications":

1. Follow to extent applicable to work.

1.03 DEFINITIONS

A. Calibrate: To standardize a device so that it provides a specified response to known inputs.

1.04 SYSTEM DESCRIPTION

A. Control System Requirements:

1. This Specification Section 13440 provides the general requirements for the instrument and control system.

2. The instrument and control system consists of all primary elements, transmitters, switches, controllers, computers, recorders, indicators, panels, signal converters, signal boosters, amplifiers, special power supplies, special or shielded cable, special grounding or isolation, auxiliaries, software, wiring, and

other devices required to provide complete control of the plant as specified in the Contract Documents.

B. Unless otherwise required for instrument compatibility, electric control signals shall be 4 to 20 milliampere.

C. All signals shall be directly linearly proportional to measured variable unless specifically noted otherwise.

D. Single Instrumentation Subcontractor:

1. Furnish and coordinate instrumentation system through a single instrumentation subcontractor. The instrumentation subcontractor will be responsible for final design and functional operations of all systems, performance of control system engineering, supervision of installation, final connections, calibrations, preparation of drawings and operation and maintenance manuals, startup, training, demonstration of substantial completion and all other aspects of the control system.

1.05 SUBMITTALS

A. Shop Drawings:

1. See Special Provisions Section 2-13.
2. Product technical data including:
   a. Acknowledgement that products submitted meet requirements of standards referenced.
   b. Manufacturer's installation instructions.
      1) Loop diagrams per ISA S5.4.
         a) Each loop diagram and description on a separate 8-1/2 x 11 IN sheet.
         b) Each sheet shall contain the following minimum information.
            (1) All loop devices clearly identified.
            (2) Identification of the loop and each loop component, including connections to such things as recorders and computers. Numbering and tagging must agree with the P&ID.
            (3) All interconnections with identifying numbers for:
               (a) Electrical cables.
               (b) Conductor pairs.
               (c) Pneumatic or hydraulic tubing.

(4) Identification of connections including:

(a) Junction boxes.

(b) Terminals.

(c) Bulkheads.

(d) Ports.

(e) Computer input/output connections.

(f) Grounding systems.

(5) Signal levels and ranges.

(6) Device location.

(7) Energy sources designating voltage, pressure, and other applicable requirements.

(8) Enough process lines and equipment to clearly show the process side of the loop and provide clarity of control action. This includes:

(a) What is being measured.

(b) What is being controlled.

(c) Other information required to complete the process loop.

(9) Reference to supplementary records and drawings to show inter-relation to other control loops.

2) Instrument component technical brochures.

3) Instrument data sheets:

a) ISA S20 or approved equal.

b) Separate data sheet for each type of instrument.

4) Process connected instrument installation details containing the following minimum information:

a) Bill of materials.

b) Minimum clearances.

c) Required elevations and dimensions.

5) Comprehensive set of point-to-point wiring diagrams showing all interconnections between packaged systems or equipment control panels, motor control centers, instrumentation and all other electrical equipment as required to depict a complete and functional plant-wide electrical control system. Instrumentation wiring already shown on loop diagrams need not be included on point-to-point wiring diagrams.

a) Diagrams shall provide the following minimum information:

(1) Terminal block identification (includes terminals on remote equipment furnished by Others).

(2) Wire size.

(3) Wire type.

(4) Wire color.

(5) Wire shielding and insulation type.

(6) Conductor quantities and associated conduit size.

(7) Ground points.

(8) Interconnection requirements to existing systems or equipment furnished by Others.

b) Diagrams shall be provided on Drawings of sufficient size so as to minimize the number of drawings.

(1) Maximum drawing size: 24 x 36 IN.

(2) Minimum drawing size: 11 x 17 IN.

6) Electrical schematic control diagrams. Diagrams shall include:

a) Terminal identification.

b) Unique identification of all control devices and contacts.

(1) Utilize Owner's device identification numbers where applicable.

c) Wire identification.

d) Equipment identification.

e) indication of remote and local devices and wiring.

f) Overcurrent protection indication.

g) Voltage.

h) All control logic.

7) Panel fabrication drawings.

8) Scaled floor plan layouts of control room.

9) PLC/DCS equipment drawings.

10) Graphic layouts.

11) Graphic component construction.

12) Nameplate layout drawings.

3. Drawings, systems, and other elements are represented schematically in accordance with ISA S5.1 and S5.3. The nomenclature, tag numbers, equipment numbers, panel numbers, and related series identification contained in the Contract Documents shall be employed exclusively throughout submittals.

4. Provide circuit diagrams and certification with the shop drawing indicating how voltage transient protection requirements are met.

5. Warranties: Provide copies of warranties and list of factory authorized service agents.
6. Testing reports:
    a. Source quality control reports.

B. Operation and Maintenance Manuals:
    1. See Special Provisions Section 1-09.09.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Do not remove shipping blocks, plugs, caps, and desiccant dryers installed to protect the instrumentation during shipment until the instruments are installed and permanent connections are made.

PART 2 - PRODUCTS

2.01 PERFORMANCE AND DESIGN REQUIREMENTS

A. System Operating Criteria:
    1. Stability: After controls have taken corrective action, as result of a change in the controlled variable or a change in setpoint, oscillation of final control element shall not exceed two cycles per minute or a magnitude of movement of 0.5 percent full travel.
    2. Response: Any change in setpoint or change in controlled variable shall produce a corresponding corrective change in position of final control element and become stabilized within 30 seconds.
    3. Agreement: Setpoint indication of controlled variable and measured indication of controlled variable shall agree within 3 percent of full scale over a 6:1 operating range.
    4. Repeatability: For any repeated magnitude of control signal, from either an increasing or decreasing direction, the final control element shall take a repeated position within 0.5 percent of full travel regardless of force required to position final element.
    5. Sensitivity: Controls shall respond to setpoint deviations and measured variable deviations within 1.0 percent of full scale.
    6. Performance: All instruments and control devices shall perform in accordance with manufacturer's specifications.

B. Equipment Surge Protection:
    1. Provide power supplies for electronic equipment to successfully withstand surges in AC power circuits per the wave form, voltage amplitude, current amplitude, and frequency provided in IEEE C62.41.

a. Successfully withstanding transients requires that none of the following conditions occur as a result of the transient:

1) Erroneous output.

2) Component failure.

3) Calibration change exceeding normal tolerances.

2.02 ACCESSORIES

A. Provide instruments with manufacturer's identification nameplate showing:

1. Manufacturer's model number.
2. Manufacturer's serial number.
3. Range. (English units)
4. Power supply requirement.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install instrument mounting pipe stands level and plumb.

C. Use bottom entry for all conduit entry to instruments and junction boxes.

D. Install electrical components per Division 16.

E. Instrument Mounting:

1. Mount all instruments where they will be accessible from fixed ladders, platforms, or grade.
2. Mount all local indicating instruments with face forward toward the normal operating area, within reading distance, and in the line of sight.
3. Mount instruments level, plumb, and support rigidly.
4. Mount to provide:
   a. Protection from heat, shock, and vibrations.
   b. Accessibility for maintenance.
   c. Freedom from interference with piping, conduit and equipment.
5. Do not mount current-to-pressure transducers on the control valves unless the transducers are received from the Manufacturer already valve mounted and tubed, or specific instructions to valve mount the transducers are given on the Drawings.

F. Connect surge arresters to ground.

G. Panel-Mounted Instruments:

1. Mount and wire so removal or replacement may be accomplished without interruption of service to adjacent devices.
2. Locate all devices mounted inside enclosures so terminals and adjustment devices are readily accessible without use of special tools and with terminal markings clearly visible.

3.02 FIELD QUALITY CONTROL

A. Maintain accurate daily log of all startup activities, calibration functions, and final setpoint adjustments.

B. Instrumentation Calibration:

1. Verify that all instruments and control devices are calibrated to provide the performance required by the Contract Documents.
2. Calibrate all field-mounted instruments, other than local pressure and temperature gages, after the device is mounted in place to assure proper installed operation.
3. Calibrate in accordance with the manufacturer's specifications.
4. Bench calibrate pressure and temperature gages. Field mount gage within 1 day of calibration.
5. Calibrate each transmitter and gage across its specified range at 0, 25, 50, 75, and l00 percent. Check for both increasing and decreasing input signals to detect hysteresis.
6. Replace any instrument which cannot be properly adjusted.
7. Stroke control valves with clean dry air to verify control action, positioner settings, and solenoid functions.
8. Mark range, date, setpoint and calibrator's initials on each instrument by means of blue or black ink on a waterproof tag affixed to the instrument.
9. Certify calibration equipment by an independent agency with traceability to NIST immediately prior to utilization of the equipment on this Project. Re-certify calibration equipment if the accuracy of the equipment is questioned by the Engineer.
10. Dead weight calibrate precision test gages and use as secondary calibration standards. Recalibrate precision test gages on a weekly basis or as requested by Engineer. Provide a dead weight tester certified with traceability to NIST.

C. Loop checkout requirements are as follows:

1. Check control signal generation, transmission, reception and response for all control loops under simulated operating conditions by imposing a signal on the loop at the instrument connections. Use actual signals where available. Closely observe controllers, recorders, alarm and trip units, remote setpoints, ratio systems, and other control components. Make corrections as required. Following any corrections, retest the loop as before.
2. Stroke all control valves, cylinders, drives and connecting linkages from the local control station and from the control room operator interface.
3. Check all interlocks to the maximum extent possible.
4. In addition to any other as-recorded documents, record all setpoint and calibration changes on all affected Contract Documents and turn over to the Owner.

D. Provide verification of system assembly, power, ground, and I/O tests.

E. Verify existence and measure adequacy of all grounds required for instrumentation and controls.

F. During the demonstration period, observe each signal circuit for the existence of electrical noise.

1. Utilize noise suppression techniques given in Section 6.5, "Suppressive Techniques," of IEEE 518 for all circuits for which electrical noise introduces an error greater than the instrumentation accuracy.

END OF SECTION 13440

SECTION 13441

CONTROL LOOP DESCRIPTIONS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Instrumentation control loops.

1.02 QUALITY ASSURANCE

A. See Section 13440.

1.03 SYSTEM DESCRIPTION

A. Functional descriptions contained are for informational purposes intended to supplement and complement instrumentation control schematics and other details when included in drawings and specifications. Provide instrumentation hardware and software as necessary to perform control functions specified herein and shown on drawings. Ensure coordination of instrumentation manufacturer with other work to ensure that necessary wiring, conduits, contacts, relays, converters, and incidentals are provided in order to transmit, receive, and control necessary signals to other control elements, to control panels, and to receiving stations.

B. The control loop descriptions are not intended to be an inclusive listing of all elements and appurtenances required to execute loop functions and shall not be considered equal to a bill of materials.

C. The standard PLC code and operator interface program will be provided to the Contractor by the City for modification and installation by the Contractor.

1.04 SUBMITTALS

A. See Section 13440.

B. Submit control loop descriptions for each loop in system. Ensure that tag numbers cross reference with loop diagrams and tag numbers shown on instrument specification forms. Describe each element and include appropriate tag number in parenthesis. When additional elements are necessary, use and assign tag number not in conflict with others and in accordance with ISA procedures.

C. Operation and Maintenance Manuals:

1. See Special Provisions Section 1-09.09.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION

3.01 CONTROL LOOPS

A. Well Pump:

1. All switches and lights except lockout switch (LOS) and motor protection switches will be in software graphically on operator interface and will have software actions as described.
2. LOS switch will lock out pump start circuit directly in starter with indication on the operator interface.
3. Start sequence software:
   a. Start signal received from remote or operator interface by PLC (momentary).
   b. PLC opens pre-lubrication line solenoid 1 minute before starting pump.
   c. Pump will not start if:
      1) Diversion valve is not open.
      2) Motor phase unbalance.
      3) Motor winding high temperature.
      4) The 7-day-off timer has timed out (pump has not been operated for more than 7 days). Operator local reset at the touch screen is required.
   d. Open diversion valve if it is not open, start pump.
   e. If pump fails to start or flow does not attain preset rate within adjustable time after start initiation from remote (0-5 minutes) initiate pump fail alarm.
   f. Diversion valve will remain open for timed period after pump starts, then diversion valve closes.
   g. If diversion valve fails to close when called, shut down well and generate alarm.
4. During operation the following conditions will initiate a software alarm:

a. Motor fail (from Multilin 269).

b. Low flow (software initiated).

c. Diversion valve is not closed after a delay when pump is called to run (valve fail) (hardwire input).

d. Pump is not running while still called to run (pump fail) (software initiated).

e. Chlorine level high or low (software initiated).

f. Fire common alarm (hardwire input).

g. Pump lockout shutdown.

5. During well pump operation, monitor and accumulate running time and flow totalization in software.

6. When pump is called to stop by remote or operator interface command (momentary) the following actions take place:

a. Open diversion valve.

b. Stop pump after preset time.

c. Close pre-lubrication line solenoid.

7. Alarms are indicated on operator interface.

B. Chlorination System:

1. Control the operation of chlorination feed pumps as specified herein and as shown on the P&IDs.

The feed pumps shall be wired for semiautomatic control, furnished with single speed motors and the flow rate shall be manually adjusted at the pump. The start/stop commands shall be issued by the PLC through local HOA switches interlocked with the well pump motor starter for permissive to run (hardwired). In normal operation the HOA switch shall be in AUTO and the well pump shall be running for the PLC to start either feed pump. The PLC shall monitor the feed pump running status, run time, motor fail, and seal leakage alarms. In the event of a pump failure, the stand-by pump shall be automatically started by the PLC and a pump failure alarm issued. When the HOA switch is in HAND mode the pump shall be started locally without the PLC intervention but still with the well pump running permissive required.

2. Monitor the level and leakage of storage tanks.

C. Input/Output:

1. As shown on drawings and in I/O schedule in Section 13500.

END OF SECTION 13441

SECTION 13442

PRIMARY ELEMENTS AND TRANSMITTERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Flow components.
2. Pressure components.
3. Level components.

1.02 QUALITY ASSURANCE

A. Referenced Standards:

1. American Iron and Steel Institute (AISI).
2. American National Standards Institute (ANSI):
   a. B16.5, Pipe Flanges and Flanged Fittings.
3. American Society of Mechanical Engineers (ASME):
   a. Fluid Meters, Sixth Edition.
4. American Society for Testing and Materials (ASTM):
   a. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
   b. A182, Standard Specification for Forged or Rolled Alloy Steel Pipe Flanges, Forged Fittings and Valves and Parts for High Temperature Service.
   c. A240, Standard Specification for Heat Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.
   d. B61, Standard Specification for Steam or Valve Bronze Castings.
5. National Electrical Manufacturers Association (NEMA):
   a. ICS 6, Enclosures for Industrial Controls and Systems.

B. Miscellaneous:

1. Comply with electrical classifications and NEMA enclosure types specified in this section or shown on Drawings.

1.03 SYSTEM DESCRIPTION

A. The instruments specified in this Section are the primary element components for the control loops shown on the "I" series Drawings and the functional descriptions specified in Section 13441. These instruments are integrated with other control system components specified under the 13440 specification series to produce the functional control defined in the Contract Documents.

1.04 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Materials of construction.
      d. Minimum and maximum flow ranges.
      e. Pressure loss curves.
      f. Physical limits of components including temperature and pressure limits.
      g. Size and weight.
      h. Electrical power requirements and wiring diagrams.
   3. Certifications:
      a. Electrical area classification certification.

B. Operation and Maintenance Manuals:
   1. See Special Provisions Section 1-09.09.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the Manufacturers listed in the articles describing the elements are acceptable.

B. Submit requests for substitutions in accordance with Special Provisions Section 1-06.02.

2.02 MAGNETIC FLOW METERS

A. Acceptable manufacturers:

1. Sparling
2. Marsh McBirney
3. Toshiba

B. General:

1. Where indicated on the construction drawings, a magnetic flow meter shall be furnished and installed per the manufacturer's recommendations. The magnetic flow meter shall be microprocessor-based, and bi-polar DC - pulsed coil excitation design. The meter shall be one that senses fluid flow and develops a signal directly proportional to the fluid velocity. Meter accuracy shall be ± 0.15 % of indicated rate. Calibration must be traceable to NIST, or nationally accredited flow laboratory equipment. Meter repeatability shall be ± 0.05 %. The meter shall give flow indication (in gallons per minute) and totalization (in hundreds of cubic feet) and shall have empty pipe detection. The flow meter shall have an FDA approved Polyurethane lining approved for chlorinated potable water use. The meter tube shall be constructed of 304 SST with carbon Steel flanges, class 150 with a 250 psi pressure rating. The meter shall come with a built-in grounding electrode. Flanges shall be compatible with connecting Class E pipe flanges.

2. The flow sensor shall be without obstructions. The electronics and transmitter shall be integrally mounted within a NEMA-4X enclosure. The meter remote electronics shall include an isolated 4-20 mA output. The flow sensor electrodes shall be 316SS. The electrodes shall be non-removable design. The enclosure shall incorporate a local LED display for flow monitoring.

3. The transmitter shall be microprocessor based design and integrally mounted to the sensor. The transmitter shall have as a standard: 1 analog output, 2 pulse outputs, 2 alarm outputs, 1 contact input (can activate 2nd span, drive output to zero, clear totalizer, or hold output). The transmitter shall be powered by AC, 85 to 265V. The input impedance of the transmitter shall be a minimum 10 / 15 Ohms. Flow meter parameters shall be assessed locally from the front transmitter face through a password protected keypad, or RS232 connection. The transmitter shall be capable of performing on-line system diagnostics, including sensor circuit checks, along with self-verification test mode.

2.03 PRESSURE TRANSMITTERS

A. Acceptable manufacturers:

1. Rosemount or SMAR with HART protocol.

B. Materials:

1. Isolating diaphragm: 316 stainless steel

C. Design and fabrication:

1. Output: 4-20 mA DC proportional to pressure.
2. Solid-state electronics two wire type.
3. Power supply: 24 V DC.
4. Adjustable zero and span.
5. Temperature limits: -20 to 160 DegF.
6. Overpressure limits: Withstand 150 percent of stated maximum service pressure without damage.
7. Humidity limits: 0 to 100 percent relative humidity.
8. Damping: Time constant adjustable between 0.2 and 1.67 seconds.
9. Accuracy (includes effects of linearity, repeatability and hysteresis): $\pm$ 0.2 percent of calibrated span.
10. Linearity: $\pm$ 0.l percent of calibrated span.
11. Hysteresis: $\pm$ 0.l percent of calibrated span.
12. Stability: $\pm$ 0.2 percent of upper range limit for 6 months.
13. Temperature effect at maximum calibrated span:
    a. Zero error: $\pm$ 0.5 percent of span per 100 DegF.
    b. Total effect including span and zero errors: $\pm$ 1.0 percent of span per 100 DegF.
14. Temperature effect at minimum calibrated span:
    a. Zero error: $\pm$ 3.0 percent of span per 100 DegF.
    b. Total effect including span and zero errors: $\pm$ 3.5 percent of span per 100 DegF.
15. Minimum 1/4 inch pressure connection.
16. Zero elevation: 600 percent of calibrated span.
17. Zero suppression: 500 percent of calibrated span.
16. Indicator: Built-in, 0-100% 2 inches round minimum.

2.04 LEVEL TRANSMITTERS

A. Acceptable manufacturers:

1. Milltronics, model HydroRanger.

B. Transponder and Signal Cable:

The transponder shall include an ultrasonic signal generator/receiver and a thermal sensor encapsulated in a NEMA 4X, material resistant to chlorine corrosion. It shall be supplied with sufficient length of shielded signal cable for connection to the transmitter which may be located up to 200 feet from the transponder. The transponder shall be supplied with a connector suitable for cable conduit connection. As an alternative transponder may be making an integral part of transmitter. Mounting to be on 2-inch NPT connection.

C. Transmitter:

The transmitter shall be housed in a weather-proof NEMA 4X enclosure suitable for mounting on transponder or shall be wall mounting. It shall produce an isolated 4-20 mAdc signal. Signals shall be fully compensated for variations in ambient temperature in the range of +30^{o}F to 120^{o}F. Operation of the digital solid state circuitry shall be controlled by a microprocessor or equivalent. The transmitter shall have range and span adjustment with resolution of 0.1 inches for direct reading zero adjustments, and for setting span. The adjustment controls shall accommodate spans of zero to 4 inches minimum and zero to maximum specified on the drawings. Automatic gain control shall be included in the transmitter amplifier to eliminate gain adjustments at installation. The transmitter shall be provided with an indicator reading 0-100 linear with level. To assure proper adjustment of the transponder, an on/off echo strength switch shall convert the process indicator into an echo strength indicator. A hardware or software system for dampening shall be included to reduce output oscillations caused by water surface turbulence below the transponder. The accuracy shall be ±1 percent of full scale. Transmitter shall be supplied with two sets of voltage free Form C level switches adjustable at the full range of operation.

D. Calibrator:

Provide either separate integral internal or a single portable external electronic range simulator. The portable range simulator shall be a terminal connected solid state range calibration standard, which will allow an operator to recalibrate and adjust each system by generating an artificial target fully adjustable throughout the required measurement range. This device shall allow recalibration without process manipulation.

E. Power:

The system shall operate from 120 Vac, 60 Hz power, and variations of +10 percent in voltage of frequency shall not affect the accuracy in excess of 0.1 percent.

2.05 WELL WATER LEVEL TRANSMITTER

A. Acceptable Manufacturers:

1. Rittmeyer, model MPOTRN. 100, with J-box termination enclosure MPZAD. 002, with vented cable.

B. General:

Fully submersible well water level shall be designed for long-term monitoring application. It shall be compatible for direct connection to a PLC analog input card.

C. Material:

1. Probe: 316 SST, Teflon tip.
2. Cable: Polyurethane cover over 316 SST braid, PTFE vent tube.
3. All components in contact with the well water shall be safe for use in potable water.

D. Range:

1. Pressure: 0-100 PSI
2. Temperature: $35^{o}F – 85^{o}F$

E. Size:

1. Maximum diameter: 1-1/2 inch
2. Cable length: (To be determined)

F. Electrical:

1. Signal Output: 4-20 m Adc
2. Automatic temperature compensation of water level reading between 30^{o} to $86^{o}F$.

G. Accuracy:

1. Pressure sensor: ±0.15%

2.06 PRESSURE GAUGES

A. Acceptable manufacturers:

1. Ashcroft.
2. Ametek.

B. Materials:

1. Bourdon tube, socket, connecting tube: 316 stainless steel.
2. Case: Phenolic.
3. Diaphragm seal housing: 316 stainless steel.

4. Pressure snubber:
    a. Filter disc: 316 stainless steel.
    b. Housing: 316 stainless steel.
5. See also Section 15010 2.02.G.

C. Accessories:
1. Provide valve at point of connection to equipment and at panel if panel mounted.
2. Utilize pressure snubbers with porous metal discs to provide pulsation dampening on all gauge applications which involve positive displacement equipment.
3. In-line isolating sleeve:
    a. Acceptable manufacturers:
        1) Red Valve.
        2) Or equal.
    b. Provide full 360 degree circumferential reading of line fluid with flexible in-line rubber sleeve.
    c. Mounting: In-line mounting between standard ANSI pipe flanges.
4. System fill applications:
    a. Liquid filled case.
    b. Diaphragm seal.
    c. Sealed sleeve.
5. System fill material:
    a. Utilize halocarbon fill for process applications involving strong oxidizing agents. Agents include but are not limited to: C12, KMN04, FeCl, NAOH, and NaOC1.
    b. Utilize manufacturer's standard fill for other applications. Ensure fill is suitable for application temperatures.
6. Provide 1/2 inch stainless steel antisiphon pigtail inlet connection for hot water and steam applications.

D. Design and fabrication:
1. All components suitable for service at 250^{o}F.
2. Calibrate gages at jobsite for pressure and temperature in accordance with manufacturer's instructions.
3. Unless otherwise required by codes, provide stem mounted or flush mounted as required units with dial diameter as follows:

Pipe Size	Dial Size	Gage Connection
1-1/2 Inch Or Less	2-1/2 Inch	1/4 Inch
Larger than 1-1/2 Inch	4-1/2 Inch	1/2 Inch

4. Equip with white faces, black numerals and black pointers.
5. Gage tapping position to be clear of equipment functions and movements, and protected from maintenance and operation of equipment. Gage to be readable from an accessible standing position.
6. Gage accuracy: 1 percent of full range.

2.07 LEVEL SWITCH FOR LEAK DETECTION

A leak detection system shall be provided and installed to continuously monitor and alarm a leak in the sodium hypochlorite storage tank. The system shall include a capacitance type level sensor with reference probe and electronics to provide a set of Form C dry contact, which shall be connected to the station control panel by others. Vendor may quote an alternative type of level sensor, providing detailed justification for such change. The components shall be housed in a NEMA 4X enclosure. The enclosure shall be direct mounted on the tank. The system components shall meet the following requirements:

A. Power: 115 VAC, 60 HZ.

B. Enclosure: NEMA Type 4X UL listed for corrosive outdoor applications.

C. Relay Contact Rating: Form C (SPDT), 3A/125 VAC.

D. Acceptable manufacturers: Provided by the tank vendor.

2.08 WELL PUMP MOTOR VIBRATION TRANSMITTER

A. See Section 11005, 2.02, Item - Motor Accessories.

2.09 ACCESSORIES

A. Furnish all mounting brackets, hardware and appurtenances required for mounting transmitters.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. The well water level and temperature transmitter shall be installed in the 4” sounding/camera port tube. Provision shall be made to facilitate removal of transmitter when lowering the camera.

END OF SECTION 13442

SECTION 13448

CONTROL PANEL

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Control panel.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society for Testing and Materials (ASTM):
      a. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
   2. Joint Industrial Council (JIC):
      a. EMP-1-1967, Mass Production Equipment.
   3. National Electrical Manufacturers Association (NEMA):
      a. ICS 4, Terminal Blocks for Industrial Use.
      b. ICS 6, Enclosures for Industrial Controls and Systems.
      c. 250, Enclosures for Electrical Equipment (1000 V Maximum).
   4. National Fire Protection Association (NFPA):
      a. National Electric Code (NEC).

B. Miscellaneous:
   1. Prior to placement of conduit feeds, assure approved control panel layouts available.
   2. Assure completely matching color tones for any individual color specified.
   3. Provide panel with the required NEMA rating per NEMA Publication No. 250 to meet classifications shown on drawings or specifications.

1.03 SUBMITTALS

A. Shop Drawings:

1. See Special Provisions Section 2-13.
2. Scaled panel face and subpanel face instrument and nameplate layout drawings.
3. Panel and subpanel materials of construction.
4. Panel and subpanel dimensions and weights.
5. Panel access openings.
6. Conduit and wiring access locations.
7. Internal wiring and terminal block drawings.
8. Nameplate text.

B. Samples:

1. Color selection range of a minimum of 20 colors for panel finish paint. To be coordinated with and match the electrical panel.

C. Operation and Maintenance manuals:

1. See Section 1-09.09.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Front Panel, Subpanel or Front Door: Steel.

B. Frame and Bottom Angles: Steel.

C. Too, Sides, Back, Sides, and Back Door: Steel.

D. Hinges: Stainless Steel.

E. Nameplates: Phenolic.

F. Filler Panels: Steel.

2.02 ACCESSORIES

A. Panel Nameplates and Identification:

1. Identify each item on the control panel with rectangular nameplates.
2. Provide nameplates with black letters on white background.
3. Minimum letter height is 1/2 IN for instrument description and 1/4 IN height for instrument tag number.

4. For all panels which have a panel identification number, provide 2 IN high white nameplate with black, 1 IN high lettering with panel identification number.

2.03 UNINTERRUPTIBLE POWER SUPPLY

A. Manufacturers. The UPS shall be a rack-mount type unit, Liebert or approved equal.

B. General. An uninterruptible power system (UPS) shall be furnished to provide a reliable source 120 Volt, 60 HZ isolated, regulated and uninterruptible power with no break in AC output power during a complete or partial interruption of incoming line power. The UPS shall include an intelligent interface and a voltage-free alarm contact in order to keep operator advised of system status.

1. Isolation. The UPS shall provide a true, separately-derived power source with output neutral bonded to ground. There shall be no direct connection between input and output and less than 2 pF of effective input to output capacitance.
2. Regulation. The UPS output shall be regulated to within the ANSI/NEMA C84.1 point of utilization range of 104 to 127 (for 120 V AC) over the full dynamic range from no load to full load and low line AC voltage to high line AC voltage and low battery voltage to high battery voltage.
3. Uninterruptibility. The UPS shall provide continuous, no-break power during a power outage or momentary interruption. Standby power systems, which have any measurable transfer time and interruption of the output waveform, are unacceptable.
4. Sine-wave Power. The UPS shall provide computer-grade, sine wave power with five percent or less total harmonic distortion capacity.
5. Switch-mode Power Supply Rated. Capacity shall be rated in volt-amperes (VA) while loaded with typical computer-grade switch-mode power supplies having a power factor of 0.6 to 0.7.
6. The UPS shall be comprised of a microprocessor-controlled static inverter, precision battery charger, sealed maintenance-free batteries, electronic indicators and shall be contained in a single compact package.

   The UPS shall be capable of monitoring from front panel, the functions and alarm conditions. The UPS shall also include front panel test capability.
7. The UPS shall have an efficiency of at least 90% when operated from AC line.
8. The output capacity of the UPS shall be a minimum of one KVA. Typical run time shall be minimum of 10 minutes when it is half loaded.

2.04 FABRICATION

A. General:

1. Fabricate panels with instrument arrangements as shown on the Drawings.
2. Prime control panels with rust inhibitive shop applied primer and paint with one coat of epoxy enamel.
3. Finish interior of panel with epoxy gloss white.
4. Provide control panel which meets the following requirements:
   a. Panel depth per JIC EMP-1-1967, E7.1.4.
   b. Door opening per JIC EMP-1-1967, E7.1.5.
   c. Data pocket per JIC EMP-1-1967, E7.1.6.
   d. Rigidity per JIC EMP-1-1967, E7.1.7.
   e. Door alignment and reinforcement per JIC EMP-1-1967, E7.1.8.
   f. Panel holes and openings per JIC EMP-1-1967, E7.3.2, E7.3.3, and E7.3.4.
   g. Doors per JIC EMP-1-1967, E7.5.
   h. Clear panel mounting space per JIC EMP-1-1967, E8.2.9.
   i. Panel mounted control device location per JIC EMP-1-1967, E8.3.4.
   j. Clearances in enclosures per JIC EMP-1-1967, E8.4.

B. Free-Standing Panels:

1. Minimum construction thicknesses:
   a. Front panel, subpanel, or front door with cutouts: 0.125 IN.
   b. Top, sides, back, filler plates and side or doors with no cutouts: Minimum thickness per, NEMA ICS 6, Tables 3-8,9.
2. Welded construction.
3. Completely enclosed, self-supporting, and gasketed dust-tight.
4. Edges turned back minimum of 2 IN.
5. Seams and corners welded and ground smooth to touch and smooth in visual appearance.
6. Arrange control panel faces continuous and flush with face of adjacent electrical panels.
7. Provide filler panels where necessary to close gaps between panels or back of panel and wall. Provide full length flush pan doors.
8. Provide full length piano hinges rated for 1.5 times door plus instrument weight.
9. Furnish doors with keyed alike locking handles and three point catch.

10. Provide appropriate conduit, wiring, and instrument openings in accordance with best panel design.
11. After cutouts have been made, finish opening edges to smooth and true surface condition.
12. Provide each panel with lifting eyebolts. Furnish hot-dipped galvanized steel base channels.
13. Slotted bolt holes in base, 1 1/2 long for field adjustment.

C. Panel Front Construction:

1. Minimum construction thicknesses: per NEMA ICS 6, Tables 3-8,9.
2. Welded construction.
3. Edges turned and ground smooth to touch and visual appearance.
4. At joints where panel face meets side walls, provide dustproof sponge rubber gasket entire height and face.
5. Use full length piano hinges rated for 1.5 times door weight for panel access door.
6. Equip doors with locking devices and handle and three point catches.
7. Finish all instrument cutouts smooth and true.

D. Panel Wiring:

1. Factory wire panels to identified terminal blocks equipped with compression-type terminals.
2. Install all wiring without splicing in factory in raceways:

a. Size raceways per the requirements of NEC Article 373.

b. Raceways shall have removable covers.

3. Wire bending space shall be in accordance with Tables 307B, C in NEMA ICS 6.
4. Keep AC power lines separate from low-level DC lines, I/O power supply cables, and all I/O rack interconnect cables.
5. Keep AC signal wires separate from DC signal wires.
6. When I/O wiring must cross AC power wiring, it shall only do so at right angles.
7. Arrange circuits on terminal blocks plus any spare conductors on adjacent terminals.
8. Provide necessary power supplies for control equipment.
9. Equip each panel with a main thermal magnetic circuit breaker. Limit load to maximum of 80 percent of circuit breaker rating.
10. Provide all necessary stabilizing voltage transformers, balancing potentiometers and rectifiers as necessary for specific instrument requirements.

11. Assure each panel mounted device is bonded or otherwise grounded to panel or panel grounding system by means of locknuts or pressure mounting methods.
    a. Equip panel with grounding terminals.
12. Arrange wiring with sufficient clearance for all leads.
13. Wiring to subpanels or rotary switches shall be individually bundled and installed with a "flexible loop" of sufficient length to permit the component to be removed from panel for maintenance without disconnecting wiring.
14. Identify all wires with plastic sleeve type wire markers at each end. Markers shall:
    a. Identify circuit numbers.
    b. Identify function and polarity.
15. Termination requirements:
    a. Terminal block markings, mechanical characteristics and electrical characteristics shall be in accordance with NEMA ICS 4.
    b. Terminals shall facilitate wire sizes as follows:
        1) 120 V AC applications: Wire size 12 AWG and smaller.
        2) Other: Wire size 14 AWG and smaller.
    c. Provide terminal blocks with continuous marking strip.
    d. Tag each I/O terminal to indicate tag number of the connected device.
    e. Provide terminals for individual termination of each signal shield.
    f. Provide 20 percent excess terminals for future expansion.

E. Panel Lighting and Power:
1. Receptacles: One GFI duplex on inside panel face.
2. Lighting: single tube fluorescent full length stip with switch.

F. Environmental Controls:
1. Furnish circulation fans near hot spots where required to prevent temperature from exceeding instrument rating.
2. Over-temperature switches shall be utilized to provide special cooling if required to maintain operating temperatures within the manufacturer's specified range.
3. Air conditioning applications shall include means of preventing moisture condensation.
4. For panels or control cabinets located outside, or in area classification requiring a NEMA 4 or 4X rating:
    a. Provide printed circuit boards with "Humiseal" conformal coating, covering entire components on both side of board except not covering adjustable components.

b. Furnish gold plated edge connectors on circuit board and socket contacts.

2.05 PANEL SCHEDULE

A. Control Panel.
   1. NEMA 12 to match and lineup with electrical panel.
   2. Lockable outside doors keyed to same key as electrical panel.
   3. Provide seismic tie down as called for in Specification Section 11005.

B. Major components. To include the following (also refer to the panel drawing):
   1. 24 VDC loop power supply.
   2. PLC.
   3. Relays (if required.)
   4. Terminal strips for connections.
   5. Radio.
   6. UPS

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install free-standing panels on concrete pads as detailed on the Drawings.

END OF SECTION 13448

SECTION 13449

SCADA SOFTWARE AND HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. References:
1. NFPA 70 (NEC)
2. UL508
3. EN61131-2
4. IEC 61000-6-2
5. FCC (Class A)
6. UL 1604
7. CSA C22-2 #14
8. ANSI/NEMA ICS 6
9. API RP550
10. ISA S5.4
11. ISA S20
12. ISA S50.1
13. ISA S51.1

1.2 SUMMARY

A. This Section includes SCADA software and hardware for control of process equipment, process oriented machinery, and process systems.

B. The SCADA system supplier, as defined below shall be responsible for the following:
1. Supply of the plant network and main SCADA servers and/or Operator Stations.
2. Supply of all control panels that are not specifically associated with a machine or process system specified elsewhere.
3. Coordination with all panel suppliers to insure proper data transfer between the SCADA operator stations and control panels.

C. Related Sections include the following:

1. Section 13500 “Programmable Logic Controllers”

2. Section 13502 “Operator Interface Terminals”

1.3 DEFINITIONS

A. AI: Analog Input

B. AO: Analog Output

C. Control Panel Designer: A firm or individual that is responsible for designing the layout of control panels. This person will choose the devices to be included in the panel, and will decide on the actual layout.

D. CPU: Central Processing Unit

E. DI: Digital Input

F. DO: Digital Output

G. HMI: Human-Machine Interface

H. I/O Input and/or Output

I. Node: A network connection point. Examples include a PLC, PC, Operator Interface Terminal, Switch, Server, etc.

J. Open Protocol: A network protocol whose configuration code is available with or without a fee or license.

K. Operator Interface Terminal: A terminal usually embedded in a control panel that allows the operator to view and modify control system parameters. Operator Interface Terminals are not capable of running commercially available software.

L. Operator Station: A terminal that runs a commercially available operating system such as Windows. An Operator Station will usually execute the SCADA software. Operator Stations are usually desktop mounted personal computers. However, they may be computers that are designed to be embedded in the doors of control panels and

M. PID: Control action, proportional plus integral plus derivative.

N. PLC: Programmable Logic Controller

O. Public Domain: A network protocol whose configuration code is available without the need to pay a fee or buy a license.

P. SCADA: Supervisory Control and Data Acquisition. A SCADA System is a computer (typically a personnel computer), or a group of computers and servers running a software dedicated for SCADA purposes. This SCADA software can exchange over industrial networks, with PLC's, VFD's, and other industrial devices. Typically, the SCADA software will allow for trending, graphic display, alarm tracking, and reporting of data.

Q. SCADA System Provider: A company that takes a commercially available SCADA software package, and then develops a project specific application. This company will typically supply hardware for the SCADA software and application to operate on.

R. SDT: Site Demonstration Test

1.4 SUBMITTALS

A. Product Data:
   1. The SCADA system provider shall be responsible for the accuracy and completeness of all aspects of the SCADA submittal. This includes SCADA software detailed herein, and applicable hardware. If the SCADA system provider is providing Operator Interface Terminals, then the relevant Operator Interface Terminal Submittals must be completed in addition to the four types listed below:
      a. Design submittal:
      b. System Documentation Submittals
      c. Testing Submittals
      d. Training Submittals:

B. Each Operator Station type, and each type of SCADA software submittal, shall have a separate check sheet. This check sheet shall be an acknowledgement of all specified criteria. The check sheet will consist of three columns. The leftmost column will indicate the referenced section of the specification. The middle column will indicate rather the indicated specification criteria are met, not met, or has a variance. The rightmost column will be used to describe reasons for variances or not meeting the specified criteria. Each row on the check sheet will be for a dedicated spec section or sub section. Each specification delineation will have its own dedicated row. For instance, you cannot accept section 1.5B and its corresponding subparagraphs in a single row. You must accept 1.5B in a row, and 1.5B1 in another row.

C. SCADA system provider shall be responsible for providing accurate and complete submittals in a timely fashion so as to not cause delay to the project schedule.

D. Once submitted, SCADA suppliers shall not proceed with their associated work until the receipt of submittals marked as “Approved”, or “Approved as noted".

E. Operation and Maintenance Data: Provide documentation detailing routine maintenance requirements (if any) for all SCADA Server hardware and Operator Display Station hardware that is provided.

F. All submitted information shall be in English.

G. SCADA System Submittals:
   1. Design Submittals:
      a. Hardware Product Information Submittal:
         1) Hardware product information shall include, but not be limited to: catalog cut sheets, data sheets, performance surveys, test reports, equipment lists, material list, diagrams, pictures, and descriptive material. The product information shall cover all items including mechanical devices, mounting components, wiring, terminal strips, connectors, accessories, and spare parts. The submittal information shall show the standard and optional product features, as well as all performance data and specifications.
         2) Prior to commencement of manufacture (or shipment for stock items), the SCADA System Provider shall submit for review product information for all

equipment and material specified in this Section, or required to support equipment or systems specified in this RFP.

b. Power Distribution Submittal:
   a) SCADA System Provider shall prepare a summary of all SCADA hardware power requirements and provide load calculations that will be used for planning power distribution across existing UPS systems. SCADA System Provider shall provide a submittal for approval 60 days prior to Comprehensive System Test.

c. Software Product Information Submittal (SPID):
   1) The software documentation shall provide a comprehensive description of all software, necessary for the operation and maintenance of the system. A software document shall be furnished for each software or program in the System. Warranty information shall be supplied for each software or program in the System. Software License information shall be submitted for each software or program in the system, indicating the number of licenses provided for each type of program or software.
   2) The SCADA System Provider shall submit software documentation for review within 21 calendar days of Contract award. Software procurement shall not begin until submittal review is successful.

d. Connection Diagrams:
   1) Connection diagrams shall show the placement, labeling and wiring of components within panels, cabinets, and consoles. Wire lists and wireless diagrams shall not be accepted. Components shall be shown arranged in the physical layout (not necessarily to scale), as it would appear to a person servicing the equipment. Wiring designations, and routing designations, will follow the projects drawings standards.
   2) The SCADA System Provider shall submit connection diagrams for all new panels, cabinets, and consoles. The SCADA System Provider shall also prepare and submit connection diagrams for existing panels, cabinets and consoles, which are modified or refurbished. Connection diagrams shall be Successfully Reviewed prior to the start of panel assembly. Loop diagrams may not be substituted for connection diagrams.

e. Interconnection Diagrams:
   1) Interconnection diagrams shall show the external wiring between terminals of associated equipment, control panels, motor control centers, terminal boxes, field switches, and any other device, panel, or enclosure. Interconnection diagrams shall clearly depict all cable tags. Cable tagging shall conform to project standards.
   2) The SCADA System Provider shall prepare and submit interconnection diagrams for all major system components. Interconnection diagrams shall be Successfully Reviewed prior to the start of fabrication.

f. Panel Fabrication and Layout Drawings (PLFD):
   1) As a minimum, PLFD shall include front, back, and section views; the locations of all mounted components; drawing scale; nameplate engraving schedule; and structural materials and supports. A bill of material shall also be provided on the drawing, or as a separate document. All drawings shall be scaled. Overall dimensions and minimum clearances shall be shown. Sufficient detail shall be included to demonstrate material choices, outward appearance, construction methods, and seismic force resistance.
   2) Complete shop drawings shall be submitted for all panels, cabinets, and consoles which are fabricated, or modified, for this project. Reviewers shall

have the right to make modifications to the interior and exterior layouts of panels as part of the shop drawing review. No additional compensation will be provided to the SCADA System Provider for changes. The SCADA System Provider shall budget for one redesign of the panel layout to incorporate the reviewers' changes. Fabrication or modification shall not be started until PFLD submittals have been Successfully Reviewed.

2. Functional design documentation submittal:
    a. Functional Network Design Document: The SCADA System Provider shall provide a functional network design document shall contain the following:
        1) A complete network system diagram showing the interconnections between hardware subsystems. This shall include fiber optic cabling, network switches, routers, fiber patch panels and other network components.
        2) Complete description of switch setup and programming to accomplish Ethernet configuration shown on the drawings.
        3) Complete list of all major system components. This includes existing panels and panels not supplied by the SCADA system supplier.
        4) Assignment of each component a unique device identifier.
        5) Labeling of all components on all block diagrams.
        6) Provide locations for all major system components
    b. Functional SCADA Architecture Design Document: The SCADA System provider shall provide a Functional SCADA Architecture design document shall contain the following:
        a) A complete system diagram showing the major components and interconnections of the Proposed SCADA system. This shall include all servers, all Workstations, Remote Terminal Units, and PLC's, at a minimum.
        b) Any required transceivers, media converters or other interconnecting equipment shall be included on the diagram.
        c) Complete description of IP addressing scheme for the proposed system
        d) Complete list of all major system components
        e) Assign each component a unique device identifier
        f) Label components on all block diagrams
        g) Provide locations for all major system components.
        h) An interface design for all areas where the facilities existing hardware interfaces with the new network
    c. Functional Software Design Document (FSDD):
        1) The FSDD shall show the top-level design of the SCADA System Provider's proposed software in a concise manner. The complete description of support, interface, diagnostic, and general I/O software shall also be included. An inventory of major software packages, including third party, provided shall be included. A separate summary shall be provided for each major system component. The FSDD shall illustrate the flow of data from one process to another (i.e. the flow of data from field data acquisition to polling by the SCADA system to alarming to historical logging). The FSDD shall include a description of the historical data collection subsystem, including table usage and data storage rates. The document shall include, but not be limited to:
            a) Polling Process, including anticipated scan rates
            b) Data consolidation techniques for use in RTU
            c) Peer to Peer data flow
            d) Hard Drive Storage space required for each software component

e) Memory requirements (RAM) for each software component.

2) Within 21 days from notice to proceed, the SCADA System Provider shall submit for review the FSDD submittals.

d. Installation Drawings:

1) Installation drawings shall show installation arrangements for all provided equipment, mounting and anchoring details, conduit entries into cabinets, and SCADA electrical power supply distribution conduit and wiring. Data sheets and/or catalog cuts for mounting devices, anchors, wire, and other incidental installation materials shall be included.

2) Within 21days prior to the start of System Testing, the SCADA System Provider shall submit installation drawings. System Testing shall not begin until the system installation drawing submittal has been Successfully Reviewed.

3. System Documentation Submittal:

a. Operation and Maintenance (O&M) Manuals:

1) SCADA System Provider shall supply O&M manuals for all equipment and software provided. The manuals shall be developed for electronic technician audience. The manuals shall detail preventive and restorative procedures required to keep the equipment in good operating condition. A manual, or manuals, shall be furnished for all deliverable hardware, including OEM equipment. Manuals for OEM equipment shall contain original printed materials, not copies, and may be in the manufacturer's original format. The O&M manuals shall contain the following:

b. Instruction Manual:

1) The manual shall contain a detailed analysis of each major component so that maintenance personnel can effectively service, troubleshoot, and repair the equipment. Each manual shall include a Table of Contents, and shall be divided into the following sections:

a) Introduction: The purpose of the manual, special tools and equipment, and safety precautions.

b) General Information and Specifications: A general description of each equipment item, and its specifications.

c) Listings: Include contact information for each product provider, recommended maintenance provider, and local source for replacement parts.

d) Theory of Operation: Explain the relationship of all equipment to each other, and its purpose in the overall SCADA network.

e) Software: Listing and explanatory text for any software or firmware.

f) Operation Procedures: The locations and functional descriptions of all controller indicators, or displays.

g) Troubleshooting: A tabular list of all symptoms, probable causes of malfunction or improper operation, and probable remedies to each specific malfunction, down to the smallest board replaceable components.

c. Preventive Maintenance Instructions:

1) These instructions shall include all applicable visual examinations, hardware testing, and diagnostic hardware/software routines. Instructions on how to load and use any test and diagnostic programs and any special or standard test equipment shall be an integral part of these procedures.

d. Corrective Maintenance Specific Instructions:

1) These guides shall include adequate details for quickly and efficiently locating the cause of an equipment malfunction and shall state the probable source(s) of trouble, the symptoms, probable cause, and instructions for remedying the malfunction. These guides shall explain how to use on-line test and diagnostic programs for all devices and any special test equipment, if applicable. The corrective maintenance specific instructions shall include:
   a) Explanations for the repair, adjustment, or replacement of all equipment items.
   b) Schematic diagrams of electrical, mechanical, and parts location, illustrations, photographs, and sectional details as necessary to facilitate repair or replacement.
   c) Mechanical items requiring field repair, shall have the following:
      1. Information on tolerances, clearances, wear limits, and maximum bolt-down torques
      2. Information on the loading and use of special off-line diagnostic programs, tools, and test equipment
      3. Cautions or warnings, which must be observed to protect personnel and equipment.
      4. A list of test equipment and special tools required.
      5. A list of recommended spare parts necessary to maintain and repair SCADA components. The list shall identify the specific part or model number, description, manufacturer's name and address, commercial equivalents, and recommended quantity to be stored. The spare parts list shall indicate which components (by model and serial number) have been provided with the delivered system as part of the spares inventory.

e. Drawings:
   1) O&M Manual drawings (with the exception of those provided by third-party manufacturers) shall not be larger than 11 inches by 17 inches. Drawings shall be legible when reproduced using conventional office copying machines. Originals shall be provided for all third-party O&M Manual materials. Preprinted O&M Manual drawings, which do not meet the above criteria, or which must be modified to show the actual as-built design, shall be redrawn as new specially-prepared shop drawings. Equipment manufacturer's drawings need not be duplicated or removed from the manuals.

f. Binders and Electronic Copies:
   1) Each O&M Manual shall be bound in 8 1/2" x 11 inch 3-ring side binders with commercial quality hardback, cleanable plastic covers. Final versions of the O&M Manual shall also be provided on CD-ROM. The manuals shall be subdivided with permanent page dividers with tab titling clearly printed under reinforced laminated plastic tabs. Each volume shall have a Table of Contents, with each product or system description identified.

g. System Operator's Manuals:
   1) The System Operator's Manuals shall describe the configuration and all functions for the systems and equipment provided. Functional descriptions shall include algorithms necessary to fully understand the functions. The manuals shall be organized for quick access to each detailed description of the operator's procedure. The manuals shall be limited only to description of procedures for functions that are performed by the operator. The System Operator's Manuals shall serve as a complete instruction to the system and

equipment and shall describe in detail the operator interfaces and operator procedures. In addition to the Operator interaction sequences, the following shall be provided, as a minimum:

a) Summary description of all major functions
b) Presentation of data on displays.
c) Description of how the system and equipment react to situations such as heavy alarming, loss of communication links, heavy operator interaction, and loss of power and restoration of power.
d) Description of the hardware configuration and device switching capabilities.
e) Description of every message and alarm that the system is capable of outputting, an explanation of what the message indicates, and what action the system operator should take.

h. System Administrator Guide:

1) The System Administrator Guide shall be a user's manual for all the corresponding systems programs. It shall include information on system generation from file backups, starting and bootstrapping the system, editing and expansion techniques (including display/report compiler, database, and applications edit), batch mode operation of software utilities, and troubleshooting to be used in conjunction with the system dumps, error and abort messages. User instructions for each of the peripherals and for all Software Engineer procedures shall be in the guide.

i. Software support materials:

1) Program Media:

a) The SCADA System Provider shall furnish complete sets of program media documentation. These documents shall include source of all programs written by the SCADA System Provider specifically for the proposed system. This includes, RTU and PLC programs, HMI scripting, OIT applications, and objects of all programs necessary for the operation and maintenance of the systems programs. If any changes are made to programs during system test and acceptance, the SCADA System Provider shall provide, within 5 days, corrected copies of source, object, and system media.

2) Program Listings:

a) Each program listing shall include revision information. Each time a change is made in the listing, its revision level shall be documented by the party making the change. Program listings will include all in-program comments and documentation, and must be clearly understandable by programmers familiar with the language used. Undocumented code is not acceptable.

3) Programmer Manuals:

a) The purpose of these manuals will be to enable systems and applications programmers, to maintain, modify, and expand the capacity and functionality of the system. These manuals shall comprise the standard manuals furnished by the computer system manufacturer covering the Operating System, Utilities, and Diagnostics, and High Level Language(s) supplied, together with SCADA System Provider furnished manuals that are specific to the system. The manuals shall include descriptions of the procedures to be used for:

1. Computer system startup, restart, manual failover, and operation.

2. Modifying and expanding the system databases and testing revised versions.
3. Defining, linking to the database, and testing revised and new displays, logs, reports, data acquisition, process control, and data processing procedures including the addition of communication links, RTUs, PLC's, and input/output points.
4. System operational troubleshooting including descriptions of the system error messages and the interpretation of crash dumps.
5. Instructions for configuring and rebuilding servers and workstations as if starting a new system, as well as rebuilding from backups (this will apply to peripherals applicable to the system as a whole, including network items).
6. Provide effective procedures/techniques for creating, expanding, and editing SCADA and PLC applications. Include useful backup procedures required for system recovery.

4) System Configuration Inventory List:

a) An inventory list shall be furnished for all contract material, software, documentation, spare parts, and test equipment. Hardware identification of each unique module by serial number and each software unique module shall be included on the list. The inventory list shall include, but not be limited to, the following information:

1. Manufacturer's name, part number, and serial number
2. Quantity of units supplied with the deliverable System/subsystem
3. Software modules supplied
4. Operating system software provided for all CPUs/microprocessors
5. Operating systems enhancements provided
6. System documentation supplied
7. Applicable cabinet, rack number or slot, and cables.

b) The inventory list, which shall be prepared and updated by the SCADA System Provider, shall be subdivided by hardware, software, test equipment, spares, documentation, and training courses. Each of these major divisions shall be further subdivided to the individual deliverable item level. Each item must be defined in sufficient detail to permit identification in shipping documents and inventory checks. The organization of the inventory list shall include provision for annotating each item with forecast and actual dates for:

1. Review (Documentation)
2. Shipping and Delivery (All items Except Documentation)
3. System Testing (Hardware and Software)
4. Site Demonstration Tests (Hardware and Software)
5. Final Acceptance (Spares, Documentation, etc.)
6. Delivery (Training Courses).

c) A preliminary version of the System Configuration Inventory List that demonstrates the form and content to be provided shall be submitted for review within 10 days of Notice to Proceed. A completed System Configuration Inventory List shall be submitted no later than 10 days prior to the scheduled start of System Testing. The SDT shall not be initiated until the System Configuration Inventory List submittal has been Successfully Reviewed. A System Configuration Inventory List

updated to reflect any additions or changes during system installation shall be included as part of the Record Documents.

5) Record Documents:

a) The SCADA System Provider, within 10 days after successful completion of Site Demonstration Test (SDT), shall submit a preliminary version of the Record Documents. Final Record Documents shall be submitted prior to the conclusion of the Site Availability Demonstration (SAD). The SAD shall not be considered complete until the final Record Documents submittal has been Successfully Reviewed.

j. Submission Procedure:

1) Within 5 days prior to the start of System Testing, the SCADA System Provider shall submit preliminary copies of the O&M Manuals, System Operator's Manuals, and System Administrator Manuals. These preliminary copies shall contain sufficient detail to review the basic outline and scope of the manuals. At least 5 days prior to the start of the first operator training session, the SCADA System Provider shall submit draft copies of the O&M Manuals, System Operator's Manuals, and System Administrator Manuals. These draft copies shall generally be complete (at least 90%) and shall be clearly marked to indicate where all missing or incomplete information will be included. Final versions of the O&M Manuals, System Operator's Manuals, and System Administrator Manuals shall be submitted prior to the beginning of the Site Availability Demonstration (SAD). The SAD shall not be initiated until the final submittal has been Successfully Reviewed. Five (5) printed copies of the Final O&M Manuals, System Operator's Manuals, and System Administrator Manuals, and associated drawings, shall be provided. In addition, an electronic format copy of the manuals shall be provided on CD-ROM compatible with CD-ROM drives supplied with system. Electronic documents shall be provided in both the native application used for creating the documents (MS Word, AutoCAD, etc.) and the Adobe PDF format

4. Testing Documentation Submittals

a. System Test Plan: The SCADA System Provider shall prepare and submit for review a System Test Plan within 21 days after Notice to Proceed.

b. Test Procedures: The SCADA System Provider shall prepare and submit for review a Test Procedures within 21 days after Notice to Proceed.

c. Test Reports: The SCADA System Provider shall prepare and submit for review a Test Report within 21 days after Notice to Proceed.

5. Training Documentation Submittals:

a. Training Plan: The SCADA System Provider shall prepare and submit for review a Training Plan within 21 days after Notice to Proceed.

b. Course Outlines: The SCADA System Provider shall prepare and submit for review a Course Outlines within 21 days after Notice to Proceed.

c. Training Manuals: The SCADA System Provider shall prepare and submit for review a Training Manuals within 21 days after Notice to Proceed.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer shall have, within 100 miles of Project site, a facility, system integrator, or panel shop capable of providing training, parts, and coordination of emergency maintenance and repairs.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

D. SCADA system shall use an Ethernet network as the preferred peer-to-peer network. To protect the municipality's ability to competitively bid future projects, the Ethernet network shall utilize open protocols that are in the public domain. Equipment to convert a non-public domain Ethernet protocol to a public domain protocol shall not be accepted.

E. SCADA System Availability Requirements:
   a. A fundamental objective of the SCADA System Supplier's proposed system design shall be to ensure that no single equipment failure or temporary error condition can disable the system operation or generate any spurious control commands to the system equipment.
   b. Single Point of Failure:
      c. The SCADA equipment configuration shall prevent any single hardware or software failure from causing loss of any system function or from causing overall system malfunction. Single hardware failures may cause loss of specific communication channels temporarily until failed equipment is replaced.
   d. SCADA Operational Checks: The SCADA System Supplier's proposed system shall continually check the operation of all devices in the system and report any problem to the user. Upon detecting a malfunction, the failed operation shall be attempted a number of times (programmable) in order to determine whether the malfunction is temporary or permanent. Permanent malfunctions shall be alarmed and logged. Temporary malfunctions shall not be alarmed but shall be logged for maintenance purposes. Failed devices shall be automatically replaced by spare or backup devices if such devices are available.
   e. System Availability: During the System Availability Demonstration, the SCADA system shall achieve an average availability rate for all functions of at least 99.95 percent. This is equivalent to a total downtime of approximately 4 hours per year for the System.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver Operator Stations and SCADA software in packaging designed to prevent damage from static electricity, and physical damage.

B. Store Operator Stations and SCADA software according to manufacturers' requirements. As a minimum, store indoors in clean, dry space with uniform temperature to prevent condensation. Protect Operator Stations and SCADA software from exposure to dirt, fumes, water, corrosive substances, and physical damage. Also, protect the Operator Stations and SCADA software from all forms of electrical and magnetic energy that could reasonably cause damage.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions, unless otherwise indicated:

1. Ambient Temperature: 0 to 40 deg C.
2. Humidity: Less than 90 percent (noncondensing).
3. Altitude: Not exceeding 6500 feet (2000 m).

1.8 SPARE PARTS

A. Furnish spare parts and consumables as described below. Material shall be packaged for long term storage and identified with labels describing contents. Coordinate with each all control panel vendor to optimize the amount of spares provided.

1. Provide Five (5) spare fuses for each type of computer power supply, monitor, UPS and other devices provided with embedded replaceable fuses.
2. Provide a spare monitor for every 10 monitors supplied of a given size and type. Operator Interface Terminals are not included in this count.
3. Provide a spare mouse for every 10 mice used.

1.9 WARRANTY:

A. System Warranty Overview:
1. The system warranty shall consist of a full scope, in-place warranty, consistent with the provisions of the Terms and Conditions of the RFP and the Agreement. The warranty duration shall be 12 months beyond Final Acceptance. All software and hardware components that are part of the completed system shall be covered by the warranty. The SCADA System Provider shall coordinate any warranties provided by third party suppliers. In addition, the SCADA System Provider shall provide warranty services for the existing instrumentation shown on the drawings. This warranty service shall begin with an initial cleaning and calibration of the existing instrumentation in accordance with the equipment manufacturer's recommendations.

1.10 MAINTENANCE:

A. Preventive Maintenance:
1. The SCADA System Provider's price shall include the services of factory-trained service technicians continuing for 12-months beyond Final Acceptance. All equipment shall be systematically serviced according to equipment manufacturers' service recommendations or six months, whichever is less. All preventive maintenance activities shall be documented with service reports which shall identify the equipment being serviced, state the condition of the equipment, describe all work performed, list materials used, and include the name of the technician performing the work and his signature. A copy of all service reports shall be delivered to the facility on the day that the work is performed. All preventive maintenance procedures shall minimize disruption of the live system operation. No preventive maintenance procedure shall be allowed to jeopardize the

facilities ability to monitor and control system operation. At the Facilities option, their maintenance personnel may participate in any preventive maintenance procedures.

B. Corrective Maintenance:

1. The SCADA System Provider shall provide the services of factory-trained service technicians for the purpose of performing corrective maintenance on all system hardware and software. The period of coverage for each piece of equipment shall begin upon initial equipment purchase or manufacture and shall continue for 12-month after final acceptance or until expiration of the manufacturer's warranty, whichever period is longer. The SCADA System Provider shall provide a 24-hour, 7-day/week-service hotline for telephone notification of system malfunctions. Within 2 hours from notification by the facility the SCADA System Provider shall have a qualified service representative establish telephone contact with the facility to discuss corrective measures. If it is not possible to correct the defective operation over the telephone, the SCADA System Provider shall have a qualified service representative at the facility within 4 hours from initial notification. Prior to beginning any procedure, the SCADA System Provider shall review the recommended action plan with the facility in order to inform of any impact on the operation of the facility. Once the defect has been corrected, the facility shall be notified indicating the source of the defect and specific action taken. Any spares from the onsite supply of spares used by the SCADA System Provider in correcting the system malfunction shall be replaced within 2 days. If 2-hour response time is not provided, or other corrective maintenance requirements are not met by the SCADA System Provider, the facility shall have the right to obtain corrective maintenance from other sources and charge the SCADA System Provider reasonable time and material costs of the alternative services.

C. Software Update Services:

1. Starting with installation of the SCADA system and continuing until 12-months after Final Acceptance, the SCADA System Provider, upon authorization from Engineer, shall provide, install, test, and commission updates to the SCADA system software and computer provided software within 30 days from when such updates are announced and released by the manufacturer. All updates shall be provided which are necessary to maintain the SCADA system in compliance with the Contract Documents, as well as any incremental releases. Should an update be announced and released by the manufacturer prior to the end of the 12 month period beyond final acceptance, the SCADA System Provider shall be required to install that update if authorized by Engineer.

D. Costs:

1. The cost for one year of the preventive and corrective software maintenance services and software update service described above shall be included in the Contract price.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include:

B. Qualified Manufacturers:

1. Only manufacturers that have been selling SCADA software for a minimum of 10 years will be considered acceptable.

C. Basis-of-Design Product: Schneider Electric Wonderware Archestra SCADA software.

2.2 COMPUTERS AND PERIPHERIAL EQUIPMENT:

A. REQUIREMENTS:
1. The requirements defined in this subsection apply to the computer-based components of the SCADA System Provider's proposed system. All workstations shall be from a single manufacturer and be from the same "family" or product line. All computer equipment shall be from the equipment manufacturer's standard offering and shall not be specifically built nor require major modifications in order to meet the requirements set forth in this Specification.
2. Computer related components shall be covered by the computer manufacturer's 3 year Next Business day on-site service warranty that includes parts and labor.

B. MINIMUM HARDWARE REQUIREMENTS:
1. Workstations will be HP t620 or an equivalent with equal or higher quality. Unless specified below, the minimum workstation hardware requirement will be as follows:
    1) 3.00 Ghz Intel® Pentium 4 processors w/2 MB Cache
    2) 2GB ECC RAM
    3) HP 20" flat panel monitor
    4) 80 GB Hard Drive, ATA-100 interface, 7200 RPM
    5) 48X CD-ROM and 48X CD-RW/DVD combo
    6) Two (2) 3COM 3C905 10/100 Ethernet, PCI Adapter, Twisted Pair network cards. Motherboard mounted Ethernet ports are not acceptable.
    7) Graphics card suitable to handle the graphics of the SCADA application
    8) External keyboard
    9) Microsoft Mouse
    10) Sound Card
    11) Speakers

    b. Servers will be a HP Proliant or an equivalent with equal or higher quality. Sever shall be in a rack mountable chassis. Unless specified below, the Servers shall have the following minimum characteristics:
    1) 3.00 Ghz Intel® Pentium 4 processors w/2 MB Cache
    2) 4GB ECC RAM
    3) HP 20" flat panel monitor
    4) RAID 5 Controller
    5) Drive Bay for five (5) 1 inch Hot Pluggable SCSI Hard Drives
    6) Five (5) 146 GB Ultra 320 SCSI Hard Drives, 10000 RPM
    7) 24X CDRW/DVD
    8) Two (2) 3COM 3C905 10/100 Ethernet, PCI Adapter, Twisted Pair network cards. These are in addition to any motherboard-mounted Ethernet ports to facilitate replacement.
    9) Redundant Power Supply
    10) A graphics card that can handle the projects graphics capabilities.
    11) External keyboard
    12) Microsoft Mouse

C. OPERATOR AND NETWORK MANAGER WORKSTATIONS:

1. The following paragraphs discuss the specific Operator and Network Management Workstations requirements for this project. This specification applies to Operator and Network Manager Workstations and Field Workstations which are thick clients.
    a. General Requirements: Operator or Network Manager Workstation is a position from which an operator or network manager can monitor and control the entire process and view all real-time data and all historical data via displays on a Computer Display Screen including all network activities. The workstations shall be equipped with Ethernet network interface cards to allow communications to the Local Area Network (LAN).
    b. Minimum Hardware Requirements: The Operator and Network Manager Workstations shall consist of the previously specified minimum hardware configuration, with the following additional requirements:
        1) Dual monitors, sized as indicated above, required for three of the workstations. Include a graphics card that makes the dual monitors work together for these stations.
    c. SCADA Software Requirements:
        1) The Operator and Network Manager Workstations shall have the SCADA Software loaded as specified in Section 2.3

D. PROGRAMMER WORKSTATIONS:

1. The following paragraphs discuss the specific requirements for the Programmer Workstations.
    a. General Requirements: The Programmer Workstations is a position from which a System Administrator can configure, test, and monitor the SCADA network devices. The workstation functionality will include:
        1) HMI development
        2) SCADA Top-End Control Strategy development
        3) Report Development
        4) Full HMI Thick Client functionality
        5) Full HMI Thin Client Functionality
        6) RTU Programming development capability
        7) Overall SCADA system configuration
        8) Firewall and Network Monitoring and Management.
    b. Minimum Hardware Requirements: The Operator and Network Manager Workstations shall consist of the previously specified minimum hardware configuration, with the following additional requirements:
        1) Dual monitors, sized as indicated above, required for three of the workstations. Include a graphics card that makes the dual monitors work together for these stations.
    c. SCADA Software Requirements:
        1) The Operator and Network Manager Workstations shall have the SCADA Software loaded as specified in Section 2.3

E. DATABASE SERVERS:

1. The following paragraphs discuss the specific requirements for Database Servers. These servers will interface with the SCADA System Servers for the collection and storage of historical data.
    a. General Requirements: The Historian and Replicated subsystems shall capture equipment status changes, all significant changes in value for all analog points in the control system, and all alarms which occur in the system. The Historian and

Replicated shall also generate reports based on data enterable fields, scanned, and calculated information. These database servers shall be configured to maintain historical data on-line for immediate access. The database server processors shall be physically separate from the SCADA System Servers and Operator Workstation processors and shall communicate with those other processors via the LAN.

b. Hardware Requirements: As Detailed above.

F. WEB SERVER:

1. The following paragraphs discuss the specific requirements for SCADA Web Server:
   a. General Requirements: The Web Server shall enable thin clients the ability to access the SCADA System Provider's proposed display screens, reports, trends, etc. through the use of a web browser in a read-only fashion.
   b. Hardware Requirements: Web Server shall reside on a dedicated Server. This Server shall be identical to the minimum server requirements listed above.

G. SCADA SYSTEM SERVERS:

1. The following paragraphs discuss the specific requirements for the SCADA System Servers:
   a. General Requirements: Primarily these servers shall interface to the locally connected RTUs/PLCs, and/or remotely connected RTUs/PLCs via Ethernet/radio connection. These SCADA System Servers shall store, distribute and gather data. The SCADA System Servers shall be configured in a redundant server system configuration.
   b. Hardware Requirements: As detailed above.
   c. SCADA Software Requirements:
      1) The Operator and Network Manager Workstations shall have the SCADA Software loaded as specified in Section 2.3

H. PRINTERS:

1. Graphics Printer: The Graphics Printer shall be a Hewlett-Packard LaserJet 5500dn. The printer shall include paper trays for 8 ½ x 11 printing. The printer shall have a built-in 10/100 network card, and a minimum of 96 MB RAM.
2. Report Printer: The Report Printer shall be a Hewlett-Packard LaserJet 5500dn. The printer shall include paper trays for 8 ½ x 11 printing. The printer shall have a built-in 10/100 network card, and a minimum of 96 MB RAM.

I. SWITCHES:

1. To minimize collisions, the system will utilize switches for network control. Hubs will not be accepted. At a minimum, each control panel will consist of a switch. This switch will insure that in panel networking will not cause collisions with the overall network. Each control panel supplier shall be responsible for providing switches that meet this specification.
2. Basis of Design: Etherwan Network Switches:
3. General:
   a. Copper Cable Ports shall be as specified below unless otherwise noted:
      1) 100 BASE-T/1000 BASE-T communication
      2) RJ-45 connections
      3) Shielded Twisted Pair Cat 6E cable
      4) Total Length: 100 meter
   b. Fiber Optic Ports: shall be specified below unless otherwise noted:
      1) 1000 BASE-FX ports
      2) LC connectors managed switches.

3) Total Length: up to 32,500 meters.
4) Attenuation Analysis less then 16db

4. Unmanaged:
   a. 24 VDC SELV suitable for P1 and P2 redundant power supplies.
   b. Minimum 0-60 degree C. operating temperature.
   c. Multimode or single mode optical fiber
   d. Switches shall be configured for project conditions. If a switch is not available with the proper configuration, then switch cascading is allowed.
5. Managed Switches:
   a. 24 VDC SELV.
   b. Multimode or Single mode optical fiber
   c. 0-60 degree C. operating temperature or greater
   d. Switches shall be configured for project conditions. Switch cascading is not allowed.

J. UNINTERRUPTIBLE POWER SUPPLIES:

1. Uninterruptible Power Supplies (UPS) will be provided for the workstations, servers, and major switches in the project. As a general rule, provide a dedicated UPS for each workstation and server. Sharing of UPS's is allowed as long as a single point of UPS failure cannot disable the system. The UPS system shall be able to run on Utility or generator power without any disruption in service. The UPS shall also be able to absorb the transients generated by ATS changeover. UPS's will be sized according to the following:
   a. 5000VA to 10000VA
      1) 160 to 280 VAC Input with automatic 50/60 detection, with full time multi-pole noise filtering, 0.3% IEEE surge let-through, zero clamping response time, and meets UL 1449. The UPS shall have a TVSS screw for connection to telephone and network surge protection.
      2) The UPS shall have audible alarms, automatic internal bypass, automatic load restart after UPS shutdown, automatic self test, and predictive failure notification.
      3) Continuous battery recharging, even if the power button is set to OFF. The UPS shall have a battery replacement indicator, disconnected battery notification, and shall allow batteries to be replaced with equipment energized.
      4) The UPS shall have a minimum of 16 NEMA 5-20R, 2 NEMA L14-30R, 6 NEMA L6-20R, and 3 NEMA L6-30R plugs. The UPS shall be able to support 50% full load for a minimum of 15 minutes, and shall be able to startup without mains power.
      5) The UPS shall be in compliance with CSA,FCC Part 15 Class A, and UL 1778.
      6) The UPS shall have a 2 year repair or replace warranty.
      7) The UPS shall have a USB port and communications cable for connection to the workstation. The UPS will use InfraStruXure Manager Incident Management software. The UPS shall have a power management software package suitable for Windows.
      8) Basis of design: Basis of design is the APC UPS by Schneider Electric.

K. MISCELLANEOUS REQUIREMENTS:

1. All material shall be new, unused and actively marketed for new applications when shipped for configuration. All acquired hardware and software shall be registered to "THE OWNER", as user, and "Owner's Company's Name", as the organization.

2.3 SCADA SOFTWARE

A. GENERAL

1. Description: The SCADA software package shall support dual core and multi-processor CPU's. The SCADA software shall be part of a complete SCADA system. This system shall include personal computer(s) and industry standard networking hardware.
2. Core SCADA functionality: All core SCADA functionality offered, such as communications drivers, graphics capabilities, reporting, historical storage, trend and alarm displays and the development environment are offered as a single integrated software package or suite of packages. The software must be designed with the ability to make changes to the graphics while the system is running. Shutting down the system for graphic changes is not acceptable.
3. Operating Systems: As a minimum, the SCADA software shall run development and runtime implementations on the following Microsoft operating systems.
    a. Windows 2016 Server
    b. Windows 10
4. Windows Services: It shall be possible to run the SCADA software as a service under Windows.
5. Global Database: The SCADA software shall be configurable as a single global database regardless of the number of nodes in the system. Configuration changes to the global database shall be made at any node on the system, and in a manner that is completely transparent to the user. Each SCADA node shall either access the database locally or remotely in a file serving environment.
6. Application size: The SCADA software and engineering configuration shall initially be priced based on the following criteria:
    a. SCADA servers: 2 Configured fully redundant which will also function as operator stations.
    b. SCADA operator stations: In addition to the operator stations that double as servers, the project will require 5 additional operator stations.
    c. Internal Data tags: Internal data tags are those used within SCADA software to perform internal calculations. Internal data tags are also used to exchange data between operator stations and server databases.

B. CONNECTIVITY:

1. Description: The SCADA software shall employ I/O Servers to manage the reading and writing of data from PLC's and RTU's. The I/O Servers shall provide the data on request to any client on the Network.
2. General I/O Server capabilities: The I/O servers shall have the following:
    a. PCs running I/O servers shall have the same graphical display capabilities of any other display station on the network.
    b. The I/O Servers shall maintain a cache of data for a configurable time, such that requests from multiple display station clients do not generate unnecessary requests to the field controllers and will read from the I/O Server cache and not directly poll the field devices.
    c. The SCADA software shall support Primary and Standby I/O Servers to provide automatic redundancy in the event of a Primary I/O Server failure without any user

intervention or special scripting required. This switch over from a Primary to a Standby I/O Server shall be accomplished in under 1 second when a communication failure is detected. The system shall support automatic switching of I/O communications at least 5 standby I/O servers for a single field controller if installed at a latter date.

3. As a minimum the software shall be provided with the following connectivity options to 3rd party programs or databases:
   a. OPC Client
   b. OPC Server
   c. ODBC Client
   d. ODBC Server
   e. DDE Client
   f. DDE Server
   g. Open API
      1) Open API shall allow third party applications written in C, C++, C#, VBA, Pascal or Fortran access to tag, alarm and trend data. This API shall support the standard SCADA security model provided and should allow both read and write access to the SCADA data.
4. Custom Driver Generation:
   a. The SCADA software vendor shall have a package available that allows the generation of user-written device drivers. The package shall include source code for various types of working drivers that are similar to the requirements of the user (e.g. Serial Driver, TCP/IP Driver, report by exception, proprietary board etc).

C. COMMUNICATIONS
1. Description: The SCADA software shall be capable of communicating to PLCs connected to the network, remote PLCs, I/O servers, and other devices on the network.
2. General communication capabilities. The SCADA software shall have the following communications capabilities:
   a. Support of redundant communication paths to field controllers, and provision for automatic changeover to the standby path in the event of a communications failure.
   b. Support of communication to redundant field controllers. If a primary processor fails, the software shall automatically detect the failure and switch to communicating to the standby processor. This shall require no user intervention, special scripting or use of redundant tags within the software.
   c. Built in diagnostic alarms shall be provided with the system that will automatically notify the operator of the failure of any communications path.
   d. A package of communication drivers that shall include the following as a minimum:
      1) GE SRTP
      2) Modbus over Ethernet (TCPIP)
      3) DF1 Driver
      4) EthernetIP Driver
      5) DH+
      6) Profibus Driver
      7) Siemens S5 and S7 family of controllers Ethernet Driver
      8) GE Fanuc 90/30 and 90/70 Serial and Ethernet Drivers
3. Communication re-establishment:
   a. Despite the failure, upon re-establishment of communications all historical alarm, event and trend data archived by the remote field device (RTU) shall be

automatically backfilled into the native SCADA alarm and trend history files. The data shall be fully viewable via the standard SCADA alarm and trend viewers.

D. SECURITY

1. Description: Security features shall be fully integrated to allow only users with appropriate security levels access to individual parts of the system.
2. Security Capabilities: The SCADA software shall have the following:
    a. Encrypted passwords that are checked on the server side.
    b. Passwords hidden in both the configuration and runtime environments to ensure that other personnel cannot access another account.
    c. Monitoring and logging of each control action of each user. This shall include all operator control actions, including system log in and log out. The sequence of actions shall be viewable within the SCADA package and also stored in an external open file format (e.g. txt, csv, dbf, sql) for later analysis.
    d. Automatically log out a user after an adjustable time period. Logging out a user will only cause the system shall revert to a view only security status. Logging out will not shutdown the system.
    e. A minimum of 8 privilege levels for each user. The software shall ensure that a user has access to all tasks for his privilege level. If the user does not have the correct privilege for a task a message will indicate insufficient privilege.
    f. Assign each graphic object to a plant area, define the privilege level, define whether operator input is enabled or disabled, and if the object will be visible or not based on the operator's current privilege levels within the plant area.

E. GRAPHICAL DISPLAYS

1. Description: Graphical displays are windows that are used to represent part or all of a process in a graphical manner.
2. General Graphical Display Capabilities: The SCADA software shall have the following graphical display features:
    a. Unlimited number of graphical displays:
    b. Capable of a minimum of 2000 analog variables, with real time updates of less than 500ms (for all data to appear or change on the page)
    c. Capable of automatically re-sizing to match the screen resolution of the computer on the network, irrespective of the resolution the pages were developed in or configured for, and irrespective of whether vector or bitmap graphics are used on the page, without shutting down the SCADA software, without recompiling, and without having multiple copies of graphic pages for different resolutions.
    d. Support a screen resolution of up to 4000 x 4000 pixels.
    e. Support full 32 bit graphics, and capable of displaying images from 3rd party packages for use within the SCADA displays, including animating and color flooding the image
    f. Capable of pop-up windows for trends, loops, device status, and device control by clicking on hot spots or objects on the main graphics page. 100 simultaneously opened popup display windows shall be supported by the graphics display system.
    g. Inclusion of page name, current time and date together with details of the last 3 alarms that have occurred on all graphical displays.
    h. Ability to allow the user to navigate around the graphics system utilizing a variety of navigation methods.
    i. Ability to have Hot Key links to specific graphics pages from the keyboard.

j. Windows style navigation menus allowing access to any configured page in the system from any other page.
k. Configured with “hot spots”, where as a user can click on the area and drill down into a detailed view (if available) of the plant area.
l. Ability to display communication loss for a particular I/O point wherever that data is displayed in the software.

3. Dynamic Objects: Dynamic objects are symbols that visually change when a property, tag or expression changes. Dynamic objects shall be as described below:
   a. Support the following graphical dynamic objects as a minimum:
      1) freehand lines
      2) straight lines
      3) poly-lines
      4) rectangles (including the latest curved corner style)
      5) ellipses
      6) pie slices
      7) text
      8) buttons
      9) 3D Pipes
      10) Bitmaps
   b. Dynamic objects shall have a series of properties that can be used independently or concurrently. Each dynamic object shall have the following properties:
      1) Horizontal, Vertical and Rotational movement
      2) Up, Down, Left or Right Level Fill
      3) Gradient Level Fill
      4) On-Off, Multi-State, Integer, Threshold or Gradient Color Change
      5) Horizontal and Vertical Size
      6) Visibility
      7) Keyboard Input
      8) Touch (Mouse Up, Down, While Down) input
      9) Horizontal and Vertical or Rotational Slider
      10) Ability to disable the object based on security levels.
      11) Popup information in a “tool tip” form by rolling the mouse over the object
4. ActiveX: The SCADA software will be an ActiveX container and allow for insertion of ActiveX objects into standard graphics pages. The SCADA software shall interact with ActiveX objects in the following ways:
   a. Dynamically change properties of an ActiveX object via a Tag from an I/O Device
   b. Dynamically change properties from SCADA software high level language.
   c. ActiveX object to trigger actions in the SCADA software based on events in the ActiveX Object.
   d. ActiveX property values can be read by the SCADA software.
5. Live Video: The software shall support full screen live camera video, and video from disk (MPEG, AVI) concurrently with screen displays without interruption to data collection. Update times in the Process Control System windows shall not be affected.

F. DISPLAY CLIENT
1. Description: Display clients shall connect to the individual station servers to allow personnel on the network to view graphics pages, alarms and trends from all the compressor stations simultaneously.
2. General display client functionality: The display client shall have the following:
   a. Response times less than 2 seconds to access any real time data on the network.

b. Support casual web browser clients so that personnel on the WAN can have access to the system with the correct security settings. The web browser client shall have the following:
    1) Identical functionality to the standard client software including but not limited to graphics displays, trend pages, alarm pages and system security.
    2) Support view and control capabilities, controlled by both login security and license types.
    3) No requirement for additional engineering or specialized software other than a web server such as MS IIS or Apache Tomcat. The standard graphics pages, alarm pages and trend pages used for operator display stations shall be available via the web browser clients without any additional engineering requirements. Configuration changes shall be automatically recognized and used by the web clients without any additional engineering.
    4) Browser clients shall support page changes of under 2 seconds and data updates of under 500ms on the corporate WAN.

G. ALARMS
1. Description: Alarms are meant to alert and operator of an abnormal condition. They are logged, and often times require operator intervention.
2. General Alarm functionality: The alarm functionality shall have the following:
    a. No software limit to the number of alarms supported
    b. A minimum or 100 million alarm summary events shall be stored in the native trend archive to recall through standard trend display screens.
    c. Acknowledgement on one operator station shall be globally acknowledged and as such shown as Acknowledged on all operator stations. This shall be configured as one common database, with no other programming necessary to enable global acknowledgment of alarms from any PC on the network.
3. Alarm Types: The SCADA software shall monitor analog and discrete variables and calculated conditions, and determine if the variable is in an alarm condition. The SCADA software shall perform the following:
    a. All analog alarm conditions shall have adjustable dead bands and delay timers to minimize nuisance alarms. All analog alarm properties shall be adjustable without the need to shut the system down. For each Analog Tag, an alarm for each of the following conditions shall be assignable:
        1) LOW-LOW,
        2) LOW,
        3) HI,
        4) HI-HI
        5) Deviation LO
        6) Deviation HI
        7) Rate of Change
    b. Discrete alarms shall have an assignable alarm for each of the following:
        1) Variable ON
        2) Variable OFF
    c. Multi-Digital Alarms based on a combination of discrete tags. Any combination of states of the discrete tags may be configured to be an alarm. Furthermore, alarming will occur whenever a new alarm state is encountered.
    d. All alarm processing shall have the facility for time stamping and can track time to a precision of 1 millisecond.
4. Alarm Display: Alarm display shall have the following:

a. Depending on user's log-in privileges, it shall be possible to display or acknowledge any alarm and/or the most recent alarm on any page.
b. Alarm shall be configurable in multiple levels. The color of the text of the alarm message shall indicate priority. Text color shall be configurable by engineers.
c. Sound indication for each alarm category shall be configurable. This must be possible at each node via internal or external speaker. The sound indication shall support the playing of any standard .WAV file.
d. Provided with a standard alarm user modifiable display page. The alarm page shall allow for scrolling of alarms, and acknowledgment of individual alarms or all alarms on the page
e. Possibility to display the following information for each alarm as it appears on an alarm display page:
    1) Alarm Tag Name
    2) Alarm Description
    3) Value of the Variable
    4) Trip point
    5) Alarm Status - Disabled, Acknowledged, Unacknowledged
    6) Alarm Category or Priority
    7) Alarm Priority
    8) Time & Date
    9) Privilege
    10) Category
    11) Operator Comments
    12) Value of any Tag or result of any calculation.
f. Ability to display each alarm state in a different color (including flashing colors).
g. Support for both proportional and fixed fonts with all alarm fields displayed in properly aligned columns.
h. Based on user's privileges, it shall be possible to disable alarms on individual basis, by page or by alarm category or all alarms. A disabled alarm page shall indicate to every user what alarms have been disabled.
i. Based on user's privileges, it shall be possible for user comments to be attached to any alarm. These comments shall either be displayed with the alarm or by clicking on the alarm.
j. Possibility to automatically display any graphic display when an alarm occurs or to dynamically change the appearance of any graphical object based on whether an alarm is On, Off, Acknowledged, Communications Error or Disabled.
k. A mechanism for operators to dynamically define filtering of alarms by alarm name, tag name, date /time range, state or type

5. Alarm Logging: The following alarm functionality shall be provided:
    a. The alarms shall be able to be logged to any designated network or local printer, disk file or database with alarm text, time and date labels. Alarms shall be printed or filed in a user-configurable format. The software shall be able to redirect printing to another printer while the system is on-line.
    b. It shall be possible to define a different method of logging alarms for each alarm category. It shall be possible to define if alarms are to be logged when the alarm transitions to ON, to OFF or on Acknowledgement.
    c. Alarms that are logged to disk shall be viewable while the system is online or offline without interrupting data collection. The software shall not limit the number of alarms logged to disk. The alarm logging shall be capable of logging an instantaneous burst of at least 4000 alarms without losing a single alarm.

6. Alarm Redundancy: All alarm calculations and management shall be performed in the Primary Server. The software shall automatically ensure that if the Primary Server fails, all alarm functions shall continue to operate normally in the standby server. The software shall automatically generate a diagnostic alarm to indicate that the Primary or Standby Server has failed. Adding, deleting or modifying alarms shall not require any changes to the software that handles the redundancy. On restoration of a failed Server, the historical alarm history must synchronize between the Primary and Standby servers so that there are no miss matches in historical alarm history.

H. TRENDS

1. Description: Trends are a collection of data points over time. When viewed over time, the trends will indicate general progression of the data.
2. General Trend Functionality: The software shall have the following functionality.
    a. The number of trends collected shall not be limited by the software.
    b. The software shall be capable of logging historical trend information at configurable sample periods from 1 Millisecond to 24 Hours.
    c. Trend data shall be stored in a circular file system with the number of files, the size of each file, the sample period, file location, privilege and area being user definable individually for each trend. File names and paths shall support file names up to 255 characters in length.
    d. Every tag defined in the system configuration shall be trended. Each trend shall contain a minimum of seven years historical data at a 10 second sample rate. The trends shall be maintained online for operator call back without the need to backup or restore history files.
3. Trend Display: The software shall have the following in its native functionality:
    a. Each operator and login shall be able to see their own fully customized trend pages. These pages must be customizable on line by each user in a drop and drag manor. Any setting available to be made in a configuration environment shall be available to the user to modify the trend graphs in run time. These include the color, scaling, pen selection as examples.
    b. Line graphs with time on a linear, continuous horizontal or vertical axis and the trended variable on the vertical or horizontal axis. Resolution of each graph shall be to within 0.1% of full scale.
    c. Where more than one variable is displayed on the same graph, the pen color of each variable and associated information shall be displayed in a different color.
    d. Each trend graph shall be capable of displaying a minimum of 32 trend pens with adjustable time base to one second samples and shall be capable of viewing the entire archived trend history.
    e. Historical system alarms shall be able to be overlaid on the trend pages showing the alarms state transitions.
    f. A standard graphics page shall support a minimum of 100 individual trend windows embedded within the display so that an overview of multiple site levels can easily be produced.
    g. Possibility to trend multiple pens or multiple plots of the same pen over various time spans for comparison purposes (i.e. previous day to today’s results).
    h. Each pen shall display individual ranges and engineering units. Each pen shall be scalable for display purposes independent to each other pen displayed on a page.
    i. Include the capability to pan backward and forward within a selected time range to read the exact value of any displayed variable, by selecting a point on the graph or chart. The system shall display historical information as far back in time as desired, with all information being displayed within 1 second.

j. The trend display shall be dynamic, scrolling through time, with the capability to 'replay' or scroll through historical time as well as current time. There shall also be the capability to stop the automatic scrolling of the trend for detailed analysis of a point in history. Pens on the same pane shall be able to be separated both in the time axis and the range axis.

k. The trend display shall have a minimum of 2 slide wire that can be moved over the page. The slide wire will provide indication of the date, time, and value at the intersection of the slide wire and the trend point.

l. The software shall provide "zoom" and "pan" facilities for both the trended variable range and the time axis range. The "zoom" facility shall allow an operator to compress or expand the axis range whilst the "pan" facility shall allow an operator to shift the origin of the axis. The software shall allow a user to define any zoom area by dragging a mouse across the trend.

m. The software shall make available trending data from the historical database for export to disk files or external databases. It shall be possible to define the section of the trend to be exported by clicking and dragging the mouse across the trend. Data shall be exported to csv, dbf or txt formatted files. It shall also be possible to export any portion of the historical trend database via ODBC, DDE, dbf, CSV and TXT formats.

n. The software shall provide the capability of printing out either instantaneous or historical based trends on the designated trend printer. The software shall have the capability to perform a trend print (not a screen print). The trend print function shall print to the printer using objects, not bitmaps. The trend printout shall include the engineering units and ranges for each trend, a trend grid and the time base for each trend. Each trend shall be identified by a different line style (i.e. dotted, dashed, solid etc) on monochrome printers, and a different color for color printers.

4. Trend Redundancy: Trend collection and management shall be performed utilizing primary and standby servers; both shall contain all the historical trend information. If the primary server fails then the standby server shall ensure all trend functions continue to operate. Upon restoration of the primary, the standby shall automatically update the primary server such that there are no gaps in the historical trend data. No operator involvement shall be required. Failure of the primary and standby servers shall be monitored such that a failure at anytime will produce a diagnostic alarm.

I. DEVELOPMENT ENVIRONMENT

1. Description: The development environment is the area that allows generation of graphic screens, alarms screens, tag database, trend screens etc.

2. General Development Environment Functionality: The SCADA software shall include a development environment with the following:

a. An integrated development package utilizing menu driven, fill in the forms style configuration to develop the runtime system.

b. All development functions shall be available at every node on the system, and allow multiple users at separate nodes to simultaneously modify the same master database. A minimum of 5 simultaneous developers shall be supported.

c. Comprehensive on-line help shall be available for all development functions, the on-line help shall contain all information provided in the hard copy manuals.

d. A utility to back-up or restore an entire database including all graphic displays, configuration data and source code, as well as online configuration (such as menu navigation, trend groups and alarm groups), via a simple point and click method. The backup/restore utility shall prompt the user prior to over writing any existing files. The utility shall employ automatic file compression/decompression.

e. Ability to import field controller tag definitions shall be included as a standard feature. Automatic updating upon a change of a definition in the I/O device tag names, addresses, ranges etc will automatically be imported into the SCADA software database. In addition it shall be possible to manually initiate the import of tag definitions at any time. The Tag import function shall be user configurable such that a user can specifically define which definition fields must not be overwritten or define how the import will operate. The import function shall support generic OPC data sources and CSV file imports in conjunction to native field controller programming software database imports.

J. GRAPHIC BUILDER

1. Description: The graphic builder allows for development of graphic screens.
2. General Graphic Builder functionality: The graphics builder shall be interactive and menu-driven, requiring no programming. It shall consist of the following:
   a. Directly import graphics and text in the following file formats:
      1) Autocad DXF
      2) Windows BMP
      3) Windows Meta File WMF
      4) GIF
      5) TIF
      6) PCX
      7) TXT
      8) DIB
      9) RLE.
   b. The graphics builder shall be capable of creating screens composed of both static and dynamic objects. To create these objects, the software shall provide sample screens and a set of standard shapes in a library. The developer shall be able to include these symbols by reference, or create new symbols/objects.
   c. The following Tools:
      1) Grid and guidelines (which can be displayed on screen) together with snap to grid and snap to guidelines to assist in aligning objects precisely.
      2) Horizontal and vertical alignment together with even spacing.
      3) Send to front/back. Bring Forwards one layer, Send backwards one layer.
      4) Bitmap editing including pixel drawing, image resizing, image cropping.
      5) Color swap from one color to another for a group of selected objects including colors within a bitmap. Color swap shall also include swapping a range of colors such as all reds to all greens so that shaded objects can be color changed without redrawing or re-rendering.
      6) Editing of nodes on polylines that provides the addition or removal of nodes plus movement of nodes.
   d. Unlimited “undo” and “redo” feature.
3. ActiveX: The graphics builder shall be an ActiveX container. ActiveX objects shall be inserted and edited in a visually interactive manner. It shall be possible to connect ActiveX properties to tags, allowing read/write between properties and tags without the need for script or code. ActiveX objects must have the same security as native graphics objects and ActiveX objects shall be visible or hidden based on the users’ privilege level.

K. CUSTOM SCRIPTING LANGUAGE

1. Description: The scripting language shall be used to develop custom routines, and algorithms not supplied as part of the standard package.

2. Standard Functionality: Scripting shall not be needed to develop any custom code to achieve standard functionality including redundancy failover, recovery and backfilling of historical data.
3. General Custom Scripting Functionality: The SCADA software's scripting functionality shall include the following.
    a. An integrated high level language specifically designed for SCADA applications that shall be inherently multi-tasking and multi-threading.
    b. Fully integrated and multi-threaded Visual Basic (VB) scripting.
    c. Access to all field tags, alarms, graphics displays, database and ASCII files. The languages shall include functions with clear and precise syntax. The languages shall support user written functions and function libraries supported by the computer's operating system. The language shall have the capability to export or import data from other applications.
    d. Creation of calculated (inferred) variables based upon formulae including constants, measured variables and other calculated variables. All facilities available for logging, reporting, trending, monitoring, controlling, alarming and displaying measured variables shall also be available for calculated variables.
    e. Support of mathematical and Boolean operators including:
        1) Addition
        2) Subtraction
        3) Division
        4) Multiplication
        5) AND
        6) OR
        7) XOR
        8) NOT
        9) Greater Than
        10) Less Than
        11) Equal
        12) Parenthesis.
    f. Support for the following mathematical functions:
        1) Absolute
        2) ArcCos
        3) ArcSin
        4) ArcTan
        5) Cos
        6) DegToRad
        7) Exponent
        8) Factorial
        9) HighByte
        10) HighWord
        11) Ln
        12) Log
        13) LowByte
        14) LowWord
        15) Max
        16) Min
        17) Pi,
        18) RadToDeg
        19) Random
        20) Round

21) Sign
22) Sin
23) Sqrt
24) Tan.

g. Prevention of any functions from interfering with proper SCADA functionality.

h. Permit users to create their own functions and integrate them in the language; functions shall be reusable without the need to copy and paste. It shall be possible to call the same function multiple times from different locations, with different parameters simultaneously.

i. Provisions to run functions automatically on start up, on page entry, on page exit, while a page is open, on button down, while button down, embedded in reports, alarm on, alarm off, on any keystroke, any keyboard entry on any mouse button click, etc.

j. Ability to test and debug the languages on line. The debug tool shall display the source code as it executes with a pointer identifying the current line of code being executed, the value of local and global variables and any output as the user single steps through the code. Facility to set break points, single step, step over sub functions, step out of sub functions and continue execution shall be included.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, surfaces, and substrates to receive SCADA System and associated control panels for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Select SCADA Software based on application type, tag count, type of node. It is recommended that a manufacturer’s representative be consulted during the selection.

3.3 INSTALLATION

A. Anchor servers, control panels, and other devices over 36 inches high and at least 19 inches across.

B. Ventilation slots shall not be blocked, or obstructed by any means.

C. SCADA Computers shall be installed in an environment as indicated by the computer supplier. Insure that the computers are protected from exposure to high levels of dirt and dust. Also

D. SCADA System Supplier shall insure that all cables are neatly routed and bundled.

3.4 IDENTIFICATION

A. Identify components, and wiring according to all applicable codes, standards and contract document sections.

3.5 FIELD QUALITY CONTROL

A. Field Service:
   1. The SCADA system supplier shall provide a qualified service representative to perform the following:
      a. Inspect wiring, components, connections, and equipment installation.
      b. Assist in field testing of equipment
      c. Install and test SCADA software as detailed below
      d. Install and test SCADA application as detailed below
      e. Report results in writing. As detailed below.

B. Installation and Start-Up:
   1. The SCADA System Provider shall develop a specific plan for the startup of the new SCADA system and for cutover of control to the new system. No startup or cutover activities shall be performed until the plan has been successfully approved by the Engineer. The sections below give some guidelines and suggestions for cutover.

C. Factory Acceptance Test (FAT):
   1. Description:
      a. Thorough testing and verification for all deliverable equipment, software, and associated documentation shall be performed on all SCADA System Provider proposed system components. The tests shall be performed to verify that the equipment is manufactured and assembled correctly, is operating as designed, and complies with the contractual requirements. The tests shall be performed to verify that the software and hardware will meet the functional and performance requirements of this document. The equipment shall be interconnected and subjected to comprehensive system testing that simulates field conditions and operations. The Factory Acceptance Test (FAT) shall include the test and verification activities specified in this section. The FAT will be attended by the Engineer. The FAT will be conducted by the SCADA System Provider.
   2. System Configuration Verification:
      a. Prior to beginning the Factory Acceptance Testing, the system/subsystem/elements shall be subjected to deliverable configuration and serialization verification. A copy of the System Inventory List annotated to reflect this verification shall be included with the Factory Acceptance Test Report. No equipment replacement or substitutions shall be permitted without rigorous quality control accounting and retesting of affected equipment.
   3. Equipment Test and Verification:
      a. Hardware Tests:
         1) The Factory Acceptance Test shall include individual end-item verification and integrated tests of all hardware. These tests shall include visual inspection verification, running standard hardware diagnostic programs, and running all special diagnostic programs used by the SCADA System Provider to demonstrate that the hardware integration task has been completed. Performance testing of all Individual Servers and Workstations,

including demonstration of CPU, Memory and Storage functions shall be conducted. All hardware enclosures shall be inspected. As a minimum, the following shall be inspected and verified:

a) Cabinet enclosures
b) Frame structure
c) Paint work and finish
d) Dimensions

b. Inspections:

1) As a minimum the following inspections shall be performed:

a) Power supply mounting
b) Power cable routing
c) Data cable routing
d) Wiring runs across hinges properly installed
e) Fans and blowers are unobstructed
f) Power conditioning correctly installed.

4. System Functional Test

a. Test Functionalities:

1) The functional test shall exercise and demonstrate the successful operation of every specified system function and shall include, but not be limited to, the following:

a) Rigorous exercising of all devices both individually and collectively.
b) Verification of proper scanning and data acquisition of all status and data points.
c) Verification of proper Control Strategy up/down loading to the PLCs/RTUs.
d) Demonstration of analog input, pulse input, and analog output accuracy.
e) Testing of all user interface functions.
f) Verification of all control operations to ensure that they result in the correct sequence of operation at all the PLCs/RTUs using the test PLC/RTU.
g) Simulation of communication error conditions and demonstration of error detection and handling.
h) All specified display types, reports, and operator/user procedures must be shown to be implemented and verified for accuracy.
i) Create and process device failure conditions including PLC failure, Operator Workstation failure, peripheral failures, etc. Special attention shall be given to creating failures in the middle of operator sequences and control actions such as:
j) Communication failure after a command is issued but before the result is recorded in the database.
k) Computer failure after a command is issued but before the result is recorded in the database.
l) Failure of a major communications component.
m) Incorrect operator entry in the middle of a multi-step action.
n) Operator Workstation failure in the middle of a control action.
o) Demonstration of all redundant functions and components.
p) Demonstration of all required alarm processing functionality, including audible annunciation.
q) Demonstration of all required historical capture, storage, and retrieval functions.

r) Demonstration of all required data logging functions.
s) Demonstration of all required IT interface functions.
t) Demonstration of all required device control functions.
u) Demonstration of all required database management functionality.
v) Demonstration of all required software support utilities.
w) Demonstration of all system diagnostics, both on-line and off-line.
x) Demonstration of correct operation of calculated quantities including totalized values
y) Demonstrate the proper operation of all changes to the system negotiated and approved during the implementation period.

b. Configuration Testing:
1) The Factory Acceptance Test for the support software shall include the following, as a minimum:
a) Demonstration of restoration of system using backup media.
b) Demonstration of system editing capabilities including the addition and deletion or modification of points in an RTU, displays, report formats, control strategies, and the modification of the database and all database parameters.
c) Demonstration of the editing of system parameters including timers, intervals, etc.
d) Demonstration of utility software facilities, including assembling, compiling, appending, and executing new programs.
e) On-line program debug facilities shall also be demonstrated, including downloading of a program from the central system to a remote PLC/RTU.
2) The FAT shall demonstrate compliance to each section in this specification.

c. System Performance Testing:
1) The System Performance verification shall demonstrate that the system meets the performance requirements specified in this specification.

5. System Testing:
a. The SCADA System Provider shall stage the entire system in an integrated Factory Acceptance Test. The following system components shall be used for FAT. All components shall be interconnected using the LAN equipment:
1) All Workstations provided by this Contract
2) All Printers provided by this Contract
3) All communication equipment and PLC/RTUs provided by this Contract, with final configuration loaded. These PLC/RTU programs shall include all Communication Strategies for the individual communication channels.
4) Complete SCADA Server provided by this Contract
5) Web Server provided by this Contract
6) Historian Server provided by this Contract
7) PLC/RTU test set provided by the Integrator

6. Simulation Software:
a. The SCADA System Provider shall utilize software that simulates system loading conditions equivalent to the Steady State and Heavy load conditions defined in this specification.

7. 72 Hour Continuous Test:
a. After the successful completion of the functional testing specified above, a 72-hour continuous test of the system shall be initiated. The test shall be deemed successful if no system function is lost, no hardware or software failure occurs, and no module automatic failover occurs (unless instigated by testing efforts). Hardware

failure is defined for this test as the loss of a major piece of hardware, such as a peripheral, monitor, processor, I/O board, etc. Software failures will include, but not be limited to, server or workstation “lockups” or failure to respond to operator input. During this test, the system shall be exercised with simulated inputs, events, and conditions in a manner similar to an operational environment. No software "patches" or changes will be allowed to bypass failed modules during this test. Any software and/or hardware correction made to the system shall result in the mandatory rerun of the entire 72-hour test. During the 72-hour period, at least 24 hours of unstructured testing shall be included, in which the Engineer or the end user’s representatives shall be allowed to operate the system without the SCADA System Provider's supervision (SCADA System Provider may observe).

8. I/O Point Checkout:
   a. The SCADA System Provider shall perform a checkout of selected I/O points as the SCADA system is installed. The SCADA System Provider will provide testing support at the Control Center. As each PLC/RTU is switched to the new SCADA system, the integrator will test a representative sample of the I/O present on the PLC/RTU. Up to 25% of the I/O on each PLC/RTU shall be tested to confirm the database setup and HMI graphic connection. The SCADA System Provider shall verify the tested points at the HMI database level and on the configured SCADA system screens. The testing shall be witnessed by the Engineer or end user’s Representative. The quantity of points selected for testing shall be controlled by the engineer, and shall be sufficient to confirm proper database configuration. Should improper database configuration be found during the testing process, additional testing shall be conducted at no additional costs to the project. Test signals shall be injected to verify the operation of the selected Analog Input (AI), and Discrete Input (DI) point. The signal injection point shall be at the field instrument for each Analog Input or Discrete Input. Each Analog Output (AO) and Discrete Output (DO) shall be also tested for proper operation, to the Final Control Element. End-to-end testing shall use the process graphic displays to verify proper operation of the I/O points all the way to the Operator Workstation control console. I/O point checks will also verify the proper configuration of the Historical Data Storage and Alarm/Event Subsystems on the SCADA HMI Software. I/O point checks shall utilize final communications system and SCADA network. The SCADA software must be fully operational in order to conduct this test. The Contractor shall develop a complete I/O Point Checkout Test Procedure. The test procedure shall identify the method to be used by the Contractor for verifying the I/O signals in each database location. The Contractor shall develop a point checkout form for each I/O point. The point checkout form shall include the point ID, description, all checks performed for the point, date and time of the check, and a signoff block for both the Contractor’s representative and the Engineers’ representative. For each item checked, the form shall include both the expected value/result and the actual value/result witnessed.
      1) For each analog input point tested, the following values shall be checked:
         a) Value at 0% of full scale (ramped in both directions)
         b) Value at 100% of full scale (ramped in both directions)
      2) For each analog input tested and its associated alarms, verify that the testing signals are stored in the Historical Database, if the signal is designed for historical data collection, that each alarm is displayed on the alarm displays on the SCADA Software and that each alarm is shown on the hard-copy alarm log.
      3) For each analog output point tested, the following values shall be checked:

a) Milliamp reading at 0% of full scale (ramped in both directions)
b) Milliamp reading at 100% of full scale (ramped in both directions).

4) For each analog output tested, verify that the change in each output is stored in the Replicated Database, Event Historian and that each event is shown on the hard-copy event log.
5) For each discrete input point tested, the following items shall be checked:
   a) For status points, proper indication
   b) For alarm points, proper alarm notification.
6) For each discrete input tested, verify that the testing signals are stored in the alarm/event historian, that each alarm is displayed on the alarm displays and each event on the event displays, and that each alarm/event is shown on the hard-copy alarm or event log.
7) For each discrete output point tested, the following items shall be checked:
   a) Proper operation
   b) Actuation time-out alarm (if value is entered in database).
8) For each discrete output, verify that the change in each output is stored in the Event Historian and that each event is shown on the hard-copy event log. The completed I/O Checkout forms for all points shall be included as part of the I/O Checkout Test Report to be prepared and submitted at the conclusion of all I/O checkout activities.

D. Site Acceptance Test (SAT):

1. A Site Demonstration Test of the functions, software, and performance shall be conducted after all system elements have been installed and the I/O Point Checkout has been completed. The system site demonstration tests shall be performed to verify complete operation of the system, requiring a repeat of much of the comprehensive system tests but with the equipment installed at the permanent sites, and shall include additional tests required to verify field installed equipment, which was not available during the FAT. The SCADA System Provider shall:
   a. Verify all the facility installations.
   b. Demonstrate each functional requirement identified by the specification. This demonstration shall repeat the tests used during FAT, but using real rather than simulated conditions.
   c. Demonstrate all equipment control functions, including the operation of automatic control strategies. Actuation of field devices shall be closely coordinated with facility operations.
   d. Verify system performance parameters and system responses under field operational conditions.
   e. Verify accuracy of documentation, especially operator’s manuals, software documentation, and general system operating instructions.
2. The SCADA System Provider shall provide the appropriate technical representatives for the execution of the Site Demonstration Test. The SCADA System Provider's test support personnel shall be qualified to resolve and correct problems encountered with the system during the tests. In addition to test support personnel, the SCADA System Provider shall provide all test instruments and equipment necessary to troubleshoot any of the SCADA System Provider’s proposed system problems encountered. The Engineer reserves the right to increase the requirements for test support personnel if support by the SCADA System Provider is inadequate.

E. Demonstration

1. SCADA System Provider shall provide a qualified service representative to train Owner's maintenance personnel to adjust, operate, and maintain SCADA system as detailed below.
2. Site Availability Demonstration (SAD):
    a. Test Requirements:
        1) At the completion of Site Acceptance Test, the Integrator will conduct a Site Availability Demonstration (SAD) test utilizing all equipment, software, and services provided under this Contract in the normal day-to-day operation of the water treatment plant. During the test the system shall meet the availability criteria defined below and shall meet the performance requirements stated in the specification. SCADA System Provider personnel may participate in any and all parts of this demonstration as observers at the discretion of SCADA System Provider.
    b. Scope of Test:
        1) All equipment and software delivered with the system shall be subject to the availability measurements.
    c. Test Equipment:
        1) The Site Availability Demonstration shall be performed under field operating conditions. All functional and performance requirements specified in this document shall be met during the SAD.
    d. Length of Test:
        1) The system shall be subjected to Site Availability Demonstration evaluation for a period of not less than 60 days (1440 hours). If at the end of the 60 days, the system availability is determined to be less than that required, the test shall continue on a day-by-day basis, dropping off the oldest day's test results. This sliding window concept shall continue until the system passes the test or until 120 days time has passed, at which time the facility shall have the right to pursue other avenues as specified under the contract.
    e. Preventive Maintenance:
        1) During the Site Availability Demonstration period, the SCADA System Provider shall perform preventive maintenance of the type and the frequency of service defined in the SCADA System Provider-provided maintenance manuals. The SCADA System Provider shall supply a recommended maintenance plan prior to start of the test.
    f. Test Prerequisites:
        1) Prerequisites to starting the SAD are successful completion of the Comprehensive System Test and the Site Demonstration Test and resolution of all outstanding Discrepancy Reports. In addition, the following documentation shall be on hand at the facility:
            a) Final copies of O&M manuals
            b) Final copies of System Operator's manuals
            c) Final copies of System Administrator manuals
            d) Final Record Documents (prior to conclusion of SAD).
    g. Availability Definitions:
        1) Availability Formula:
            a) The system availability shall be determined using the following formula:
                1. Availability=Uptime/(Downtime+Uptime)
                2. Where the detailed definition of terms is as described below:

a. Uptime means the total clock time from start to end of testing minus downtime and minus any suspension time that may be mutually agreed upon, as the testing is ongoing.
b. Downtime accrues in three ways as defined below:
1.) Downtime accrues when one or more system functional capability required by the Specification cannot be performed due to failure of equipment or software provided and/or installed by SCADA System Provider. For failures that occur outside of 8:00 AM to 4:30 PM Monday through Friday, a four-hour travel time allowance will be made before downtime begins to accrue. It is the SCADA System Provider's responsibility to arrange suitable communications to enable the facility to promptly notify SCADA System Provider of failures.
2.) Downtime accrues if the same piece (or redundant pair) of equipment fails more than twice in the same 168 hour period or more than three times during the entire test. In other words, repeated failover to backup equipment will not be allowed even though each individual failover action is successful and no functionality is lost.
3.) Downtime accrues if backup equipment remains unavailable for more than a twelve-hour grace period, allotted for repair, after the initial failure. Accrual begins after the grace period allotted for repair.

2) System Availability Exclusions:
a) The following assumptions apply in the determination of system availability:
1. All end user provided facilities and auxiliary support equipment are assumed to be 100% available. Any periods of failure of such equipment will be treated, therefore, as Uptime.
2. Any downtime caused by actions of engineers or facilities personnel will not be counted.
3. Outage of the system caused by malfunction of equipment not supplied by the SCADA System Provider will not be considered as downtime, unless malfunction of equipment was caused by a malfunction of the SCADA System.
4. System downtime will not accrue for outages caused by failure of the facilities supplied power.

3) Test Suspensions:
a) The availability test may be placed in suspension on mutual agreement between engineer and SCADA System Provider for such reasons as:
1. Performing preventive maintenance on an item that is not redundant.
2. SCADA System Provider requires time to analyze a repetitive failure situation.

4) Record Keeping:
a) Records of system maintenance and equipment/software failure with the times of occurrence will be maintained continuously by SCADA System Provider personnel.

5) Corrective Action:

a) All failures shall be analyzed to the extent necessary to provide a viable explanation. Recurrent failures may require the use of sophisticated hardware failure analysis techniques or software simulation. All such analysis shall be performed by the SCADA System Provider. Where such analysis indicates that a design modification is in order, such correction shall be completed by the SCADA System Provider and incorporated in all systems provided under the terms of the Contract by either retrofit or replacement. The availability demonstration shall be deemed successfully completed if the calculated availability for the system is equal to or greater than the specified availability requirement at the end of a 60-day period. If the calculated availability achieved during the demonstration period is less than that specified, corrective action shall be implemented, and the demonstration shall be continued until the required availability is met for 60 consecutive days (1440 hours).

6) Site Availability Demonstration Considerations:
   a) The SCADA System Provider shall submit to the facility and engineer a recommended preventive maintenance schedule prior to the test run. The downtime resulting from an intermittent failure that causes a system trip but does not preclude an immediate restart, will be limited to the time that it takes to restart the system. However, repetitive occurrences of intermittent faults in either the on-line or the backup equipment shall constitute system failure until the flaw is corrected. Failure of backup hardware, if supplied, will not be considered downtime provided that this failure does not adversely affect the operation of the system. Uptime, under this condition, will continue while the backup hardware is being repaired. Alterations to the hardware/software shall not be permitted without the engineers and facilities approval. Replacement of failed boards is acceptable.
7) Progress Reports:
   a) The SCADA System Provider will maintain the official record of operating time, recorded incidents and disposition, maintenance action, and calculated availability. At the completion of system availability demonstration, the SCADA System Provider shall prepare a separately bound test report for Engineer to evaluate and approve.
8) Letter of System Acceptance:
   a) Upon review and approval of test report, the Engineer shall provide a letter of System Acceptance, which will be signed by all parties and serve as designation of the beginning of the warranty period.

F. Cutover Sequence:
1. Installation, field testing and cut-over shall consist of a sequence of activities and tests conducted as the SCADA components are installed and integrated at the job site.

G. Training:
1. Training Overview:
   1) A comprehensive training program shall be provided by the SCADA System Provider covering the operation and maintenance of all elements of the SCADA System Provider's proposed system. Several specific requirements for the training program are listed below:

2) Training classes shall be tailored to the specific needs of the class participants.
3) For training classes conducted on-site, spare PLCs / RTUs, spare workstations, and the development workstations and Server may be temporarily installed in a training area to be designated by the Facility.
4) All training classes shall be completed prior to the start of the Site Acceptance Test.
5) All instructors shall be highly qualified for technical training with demonstrated expertise in not only SCADA system functionality but also professional training techniques. During training, instructors should have no other duties that would interrupt training. Training shall not be combined with other activities such as system configuration or startup.
6) Complete, professional, training materials shall be provided for all training classes including course outline and schedule, training manuals (in addition to system documentation), and review/testing materials.
7) Training courses shall be a combination of classroom and hands-on training. To the extent possible, hands-on training shall utilize components from the SCADA System Provider's proposed system.

2. Training Plan
1) The training plan shall include complete descriptions of all training classes, a preliminary training schedule, a list of all proposed instructors along with resumes, examples of proposed training manuals, and a description of any special training tools available (simulators, self-paced modules, personal computer-based training, etc.). The Engineer and Facilities staff will review the training plan for assurance that the training planned by the SCADA System Provider will meet the training needs.

3. System Specific Training
a. Training Manuals:
1) Comprehensive training manuals shall be professionally written to present the course material in a format that is easy to comprehend. The manuals shall serve as teaching aids during presentation of the training classes and shall additionally serve as reference material after the training has been completed. Portions of system documentation may be incorporated into training manuals provided that the overall manual achieves an instructional format. If the SCADA System Provider proposes to use standard training manuals, these manuals shall be appended to reflect system characteristics specific to the projects SCADA System.
b. Required Training Courses:
1) Training courses shall be tailored to meet the specific needs of facility personnel. Class sizes shall be restricted to the number of students that can easily be accommodated. Classes that involve extensive hands-on activities (such as operator training, maintenance training, and software engineering) shall be limited to five students per class. Supervisor and overview courses may include up to ten participants. Sufficient sessions of each course shall be presented to satisfy class size restrictions and conflicts in facility personnel scheduling. If the SCADA System Provider's standard training curriculum includes applicable courses in addition to those discussed below, the SCADA System Provider shall also provide these courses. Following is a description of the categories of training to be provided.
a) Operator Training:

1. Training courses shall be presented that instruct the system operators in the efficient operation of all aspects of the SCADA. The course material shall include the general operation of the SCADA system, and the operation of the specific system features incorporated in the SCADA system. In particular, the operator training shall include instruction on the use of all operational functionality.

b) Software Maintenance Training:

1. Training courses shall be presented that will enable facilities staff to develop and maintain all aspects of the system software. Separate sessions shall be presented that deal with the following topics:
    a. Process database development and modification
    b. Historical database development and modification
    c. Process display development and modification
    d. Supervisory Control strategy development and modification
    e. Report development and modification
    f. General software maintenance, including system backup, restoration and archiving.
    g. Calculation additions, alarm and event logging additions, Graphic display, report and trend additions
    h. Network training for adding additional equipment (printers, workstations, etc) or additional PLCs / RTUs and I/O from the SCADA Network
    i. Adding, editing, transporting and testing of data sent to historical database system
    j. Any Third party tools for accessing data from any database.

c) These courses shall address the procedures for the standard SCADA system software, plus material explaining the specific conventions and procedures used by the SCADA System Provider in developing the SCADA applications. The courses shall provide instruction in techniques for developing and maintaining current, comprehensive documentation for all applications.

END OF SECTION 13449

SECTION 13500

PROGRAMMABLE LOGIC CONTROLLER (PLC) CONTROL SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Programmable logic controller (PLC) hardware and software requirements.
2. Startup of complete control system.
3. Owner to provide standard program for PLC. Contractor to adapt to this project.
4. Operator interface.

1.02 QUALITY ASSURANCE

A. Referenced Standards:

1. American National Standards Institute (ANSI) / Institute of Electrical and Electronic Engineers (IEEE):
   a. C37.90.1, IEEE Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems.
   b. C37.90.2, Trial Use Standard Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers.
2. Electronic Industries Association (EIA):
   a. RS-232-C, Interface Between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange.
   b. RS-422-A, Electrical Characteristics of Balanced Voltage Digital Interface Circuits.
3. National Electrical Manufacturers Association (NEMA):
   a. ICS 1, General Standards for Industrial Control and Systems.
   b. ICS 1.1, Safety Guidelines for the Application, Installation and Maintenance of Solid State Control.
   c. ICS 4, Terminal Blocks for Industrial Use.
   d. ICS 6, Enclosures for Industrial Controls and Systems.
   e. Publication No. 250, Enclosures for Electrical Equipment (1,000 V Maximum).
4. National Fire Protection Association (NFPA):
   a. National Electric Code (NEC).

B. Qualifications:

1. Installation supervisor shall have had experience in overseeing installation and startup of at least three similar installations.

1.03 SUBMITTALS

A. Shop Drawings:

1. See Section 01340.
2. See Section 13440.
3. Product technical data including:
    a. Results of factory testing procedures.
    b. Arrangement drawings for PLC system components.
    c. Panel and enclosure plans, sections and details.
    d. Access opening locations and required clearances for each panel and enclosure.
    e. Enclosure internal wiring and terminal blocks.
    f. Full size diagrams of all CRT process control displays with identification of actual colors. Diagrams of all keyboards, included in PLC system.
    g. Tabular I/O listing including the following data:
        1) Each I/O point.
        2) Name of I/O device such as solenoid valve or limit switch.
        3) Instrumentation tag number of the I/O device in the Contract Documents.
        4) Electrical characteristics of I/O signal.
        5) PLC system internal address of each I/O.
    h. Index of all training offered by PLC system equipment manufacturers including operations and maintenance.
    i. Spare parts guarantee.
4. Certifications.
    a. Qualifications of installation supervisor.
5. Factory test reports.

B. Operation and Maintenance Manuals:

1. See Special Provisions Section 1-09.09.
2. Submit maintenance procedures available to Owner. Include the location and phone numbers of service centers (including 24-hour “hot lines”). Provide specific information including operation and maintenance requirements, programming assistance, troubleshooting guide, parts ordering, field service personnel requests, and service contracts.

1.04 WARRANTY

A. The availability of spares shall be guaranteed for a minimum of ten years.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturer is acceptable:

1. GE Fanuc, Series Rx32 PLC with CPU part no. IC695CPE305.

2.02 PERFORMANCE AND DESIGN REQUIREMENTS

A. See Section 13440.

B. The PLC system shall accomplish the control requirements of the loop descriptions, Drawings and Specifications.

C. The design application and installation of the PLC system shall conform to NEMA ICS 1.1.

D. The PLC system shall operate in ambient conditions of 32 to 140 degree F temperature and 0 to 95 percent relative humidity without the need for purging or air conditioning.

E. Utilize a power turn-on time delay circuit when powering up and down DC power supplies to ensure power supply output voltage has reached the proper value prior to application of power to solid state logic and output circuits.

F. Environmental Controls:

1. Furnish circulation fans in solid state control system enclosures, where required.
2. Over-temperature switches shall be utilized to provide special cooling if required to maintain operating temperatures within the manufacturer’s specified range.

G. Input/Output Condition Requirements:

1. Outputs shall be fused:
    a. External fusing shall be provided if output module does not possess internal fusing.
    b. Fuses provided external to output model shall:
        1) Be in accordance with module manufacturer’s specifications.
        2) Be installed at terminal block.
2. Make connections to I/O subsystem by terminating all field wiring on terminal blocks within the I/O enclosure.
3. Prewire I/O modules to terminal blocks.
4. Provide terminal blocks with continuous marking strip.

5. Size terminals to accommodate all active and spare data base points with 20% extra spare.
6. Provide terminals for individual termination of each signal shield.
7. Field wiring shall not be disturbed when removing or replacing an I/O module.

H. All PLC control system components shall be capable of meeting of exceeding electromagnetic interference tests per ANSI/IEEE C37.90.2.

I. Incorporate the following minimum safety measures:
   1. Master Safety Relay:
      a. Cuts off power to I/O devices upon de-energization.
      b. Multiple master safety relays shall be available as required to provide ability to control separate designated blocks of the control program.
   2. External watchdog function to monitor:
      a. Internal processor clock failure.
      b. Processor memory failure.
      c. Loss of communication between processor and I/O modules.
      d. Processor ceases to execute logic program.
   3. Safety function wiring:
      a. Emergency shutdown switches shall not be wired into the controller.
   4. An emergency power disconnect shall be placed in the power circuit feeding the power supply as a means of removing power from the entire PLC system.
      a. Capacitor shall be placed across the disconnect to protect against current outrush through triacs.
   5. Safe wiring:
      a. Equipment failure mode shall be selected so that the loss of power or control signal to the equipment will result in the equipment either shutting down or operating safely.
      b. Activation of alarms and stopping of equipment shall result from the de-energization of control circuits, rather than the energization of control circuits.
      c. Lower voltage control signal wires:
         1) Place in conduit segregated for that purpose only.
         2) Twisted shielded wire pair.
         3) Not located in the same conduit or bundle with power wiring.

6. Initial safety conditions:
    a. Utilize program module to dictate output states in a known and safe manner prior to running of control program.
    b. Utilize program each time PLC is re-initiated and the control program activated.
7. PLC fault relay:
    a. Placed in series with any other emergency stop conditions.
    b. Opening of PLC fault contact:
        1) Upon unsafe or undesirable system operation, including:
            a) Loss of memory.
            b) Processor fault.
            c) Power supply fault.
            d) Isolation failure.
            e) Communications failure.
            f) Scan time overrun.
            g) Module failure.
        2) Results from de-energization of PLC fault relay.
        3) Causes master safety relay to de-energize.
8. Monitoring of internal faults and displays:
    a. Internal PLC system status and faults shall be monitored and displayed. Monitored items shall include:
        1) Memory okay/loss of memory.
        2) Processor okay/processor fault.
        3) Battery okay/battery low.
        4) Power supply okay/power supply fault.
        5) Isolation failure.
        6) High CPU temperature.
        7) Scan time overrun.
        8) Module failure.
9. Effects of failure:
    a. PLC system shall incorporate safe responses to the following failure effects.
        1) Power losses, interruptions, excursions, dips, and transients.
        2) Loss or corruption of memory.
        3) Information transfer corruption or loss.
        4) “Fail on” or “fail off” of inputs or outputs.

5) Unreadable signals.
6) Addressing errors.
7) Processor faults.

10. Design PLC system with high noise immunity to prevent occurrence of false logic signals resulting from switching transients, relay and circuit breaker noise or conducted and radiated radio frequency interference.
11. Incorporate noise suppression and inductive load suppression design into input, output, and logic modules.
12. Operator intervention:
    a. Logic system failure shall not preclude proper operator intervention.
    b. Safety shutdown of equipment or a system shall require manual operator intervention before the equipment or system operation may be reestablished.

J. Communications:
1. Provide the following communication provisions:
    a. Provide communications coprocessor card GE IC695ETM001.
    b. Communication protocol with the operator interface: TCP/IP.
    c. Communication protocol with the radio: GE CCM.

2.03 COMPONENTS

A. PLC System Central Processor Unit (CPU):
1. Completely solid state CPU designed to provide:
    a. Digital relay logic.
    b. Analog loop control.
    c. Other required control functions:
        1) Counting.
        2) Floating point math computations.
        3) Timing.
2. To use electrical ladder diagram style programming for discrete logic applications.
3. Memory:
    a. Battery-backed RAM.
4. Memory battery backup shall be capable of 60 days memory retention with fresh battery.
    a. Provide visual indication of battery status and alarm low battery voltage.
    b. Memory battery backup shall be capable of 14 days memory retention after the “Battery Low” indicating LED is on.
5. Plug-in card design to allow quick field replacement of faulty devices.

a. Provide unit designed for field replacement and expansion of memory without requiring rewiring or use of special tools.

6. Capable of executing all control functions required by the Specifications and Drawings including digital and analog loops.
   a. As directly selectable algorithms requiring no user knowledge of programming languages.
7. On line reconfigurable.
8. Lighted status indicators for “RUN” and “FAILURE.”

B. Input/Output (I/O) Modules:
1. Provide plug-in modular-type I/O racks with cables to connect to all other required PLC system components.
2. Provide I/O system with:
   a. I/O solid state boards with status lights indicating I/O status and board failure.
   b. Electric isolation between logic and field device.
   c. Individually fused outputs with blown fuse indication.
   d. Interchangeable boards for similar I/O type to allow substitution of operating boards for failed units by the operator.
   e. Capability of withstanding low energy common mode transient to 1,500V without failure.
   f. Incorporate noise suppression design.
   g. Capable of meeting or exceeding surge-withstand capability tests, per ANSI/IEEE C37.90.1.
   h. Capable of meeting or exceeding electrical noise tests, NEMA ICS 1-109.60-109.66.
   i. Capable of being removed and inserted into the I/O rack under power, without affecting any other I/O modules in the rack.

3. Discrete I/O modules:
    a. Interface to ON/OFF devices.
    b. I/O status indicator on module front.
    c. Voltage rating to match circuit voltage.
    d. Output module current rating:
        1) Match maximum circuit current draw.
        2) Minimum 1.5 A/point for 120 V AC applications.
    e. Isolated modules for applications where one module interfaces with devices utilizing different sources of power.
    f. Individually fused with blown fuse indication.
4. Analog I/O modules:
    a. Input modules to accept signals indicated on Drawings or in Specifications.
    b. Twelve (12) bit resolution.
    c. I/O chassis supplied power for powering connected field devices.
    d. Isolated (differential) inputs and outputs.
    e. User configurable for desired fault-response state.
    f. Provide output signals as indicated on Drawings and Specifications.
    g. Individual D/A converter for each output module.
    h. Individual A/D converter for each input module.

C. Power Supply Units
1. Provide regulated power units:
    a. Designed to operate with PLC system and shall provide power to:
        1) All components of PLC system.
        2) All two-wire field instruments.
        3) Other devices as indicated on Drawings or in Specifications.
    b. Capable of supplying PLC system when all of the specified spare capacity is utilized.
    c. Each power supply shall be sized such that it will carry no more than 75 percent of capacity under normal loads.
2. Electrical service to PLC system is 105 to 125V, 60 HZ, $\pm$1 percent, 1 pH power.
3. Separate AC circuit breakers shall be provided for each power supply.
4. If the PLC system is field expandable beyond the specified spare capacity, and if such expansion requires power supply modification, note such requirements in the submittals and allow room in the PLC system enclosure.

5. Provide integral battery backup to maintain DC power for all DC power users for a minimum of 60 seconds upon loss of all AC power. This is required to ensure transient power surges and dips do not affect the operation of the PLC system.
6. Capable of meeting or exceeding electrical noise tests, NEMA ICS 1-109.60-109.66.
7. Capable of meeting or exceeding surge-withstand capability tests per ANSI/IEEE C37.90.1.
8. Power distribution:
    a. Immune to transients and surges resultant from noisy environment.
    b. Shall provide constant voltage level DC distribution to all devices.

D. Process Control Operator Interface System:
1. The operator interface shall be flush mounted on the panel front on the panel swing-out door to allow easy access to panel back for maintenance.
2. Compatible with GE-90-30 SNP protocol.
3. Communication with the PLC through the CCM311 card.
4. The program for the operator interface for pumping station will be supplied to the Contractor in generic form by the Owner. The Contractor is responsible for making necessary modifications to the program for proper operation according to the Owner standard. Two configured graphic displays (pumping station and sodium hypochlorite storage/pumping) will be provided, as well as one alarm summary page.
5. The operator interface shall be a GE Quickpanel, or latest touch screen model, without exception.
6. Develop screens as follows (see also Table 3.1):
    a. Control:
        1) Well pump start pushbutton.
        2) Well pump stop pushbutton.
        3) Well pump run indicator.
        4) Well pump stopped indicator.
        5) Well pump running time.
        6) Diversion valve open indicator.
        7) Diversion valve closed indicator.
        8) Pressure indication (analog).
        9) Flow indication (analog), gpm and total flow.
        10) Chlorine residual indication (analog).
        11) Well level indication (analog).
        12) Sodium hypochlorite storage tanks level indications (analog).
        13) Local remote selector for well pump.

14) Hand-off-auto selector for diversion valve.
15) Diversion valve manual open pushbutton.
16) Diversion valve manual close pushbutton.
17) Hand-off-auto selector for prelubrication solenoid valve.
18) Hand-off-auto selector for thesodium hypochlorite feed pumps.
19) Prelubrication valve manual open pushbutton.
20) Prelubrication valve manual close pushbutton.
21) Pump motor kWh indication (analog).
22) NaOCl feed pumps on indications (two indications).
23) NaOCl feed pumps running time (two times).
24) Screen layout as shown on P&ID drawings with animated pump, pump control valve, waste line, storage tanks and metering pumps.

b. Alarm:

1) Alarm reset pushbutton.
2) Normal power failure indicator.
3) High motor temperature alarm.
4) Starter phase failure alarm.
5) Security alarm indicator.
6) Low flow alarm with pump running or called to run.
7) Pump failure to start or to run when called, alarm.
8) Sodium hypochlorite feed pumps failure (two alarms).
9) Sodium hypochlorite storage tanks low level (two alarms).
10) Diversion valve failure alarm.
11) Chlorine residual high alarm.
12) Chlorine residual low alarm.
13) Fire common alarm.
14) Sodium hypochlorite feed pumps seal leak (two alarms).
15) Pump lockout shutdown

c. Service:

1) Prelube timer setting.
2) Time from start signal to sensing of flow timer (failure to start).
3) Diversion valve open timer.
4) Any other operator adjustable variables or choices.

d. Trend: Trends for all analog variables.

2.04 ACCESSORIES

A. Provide all accessories required to furnish a complete PLC control system to accomplish the requirements of the Drawings and Specifications.

2.05 SOFTWARE

A. Provide PLC application software GE VersaPro Professional Edition, Cat no. IC641VPP700 licensed to the City for its use on both 90/30 and 90/70 PLC's.

B. City will furnish Contractor floppy disk with City standard water production facility control program software.

C. Contractor to adapt this software to Project, develop final software, and debug.

D. Contractor to supply a set of PLC and operator interface programming and configuration software running on PC, complete with all required communication hardware.

2.06 SOURCE QUALITY CONTROL

A. Provide a performance test after factory completion and prior to shipment.

1. Conduct a continuous 7-day burn-in period where the system is operated continuously and checked for correct operation including loop controls, displays, printing, keyboard functions, alarm responses, noise immunity (NEMA showering arc test), and on/off sequencing control.
2. Conduct testing with dummy I/Os to verify each control loop operation.
3. Allow for Owner and Engineer representatives to witness testing program.
4. Do not ship prior to successful completion of this testing program.
5. Provide information on mean time between failure for all major PLC components.

2.07 MAINTENANCE MATERIALS

A. Furnish Owner with the following extra materials:

1. 10 percent spare I/O points (installed).
2. A list of all the recommended spares for maintenance of the Vendor's control system with each item separately priced. The list shall include all the special tools and test equipment necessary for the maintenance of the complete system.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install PLC control system in accordance with manufacturer's written instructions.

B. Ground PLC in strict accordance with manufacturer's instructions.

C. Install PLC in control panel.

3.02 FIELD QUALITY CONTROL

A. Employ and pay for services of equipment manufacturer's or integrator's field service representative(s) to:

1. Inspect equipment covered by these specifications.
2. Supervise adjustments and installation checks.
3. Maintain and submit an accurate daily or weekly log of all commissioning functions.
    a. All commissioning functions may be witnessed by the Engineer.
    b. All reports shall be cosigned by the Vendor and the Engineer if witnessed.
4. Conduct startup of equipment and perform operational checks.
5. Provide Owner with a written statement that manufacturer's equipment has been installed properly, started up, and is ready for operation by Owner's personnel.

3.03 DEMONSTRATION

A. Demonstrate system in accordance with Specifications.

B. On-Site Training:

1. Provide employee of the manufacturer or integrator to provide three sections at 8 hours per section of operating and maintenance training at the Project site after the system has successfully undergone all field testing and acceptance procedures. This is to be system training covering control panels, PLC, and application to the particular facility/installation.

3.04 INPUT/OUTPUT SCHEDULE

For input/output schedule see attached I/O List.

END OF SECTION 13500

CITY OF ANAHEIM

INSTRUMENTATION AND CONTROL

PLC INPUT/OUTPUT LIST

THIS TABLE IS FOR GENERAL GUIDANCE ONLY. INSTRUMENTATION & CONTROL SUBCONTRACTOR SHALL PROVIDE ALL REQUIRED I/Os AS PER THE REQUIREMENTS OF THE PROJECT.

INSTRUMENTATION & CONTROL SUBCONTRACTOR SHALL COMPLETE THIS TABLE AS REQUIRED AND SUBMIT FOR APPROVAL TOGETHER WITH THE OTHER PANEL AND PLC DOCUMENTS.

LN	TAG # TRANSMITTING INSTRUMENT	TAG # RECEIVING INSTRUMENT	SERVICE	P&ID	I/O TYPE	SIGNAL TYPE	RANGE	STATUS CNTC'T	STATUS EQUIP.	ADDRESS (Note 2)
1	AIT-53	AI-53	CHLORINATION RESIDUAL	I-2	AI	4-20 mA	0-2 PPM			
2	AS-53	AA-53	SMOKE DETECTION (FIRE) ALARM	I-2	DI	120 VAC				
3	FIT-53	FI-53	PIPELINE DISCHARGE FLOW	I-2	AI	4-20 mA	0-4,000 GPM			
4	HS-531B	HS-531A	P-531 START/STOP	I-2	DO	120 VAC				
5	HS-532B	HS-532A	P-532 START/STOP	I-2	DO	120 VAC				
6	HS-53A	HS-53A	P-53 START/STOP	I-2	DO	120 VAC				
7	HS-53C	SV-53	DRAIN VALVE FCV-53 CLOSE/OPEN	I-2	DO	120 VAC				
8	HS-53D	ZI-53D	PUMP P-53 HOR SWITCH IN REMOTE	I-2	DO	120 VAC				
9	HS-53G	FV-53	PRELUBRICATION VALVE FV-53 OPEN/CLOSE	I-2	DO	120 VAC				
10	LIT-53A	LI-53A	NaOCl STORAGE TANK T-53A LEVEL	I-3	AI	4-20 mA	0-7 ft			
11	LIT-53B	LI-53B	NaOCl STORAGE TANK T-53B LEVEL	I-3	AI	4-20 mA	0-7 ft			
12	LSH-53C	LAH-53C	TK-53A LEAK DETECTION	I-3	DI	120 VAC				
13	LSH-53D	LAH-53D	TK-53B LEAK DETECTION	I-3	DI	120 VAC				
14	LSL-53A	LAL-53A	NaOCl STORAGE TANK T-53A LEVEL LOW	I-3	DI	120 VAC				
15	LSL-53B	LAL-53B	NaOCl STORAGE TANK T-53B LEVEL LOW	I-3	DI	120 VAC				
16	LT-53	LI-53	WELL LEVEL	I-2	AI	4-20 mA	0-250 ft			
17	OIL CONSOLE	XA-53B	DIESEL FUEL SYSTEM COMMON ALARM	I-4	DI	120 VAC				
18	PIT-53	PI-53	PUMP DISCHARGE PRESSURE	I-2	AI	4-20 mA	0-200 PSIG			
19	PUMP 531-FAIL	XA-531A	NaOCl FEED PUMP P-531 MOTOR FAILURE	I-3	DI	120 VAC				
20	PUMP 531-RUN	ZI-531	NaOCl FEED PUMP P-531 RUNNING	I-3	DI	120 VAC				
21	PUMP 532-FAIL	ZI-532A	NaOCl FEED PUMP P-532 MOTOR FAILURE	I-3	DI	120 VAC				
22	PUMP 532-RUN	ZI-532	NaOCl FEED PUMP P-532 RUNNING	I-3	DI	120 VAC				
23	PUMP 53-RUN	ZI-53A	PUMP P-53 RUNNING	I-2	DI	120 VAC				
24	TIS-53	ZA-53	P-53 MOTOR FAILURE	I-2	DI	120 VAC				

LN	TAG #	TAG #	SERVICE	P&ID	I/O	SIGNAL	RANGE	STATUS		ADDRESS
	TRANSMITTING INSTRUMENT	RECEIVING INSTRUMENT			TYPE	TYPE		CNTC'T	EQUIP.	(Note 2)
25	VT-53	VI-53	P-53 VIBRATION	I-3	AI	4-20 mA	0-1.9 in/sec			
26	XS-531	XA-531B	NaOCl FEED PUMP P-531 SEAL LEAK	I-3	DI	120 VAC				
27	XS-532	XA-532B	NaOCl FEED PUMP P-532 SEAL LEAK	I-3	DI	120 VAC				
28	XS-53A	XA-53A	GENERATOR SYSTEM COMMON ALARM	I-3	DI	120 VAC				
29	XS-53B	XI-53B	NORMAL POWER ON	I-3	DI	120 VAC				
30	XS-53C	XI-53C	EMERGENCY POWER ON	I-3	DI	120 VAC				
31	XS-53D	XI-53D	STANDBY GENERATOR RUNING	I-3	DI	120 VAC				
32	XS-53E	XA-53E	NORMAL POWER FAIL	I-3	DI	120 VAC				
33	XS-53F	XA-53F	SECURITY SYSTEM ALARM	I-2	DI	120 VAC				
34	XS-53G	XA-53G	FIRE COMMON ALARM	I-2	DI	120 VAC				
35	XS-53K	XA-53K	SMOKE DETECTION (FIRE) SYSTEM FAILURE	I-2	DI	120 VAC				
36	XS-53L	XY-53L	TRANSFER SWITCH TO EMERG GENERATOR	I-4	DO	120 VAC				
37	XT-53	XI-53	WELL PUMP Kwh	I-2	DI	120 VAC	PULSE/KW			
38	ZSC-53A	ZIC-53A	DIVERSION VALVE FCV-53 CLOSED	I-2	DI	120 VAC				
39	ZSO-53A	ZIO-53A	DIVERSION VALVE FCV-53 OPEN	I-2	DI	120 VAC				
		Notes:	1- SOFTWARE POINTS ARE NOT SHOWN							
			2- TO BE PROVIDED BY THE CONTRACTOR.							

SECTION 13502

OPERATOR INTERFACE TERMINAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. References:
1. NFPA 70 (NEC)
2. UL508
3. EN61131-2
4. IEC 61000-6-2
5. FCC (Class A)
6. UL 1604
7. CSA C22-2 #14
8. ANSI/NEMA ICS 6
9. API RP550
10. ISA S5.4
11. IAS S20
12. ISA S50.1
13. ISA S51.1

1.2 SUMMARY

A. This Section includes Human Machine Interface Terminals and associated configuration software for control and visualization of process equipment, process-oriented machinery, and process systems.

B. Related Sections include the following:

1. Section 13500 Programmable Logic Controllers

2. Section 13449 SCADA Software and Hardware

1.3 DEFINITIONS

A. AI: Analog Input

B. AO: Analog Output

C. Control Panel Designer: A firm or individual that is responsible for designing the layout of control panels. This entity will choose the devices to be included in the panel, and will decide on the actual layout.

D. CPU: Central Processing Unit

E. DI: Digital Input

F. DO: Digital Output

G. HMI: Human-Machine Interface

H. I/O Input and/or Output

I. Node: A network connection point. Examples include a PLC, PC, Operator Interface Terminal, Switch, Server, etc.

J. OIT: Operator Interface Terminal: A terminal usually embedded in a control panel that allows the operator to view and modify control system parameters. Operator Interface Terminals are not capable of running commercially available software.

K. Operator Station: A terminal that runs a commercially available operating system such as Windows or Linux. An Operator Station will usually execute the SCADA software. Operator Stations are usually desktop mounted personal computers. However, they may be computers that are designed to be embedded in the doors of control panels and motor control centers (MCC)

L. PID: Control action, proportional plus integral plus derivative.

M. PLC: Programmable Logic Controller.

N. SCADA: Supervisory Control and Data Acquisition. A SCADA System is a computer (typically a personnel computer), or a group of computers and servers running a software dedicated for SCADA purposes. This SCADA software can exchange over industrial networks, with PLC's, VFD's, and other industrial devices. Typically, the SCADA software will allow for trending, graphic display, alarm tracking, and reporting of data.

O. SCADA System Supplier: A company that takes a commercially available SCADA software package, and then develops a project-specific application. This company will typically supply hardware to run the SCADA software and project-specific application.

1.4 SUBMITTALS

A. Product Data:

B. For each type of Operator Interface Terminal include dimensions, mounting arrangements, and weights. Also include manufacturer's technical data on features, performance, electrical ratings, characteristics, terminal connections, and finishes.

C. Each Operator Interface Terminal type shall have a separate check sheet. This check sheet shall be an acknowledgement of all criteria in this specification. The check sheet will consist of three

columns. The leftmost column will indicate the referenced section of the specification. The middle column will indicate whether the indicated specification criteria are met, not met, or has a variance. The rightmost column will be used to describe reasons for variances or for not meeting the specified criteria. Each row on the check sheet will be for a dedicated specification section or sub-section. Each organization delineation will have its own dedicated row. For instance, you cannot accept section 1.5B and its corresponding subparagraphs in a single row. You must accept 1.5B in a row, and 1.5B1 in another row.

D. Operator Interface Terminal supplier shall be responsible for providing accurate and complete submittals in a timely fashion so as to not cause delay to the project schedule.

E. Once submitted, Operator Interface Terminal suppliers shall not proceed with their associated work until the reception of submittals marked as “Approved” or “Approved as noted”.

F. Operation and Maintenance Data: Provide for each Operator Interface Terminal component literature detailing routine maintenance requirements (if any).

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer shall have, within 100miles of Project site, a facility, system integrator, or panel shop capable of providing training, parts, and coordination of emergency maintenance and repairs.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

C. Source Limitations:
   1. All Operator Interface Terminals shall be from a single manufacturer.
   2. Operator Interface Terminals shall be from the same manufacturer of the PLC SCADA, and power distribution equipment.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NFPA 70.

F. Product Selection for Restricted Space: Drawings indicate maximum dimensions for Operator Interface Terminals, minimum clearances between Operator Interface Terminals, and adjacent surfaces and other items. Comply with indicated maximum dimensions and clearances, or with Operator Interface Terminal vendors required distances if they are greater than the distances indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver Operator Interface Terminals in packaging designed to prevent damage from static electricity, and physical damage.

B. Store Operator Interface Terminals according to manufacturers' requirements. As a minimum, store indoors in clean, dry space with uniform temperature to prevent condensation. Protect Operator Interface Terminals from exposure to dirt, fumes, water, corrosive substances, and physical damage. Also, protect the Operator Interface Terminals from all forms of electrical and magnetic energy that could reasonably cause damage.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions, unless otherwise indicated:

1. Ambient Temperature: 0 to 50 deg C.

2. Humidity: Less than 85 percent (non-condensing).

3. Altitude: Not exceeding 2000 meters (6500 feet).

1.8 PRODUCT PROTECTION

A. Control panel designer supply independent line fuses or circuit breakers, per the manufacturers' recommendation, for each Operator Interface Terminal.

B. Control panel designer shall insure that communication signals are properly conditioned for the Operator Interface Terminal and protected from all sources of radiated energy or harmonics.

1.9 SPARE PARTS

A. Furnish spare parts as described below for each type of Operator Interface Terminal. Material shall be packaged for long term storage and identified with labels describing contents. Coordinate with each Operator Interface Terminal based control panel vendor to optimize the amount of spares provided.

1. Provide a spare memory card for each Operator Interface Terminal.
2. Provide Five (5) spare fuses for each type of Operator Interface Terminal

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following: General Electric

B. Qualified Manufacturers:
   1. Only manufacturers that have been selling Operator Interface Terminals for a minimum of 10 years will be considered acceptable.

C. Basis-of-Design Product: General Electric; GE QuickPanel+.

2.2 TRADITIONAL OPERATOR INTERFACE TERMINALS

A. GENERAL:
   1. All of the Operator Interface Terminals shall comply with the following general requirements as a minimum.
      a. Certifications: The Operator Interface Terminal will have certifications by CE, CSA, UL Class 1 Division 2 T4A or T5 (UL and CSA), and C-Tick
      b. Power Supply: The Operator Interface terminal will have a nominal voltage of 24VDC with a range of 19.2-28.8Volts DC. The power supply will have a voltage cut of </= 10milliseconds maximum and an Inrush current of </= 50A Maximum. Connection of power will be via a 3 terminal screw terminal block. This block will be pitched at least 5mm, and will have a tightening torque of 0.5Nm.
      c. Real-time Clock: All Operator Interface Terminals shall have a built-in real-time clock.
      d. To protect the municipality's ability to competitively bid future projects, the Operator Terminal shall utilize Ethernet networks that are available for multiple vendors. Ethernet protocols shall either use Port 502 or be supported by the Open Device Net Vendors Association (ODVA). Conversion equipment to convert a non compliant Ethernet protocol will not be accepted.

B. ENVIRONMENTAL REQUIREMENTS:
   1. All of the Operator Interface Terminals shall be capable of withstanding the following criteria as a minimum.
      a. Temperature: The Operator Interface Terminal shall be rated to operate in a range of 0-50º C. (32-122 º F.). The unit shall be able to withstand a range of -20-60º C. (-4-140 º F.) while in storage.
      b. Relative Humidity: The Operator Interface Terminal shall be capable of handling a minimum of non-condensation humidity of 0-85%.
      c. Altitude: The Operator Interface Terminal shall be designed to operate between 0-6500 feet above sea level minimum without derating.
      d. Degree of Protection: The Operator Interface Terminal shall have a front panel rating of IP 65 and conform to IEC 60529. This rating shall be a NEMA 4X rating suitable for indoor use only. The back panel rating shall be IP 20 and conform to IEC60529.
      e. Shock Resistance: The Operator Interface Terminal shall conform to one of the following
         1) IEC 60068-2-27; Semi-sinusoidal Pulse for 11ms, and 15gn on 3 axes.
         2) IEC 61131-3; 15gn 11ms
      f. Vibration: The operator Interface Terminal shall conform to one of the following
         1) IEC 60068-2-6. The Terminal shall be capable of 5-9Hz at 3.5 mm, and 9-150Hz at 1g.
         2) IEC 61131-3; 1gn 5Hz to 150Hz (maximum 3.5 mm (0.13 in.))

g. Electrostatic Discharge: The Operator Interface Terminal shall conform to one of the following
   1) IEC61000-4-2, level 3.
   2) 6 kV direct contact, or 8Kv air contact

h. Electromagnetic Interference: The Operator Interface Terminal shall conform to one of the following
   1) IEC 61000-4-3, 10 V/m.
   2) 10 V/m / 80 MHz to 2.7GHz Sinus amplitude modulated 80 % 1 kHz + Internal clock frequency

C. OPERATOR INTERFACE TERMINAL

1. Description: Operator Interface Terminals shall have viewable screen sizes between eleven (11) inches and sixteen (16) inches.
2. Screen Type: Large Operator Interface Terminals will use a color TFT screen with 65,536 solid colors, or 16,384 colors if flashing. The screen shall have an 800x600 pixel (SVGA) resolution, with a backlighting service life of 50,000 hours of continual usage. There shall be an embedded analog touch sensitive zone with a resolution of 1024x1024. The screen shall have eight (8) levels of brightness via tactile feedback.
3. Primary Memory: The Operator Interface Terminals shall have a 32Mb flash EPROM memory and a Compact Flash expansion memory slot. The Compact Flash slot shall be capable of handling cards up to 1GB.
4. RAM: The Operator Terminal shall be supplied with lithium batteries to back up 512Kb SRAM.
5. The Operator Interface Terminal shall have video and audio input jacks for connection to a video camera. The Operator Interface Terminal shall also have audio output jacks.
6. Communication Ports: The Operator Interface Terminals shall have an RJ-45 port, and an integral 9-way male SUB-D connector, dedicated to serial communications. The 9-way SUB-D connector shall support RS232/RS485 Communications. The RJ-45 port shall support RS485 communications. Additionally, two (2) type A host USB connectors shall be provided for application downloading and peripheral use. Furthermore, the terminal will be supplied with an integral RJ-45 port dedicated to 10BASE-T/100BASE-TX Ethernet TCP/IP communications. Operator Interface Terminals relying on the same port for communications and downloading shall not be acceptable.
7. Basis of Design: The basis of design is the General Electric QuickPanel+ terminal series.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, surfaces, and substrates to receive Operator Interface Terminals for compliance with requirements, installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Select Operator Interface Terminals based upon I/O, memory, communication, expansion, and other criteria. If multiple Operator Interface Terminal-based control panels will be supplied from different vendors, coordinate with other vendors to insure that Operator Interface Terminals are of identical brand and are equipped to utilize identical communication networks.

3.3 INSTALLATION

A. Anchor Operator Interface Terminals within enclosures as recommended by the Operator Interface Terminal manufacturer.

B. Provide spacing around Operator Interface Terminals as required by the Operator Interface Terminals manufacturer to insure adequate cooling. Insure that the air surrounding and penetrating the rear and sides of the Operator Interface Terminal has been ambiently conditioned to maintain the required temperature and humidity range of the Operator Interface Terminal.

C. Wires entering and exiting Operator Interface Terminals shall be sized to comply with the manufacturers requirements.

D. During installation, upper ventilation slots shall be covered to prevent accidental debris entry. However, during normal operation ventilation slots shall not be blocked, or obstructed by any means.

3.4 IDENTIFICATION

A. Identify Operator Interface Terminal components, and wiring according to all applicable codes, standards and contract document sections.

3.5 FIELD QUALITY CONTROL

A. Field Service: The Operator Interface Terminal-based control panel supplier shall provide a qualified service representative to perform the following:

1. Inspect Operator Interface Terminal, wiring, components, connections, and equipment installation.
2. Assist in field testing of equipment.
3. Report results in writing.

B. DEMONSTRATION

1. Control panel supplier shall provide a qualified service representative to train Owner's maintenance personnel to adjust, operate, and maintain Operator Interface Terminals. Manufacturer’s standard training will be sufficient unless specified elsewhere.

END OF SECTION 13502

SECTION 16010
ELECTRICAL: GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Basic requirements for electrical work.

B. Install and wire all equipment, including prepurchased equipment, and perform all tests necessary to assure conformance to the Specifications and ensure that equipment is ready and safe for energization.

C. Related Sections include but are not necessarily limited to:
   1. Section 11005 - Equipment: Basic Requirements.
   2. Section 16100 – Basic Electrical Materials and Methods.

D. Installation of all systems and equipment is subject to clarification as indicated in reviewed shop drawings and field coordination drawings.

1.2 AREA CLASSIFICATIONS

A. Classification of an area will determine the NEMA rating of the electrical equipment enclosures to be used in that area. Selection of electrical equipment enclosures shall be based on the following criteria:
   1. Outdoor locations may be classified as Wet or Corrosive.
      a. For Wet outdoor locations all equipment enclosures shall be NEMA 4.
      b. For Corrosive outdoor locations all equipment enclosures shall be NEMA 4X.

1.3 DEFINITIONS

A. Outdoor Areas:
   1. Those locations on the Project site where the equipment is normally exposed to wind, dust, rain, snow, etc.

B. Indoor Areas:
   1. Those locations on the Project site where the equipment is normally protected from wind, dust, rain, snow, etc.

C. Shop Fabricated:
   1. Manufactured or assembled equipment for which a UL test procedure has not been established.

1.4 QUALITY ASSURANCE

A. Referenced Standards:
   1. American National Standards Institute (ANSI):
      a. C2, National Electrical Safety Code.

2. ETL Testing Laboratories, Inc (ETL).
3. Factory Mutual System (FM):
   a. A Guide to Equipment, Materials and Services.
4. Institute of Electrical and Electronics Engineers (IEEE):
   a. 141, Recommended Practice for Electrical Power Distribution for Industrial Plants.
   b. 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
5. National Electrical Manufacturers Association (NEMA):
   a. ICS 6, Enclosures for Industrial Controls and Systems.
6. National Fire Protection Association (NFPA):
   a. 70, National Electrical Code (NEC).
7. Underwriters Laboratories, Inc (UL):
   a. 508, Safety Industrial Control Equipment.
   b. 698, Industrial Control Equipment for Use in Hazardous Locations.

B. In case of conflict or disagreement between codes, standards, laws, ordinances, rules, regulations, specifications, or within either document itself, the more stringent condition shall govern.

C. Miscellaneous:
   1. Verify motor horsepower loads, other equipment loads, and controls from approved shop drawings and notify Engineer of any discrepancies.
   2. Verify the required control wiring for a complete system and notify Engineer of any discrepancies.

1.5 SYSTEM DESCRIPTION

A. Provide functioning systems in compliance with manufacturer's instructions, performance requirements specified, and modifications resulting from reviewed shop drawings.

1.6 SUBMITTALS

A. Shop Drawings:
   1. See Section 11005.
   2. Submit shop drawings prior to purchase or fabrication of equipment. See individual Division 16 sections for specific requirements.
   3. Prior to submittals of shop drawings, coordinate electrical equipment with all applicable equipment and systems interfacing with that equipment.
   4. For each product, clearly identify manufacturer by name.
   5. Provide manufacturer's technical information on products to be used, including:
      a. Product descriptive bulletin.
      b. Electrical data pertinent to the Project and necessary to assure compliance with Specifications.
      c. Equipment dimensions, where applicable.

d. Evidence that the products submitted meet the requirements of the standards referenced.

6. When general data sheets are provided as part of the submittal, specifically identify the products to be used on this Project.
7. Ensure that all submittals clearly indicate the equipment is UL or ETL listed or is constructed utilizing UL or ETL listed or UL recognized components. Where a UL standard has not been established clearly identify that no UL standard exists for that equipment.
8. For all equipment, provide manufacturer's installation instructions.

B. System Coordination Report:
   1. As a minimum it shall include the following:
      a. Manufacturer's information.
      b. Assumptions.
      c. Advise the Engineer of potential coordination problems discovered during and include recommendations to resolve the problem.
      d. The report shall be submitted for approval 5 days prior to equipment energization.

C. Operation and Maintenance Manuals:
   1. See Section 14.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect nameplates on electrical equipment to prevent defacing.

B. Repair, restore or replace damaged, corroded and rejected items at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Refer to related Division 16 sections.
   1. All equipment of a similar type shall be by one manufacturer unless otherwise noted in the Specifications.

2.2 MATERIALS

A. Trade names and catalog numbers may be used in the Specifications to establish quality standards and basics of design.
   1. Other listed manufacturers in the applicable specification sections with equal equipment may be acceptable.
   2. If no other manufacturer is listed, then manufacturers of equal equipment may be acceptable.

B. Listed:

1. Where UL test procedures have been established for the product type, electrical equipment shall be approved by UL or ETL and shall be provided with the UL or ETL label.

2.3 FABRICATION

A. When equipment is shop fabricated for the Project, the electrical devices and enclosures utilized shall be UL or ETL listed and labeled or shall be UL recognized.

B. Shop or Factory Finishes:
   1. See Section 11005.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment shall be installed in accordance with the requirements of the NEC.

B. Enclosures for Use with Electrical Equipment:
   1. NEMA 12: Use in unclassified indoor locations.
   2. NEMA 4:
      a. Use in wet indoor locations.
      b. Use in wet outdoor locations.
      c. Unless other enclosures are approved and UL listed for the application.
   3. Exceptions:
      a. As modified in other Division 16 sections.
   4. Standards:
      a. NEMA ICS-6, Enclosures for Industrial Controls and Systems.
      b. UL 508, Safety Industrial Control Equipment.
      c. UL 698, Industrial Control Equipment for Use in Hazardous Locations.

C. Verify that equipment will fit.

D. Install equipment in accordance with the manufacturer's instructions.

E. Equipment shall be installed plumbed, square and true with the building construction and shall be securely fastened.

F. Equipment shall be provided with corrosion-resistant spacers to maintain 1/4 IN separation between the equipment and the wall.

G. Provide all necessary anchoring devices and supports.
   1. Use supports as specified.
      a. Where not specified, use supports and anchoring devices rated for the equipment load and as recommended by the manufacturer.
   2. Supports and anchoring devices shall be rated and sized based on dimensions and weights verified from approved equipment submittals.
   3. Hardware shall be malleable type, corrosion resistant and shall be supported by heavily plated machine screws or brass, bronze or stainless steel bolts.

H. Material that may cause rusting or streaking on a building surface shall not be used.

3.2 FIELD QUALITY CONTROL

A. System Coordination Study:
   1. Perform a system coordination study of all new equipment and the first upstream and downstream protective devices of existing equipment for the electrical distribution system.
      a. The electrical distribution system shall include equipment from the point of connection to the last branch circuit protective device.
      b. The study shall be performed in accordance with ANSI/IEEE Standards 141 and 242, and shall use actual equipment data from the manufacturer supplying the equipment.

B. After installation, all equipment shall be tested as recommended by the manufacturer.

C. Verify all components are operational.

D. Perform ground-fault performance testing as required by NEC Article 230-95(c).

E. Test Equipment Interface:
   1. Verify systems coordination and operation.

F. Set all adjustable trip protective devices as required for system protection and coordination.
   1. Settings shall be as recommended in the System Coordination Study.

G. Verify all system and equipment ground continuity.

H. Adjust installed equipment for proper operation of all electrical and mechanical components.

I. Replace equipment and systems found inoperative or defective and re-test.
   1. If equipment or system fails re-test, replace it with products which conform with Contract Documents.
   2. Continue remedial measures and re-tests until satisfactory results are obtained.
   3. Remedial measures and re-tests will be done at no cost to the Owner.

J. At Completion of Installation:
   1. Test to ensure all equipment is free of short circuits and improper grounds.
   2. Test to ensure all equipment is operational.

3.3 CLEANING

A. Clean dirt and debris from all surfaces.

B. Apply touch-up paint as required to repair scratches, etc.

C. Replace nameplates damaged during installation.

D. Thoroughly vacuum the interior of all enclosures to remove dirt and debris.

3.4 DEMONSTRATION

A. Demonstrate equipment in accordance with applicable codes and manfacturers' requirements.

END OF SECTION

SECTION 16100

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 DESCRIPTION

Requirements specified in Conditions of the Contract, Division 1 and Section 160l0 form a part of this section. This Section outlines the requirements for the basic electrical materials and methods for the electrical work, and forms a part of all other Sections of Division 16 unless otherwise specified.

A. Related Work Included in Other Divisions or Sections (Related Work not Included in This Section).

1. Earthwork, Division 2.
2. Concrete, Division 3.
3. Painting and Protective Coatings, Section 09900.
4. Instrumentation, Division 13.
5. Induction Motors, Section 16150.
6. Service and Distribution, Section 16400.
7. Electrical Controls, Section 16900.
8. Electrical Equipment Testing, section 16960.

1.02 SUBMITTALS

Submit for the Owner's approval material lists, shop drawings, factory test reports and technical data to the extent required in this Section and Section 16010.

1.03 WIRING

Wiring for furnished equipment shall include the following:

A. Wiring for Furnished Equipment. The wiring from electrical panels, control panels and motor control centers to the furnished equipment shall include all the required materials and installations to complete the wiring as shown on the Drawings, specified and required.

PART 2 - PRODUCTS

2.01 GENERAL

Provide basic materials and all wiring installations as indicated, specified and required.

2.02 METAL CONDUITS

A. Metal conduits shall be steel, hot-dipped galvanized (including threads) and equipped with couplings and thread protector caps. The surfaces and threads shall be corrosion-resistant coated. Conduits shall be in ten foot lengths and manufactured in accordance with U.L. 6 by Triangle, Pittsburgh, V.A.W., Wheatland, Allied or equal. Conduits shall be a minimum size of 3/4 inch.

B. PVC Coated Conduit shall have a polyvinyl chloride coating bonded to the outer surface of rigid steel conduit and couplings. The plastic coating shall have an average thickness of 0.020 inches on 3/4-inch and 1-inch conduits. For conduits 1-1/4 inch and larger, the PVC coating shall have an average thickness of 0.040 inches. The bonding of the PVC coating to the conduit shall be stronger than the tensile strength of the PVC coating. The polyvinyl chloride coating shall be bonded to the galvanized surface of rigid steel conduit by Youngstown, Kor-Kap, Occidental Coating, Robroy or equal.

2.03 NONMETALLIC CONDUITS

Nonmetallic conduits shall be polyvinyl chloride, low temperature, corrosion and moisture resistant, Schedule 80, as manufactured by Certainteed, Carlon or equal. All the conduit shall be of one type.

2.04 FLEXIBLE CONDUIT

A. Liquid-tight Conduit shall have an interlocked, flexible, galvanized steel core, permanently bonded exterior gray polyvinyl chloride jacket and shall be UL listed.

B. Conduits, l-l/4 inch and smaller shall have an internal copper bonding conductor wound spirally in the space between each convolution.

C. Manufacturers of liquid-tight flexible conduit shall be Anaconda (by Anamet, Inc.), Type UA, Electri-Flex Type LA, Universal or equal.

2.05 CAST METAL BOXES AND FITTINGS

Cast boxes and fittings shall be finished as specified in Section 16010. The outlet bodies, boxes, fittings, covers and supports shall be cast iron alloy with threaded hubs. The materials shall be manufactured by Crouse-Hinds, Appleton, Pyle-National, Efcor or equal.

A. Covers and Gaskets shall be provided for all conduit outlet bodies, boxes and fittings. The covers shall be cast iron alloy and equipped with neoprene gaskets.

B. PVC Coated Fittings shall have the same polyvinyl chloride coating that is on the conduit to which they shall be connected. The PVC coating shall have an average thickness of 0.040 inches and the bonding shall be stronger than the tensile strength of the PVC coating. The PVC coating shall be bonded to the surfaces of cast outlet bodies, boxes, fittings, supports, etc. by Occidental Coating, Kor-Kap, Robroy, Youngstown, or equal.

C. Plastic Fittings shall be solvent weld type and shall be compatible with the conduit to which they shall be connected.

D. Expansion/Deflection Fittings shall consist of cast metal conduit hubs securely attached to a flexible outer neoprene jacket. A flexible copper grounding strap shall be provided inside the fitting and connected to the two hubs. The linear expansion or contraction shall be a movement up to 3/4 inch. The linear misalignment shall be a movement up to 3/4 inch. The angular misalignment shall be a movement up to 30 degrees. The expansion/deflection fittings shall provide flexible and watertight conduit joints.

E. Thread Lubricant shall inhibit corrosion and maintain grounding continuity, and shall be Crouse-Hinds STL, Thomas and Betts "Koper-Shield" or UL listed equal.

F. Couplings and Elbows. For rigid steel conduits, the couplings and elbows shall be steel, hot dipped galvanized, threaded and one-piece. For plastic conduits, couplings and elbows shall have plain ends for tight weld fits, which form watertight joints. For joining plastic and rigid steel conduit systems, couplings shall have a plain end and a threaded end.

2.06 STEEL BOXES AND FITTINGS

Pull Boxes. Boxes 24 inches square and smaller shall have gasketed screw type covers. Larger boxes shall have bi-parting gasketed hinged doors with latch mechanisms, handles and cylinder locks complete. Provide two keys for each lock. Pull boxes shall be painted as specified in Section 16010. The pull boxes shall be Hoffman, Boss, Circle A-W or equal.

2.07 WATER AND GAS SEAL FITTINGS

A. Water and gas seal fittings shall consist of a thick, synthetic rubber, sealing ring secured between two metal plates by socket head screws. When the conduit water and gas seal fitting is in place and the screws are tightened, the synthetic rubber shall become compressed between the metal plates and be forced against the conduit inside wall and also against the conductor insulation to form a watertight seal inside the conduit. The synthetic rubber shall resist aging, ozone, sunlight, water, chemicals and extreme temperature variations. The water and gas seal fittings shall be O-Z/Gedney Type CSB or equal.

B. Water and gas wall and floor seals shall consist of a synthetic rubber sealing ring between two pressure rings or a series of synthetic rubber links between pressure plates held together with corrosion resistant bolts, nuts and washers. When the bolts are tightened, the synthetic rubber expands to provide a watertight seal between the outer surface of the entering conduit, and the inner surface of the wall or floor penetration. The synthetic rubber shall resist aging, ozone, sunlight, water, chemicals and extreme temperature variations. The seals shall be Thunderline "Link-Seal", O-Z/Gedney Type CSM, FSK, WSK or equal.

2.08 CONDUIT FITTINGS

Conduit fittings shall be hot dipped galvanized steel and cast iron as required.

A. Liquid-tight Conduit Fittings shall be Types LT, ST, CT as manufactured by Crouse-Hinds, Appleton, Pyle-National or equal. Fittings 1-1/2 inch and larger shall have provision for a separate equipment ground conductor.

B. Unions shall be type UNY or UNF. Running threads are not acceptable. Unions shall be Appleton, Crouse-Hinds, Pyle-National or equal.

C. Bushing reducers shall be Appleton, Thomas and Betts, Efcor or equal.

D. Conduit Enlargers shall be Appleton, Thomas and Betts, Efcor or equal.

E. Locknuts shall have notches all around for tightening with a screwdriver. Locknuts shall be Appleton, O-Z, Thomas and Betts or equal.

F. Metallic Insulated Bushings shall have ground terminals and smooth and well rounded surfaces to protect the conductor insulation. The conduit threads shall be deep, clean and easily attached to the conduits. The bushings shall be O-Z, Efcor, Thomas and Betts or equal.

G. Plugs shall be the recessed type and Appleton, Crouse-Hinds or equal.

H. Interchangeable Hubs shall have an insulated throat, sealing ring and vibration-proof nut. Machined serrations on hub and nut shall bite into the metal enclosure assuring an equipment ground. The hubs shall be Myers "Scru-Tite", Efcor "Space-Saver" or equal.

2.09 CONDUCTORS AND CABLES

Conductors and cables shall be new, single conductor, copper, not smaller than #12 AWG for power and #14 AWG for control unless otherwise indicated, and as shown on the Drawings.

A. Conductors 250 kcmil and larger shall be stranded, 600 volts, flame retardant, ethylene propylene rubber insulation, UL labeled, Type RHW, without outer covering. Insulation other than ethylene propylene rubber shall not be used. Conductors shall be Rome FR-EPR, Okonite-FMR, Houston Wire and Cable FREP or equal.

B. Conductors Smaller than 250 kcmil shall be stranded (except #10 and #12 for lighting and receptacle circuits which shall be solid), 600 volt and Type THWN or THHN. Conductors shall be Rome, Carol Cable, Techbestos, Triangle, Atlas, Northern or equal. Sizes #10 and smaller shall have colored insulation where indicated.

C. Ground and Neutral Conductors.

1. Insulated ground and neutral conductors shall be the same type as the phase conductors, except for circuits above 600 volts which shall be Type THWN.

2. Bare ground conductors shall be copper, soft drawn, annealed, concentric lay, stranded conforming to ASTM Specifications B3 and B8.

D. Fixture Wires shall be rated 90^{o} centigrade, #16 AWG stranded, thermoplastic insulated with an outer jacket. The wire shall be Type TFFN and manufactured by Brand-Rex, Carol Cable or equal.

E. Instrumentation Signal Cables shall be single twisted pair or multi twisted pairs of stranded, copper cables with 600 volt, 15 mil polyvinyl chloride insulation with 4 MIL nylon jacket over each conductor, overall aluminum-mylar tape shield, overall tinned copper drain wire and 45 mil minimum polyvinyl chloride jacket overall, 90° centrigrade dry/75° centrigrade wet rating. Twisted pair cables that are required to be shielded, shall have aluminum-mylar tape shields and tinned copper drain wires over individual twisted pairs of cable. Single twisted pair cables shall be #16 AWG minimum. Cables shall be Okonite "Okoseal-N-type P-OS, type TC", Dekoron type TC or equal.

F. Wire Lubricant shall be Burndy "Slikon", Holub "Hi- Green", Ideal "Yellow 77" or equal.

G. Identifications on the conductors and cables shall be continuous and include the type, voltage, size and name of the manufacturer.

2.10 WIRE CONNECTORS

Connectors shall be provided for splices and terminal connections of all conductors and cables. The connector shall fit the conductor to which it shall be connected, and the assembly shall have joint contact surfaces not less than 50 percent.

A. Compression Connectors shall be copper lugs for terminal connections, and two-way copper sleeves and taps for splice connections. A crimping tool shall be provided to make tight and neat compression connections. The connectors and crimping tool shall be Anderson-Square D, Thomas and Betts, Buchanan or equal.

B. Tapered Spring Connectors shall have live springs attached to inner steel housings and enclosed with plastic insulators, and shall be Buchanan B-Cap, 3-M, Scotchlok Type Y, R, G, B, Ideal Wire-Nut or equal.

C. Connectors in all flush with grade pull boxes shall be watertight. Connector splice kits for the wire range size for which they apply shall be 3M Type DB-6 and DBR-6, Buchanan B-cap Twist and Seal, or equal.

D. Electrical Tape shall be plastic, 0.007 inches thick, and resistant to abrasion, alkalies, acids, corrosion, moisture, low and high temperatures. The tape shall be Scotch No. 33 Plus, Plymouth Premium Black No. 4453 or equal.

E. Wire Markers. The individual conductor wire markers shall be adhesive and manufactured by Thomas and Betts, Brady, Scotch 3M or equal. The wire marker to identify groups of conductors shall be nylon cable tie markers as manufactured by Thomas and Betts, Panduit or equal. The marker pads on the cable tie markers shall be large enough to show the motor or device numbers using minimum 3/16 inch high numbers and letters. Manufacturer shall provide permanent marking pens.

2.11 PANELBOARDS

Panelboards shall be factory assembled, metal enclosed, dead front and equipped with bus, terminals and thermal-magnetic molded case circuit breakers as shown on the drawings.

A. Circuit Breakers shall be molded case, quick-make, quick-break, single and multipole, bolted type, and arranged as shown on the Drawings. Each circuit breaker shall have clear indications for "ON", "OFF" and "TRIP" positions. The minimum interrupting capacity shall be 10,000 symmetrical amperes at 240 volts. As indicated, provide devices to lock the branch circuit breaker in the "ON" and "OFF" positions. Ground fault protection, 5 milliampere sensitivity, shall be provided for the indicated branch circuits, which shall be an integral part of the regular branch breaker. A circuit breaker with integral ground fault circuit interruption shall require no more panelboard branch circuit space than the regular circuit breaker. Branch circuits that have exterior convenience outlets, and as indicated shall be equipped with ground fault protection.

B. Copper Bus shall be provided for panelboards. Bus shall be provided for the complete length of the panelboard branch circuit area including circuits indicated as spaces. Bus bars shall be drilled and tapped for the indicated spaces for installation of future circuit breakers.

C. Single Phase Panelboards, three wire, shall be bussed so that any two adjacent single-pole breakers shall be connected to opposite polarities. A single handle two-pole circuit breaker can be installed in any location, and in place of two adjacent single pole breakers.

D. Three Phase Panelboards, four wire, shall be bussed so that any three adjacent single-pole breakers shall be connected to different phases. A single handle two-pole breaker or three-pole breaker can be installed in any location, and in the same space of two or three adjacent single pole breakers.

E. Terminals and connectors shall be provided for all feeder, branch, neutral and ground conductors shown on the Drawings.

F. Circuit Numbers shall start at the top of the panelboard. Odd numbers shall be assigned in sequence on the left side, and even numbers shall be in sequence on the right side of the panelboard.

G. The Cabinet shall enclose the bus and breaker assembly, and shall be steel fabricated and coated with corrosion-resistant finish as specified in Section 16010. The front of the panelboard shall include a trim, hinged door, flush cylinder lock with catch. The lock shall be furnished with two keys, and all locks shall be keyed alike. Fronts shall not be removable when the door is in the locked position.

H. Metal Circuit Directory frame and card with clear plastic covering shall be provided on the inside of the door. The directory card shall provide a space at least 1/4-inch high and 3 inches long for each branch circuit. The card shall be completely typed to identify each connected circuit, spare and space.

I. Manufacturers for the single phase 120/240 volt and three phase 208Y/120 volt panelboards shall be Square D Type NQOD, Cutler-Hammer POW-R-LINE 1, General Electric Type AQ or equal.

2.12 OVERCURRENT PROTECTION

Circuit breakers, fuses, relays and other protective devices that protect the conductors and equipment against overload currents and short circuit currents shall be provided as indicated, specified and required. The circuit breakers shall be coordinated as specified in this Section.

A. Circuit Breakers shall be molded case type unless otherwise indicated. Breakers shall be quick-make and quick-break on automatic operation. The drawings shall indicate the number of poles and ampere trip ratings. The handle mechanism shall be trip-free which prevents holding the contacts against overload or short circuit conditions. Circuit breakers shall be equipped with lugs properly sized to terminate all required conductors as shown on the drawings.

1. The thermal device shall provide time-delay tripping on overloads, and the magnetic device shall provide instantaneous tripping on short circuits. The instantaneous magnetic trip shall be adjustable and accessible from the front of the circuit breaker on frame sizes above 100 amperes. Non-automatic breakers shall have no tripping devices, and shall be used for manual switching of circuits. Molded case thermal-magnetic circuit breakers shall have at least the following interrupting capacities in symmetrical amperes at 480 volts unless otherwise indicated.

100 Ampere Frame - 22,000.
225 Ampere Frame - 22,000.
400 Ampere Frame - 30,000.
600 Ampere Frame - 30,000.
800 Ampere Frame - 30,000.

2. Solid state circuit breakers shall be equipped with programmers, integral current sensors, logic and trip circuitry, sensor-powered shunt trips and integral ground fault protection. The programmer shall include silicon transistors, silicon diodes, silicon controlled rectifiers and printed circuit boards to assure the circuit breaker's reliability and stability. Each printed circuit board shall be given a protective epoxy coating to prevent moisture absorption, fungus growth and signal leakage. Gold plated surfaces shall be provided on all electrical connectors and adjustment taps. Sensing power and signals shall be derived from three current transformers inside the circuit breaker, which shall supply power to the solid state programmer. The trip shall utilize logic circuitry contained in the programmer. The ampere setting shall be a tap adjustment which selects the continuous current setting of the breaker. These tap adjustments shall be made with knobs on the front of the programmers. Regulated d-c power shall be provided by the full wave rectifiers and filters in the power supply. There shall be individual signals from the programmer which shall trip the breaker on overloads, short circuits, ground faults and high temperatures. The interrupting capacity for the solid state circuit breaker shall be 65,000 symmetrical amperes at 480 volts. It shall be possible to lock the operator handle in the "off" position with a padlock. The solid state circuit breaker shall be 100% rated.

3. Motor circuit protectors shall be provided as shown on the drawings. They shall be molded case magnetic-trip-only circuit breakers. Each pole shall provide instantaneous protection by means of a single adjustable magnetic element that trips all currents equal or above the trip setting. The single adjustment screw shall adjust all poles simultaneously. Tripping shall be clearly indicated by the handle automatically assuming a position midway between the manual "OFF" and "ON" positions. All poles shall be constructed to open, close and trip simultaneously. The contacts shall be of non-welding silver alloy. It shall be possible to lock the operator handle in the "OFF" position with a padlock.

4. The circuit breakers shall be mounted inside low voltage switchgears, motor control centers, switchboards and separate metal enclosures as indicated. Breakers shall be equipped with indications for the "trip," "on" and "off" positions, and connectors that fit the conductors shown on the Drawings. The molded case circuit breakers shall be General Electric, Square D, Cutler-Hammer or equal.

B. Overcurrent Protective Device Coordination. Properly coordinated automatically operated overcurrent protective devices shall be provided for this project. The overcurrent protective devices shown on the Drawings shall be coordinated for adequate continuous current and interrupting capacity to assure proper overcurrent protective devices operation under normal and fault conditions in the system.

All overcurrent protective devices on this project and the first upstream device of the existing electrical system shall be coordinated so that they will perform as follows:

When two or more overcurrent protective devices (including the first upstream protective device of the existing system) in series with each other experience current flow greater than their rated current, the device with the lowest rated current shall trip and/or open the circuit first and thereby prevent the higher rated devices from operating.

An overcurrent protective device coordination study to verify the above stated performance requirements shall be submitted for the Owner's approval. The study shall be performed, stamped, and signed by a registered professional engineer in the State of California. The documents included in the study shall include but not be limited to the following:

1. A composite drawing or drawings (on full size, reproducible, log-log paper) showing the entire new electrical system (including the first upstream protective device of the existing system) showing all protective device curves (including motor overloads), short circuit duties, motor starting curves and damage curves for motors, equipment and conductors. This drawing or drawings shall show that all protective devices are properly coordinated to perform as stated above.
2. Manufacturer's overcurrent operating curves (on full size, reproducible, log-log paper) for each overcurrent device. In the case of fuses, both minimum melt and maximum clearing time curves shall be included.
3. Reproducible copies of all project single line diagrams so marked to show which operating curve applies to each overcurrent device on the diagram (the operating curves shall also be correspondingly marked);
4. A tabulation of the required settings of all of the adjustable overcurrent devices so that the performance requirements are met.

This documented coordination study shall be submitted for review before the overcurrent devices are supplied for the project. Protective devices which have ground fault protection features are specifically required to meet this performance requirement.

2.13 WIRING DEVICES

Receptacles and switches shall be specification grade, heavy duty and rated as indicated on the Drawings and these Specifications.

A. Duplex convenience receptacles shall be grounding type, polarized, NEMA 5-20R, rated 20 amperes and 125 volts AC, and shall have double sided screw terminals for copper wire unless otherwise indicated. The receptacles shall be Hubbell #5362 brown and ivory, or equal by Leviton or Arrow.

B. Single convenience receptacles shall be grounding type, polarized, NEMA 5-20R, rated 20 amperes and 125 volts AC, and shall have side screw terminals for copper wire unless otherwise indicated. The receptacles shall be Hubbell #5361 brown, or equal by Leviton or Arrow.

C. Weatherproof receptacle coverplates shall attach to the boxes with corrosion resistant screws. The plug opening in the coverplate shall have a ethylene propylene rubber gasket. Attached to the coverplate shall be a hinge-spring cover. The convenience outlet shall be weatherproof both when the receptacle is in use and a cord plug is attached and when the receptacle is not in use and the cover is closed. The coverplate for single convenience receptacles shall be Crouse-Hinds type WLRS, Appleton FSK-WR1 or equal. The coverplate for duplex convenience receptacles shall be Crouse-Hinds type WLRD, Appleton FSK-WR2 or equal

D. Local and Weatherproof Switches shall be toggle type, Specification grade, rated 20 amperes and 120-277 volts AC, and equipped with side screw terminals for copper wire. Single pole switches shall be Hubbell #1221, brown or ivory, or equal by Leviton or Arrow. Double pole switches shall be Hubbell #1222, brown or ivory, or equal by Leviton or Arrow. Three way switches shall be Hubbell #1223, brown or ivory, or equal by Leviton or Arrow. Four way switches shall be Hubbell #1224, brown or ivory, or equal by Leviton or Arrow.

2.14 SUPPORTS

A. Channels shall be stainless steel 304. One side of the channel shall have a continuous slot. On both sides of the slot, the edges turn inward and forms a guide for the spring nuts. The fittings shall be fabricated from stainless steel 304 and attached to the channel with bolts and spring nuts. The channel, fittings and hardware shall be stainless steel 304 and manufactured by Unistrut, Power-Strut, Kindorf or equal.

B. One-Hole Clamps shall be stainless steel 304, for steel conduits and equipped with clamp-backs. The clamps shall be Efcor, Thomas and Betts, Appleton or equal.

C. Beam Clamps shall be stainless steel 304, right angle and parallel types. The clamps shall be manufactured by Efcor, Thomas and Betts, Appleton or equal.

D. Spacers, provided to support underground conduits in concrete encasements, shall be plastic. The spacers shall be Carlon, Johns-Manville, Underground Products or equal.

E. Steel Anchors shall be stainless steel 304 and shall be sleeve and stud types for securing equipment to concrete foundations, floors and walls. The anchors shall be Phillips "Red Head", Diamond or equal.

F. Toggle Bolts shall be stainless steel 304, spring wing type for securing equipment to hollow walls and ceilings. Toggle bolts shall be Phillips "Red-Head", Diamond or equal.

G. Stanchions shall be stainless steel 304 as shown on the drawings.

H. Conduit Hangers shall be stianless steel 304 and equipped with carriage bolts, 1/4-inch rods and nuts. The hangers shall be Efcor, Kindorf, Appleton or equal.

I. U-Bolts shall be stainless steel 304, and equipped with two hexagon steel nuts. The U-bolts shall be Efcor, Kindorf or equal.

J. Fixture Hangers shall be stainless steel 304, cushion type, equipped with cover, screw terminal blocks, and permits the pendant to swing 20 degrees from perpendicular in any direction. Hangers shall be Crouse-Hinds Type ALT, Appleton Type ALT, Pyle-National Type A-2152M or equal.

K. All nuts and bolts shall be stainless steel 304.

2.15 NAMEPLATES

A. The Nameplates shall be engraved, laminated black plastic with minimum 1/4 inch high letters showing through from the white core, NEMA ES-1, 3-ply (Black-White-Black), 1/16-inch thick, beveled and satin finished. Nameplate inscriptions shall include the identifications for the equipment and loads and shall identify the controls on control equipment as shown on the Drawings. Nameplates shall be provided on receptacle plates with 1/8 inch high letters.

2.16 TAGS

Tags shall be 1/16 inch thick stainless steel and shall have embossed (raised) lettering. Lettering shall be a minimum of 3/8 inch high. Provide a 1/8 inch hole at each end for mounting or wire attachment. All corners shall be rounded and edges ground smooth.

2.17 GROUNDING

Provide all the equipment and materials to complete all the grounding installations as indicated, specified and required.

A. Ground Rods shall be sectional copper-clad, high strength steel, minimum 3/4 inch diameter, minimum 10 feet long and with pointed ends and chamfered tops. The sectional ground rods shall be equipped with bronze couplings and driving bolts. The ground rods shall be Copperweld, Hubbard, Chance or equal.

B. Ground Clamps shall be copper alloy, heavy duty, corrosion resistant and consist of U-bolts and saddles with bolted cable connections. The ground clamps shall be O-Z, Thomas and Betts, Burndy or equal.

C. Ground Connectors shall be cast copper alloy interlocking clamps equipped with silicon bronze bolts, nuts and lock washers or interlocking lugs with allen head set screws and one-hole tongues. Ground connectors shall be corrosion resistant and provided for cable to flat surface connections on equipment and structural steel. The connectors shall be O-Z, Burndy, Thomas & Betts or equal.

D. Direct Buried Ground Connections shall be the exothermic method and supplied by Cadweld, Thermoweld or equal. Exothermic welding method produces a super heated flow of molten copper by burning powder in the crucible-mold. Brazed, soldered, impact and bolted connections shall not be used for buried connections.

E. Ground Conductors shall be provided as shown on the Drawings and specified in Section 16100.

F. Ground Well shall consist of a concrete box, cover, ground rod and ground rod clamp. The box shall be pre-cast concrete, and the inside dimensions shall be at least 10-1/2 inches wide, 17-1/4 inches long and 12 inches high. The cover shall be traffic type, cast iron and marked "GROUND". Concrete box and cover shall be Brooks No. 3-1/2 T, Quikset No. W-17 or equal.

PART 3 - EXECUTION

3.01 GENERAL

Provide the wiring installations and equipment installations, including connections and interconnections as indicated, specified and required in a neat and workmanlike manner. Assure proper fits for all equipment and materials in the spaces shown on the Drawings.

A. Excavations and Backfills. Earthwork shall be performed for equipment foundations, supports and underground conduits as indicated and as specified in Section 02200.

B. Concrete shall be provided for electrical equipment foundations, support foundations and conduit encasements as indicated and as specified in Section 03300.

C. Painting. Painting shall be provided for installations having unfinished surfaces per requirements of Section 09900. Field damaged factory finishes on equipment shall be touched-up with paint that is equal in quality and color to the original factory finish. Paint galvanized stanchions in accordance with Section 09900 requirements.

3.02 RACEWAYS

Provide all conduit installations, including the outlet bodies, boxes, gaskets, covers, fittings and supports to complete the raceway systems as shown on the Drawings and as required. Conduits shall be a minimum size of 3/4 inch. Install ground conductors in all conduits.

A. Underground Installations – Outside Building.

1. Bottom of trench shall be of select backfill or sand.
2. All underground raceways shall be concrete encased.
    a. Nonmetallic conduit may be installed for underground conduit runs which are outside of the buildings and structures and run between buildings and structures.
    b. Rigid galvanized steel conduit shall be installed under roads and paved parking areas.
        1) The rigid galvanized steel conduit shall extend 5 feet passed the edge of the pavement at which point it may transition to nonmetallic conduit.
3. Provide at least 3 inches of concrete between the conduits and the outside of the encasement, and at least 2 inches of concrete between the conduits unless otherwise indicated.
    a. Fifteen (15) pounds of red iron oxide No. 188 per cubic yard of concrete shall be used for coloring of the concrete.
    b. Couplings shall be staggered at least 6 inches.
    c. Install spacers and adapters to support and terminate underground conduits.
        1) Horizontal and vertical separation shall be maintained by plastic spacers set sever 5 feet and duct system shall be anchored at least every 4 feet to prevent movement during placement of concrete.
4. Underground conduits shall be installed so that the top of the concrete encasement is a minimum of 24 inches below grade, with a minimum slope of 4 inches per 100 feet of duct towards pull-boxes, handholes and manholes so that moisture is not allowed to collect in the conduits.
    a. Horizontal changes in direction, where conditions permit, shall be accomplished with long sweep bends of minimum radius of 24 times conduit diameter.
    b. Conduit entrances into manholes, handholes and pull-boxes shall be terminated with flush end bells and grouted smooth.
5. Rigid steel bends and risers shall be used with nonmetallic conduit wherever conduit rises above grade.
    a. Provide and connect the adapters between the rigid steel conduit risers and non-metallic conduits.
    b. Conduit risers shall be completely concrete encased to finished grade.
6. Each conduit of a completed duct bank shall be cleaned by drawing through it a standard flexible mandrel one foot long and ¼ inch less diameter than the conduit.
    a. After the passing of the mandrel, a wire brush and swab shall be drawn through.

b. All spare conduits shall have their ends plugged and contain a 1/8 inch polypropylene pull cord for future use.

1) Pull cord is not required for capped stubouts.

7. Each conduit entering a pullbox shall be identified by conduit number on an embossed tag securely fastened to the wall above the conduit. Where view of this tag is obscured, a second similar tag shall be added. This tag shall be attached to the conduit or conductors with #18 AWG stainless steel wire.

B. Conduits in Concrete. Rigid galvanized steel conduits shall be installed in concrete encasements, slabs, foundations, floors and walls as shown on the drawings. The conduits shall be properly positioned in the concrete forms to provide the required clearance space with reinforcing steel.

C. Conduits installed under the concrete floor slab of buildings shall be rigid galvanized steel type. When galvanized conduits are installed in concrete slab, they shall be coated with two heavy coats of asphaltum paint. Acceptable coatings are Kopper Inertol No. 49 or Sherwin Williams Coat Tar Epoxy C-200.

D. Exposed Installations. The installations shall be completed with PVC coated hot-dipped galvanized rigid steel conduits with wrench tight connections in a neat and workmanlike manner. A minimum of 5 threads shall be engaged and the tapered portion of the threads shall be sufficiently engaged to provide electrical continuity. Supports shall be provided for all conduits. Where new conduits may interfere with existing facilities such as lighting fixtures, control stations, lighting switches, instruments, control panels, etc., consult the Owner or his representative for direction prior to proceeding with installation. Maintain a minimum clearance of 12 inches for conduits installed near hot pipes or surfaces (150^{O}F or higher). Exposed conduits shall be installed parallel or perpendicular to buildings and structures. Where two or more conduits change direction at the same location, all bends shall be concentric around a common center point.

E. No run of conduit, between device, equipment, box or fitting and another device, equipment, box or fitting, shall contain more than the equivalent of three 90 degree bends (270 degrees total), including offset bends located immediately at the device, equipment, box or fitting.

F. Couplings and Elbows shall be of the same type as the conduit to which they shall be connected, except where rigid steel bends and risers are connected to non-metallic conduits where conduits rise above grade or as required by Section 351-9 of the National Electrical Code.

G. Flexible Conduits. Flexible conduits shall be liquid-tight with fittings for short tight connections (30 inches maximum) to equipment, except in Class 1, Division 1 areas. A separate ground conductor shall be installed in flexible conduit that does not have the internal copper bonding conductor included by the manufacturer.

H. Threads. All steel conduit threads shall be coated with a conductive, corrosion resisting lubricant, and the connections shall be made watertight. The lubricant shall maintain the grounding continuity.

I. Conduit Connections. Where conduits are connected to couplings, fittings, boxes, etc., a minimum of 5 threads shall be engaged so that the system is rigid and sturdy. Also, the tapered portion of the threads shall be sufficiently engaged to provide electrical continuity. The use of lock-nuts, or other gimmicks with threaded fittings to add rigidity, is not acceptable. Unions shall be provided, as required, for conduit connections to threaded outlet bodies, boxes and equipment, and for connecting two steel conduits together. Conduit enlargers shall be provided for connecting two conduits of different sizes together.

J. Water and gas seal fittings shall be provided on all conduits that enter or leave corrosive areas. The seal fitting shall prevent corrosive gases from passing from a corrosive area to a non-corrosive area through the conduit system. Ceramic or other non-asbestos fiber material and sealing compound shall be placed in the fitting to complete the seal.

K. Water and gas seal fittings shall be installed on the ends of exterior conduits that terminate at indoor equipment. The fittings shall provide a water and gas tight seal between the wires and cables and the inside of the conduit.

L. Water seal fittings shall be installed to completely water seal the areas around conduits that pass through concrete floors and outside walls, unless concrete is placed after conduit is installed.

M. Penetrations. Penetrations through concrete for sleeves and conduits shall be approved by the Owner. Submit the sizes, locations and methods for all penetrations.

N. Expansion/Deflection Fittings. Expansion/Deflection fittings shall be connected to steel conduits, to permit movement between two conduits without damage to the conduits or conductors, as indicated and required.

O. Stub-ups and Stub-Outs. All steel conduit stub-ups and stub-outs shall be painted per requirements in Section 09900. Conduits shall be painted a minimum of 4 inches each side of concrete slabs and walls. Finish shall be applied before concrete is poured. Where a spare conduit stubs-up below a control panel, motor control center, switchboard or other electrical equipment, it shall be terminated with a metallic insulated bushing and grounded. Where a spare conduit stubs-up in a floor, it shall terminate flush with the floor using a coupling and recessed plug. Where a spare conduit stubs out through a wall, it shall be capped. Identify

all spare stub-ups and stub-outs with tags as to the location of the termination of the conduit at the other end.

P. Conduit Terminations. Conduits entering equipment, including control panels, motor control centers, switchboards, etc. shall enter in the same vertical section in which the circuit will terminate. Metallic bushings with insulating inserts and ground terminals shall be provided on the ends of threaded steel conduits and nipples that terminate through openings in sheet steel enclosures. Locknuts and bushings shall be installed on the threads of steel conduits that enter through close-fit openings in enclosures. Interchangeable hubs shall be provided for rigid steel conduit connections to sheet steel enclosures. Bushing reducers shall be provided in conduit fitting hubs for connections to smaller size conduits.

Q. Tool Marks. Conduits and fittings that have tool marks shall be smoothed and finished with paint that matches the original finish.

R. Conduit Through Roof. Provide a watertight seal around the conduit on the roof. Coordinate the work with the roofing contractor.

S. Furnished Equipment. Provide conduit installations as shown on the Drawings, and specified in other Sections of the Specifications for furnished equipment.

3.03 BOXES AND FITTINGS

Conduit outlet bodies, boxes, fittings, gaskets, covers and supports for lighting outlets, lighting switches, receptacles, control stations, alarm switch and thermostat outlets, etc. in exposed conduit installations, shall be installed as indicated, specified and required, and shall be of sufficient size to provide free space for all conductors that shall be enclosed.

A. PVC Coated. Outlet bodies, boxes, gasketed covers and fittings shall be PVC coated and connected to PVC coated steel conduits.

B. Sheet Steel. Sheet steel boxes shall be of sufficient size to accommodate the connected conduits and enclosed conductors and provided with close-fit holes for steel conduit connections. Weatherproof boxes shall be provided with interchangeable conduit hubs for steel conduit connections as indicated.

C. Interchangeable Hubs. The hubs shall be installed in steel enclosures for rigid steel conduit connections. Cut a close fitting hole in the sheet steel enclosure and place the interchangeable hub in the opening. Connect the hub on the conduit and make a tight connection to the enclosure.

3.04 CONDUCTORS, CABLES, CONNECTIONS AND WIRE MARKERS

Install all the conductors, cables and connections for the wiring as indicated, specified and required. Recommended pulling tensions shall not be exceeded. Pulleys and/or rollers shall be provided so that conductors do not come in contact with ground, concrete, manhole entrance rings, edges of handholes, edges of boxes, or any other surface likely to damage the outer covering, etc. during pulling operations. Branch circuits that have exterior convenience outlets, and as indicated shall be equipped with ground fault protection. Provide separate neutral conductors as required. Ground conductors shall be insulated wire unless noted otherwise on the Drawings.

A. Conductors. Conductors shall be completely installed and connected. Apply wire lubricant to ease the pulling of conductors in conduits. Splice and terminal connections shall be made tight with spring and compression connectors. The connectors shall be crimped with a tool that provides uniform and tight connections. Connectors shall be sized as outlined in paragraph on Wire Connectors in this Section. Include all the required wiring interconnections. When routing conductors and cables through pull boxes, the longest (not shortest) route from entrance to exit shall be used.

B. Connections.

1. Low Voltage Connectors. Connectors for conductors No. 8 AWG and larger shall be compression type. Connectors for conductors No. 10 AWG and smaller shall be tapered spring type.
2. Conductor and cable splices shall be located only in pull-boxes, junction boxes, handholes and manholes.

C. Wire Markers shall be provided to identify each conductor at equipment terminals, and in intermediate junction boxes, pull boxes, handholes and manholes. At motor control centers and control panels, identify each motor or other electrical device circuit conductor with the motor or device number shown on the Drawings and with the terminal number of the motor control center or control panel to which the conductor is connected. At motor and device terminals, at control stations, and in junction boxes, pull boxes, handholes and manholes, identify each motor or device circuit conductor with the terminal number of the motor control center or control panel to which the conductor is connected. In addition to identifying each conductor with the terminal number, in junction boxes, pull boxes, handholes and manholes, identify each group of conductors forming a motor or device circuit with the motor or device number shown on the Drawings. The motor or device numbers on the cable tie markers shall be 3/16 inch high minimum and shall be applied to the marker pads using marking pens for the purpose which shall be provided by the manufacturer of the cable tie markers. When a device is not numbered on the Drawings, use a short descriptive title or assign numbers and provide the Owner with a list of the devices and assigned numbers. Electrical devices include items such as solenoid valves, vibrators, horns, heaters, analyzers, computers, instruments, etc. At

panelboards, junction boxes, pull boxes, handholes and manholes, identify each panelboard circuit conductor with the panelboard number and circuit number.

D. Insulate. All connections shall be insulated as required with tight wraps of plastic tape. Apply insulation putty to fill irregularities and voids in splices

E. Furnished Equipment. Provide wiring installations as shown on the Drawings, and specified in other Sections of the Specifications for furnished equipment.

3.05 PANELBOARDS

Install and completely connect all the factory assembled panelboards as shown on the Drawings.

A. Panelboard shall be installed in motor control center as shown on the drawings.

B. Locking Devices. Attach locking devices on the handles of branch circuit breakers for the "ON" and/or "OFF" positions as shown on the Drawings.

C. Circuit Directory Card. Completely type the card to identify each connected circuit, spare and space.

D. Tight Connections. Provide tight connections for feeder and branch circuit wiring.

3.06 OVERCURRENT PROTECTION

Install all the overcurrent protective equipment as indicated, specified and required.

A. Metal Enclosures. The enclosures for individual equipment shall be constructed to satisfy the condition in the location where they shall be installed.

B. Trip Settings. Circuit breakers shall assure the required circuit protection with the indicated trip settings.

3.07 WIRING DEVICES

Install the required local switches, and convenience outlets complete, in cast iron boxes with covers, including the supports and wiring, as identified and located on the Drawings. Unless otherwise indicated, the device phenolic color shall be ivory for all receptacles and local switches. One-hole plates shall be provided on telephone outlets. All surface device outlets shall have cast iron boxes.

3.08 SUPPORTS

Install the required structural channels, brackets, stanchions, U-bolts, clamps, anchors, hangers, fittings and other hardware to securely attach and support all the equipment, materials and conduits, as indicated, specified and required. Supports shall be stainless steel 304 for all exposed conduits.

3.09 NAMEPLATES

Nameplates shall be provided as indicated to identify equipment, and the positions and circuits within the equipment. Also, individually enclosed equipment shall be provided nameplates as indicated. Plastic nameplates shall be positioned and lined-up to provide a neat appearance, and shall be attached to the cleaned metal surfaces of enclosures with stainless steel screws.

A. Plastic Nameplates. Nameplates shall be provided on, switchboards, service equipment, motor control centers, panelboards, and individually enclosed circuit breakers, disconnect switches, magnetic starters, manual starters, relays and control stations unless otherwise indicated. Provide lighting switch nameplates as indicated on the Drawings.

B. Nameplates shall be attached to the object, or adjacent to the object, with self taping screws. Adhesive materials shall not be used for attachment. Objects such as explosion proof enclosures, that would have their UL listing nullified by drilling for mounting screws shall have their nameplate mounted on an adjacent wall or plate provided by the constructor.

3.10 GROUNDING

Install all the equipment, materials and wiring to complete the equipment, structural, lightning and system grounding installations as shown on the Drawings, specified and required.

A. Ground Rods, sectional, shall be long enough and driven to reach the permanent moisture level of the soil. The resistance of any driven ground rod shall not exceed 10 ohms, and additional sections shall be installed to obtain the required lower resistance. The hand or power driving methods shall produce a force in line with the main axis of the ground rod, and the blow shall drive the rod straight to the required depth in the earth.

B. Ground clamps and Connectors shall be connected tight to ground conductors and securely attached to equipment, structural steel, conduits, metal pipes and ground rods with set screws, bolts and nuts.

C. Grounding Bushings shall be installed tight on the ends of metal conduit, and ground jumpers shall be securely attached to the bushings and equipment enclosure or ground bus.

D. Where a ground loop is installed around structures or equipment, it shall be placed, as much as possible, in undisturbed earth.

E. Exothermic Welding Connections shall be provided for buried connections and as indicated. Brazed, soldered, impact and bolted connections shall not be used for buried connections.

F. Ground Conductors shall be completely installed and connected in conduits, in trenches, in pull-boxes, and on poles as shown on the Drawings. When installing the copper conductor in a trench, allow 5 percent additional length for slack, to

the conductor length, before backfilling the trench. When routing ground conductors through pull boxes, the longest (not shortest) route from entrance to exit shall be used.

G. Ground Well shall include a precast concrete box, cover, ground rod and clamp. The ground rod shall be located in the center of the box and equipped with a ground clamp.

H. Connectors and Clamps shall be installed for conductor connections and supports as required.

I. The resistance to earth of the grounding electrode system shall be measured by an approved testing service using the three point, fall of potential method. If 10 ohm ground resistance is not achieved, the Contractor shall provide sufficient additional ground wells, ground rods, ground connections and interconnecting wiring, arranged and located in a similar manner as is shown on the Drawings, to achieve the indicated value. The modified grounding electrode system shall be tested in the same manner to verify the modification achieved the specified requirements.

3.11 CHECKING, ADJUSTING AND TESTING

Provide the required labor and equipment, and all checking, adjusting and testing operations on the electrical installations.

A. Check. All wire terminals shall be checked to assure tight connections.

B. Tests.

1. Tests shall be per Section 16960.
2. For items not included in Section 16960, tests shall be performed per NETA and IEEE standards, to detect wrong connections, short circuits, continuity and ground. Tests shall be made with a hand crank test instrument (meggar) on all motor control center busses, transformer windings, motor windings and all cables and conductors.

NOTE: WARNING. Do not make insulation tests on any conductors either signal or power, that are connected to semi-conductor type equipment. Remove the conductors from the equipment before insulation testing; severe damage may result from meggar-type instruments. Power feeders and branch conductors shall be tested phase to phase and phase to ground. Phase to ground tests on shielded cable shall mean "conductor to shield". Test voltage and application time for the various cables and conductors shall be submitted to the Owner. Correct any defects in the wiring systems.

C. Equipment Tests. Perform equipment tests as indicated and directed by the manufacturer. Refer to Section 16010 for Manufacturers' Certified Reports on service equipment and motor control centers.

D. Test Data. Test data for equipment, shielded cables and supply voltage shall be submitted to the Owner.

E. Supply Voltage. Test the supply voltage while the normal plant loads are operating. If the voltage is not within normal limits (plus or minus one percent), notify the power company and request a voltage correction.

F. Operation Tests. Perform operation tests and observe that all loads operate satisfactorily. Refer to Section 16010 for Demonstration and Final Operation Test Plans and Results.

END OF SECTION 16100

SECTION 16400

SERVICE AND DISTRIBUTION

PART 1 - GENERAL

1.01 DESCRIPTION

Requirements specified in Conditions of the Contract, Section 16010 and Section 16100 form a part of this Section. This Section outlines the electrical requirements for the service equipment consisting of the pull section and main circuit breaker section of the main switchboard. The MCC section of the main switchboard shall be covered under Section 16900.

A. Related Work Not Included In This Section.
   1. Electrical Controls, Section 16900.
   2. Earthwork, Division 2.
   3. Concrete, Division 3.
   4. Painting, Division 9.

B. Power Service. The underground power service shall be complete and as shown on the Drawings. The service installation shall conform with City of Anaheim's service requirements.

C. Distribution. The power distribution system shall include equipment installations and underground wiring installations as shown on the Drawings.

1.02 SUBMITTALS

Submit for the Owner's approval material lists, shop drawings, factory test reports and technical data to the extent required in Section 16010.

PART 2 - PRODUCTS

2.01 GENERAL

Provide all the equipment and materials, and complete all of the power service and power distribution as indicated, specified and required. Sizes of equipment shown on the Drawings and space allowed for the equipment are based on equipment manufactured by only one of the listed acceptable manufacturers. The manufacturers and models listed in this Section of the Specifications are acceptable providing they conform to the Specifications and that the equipment and materials provided fit properly in the available space. Refer to Section 16100 for conduits, conductors, circuit breakers and nameplates.

2.02 SERVICE EQUIPMENT

Provide the totally metal enclosed, dead front, service equipment as shown on the Drawings, specified and in accordance with City of Anaheim Public Utility Department requirements. The equipment shall be completely fabricated, assembled, wired, checked and tested at the factory in accordance with applicable ANSI, NEMA and UL standards. Shipment shall be made in sections to facilitate field handling and the shipped sections shall be joined together in the field to form a complete unit assembly. The service equipment shall be Cutler-Hammer "POW-R-LINE", Square D "Power Style" or equal. Service equipment shall line up with motor control center to form a single assembled unit as shown on the Drawings.

A. The service equipment shall be totally metal enclosed, dead front, totally front accessible, and shall include an underground power service pull section for terminating the power company service conductors, power service metering and main circuit breaker section, and any other required components to complete the assembly.

B. Pull Section shall be totally metal enclosed, full height, free standing and equipped with copper busses and connectors for terminating the underground service conductors and connecting to the Main Circuit Breaker Section.

C. Main Circuit Breaker Section shall be free standing, full height and shall contain power bus, supports, ground bus, fuses, metering, test equipment, terminals, wiring and main circuit breaker. The section shall be complete, and in accordance with City of Anaheim's utility service requirements. Meter sockets shall be provided for power company meters as required. Bus work shall include provisions for mounting power company current transformers and potential transformers or potential taps as required by City of Anaheim.

D. Main Circuit Breaker shall be rated as shown on the Drawings, and specified in Section 16100. Main Circuit Breaker shall be interlocked with the vertical section door such that door cannot be opened when main circuit breaker is on, and the breaker cannot be closed when the door is open. Provide defeater mechanism for use by authorized personnel.

E. Vertical Sections shall be fabricated from standard gauge formed steel with uniform surfaces, shall be 90 inches high, depth and width as indicated and required. The sections shall contain busses, supports, brackets, protective devices, metering, barriers, doors, trims, base channels, provision for lifting, hardware, terminals, wiring and connectors. Front to rear bracing shall not interfere with the conduit entrance areas.

F. Bus Bars shall be provided for power and grounding. The power bus bars shall be copper, and shall be braced to withstand mechanical forces exerted during short circuit conditions, to the rating of the main circuit breaker specified. Verify short circuit duty with the power company. The power bus bars shall be rigidly supported on insulators, and enclosed with non-metallic barriers. At the bottom of each section, provide a 1/4-inch by 2-inch copper ground bus, and splices that

connect the bus in each section for the full length of the main switchboard. The minimum continuous current rating of the power bus bars shall be as shown on the drawings.

G. Provide under-voltage relay as shown in the drawings.

H. Wiring inside the switchboard shall be provided as required. The wiring shall include terminal blocks with numbered terminals, fuse blocks and wire connectors.

I. Nameplates shall be provided on the main switchboard. Refer to Section 16100 for nameplates.

J. Finish shall be as specified in Section 16010.

PART 3 - EXECUTION

3.01 GENERAL

Provide all the equipment installations and wiring installations including connections and interconnections for the power service, distribution and grounding as indicated, specified and required. Assure proper fits for all equipment and materials in the spaces shown on the Drawings.

A. Service Equipment. Install the metal enclosed service equipment and wiring as indicated, specified and required.

1. Equipment shall be installed level and securely attached to the concrete foundation with anchor bolts. The sections shall be joined together with bolts, washers and nuts to form a unit assembly. Provide concrete housekeeping pads as shown on the drawings.
2. Wiring installations shall be complete and in accordance with City of Anaheim's utility service requirements.
3. Nameplates shall be attached to clean surfaces of the metal enclosures with stainless steel screws.

END OF SECTION 16400

SECTION 16900

ELECTRICAL CONTROLS

PART 1 - GENERAL

1.01 DESCRIPTION

Requirements specified in Conditions of the Contract, Division l, Section 16010 and Section 16100 form a part of this Section. This Section outlines the electrical work for motor controls.

A. Related Work Not Included in This Section.
   1. Induction Motors, Section 16150.
   2. Service and Distribution, Section 16400.
   3. Earthwork, Division 2.
   4. Concrete, Division 3.
   5. Painting, Division 9.

B. Instruments. Voltmeters, ammeters, meter switches and elapsed-time meters shall be provided as shown on the Drawings and as specified.

C. Controls. Controls shall be provided as indicated, specified and required.
   1. Motor Controls shall include the installations for motor control centers, and individual enclosed combination starters, control stations and other controls including complete wiring and all interconnections.
   2. Motors shall be provided with the driven equipment, and as specified in Section 16150 and equipment sections of the mechanical specifications.
   3. Individual Enclosed Equipment shall be provided as shown on the drawings. The equipment shall be metal enclosed, NEMA 12 and/or NEMA 3R gasketed as indicated.
      a. Enclosed control stations shall be provided as indicated and specified in this Section.
      b. Enclosed combination starters shall be provided as indicated and as specified in this Section.

1.02 SUBMITTALS

Submit for the Owner's approval material lists, shop drawings, factory test reports, manufacturers' certified reports and technical data to the extent required in this Section and Section 16010.

A. Shop Drawings. In addition to the information required to be included in the shop drawings as specified in Section 16010, shop drawings shall include the following:

1. Schematic and elementary wiring diagrams, for each control unit, showing numbered terminal points, numbered wires and numbered interconnections to other equipments and remote devices.
2. Connection wiring diagrams, for each control unit, showing numbered terminal points, numbered wires and numbered interconnections to other equipment and remote devices.
3. Numbering of external wiring to other equipment and remote devices may be included in the Operation and Maintenance Manuals.
4. Complete catalog information for all components.
5. A complete list of parts, with prices, that would be necessary to maintain and/or modify the equipment.

PART 2 - PRODUCTS

2.01 GENERAL

Provide all the equipment and materials and complete the control installations as shown on the Drawings, specified and required. Sizes of equipment shown on the Drawings and space allowed for the equipment are based on equipment manufactured by only one of the listed acceptable manufacturers. The manufacturers and models listed in this Section of the Specification are acceptable providing they conform to the Specifications and that the equipment and materials provided fit properly in the available space. Refer to Section 16100 for conduits, conductors, overcurrent protective devices and nameplates.

2.02 MOTORS AND CONTROLS

The motors shall be furnished and installed with the driven equipment as indicated and specified in Division 11 and Section 16150.

A. Motor Wiring shall be provided as shown on the Drawings. Include the wiring interconnections between the motors, motor starters, control panels and controls as required.

B. Control Power shall be 120 volts, single phase and 60 hertz unless otherwise indicated.

A separate control transformer shall be provided for each motor magnetic starter, contactor and grouped relays as indicated.

C. Control Stations shall be heavy duty, oil-tight and shall consist of operators, contact blocks and legend plates. Control stations shall be included in equipment as shown on the drawings. The pushbutton, selector switch, cylinder lock and pilot light operators shall include the number of units as indicated and required. Operators shall be non-illuminating and black, except the "STOP" button shall be red. Provisions shall be included for locking the "STOP" button in the depressed position, and locking the selector switch in the "OFF" position. Cylinder lock operators shall be provided as

indicated. Locks shall be keyed alike and provide two keys. Pushbutton operators shall have full guards, momentary or maintained contacts as indicated and required. Legend plates shall indicate the operator functions. Selector switch operators shall have standard knobs with manual return and the indicated positions. Indicating lights shall be transformer type, push-to-test, 60 hertz with 6 volt lamps and color caps as shown on the drawings. The control stations shall be Square D Class 9001, Type K, Cutler Hammer Type T, Allen-Bradley Bulletin 800T, General Electric Type CR2940 or equal.

D. Magnetic Contactors shall be electrically held unless otherwise indicated, 600 volt, 60 hertz, industrial duty, and connected to 120 volts AC circuit with remote control device. The Drawings shall indicate the number of poles and ampere ratings or NEMA size for the contactors and the locations, which shall be mounted inside motor control centers, panelboards or separate metal enclosures as indicated. Contactors shall be NEMA type and NEMA rated; IEC type and rated contactors are not acceptable. Enclosures shall be finished as specified in Section 16010. The silver alloy power contacts shall be load break within the rating of the contactor without assistance from additional arcing contacts. The magnetic coil shall be continuous duty, encapsulated and easily removable. The magnet shall provide rapid action on pickup or dropout and satisfactory operation without hum. The 120 volt circuit shall be provided by an individual control power transformer for each contactor. The contactors shall be Square D Class 8903, Cutler-Hammer Type C30, Allen-Bradley Bulletin 500L or equal.

E. Magnetic Starters shall consist of a magnetic contactor equipped with an ambient compensated overload relay in each phase and an external manual reset button. The overload relays shall be thermal bi-metallic types. All relays shall be of the same type. NEMA sizes for magnetic starters shall be shown on the Drawings. Motor starters shall be NEMA type and NEMA rated; IEC type and rated starters are not acceptable. The molded magnetic coil shall be connected to the 120 volt, 60 hertz control circuit and shall operate satisfactorily through a range of plus and minus 10 percent of the control circuit voltage. Each motor starter shall be equipped with minimum two normally open and two normally closed auxiliary contacts.

F. Relays shall be provided as specified in this Section and as shown on the Drawings.

G. Manual Motor Starters shall be provided for controlling and protecting single phase motors as shown on the Drawings and as required. The starters shall consist of a manually operated toggle switch equipped with proper overload relays, box and cover. The Drawings shall indicate the number of poles, the loads and the starter locations which shall determine the types of enclosure. The starters snap action shall be obtained by a spring over- center toggle. The contacts shall be opened and closed with positive force. The overload shall operate on the thermal principle. Indication of an overload condition shall be provided by the toggle operator tripping into the center of the normal "ON" and "OFF" positions. On the front of the enclosure, attach a plastic, laminated nameplate which identifies the load. The manual motor starters shall be Allen-Bradley Bulletin 600, Cutler-Hammer Type B200, Square D Class 2510 or equal.

2.03 MOTOR CONTROL CENTERS

Provide the metal enclosed motor control centers as indicated, specified and required. The enclosures shall be NEMA 12 indoors and NEMA 3R gasketed outdoors, unless otherwise noted. The motor control centers shall be completely fabricated, assembled, wired, checked and tested at the factory in compliance with applicable NEMA, ANSI and UL standards, and shall be Cutler-Hammer "Series 2100", General Electric "8000 Line," Allen-Bradley "Centerline," Square D "Model 6", or equal by Klochner Moeller. Shipment shall be made in sections to facilitate field handling, and the shipped sections shall be joined together to form a complete back-to-wall or back-to-back unit assembly as indicated. The equipment shall be finished as specified in Section 16010. The motor control center shall line up with and include the service equipment specified in Section 16400.

A. Vertical Sections shall contain adequate space for connecting the incoming power supply conductors, outgoing branch circuits, motor and control circuits to terminals, horizontal and vertical power bus bars, horizontal ground bus, circuit breakers, magnetic starters, contactors, control stations, pilot lights, timers, terminals, transformers, panelboards, relays, and manual transfer switches. The vertical sections shall be fabricated from heavy gauge steel, in compliance with UL 845, with uniform surfaces, and shall be 90 inches high, 20 inches wide and 20 inches deep as indicated and required. Holes shall be provided in the structural base of each section for anchor bolts. Sections shall contain wireways, brackets, supports, plates, trims, barriers, gaskets, doors, base channels, lifting angles and hardware. Each section shall have a maximum of six vertical control units, which can enclose Size 1 and Size 2 full voltage non-reversing combination starters. Horizontal wireways (top and bottom) shall extend through the width and depth of the section. Wireway openings shall be provided between sections with closing plates on the end sections. Each vertical section shall contain its own individual full height vertical wireway separated from the vertical bus by a metal barrier, and also separated from the individual control unit by the side pan of the control unit. Wire ties shall be furnished in the vertical wireways to group and securely hold the conductors in place. A separate cover shall be provided on the vertical wireway. Control units shall be isolated from one another by horizontal steel barriers. Front to rear bracing shall not interfere with the conduit entrance areas. Hinged doors shall be equipped with screwdriver operated quarter-turn latches that catch automatically when the door is pushed closed. Large doors shall be equipped with additional latches. The door shall be furnished with a removable control device panel. Provision shall be included to add a vertical section on the end of the line up in the future.

B. Power Supply Compartment shall be sized to accommodate the incoming power conductors. The compartment shall be located at the top or bottom of the vertical section as shown on the Drawings. The power compartment shall be covered by a hinged door and shall be held closed with quarter-turn pawl type latches.

C. Bus Bars shall be provided for the power and ground systems. Bus joints shall be connected with bolts, nuts and spring washers. The main horizontal power bus shall be located in the center or near the top of each section, joined together to form a

continuous bus for the full length of the motor control center. The horizontal power bus shall be copper and the current rating shall be as shown on the Drawings. The vertical power buses shall be copper full height and rated for the section total load. The minimum current rating for the vertical power buses shall be 300 amperes. The power bus bars shall be braced to withstand short circuit currents of 42,000 RMS symmetrical amperes at 480 volts unless otherwise indicated. The horizontal and vertical power buses shall be rigidly supported on molded insulators, and enclosed with non-metallic barriers. Small openings in the vertical barriers shall permit the plug-on control unit contacts to pass through and engage with the vertical bus bars. Unused plug-on openings in the vertical barriers shall be equipped with plastic snap-in closing plugs. In the bottom horizontal wireway, provide a 1/4 inch by 2 inch copper ground bus, and splices that connect the bus in each section for the full length of the motor control center. Each vertical section shall contain a 1/8 inch by 1 inch copper, vertical ground bus connected to the horizontal ground bus.

D. Control Units shall be plug-on type, metal enclosed, with a single door, and contain the equipment indicated and required. The plug-on contacts shall be a high quality two point connection for each phase. The contacts shall be self-aligning, copper, silver plated and backed by steel clips to provide high pressure connections. An interlock shall be provided to prevent insertion or removal of the control unit unless the circuit is in the "OFF" position. There shall be a copper ground plug-on contact, in each control unit, that engages the vertical ground bus prior to the phase plug-on contacts engaging the vertical power bus. The unit door shall be equipped with the required control stations, pilot lights, reset pushbutton, hardware and other indicated devices. An operator handle, with positive handle position indication, shall be provided on the control unit door for each circuit breaker. The handle shall have an up-down motion or equal, and the down position shall be "OFF". It shall be possible to lock the operator handle in the "OFF" position with a padlock. The handle shall be interlocked with the control unit door so that the circuit breaker cannot be placed in the "ON" position when the door is open, nor can the door be opened when the circuit breaker is in the "ON" position without by-passing the interlock by using a small screwdriver. The highest position of the circuit breaker operator handle shall not exceed 78 inches above the floor with the motor control center installed on a concrete housekeeping pad as shown on the Drawings. The control units shall accommodate the circuit breakers, magnetic starters, reset buttons, contactors, switches, transformers, control circuit fuses, control stations, relays, timers, pilot lights, wiring, terminals and nameplates as indicated. Each control unit shall be sized to accommodate the required relays and other equipment as shown on the Drawings. There shall be a provision to disconnect external 120 volts control circuits inside the control unit when the circuit breaker is opened.

E. Circuit Breakers shall be molded case, 600 volt, three pole and two pole, and shall have the ampere trip ratings as shown on the drawings, and as specified in Section 16100. The circuit breakers shall operate satisfactorily in an ambient temperature of 40 degrees centigrade. Each circuit breaker shall have a single operating handle, positive handle indication and proper wire connectors. Circuit breakers shall be equipped with lugs properly sized to terminate all required conductors as shown on the Drawings.

Circuit breakers in combination motor starters shall be instantaneous (motor circuit protector) type.

F. Provide solid-state soft start type motor starter of the size shown on the drawings. Solid-state starter shall be equipped with fast acting fuses for SCR protection, and surge protection device on the line side of solid-state starter. Starter motor protection module shall protect the motor. Provide Multilin 269 plus motor protector relay. Provide current transformers and motor trip connection as shown on the drawings. Solid-state starter shall be G.E. Astat-CD rated for continuous duty with no bypass, with the LCD mounted on the exterior face of the door, 5-feet above finished floor.

G. The pumps' electric motors shall be equipped with variable frequency drives (VFDs). The contractor shall furnish and install two (2) VFDs, each rated at 480 VAC , 60 Hz, 3 phase, variable torque type, and with amperage ratings of 30 amps or 125% of the motor full load rating, whichever is greater. The motor control center and VFDs shall be installed outdoors as shown on the drawings. The VFD shall be capable of accepting supply variation of 480 volt plus or minus 10% at 60 hertz plus or minus 3 hertz. The VFD shall be designed to operate in conjunction with a standard NEMA electric motor, as specified in subsection 6-02.01, and shall attain an efficiency of at least 95% at full load. These drives shall also have the following features:

1. AC line reactor 3 phase
2. DC choke
3. Nema 3R enclosure for mounting outdoors
4. Isolated digital relay outputs (running, fail and ready)
5. Isolated digital inputs (run, stop)
6. Isolated analog input 4-20 mA (speed control)
7. Isolated analog output 4-20 mA (speed indication)
8. Made for centrifugal pump application
9. Motor rating 1800 rpm
10. Keypad 3m extension cable

The VFDs shall be Danfoss VLT® 5000 series or Hitachi J300 series, or approved equal. Manual constant speed operation of each pump shall be possible in case of failure of its VFD. The control system shall also permit either pump to operate on hand variable speed. Spare parts sufficient to maintain the VFD shall be provided. The Contractor shall provide the required spare parts.

H. Provide two speed full voltage non-reversing motor starters as shown on the drawings.

I. Provide dry type transformer in motor control center as shown on the drawings. Transformer shall be 480 volt primary, 120/240V secondary, single phase, 3-wire, KVA rating is shown on the drawings. Transformer shall be factory mounted by MCC manufacturer. Transformer shall be equipped with two 5% full capacity taps below primary voltage. Transformer winding temperature rise shall not exceed 115^{o}C under full load condition.

J. Control Stations shall be provided as shown on the Drawings and specified in this Section.

K. Panelboards shall be provided as shown on the Drawings and specified in Section 16100.

L. Control Transformers shall be encapsulated dry-type, single phase, 60 hertz, with 120-volt secondary voltage. A separate control transformer shall be provided for grouped relays, space heaters and each starter and contactor. Control transformers shall have both primary and secondary fused protection and a grounded secondary. Transformers shall be provided as shown on the Drawings.

M. Relays shall be open type, and provided in the motor control center as shown on the Drawings and specified in this Section. The motor control center plug-in control unit shall have adequate space for the required control and time delay relays and the other indicated equipment.

N. Repeat Cycle Timers shall be open type and provided inside the motor control centers as shown on the drawings, specified and required. The timers shall be tork, A.T.C., Eagle or equal. Timer contacts shall be heavy duty, single pole, double throw, rated 20 amperes and 240 volts AC. The timing motor shall be self-starting, synchronous, 120 volts, 60 hertz and rated for a temperature range of minus 60 degrees to plus 150 degrees Fahrenheit. The dial shall be approximately 3-1/4 inches in diameter, and shall be adjustable from 2-minute (minimum) cycles to 60-minute (maximum) cycles. Terminals shall be provided for the required remote wiring.

O. Interval Timers shall be open type and provided inside the motor control centers as shown on the Drawings, specified and required. The interval timers shall be A.T.C., Eagle, Tork or equal. Timer contacts shall be heavy duty, 120 volts, AC, and 40 amperes. The timing motor shall be self- starting, synchronous, 120 volts, 60 hertz and rated for a temperature range of minus 60 degrees to plus 150 degrees Fahrenheit. The large dial shall be adjustable at any selected hour or hours. The small dial shall be adjustable from 1 to 24 hours. Terminals shall be provided for the required remote wiring.

P. Wiring shall be NEMA Class II, Type B for the motor control centers, and the control conductors shall be No. 14 AWG minimum. The wire shall be 600 volt, single conductor, 90 degrees centigrade and Type MTW. The wiring shall be provided with pull-apart terminals for power and controls inside each motor control unit. The pull-apart terminals shall be 600 volt, properly marked and shall accommodate the conductors shown on the drawings.

2.04 CONTROL RELAYS

Control relays shall be provided for the control and alarm circuits as shown on the Drawings and as required. The relays shall be electrically held, 60 hertz, continuous duty, multipole, connected to 120-volt ac control circuits and mounted inside motor control centers or separate metal enclosures as indicated. Enclosures shall be finished as specified in Section 16010. Control relays shall have convertible contacts with a continuous rating of 10 amperes at 75 percent power factor. The relay base assembly shall accept from 1 through 8 convertible poles. Magnetic coil inrush power for relays 2-8 poles shall be approximately 155 volt-amperes, and the operating time shall average 10 milliseconds. Relays shall be attached to pre-spaced mounting channels with captive screws. The

control relays shall be Cutler-Hammer Type D26, Allen-Bradley Type P, Square D Type X or equal.

PART 3 - EXECUTION

3.01 GENERAL

Provide all the control equipment installations, wiring installations and tests, including connections and interconnections for the electrical controls as indicated, specified and required. Assure proper fits for all equipment and materials in the spaces shown on the Drawings.

3.02 CONTROLS

Install the metal enclosed control equipment as indicated, specified and required.

A. Equipment shall be installed level and securely attached to the concrete foundations and walls with expansion anchors. The sections shall be joined together with bolts, nuts and washers to form a complete unit assembly. Floor standing equipment shall be installed on concrete housekeeping pads as shown on the Drawings.

B. Wiring installations shall be complete as indicated and specified in Section 16l00.

C. Relays. Provide the control and time delay relays as shown on the drawings and as required. Adjust the time delay relays so motors shall start- up in proper sequence.

D. Nameplates shall be attached to clean surfaces of the metal enclosures with stainless steel screws. Identify relays, contactors, timers, etc. with typed label, W.H. Brady or equal, in accordance with the tag numbers shown on the Drawings. Install one label on panel adjacent to the device and a second label affixed to the device. “Dymo” type labels shall not be used.

E. Grounding shall be provided as shown on the Drawings and specified in Section 16100.

F. Checking, Adjusting and Testing operations on equipment and complete installations shall be performed as specified in Sections 16100 and 16960.

3.03 MOTOR CONTROLS

Install all the wiring and control equipment as indicated, specified and required.

A. Motors. Motors shall be provided with the driven mechanical equipment.

B. Wiring. The wiring installations shall be complete. Include all the required wiring interconnections between the motor magnetic starters, and between the starters and the instrument control panels. Provide motor frame conduit connection boxes as required. Be certain that all wiring connections provide the proper motor rotation.

C. Control Stations. Provide the control stations near motors as shown on the drawings.

D. Magnetic Starters. The magnetic starters shall be provided in the motor control centers unless otherwise indicated.

3.04 PAINTING

A. Field damaged factory finishes shall be touched-up with paint that matches the original equipment finish as specified in Division 9 Section 09900.

END OF SECTION 16900

SECTION 16960

ELECTRICAL EQUIPMENT TESTING

PART 1 - GENERAL

1.01 DESCRIPTION

Requirements of Conditions of the Contract, Division 1, Section 16010 and Section 16100 form a part of this Section.

A. Work Included in This Section.
   1. Testing of electrical equipment.

B. Related Work Included in Other Divisions and Sections.
   1. Basic Electrical Materials and Methods, Section 16100.
   2. Service and Distribution, Section 16400.
   3. Electrical Controls, Section 16900.

1.02 REFERENCES

The inspections and tests shall be in accordance with the following applicable codes and standards except as provided otherwise herein.

A. National Electrical Code - NEC (NFPA 70).

B. National Electrical Manufacturer's Association - NEMA.

C. American Society for Testing and Materials - ASTM.

D. Institute of Electrical and Electronic Engineers - IEEE.

E. National Electrical Testing Association - NETA.

F. American National Standards Institute - ANSI.

G. State and Local Codes and Ordinances.

H. Insulated Cable Engineers Association - ICEA.

J. Illuminating Engineering Society - IES.

K. OSHA Part 1910; Subpart S, 1910.308.

L. National Fire Protection Association - NFPA.

M. Power Producers Interconnection Handbook - Pacific Gas and Electric Company.

1.03 SUBMITTALS

A. Prior to the Start of Work

1. Qualifications of Testing Service Company. The Owner reserves the right to disqualify any Test Service or testing personnel based upon qualification submitted.
2. Contractors Test and Report Forms.

B. Upon completion of testing provide formal Test Report to include the following:

1. Summary of project.
2. Description of equipment tested.
3. Description of test.
4. Test results.
    a. The following is a list of reports and forms that the Contractor or the Testing Service shall use in reporting the results:
        (1) Instrument Calibration Test and Data Sheet (2 sheets).
        (2) Low Voltage Circuit Breaker Test Report.
        (3) Switchboard Inspection Report.
        (4) Ground Fault System Test Report.
        (5) Watthour Meter Calibration Report.
        (6) Insulation Resistance Test Report.
        (7) DC High Potential Test Report.
        (8) Distribution Switchboard Test Report.
        (9) Switchboard Metering Test Report.
        (10) Motor Control Center Test Report.
    b. Contractor may use its standard forms in place of the forms provided if they provide essentially the same information.
        1) Submit forms for approval.
    c. Where test forms are not provided Contractor may provide its own forms.
        1) Submit forms for approval.
5. Conclusions and recommendations.
6. Appendix, including appropriate completed test forms.
7. List of test equipment used and calibration date.

1.04 QUALIFICATIONS

A. The Testing Service shall meet federal OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907.

B. Testing Services shall submit proof of the above qualifications to the Engineer.

1.05 SYSTEM DESCRIPTION

A. The Contractor shall engage the services of a recognized Testing Service for the purpose of performing inspections and tests for equipment safety and operability, and functionally verify the control system operates in accordance with the contract documents.

B. The Testing Service shall provide all material, equipment, labor and technical supervision to perform such tests and inspections.

C. The intent of these tests is to assure that all electrical equipment is operational within industry and manufacturer's tolerances and to functionally test all electromechanical systems.

D. Upon completion of the tests and inspections noted in these Specifications, a label shall be attached to all devices tested. These labels will indicate date tested and the service company responsible.

E. The tests and inspections shall determine suitability for continuous reliable operation.

F. The Contractor may submit another electrical equipment test procedure in lieu of this Section to the Owner for approval.

G. The Contractor and to facilitate the project start-up and commercial operation.

H. The inspections and tests shall utilize the following references.

1. Project design Specifications.
2. Project design Drawings.
3. Manufacturer's instruction manuals applicable to each particular apparatus.
4. Contractor generated drawing and documents.
5. Contract Drawings submitted by manufacturers and vendors.

I. All instruments used to evaluate electrical performance shall meet Specifications for Test Instruments (refer to Part 2 of this Specification).

J. Electrical performance tests shall include the following:

1. Control panels.
2. Motor control centers.
3. Distribution switchboards.
4. Low voltage circuit breakers.
5. 600 volt feeder cables.
6. Current and potential transformers.
7. Grounding systems.
8. System functions tests.
9. Generators.

K. The Contractor shall perform routine insulation resistance, continuity and rotation tests for all distribution and utilization equipment prior to and in addition to tests performed by the Testing Service specified herein.

L. The Contractor shall notify the Owner when equipment becomes available for electrical tests. Work shall be coordinated to expedite project scheduling.

M. The Contractor shall supply a set of electrical plans, specifications and any pertinent change orders to the Testing Service prior to commencement of testing.

N. The Contractor shall notify the Owner prior to commencement of any testing.

O. The Testing Service shall be responsible for implementing the final settings and adjustments on protective devices and electrical equipment in accordance with approved values. Refer to Section 16100 for coordination study requirements.

P. Set points shall be noted on all calibration stickers.

Q. Any system material or workmanship which is found defective on the basis of electrical tests shall be replaced and retested at no additional cost to the Owner.

R. The Testing Service shall maintain a written record of all tests and upon completion of the project, assemble and certify a final test report.

PART 2 - PRODUCTS

2.01 TEST INSTRUMENT TRACEABILITY

A. The Testing Service shall have a calibration program which maintains applicable test instrumentation within rated accuracy.

B. The accuracy shall be traceable to the National Institute for Standards and Technology in an unbroken chain.

C. Instruments shall be calibrated in accordance with the following frequency schedule:

1. Field instruments - 6 months maximum.
2. Laboratory instruments - 12 months.
3. Leased specialty equipment - 12 months. (Where accuracy is guaranteed in writing by the lessor.)

D. Dated calibration labels shall be visible on all test equipment.

E. Records must be kept up to date which show date and results of all instruments calibrated or tested.

F. An up-to-date instrument calibration instruction and procedure will be maintained for each test instrument.

PART 3 - EXECUTION

3.01 SAFETY AND PRECAUTIONS

A. Safety practices shall include, but are not limited to, the following requirements:

1. Occupational Safety and Health Act of 1970-OSHA.
2. Accident Prevention Manual for Industrial Operations, Seventh Edition, National Safety Council, Chapter 4.
3. Applicable State and local safety operating procedures.
4. NETA Safety/Accident Prevention Program.
5. National Fire Protection Association - NFPA 70 (NEC).
6. National Fire Protection Association - National Electrical Safety Code.

B. All tests shall be performed with apparatus de-energized except where otherwise specifically required herein.

C. The Testing Service's lead test engineer for the project shall be a designated safety representative and shall be present on the project and supervise testing operations and safety requirements.

D. Power circuits shall have conductors shorted to ground by a hotline grounding device approved for the purpose.

E. In all cases, work shall proceed only when the safety representative has determined that it is safe to do so.

F. The Testing Service shall have available sufficient protective barriers and warning signs to conduct specified tests safely, and shall post safety personnel as necessary while dangerous tests are being performed.

G. The Owner's safety procedures shall be reviewed and understood by the Contractors and Testing Service personnel.

3.02 SPECIAL REQUIREMENTS

Testing of the equipment associated with the interconnection to the local utility is required to be tested in strict accordance with the methods and procedures of the "Power Producers Interconnection Handbook."

A. Where the methods or procedures required under this Section are in conflict with the "Power Producers Interconnection Handbook" the requirements of the "Power Producers Interconnection Handbook" shall govern.

B. The Testing Service is responsible for:

1. Obtaining the latest edition of the "Power Producers Interconnection Handbook."
2. Coordinating with the local utility in the performance of the required tests.

3.03 TEST PROCEDURES

A. Metering and Instrumentation

1. Visual and Mechanical Inspection

a. Examine all devices for broken parts, indication of shipping damage and wire connection tightness.

b. Verify meter connections in accordance with single line meter and relay diagram.

2. Electrical Tests

a. Calibrate all meters at mid-scale. Calibration instruments shall have precision no more than fifty percent (50%) of the instrument being tested.

b. Calibrate watt-hour meters to one-half percent (1/2%).

c. Verify all instrument multipliers.

B. Main Switchboards

1. Visual and Mechanical Inspection

a. Inspect for physical damage, proper anchorage and grounding.

b. Compare equipment nameplate data with design plans or starter schedule.

c. Check tightness of bolted connections.

2. Electrical Tests

a. Insulation Tests. Measure insulation resistance of each bus section phase to phase and phase to ground for one (1) minute. Test voltage and minimum acceptable values in accordance with Table 16960.2.

3. Test Values

a. Bolt torque levels shall be in accordance with Table 16960.1 unless otherwise specified by manufacturer.

b. Insulation resistance test to be performed in accordance with Table 16960.2.

C. Circuit Breakers - Low Voltage

1. Visual and Mechanical Inspection

a. Inspect for physical damage and nameplate compliance with single line diagram.

b. Mechanical operational tests shall be made in accordance with manufacturer s instruction manual.

c. Cell fit and element alignment shall be checked.

d. Check tightness of connections.

2. Electrical Tests

   a. A contact resistance test shall be performed.

   b. An insulation resistance test shall be performed at 1,000 volts DC for one (1) minute from pole to pole and from each pole to ground and across open contacts of each phase.

   c. Minimum pickup current shall be determined by primary current injection.

   d. Long time delay shall be determined by primary injection at three hundred percent (300X) pickup current.

   e. Short time pickup and time delay shall be determined by primary injection of current.

   f. Instantaneous pickup current shall be determined by primary injection.

   g. Trip unit reset characteristics shall be verified.

   h. Adjustments shall be made for final settings in accordance with prescribed settings.

   i. Auxiliary protective devices, such as ground fault or under-voltage shunt trip devices.

3. Test Values

   a. Contact resistance shall be determined in micro-ohms. values exceeding two hundred (200) micro-ohms or any values which deviate from adjacent poles or similar breakers by more than fifty percent (50%) should be investigated.

   b. Insulation resistance shall not be less than fifty (50) megohms.

   c. Minimum pickup current, trip times and instantaneous pickup values shall be adjusted to approved settings. Test values should fall within manufacturer's published time-current characteristic tolerance band.

D. Cables - Low Voltage (600 Volt Feeders)

1. Visual and Mechanical Inspections

   a. Inspect exposed section for physical damage.

   b. Verify cable is supplied and connected in accordance with single line diagram.

   c. Inspect for cable support and termination.

   d. Visible cable bends shall be checked against ICEA or manufacturer's minimum allowable bending radius.

2. Electrical Tests

   a. Dielectric absorption ("megger") test.

      (1) Tests shall be phase-to-phase and phase-to-ground.

      (2) Test for 5 minutes at voltage given in Table 16960.2.

3. Test Values

a. Dielectric absorption test results.

(1) Minimum acceptable values of insulation resistance shall be as recommended by the cable manufacturer.

(2) Test should show no evidence of cable damage.

E. Instrument Transformers

1. Visual and Mechanical Inspection

a. Inspect for physical damage and compliance with design drawings.

b. Check mechanical clearances and proper operations of all disconnecting and grounding devices associated with potential transformers.

c. Verify proper operation of grounding or shorting devices.

2. Electrical Tests

a. Confirm transformer polarity electrically.

b. Verify connection at secondary CT leads by driving a low current through the leads and checking for this current at applicable devices.

c. Confirm transformer ratio.

d. Measure insulation resistance of transformer secondary and leads with five hundred (500) volt megohm meter.

e. Measure transformer primary insulation with applicable overpotential tests.

f. Verify connection of secondary PT leads by applying a low voltage to the leads and checking for this voltage at applicable devices.

g. Check for PT secondary load with secondary voltage and current measurements. Make sure load is less than VA of PT.

F. Grounding Systems

1. Visual and Mechanical Inspection. Inspect ground system for compliance with plans and specifications.

2. Electrical Tests

a. Perform fall of potential test per IEEE Standard No. 81, Section 9.04 on the main grounding electrode or system.

b. Perform the two (2) point method test per IEEE No. 8, Section 9.03 to determine the ground resistance between the main grounding system and all major electrical equipment frames, system neutral and/or derived neutral points.

3. Test Values. The main ground electrode system resistance to ground should be ten (10) ohms or less unless otherwise specified.

G. Generators

1. The following tests shall be done in the presence of the Owner, and the generator manufacturer's representative.
    a. Phase rotation to be the same as the utility.
    b. Phase relation to be the same as the utility.
    c. Polarity.
    d. Equality of voltage before connecting to the utility.
2. The tests shall be performed by the Testing Service with the appropriate test devices including a phase rotation meter.
3. Scheduling of these tests and notifying the parties to attend is the responsibility of the Contractor.
4. The tests shall be done in accordance with IEEE Std. 115.

H. Motor Control Centers

1. Visual and Mechanical Inspection
    a. Inspect for physical damage, proper anchorage and grounding.
    b. Compare equipment nameplate data with design plans or starter schedule.
    c. Compare overload heaters with motor full load current for proper size. Adjust size for service factor, temperature differences and time delay in accordance with the NEC Article 430 C and with the starter manufacturer's recommendations.
    d. Check tightness of bolted connections.
2. Electrical Tests
    a. Insulation Tests
        (1) Measure insulation resistance of each bus section phase to phase and phase to ground for one (1) minute. Test voltage and minimum acceptable values in accordance with Table 16960.2.
        (2) Measure insulation resistance of each starter section phase to phase and phase to ground with the starter contacts closed and the protective device open. Test voltage and minimum acceptable values in accordance with Table 16960.2.
        (3) Measure insulation resistance of each control circuit with respect to ground.
        (4) Motor overload units shall be tested by injecting primary current through overload unit and monitoring trip time.
    b. Perform operational tests by initiating control devices to affect proper operation.
    c. Check and verify callibration of motor winding RTDs, and vibration switch.
    d. Check and verify the operation of the motor protective relay (MPR).

3. Test Values

   a. Bolt torque levels shall be in accordance with Table 16960.1 unless otherwise specified by manufacturer.

   b. Insulation resistance test to be performed in accordance with Table 16960.2.

   c. Control wiring insulation test voltage shall be 500V DC. Manufacturer shall be consulted for test voltage where solid state control devices are utilized.

   d. Overload tests shall be made at three hundred percent (300%) of motor full load current. Trip times shall be in accordance with manufacturer's tolerances. Values in excess of one hundred twenty (120) seconds shall be investigated.

3.04 TABLES

TABLE 16960.1

US Standard

BOLT TORQUE'S FOR BUS CONNECTIONS

Heat Treated Steel

Grade	SAE 1 & 2	SAE 5	SAE 6	SAE 8
Minimum Tensile (PSI)	64K	105K	133K	150K
Bolt Diameter	Torque (Foot Pounds)			
¼	5	7	10	10.5
5/16	9	14	19	22
3/8	15	25	34	37
7/16	24	40	55	60
½	37	60	85	92
9/16	53	88	120	132
5/8	74	120	167	180
¾	120	200	280	296
7/8	190	302	440	473
1.0	282	466	660	714

Note: Reduce torque by 20% when Cadmium plated bolts are used.

Silicon Bronze Fasteners*

Bolt Diameter	Torque (Foot Pounds)	
	Non-Lubricated	Lubricated
5/16	15	10
3/8	20	14
1/2	40	25
5/8	55	40
3/4	70	60

Aluminum Alloy Fasteners**

Bolt Diameter	Torque (Foot Pounds) Lubricated
5/16	8.0
3/8	11.2
1/2	20.0
5/8	32.0
3/4	48.0

* Bronze alloy bolts shall have a minim tensile strength of 70,000 pounds square inch.

**Aluminum alloy bolts shall have a Minimum tensile strength of 55,000 pounds per square inch.

Grade	SAE 1 & 2	SAE 5	SAE 6	SAE 8
Minimum Tensile (PSI)	64K	105K	133K	150K
Bolt Diameter	Torque (Foot Pounds)			

Bolt Diameter	Torque (Foot Pounds)	
	Non-Lubricated	Lubricated

TABLE 16960.2

INSULATION RESISTANCE TEST VOLTAGE

Maximum Voltage Rating of Equipment	Minimum Test Voltage, DC	Minimum Insulation Resistance in Megohms
250	500	25
600	1,000	100
5,000	2,500	1,000
8,000	2,500	2,000
15,000	2,500	5,000

Values of insulation resistance less than manufacturer's minimum or kV + 1 in megohms should be investigated. Overpotential tests should not proceed until insulation resistance levels are raised to said minimum.

TABLE 16960.3

AC/DC OVERPOTENTIAL TEST VOLTAGES

Rated kV	AC Test Voltage (kV)	DC Test Voltage (kV)
15	27.0	37.5
69	115.0	Consult Manufacturer

TABLE 16960.4

INSULATION RESISTANCE CONVERSION FACTORS FOR CONVERSION OF TEST TEMPERATURE TO 20°C

TEMPERATURE		TRANSFORMER	
°C	°F	OIL	DRY
0	32	.25	.40
5	41	.36	.45
10	50	.50	.50
15	59	.75	.75
20	68	1.00	1.00
25	77	1.40	1.30
30	86	1.98	1.60
35	95	2.80	2.05
40	104	3.95	2.50
45	113	5.60	3.25
50	122	7.85	4.00
55	131	11.20	5.20
60	140	15.85	6.40
65	149	22.40	8.70
70	158	31.75	10.00
75	167	44.70	13.00
80	176	63.50	16.00

TABLE 16960.5

HIGH VOLTAGE TEST
FOR RUBBER - THERMOPLASTIC - XLPE - EPR INSULATIONS

Rated circuit Phase to Phase, Volts	Conductor Size AWG or KCMIL	Test Voltage, kV	
		100 Percent Insulation Level	133 Percent Insulation Level
2,001-5,000	8-1,000	25	25
5,001-8,000	6-1,000	35	35
8,001-15,000	2-1,000	55	65

TEST MAXIMUM DC VOLTAGE REFERENCES

Cable Type	Standard	
Rubber	ICEA S-19-81	Table 6-17
Varnish Cambric	ICEA S-65-375	Table 3-4*
Thermoplastic	ICEA S-61-402	Table 6-10
Cross Linked Polyethylene	ICEA S-66-524	Table 6-9
Ethylene Propylene (EPR)	ICEA S-68-516	Table 6-9
Armored Cable	ICEA S-67-401	80% of factory

* For DC tests multiply table values by 2.

** Consult manufacturer.

END OF SECTION 16960

CITY OF ANAHEIM

APPENDIX F

CIVIL WORK SPECIFICATION

CIVIL WORK SPECIFICATION

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APPENDIX F

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07920 Joint Sealants

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09900 Painting and Protective Coatings

SECTION 02200

EARTHWORK

PART 1 - GENERAL

1.01 QUALITY ASSURANCE

A. Referenced Standards:

1. American Society for Testing and Materials (ASTM):
    a. C33, Standard Specification for Concrete Aggregates.
    b. D1557, Tests for Moisture Density Relations of Soils and Soil Aggregate Mixtures Using a 10 LB Rammer and a 18 IN Drop.
    c. D2487, Classification of Soils for Engineering Purposes.
    d. D4253, Test Methods for Maximum Index Density of Soils Using a Vibratory Table.
    e. D4254, Test Methods for Minimum Index Density of Soils and Calculation of Relative Density.

1.02 SUBMITTALS

A. Shop Drawings:

1. Product technical data including:
    a. Acknowledgment that products submitted meet requirements of standards referenced.
2. Certifications.
3. Test reports:
    a. Soils inspection and testing results.

B. Samples:

1. Submit samples and source of fill and backfill materials proposed for use.
2. Submit samples and source of borrow materials proposed for use.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Fill and Backfill: Selected material approved by Soils Engineer from site excavation or from off site borrow.

B. Granular Fill Under Building Slabs: Select material approved by Soils Engineer.

C. Granular Fill Under outdoor Slab-On-Grade: Clean, crushed, nonporous rock, crushed or uncrushed gravel complying with ASTM C33 gradation size No.67, 3/4-inch to No.4.

PART 3 - EXECUTION

3.01 PROTECTION

A. Protect existing surface and subsurface features on-site and adjacent to site as follows:

1. Provide barricades, coverings, or other types of protection necessary to prevent damage to existing items indicated to remain in place.
2. Protect and maintain bench marks, monuments or other established reference points and property corners. If disturbed or destroyed, replace at own expense to full satisfaction of Owner and controlling agency.
3. Verify location of utilities. Omission or inclusion of utility items does not constitute non-existence or definite location. Secure and examine local utility records for location data.
    a. Take necessary precautions to protect existing utilities from damage due to any construction activity.
    b. Repair damages to utility items at own expense.
    c. In case of damage, notify Engineer at once so required protective measures may be taken.
4. Maintain free of damage, existing sidewalks, structures, and pavement, not indicated to be removed. Any item known or unknown or not properly located that is inadvertently damaged shall be repaired to original condition. All repairs to be made and paid for by Contractor.
5. Provide full access to public and private premises, fire hydrants, street crossings, sidewalks and other points as designated by Owner to prevent serious interruption of travel.
6. Maintain stockpiles and excavations in such a manner to prevent inconvenience or damage to structures on-site or on adjoining property.
7. Avoid surcharge or excavation procedures which can result in heaving, caving, or slides.

B. Salvageable Items: Carefully remove items to be salvaged, and store on Owner's premises unless otherwise directed.

C. Dispose of waste materials, legally, off site. Burning, as a means of waste disposal, is not permitted.

D. During all earthmoving operations the Contractor shall be in compliance with applicable sections of the South Coast Air Quality Management District Rule 403, Fugitive Dust.

3.02 SITE EXCAVATION AND GRADING

A. The work includes all operations in connection with excavation, borrow, construction of fills, rough grading, and disposal of excess materials in connection with the preparation of the site(s) for construction of the proposed facilities.

B. Excavation and Grading: Perform as required by the Contract Drawings.

1. Contract Drawings may indicate both existing grade and finished grade required for construction of Project. Stake all slabs-on-grade, driveways, piping, parking areas and sidewalks and establish their elevations. Perform other layout work required. Record, protect, restore, and file record surveys on all property corners, per the WSSS.

2. Preparation of ground surface for fills: Before fill is started, scarify to a minimum depth of 6 inches in all proposed embankment and fill areas.

3. Protection of finish grade: During construction, shape and drain excavations. Maintain ditches and drains to provide drainage at all times. Protect graded areas against action of elements prior to acceptance of work. Reestablish grade where settlement or erosion occurs.

C. Construct fills as required by the Contract Drawings:

1. Construct fills at locations and to lines of grade indicated. Completed fill shall correspond to shape of typical cross section indicated regardless of method used to show shape, size, and extent of line and grade of completed work.

2. Provide approved fill material which is free from roots, organic matter, trash, frozen material, and stones having maximum dimension greater than 6 IN. Ensure that stones larger than 4 IN are not placed in upper 6 IN of fill or embankment. Do not place material in layers greater than 8 IN loose thickness. Place layers horizontally and compact each layer prior to placing additional fill.

3. Compact by sheepsfoot, pneumatic rollers, vibrators, or by other equipment as required to obtain specified density. Control moisture for each layer necessary to meet requirements of compaction.

3.03 FIELD QUALITY CONTROL

A. Moisture density relations, to be established by the Soils Engineer required for all materials to be compacted.

B. Extent of compaction testing will be as necessary to assure compliance with Specifications.

C. Give minimum of 24 HR advance notice to Soils Engineer when ready for compaction or subgrade testing and inspection.

D. Should any compaction density test or subgrade inspection fail to meet Specification requirements, perform corrective work as necessary.

E. Pay for all costs associated with corrective work and retesting resulting from failing **compaction density tests.**

3.04 COMPACTION DENSITY REQUIREMENTS

A. Obtain approval from Soils Engineer with regard to suitability of soils and acceptable subgrade prior to subsequent operations.

B. Remove loose, wet, or soft material and replace with approved material as directed by Soils Engineer.

C. Stabilize subgrade with well graded granular materials as directed by Soils Engineer.

D. Assure by results of testing that compaction densities comply with the following requirements:

	SITEWORK	COMPACTION DENSITY
1.	Under Paved Areas, Sidewalks and Piping:	95 percent, ASTM D1557
	Unpaved Areas	90 percent, ASTM D1557
2.	STRUCTURES	
	Under structure footings and foundations, under equipment support pads, under slabs-on-grade	95 percent, ASTM D1557
	Outside structures and pipe trench backfill	90 percent, ASTM D1557

3.05 EXCAVATION, FILLING, AND BACKFILLING FOR STRUCTURES

A. General:

1. In general, work includes, but is not necessarily limited to, excavation for walls, removal of underground obstructions and undesirable material, backfilling, filling, and fill, backfill, and subgrade compaction.

2. Obtain fill and backfill material necessary to produce grades required. Materials and source to be approved by Engineer. Excavated material approved by Engineer may also be used for fill and backfill.

3. In this Section of the Specifications, the word "foundations" includes footings, base slabs, foundation walls, mat foundations, grade beams and any other support placed directly on soil.

4. In the paragraphs of this Section of the Specifications, the word "soil" also includes any type of rock subgrade that may be present at or below existing subgrade levels.

B. Excavation Requirements for Structures:

1. General. Do not commence excavation for foundations for structures until:

a. Engineer approves:

1) The removal of topsoil and other unsuitable and undesirable material from existing subgrade.

2) Density and moisture content of site area compacted fill material meets requirements of specifications.

3) Site surcharge or mass fill material can be removed from entire construction site or portion thereof.

4) Surcharge or mass fill material has been removed from construction area or portions thereof.

b. Engineer grants approval to begin excavations.

2. Dimensions:

a. Excavate to elevations and dimensions indicated on plans or as directed by geotechnical engineer.

b. Allow additional space as required for construction operations and inspection of foundations.

3. Removal of obstructions and undesirable materials in excavation includes, but is not necessarily limited to, removal of old foundations, existing construction, unsuitable subgrade soils, expansive type soils, and any other materials which may be concealed beneath present grade, as required to execute work indicated on Contract Drawings. If undesirable material and obstructions are encountered during excavation, remove material and replace as directed by Engineer.

4. Level off bottoms of excavations to receive foundations, floor slabs, equipment support pads, or compacted fill. Remove loose materials and bring excavations into approved condition to receive concrete or fill material. Where compacted fill material must be placed to bring subgrade elevation up to underside of construction, scarify existing subgrade upon which fill material is to be placed to a depth of 6 IN

and then compact to density stated in this Section of Specifications before fill material can be placed thereon. Do not carry excavations lower than shown for foundations except as directed by Engineer. If any part of excavations is carried below required depth without authorization, maintain excavation and start foundation from excavated level with concrete of same strength as required for superimposed foundation, and no extra compensation will be made to Contractor.

5. Make excavations large enough for working space, forms and inspection.

6. Notify Engineer as soon as excavation is completed in order that subgrades may be inspected. Do not commence further construction until subgrade under compacted fill material, under foundations, under slabs-on-grade, under equipment support pads, and under wall footings has been inspected and approved by the Engineer as being free of undesirable material, being of compaction density required by this specification, and being capable of supporting the allowable foundation design bearing pressures and superimposed foundation and fill loads to be placed thereon. Engineer shall be given the opportunity to inspect subgrade below fill material both prior to and after subgrade compaction.

    a. Place fill material, foundations, wall footings, floor slabs-on-grade, and equipment support pads as soon as weather conditions permit after excavation is completed, inspected, and approved and after forms and reinforcing are inspected and approved. Before concrete or fill material is placed, protect approved subgrade from becoming loose, wet or soft due to weather, construction operations, or other reasons.

7. Subgrade stabilization: If subgrade under foundations, fill material, floor slabs-on-grade, or equipment support pads is in a loose, wet, or soft condition before construction is placed thereon, remove loose, wet, or soft material and replace with approved compacted material as directed by Engineer. Provide compaction density of replacement material as stated in this specification section. Loose, wet, or soft materials, when approved by Engineer, may be stabilized by a compacted working mat of well graded crushed stone. Compact stone mat thoroughly into subgrade to avoid future migration of fines into the stone voids. Method of stabilization shall be performed as directed by Engineer. Do not place further construction on the repaired subgrades, until the subgrades have been approved by the Engineer.

8. Do not place floor slabs-on-grade including equipment support pads until subgrade below has been approved, piping has been tested and

approved, reinforcement placement has been approved, and Contractor receives approval to commence slab construction. Do not place building floor slabs-on-grade including equipment support pads when temperature of air surrounding the slab and pads is or is expected to be below 40 DegF before structure is completed and heated to a temperature of at least 50 DegF.

9. Protection of structures: Prevent new and existing structures from becoming damaged due to construction operations or other reasons. Prevent subgrade under new and existing foundations from becoming wet and undermined during construction due to presence of surface or subsurface water or due to construction operations.

10. Drainage: Control grading around structures so that ground is pitched to prevent water from running into excavated areas or damaging structures. Maintain excavations where foundations, floor slabs, equipment support pads or fill material are to be placed free of water. Provide pumping required to keep excavated spaces clear of water during construction. Should any water be encountered in the excavation, notify Engineer. Provide free discharge of water by trenches, pumps, wells, well points, or other means as necessary and drain to point of disposal that will not damage existing or new construction or interfere with construction operations.

C. Fill and Backfill Below Foundations, Base Slabs, Floor Slabs, Equipment Support Pads and Piping:

1. General: Subgrade to receive fill or backfill shall be free of undesirable material as determined by Engineer and scarified to a depth of 6 IN and compacted to density specified herein. Surface may be stepped by at not more than 12 IN per step or may be sloped at not more than 2 percent. Do not place any fill or backfill material until subgrade under fill or backfill has been inspected and approved by Engineer as being free of undesirable material and compacted to specified density.

2. Obtain approval of fill and backfill material and source from Engineer prior to placing the material.

3. Granular fill under floor slabs-on-grade: Place all floor slabs-on-grade on a minimum of 6 IN of granular fill unless otherwise indicated.

4. Fill and backfill placement: Prior to placing fill and backfill material, optimum moisture and maximum density properties for proposed material shall be obtained from Soils Engineer. Place fill and backfill material in thin lifts as necessary to obtain required compaction density. Compact material by means of equipment of sufficient size and proper type to obtain specified density. Use hand operated equipment for filling and backfilling next to walls. Do not place fill

and backfill when the temperature is less than 40 DegF and when subgrade to receive fill and backfill material is wet, loose, or soft. Use vibratory equipment to compact granular material; do not use water.

5. Where fill material is required below foundations, place fill material, conforming to the required density and moisture content, outside the exterior limits of foundations located around perimeter of structure the following horizontal distance whichever is greater:
   a. As required to provide fill material to indicated finished grade.
   b. 5 FT.
   c. Distance equal to depth of compacted fill below bottom of foundations.
   d. As directed by Engineer.

D. Filling and Backfilling Outside of Structures. This paragraph of these specifications apply to fill and backfill placed outside of structures above bottom level of both foundations and piping but not under paving. Provide material as approved by Engineer for filling and backfilling outside of structures.

1. Fill and backfill placement: Prior to placing fill and backfill material, obtain optimum moisture and maximum density properties for proposed material from Engineer. Place fill and backfill material in thin lifts as necessary to obtain required compaction density. Compact material with equipment of proper type and size to obtain density specified. Use only hand operated equipment for filling and backfilling next to walls and retaining walls. Do not place fill or backfill material when temperature is less than 40 DegF and when subgrade to receive material is wet, loose, or soft. Use vibratory equipment for compacting granular material; do not use water.

E. Backfilling Outside of Structures Under Piping or Paving: When backfilling outside of structures requires placing backfill material under piping or paving, the material shall be placed from bottom of excavation to underside of piping or paving at the density required for fill under piping or paving as indicated in this Section. This compacted material shall extend transversely to the centerline of piping or paving a horizontal distance each side of the exterior edges of piping or paving equal to the depth of backfill measured from bottom of excavation to underside of piping-or paving. Provide special compacted bedding or compacted subgrade material under piping or paving as required by other sections of these Specifications.

3.08 SPECIAL REQUIREMENTS

A. Erosion Control: Conduct work to minimize erosion of site. Construct stilling areas to settle and detain eroded material. Remove eroded material washed off site. Clean streets daily of any spillage of dirt, rocks or debris from equipment entering or leaving site.

END OF SECTION 02200

SECTION 02221

TRENCHING, BACKFILLING, AND COMPACTING FOR UTILITIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Excavation, trenching, backfilling and compacting for all underground utilities.
2. All related utility and process appurtenances.

B. Related Sections include but are not necessarily limited to:

1. Section 02200 - Earthwork.

1.02 QUALITY ASSURANCE

A. Referenced Standards:

1. American Association of State Highway & Transportation Officials (AASHTO):
   a. T99, The Moisture-Density Relations of Soils Using a 5.5 LB Rammer and a 12-inch Drop.
   b. T180, Moisture-Density Relations of Soils Using a 10 LB Rammer and an 18-inch Drop.
2. American Society for Testing and Materials (ASTM):
   a. C33, Concrete Aggregates.
   b. D1557, The Moisture-Density Relation of Soils Using a 10 LB Rammer and an 18-inch Drop. D1557 is "Modified Proctor."
   c. D2487, Classification of Soils for Engineering Purposes.
   d. D4253, Maximum Index Density of Soils Using a Vibratory Table.
   e. D4254, Minimum Index Density of Soils and Calculation of Relative Density.

1.03 DEFINITIONS

A. Excavation:

1. All excavation will be defined as unclassified.

1.04 SUBMITTALS

A. Submit test reports and fully document each with specific location or stationing information, date, and other pertinent information.

B. Submit respective pipe or conduit manufacturer's data regarding methods of installation and general recommendations.

C. Submit sieve analysis reports on all granular materials.

1.05 SITE CONDITIONS

A. Avoid overloading or surcharge a sufficient distance back from edge of excavation to prevent slides or caving. Maintain and trim excavated materials in such manner to be as little inconvenience as possible to public and adjoining property owners.

B. Provide full access to public and private premises and fire hydrants, at street crossings, sidewalks and other points as designated by Owner to prevent serious interruption of travel.

C. Protect and maintain bench marks, monuments or other established points and reference points and if disturbed or destroyed, replace items to full satisfaction of Owner and controlling agency.

D. Verify location of existing underground utilities.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Backfill Material:

1. As approved by Engineer.

a Free of rock cobbles, roots, sod or other organic matter.

b. Moisture content at time of placement: 3 percent plus/minus of optimum moisture content as specified in accordance with ASTM D1557.

c. Free drainage material having a sand equivalent (SE) of not less than 30 all buried valves and fittings are to be backfilled with clean sand. The sand shall be installed in such a manner that after compaction, no earth or other backfill will be less than 6-inches from any part of the valve, fitting, flanges, bolts, or nuts.

B. Embedment Materials:

1. As approved by the Soils Engineer.
2. Granular bedding materials:

ASTM C33, gradation 67 (3/4-inch to No.4 sieve) defined below:

Sieve Size	1 IN	3/4 IN	3/8 IN	No.4	No.20
Percent Passing by Weight	100	90-100	20-55	0-10	0

1) Well-graded crushed stone.
2) Well graded crushed gravel.
3) Well graded gravel.

PART 3 - EXECUTION

3.01 GENERAL

A. Remove and dispose of unsuitable materials as directed by Soils Engineer to site provided by Contractor.

3.02 EXCAVATION

A. Unclassified Excavation:
   1. Remove rock excavation, clay, silt, gravel, hard pan, loose shale, and loose stone as directed by Soils Engineer.

B. Excavation for Appurtenances:
   1. 12 inches (minimum) clear distance between outer surface and embankment.
   2. See Section 02200 for applicable requirements.

C. Trench Excavation:
   1. Excavate trenches by open cut method to depth shown on Drawings and necessary to accommodate work.
   2. Open trench outside buildings, units, and structures:
      a. No more than the 600 LF. For street work, maximum length of open trench shall be 500 feet or the distance of pipe installed in one day, whichever is greater.
      b. Field adjust limitations as weather conditions dictate.
   3. Trenching within buildings, units, or structures:
      a. No more than 100 LF at any one time.
   4. Any trench or portion of trench, which is opened and remains idle for seven calendar days, or longer, as determined by the Owner, may be directed to be immediately refilled, without completion of work, at no additional cost to Owner. Said trench may not be reopened until Owner is satisfied that work associated with trench will be prosecuted with dispatch.
   5. Observe following trenching criteria:

a. Trench size.
    1) Excavate width to accommodate free working space.
    2) Maximum width of the trench at the bottom of the excavation shall not exceed 10-inches on either side of the pipe.
    3) Cut trench walls vertically from bottom of trench to 1 FT above top of pipe, conduit, or utility service.
    4) Keep trenches free of water. Include cost of dewatering in original proposal.

D. Trenching for Electrical Installations:
    1. Observe paragraph 3.02 C "Trench Excavation"
    2. Modify for electrical installations as follows:
        a. Open no more than 600 LF of trench in exterior locations for trenches more than 12 IN but not more than 30 IN wide.
        b. Any length of trench may be opened in exterior locations for trenches which are 12 IN wide or less.
        c. Do not over excavate trench.
        d. Cut trenches for electrical runs with minimum 30 IN cover, unless otherwise specified.
        e. See Division 16 for additional requirements.

3.03 PREPARATION OF FOUNDATION FOR PIPE LAYING

A. Over-Excavation:
    1. Backfill and compact to 95 percent of maximum dry density per ASTM D698.
    2. Backfill with granular bedding material as option.

B. Rock Excavation:
    1. Excavate minimum of 6 inches below bottom exterior surface of the pipe or conduit.
    2. Backfill to grade with suitable earth or granular material.
    3. Form bell holes in trench bottom.

C. Subgrade Stabilization:
    1. Stabilize the subgrade when directed by the Owner.
    2. Observe the following requirements when unstable trench bottom materials are encountered.
        a. Notify Owner when unstable materials are-encountered.
            1) Define by drawing station locations and limits.
        b. Remove unstable trench bottom caused by Contractor failure to dewater, rainfall, or Contractor operations.

1) Replace with subgrade stabilization with no additional compensation.

3.04 BACKFILLING METHODS

A. Do not backfill until tests to be performed on system show system is in full compliance to specified requirements.

B. Carefully Compacted Backfill:

1. Furnish where indicated on drawings, specified for trench embedment conditions and for compacted backfill conditions up to 12 IN above top of pipe or conduit.
2. Comply with the following:
   a. Place backfill in lifts not exceeding 8 IN (loose thickness).
   b. Hand place, shovel slice, and pneumatically tamp all carefully compacted backfill.
   c. Observe specific manufacturer's recommendations regarding backfilling and compaction.
   d. Compact each lift to specified requirements.

C. Common Trench Backfill:

1. Perform in accordance with the following:
   a. Place backfill in lift thicknesses capable of being compacted to densities specified.
   b. Observe specific manufacturer's recommendations regarding backfilling and compaction.
   c. Avoid displacing joints and appurtenances or causing any horizontal or vertical misalignment, separation, or distortion.

D. Water flushing for consolidation is not permitted.

E. Backfilling for Electrical Installations:

1. Observe paragraph 3.04 C or D "Backfilling Methods."
2. Modify for electrical installation as follows:
   a. Observe notes and details on electrical drawings for fill in immediate vicinity of direct burial cables.

3.05 COMPACTION

A. General:

1. Place and assure backfill and fill materials to achieve an equal or "higher" degree of compaction than undisturbed materials adjacent to the work.
2. In no case shall degree of compaction below "Minimum Compaction" specified be accepted.

B. Compaction Requirements: Unless noted otherwise on Drawings or more stringently by other sections of these Specifications, comply with following trench compaction criteria:

1. Carefully compacted backfill:

MINIMUM COMPACTIONS

LOCATION	SOIL TYPE	DENSITY
All applicable areas	All soils	95 percent of max dry density by ASTM D1557

3.06 FIELD QUALITY CONTROL

A. Testing:

1. In-place moisture-density tests will be performed by the Owner.
2. Costs of "Passing" tests will be paid by Owner.
3. Cost associated with "Failing" tests shall be paid by the Contractor.
4. Reference to Engineer in this section will imply Soils Engineer when employed by Owner and directed by Engineer to undertake necessary inspections as approvals as necessary.
5. Assure Owner has immediate access for testing of all soils related work.
6. Ensure excavations are safe for testing personnel.

END OF SECTION 02221

SECTION 03200

REINFORCING

PART 1 - GENERAL

1.01 DESCRIPTION

Requirements specified in the Conditions of the Contract and Division 1 form a part of this Section. Provide reinforcing work, complete as indicated, specified and required.

A. Work Included in This Section. Principal items are:

1. Furnishing and placing bar and mesh reinforcing for cast-in-place concrete.

B. Related Work Specified Elsewhere.

1. Section 03300, Cast-In-Place Concrete.

1.02 QUALITY ASSURANCE

A. Code Requirements. Unless otherwise specified all work specified herein and as shown on the drawings shall conform to the applicable requirements of the 2001 California Building Code.

B. Testing. Materials shall be tested as hereinafter specified, and unless specified otherwise, all sampling and testing shall be performed by a Testing Laboratory responsible to the Owner and with cost borne by the Contractor.

1. Test Samples. Bars, ties, and stirrups shall be selected by Testing Laboratory representative from material at the site or from place of distribution. Selection shall include at least 2 pieces, each 18 inches long, of each sampling.
2. Required Tests.
   a. Identified Bars. Testing will not be required if reinforcement is taken from bundles as delivered from the mill, identified as to heat number and accompanied by certified mill analyses and mill test reports, and is properly tagged with Identification Certificate so as to be readily identified, unless otherwise directed by the Owner.
   b. Unidentified Bars. When positive identification cannot be made or when random samples are taken, tests shall be made from each 2 tons or fraction thereof for each size. One tensile and one bend test shall be made from specimens of each size of reinforcement. Contractor shall bear costs and delays caused by testing unidentified bars.

C. Standard. Reinforcing steel installations shall conform to the specification requirements of the Concrete Reinforcing Steel Institute "Manual of Standard Practice" (herein referred to as the CRSI Manual) except as otherwise indicated or specified.

D. Field Quality Control. All continuous inspections shall be performed by "Special Inspectors' qualified and approved by Governing Building Code Authority or

inspector as otherwise qualified and approved by the Owner. Prepare and submit to Owner reports as required by Code.

1. Inspection of Reinforcing. Provide 24-hour advance notice to permit inspection of in-place reinforcement prior to closing forms, and refer to applicable requirements of Section 03300 "Cast-In-Place Concrete".
2. Concreting Operations. During concrete placing, assign construction personnel to inspect reinforcement and maintain bars in correct positions at each pour location.

1.03 SUBMITTALS

Submit the following in advance of fabrication in conformance with applicable requirements of General Conditions.

A. Shop Drawings. Submit shop drawings for reinforcing steel prepared in accordance with ACI 315, "Manual of Standard Practice for Detailing Reinforced Concrete Structures". Show layouts, bending diagrams, assembly diagrams, dimensioned types and locations of all bar laps and splices, and shapes, dimensions, and details of bar reinforcing and accessories. Include layout plans for bar supports and chairs, with typical details. Dimensions and quantities shown on the shop drawings are the responsibility of the Contractor and Owner approval of shop drawings shall not constitute approval of dimensions and quantities thereon.

B. Samples. Submit two 12-inch long samples of each bar support and two samples of each individual type chair, with catalog data.

PART 2 - PRODUCTS

2.01 REINFORCING

Use deformed bars conforming to ASTM A615, Grade 60 Marked "S".

2.02 WELDED WIRE MESH

Conform to ASTM A185.

2.03 ACCESSORIES

A. Tie Wire: Annealed steel, 16 gage minimum.

B. Coupler Splice Devices. Reinforcing bar coupler/splice devices which bear current I.C.B.O. Research Recommendation Approval, and which develop at least 125 percent of bar yield strength in tension may be used in lieu of lapped bar type splices. Submit sample for Owner approval in each instance.

C. Supports And Accessories. Do not use aluminum, galvanized steel, plastic or stainless steel supports or accessories. Supports as herein specified shall conform to CRSI Manual of Standard Practice, Chapter 3, for Types SB, BB, BC, JC, HC, CHC, and others of standard types as required. Use precast concrete block supports with embedded wire ties or dowels for placement on grade or on membranes. Use Class

"1" plastic coated chairs and spacers at waterbearing surfaces, roofs of waterbearing structures, and at all interior or exterior surfaces exposed to view or weather in the completed structure.

2.04 DOWELS

Where and as designated on Structural Drawings, provide reinforcing bar dowels in new work and for anchorage to existing concrete. For anchorage where shown or required to existing construction use non-shrink epoxy type grout or deferred bolting devices as approved in each instance and conforming to requirements of Part 2, Products of Section titled "Cast-In-Place Concrete" in Division 3.

2.05 FABRICATION AND DELIVERY

Conform to CRSI Manual Chapters 6 and 7 except as otherwise indicated or specified. Bundle reinforcement and tag with suitable identification to facilitate sorting and placing, and transport and store at site so as not to damage material. Keep a sufficient supply of tested, approved, and proper reinforcement at site to avoid delays.

A. Bending and Forming. Fabricate bars of indicated size and accurately form to shapes and lengths indicated and required by methods not injurious to materials. Do not heat reinforcement for bending. Bars with kinks or bends not scheduled will be rejected. Do not field bend bars that are partially embedded in concrete, except as shown on the plans or specifically approved by the Owner.

B. Reinforcing Bars for Masonry. Detail and fabricate bars at the shop, ready for installation by masons.

PART 3 - EXECUTION

3.01 PLACING

Unless otherwise indicated or specified, conform to CRSI Manual Chapter 8 including placement tolerances, except no reduction of concrete cover is allowable for bars at concrete surfaces exposed in liquid or water-containing structures.

A. Cleaning. Before placing reinforcing, and again before concrete is placed, clean reinforcement of loose mill scale, oil, or other coating that might destroy or reduce bond. Do not allow form coatings, release agents, bond breaker, or curing compound to contact reinforcement.

B. Concrete Coverage over reinforcing bars shall be as indicated. The coverage shall be to the outer edge of ties, stirrups, bar spacers, hangers, and like items, and the reinforcing shall be detailed and fabricated accordingly. Refer to Structural General Note requirements.

C. Securing in Place. Accurately place reinforcement and securely wire tie in precise position at all points where bars cross. Tie stirrups to bars at both top and bottom. Bend ends of binding wires inward allowing no encroachment on the concrete cover; exercise special care at surfaces to remain exposed and unpainted. Support bars in accordance with CRSI Manual Chapter 3, Specifications for Placing Bar Supports, using approved chairs and supports.

D. Splices shall be wired contact lap splices unless otherwise indicated or approved. Splices shall conform to ACI 318, (Class B). Lap lengths shall be as indicated on the Drawings.

1. Vertical Bars. Except as specifically detailed or otherwise indicated, splicing of vertical bars in concrete is not permitted except at the indicated or approved horizontal construction joints or as otherwise specifically detailed.
2. Horizontal Bars. Unless otherwise shown, make lap splices with at least one continuous bar between adjacent splices. Splices in any one run of bar shall be spaced at least 20 feet apart with splices in adjacent bars offset at least 10 feet. Where double mats of bars occur in walls, lap splices in opposite mats shall be offset at least 5 feet.

E. Welding of reinforcing bars is not permitted unless approved in each case.

F. Additional Reinforcing. Provide additional reinforcing bars at sleeves and openings as indicated or required.

G. Welded Wire Mesh. Install necessary supports and chairs to hold in place during concrete pours. Straighten mesh to lay in flat plane and bend mesh as shown or required to fit work. Laps shall be no less than one complete mesh unless otherwise detailed. Tie every other wire at laps.

H. Do not displace or damage vapor barrier.

I. Accommodate placement of formed openings.

END OF SECTION 03200

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 DESCRIPTION

Requirements specified in the Conditions of the Contract and Division 1 form a part of this Section. Provide cast-in-place concrete work, complete as indicated, specified and required.

A. Work Included in This Section. Principal items are:

1. All cast-in-place concrete including bases for mechanical and electrical equipment and encasement for underground conduits.
2. Concrete finishing, patching, grouting, and crack repair.
3. Embedded waterstops for cast-in-place concrete.
4. Concrete curing.

B. Related Work Specified Elsewhere.

1. Section 03200, Reinforcing.
2. Section 02200, Earthwork.

1.02 REFERENCE STANDARDS

Except as herein modified, concrete work shall conform to requirements of ACI 301, Specifications for Structural Concrete for Buildings, and to requirements of ACI 350R, Concrete Sanitary Structures, and to requirements of ACI Standards and ACI Recommended Practices as contained therein.

1.03 SOURCE QUALITY CONTROL

A. Code Requirements. Unless more stringent requirements are specified herein or shown on the Drawings all work shall conform to the applicable requirements of the 2007 California Building Code (CBC).

B. Testing. Materials shall be tested as hereinafter specified and unless specified otherwise all sampling and testing shall be performed by Owner approved Testing Laboratory with cost borne by the Owner, except costs of retesting and reinspection because of faulty materials or methods shall be borne by the Contractor.

1. Cementitious Materials. Provide the following as applicable when material is to be used in performance of the Work.
    a. Portland Cement. Submit notarized Mill Certificates, provided by the cement manufacturer, including full compliance with requirements specified. In the absence of certificates, Testing Laboratory shall perform sampling of cement in conformance with ASTM Designation: C 183 and testing of cement in accordance with ASTM Designation: C 150, all at Contractor's expense. Cement shall be tagged for identification at location of sampling.
    b. Fly Ash. Submit notarized certificate of compliance to standard specifications of ASTM Designation: C 618, Class F or C, and as further qualified hereinafter Article 2.01. In addition, provide notarized test reports for compliance with ASTM Designation: C 618.
2. Stone Aggregate for Concrete. Test aggregate before concrete mix is established and whenever character or source of material is changed. Include a sieve analysis to determine conformity with limits of gradation. In accordance with ASTM D75, take samples of aggregates at source of supply or at the ready-mix concrete plant and conduct the following tests:
    a. Sieve Analysis. ASTM Designation: C 136.
    b. Organic Impurities. ASTM Designation: C 40. Fine aggregate shall develop a color not darker than reference standard color.
    c. Soundness. ASTM Designation: C 88. Loss resulting therefrom, after 5 cycles, shall not exceed: 8% of coarse aggregate, 10% for fine aggregate when using sodium sulfate solutions; or 11% and 14% respectively, when using magnesium sulfate solution.
    d. Abrasion of Concrete Aggregate. ASTM Designation: C 131; loss shall not exceed 10-1/2% after 100 revolutions, 42% after 500 revolutions.
    e. Deleterious Materials. ASTM Designation: C 33.
    f. Material Finer Than 200 Sieve. ASTM Designation: C 117; not to exceed 1% for gravel, 1.5% for crushed aggregate per ASTM Designation: C 33.
    g. Reactivity Potential. Aggregates shall be considered innocuous in accordance with Figure 2 of ASTM Designation C 289.
    h. Cleanliness and Sand Equivalent. For all aggregate, not less than 75 for average of 3 samples tested according to Test Method No. California 217E (Materials Manual, Testing and Control Procedures - Materials and Research Department, State of California).

1.04 CONCRETE MIX DESIGNS AND PRELIMINARY TESTS

At Contractor's expense, Testing Laboratory shall prepare mix designs for all cast-in-place concrete and shall perform preliminary testing in accordance with the following requirements. Submit test results to Owner. With Owner's prior approval, structural concrete mix designs may be based upon field experience with materials to be employed when certified test results, and criteria meet or exceed herein specified requirements, and when supplier certifies that materials to be supplied are those represented by such tests. During job progress, verification of such results shall be by Independent Testing Laboratory.

A. Mix Designs

1. Basis for Mix Designs. Design concrete mixes for workability of mix and durability of concrete. Concrete mixes shall be rigidly controlled in accordance with laboratory trial batch method or combinations of materials previously evaluated as required by Sections 5.4 and 5.3, respectively, Standard Building Code Requirements for Reinforced Concrete (ACI 318), of the American Concrete Institute and to satisfy herein specified concrete strength requirements. When necessary, increase the cement content to achieve the required strength, at no extra cost to Owner.
2. Compressive Strength Requirements. Unless otherwise shown on the Structural Drawings or otherwise specified herein, normal weight aggregate concrete mixes shall provide the following minimum compressive strength for use in various locations:
    a. Class 1, 4,000 psi Concrete shall be used for all water bearing structures including top slab of water bearing structures.
    b. Class 2, 3,000 psi Concrete shall be used for structural concrete such as concrete fill for steel deck, on-grade walks, paving, curbs, gutters, structural footings, slabs on-grade, and other structural concrete not occurring in water bearing structures.
    c. Class 3, 2,000 psi Concrete shall be used for non-structural concrete such as encasement of pipe or conduit, fills for over-excavations, fence post footings, thrust blocks, and other locations requiring similar non-structural concrete.
3. Water/Cement Ratios. Unless otherwise specified or shown on Structural Drawings, prepare mix designs in conformance with methods No. 1 or No. 2 as outlined in Section 3.8 of ACI Std. 301 with Contractor having option of selecting water/cement ratio which assures a compatibility with strength and workability requirements, but not greater than 0.53.
4. Admixtures. Add to concrete mixes, upon approval prior to use, and modify mix design proportions accordingly. Fly ash may be used at Contractor's option, except where prohibited herein.

B. Preliminary Strength Tests. In laboratory, prepare 6 compressive test cylinders for each concrete mix design (unless more tests are required for an earlier age). Fabricate and cure cylinders in accordance with ASTM Designation: C 31. Use cement, aggregates and admixtures proposed for the concrete work. In accordance with ASTM Designation: C 39, test three sets of two cylinders at 28-day age. For each mix, no individual strength test result shall fall below the required f'c.

C. Reports. File 3 copies of each mix design and preliminary strength test report, with the Owner for review and approval. Submit a letter of certification that the concrete materials, mixes, properties, and work conform to the requirements indicated and specified.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

Deliver materials in a timely manner to insure uninterrupted progress of work. Store materials in a manner that will preclude damage and permit ready access for inspection and identification.

PART 2 - PRODUCT

2.01 MATERIALS

A. Cementitious Materials

1. Portland Cement. Standard brand of domestic Portland cement, ASTM Designation: C 150, Type I. Do not change brand of cement during progress of Work without written approval of the Owner.
2. Fly Ash. Except for instances requiring high early strength, the use of Class F or Class C fly ash meeting ASTM Designation: C 618 with ignition loss limited to 1.5 percent may be used in lieu of Portland cement to the limits of not less than 10 percent nor more than 20 percent by weight. This substitution or any changes in brand or type of cement shall not be made without advanced written approval of the Owner.

B. Normal Weight (Stone) Aggregates. Furnish natural aggregates from approved pits, free from opaline, feldspar, mica (fools gold), siliceous magnesium limestone or other deleterious or reactive substances. Aggregate shall conform to ASTM Designation: C 33 except as modified herein. Fine aggregates shall pass a #4 sieve. Do not use pozzolan or other additives to compensate for aggregate-alkali reactivity.

1. Coarse Aggregates. Clean, hard, fine-grained sound crushed rock or washed gravel which does not contain in excess of 5% in weight of flat, chip-like, thin and elongated, friable or laminated pieces, or more than 2% by weight of total amount of cherty material and soft particles, or more than 1% of chert as soft material as defined on Table 3 of ASTM Designation: C 33. Consider any piece having a major dimension in excess of 5 times its thickest dimension perpendicular to the major dimension to be flat or elongated.
   a. Maximum Sizes. As indicated on Drawings, except for concrete in water

bearing structures where coarse aggregate sizes per Table 2 of ASTM Designation: C 33 shall be No. 467 (1-1/2 in.), No. 57 (1 in.), or No. 67 (3/4 in.) as otherwise required by design, specifications and ASTM Designation: C 33, and except that coarse aggregate nominal maximum size shall not exceed one-fifth the narrowest dimension between sides of forms and reinforcing steel, one-third the depth of slabs, or three-fourths of minimum clear spacing between reinforcing bars.

b. Quality. All aggregates shall meet the test requirements of Article "Source Quality Control" hereinbefore.

C. Admixtures. Use one manufacturer's products throughout. Upon Owner's approval of use and of a particular brand or type, assure that use is reflected in mix designs.

1. General. Use no admixture that has chlorides added during manufacture. Admixtures used in combination shall be physically and chemically compatible and shall be so certified by each admixture manufacturer and by Testing Laboratory that prepared respective mix designs.

2. Admixture. At Contractor's option in Class "2" concrete in amounts recommended by manufacturer, as approved by Owner, use water-reducing, retarding chemical admixture conforming to ASTM Designation: C 494, Type A or Type D. The admixture shall provide the following, and Contractor shall provide proof thereof at time of request for approval:

a. Decrease drying shrinkage.

b. Increase compressive strength at all ages up to and including five years.

c. Increase flexural strength, modulus of elasticity, and abrasive resistance.

d. The water-cement ratio and required strengths shall be maintained as scheduled (cement factor for a cubic yard of concrete, reduced proportionately).

e. There shall be no loss of workability resulting from reduction in slump. If the admixture is of liquid type, it must be considered in proportioning water.

3. Air Entrainment. Use air entrainment additive conforming to ASTM Designation: C 260 as approved by the Owner.

a. For normal weight aggregate concrete subject, after curing, to freezing temperature while wet shall contain air entrainment within limits of Table 4.5.1 of ACI 318 and Table 3.4.1 of ACI 301.

D. Water. From a domestic potable source.

E. Preformed Plastic Adhesive Waterstops. In horizontal construction joints of vertical walls, use preformed plastic adhesive waterstops in lieu of PVC waterstops. Preformed plastic adhesive waterstops shall be the product of Synko-Flex Products Inc. or approved equal.

F. Concrete Joint Sealants. For sealing joints in concrete surfaces, use materials conforming with requirements specified in Section 07920, "Sealants and Caulking".

1. Primer. Use primer produced and/or recommended by sealant manufacturer.
2. Back-up Preformed Joint Filler. Use closed cell polyethylene foam or equal impervious, compatible, compressible foam material recommended for retaining sealant depth in expansion joints while curing. Use no bitumen or oil saturated material.
3. Bond Breakers, where required, shall be polyethylene tape or equal as recommended by sealant manufacturer to prevent adherence of sealant to back-up material.

G. Nonshrink Grout. Use "Masterflow 713" manufactured by Master Builders or Five Star grout manufactured by U.S. Grout, or an approved equal nonmetallic, nonshrinking, nonstaining, premixed, water and oil resistant, high-strength grout.

H. Deferred Bolting Devices (DBD).
1. Deferred bolting devices may be used in lieu of anchor bolts and expansion bolts in interior and exterior dry locations. The anchor shall be Hilti HD1 304 SS or approved equal. Installation shall be in accordance with current International Conference of Building Officials (ICBO) Research Report recommendations.
2. Deferred bolting devices will not be permitted:
   a. In wet or submerged locations.
   b. For anchorage of vibrating machinery or equipment.

I. Epoxy. Epoxies for grouting, crack repair, patching, bonding or other uses shall be as follows as manufactured by Master Builders, Sika Chemical Company, Select Products, or equal by other manufacturer. Throughout use products of single manufacturer, except as approved by Owner.
1. All epoxy mixing, surface preparation and application shall be made in conformance with manufacturer's printed specifications, as approved by the Owner.
2. For bonding new concrete to old concrete, grouting metal anchors, and for overhead and vertical bonding and embedment, use "Sikadur 31 Hi-Mod Gel", Select Products GP-3000 or approved equal. All epoxies shall be used as recommended by manufacturer to satisfy entailed project temperature and surface moisture variations at time of application.
3. For pressure injection or gravity-feed grouting, use; Sika's "Sikadur 35 Hi-Mod LV", Select Products GP-2000, or approved equal.

J. Liquid Curing Compound. Use white pigmented Burke "Rez-X" or equal white pigmented compound conforming to ASTM Designation: C 309 and providing no detrimental effects with deferred finishes. On surfaces within reservoirs or other concrete structures containing potable water, use nontoxic materials which are free of odor and taste. Provide supporting technical data. Floor hardener treated floors shall use curing materials only as recommended in writing by hardener manufacturer.

K. Sheet Curing Materials. ASTM Designation: C 171, waterproof paper, polyethylene film or white burlap-polyethylene sheet, non-staining.

L. Vapor Barrier Membrane. Under interior on-grade slabs indicated on the Drawings provide lapped and sealed vapor barrier membrane using Fortiber "Moistop-2", Damproof xx" by Nicolet of California, Inc., or equal with manufacturer's recommended pressure sensitive tape sealant used continuously at lapped joints, penetrations and at perimeter walls or footing surfaces. Use products and system of single manufacturer throughout.

2.02 CONCRETE MIXES

A. 28-Day Compressive Strength. Concrete used on the job shall be of 150 lb/cu. ft. nominal density and shall attain the compressive strength at 28 days as designated on Structural Drawings for use in various locations.

B. Maximum Aggregate Size. Conform to Article 2.01 B.1. For Class "2".

   a. Use 1-1/2 in. max. size aggregate typical and

   b. 3/4" maximum for concrete fill roof deck, unless otherwise designated. In no case shall the size of the coarse aggregate exceed 75% of the horizontal space between reinforcing bars or between reinforcing bars and forms.

C. Mix Designs. Conform with requirements of Article 1.04 "Concrete Mix Designs and Preliminary Tests". At least 30 days before any Class concrete is to be placed, the Contractor shall submit for approval, mix designs for each proposed mix prepared and supervised by a Testing Laboratory approved by the Owner.

2.03 CONCRETE MIXING

Concrete shall be ready-mixed, supplied from an off-site commercial ready-mix plant approved by Owner, each load accompanied by a bonded weightmaster's certificate listing the quantity of each concrete ingredient, admixture quantity, water content and slump, and time of loading and departure from ready-mix plant. Also include notations to indicate equipment was checked and found to be free of contaminants prior to batching.

A. Ready-Mixed Concrete. Unless approved otherwise in advance of batching all concrete of a single design mix for any one day's pour shall be from a single batch plant of a single supplier. Conform to ASTM Designation: C 94, except materials, testing and mix design shall be as specified herein. Use transit mixers equipped with automatic devices for recording number of revolutions of drum.

B. Mixing Water Limitations. If water is added at the batching plant, do not hold ready-mixed concrete in the mixer for more than one hour from the time the water is added. Do not deliver ready-mixed concrete to job with the total specified amount of water incorporated therein. Withhold 2-1/2 U.S. gal. of water per cubic yard, then incorporate in mix before concrete is discharged from mixer truck. If no water is added at the batching plant, add measured quantities of water at the site and rotate mixer at 70 to 100 revolutions in accordance with requirements of ASTM Designation: C 94 to achieve uniformity of mix without segregation and without exceeding water/cement ratio or slump. Adding of water shall be under observation of Inspector. Each mixer truck shall arrive at the job site with its water container full. In event container is not full or concrete tests to a greater slump than specified, the load is subject to rejection.

C. Job Mixed Concrete. Obtain the approval of the Owner for equipment and procedures proposed for job mixed concrete.

D. Consistency. Adjust quantity of water so concrete does not exceed maximum slumps specified when placed or specified water cement ratio; use minimum necessary for workability required by the part of the structure being cast. Measure consistency of concrete in accordance with ASTM Designation: C 143. Concrete exceeding maximum slump will be rejected.

Part of Structure	Slump
Footings and mass concrete not reinforced	3 inches maximum
Slabs and floors	4 inches maximum
Columns, walls	4 inches maximum
Equipment bases	3 inches maximum

PART 3 - EXECUTION

3.01 PREPARATION BEFORE PLACING

Remove excess water from forms before concrete is deposited. Do not allow water to flow over freshly deposited concrete. Remove hardened concrete, debris, and foreign materials from interior of forms and from inner surfaces of mixing and conveying equipment.

A. Secure reinforcement as specified in Section 03200, and obtain Engineer's approval. Embedded metal shall be free of old mortar, oils, mill scale, and other encrustations or coatings that might reduce bond. Wheeled concrete-handling equipment shall not be wheeled over reinforcing nor shall runways be supported on reinforcing.

B. Wetting. Wet wood forms sufficiently to tighten up cracks. Wet other materials sufficiently to reduce suction and maintain concrete workability.

C. Earth Subgrade. Fine grade subgrades smooth and level and lightly dampen 24 hours in advance of concrete placing. Remove all loose materials.

D. Vapor Barrier Membrane. Roll finish grade surfaces free of protrusions that may perforate membrane sheet. Use maximum feasible sheet width, make 6 in. laps with top lap in direction of concrete spreading, and seal membrane laps with minimum 2 inch wide pressure-sensitive tape or membrane manufacturer's recommended adhesive. Closely cut around penetrations and seal with tape. Terminate membrane at walls, footings and other vertical surfaces and tape seal. Remove and replace torn, punctured, or damaged vapor barrier membrane as directed prior to placement of sand cushion or drainage fill.

1. Sand Cushion. Prior to placing reinforcing or concrete, place a uniform 2-inch minimum thickness of clean sand on the intact membrane. Moisten sand immediately prior to pouring concrete.

3.02 JOINTS IN CONCRETE

Locate joints in concrete where indicated unless otherwise approved. Obtain approval of points of stoppage of any pour.

A. Construction Joints. Unless otherwise shown, provide all construction joints with suitable keyways or other keying methods. Clean and roughen contact surfaces of construction joints by removing entire surface and exposing clean aggregate solidly embedded in mortar matrix. Use mechanical chipping, sandblasting, or application of surface mortar retarder followed by washing and scrubbing with stiff broom. Cover and protect waterstops and other inserts from damage. The hardened concrete shall be watered and kept wet for at least 24 hours before placing new concrete. Just prior to placing adjoining concrete, slush face of construction joints with 1:2 mix of cement and sand mixed to paint consistency. At construction joints not containing water-stops, the coarseness amplitude of the prepared surface shall be 1/4 inch minimum in accordance with ACI 318, Section 11. 7.9.

3.03 CONVEYING AND PLACING CONCRETE

Do not pour concrete until reinforcing steel and forms have been inspected and approved as specified in Section 03200. Notify Owner not less than one full working day in advance of readiness for inspection of forms and reinforcing. Do not use aluminum equipment to handle or pump concrete.

A. Weather. Do not place concrete during rain or freezing weather unless approved measures are taken to prevent damage to concrete. Concrete placed during periods of

dry winds, low humidity, high temperatures, and other conditions causing rapid drying shall be initially cured with a fine fog spray of water applied immediately after finishing and maintained until final curing operations are started. Also under hot weather conditions, steps shall be taken to reduce concrete temperature and water evaporation by proper attention to ingredients, production methods, handling, placing, protection, and curing. Subject to Owner's approval, applicable preventive measures shall be taken for placing concrete during hot and cold weather in conformance with ACI Reports 305R and 306R respectively entitled, "Hot Weather Concreting", and "Cold Weather Concreting".

B. Conveying. Do not drop concrete from its point of release at mixer, hoppers, tremies, or conveyances more than 3 feet, nor through reinforcing bars in a manner that causes segregation. Provide form windows, tremies, elephant trunks, and equivalent devices as required. The use of chutes for conveying or depositing concrete is not allowed except for small isolated portions of the work and only with prior approval of Owner. Deposit concrete directly into conveyances and from conveyances to final points of repose. Deposit concrete so that the surface is kept level throughout, a minimum being permitted to flow from one portion to another.

C. Placing Concrete. Place and compact concrete within 90 minutes after water is first added to the mix; no concrete shall be placed after there is evidence of initial set. Retempering of concrete is not allowed.

1. Lifts. Pour concrete into forms immediately after mixing in a manner that will prevent separation of ingredients. Except as interrupted by joints, place all formed concrete in continuous, approximately horizontal layers, not generally exceeding 18 inches in depth. The Owner may require lesser depths where necessary to insure each new layer being placed while the previous layer is still soft and so the two layers can be made monolithic by penetration of the vibrators. All construction joints which will be exposed to view shall be made straight and level or plumb.

    a. Walls. Pour walls of water-containing structures including tank exterior walls, as one continuous operation from footing to top of wall between indicated construction joints at the specified pour rate. Each section of wall shall be in place at least 7 days before the adjoining wall section is cast. Shear walls and columns within tanks and other walls may have horizontal construction joints at approved locations.

    b. Slabs. Pour slabs as one continuous operation between indicated or approved construction joints. Cure in place slabs not less than 7 days prior to pouring alternate slabs. Then continue to cure until required curing time is attained.

    c. Monolithic Elements. Pouring of all beams and slabs must be continuous and monolithic with the floor system where so shown on the Drawings. At least two hours must elapse after depositing concrete in walls or columns before pouring beams, etc. supported thereon.

2. Pumping Concrete. No increase in the specified slumps will be allowed and

required water/cement ratios shall be maintained for concrete pumping. Do not use aluminum tubes to convey concrete. Equipment shall be capable of maintaining the specified pour rates. Conform with guide lines of ACI 304, except where more stringent requirements are specified herein. Minimum conduit (tube) diameter shall be 4 inches. Submit special mix designs to Engineer and obtain his approval for all concrete to be pumped.

3. Pouring Openings. Pouring of walls may be done only through pouring openings on one of the wall sides, and may not be pumped or poured from the top through the use of "elephant trunks" or tremies. The horizontal centerline distance between such openings shall not exceed 96 inches nor shall the distance between the nearest opening and the bulkhead for the vertical joint exceed 36 inches. The vertical centerline distance between horizontal rows of openings shall not exceed 96 inches. The minimum pouring opening size shall be 18" x 18". The bottom of the lower opening shall be no more than 48 inches from the top of the wall footing. Under no circumstances shall forming be such that the drop of concrete in the forms will exceed 8 feet in any one place.

4. Pour Rates.

   a. Vertical Elements. Place concrete in lifts as specified at a rate that does not overstress forms nor allows the top of a lift to begin to harden before the next lift is placed.

   b. Slabs. Place concrete at a rate that ensures all deposits are joined to concrete that is still plastic.

   c. Do not place concrete adjoining a construction joint until the adjoining concrete has cured for at least seven days unless approved by the Owner.

D. Compaction. Obtain effective compaction by vibration, agitation, spading, and rodding until the concrete is free from voids, or rock pockets. Do not use vibrators to move concrete within the forms. During pours, maintain at least one spare vibrator in good condition for each two vibrators in use. Assign one experienced workman exclusively to the operation of each vibrator during the placing operation. Immediately correct operations not deemed to be satisfactory by the Owner.

1. Vibration. Compact all concrete, with the exception of concrete slabs 4 in. or less in depth, with high frequency, internal mechanical vibrating equipment supplemented by hand spading. Concrete slabs 4 in. or less in depth shall be consolidated by wood or metal grid tampers, spading and settling with a heavy leveling straight edge. Carefully vibrate concrete around waterstops and ensure the waterstops are not bent or damaged.

   a. Vibrators shall be designed to operate with vibratory element submerged in the concrete, and shall have a frequency of not less than 7,000 impulses per minute when submerged. The vibrating equipment shall be adequate at all times in number of units and power of each unit to consolidate the concrete to the maximum practicable density so that it is free from air pockets, honeycomb, entrapped air and so it closes snugly against all surfaces of forms and embedded items.

b. Operation of Vibrators. Do not allow vibrators to contact forms or reinforcing. When vibrating a freshly placed layer of concrete, insert the vibrator vertically through the preceding layers that are still completely plastic and withdrawn slowly, producing the maximum obtainable density in the concrete without creating voids. Do not permit the vibrator to enter or disturb concrete that has stiffened or partially set. The interval of vibrator placing shall not exceed 2/3 the effective visible vibration diameter of the submerged vibrator. Avoid excessive vibration that causes concrete segregation or causes an inordinate amount of entrained air to move to the face of the forms.

c. Revibration of Retarded Concrete. Place concrete containing retarding admixture for structural walls and columns on a schedule that allows each layer of concrete to be in place and compacted for at least 30 minutes before the next layer of concrete is placed. Remove bleed water on the surface of the concrete before additional concrete is placed and revibrate the concrete in place before the next lift is placed. Remove concrete containing excess water or fine aggregate caused by vibration from tops of walls and columns while plastic, fill the spaces with compacted concrete of the correct proportions, and vibrate in place.

E. Slabs. Set screeds at maximum centers, as approved and verify correct elevations and consideration for any camber in the form. Compact and tamp concrete to bring 3/8 inch mortar to surface, and wood float to straightedges and screeds. Make finished surfaces level or sloped as detailed, with maximum deviation of 1/4 inch from 10 feet straightedge for exposed finishes, and there shall be no low spots to impound water. Do not use steel or plastic floats of any kind for initial floating operations. Unless otherwise specified, do not apply hereinafter specified finishes until surface water disappears and surface is sufficiently hardened. Remove all bleed water and laitance as it appears.

3.04 CURING FORMED CONCRETE

Maintain forms containing concrete in a thoroughly wet condition until removal. Maintain all concrete in a continuously moist condition for not less than 7 consecutive days after pouring. Keep concrete moist with fine fog spray until protected by curing materials. Use water curing method, specified liquid membrane-forming compound, or concrete curing paper or mats. Obtain Engineer's approval for each specific use.

3.05 FINISHING FORMED CONCRETE

A. Immediately remove projections and offsets. Saturate form tie holes with water and fill voids with mortar of same mix as concrete (less coarse aggregate), cure, and dry. Cut out all surface holes 1/4 inch and larger, all rock pockets and damaged surfaces to sound concrete, edges square to surface and back beveled. Apply approved epoxy concrete adhesive and fill patched area with mortar as specified for the holes; allow

mortar to temper 1/2 hour before placing. Finish patches flush with adjoining surfaces and cure the same as the concrete. No other finishing operations are required for permanently concealed concrete.

B. All exposed interior and exterior formed concrete shall have grout cleaned finish in conformance with applicable requirements of Section 10.3.2 of ACI Standard 301 to produce reasonably smooth surfaces suitable for painting, waterproofing and protective coating work. Provide similar finish on formed concrete surfaces of tank interiors and other waterbearing surfaces.

3.06 FINISHING SLABS AND FLATWORK

As specified in the preceding Article, initially compact, bring 3/8 in. mortar to surface, and float surfaces. Finished surfaces shall be "puddle-free" and level or sloped as indicated to above specified maximum deviation limits. Remove and replace surfaces which are not within these limits at no additional cost to Owner. Patching is not acceptable. Keep surface moist with monomolecular film or fine fog spray of water to prevent drying until curing media is applied, except that no sprinkling of water shall be done while mechanically finishing concrete. Do not dust with cement or sand during finishing operations.

A. Precautions. Slabs have not been designed for heavy construction loads. Repair or replace as directed by Engineer, at no extra cost to Owner, all slabs damaged by use of heavy equipment at loadings.

B. Rough Slabs. Broom surfaces of slab after initial set of concrete leaving coarse aggregate slightly exposed. Apply on following areas and surfaces:

1. Concrete to receive deferred concrete, grout or mortar.
2. Tops of footings for masonry.
3. Chemical and Ammonia Rooms ~ Ramp entrances provide non-slip/non-skid rough finish.

C. Monolithic Trowel Finish. For all floor, slab, and flatwork surfaces not otherwise indicated or specified. After surface water disappears and floated surface is sufficiently hardened, steel trowel and retrowel to smooth surface. After concrete has set enough to ring trowel, retrowel to a smooth uniform finish free of trowel marks or other blemishes. Avoid excessive troweling that produces burnished areas.

D. Steel Float Finish. Same as monolithic trowel finish, except omit second retroweling. Apply on following area and surfaces:

1. Apply on floor slab surfaces in water-bearing structures.

E. Wood Float Finish. Float to screeds. When ready, finish with wood floats to a uniformly textured surface. Apply on following areas and surfaces:

1. Exterior walking surfaces exceeding 1:10 slope.

3.07 CURING SLABS AND FLATWORK

Apply curing media as soon as feasible after finishing operations without marring surfaces, and in

any case on same day. Keep surfaces moist until curing is applied. Apply liquid compounds in strict accordance with material manufacturer's published application rates; apply 2 spray coats, second coat sprayed at right angle direction from first coat. Carefully mask and protect adjoining surfaces where compound is used.

A. Curing Period and Protection. Maintain curing materials in proper sealed condition for minimum of 14 days after application. Keep traffic on curing surfaces to minimum possible, and completely off liquid compound cured surfaces. Immediately restore any damaged or defective curing media.

B. Restriction. Do not use liquid membrane-forming curing compound within water bearing structures, or on surfaces to receive deferred concrete or masonry, or on surfaces to receive fluid-applied protective coatings or waterproofing.

C. Liquid Membrane-Forming Curing Compound. Except as restricted above, use liquid curing compound for all slabs, floors, and flatwork. Cure slabs having floor hardener treatment in strict conformance with printed recommendations of floor hardener manufacturer.

D. Sheet Curing. Use concrete curing sheet material, all joints sealed with pressure-sensitive tape; immediately repair any tears during curing period. Verify that surfaces remain damp for full curing period; if necessary or directed, lift sheeting and wet surfaces with clean water, and replace sheeting. Use on surfaces where liquid curing is not permitted.

E. Water Curing. Alternate to either liquid curing compound or sheet curing method. Keep concrete continuously wet by ponding, sprinklers, or equivalent for entire curing period.

3.08 CHAMFERS AND FILLETS

Unless otherwise shown on the drawings or directed by the Owner, exposed edges of formed concrete structure shall be provided with a 3/4 in. x 3/4 in. chamfer. Where fillets are shown on the drawings they shall be formed with a 3/4 in. x 3/4 in. form chamfer.

3.09 JOINTS WITH SEALANT

Prepare surfaces and joints, mix and apply sealant in strict accordance with Section 07920 of these Specifications.

A. Manufacturer's Supervision. Arrange for a technical representative of the sealant manufacturer at the time sealant operations are started to supervise and approve preparation, sealant mixing, and sealant applications procedures and applicators. The representative shall make frequent visits to the site to ensure the sealant installations conform to the manufacturer's instructions, and shall issue a written report to Owner covering each visit. Include the technical representative's expenses in the bid price.

B. Crack Sealing. Before and after backfilling of the tanks cut out all cracks over 0.01" wide in concrete surfaces of tanks and other water-containing structures as detailed and

fill the groove with backing, primer, and sealant.

3.10 INSTALLATION OF PIPELINES THROUGH CONCRETE STRUCTURES

A. Whenever a pipeline or any material terminates at or extends through a structural wall or sump, install the fitting or special casting required for the particular installation before pouring the concrete. Otherwise, submit shop drawings of alternate installation methods and obtain Owner's approval before concreting.

B. Whenever any run of pipe is installed per approved shop/erection drawings subsequent to placing of concrete, accurately position the opening in the concrete for such pipelines. Unless otherwise required, all pipes penetrating fluid containing or earth supporting portions of the structure shall be ring flanged.

1. Opening shall be of sufficient size to permit a perfect final alignment of pipelines and fittings without deflection of any part and to allow adequate space for satisfactory packing where pipe passes through wall to insure water tightness around openings so formed.
2. The boxes or cores shall be provided with continuous keyways to hold the filling material in place and to insure a watertight joint.
3. Boxes or cores shall be filled with nonshrink grout.

3.11 FIELD QUALITY CONTROL

A. Continuous Inspection. Place all Class "1" and Class "2" concrete under the continuous inspection of Owner's Inspector.

B. Concrete Tests. Owner's selected Testing Laboratory shall perform the following concrete tests:

1. Compressive Strength Tests. Make one set of at least four standard test cylinders from each day's placing and each l00 cubic yards, or fraction thereof, each class of concrete. Date cylinder, number and tag, indicating location in structure from which sample was taken. Indicate slump test result of sample. Do not make more than one set of test cylinders from any one location or batch of concrete.
2. Test Cylinders. Provide for testing by Owner or Testing Laboratory to take test cylinders at the job in accordance with ASTM Designation: C 31. Test specimens in accordance with ASTM Designation: C 39 at the age of 7 and 28 days. Furnish labor and assistance for casting test cylinders, and furnish moist curing cabinets, as required, conforming to ASTM Designation: C 31 at the site.
3. Core Tests. Should strength of concrete, as indicated by tests, fall below required minimum, then additional tests of concrete (which the unsatisfactory samples represent) may be required by Owner. Testing Laboratory will make such tests in accordance with ASTM Designation: C 42. Contractor shall fill the holes made by cutting cores with dry pack concrete. Tests for below-strength concrete shall be paid for by the Contractor even though such tests indicate the concrete has obtained the required minimum compressive strength.
4. Air Content. At time the compressive test cylinders are cast, test a sample of the concrete for air content in accordance with ASTM Designation: C 231.

3.12 ALTERATIONS AND REWORK

Heavily sandblast existing concrete surfaces to receive new concrete to expose coarse aggregate and produce a clean coarse textured surface. Coat the prepared surfaces with epoxy bonding compound immediately prior to placing concrete. The compound shall be Sika Chemical Company's "Sikastix Adhesive", Hunt Process Company's "HB Series Epoxy Mortar", or approved equal. Use products of single manufacturer throughout. Mix and apply in strict accordance with manufacturer's printed recommendations and directions for various conditions, as approved.

3.13 QUALITY OF WORK

If so ordered by the Owner, remove and replace all concrete which is defective or not within the permissible tolerances, at no extra cost to Owner.

END OF SECTION 03300

SECTION 05990

STRUCTURAL AND MISCELLANEOUS METALS

PART I - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Custom fabricated metal items and certain manufactured units not otherwise indicated to be supplied under work of other sections.

B. Related Sections include but are not necessarily limited to:
   1. Section 09900 - Painting.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. Aluminum Association (AA):
      a. 30-86, Specifications for Aluminum Structures.
   2. American Society for Testing and Materials (ASTM):
      a. A36, Standard Specification for Structural Steel.
      b. A47, Standard Specification for Ferritic Malleable Iron Castings.
      c. A48, Standard Specification for Gray Iron Castings.
      d. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
      e. A108, Standard Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality.
      f. A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
      g. A307, Standard Specification Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
      h. A325, Standard Specification for High-Strength Bolts for Structural Steel Joints.
      i. A496, Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
      j. A500, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
      k. A536, Standard Specification for Ductile Iron Castings.
      l. A563, Standard Specification for Carbon and Alloy Steel Nuts.
      m. A668, Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use.

n. A780, Standard Practice for Repair of Damaged Hot-Dipped Galvanized Coatings.
o. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
p. B308, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Shapes.
q. B632, Standard Specification for Aluminum-Alloy Rolled Tread Plate.
r. F467, Standard Specification for Non-Ferrous Nuts for General Use.
s. F468, Standard Specification for Non-Ferrous Bolts, Hex Cap Screws, and Studs for General Use.
t. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

3. American Welding Society (AWS):
   a. AS.1, Specification for Covered Carbon Steel Arc Welding Electrodes.
   b. D1.1, Structural Welding Code Steel.
   c. D1.2, Structural Welding Code Aluminum.
4. National Association of Corrosion Engineers (NACE).
5. U.S.Department of Labor, occupational Safety and Health Administration (OSHA):
   a. 29 CFR 1910, OSHA Safety and Health Standards for General Industry (referred to herein as OSHA standards).
6. Provide all fabricated items complying with 1991 Uniform Building Code and OSHA Regulations.

B. Qualifications:
   1. NACE certified inspector shall have minimum of 2 years experience performing inspections as indicated.

1.03 DEFINITIONS

A. Installer or Applicator: Installer or applicator is the person actually installing or applying the product in the field at the Project site.
   1. Installer or applicator are synonymous.

1.04 SUBMITTALS

A. Shop Drawings:
   1. Fabrication and/or layout drawings:
      a. Submit shop drawings for all fabrications and assemblies.

2. Product technical data including:
    a. Acknowledgement that products submitted meet requirements of standards referenced.
    b. Manufacturer's installation instructions.
    c. For grating, include manufacturer's standard allowable load tables.

B. Miscellaneous Submittals:
1. NACE inspector qualifications.
2. Certification of surface preparation.
3. Certification of paint application.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Headed studs and deformed bar anchors:
    a. Nelson Stud Welding Div., TRW Inc.
    b. KSM Division Omark Industries.
    c. Eric/Jones Stud Welding Div.
2. Expansion anchors:
    a. Hilti Inc.
    b. Phillips Drill Co., Inc.
    c. Wej-it.
3. Adhesive anchors:
    a. Hilti Inc.
    b. Emhart Corp., Molly Div.
4. Castings, trench covers and accessories:
    a. Neenah Foundry Co.
    b. Deeter Foundry Co.
    c. Barry Craft Construction Casting Co.
    d. McKinley Iron Works.
5. All purpose metal framing:
    a. Unistrut Building Systems.
    b. B-Line Systems.
    c. Allied Tube and Conduit.

B. Submit requests for substitution in accordance with Specification Section 01640.

2.02 MATERIALS

A. Steel:
   1. Structural steel: ASTM A36.
   2. Steel pipe: ASTM A53, Types E or S, Grade B.
   3. Structural tubing: ASTM A500, Grade B.
   4. Bolts, nuts and washers, high strength: ASTM A325.
      a. Provide washers with all nuts.
   5. Bolts and nuts unfinished: ASTM A307, Grade A.
      a. Provide washers with all nuts.
   6. Anchor bolts: ASTM A36.
   7. Electrodes for welding steel: AWS AS.1, E70 Series.
   8. Steel forgings: ASTM A668.

B. Iron:
   1. Ductile iron: ASTM A536.
   2. Gray cast iron: ASTM A48.
   3. Malleable iron: ASTM A47, A197.

C. Stainless Steel:
   1. Stainless steel: ASTM A666, Type 302, Grade A.
   2. Stainless steel bolts and nuts: ASTM F593, Type 303 or 304 with minimum yield strength of 30,000 psi and minimum tensile strength of 70,000 psi.

D. Aluminum:
   1. Rolled shapes and extrusions: ASTM B308 or B221.
   2. Castings: ASTM B26.
   3. Alloys 6061-T6 or 6063-T6 unless specified otherwise in this Section.
   4. Aluminum angles, beams, pipes, plates and channels: Alloy 6061-T6.
   5. Aluminum weir plates and baffles: Alloy 6061-T6.
   6. Aluminum bolts: ASTM F468, alloy 2024 T4.
   7. Aluminum nuts: ASTM F467, alloy 2024 T4.
   8. Electrodes for welding aluminum: AWS Di.2, filler alloy 4043 or 5356.

E. Washers: Same material and alloy as found in accompanying bolts and nuts.

F. Expansion Anchors:
   1. Kwik-Bolt by Hilti, Red Head by Phillips Drill Co., or approved equal.

G. Adhesive Anchors:
   1. Parabond capsule anchors by Molly; HVA anchors by Hilti; or approved equal.

2.03 FABRICATION

A. Verify field conditions and dimensions prior to fabrication.

B. Form materials to shapes indicated with straight lines, sharp angles, and smooth curves.

C. Drill or punch holes with smooth edges.

D. Weld Permanent Shop Connections:
   1. Welds to be continuous fillet type unless indicated otherwise.
   2. Weld structural steel in accordance with AWS DI.1 using Series E70 electrodes conforming to AWS AS-1.
   3. Weld aluminum in accordance with AWS Dl.2.
   4. Grind smooth welds that will be exposed.

E. Conceal fastenings where practicable.

F. Punch or drill for field connections and for attachment of work by other trades.

G. Fabricate work in shop in as large assemblies as is practicable.

H. Finishes:
   1. Aluminum: Mill finished unless scheduled or otherwise specified or, if approved, finished in manufacturer's standard.
      a. Coat surfaces in contact with dissimilar materials. See Section 09900.
   2. See Section 09900 for preparation and painting of ferrous metals and other surfaces.

I. Fabricate grating, checkered plate and accessories using steel unless shown otherwise on Drawings.

2.04 SOURCE QUALITY CONTROL

A. Surface Preparation:
   1. All miscellaneous metal fabrication item surfaces shall be inspected and approved by NACE certified coatings inspector prior to application of shop-applied paint coating.
      a. Inspection shall be performed to determine depth of blast profile and cleanliness of surface.
      b. Refer to Section 09900 for surface preparation requirements.
      c. Fabricator shall reblast and or re-clean surfaces as required until acceptable.

B. Paint Coating Application:
   1. After surface has been accepted in writing by NACE certified coatings inspector, fabricator may proceed with application of paint coatings.
   2. Application of paint coatings shall be observed and certified by NACE certified coatings inspector.
   3. Refer to Section 09900 for painting requirements.

PART 3 - EXECUTION

3.01 PREPARATION

A. Prior to installation, inspect and verify condition of substrate. Installation of product constitutes installer's acceptance of substrate condition for product compatibility.

B. Correct surface defects or conditions which may interfere with or prevent a satisfactory installation.

3.02 INSTALLATION

A. Set metal work level, true to line, plumb.

B. Shim and grout as necessary.

C. Bolt Field Connections: Where practicable, conceal fastenings. Grind welds smooth where field welding is required.

D. Unless noted or specified otherwise:
   1. Connect steel members to steel members with 3/4 IN DIA high strength bolts.
   2. Connect aluminum to aluminum with 3/4 IN DIA aluminum bolts.
   3. Connect aluminum to structural steel using 3/4 IN DIA stainless steel bolts. Provide dissimilar metals protection.
   4. Connect aluminum and steel members to concrete and masonry using 3/4 IN DIA stainless steel expansion bolts unless shown otherwise. Provide dissimilar materials protection.
      a. Expansion bolts to have a minimum embedment of 4 IN into concrete and masonry unless indicated otherwise on Drawings.

E. Tighten ASTM A325 high-strength bolts in accordance with Section 11005.
   1. Provide hardened washers for all ASTM A325 bolts. Provide the hardened washer under the element (nut or bolt head) turned in tightening.

F. Do not field splice fabricated items unless said items exceed standard shipping length or change of direction requires splicing. Provide full penetration welded splices where continuity is required.

G. Provide each fabricated item complete with attachment devices as indicated or required to install.

H. Anchor aluminum and metal work so that work will not be distorted nor fasteners overstressed from expansion and contraction.

I. Tie anchor bolts in position to embedded reinforcing steel with wire. Tack welding prohibited. Coat bolt threads and nuts with heavy coat of clean grease. Anchor bolt location tolerance: 1/16 IN. Provide steel templates for all column anchor bolts.

J. Accurately locate and place frames for openings before casting into floor slab so top of plate is flush with surface of finished floor. Keep screw holes clean and ready to receive screws.

K. Prepare and paint ferrous metals in accordance with Section 09900.

L. Coat aluminum surfaces in contact with dissimilar materials in accordance with Section 09900.

END OF SECTION

SECTION 07920

JOINT SEALANTS

PART 1 - GENERAL

1.1 Work Included

A. This section includes materials, testing, and installation of joint sealants.

1.2 Related Work

A. Section 09900: Paints and Coatings

1.3 System Description

A. Where required throughout Work to provide a positive barrier against passage of moisture and air, furnish and install complete operating joint sealant system in conformance with manufacturer's installation requirements and compliance with applicable building codes and standards.

B. Caulking, if noted shall be synonymous with sealant.

1.4 References

A. ASTM C834 Latex Sealants
B. ASTM C920 Elastomeric Joint Sealants
C. Fed Spec TT-S-01543A

1.5 Submittals

A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Catalog Data	Required per catalog data requirements.	
Installation Instructions	Required per installation or application instruction requirements. Include manufacturer's recommendations for primer, joint cleaner and bond breaker.	
Certificate of Compliance	Submit sealant system certification per certificate of compliance requirements.	
Manufacturer's Statement of Responsibility	Required per manufacturer's statement of responsibility requirements.	
Material and Color Samples	Required.	
Color Charts	Submit Manufacturer's standard color charts to allow owner to select color to match adjacent work.	
Warranty	Furnish 1-year warranty from date of final acceptance	

1.6 Delivery, Storage and Handling

A. Manufacturer's instruction and warranty requirements for delivery, storage and handling of joint sealants shall be strictly followed.

B. Do not retain at the job site any material which has exceeded the shelf life recommended by the manufacturer.

C. Do not retain at the job site any mixed sealant material which has exceeded the pot life recommended by the manufacturer.

1.7 Unit Prices

A. Payment for the Work in this section shall be included as part of the lump-sum or unit-price bid amount for which such Work is appurtenant thereto.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

A. Acceptable manufacturers include the following:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Sealant Type A Self Leveling for Horizontal Surfaces	AEP Span	
	Atas International. Inc. Monarch	
	Approved equal	
Sealant Type B Non Sag for Vertical Surfaces	AEP Span	
	Atas International. Inc. Monarch	
	Approved equal	
Sealant Type C Silicone	AEP Span	
	Atas International. Inc. Monarch	
	Approved equal	
Sealant Type D Acrylic Latex	AEP Span	
	Atas International. Inc. Monarch	
	Approved equal	

2.2 Materials

A. Joint sealants shall be constructed of the following materials:

ITEM	MATERIAL	SPECIFICATION
Sealant Type A Self Leveling for Horizontal Surfaces	Pour Grade Urethane	ASTM C920 Grade P Class 25
Sealant Type B Non Sag for Vertical Surfaces	Single Component	ASTM C920 Type S Grade NS Class 25
Sealant Type C Silicone	Silicone	Fed Spec TT-S-01543A Class A
Sealant Type D Acrylic Latex	Acrylic Latex	ASTM C834
Mastic Joint Sealant for Buried Manholes and Vaults	Mortar	One part Portland cement to two parts well-graded sand passing No. 8 sieve per Specifications Section 03300.
	Plastic sealing compound	Federal Specification SS-S-00210
Primer		Nonstaining type recommended by sealant manufacturer
Joint cleaner		Noncorrosive and nonstaining type recommended by sealant manufacturer, compatible with joint compounds
Bond Breaker	Pressure sensitive tape	Recommended by sealant manufacturer to suit application.
Rope Yarn	Rope fiber or cotton wicking	Use raveled strands.

B. The following product design criteria, options and accessories are required:

ITEM	DESCRIPTION
Color	Owner will select from standard colors available from manufacturer

C. Do not use non-elastic putty-type compounds.

D. Sealant compounds shall be of proper consistency to be readily worked and not be affected by vibration or by long exposure to outside climate and temperature.

E. Sealant compounds shall form a thin, tough, elastic film on surface, but remain permanently plastic underneath.

F. Sealant compounds shall contain no acid nor ingredients which will stain stone, corrode metal or have an injurious effect on painting.

G. Sealant compounds shall be colored to match adjacent work.

H. Special sealants called for elsewhere shall be provided and installed as directed by the manufacturer.

PART 3 - EXECUTION

3.1 Preparation

A. Make field measurements needed to install joint sealants before submitting catalog data or ordering. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.

B. Verify that surfaces are ready to receive work and that joint measurements and surface conditions are as recommended by sealant manufacturer.

C. Remove loose materials and foreign matter which may affect adhesion of sealant.

D. Joints and spaces to be sealed shall be clean, free from dust, and dry.

E. Joints more than ¾-inch deep and joints where suitable backstop has not been provided shall be packed with rope yarn to within ½-inch of surface before applying and sealing.

3.2 Application

A. Install joint sealants at the location shown on the Plans and Submittals.

B. Clean joints and install joint sealants according to manufacturer's installation and warranty requirements. Manufacturer's requirements for installation, application, connection, erection, maintenance, operating, cleaning, conditioning and startup of products shall be strictly followed.

C. Install joint sealants to tolerances and within temperature ranges recommended by manufacturer.

D. Tool joints concave unless otherwise shown.

E. Joints in stone and precast work shall be slightly convex.

F. Seal joints before final coat of paint is applied to adjacent work.

G. Apply compound with a pressure gun having proper size nozzle or with knife as required.

H. Use sufficient pressure to fill all voids and joints solid. Superficial painting of joints with a skin head will not be accepted.

I. Remove excessive sealant and leave surfaces neat and clean. Upon completion, sealant shall have a smooth, even finish.

J. All sealed joints shall be watertight.

K. Refer variances between manufacturer's installation instructions and Contract Documents to Owner's Representative.

3.3 Field Quality Control

A. Field testing shall include the following:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Joint Sealants	Installation & Leakage	Visual inspection of finished installation and water test at Owner's discretion	1 inspection	Owner	Owner
	Field Performance	Demonstrate compliance to Contract Documents and Manufacturers' printed Literature	1 test	Contractor	Contractor
	11 month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturers printed Literature	1 test	Owner	Contractor

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END OF SECTION

SECTION 09900

PAINTING AND PROTECTIVE COATINGS

PART 1 - GENERAL

1.01 SCOPE

Requirements of the Conditions of the Contract apply to this Section. Provide all labor, materials, apparatus, scaffolding, and all appurtenant work in connection with painting and protective coatings, complete as indicated, specified and required.

A. Work Included in This Section. Principal items to be painted include:
   1. All exposed piping, conduits, ducts and other metal surfaces, interior and exterior, except as hereinafter specifically excluded.
   2. All submerged and intermittently submerged metal surfaces, except stainless steel.
   3. The interior of manholes, junction structures, and similar structures.
   4. Equipment furnished with and without factory finished surfaces, except as hereinafter specified otherwise.
   5. Equipment on which factory applied finishes have been marred, abraded, scratched, nicked, or otherwise damaged.

B. Related Work Specified Elsewhere. The following surfaces, in general, shall not be painted:
   1. Plastic surfaces and fiberglass reinforced plastic (FRP) surfaces unless otherwise noted or indicated.
   2. Nonferrous metals and stainless steel unless otherwise noted or indicated. Galvanized metal shall not be considered a nonferrous metal.
   3. Mechanical and electrical equipment with approved factory finish as specified herein.
   4. Waterproofing, dampproofing and roof covering work.
   5. Pavement striping and marking specified in other sections.

C. In no case shall any ferrous metal surfaces, except stainless steel, be left unpainted or uncoated even though not specifically indicated herein or on the Drawings.

D. Contractor shall provide extra paint for touch up by the Owner.

1.02 GUARANTEE

Provide a three (3) year guarantee which commences on the date of acceptance against failure of all coatings. Failure of any coating during the guarantee period shall be repaired by the Contractor who shall absorb all costs related to the repair of the coating.

1.03 REFERENCE SPECIFICATIONS AND STANDARDS

A. Without limiting the generality of other requirements of these Specifications, all cleaning, surface preparation, and coating shall conform to the applicable requirements of the referenced portions of the standards specified herein to the extent that the requirements therein specified are not in conflict with the provisions of this Section.

B. Unless otherwise specified, all work and materials for the preparation and coating of all metal surfaces shall conform to the applicable requirements specified in the Steel Structures Painting Manual, Volume 2, Systems and Specifications 1967, published by the Steel Structures Painting Council.

C. The surface preparation specifications of the Steel Structures Painting Council (SSPC) referenced herein, shall form a part of this Section.

D. Quality Evaluation. Evaluation of surface preparation for ferrous metals will be based upon SSPC-Vis 1 ASTM Designation D 2200 and "Standard Methods of Evaluating Degree of Rusting on Painted Steel Surfaces", SSPC-Vis 2 ASTM Designation D 610.

E. South Coast Air Quality Management District's Requirements. The Volatile Organic Compounds (VOC) levels of all coatings shall comply with the requirements of the South Coast Air Quality Management District (SCAQMD) for shop and field applications, current at the time of application.

1.04 SUBMITTALS

A. Schedule. The Contractor shall submit his proposed schedule of painting and coating to the Engineer for approval not less than 30 working days prior to the start of painting work.

B. Materials List. The Contractor shall submit to the Engineer for approval 6 copies of a list describing the materials he proposes to use. The materials list shall indicate the brand names and the surfaces to which the material is to be applied. Contractor shall also furnish the VOC level of each proposed coating to verify compliance with SCAQMD's requirements.

C. Color Samples. Submit to the Owner/Engineer for approval 2 samples of all selected colors. Painting shall not be started until samples of colors have been approved. For colors to be applied on smooth surfaces, the sample shall be prepared on a flat sheet of metal, tempered hardboard, or other sheet material. The minimum size of sample shall be 8-1/2 by 11 inches. The sample shall show the color of primer, undercoat, and finish coats. The finish coat shall be applied in a band not less than 3 inches wide. The color of the undercoat shall be slightly different from the finish coat so as to be distinguishable in artificial or

natural illumination. The approved colors of the undercoat and finish coats shall be uniform throughout the work.

1.05 PROTECTION OF WORK

A. Place drop cloths where required as a protection from spatter and droppings. Drip and spatter, spots and stains, shall be removed from all surfaces.

B. Provide surfaces not required to be coated, but which are adjacent to surfaces to be cleaned and coated, from stains and damage during the cleaning and coating operations.

C. Handle items of metalwork which have been coated with care and protect their coatings from damage. Repair and restore coatings which have been damaged by handling, shipping, welding, cleaning, painting, or other operations to their original condition. Items of metalwork which have been coated shall not be welded unless damaged coatings are repairable and unless the damaged coatings and repairs can be inspected by the Engineer.

D. Protect from damage all work including the work of others during the time work specified in this Section is in progress.

1.06 MANUFACTURER'S RECOMMENDATIONS

Unless otherwise specified herein, strictly observe the paint and coating manufacturer's printed recommendations and instructions for thinning, mixing, handling, applying, and protection of his coating materials; for preparation of surfaces for coating; and for all other procedures relative to coating. No substitutions or other deviations will be permitted without written permission of the Owner.

1.07 DELIVERY AND STORAGE

A. Delivery. Deliver materials in the original unbroken packages or containers bearing the brand name and manufacturer's name. Do not change or thin materials except as indicated by the manufacturer's printed directions, or as specified herein. When requested, submit complete specifications and samples of materials to the Engineer for approval.

B. Storage. Store and mix materials only in areas designated by the Engineer for that purpose. Keep storage and mixing areas clean and free of rags, waste, and scrapings.

1.08 SAFETY

In accordance with the requirements of the latest revision of the Safety Construction Safety orders of the California Division of Occupational Health and applicable OSHA Regulations for Construction provide and require the use of personal protective lifesaving equipment for all persons working in or about the project site.

A. Respirators shall be worn by all persons engaged in, and assisting in, spray painting. In addition, workers engaged in or near the work during sandblasting shall wear eye and face protection devices meeting the requirements of ANSI Z87.1 latest revision, and approved OSHA Regulations for sandblasting operations and approved air-purifying, half-mask or mouthpiece respirator with appropriate filter.

B. Ventilation. Where ventilation is used to control potential exposure to workers as set forth in Section 1910.94 of the OSHA Regulations for Construction, ventilation shall be adequate to reduce the concentration of the air contaminant to the degree that a hazard to the worker does not exist. Methods of ventilation shall meet the requirements set forth in ANSI-Z9.2, latest revision.

C. Sound Levels. In accordance with Sections 1926.52 and 1926.101 of OSHA Regulations For Construction, whenever the occupational noise exposure exceeds maximum sound levels as set forth in Table D-2 therein during blast cleaning, ear protective devices shall be fitted and determined individually and used, and a continuing, effective hearing safety program shall be administered.

1.09 RIGHT OF REJECTION

The Owner shall have the right to reject all material or work that is unsatisfactory, and require replacement at the expense of the Contractor.

1.10 JOB CONFERENCE

Prior to commencing work a pre-job conference shall be held for the purpose of reviewing and clarifying the painting and coating requirements of the project. The Owner's Representative, Contractor, Applicator, and Coatings and Paint Manufacturers, shall be present. A schedule of work to be accomplished will be established.

PART 2 - PRODUCTS

2.01 GENERAL

Surfaces to receive paint protective coating materials as herein specified in this Section shall be coated in conformance with the applicable coating systems specified herein. All materials specified by name and/or manufacturer or selected for use under these Specifications, shall be delivered unopened at the job site in their original containers and shall not be opened until inspected by the Owner. Whenever a manufacturer's brand name is specified, it is intended to define the general type and quality of paint or coating desired. Other coatings or paints of equal quality may be used. All paint, and coatings shall be produced and applied as herein called for or, if not specifically called for, it shall be applied in accordance with the manufacturer's printed recommendations as approved by Owner. As far as possible, all paint and coating materials shall be provided by a single source supplier.

2.02 PAINTING AND COATING REQUIREMENTS

A. General.

1. Except when specifically or otherwise exempted herein or on the Drawings, all exposed interior and exterior unmachined metal surfaces of piping, valves, equipment, structural steel, including galvanized surfaces, doors and window frames, and other metal work, except nonferrous or stainless steel surfaces, shall be painted in accordance with the requirements hereinafter specified, and as shown on the Drawings. Other pipe coatings are specified in Division 15. Before procuring or fabricating equipment to be finish-coated, submit for approval, by the Engineer, the finished color of each item of equipment.
2. The following listed surfaces shall not be painted:
    a. Concrete surfaces not specified under this Section.
    b. Polyvinyl chloride piping except non-pressure PVC pipe specified or required under another section.
    c. Surfaces having an approved, factory-applied finish, if it matches the Owner color code or requirement.
    d. Concealed electrical conduits.
    e. Concealed galvanized steel, except as otherwise indicated.
3. The finish coats shall be omitted for the exterior surfaces of valves, fittings, and piping in structures with manhole or right-of-way type covers for access. However, except where surfaces are to be top-coated with high solids epoxy, the valve, fittings, and bare metal surfaces of piping shall receive 2 coats of zinc-rich polyamide epoxy primer to achieve a total of 6 mils minimum dry film thickness.
4. Electrical pullboxes shall be hot-dip galvanized. Electrical pullboxes shown on the Drawings to be installed in corrosive environments shall be coated on the interior and exterior with high solids epoxy. The epoxy shall be applied in multiple coats. The finished dry film thickness shall be 30 mils. Except for the pullboxes to be coated with high solids epoxy, galvanized electrical pullboxes as shown on the drawings shall be pretreated with manufacturer's recommended vinyl wash after surface preparation, 1 coat of polyamide epoxy primer and 2 finish-coats of exterior acrylic polyurethane enamel.
5. Except as otherwise specified, galvanized surfaces required to be painted shall be given a vinyl wash pretreatment and prime coat prior to painting. Vinyl wash and prime coat shall conform to the printed recommendations of the finish-coating material manufacturer.
6. Portions of structural steel and surfaces of other metalwork to be wholly embedded in concrete need not be painted; provided, that they shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed. Bottoms of baseplates to be placed on drypack or grout, which have not been galvanized, shall be prime coated with minimum 6 mils dry film

thickness of zinc-rich primer. Bottom of handrail posts shall be coated with zinc-rich primer prior to grouting.

7. Surfaces of stainless steel; electrical outlets, fixtures and switch plates; fiberglass; and fiber-reinforced plastic (FRP) are not required to be painted.
8. Unless otherwise shown on the Drawings, surfaces which will not be accessible after assembly or after installation, except surfaces specified to receive zinc-rich primer, shall be given a second shop coat of primer.
9. Channels, struts, supports, clamps, and miscellaneous metalwork which cannot be adequately or completely painted in place shall be painted prior to installation and the accessible visible portions thereof touched up, if required, after installation.
10. Concrete block masonry surfaces required to be painted shall be given 1 full coat of concrete block and masonry primer and 2 coats of 100 percent acrylic emulsion masonry paint by Dunn-Edwards Corporation, Sherwin-Williams, or an approved equal. If a uniform finish is not obtained with 2 coats, additional coats shall be applied at no additional cost to the Owner.
11. Unless otherwise shown, portions of pipe which extend into the concrete wall of a structure, and are not coated, shall be coated with zinc-rich primer for that portion of the pipe which will be embedded in the wall, and this coating shall extend not less than 3 inches inside and outside the structure. The zinc-rich material shall be applied in multiple coats to produce a dry film thickness of not less than 6 mils.
12. Continuously submerged and intermittently submerged machinery, equipment and piping of carbon steel, including galvanized surfaces, shall be painted with high solid epoxy whether or not it is shown on the drawings.
13. All coatings in contact with water shall be approved for use in potable water systems.
14. After installation of metalwork thoroughly clean all surfaces to be painted and repair all damaged areas in the existing paint film prior to placing of succeeding coats. Repair work shall meet the Engineer's approval. Color paint shall be applied in accordance with the manufacturer's printed directions.

2.03 QUALITY ASSURANCE

A. Definitions. The term "coating materials," as used herein, shall include enamels, paints, sealers, epoxy resins, stains, and all other paints and protective coatings, excepting galvanizing, whether used as a pretreatment, primer, intermediate coat, or finish coat.

B. Product Qualifications.
   1. Paint product names and numbers used in these specifications identify materials which are approved for the use specified. Any change in the formulation or quality control tolerances of an approved product will necessitate fresh approval. Other products will be approved if sufficient proof is submitted to demonstrate that they are equal to the products specified. The Owner's decision in this respect shall be final.
   2. All specified coating systems shall have compatible products of the same manufacturer which includes primers and finish coats.

C. Compatibility. Only compatible materials shall be used in the work. Particular attention shall be directed to compatibility of primers, intermediate coat, and finish coats. If necessary, subject to approval of the Owner, a compatible barrier coat shall be applied between all existing prime coat and subsequent field coats to insure compatibility.

D. Colors. All colors and shades of colors of all coats of paints and protective coating material shall be as selected by the Owner. Each coat shall be of a slightly different shade, as directed by the Owner to facilitate inspection of surface coverage of each coat.

   Finish-paint for metalwork shall match the Federal Standard 595a(68) color listed below, as applicable. The numbers define the required color but do not necessarily indicate the required degree of luster, which shall be full gloss in each case.
   1. Light grey to be selected by Owner, for interior and exterior metal surfaces including structural steel, miscellaneous metalwork platforms, and handrails (except for handrails selected to be painted yellow). In general, the above roof equipment (antenna, vents, exhaust fans, etc.) should be the same color as the roofing
   2. Tan, color No. 20372, for hatch covers and operating handles of valves and equipment;
   3. Exterior finishes for hydrants, traffic and protective posts, doors and louvres, and other metal work shall be painted, in addition to prime coat, of a color to be selected by the Owner.

2.04 PAINTING AND COATING SYSTEMS AND MATERIALS

Materials shall include those listed in the following paragraphs:

A. Ferrous metals other than stainless steel, including architectural steel, doors and window frames, louvres and vents, exposed to normal atmospheric conditions such as valves, pumps, motors, handrails, etc. will require the following coating systems.

Ameron	Amershield Polyurethane topcoat Amerlock 400 Epoxy primer
Devoe/Napko	Prufthane 359 High Build Polyurethane topcoat Chemfast 547 Thixomastic primer
Porter	8610 Hi Build Hi Solids Polyurethane topcoat 7500 Magna Prime primer
Valspar	54-Y-12 V-Thane Polyurethane topcoat 75-W-9 High Solids Epoxy Mastic primer
Sherwin-Williams	Hi-Solids Polyurethane B65W300 top coat Epoxy Mastic Aluminum B62S10 primer

Primers shall be applied to achieve a minimum of 6 mils DFT (those listed can achieve this in one coat). Topcoats shall be applied to achieve a minimum of 4 mils DFT (those listed can achieve this in one coat). If maximum mil thickness or hiding is not accomplished in one coat then subsequent coats shall be applied. Polyurethane topcoats used on this project shall be acrylic types containing pigments that are ground into the coating at the time of manufacturing. All colors shall conform to Federal Specification 595a.

B. Submerged carbon steel items or intermittently submerged carbon steel items such as valves etc. will require coating with the following materials:

Ameron	395 High Solids Epoxy (self priming)
3-M Company	Scotchkote 306 Epoxy (self priming)
Tnemec	104 Hi Build Pota-Pox Epoxy (self priming)
Sherwin-Williams	Hi-Solids Catalyzed Epoxy, B62W201 (self priming)

Materials shall be applied in multiple coats to produce a minimum DFT of 30 mils.

C. Ductile iron and carbon steel contained in vaults and structures such as piping, etc. will require two coats of the following materials;

Ameron	400 Epoxy Mastic
Carboline	Carbomastic 15 Epoxy Mastic
Devoe/Napko	Chemfast 547 Thixomastic
Glidden	5475/5476 Glid Guard Metallic High Build Epoxy
Sherwin-Williams	B62S10 Aluminum Epoxy Mastic
Valspar	75-A-1 Alumapoxy

Materials shall be applied to produce a minimum DFT of 12 mils.

D. Zinc-rich primers applied in 2 coats to achieve 6 mils D.F.T. and not topcoated shall be as follows:

Ameron-Amercoat	68 H.S. Epoxy Zinc Rich
Devoe/Hapko	#14730 Epoxy Zinc Rich
Porter	#308 Zinc Lock Epoxy Zinc Rich
R.R.G.	#UC46079 Aquapon Zinc Rich Epoxy
Sherwin-Williams	Zinc Clad 8

Zinc-rich primers are not to be applied on any items which will receive topcoats consisting of self-priming, high solids epoxy materials.

E. Heat Fusion Epoxy Coating.
   1. Surface Preparation - Metal shall be abrasive blasted to achieve a "white metal" finish in accordance with the requirements of SSPC-5. The blast media selected shall be of such size as to achieve an anchor pattern profile of not less than 1.5 mils nor more than 2.5 mils. Prior to blast cleaning, all oil, grease, and other deposits shall be removed by solvent cleaning in accordance with the requirements of SSPC-1.
   2. Heating.
      a. Metal parts to be coated shall be preheated to the temperature and for the length of time recommended by the coating manufacturer.
      b. Post heat curing of fusion-bonded epoxies shall also be done to the temperature and for the length of time recommended by the coating manufacturer.
   3. Coating Application.
      a. After parts have been preheated, the temperature shall be tested using a calibrated pyrometer. Oxidation of steel prior to coating in the form of "blueing" or any other apparent oxide formation will not be accepted. Whenever such oxidation occurs, said part shall be cooled to room temperature and recleaned.
      b. Heat fusion bonded materials shall be applied using an electrostatic spray apparatus or fluidized bed.
      c. Finished dry mil thickness shall be a minimum of 12 mils to maximum 16 mils to produce a completely holiday-free and uniform surface. After cooling, the entire coated surface shall be tested for porosity using a 67-1/2-volt Tinker and Rasor Model M-1 non-destructive type holiday detector. Random dry film thickness testing will be done using an acceptable calibrated gauge.
      d. During the coating and curing operations, metal parts shall be hand-led with care to avoid damage to the coating. Any damages to the coatings shall be repaired in a manner and with materials recommended by the coating manufacturer.
      e. Areas not required to be coated like bolt holes shall be protected using an approved heat resistant tape.

4. Materials. Materials shall include the following:

3 M	Scotchkote No. 203
Dexter Corp	Hysol DK 18

5. Storing and shipping. Sufficient spacers and padding shall be used during storing and shipping of coated metal parts to prevent damage to the coating. Chains or steel bands shall not be used without the proper padding.

F. Secondary Containment Coating
   1. Product.
      a. Concrete surface protection for secondary containment shall be 35 to 45 mils DFT of a flake filled vinyl ester, Plasite Protective Coatings #4100 or equal.
      b. Concrete surface imperfections (bug holes, etc.) shall be filled and/or sealed with a 100% solids Epoxy filler, Plasite Protective Coatings #9028 or equal.
   2. Application.
      a. Concrete shall be abrasive blast cleaned to remove laitance and to provide a hard, firm, clean and neutral fully-cured concrete surface for coating. After blasting, concrete surface shall be clean, rough, and similar in appearance to medium grade sandpaper.
      b. All surface imperfections shall be filled and sealed in accordance with manufacturers instructions.
      c. Two or more coats of flake filled vinyl ester shall be applied in strict accordance with manufacturer's recommendations.
      d. Visual inspection shall be performed. All coated surfaces shall be free from pinholes, sags, runs, embedded debris, etc.

2.05 SHOP PAINTING OF VALVES, METERS, PUMPS AND OTHER FACTORY PAINTED EQUIPMENT

A. Unless otherwise specified, interior ferrous metal surfaces of all valves, meters, pumps, and other factory painted equipment shall be shop painted as follows: Surface preparation and cleaning shall be as specified for painting these surfaces with not less than 30 mils of high solids epoxy as specified in coating system B. An NSF approved heat fusion epoxy coating as specified in coating system E will be an acceptable alternative.

2.06 FILM THICKNESS

A. Unless otherwise specified, the completed paint coatings shall have the following minimum dry film thicknesses; however, in all cases, paint films shall be sufficiently thick to provide complete concealment of the surfaces to which they are applied:
   1. All metal specified to be painted shall have film thicknesses in accordance with Article 2.04 hereof.

2. Masonry, concrete, or plaster:
    a. Polyvinyl acetate: 3 mils
    b. Enamel: 5 mils

B. Dry film thicknesses shall include shop applied primers, field applied primers, undercoats, and topcoats, but shall not include surface fillers or galvanizing.

2.07 PROTECTION OF SHOP COATED SURFACES

Protect surfaces of all shop prime or finish coated products from solar exposure at all times. Handle with care during transport and storage in accordance with manufacturer's recommendations to avoid damage to the shop coated surfaces.

PART 3 - EXECUTION

3.01 STORAGE, MIXING, AND THINNING

Protect paint and coating materials from exposure to cold weather. Materials shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Do not mix materials of different manufacturers together. Thin packaged materials immediately prior to application in accordance with the manufacturer's directions.

3.02 EXAMINATION OF SURFACES BEFORE SURFACE PREPARATION

Examine all surfaces to be coated, and correct all surface defects before sandblasting or application of any coating material. Beginning the work of this Section without reporting unsuitable conditions to the Owner constitutes acceptance of conditions by the Contractor. Any required removal, repair, or replacement of this work caused by unsuitable conditions shall be done at no additional cost to the Owner. All marred or abraded spots on shop-primed and factory-finished surfaces shall receive touch-up restoration prior to any other coating application.

3.03 PROTECTION OF ITEMS NOT TO BE COATED

Remove or mask prior to surface preparation and painting operations all hardware, hardware accessories, name plate data tags, machined surfaces and similar items in contact with coated surfaces not to be coated. Following completion of coating of each piece, reinstall removed items. Such removal and installation shall be done by workmen skilled in the trades involved.

3.04 SURFACE PREPARATION

A. Clean and dry all surfaces and shall apply protective coatings to surfaces as herein specified. All defects shall be scraped, cleaned, and repaired as required by the Engineer to produce first-class workmanship.

B. On metal surfaces, weld spatter, burns, weld smoke stains and other irregularities shall be carefully removed or repaired, and all welds shall be ground smooth,

burrs shall be removed, and all sharp edges and corners shall be ground to a curve before cleaning the surfaces.

C. Sandblast metal surfaces, except galvanized steel, to be coated with dry sand to "white" metal in accordance with the requirements of Specifications SSPC-SP5.

D. Perform blasting with dry compressed air, compressed-air blast nozzles, and a dry silica sand of a particle size not larger than that which will pass through a 16-mesh screen, U.S. Sieve series. Any dry abrasives used on this Project shall be certified by the California Air Resources Board (CARB) for unconfined blasting pursuant to Section 92520 of Subchapter 6, Title 17, California Administration Code. In sandblasting to "white" metal, remove all mill scale, rust, loose scale, paint, and other foreign matter. After blasting, remove all traces of sandblasting products from the surfaces by cleaning with a vacuum, by brushing with clean brushes made of hair, bristle, or fiber, or by blowing with compressed air from which all oil and water have been removed.

E. The height of the surface profile after blasting shall not exceed 3 mils and the surface shall be a uniform, gray-white metallic color. Apply the first of the protective coatings to the surface within 2 hours after completion of blasting. Do not touch the surfaces between the time of blasting and the time that the coating is applied.

F. Metal surfaces which have been previously sandblasted and given the required shop coats of primer will not be required to be recleaned by sandblasting if the original coat is intact. Clean these surfaces by approved means which will properly prepare them for repriming and finish paint. Wherever any previously primed or painted surfaces have become corroded or damaged, clean the surface to "white" metal by sandblasting before any paint is applied. Clean and repair abraded and bare spots in shop-prime coats with the appropriate metal primer.

G. Galvanized metal shall be clean, dry, and free of dust, dirt, oil, grease, and other deleterious matter. All galvanized surfaces shall be power-tool-cleaned in accordance with the requirements of Specification SSPC-SP3.

H. Remove all grease, dust, bond-breaking materials, and efflorescence from concrete and concrete block surfaces. If efflorescence is present, neutralize the surfaces with 15 percent solution of phosphoric acid. Use a stiff bristle broom or brush to spread the acid solution evenly over the surface. After the foaming action stops, in 3 to 5 minutes, flush the surface thoroughly with water and re-scrub with stiff bristles to remove salts formed by the acid solution. Rinse surfaces again and allow to dry before applying coatings

3.05 APPLICATION OF PROTECTIVE COATINGS

A. General.

1. Perform painting in a skillful and workmanlike manner. Apply paint only on thoroughly dry surfaces, during periods of favorable weather. Allow each coat of paint to dry properly before the succeeding coat is applied. Replace newly applied coatings which are damaged by the elements at no additional cost to the Owner.
2. Do not paint or coat during rainy weather, or when the temperature of the surface to be coated is below 50^{o}F, or is anticipated to be below 50^{o}F within 24 hours. Unless otherwise directed by the Engineer or recommended in the manufacturer's printed instructions, surface, ambient, and paint temperatures shall be between 50oF and 100^{o}F.
3. Use oil and water separators in all compressed-air lines used in spray painting and sandblasting operations, to remove oil or moisture from the air before it is used. Place separators as close as practicable to the equipment. Application equipment shall conform to the requirements and recommendations contained in the paint manufacturer's printed instructions.
4. Do not apply paint or other coating before the Engineer has approved the surface preparation. If paint or other coating has been applied without such approval and the Engineer so directs, remove it by sandblasting or other approved means and recoat the surface in accordance with these specifications, at no extra cost.
5. Place drop cloths where required as a protection from spatter and droppings. Remove drip and spatter, spots and stains, from all surfaces.
6. Items of metal work which have been coated shall be handled with care and their coatings shall be protected from damage. Repair and restore coatings which have been damaged by handling, shipping, welding, cleaning, painting, or other operations to their original condition. Items of metal work which have been coated shall not be welded unless damaged coatings are repairable and unless the damaged coatings and repairs can be inspected by the Engineer.
7. Assembled parts shall be disassembled sufficiently before painting or coating to insure complete coverage by the required coatings. If approved by the Engineer, paint may be applied by brushing, rolling, dipping or spraying; provided, these methods of application are recommended and shown on the coating manufacturer's data sheet; and provided further; that spraying shall not be used where the paint could be deposited on surfaces other than those intended to receive it. Roller or spray applied paint shall have the same dry film thickness as brush-applied.

8. Apply paint evenly without sags or runs. Thoroughly coat rivets, welds, edges, crevices, and other irregularities. If necessary, apply an extra coat to

provide the same resistance to moisture penetration prevailing on adjacent smooth surfaces which have been coated to the required dry thickness.

9. Remove canopies of lighting fixtures and cover and protect the fixtures from damage. Remove electrical switch and outlet plates before painting adjacent surfaces and replace plates on completion of the work. Provide the necessary protection to prevent damage to the painted surfaces and repair all painted surfaces of equipment scratched or damaged. Keep equipment name and description plates free of paint. Remove all paint and thoroughly clean glass surfaces.

B. Application.

1. Apply primers, finish-paints and coatings, and linings in accordance with the printed instructions of the manufacturers of the materials and these specifications. All prime, intermediate, and finish coating materials applied to given surfaces shall be compatible products of the same manufacturer.
2. Apply all zinc-rich prime coatings for piping, valves, equipment, and miscellaneous metal surfaces by brush or spray methods to a minimum dry film thickness of not less than 3 mils.
3. Where coal-tar epoxy is shown on the Drawings, apply the coal-tar epoxy in multiple applications to produce a minimum overall dry film thickness of 20 mils in addition to primer coats. Individual coats shall not be applied in thicknesses which could cause runs. The finished coating shall be uniform in thickness and holiday free.
4. Clean all surfaces of all carbon steel flanges, including the bolt holes, by approved methods and paint with zinc-rich primer sufficient to attain a uniform dry film thickness of 3 mils.
5. Apply intermediate and finished coats to all surfaces primed with zinc-rich primer except the contact faces of flanges, flange bolt-hole surfaces, and contact faces of webs and tap plates.
6. Coat concrete surfaces as specified. Apply the coating in accordance with the manufacturer's printed instructions for such surfaces. Apply coats as recommended by the manufacturer's time intervals.

C. Galvanizing.

1. Steel designated on the drawings, shall be hot-dip galvanized after fabrication.
2. Fabricated steelwork required to be galvanized shall, after the steel surfaces have been thoroughly cleaned of rust and scale, be galvanized in accordance with ASTM Standard A 123-78, except that galvanizing shall withstand seven 1-minute immersions when tested in accordance with the requirements of ASTM Standard A 239-73 (1983).

3.06 TESTING AND INSPECTION

A. Inspection Devices. Furnish, until final acceptance of coating and painting, inspection devices in good working condition for detection of holidays and measurement of dry-film thickness of coatings and paints. Also furnish U.S. Department of Commerce, National Bureau of Standards certified thickness calibration plates to test accuracy of dry-film thickness gauge and certified instrumentation to test accuracy. Dry-film thickness gauges shall be made available for the Inspector's use at all times until final acceptance of application. Operate holiday detection devices in the presence of the Inspector. Operate inspection devices in accordance with the manufacturer's instructions at the direction of the Engineer.

B. Conduct film thickness measurements and electrical inspection of the coated surfaces with equipment furnished and recoat and repair as necessary for compliance with the Specifications.

C. After repaired and recoated ferrous metals areas have cured, final inspection tests will be conducted by the Engineer. Coating thicknesses specified in mils on ferrous substrates will be measured with a nondestructive magnetic type dry-film thickness gage such as the Elcometer, manufactured by Gardner Laboratories, Inc. Discontinuities, voids and pinholes in the coatings will be determined with a nondestructive type electrical holiday detector. Epoxy coatings and other thin film coatings will be checked for discontinuities and voids with a low voltage detector of the wet-sponge type, such as Model M1 as manufactured by Tinker and Rasor. Use a non-sudsing type wetting agent, such as Kodak Photo-Flo, which shall be added to the water prior to wetting the sponge. A high voltage, low current, spark type detector such as Model EP, manufactured by Tinker and Rasor, will be used for electrical inspection of only coal tar enamel. Tape type coatings will be inspected for holidays using a device designed for use in detecting such flaws. All holiday detection devices shall be approved by the Engineer. Mark all pinholes, repair in accordance with the manufacturer's printed recommendations, and retest. No pinholes or other irregularities will be permitted. Measure and verify wide film thickness discrepancies with a micrometer or other approved measuring instrument. Coatings not in compliance with the Specifications will not be acceptable and shall be replaced, and reinspected until the Specifications are met, at no extra cost to Owner.

D. On non-ferrous surfaces, dry film thickness readings shall be taken at random locations with a Tooke Gauge at the rate of approximately five readings per 100 square feet of surface. Repair groove cut into coating by application of all coats of paint or coating film being tested. The average of all readings for a given area or surface shall be within required dry film thickness range and no individual reading shall be more than 20 percent below the recommended dry film

thickness. Any areas that are found to be below standard shall be marked and recoated to obtain proper film thickness.

E. Warranty Inspection. Warranty inspection shall be conducted during the eleventh month following completion of all coating and painting work. All personnel present at the pre-job conference shall attend this inspection. Repair all defective work in accordance with this specification and to the satisfaction of the Owner.

3.07 CLEANUP

A. At the end of each work day place all cloths and cotton waste that might constitute an environmental hazard in enclosed metal containers. Dispose of containers regularly at an approved location.

B. Upon completion of the work, staging, scaffolding, and containers shall be removed from the site or destroy in an approved manner. Remove paint spots, oil, or stains upon adjacent surfaces shall be removed.

3.08 PIPE PAINTING AND IDENTIFICATION

A. General. Exterior surfaces of buried piping shall be painted or coated in accordance with the requirements specified in the City of Anaheim Water Services Standard Specifications. Exterior surfaces of exposed piping shall conform to the requirements specified in Article 2.04 of this Section.

B. Piping Systems. Identification of piping systems shall conform to the requirements of ANSI A13.1, "Scheme for the Identification of Piping System," unless otherwise specified herein.

C. Process Piping Color Identification Code. All exposed pipe, including steel, copper and brass tubing, galvanized steel, and polyvinyl chloride, shall be identified by color and labeling to show its function as selected by the Owner.

D. Process Valve Identification. Conform to the requirements as selected by the Owner.

END OF SECTION 09900

CITY OF ANAHEIM

APPENDIX G

MECHANICAL SPECIFICATION

MECHANICAL SPECIFICATION

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APPENDIX G

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SECTION 15010

MECHANICAL: GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Mechanical equipment.

B. Related Sections include but are not necessarily limited to:

1. Section 09900 - Painting.
2. Section 11005 - General Mechanical and Equipment Provisions.
3. Section 13440 - Instrumentation for Process Control: General Requirements.
4. Division 16 - Electrical.

1.02 QUALITY ASSURANCE

A. Comply with requirements of Section 11005.

B. Perform work in strict accordance with rules, regulations, codes, ordinances, or laws of Local, State, and Federal governments, or of other authorities having lawful jurisdiction. Such rules, regulations, codes, ordinances, or laws include but are not necessarily limited to the following:

1. State building and fire codes.
2. State plumbing and mechanical codes.
3. City building and fire codes.
4. City plumbing and mechanical codes.
5. American Gas Association (AGA).
6. National Electric Code (NEC).
7. National Fire Protection Association (NFPA).
8. Occupational Safety and Health Act (OSHA).

C. Referenced Standards:

1. Air Moving and Conditioning Association (AMCA).
2. American National Standards Institute (ANSI):
   a. B40.1, Gauges-Pressure Indicating Dial Type Elastic Element.
3. American Society of Heating, Refrigeration and Air-Conditioning Engineer (ASHRAE).
4. American Society of Mechanical Engineers (ASME).
5. American Society for Testing and Materials (ASTM):

a. A36, Specification for Structural Steel.

6. Factory Mutual Association (FM).
7. Instrument Society of America (ISA):
   a. S20, Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.
8. National Electric Manufacturers Association (NEMA).
9. Sheet Metal and Air-Conditioning National Contractors Association (SMACNA).

1.03 DEFINITIONS

A. Installer or Applicator: Installer or applicator is the person actually installing or applying the product in the field at the Project site.
   1. Installer or applicator are synonymous.

1.04 SUBMITTALS

A. See Special Provisions Section 2-13.

B. Verify sheet metal shop drawing dimensions, transverse joints, reinforcement, seams, seals, fittings, hangers and miscellaneous appurtenances. Include on fabrication drawings location and connection details of jointed sections to permit access and maintenance of connected equipment, dampers, and controls and to permit removal of connected equipment without disturbing main duct system.

C. Submit copies of any manufacturer's written directions regarding shipment and material handling, installation, operation and maintenance.

D. Detail coordinations, connections, offsets and crossovers in work.

E. Locate and dimension equipment items with reference to other items of work accurately.

F. Operation and Maintenance Manuals:
   1. See Special Provisions Section 1-09.09.

1.05 PERMITS

A. Permits, Fees, Licenses, and Inspections:
   1. Make arrangements for, obtain, and pay for necessary permits, licenses, and inspections. Pay necessary fees in conjunction with mechanical work.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. See narrow scope sections for acceptable manufacturers.

B. Submit request for substitution in accordance with Specification Section 1-06.02.

2.02 MATERIALS

A. Unions:

1. Provide union between valves and connection to each item as required to make up or disconnect piping. Install unions to facilitate removal of parts, equipment of fixtures, for inspection or cleaning. Install in position which will permit device, fixture or part to be removed without disconnecting piping except unions.
2. Use unions of type and material specified under each piping specification.
3. Where mechanical type couplings are used, they may serve as unions. Make connections between couplings and flanged equipment with flanges and flexible couplings.
4. At flanged connections additional flange unions are not required. Make connections to flanged valves and equipment using ANSI type flanges. Use flanges, rated 125 psi. In no case shall flange pressure ratings be less than equipment served or system operating pressure. Where 150 LB steel flanges mate with 125 LB cast-iron flat face flanges, use flat face steel flanges with full face gaskets.

B. Drains:

1. Install drains on plumbing, process or other piping, either as indicated or as required to permit complete drainage of systems. Use drain consisting of 3/4 inch globe valve with hose adapter. Where additional drains are required to drain low points of piping, use minimum of 6-inch length of nipple with valve which may drain that portion of piping only. Provide hose end valves on all piping 2-1/2 inches, and larger and drain cocks on piping 2 inches and smaller.
2. Pipe drains from safety valves and other items where discharge is infrequent or have test levers over edge of equipment or as indicated. Install drains on copper piping with a male iron pipe adapter and threaded brass cap except where valve drains are required.
3. Regardless of pipe size, where drains are installed on piping over electrical equipment or over other piping on equipment where access to drain valve is

difficult, pipe these drain valves to accessible location with hose bib adapter such that system may be drained without damage to equipment.

4. Coordinate work to avoid piping over electrical components (not rated NEMA 4 or better) or provide minimum 16 GA 316 stainless steel pans to protect the electric components. Slope and pipe these pans to drains.
5. Provide 1/8-inch thick heavy wire 316 stainless steel screens with maximum 3/8- inch openings on drains from potable water supply.

C. Vents:

1. Pipe vents from pressure regulating devices in compliance with applicable codes.
2. Provide 1/8-inch thick heavy wire 316 stainless steel screens with maximum 3/8- inch openings on vents from potable water supply.

D. Sleeves:

1. Furnish and install sleeves where required for installation of work under this Division.
2. Where sleeves are set in walls for future connections, close opening with lightweight concrete.
3. Set sleeves true to line, grade, position and plumb or level and maintain so during construction.

E. Pipes and Anchors:

1. Furnish and install pipe anchors as indicated, or as required to permit complete installation of system.
2. Anchors of sufficient strength structural shapes and stainless steel rods with turnbuckles are acceptable unless detailed otherwise.

F. Equipment Anchors:

1. Comply to requirements of Section 11005.

G. Electric Wiring, Motors and Controls:

1. Comply to requirements of Sections 11005 and 13440 and Division 16.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Cutting, Fitting, Repairing, Patching, and Finishing:

1. Arrange and pay for cutting, fitting, repairing, patching, and finishing of work of other trades where it is necessary to disturb such work to permit installation of mechanical work. Perform work only with craftsmen skilled in their respective trades.

2. Avoid cutting, insofar as possible, by setting sleeves, frames, and related work and by requesting openings in advance. Assist other trades in securing correct location and placement of rough-frames, sleeves, openings, and related work for piping.
3. Before cutting obtain permission from Engineer. Cut holes neatly and as small as possible to admit work. Include cutting where sleeves or openings have been omitted. Perform cutting in manner so as not to weaken walls, partitions or floors. Drill holes cut in floors without breaking out around holes.
4. Where cutting of holes through reinforced concrete is necessary, cut by rotary type drill. Use of pneumatic hammer type drills, impact type electric drills, and hand or manual hammer type drills will not be allowed. Locate holes so as not to affect structural sections such as ribs or beams. Layout holes in advance and perform drilling only after approval by Engineer.
5. Where alterations are necessary, including outside trenching, disturbing lawns, walks, paving, etc., or where new or old work join, cut, remove, patch, repair and restore adjacent surfaces and leave in as good condition as existed prior to start of work.

B. Installation of Equipment:
1. Comply to requirements of Section 11005.
2. Use galvanized structural steel installed in areas of high humidity or locations where moisture may collect due to condensation.
3. Use structural steel members conforming to ASTM A36. Furnish with shop coat of red lead primer. Retouch primer after field welding.

C. Provisions for Later Installation:
1. When mechanical work can not be installed as structure is being erected, provide and arrange for building-in of boxes, sleeves, insets, fixtures or devices necessary to permit installation later. Lay out chases, holes or other openings which must be provided in masonry, concrete or other work.
2. Verify nature and arrangements of materials and construction to which this work attaches or passes through.

D. Access to Equipment for Maintenance:
1. Install equipment and piping in such manner as to permit access for normal maintenance. Maintain easy access to motors, drives, compressors, and arrange piping, conduit, and related work to facilitate maintenance. Perform relocation of pipes and other obstacles required to permit access at request of Engineer at no additional cost to Owner.

E. Painting:
1. See Section 09900.

2. If factory finish on equipment is damaged in shipment or during construction, refinish equipment to satisfaction of Engineer.

END OF SECTION 15010

SECTION 15060

PIPING AND APPURTENANCES

PART 1 - GENERAL

1.01 DESCRIPTION

Requirements specified in the General Conditions and Special Provisions form a part of this Section. Furnish all tools, equipment, materials and supplies including all labor required for complete installation, testing, and flushing of piping and appurtenances all as shown on the Drawings and specified herein. All applicable parts of the WSSS shall govern over the requirements of this Section.

1.02 SCOPE OF WORK

A. Work Included in This Section. The Work of this Section shall include the furnishing, installation, and testing of pipe, pipe supports, fittings, specials, thrust blocks, and all required appurtenances as shown on the Drawings and as required to make the entire piping system operable. The systems include water, chemical, air, and drainage piping. The Work shall include, but not be limited to, the following items:

1. Piping from the water production system to distribution system.
2. Instrumentation piping to gages and pressure switches and all tees, flanges, thread-o-lets, nipples, fittings, etc., as required for process connections to instrumentation except where these are specifically required to be furnished under Division 13 or integrally with the mechanical equipment. Coordinate the Work of this Section with Division 13.
3. Piping for the introduction of chemicals into the water being treated.
4. Piping for system quality sampling.
5. Drainage piping.

B. Related Work Specified Elsewhere.

1. Trenching, Backfilling and Compaction related to the installation of piping and appurtenances.
2. Concrete Thrust Blocks and encasement.
3. Process Valves and Regulators.
4. Painting and Protective Coatings.
5. Instrumentation signal tubing.

1.03 CONTRACTOR SUBMITTALS

A. General. Shop and erection drawings, together with other required information specified, shall be submitted in accordance with the requirements of Special Provisions of these Specifications and the requirements specified in this Section.

B. Shop Drawings. Shop drawings, complete with material, grade, and class for all pipe, fittings, and couplings and for all joints, coatings, and appurtenances shall be submitted. Detailed catalog and engineering data sheets shall be submitted for all components such as flexible couplings, rubber gaskets, and insulating joints, and a proposed schedule for delivering and installing the piping shall be included.

C. Erection Drawings.

1. General. Complete erection drawings for all buried and exposed piping shall be submitted. The drawings shall show and identify the pipe, pipe joints, fittings, couplings, joint harnesses, wall sleeves with sealant and backup thicknesses, wall castings, hangers, saddles, straps and other supports, and miscellaneous details.

2. Buried Piping. Erection Plans and Profile Drawings for all buried pipe shall show the following information:

   a. Location, length, wall thickness, and type of joint for each pipe section and fitting to be furnished and installed;

   b. Pipe axis station and elevation at all changes in gradient or horizontal alignment;

3. Exposed Piping. Erection and elevation drawings for all exposed piping shall show the location of the pipe, joints and couplings, critical clearances, orientation of valves, spacings of hangers and supports, and the location and size of anchor bolts.

D. Erection Procedure. The installation drawings shall be supplemented with a set of written procedures for performing the field piping installation. The procedures shall cover in detail the preparation and making of the push-on, mechanical, flanged, welded, caulked, flared, hard-soldered, chemically-welded and screwed joints and couplings; measures to ensure integrity of interior pipe lining and exterior protective coating at all joints and couplings; the method of backing up and sealing the annular spaces in pipe sleeves; and the installation and adjustment of pipe hangers and other supports.

E. Protective Coating. A protective coating schedule shall be submitted, showing shop and field surface preparations, materials, methods of application, dry thicknesses and tests for defects, all in conformance with Section 09900, "Painting and Protective Coatings" unless specified otherwise in this Section.

F. Testing Procedures. Procedures for testing the piping, and arrangements for obtaining and disposing of water for the tests shall be fully described. The equipment for testing shall be itemized. Details of bulkheads, flanges, or caps for the testing of the pipe shall be included with the submittal.

G. Disinfection. Procedures for disinfection of potable water piping shall be fully described including the type of chlorine used, method of application, and details of bulkheads, corporation cocks, caps and chlorine feeding equipment shall be included with the submittal.

H. Calculations. Manufacturer's calculations of wall thickness for steel pipe and outlet design calculations shall be included in the submittal.

1.04 PRODUCT HANDLING, DELIVERY AND STORAGE

A. General. Pipe shall at all times be handled with equipment designed to prevent damage to the interior or exterior coating of the pipeline. Steel pipe with cement mortar lining or having any other special coating or lining shall only be handled with wide canvas or rubber covered slings. Bare cables, chains hooks, or metal bars shall not be allowed to come in contact with the coating.

B. Shipping. When making shipments, all chains, cables and hold-down equipment shall be carefully padded where in contact with the pipe. For steel pipe, when the deformation exceeds one percent of the diameter, each end of the pipe shall be properly braced with approved interior supports or spiders.

C. Unloading. Unloading from the trucks shall be done with care using slings as indicated above for steel pipe. No pipe shall be allowed to fall from trucks. Pipe shall only be unloaded using a crane or fork lift.

D. Gaskets. Gaskets shall be stored in containers or wrappers which will protect the gaskets from ozone and other atmospheric deterioration.

PART 2 - PRODUCTS

2.01 GENERAL

A. General Requirements. All pipe, fittings, couplings, and appurtenant items shall be new, free from defects or contamination, and wherever possible, shall be the standard product of the manufacturer. They shall be furnished in pressure or thickness classes as specified or shown. Unless otherwise indicated the size shown shall be the nominal pipe diameter.

B Length. All pipe shall be furnished in a maximum of 40 foot lengths, unless indicated otherwise.

C. Raised Face Flanges. When carbon steel or stainless steel flanges or flanged valves with raised face will be bolted directly to flat faced FRP, plastic, or cast iron flanged fittings or valves, the raised face shall be removed or spacers approved by the valve or pipe manufacturer may be installed to allow bearing over 100 percent of the flange area.

D. Joints. All pipes above ground shall have screwed or flanged joints. Welded pipes will be permitted, provided that there are sufficient flanges at valves and

equipment to permit easy disassembling. Buried pipes shall have bell and spigot joints, unless welded, flanged or other joints are shown or specified.

E. Mechanical Couplings and Expansion Joints. Pipe mechanical couplings and expansion joints shall be provided at locations shown on the Drawings as a minimum requirement.

F. Grooved Fittings. The Contractor, with the Engineer's approval, may provide Victaulic, Gustin Bacon or approved equal grooved end pipe fittings and connections in lieu of screwed or flanged fittings for steel, cast iron or ductile iron pipe unless otherwise shown on the drawings. Grooved joints and couplings shall conform to paragraph "Mechanical Couplings" herein.

G. Screwed Flanges. Where pipe is furnished with screwed on flanges, the flange is to be screwed tight on the pipe until the pipe end projects beyond the face of the flange. The flange shall then be faced to give a flush finish of the pipe and flange. The flanges shall then be drilled, after attachment to the pipe, to ensure bolt hole alignment.

H. Pipe Schedule. Unless otherwise indicated on the plans, pipe materials shall conform to the piping schedule included at the end of this Section.

2.02 STEEL PIPE (SIZES UP TO 36 INCHES)

A. AWWA C200 Pipe. Pipe shall be AWWA C200 with finished inside diameter after interior lining equal to diameters indicated on drawings. The minimum steel plate thickness shall be 0.25 inches and interior mortar lining shall be per AWWA C205. Steel pipe flanges shall be Flat Face Standard Steel Class F flanges per AWWA C 207. All pipe flanges shall be compatible with the valves, meters, pumps discharges, and other fittings indicated on the drawings. Couplings shall be sized to be compatible with pipe outside diameters.

GENERAL

All steel pipes shall be fabricated in accordance with AWWA C200. Cylinders shall be fabricated from hot-rolled carbon steel sheets or plates conforming to AWWA C200.

The outside diameter of the steel cylinder shall be as indicated on the plans.

Pipe of the type specified herein shall be the product of one company in the business of designing and manufacturing pipe of the type specified.

FIELD WELDING

All field welding shall be in accordance with AWWA C206.

PIPE FLANGES

Flanges shall be standard steel-ring flanges in accordance with AWWA C207, Class F (300 psi), with carbon steel bolts ASTM A193 Grade B7 and carbon steel nuts ASTM A194 grade 2H. Flanges, gaskets, nuts, bolts, and method of attachment shall be in accordance with AWWA C207. Flanges shall be compatible with the existing valves and other fittings indicated on the drawings.

PIPE FITTINGS

Fittings shall be in accordance with AWWA C208.

INTERNAL DESIGN PRESSURE

The internal design pressure is 200 psi, minimum.

PIPE WALL DESIGN STRESS

Pipe wall design stress shall be 50% minimum yield.

MINIMUM WALL THICKNESS

Minimum wall thickness shall be 0.25 inches.

INSPECTION

City or its authorized representative may inspect work and material at the manufacturer's plant. The interior of each pipe section and special shall be clean and free of foreign materials when they are delivered to the site of the work.

CEMENT MORTAR LINING

All steel pipe and fittings shall be cement mortar lined and mortar coated in accordance with AWWA C205. The thickness of the lining and coating, expressed in inches, shall be as listed in the following table.

Type V cement shall be used for coating and Type II cement shall be used for lining.

Diameter (Inches)	Lining Thickness (Inches)	Coating Thickness (Inches)
12 and below	½	¾
14-21	5/8	7/8
24 and above	¾	1

PIPE SPECIALS

Pipe specials shall be field fabricated, field cut and welded to fit the existing offsets and dimensions. Pipe specials shall have a minimum wall thickness of 0.25-inches.

FLEXIBLE COUPLING FOR STEEL PIPE

Sleeve type couplings shall provide a flexible, water tight connection between two plain ends as described on the construction drawings. All couplings shall be standard steel couplings, with body not less than 7 inches long. Bolts for exposed steel couplings shall be hot-dip galvanized. Steel couplings shall be epoxy primed with a minimum thickness of 3.0 mils prior to shipment.

Steel sleeve type couplings shall be Dresser Industries, Inc. – Style 38.

INTERNAL BRACING AND HANDLING

Pipe sections shall be braced internally as soon as practical after cement mortar lining has been applied. Bracing shall remain in the pipe until installation and backfilling have been completed. Pipe sections shall be braced within 12-inches of each end with two 2x4s wedged in the pipe at right angles to each other (for 18-inch diameter pipe and smaller). Pipe shall be lifted by means of a padded forklift or belt slings in such a manner as to minimize bending of the pipe section and prevent damage to the coating. When being transported, pipe shall be supported in such a manner that will prevent distortion or damage to the lining or coating. When not being handled, pipe shall be stockpiled on timber cradles or properly prepared ground with all rock points eliminated. Any pipe section that becomes damaged as a result of improper handling or stockpiling shall be repaired to the satisfaction of the City or shall be replaced with a new unit.

DRAWINGS AND SPECIFICATIONS

Drawings and specifications for the pipe, fittings, flanges, etc. shall be submitted by the manufacturer.

END CONNECTIONS

Pipe ends shall be welded and butt strap (except as otherwise indicated on the drawings).

SHOP TESTING

Upon completion of welding, but prior to lining and coating, each special shall be bulk headed and tested under hydrostatic pressure of not less than one and one half times the pressure for which the pipe has been designed, provided, however, that if straight pipe used in fabricating the special has been previously hydrostatically tested, the circumferential welds may be tested by a dye penetration process using Turco Dry-Check, or approved equal, with no further hydrostatic test. Any pinholes or porous welds which may be revealed by the test shall be chipped out and rewelded and the special retested.

Pipe of the type specified herein shall be the product of one company in the business of designing and manufacturing pipe of the type specified.

Contractor shall certify with documents signed and dated by authorized representatives of both pipe manufacturer and the pipe fabricator that all pipe and

fittings have been manufactured and tested in accordance with these specifications. An Affidavit of Compliance shall be furnished for the pipe.

Contractor shall furnish rubber gasket materials test reports and an Affidavit of Compliance for materials.

B. Mill-type steel pipe shall be welded or seamless steel pipe conforming to ASTM A53-860 type S or E, grade B, standard weight.

1. Grooved Ends. Conform to AWWA C606.
2. Flanges. Flanges shall be in accordance with paragraph 2.01G "Flanges" of this section.
3. Wall Thicknesses. Unless specifically stated otherwise in the Pipe Schedule in this Section or elsewhere in these Specifications, black steel pipe shall have the following minimum wall thickness:

Pipe Diameter	Wall Thickness	Pipe Diameter	Wall Thickness
1/2"	0.109"	5"	0.258"
1"	0.133"	6"	0.280"
1-1/2"	0.145"	8"	0.322"
2"	0.154"	10"	0.365"
2-1/2"	0.203"	12" to 16"	0.375"
3"	0.216"		
4"	0.237"		

The minimum wall thickness specified above shall be for pipe before application of linings and coatings. The diameters indicated on the plans shall be the final inside diameter after application of interior linings.

C. Fittings. Provide welding fittings or grooved fittings as indicated in the Schedule. No fabricated fittings are permitted unless specifically called out on Drawings or with permission of Owner.

1. Welding Fittings. Forged steel conforming to ASTM A-234, standard weight to match pipe.
2. Grooved Fittings. Conform to paragraph "Mechanical Couplings" herein.

D. Buried Steel Pipe. The exterior of buried steel pipe shall be cement mortar coated as shown on the drawings and shall conform to AWWA Standard C205 and Federal Specification SS-P-385a. Cement shall be Type V and coating thickness shall be 1-inch.

E. Mortar Lining of Steel Pipe. Lining may be placed by the centrifugal, pneumatic, or hand method, whichever is applicable. Cement shall be Type II. Material requirements and application procedures for the field joint application of cement

mortar shall be as stated in AWWA Designation C205-80, Field Joint Appendix. Lining thickness shall be ½ inch.

F. The interior of all welded joints shall be accessible for patching and inspecting the mortar lining. Welded joints for piping 12" and smaller shall be not more than 12" from the nearest pipe end. Welded joints for piping larger than 18" shall not be more than 36" from the nearest pipe end. All other joints in or between pipe and fittings shall be made using slip-on flanges at pipe ends and welding neck flanges on welding-type fittings ends; provided, that groove-type couplings may be installed on joint members 12 inches and smaller in nominal diameter, as appropriate.

2.03 DUCTILE IRON PIPE

Ductile iron pipe shall be cement mortar lined unless otherwise indicated in the pipe schedule and shall conform to the following requirements:

A. Pipe and Specials. Unless otherwise specified elsewhere, ductile iron pipe shall have a minimum wall thickness in accordance with Class 52 for sizes 4 inches to 12 inches, a minimum wall thickness in accordance with Class 51 for sizes above 12 inches, and shall conform to the requirements of ANSI/AWWA Specifications: ANSI/AWWA C150/A21.50 and AWWA/ANSI C-151/A21.51

B. Fittings. Fittings in pipe lines rated at 175 psi and less shall conform to the requirements of ANSI/AWWA C110/A21.10, Class 350 for up to 24 inches.

C. Lining and Coating.

1. Mortar Lining. Ductile iron pipe and fittings furnished for this project shall be cement mortar lined with seal coat per ANSI Specification A21.4 (AWWA C104).
2. Coatings. Exterior surfaces of exposed pipe shall be coated in accordance with Section 09900 "Painting and Protective Coatings". Exterior surface of buried pipe shall be coated with a bituminous coating per ANSI/AWWA C-151/A21.51.
3. Provide polyethylene encasement protection for all buried ductile iron pipe per AWWA C105.

D. Joints. Exposed joints shall be flanged or restrained mechanical joints unless otherwise shown on Drawings. Buried joints shall be push-on or mechanical joints. Joints shall conform to the requirements of ANSI A21.15 (AWWA C115) or A21.11 (AWWA C111). Push-on joints shall be restrained with Field Lok ® gaskets and mechanical joints shall be restrained with Megalugs ®.

E. Grooved End Fittings and Joints.

1. Grooved end ductile iron pipe shall conform to AWWA C-606, of the latest revision, for rigid grooving dimensions.
2. Fittings shall conform to the requirements of ANSI Specification A-21.10 or AWWA C-110, of the latest revision, with the exception of the end

preparation. End preparation shall be a radius grooved configuration conforming to AWWA C-606.

3. Couplings shall conform to AWWA Standard C-606. Coupling gaskets shall be suitable for use with ductile iron pipe.

4. Transition flanges, Victualic Style 341/342, or equal shall be used to facilitate connection from grooved pipe or fittings to 125# cast iron flanged valves, pump, pipe, fittings, or other equipment. The transition flanges shall be malleable iron conforming to ASTM Specification A-47 or ductile iron conforming to ASTM A-536. Gaskets shall have properties as designated by ASTM D-2000 and shall be suitable for the required service.

F. Thrust Restraint. The connecting joints between existing pipe and existing valves are not known. The Contractor shall exercise due caution during the abandonment of pipe and valves, including any temporary bracing until permanent restraints are serviceable.

Permanent restraints shall follow the details shown on the plans and as called for by the water inspector after a field determination can be made. The City's water inspector will verify that the thrust restraint device proposed by the Contractor will be acceptable for the site conditions.

2.04 POLYVINYL CHLORIDE SCHEDULE PIPE AND FITTINGS

Pipe and fittings shall conform to the following requirements:

A. Polyvinyl Chloride Pipe. Polyvinyl Chloride Pipe shall be of unplasticized compounds suitable for use with chemicals and sewage, as shown on the Drawings and as specified and shall bear the seal of approval to this effect from an accredited testing laboratory. Pipe shall conform to the requirements of ASTM Designation D1785, Schedule 80, Designation PVC 1120, and the fiber stress for deriving the short-time burst pressure requirement in accordance with Table 6, therein, shall not be less than 6,000 psi at 73.4 ^{o}F.

B. Polyvinyl Chloride Pipe Fittings. Fittings shall conform to the requirements of ASTM Designation D2467-76a, Class 12454-B for socket type and ASTM Designation D2464-76 for threaded type.

C. Rigid, Unplasticized Compounds. Compounds for pipe and fittings shall conform to the requirements of ASTM Designation D1784-81, Class 12454-B.

D. Joints in PVC Pipe and Fittings. Joints shall be the solvent-welded socket or flanged type. Flanges, where shown, shall be 150-pound, and shall be of the same material as the pipe.

E. Bolts. Bolts for use with PVC flanges shall be type 316 stainless steel.

F. Gaskets. Gaskets shall be Viton only.

2.05 STAINLESS STEEL TUBING AND FITTINGS

A. Stainless steel tubing shall conform to ASTM Standard A269-84c for Type TP316 and shall have a wall thickness not less than 0.065-inch. Fittings for tubing installation shall be compression-type made from Type 316 stainless steel and shall have a pressure rating equal or greater than that of the tubing. Fittings shall be "Swagelok", Parker-Hannifin, or an approved equal.

B. Stainless steel tubing shall be installed in accordance with the applicable requirements for installing copper tubing. Every cut made on tubing shall be reamed. Bends in tubing shall be made with elbow fittings, except that bends may be made with a proper bending tool if a bend without a fitting has been indicated on the Drawings and only when specifically permitted by the Engineer.

C. Tubing shall be installed with stainless steel accessories as shown on the drawings in a workmanlike manner to the satisfaction of the Engineer. Only mechanics and pipefitters skilled in their respective trades shall be engaged in this work. Parallel lines shall be held truly parallel by means of an adequate number of supports. No waviness or sagging of the lines will be permitted.

D. All tubing and connecting piping shall be flushed out with hydraulic fluid to assure the Engineer that all lines are free from obstructions, dirt, and foreign matter. The lines shall show no leaks during the operational testing of the pumps. All leaks shall be repaired to the satisfaction of the Engineer. All tests shall be made in any manner that will prevent complete inspection and tests of the installation.

2.06 MECHANICAL COUPLINGS

A. Grooved End Couplings. Couplings shall engage and lock the grooved or shouldered pipe ends allowing some degree of contraction, expansion, and angular deflection. Coupling housing shall be of ductile iron or malleable iron and shall consist of two or more segments held securely together by at least two steel bolts. Sealing gasket shall be of such design that internal pressure in the pipe increases the tightness of the seal and shall be of materials suitable for the intended service. The coupling shall have a rated working pressure not less than the pressure rating of the pipe. Couplings shall be Victaulic style 7 or 77, Gustin-Bacon No. 125 or approved equal.

B. Flexible Couplings. Flexible (sleeve) couplings shall be of the full sleeve type, split sleeve type, or flanged adapter type, as shown on the Drawings, specified herein, or as otherwise permitted by the Engineer. They shall provide the requisite pipe flexibility without jeopardizing pipe joint integrity due to hydraulic thrust, and shall have the same pressure-rating as the pipe. Couplings shall have all metal bearing surfaces and shall be provided with 316 stainless steel bolts and age hardened steel nuts. Flexible couplings shall be restrained unless the Engineer has given his approval to omit this feature for specific cases. For ductile iron pipe installation, the WSSS material call outs for flexible couplings shall govern over these specified herein.

1. Full Sleeve Type Couplings shall be properly gasketed and shall be of a diameter to fit the pipe. Each coupling shall consist of a steel middle ring, 2 steel followers, 2 gaskets, and the necessary steel bolts and nuts to compress the gaskets. The couplings shall be Dresser Style 38, Smith-Blair Type 411, or equal. Couplings to be installed underground shall be painted with 30 mils high build epoxy.
2. Split Sleeve Type Couplings shall consist of one gasket, 2 housing clamps, and 2 bolts and nuts to obtain the flexibility for connecting the piping. Steel shoulders shall be provided and welded to the pipe ends to accommodate the couplings. The couplings shall be Kuhns, Ductile Iron Pipe Lock Coupling; M.B. Skinner Seal; or equal.
3. Flexible Flanged Coupling Adapters shall be of the sleeve type, consisting of steel middle ring, steel followers, gaskets, and steel bolts and nuts to compress the gaskets. The couplings shall contain anchor studs of strength adequate to hold the pipe together under a pull equal to the longitudinal strength of the pipe at a tensile stress of 20,000 psi, and shall be Smith-Blair No. 913, Dresser Style 128, or equal. Couplings to be installed underground shall be painted with 30 mils high build epoxy.

2.07 WALL CASTINGS

Wall castings shall be flanged cast iron or fabricated steel construction with wall thickness and lining equivalent to the attached pipe, except in no case shall the wall thickness be less than 0.1345-inch. The casting shall incorporate a water stop/thrust reaction ring cast-on or secured to the barrel by continuous welds on both sides of the ring. The ring shall have a minimum width of 7/8-inch and a minimum thickness of 1/4-inch for 4" and smaller barrel size, increasing uniformly to 4-inches minimum width and 1/2-inch minimum thickness for 36-inch barrel size.

2.08 PIPE HANGERS AND SUPPORTS

Unless otherwise shown or specified, pipe hangers, brackets, saddles, clamps, and other supports shall be adjustable type conforming to the requirements of ANSI B31.1, Section 6; shall have ample strength and rigidity to resist the hydraulic thrusts at changes in direction and at dead ends as well as the dead weight loads and the load carried; and shall be hot-dip galvanized. Where not specifically identified or called out on the Drawings, computations showing adequacy of Contractor selected hangers and supports to meet these requirements shall be submitted with the Shop Drawings. Hangers and supports so identified on the Drawings does not relieve the Contractor from meeting all requirements specified herein. Wherever possible, brackets shall be used in lieu of hangers.

A. General. Hangers and supports shall include all hanging and supporting devices of metallic construction shown, specified, or required for pipe lines, apparatus, and equipment other than electrical equipment. The Contractor's working drawings, as required herein, shall show the quantity, type, design, and location of

all hangers and supports required under the various Contract items. Hangers and supports shall be painted the same as required for the supported piping.

1. Where specified or shown, bolts, stud bolts, rods, yokes, and nuts of hangers and supports shall be of 316 stainless steel for submerged application and 304 stainless for other applications. Bolts shall not be less than 1/2-inch diameter unless otherwise called for on the Drawings.
2. Except where otherwise shown, specified, or required, hangers, supports, anchors and concrete inserts shall be the standard types as manufactured by Elcen Co., Grinnell Co., Fee and Mason Manufacturing Co., or equal meeting the requirements specified herein. Unless otherwise approved by the Engineer, all hangers, supports, and concrete inserts shall be listed with the Underwriters' Laboratory.

B. Design. Hangers and supports shall be adequate to maintain the pipe lines, apparatus, and equipment in proper position and alignment under all operating conditions and have springs where necessary. Hangers and supports shall be of standard design where possible, and be best suited for the service required, as approved by the Owner. Where required, they shall be screw adjustable after installation. Supporting devices shall be designed in accordance with the best practice and shall not be unnecessarily heavy. Sufficient hangers and supports shall be installed to provide a working safety factor of not less than 4 for each hanger, assuming that the hanger is supporting 12 feet of pipe filled with water. Hangers and supports shall be designed to resist all induced thrusts and lateral loads as required for seismic design by Uniform Building Code, 1997 edition.

1. Hangers and supports shall be designed and selected in accordance with MSS Standard Practices: SP-58, Pipe Hangers and Supports - Materials and Design; and SP-69, Pipe Hangers and Supports - Selection and Application.

C. Supports for PVC Piping. Rigid plastic piping normally shall be supported by the same type of hangers used with steel pipe, except that in no instance will C-clamp, or other point-bearing supports be allowed. Riser clamps, if required, shall be full-circumferential type only. Support spacing shall be based on the plastic pipe manufacturer's recommendations for the service conditions but not more than 5 feet on center.

D. Saddle Stands. Saddle stands shall be of adjustable type. Each stand shall consist of a length of wrought pipe fitted at the base with a standard screw threaded cast iron flange and at the top with an adjustable saddle or roll. The base flange shall be bolted to the floor or foundation. Stanchions shall be of similar construction to the saddle stand, except that they shall be fitted at the top with cast iron pipe saddle supports or with pipe stanchion saddles with yokes and nuts. Where adjustable supporting devices are not required, pipe lines 3 inches in diameter and smaller may be supported on approved cast iron, malleable iron, or wrought steel hooks, hook plates, ring or ring plates.

E. Anchors. Anchors shall be furnished and installed where specified, shown, or required for holding the pipe lines and equipment in position or alignment. Anchors shall be designed for rigid fastening to the structures, either directly or through brackets. The design of all anchors shall be subject to approval by the Owner.

1. Anchors for piping shall be of the cast iron chair type with wrought steel strap, except where anchors form an integral part of pipe fittings or where an anchor of special design is required.

F. Inserts. Inserts for concrete shall be furnished galvanized and shall be installed in the concrete structures where required for fastening supporting devices. They shall be designed to permit the rods to be adjusted horizontally in one plane and to lock the rod nut or head automatically. Nail slots shall be provided in the exposed flanges of the insert. Inserts shall be designed to carry safely the maximum load that can be imposed by the rod which they engage.

G. Materials. No use shall be made of wire, straps, chains, etc., for supporting piping nor shall cast expansion shields be used for anchoring bolts. Hangers and supports of metallic construction shall conform to the requirements specified herein and to the following standards:

1.	Structural steel	ASTM A36 and A283
2.	Steel bars (grade 1022)	ASTM A107
3.	Steel castings (grade N-1)	ASTM A27
4.	Iron castings (grade 35)	ASTM A42
5.	Cast iron pipe fittings	ANSI B16.1 (class 125)
6.	Malleable iron castings	ASTM A47
7.	Bolting materials, steel	
	a. Bolts, yokes and stud bolts	ASTM A307
	b. Nuts	ASTM A563
	c. Physical requirements	
	(1) Tensile strength	60,000-72,000 psi
	(2) Yield strength	38,000-50,000 psi
	(3) Elongation	27 percent maximum
	(4) Reduction of area	35-55 percent
8.	Bolting materials, silicon bronze	
	a. Bolts, stud bolts, yokes and nuts (alloy A)	ASTM B98
	b. Physical requirements:	
	(1) Tensile strength	70,000 psi minimum
	(2) Yield strength	38,000 psi minimum
	(3) Elongation	17 percent maximum
9.	Bolting materials, stainless steel	

a. Bolts, stud bolts and nuts — ASTMA 276 (type 316)

b. Physical requirements:

(1) Tensile strength — 75,000 psi minimum

(2) Yield strength — 30,000 psi minimum

(3) Elongation — 35 percent maximum

(4) Reduction of area — 45 percent maximum

10. Where specified or shown, bolts, stud bolts, rods, yokes and nuts of hangers and supports shall be of stainless steel as specified above with dimensions, threads and sizes equivalent to those specified in steel.

H. Supports for Piping. Brackets for support of piping from walls and columns shall be made of welded wrought steel and shall be designed for three maximum loads classified as follows:

1. Light — 750 pounds
2. Medium — 1,500 pounds
3. Heavy — 3,000 pounds

When medium or heavy brackets are bolted to walls, back plates of adequate size and thickness shall be furnished and installed to distribute the load against the wall. When used on concrete walls the back plates shall be cast in the concrete. Where the use of back plates is not practicable, the brackets shall be fastened to the wall in such a manner that the safe bearing strength of the wall will not be exceeded. Pipe rolls or chairs shall be of the cast iron type. Pipe rolls shall be provided with threaded rods.

I. Spacing of Hangers. Pipe support spacing requirements are indicated on the Drawings or elsewhere in these Specifications, but in no case shall the spacing of hangers exceed the following:

MAXIMUM UNSUPPORTED PIPE SPAN
(FEET)

NOMINAL PIPE SIZE-INCHES	DUCTILE IRON	STEEL	PVC SCH 40 OR 80 MAX T=130^{o}F
1/2	-	5	3.0
3/4	-	6	3.0
1	-	7	3.33
1-1/4	-	7	3.33
1-1/2	-	9	3.5
2	-	10	3.5
2-1/2	-	11	4.0
3	-	12	4.25
3-1/2	-	13	4.25

4	8	14	4.5
5	10	16	-
6	10	17	4.8
8	10	19	-
10	10	22	-
12	-	23	-
14	-	25	-
16	-	27	-

* Spacing for guides, legs, supports shall be based on the manufacturer's recommendation for a temperature difference of 75 ^{o}F.

J. Where concentrations of valves, fittings, and equipment occur, closer spacing of supports will be required. In no case shall any total hanger load (weight of piping, insulation, and contents) exceed the following load carrying capacities for hot rolled steel rod ASTM A36-77a):

Nominal Rod Diameter - Inches	Maximum Safe Load - Pounds Maximum Temperature 650 ^{o}F
1/2	1,130
5/8	1,810
3/4	2,710
7/8	3,770
1	4,960
Nominal Rod Diameter - Inches	Maximum Safe Load - Pounds Maximum Temperature 650 ^{o}F
1-1/8	6,230
1-1/4	8,000
1-3/8	9,470
1-1/2	11,630

K. Support of Vertical Pipes. Where vertical pipe runs exceed 10 feet, and a support system is not indicated on the Drawings, provide carbon steel riser clamps for support and steadying of the pipe. Where possible, riser clamps shall be fitted and bolted below a coupling, flange, or hub. Maximum spacing of clamps shall be 10 feet.

PART 3 - EXECUTION

3.01 GENERAL

A. Care and Handling of Materials. All materials shall be carefully handled in all steps of fabrication, storing, loading, transporting, unloading, storing at the site,

and installation, using the means and following the procedures submitted with the approved shop drawings. All steel pipe over 12-inch size shall be fitted after fabrication with internal bracing and stulls at both ends as a protective measure against deformation and injury to mortar lining. Pipe slings used during handling, and tie-down straps during transit shall be not less than 4-inch wide flat fiber or plastic straps. During storage and in transit, pipe 8-inches and larger shall be rested on saddles or on another support system approved by the Engineer, which will insure freedom from damage of the barrel, interior lining, and exterior coating. Not less than 3 saddles or other longitudinal pipe supports shall be used during transit.

B. Installation.

1. The different kinds of piping (buried and exposed) shall be installed in accordance with the approved shop drawings and the erection procedures submitted with the approved shop Drawings. Such procedures and methods shall conform to or exceed the minimum requirement of the pipe manufacturer, and shall be as supplemented by the provisions specified herein. The interior of pipe, fittings, and couplings shall be clean and free from contamination when installed and effective means shall be taken to prevent the entrance of foreign matter during progress of the work. The types and sizes of pipes and fittings to be used shall be as specified herein and as shown on the Drawings. Where fittings are omitted from the Drawings, they shall be the same size as the piping and in all cases shall conform to the plumbing code requirements.

2. All pipe shall be carefully placed and supported at the proper lines and grades and where practicable shall be sloped to permit complete drainage. Piping runs shown on the Drawings shall be followed as closely as possible, except for minor adjustments to avoid architectural and structural features. If relocations are required, they shall be approved by the Owner.

C. Joints. In erecting the pipe, a sufficient number of screw unions, flanged joints, or mechanical couplings shall be used to allow any section or run of pipe to be disconnected without taking down adjacent runs. Screw unions may be employed on pipelines 3 inches in diameter and under. Flanged joints or mechanical couplings shall be employed on pipe 4 inches in diameter or larger unless otherwise shown on the Drawings. Dielectric unions must be installed at the junction of dissimilar metals.

D. Storage and Handling. During storage, handling, and transporting, every Precaution shall be taken to prevent injury to pipe. Pipe shall be handled only by means of approved hooks on ends of sections, by means of fabric slings, or other methods approved by the Engineer for the pipe used. Mortar lined pipe shall be kept sufficiently moist to prevent drying out of the mortar lining prior to installation.

E. Verification of Dimensions. All dimensions essential to the correct location of the pipe, or fit of piping at equipment and valves, or to the proper location and orientation of pipe sleeves and wall castings, or to the avoidance of obstructions or conflict with other improvements, shall be accurately determined by the Contractor prior to fabrication of the piping involved. All required changes from the nominal locations shown on the Drawings shall be made by the Contractor and shall be included as a part of the work hereunder and be approved by the Owner.

3.02 BURIED PIPING

A. Buried Pipe Installation. Buried piping shall be laid to the grades and alignment shown on the Drawings, and all trenching, bedding, and backfilling shall conform to the applicable requirements of Division 2; other work shall conform to the following sections of AWWA Standard C600:

Section 2,	"Inspection, Receiving, Handling and Storage";
Section 3.l,	"Alignment and Grade";
Section 3.3,	"Pipe Installation";
Section 3.4,	"Joint Assembly";
Section 3.6,	"Valve and Fitting Installation";
Section 3.8,	"Thrust Restraint";

The foregoing requirements shall govern the work, regardless of the type of pipe installed unless a more stringent requirement is specified. When the work is not in progress, open ends of pipe and fittings shall be securely closed. The piping shall be placed when trench and weather conditions are suitable. No pipe shall be laid in water, and responsibility for the diversion of drainage and dewatering of trenches during construction, including meeting all safety requirements, shall be borne by the Contractor. All pipe in place shall be approved as to line, grade, bedding, and proper joint construction before backfilling. In all backfilling operations, the Contractor shall be responsible for preventing damage to or misalignment of the pipe.

B. Joint Installation. Installation of joints and couplings for buried piping shall conform to the following requirements:

1. Joints for pipe 4-inch diameter and over, shall comply with the supplementary requirements specified herein, and joints of all sizes shall conform to the applicable requirements specified hereinafter for aboveground piping. Care shall be taken to keep pipe in correct alignment when making joints. Friction or lever pullers or other approved means of insuring straight pulling shall be used on pipe larger than 8 inches and also on smaller sizes where damage to the end might occur. The "popping-on" of joints will not be permitted. The fitting of piping to valves, hydrants, and wall castings shall be worked out in advance of installation to ensure correct orientation of the mating ends and bedding of approach piping.

2. Provide restrained type joints at all joints of pipe with specials and fittings in piping of lower pressure rating. Welding and qualifications of welders shall conform to the requirements of AWWA Specification C206, with welding procedure and welders to be qualified for the specific type of welding within each section of pipe.

3. The interior mortar lining of pipe at joints shall be smoothly continuous and of full thickness. Flanges, flange bolts, and other exterior surfaces of restrained joints and flanged couplings shall be given two coats of a coal tar base coating suitable for the purpose. Where coatings of pipe and valves or appurtenances do not lie in the same plane, the offset shall be filled gradually with a suitable epoxy putty to provide a smoothly continuous joint.

4. Sleeve type couplings installed underground shall have hot-dipped galvanized sleeves, with steel bolts. The complete sleeve and bolts shall be coated with a 20 mils coal tar epoxy and wrapped in 20 mil thick plastic sheeting before backfilling. Cover with sand before backfilling if sand is not required as pipe zone material.

5. Joint Harnesses shall be provided at sleeve type coupling joints. The harnesses shall be tightened just sufficiently to preclude displacement of the downstream piping under hydraulic thrust.

6. Silver solder shall be used for soldered joints in buried tubing.

C. Thrust Blocks. On all pressure pipelines 4 inch and larger with bell and spigot joints, concrete thrust blocks shall be provided at all fittings and dead-ends, and at bends greater than 22.5 degrees. The concrete shall conform to the requirements for 2,000 psi (see pg. 03300-3, Sect. 1.04.A.2.b) concrete as specified in Section 03300, "Cast in Place Concrete," and shall be placed against properly dampened, undisturbed soil, centered on the thrust resultant line. The concrete shall be free of joints, and any mortar contaminating the joints shall be removed.

D. Coverage. Unless otherwise shown on the Drawings, all buried piping shall have a coverage of at least 36 inches between the top of the pipe and the finished surface. Variations from the pipeline grade and alignment may be allowed to accommodate fabrication with the approval of the Engineer. All changes of grade shall require the approval of the Engineer on the installation drawings.

3.03 ABOVE GROUND NONBURIED PIPING

A. Pipe Installation. Install all piping in accordance with the erection drawings and the erection procedure submitted with the approved shop or erection drawings. The horizontal piping shall be run parallel to the building walls and shall be level except where otherwise shown or specified; parallel lines shall be grouped on the same horizontal or vertical plane wherever possible. Vertical piping shall be plumb, and the entire piping configuration shall allow adequate clearances for convenient access for painting and preventive maintenance of valves. Piping shall clear obstructions, preserve headroom, and keep openings and passageways

clear. If structural difficulties or other work prevent the running of pipes or the setting of equipment at the point indicated on the Drawings, the necessary minor deviations there from, as determined by the Contractor and approved by the Owner, will be allowed, and shall be shown on the erection drawings to be furnished. Except as otherwise shown or specified, piping installation work shall conform to the requirements of ANSI B31.1.0 and the printed or written recommendations of the manufacturer of the product involved for the given conditions.

B. Joint Installation. Installation of joints and couplings shall conform to the following requirements:

1. Joints and Couplings. Joints and Couplings shall be made in accordance with the specified requirements made part of the erection procedure submitted by the Contractor.

2. Steel Pipe with Welded Fittings. Joints in welded piping shall be made by oxyacetylene or electric arc process in accordance with AWWA Standard C206.

3. Pipe Threads. Pipe threads shall be in accordance with the requirements of ANSI B2.1, and shall be cut full and free from torn or ragged surfaces. No more than three threads on the pipe at any joint shall remain exposed after installation. Threaded joints shall be established with Teflon tape applied to the male ends only. The use of thread cement or caulking of threaded joints to stop or prevent leakage will not be permitted. Sharp-toothed pipe wrenches or similar wrenches shall not be used in making up copper or brass pipe.

4. Flanged Joints. Flanged joints shall be made with gaskets centered in the joint. Bolts, studs, and nuts shall be lubricated with graphite and oil so that the nuts can be turned by hand. Care shall be taken to prevent excessive initial tension to the bolt and studs and so that the tension applied is as nearly uniform as possible. The rust preventive compound applied to the faces of flanges before shipment shall be removed before installation. Where slip-on flanges are used, they shall be fillet welded to the pipe on both front and back sides.

5. Tubing. Tubing which is to be soldered shall be cut square, and all burrs shall be removed. Both the inside of the fitting and the outside of the tubing shall be well cleaned with steel wool before sweating. Care shall be taken to prevent annealing of fittings or hard-drawn tubing when making connections. Joints for soldered fittings shall be made with a 95-5 tin antimony solder and #50 flux. Tubing to be coupled with flared compression type fittings shall conform to the applicable provisions of the Joint Industry Conference (JIC) Standards and the recommendations of the manufacturer.

6. Mechanical Coupling Type Joints of the sleeve, grooved mechanical, split sleeve, and flanged coupling adapter types shall be made in accordance with

the printed instructions of the manufacturer. The pipe ends to receive the couplings shall be finished to the outside diameter and surface finish required by the coupling manufacturer. Prior to assembly, all surfaces which will be inaccessible after installation shall be given protective coating.

7. Joint Harnesses shall be provided at sleeve type coupling joints. The harnesses shall be tightened just sufficiently to preclude displacement of the downstream piping under hydraulic thrust.
8. Electrical Insulation joints shall be provided at all connections between dissimilar metals and ferrous and non-ferrous pipe except where the nonferrous pipe is an electrical non-conductor. The joints shall be tested after completion to verify non-conductivity.
9. PVC Pipe Joints at fittings and couplings to valves and equipment shall be made in accordance with the manufacturer's printed instructions.

3.04 INSTALLATION OF STEEL PIPE

Install steel pipe as shown on the Drawings. Securely anchor horizontal and vertical pipe by means of pipe hangers or supports. Sufficient unions shall be provided to facilitate taking down pipe. Pipe ends shall be reamed to the full bore of the pipe. Threads shall conform to the requirements of ANSI B2.1-1968. In making up threaded joints, Teflon tape shall be applied to the male ends only.

3.05 INSTALLATION OF DUCTILE OR CAST IRON PIPE

The WSSS shall govern over this specification.

A. Pipe Laying.

1. Inspection. All pipe shall be carefully inspected by the Owner's representative for defects before installation. Such inspection shall include light tapping with a hammer while the pipe is suspended in the air. No pipe or fittings which are cracked or which show defects excluded by the Specifications for such pipe or fittings shall be used. All injuries to the protective coating of the pipe or fittings shall be carefully repaired by the Contractor.
2. Cleanliness of Material. All pipes, valves, and fittings shall be carefully cleaned before installation. Every open end of a pipe shall be carefully and securely plugged or capped before leaving the work.
3. Positioning. For bell and spigot pipe, the position or direction of bells, which shall normally face upstream of the flow, may be altered from the positions shown on the Drawings with the permission of the Engineer. Bells and spigots must be thoroughly cleaned and free from oil, grease, blisters, and excess coating before spigots are inserted into bells. The spigot end of

the pipe shall be brought to true line and grade and be inserted to the full depth of the socket before the joints are made. The inner surface of the pipe shall be of uniform width and depth. If any pipe does not allow sufficient space for jointing material, it shall be replaced by one of proper dimensions.

4. Deflection. The maximum deflection in bell and spigot cast or ductile iron pipe joints shall be such that the joint opening measured at the outside of the pipe shall not exceed 0.8 inch and the caulking space shall be not less than 0.24 inch.

5. Anchorage. Anchorage lugs shall be provided where there is a possibility of pulling the joint under pressure. Concrete thrust blocks may be used in lieu of the above for buried pipe.

6. Piping Through the Walls. Where pipes pass through walls, care shall be exercised to insure joints being watertight. The pipe shall be free of all dirt and grease to secure a tight bond with the concrete.

B. Rubber-Ring Joints. Between lengths of buried cast or ductile iron pipe, rubber gasket joints may be used. Joints shall conform to AWWA C111. Installation shall be in accordance with the Manufacturer's printed recommendations. Gasket seats and rubber gaskets shall be thoroughly cleaned before assembly. The completed joint shall have a uniform contact by the gasket between the outer surface of the spigot and the gasket seat of the bell.

C. Flanged Joints. Flanged pipe shall be cut true to length. Joints shall be made up square, with even pressure upon the gaskets and shall be perfectly water-tight. Gaskets shall fit the inside dimension of the pipe accurately, so that no surplus material projects out into the flow area. The completed joint shall be smooth and properly aligned.

3.06 INSTALLATION OF POLYVINYL CHLORIDE SCHEDULE PIPE

A. Laying. Install plastic pipe where and as shown on the Drawings. The trench for buried plastic piping shall be excavated to six inches below the bottom of the pipe and filled to proper grade with course sand, thoroughly tamped. After the pipe is laid the trench shall be backfilled with sand to 12 inches above the top of the pipe. The remainder of the trench shall then be backfilled in accordance with Section 02221.

B. Fittings. Fittings for plastic pipe shall be flanged or of the socket type using the solvent weld process. Transition from plastic to steel pipe shall be by flanges or by threaded slip joint plastic adapter or fittings. No plastic pipe shall be threaded. No solvent shall be used on threaded end of plastic adapters or fittings.

C. Anchorage. All line valves and fittings at down pipes shall be anchored to the wall in a manner to prevent stress and rotation of the pipe.

D. Joints. Joint material for plastic pipe shall conform strictly to the printed recommendations of the pipe manufacturer. Solvent weld connections shall be made as follows:

1. Joints shall be wiped clean and a solvent supplied by the manufacturer applied to both male and female connections.
2. Two applications of the solvent shall be made.
3. The treated surface shall be forced together as soon as the pipe material becomes soft or tacky and given ¼ turn as recommended by the manufacturer.

3.07 INSTALLATION OF PIPELINES THROUGH CONCRETE STRUCTURES

A. Whenever a pipeline or any material terminates at or extends through a structural wall or sump, install the fitting or special casting required for the particular installation in advance of pouring the concrete. Otherwise, prepare and submit shop/erection drawings of other installation methods and obtain approvals in advance of commencement of work.

B. Whenever any run of pipe is installed per approved shop/erection drawings subsequent to placing of concrete, accurately position the opening in the concrete for such pipelines. Unless otherwise required, all pipes penetrating fluid containing or earth supporting portions of the structure shall be ring flanged.

1. Opening shall be of sufficient size to permit a perfect final alignment of pipelines and fittings without deflection of any part and to allow adequate space for satisfactory packing where pipe passes through wall to insure water tightness around openings so formed.
2. The boxes or cores shall be provided with continuous keyways to hold the filling material in place and to insure a watertight joint.
3. Boxes or cores shall be filled with nonshrink grout or non-shrink concrete.
   a. Non-Shrink Concrete. All non-shrink concrete shall contain one (l) pound of Embeco Aggregate per pound of water that is in excess of two gallons per sack of cement.
   b. Non-Shrink Grout. Non-shrink grout shall be made with the following proportions:

      1 part Type I Portland Cement (1 bag)

      1 part Embeco Aggregate (100 lbs.)

      1 part clean, well graded concrete sand (100 lbs.)

      Approximately 5.5 gallons of water per bag of cement.

3.08 CHANGES IN LINE AND GRADE

In the event that obstructions not shown on the Drawings are encountered during the progress of the work that will require alterations to the Drawings, the Owner shall have the authority to change the Drawings and order the necessary deviation from the line or grade. Do not make any deviation from the specified line or grade without approval by the Owner. Should any deviations in line or grade be permitted by the Owner in order to reduce the amount of rock excavation or for other similar convenience to the Contractor, all additional costs for thrust blocks, valves, blow-off assemblies, extra pipe footage or other additional costs shall be borne by the Contractor.

3.09 WELDING

A. Provide good quality welding. All welding operators shall be qualified under the Standard Qualification procedure of the American Welding Society. All welds shall be made by an electric shielded arc method of welding. Field welding of all joints shall be in conformance with AWWA C206.

B. The Owner shall have the right at any time to call for and witness the making of test specimens by any welder in accordance with these Specifications, and the expense of such tests shall be borne by the Contractor.

C. Welds considered by the Owner to be deficient in quality, or made contrary to any mandatory provision of these specifications, shall be removed throughout its depth to expose clean base metal, but in case of a strictly local deficiency, the weld need not be removed throughout its entire length, provided that sufficient amount shall be removed to insure that sound weld metal, only, remains. A cracked weld shall be removed throughout its length.

3.10 IDENTIFICATION OF PIPING

A. Piping Systems. Identification of piping systems shall conform to the requirements of ANSI Al3.1, "Scheme for the Identification of Piping System," unless otherwise specified herein.

B. Color Identification. All exposed or unburied pipe less than 4 inches diameter shall be identified by color bands to show its use function. All color bands shall be approved by the Owner. Color bands of an approved taped type may be used on PVC and all other pipe not readily susceptible to painted finish. Markers shall be adhesive type with extra strength and suitable for continuous duty at 250 degrees F. All markers shall have a protective silicone film.

Both the direction of fluid flow, and the name of the fluid in the pipe shall be stenciled on all pipe at least once every 25 feet and at every change of direction. Color bands shall be spaced at 15-foot intervals and every change in direction. The size of the letters and color bands shall be as specified in the table below:

Outside Diameter of Pipe or Covering	Width of Color Band	Height of Legend Letters
1/2 to 1-1/4	1	1/2
1-1/2 to 2	1	3/4
2-1/2 to 6	6	2
8 to 10	6	2-1/2
Over 10	6	3-1/2
All dimensions are given in inches.		

C. Process Valve Identification. After the painting of process piping is complete, the Contractor shall stencil the tag numbers of all valves numbered on the Drawings, on the pipe adjacent to the valve for pipe 2 inches and over. Characters shall be one inch high minimum and shall be oriented to be visible from the valve operating position. When the valve has extended operator shaft or chain operator, the number shall be placed both at the operating position and at the valve if the valve cannot be seen from the operating position. The latter requirement does not apply if the valve is buried. Valves in pipes under 2 inches shall have characters as large as the pipe will permit, or at the Owner's option, on an adjacent surface. Characters shall be preferably white, however, if this would not provide sufficient contrast to the pipe, the Owner may select another color. Paint used shall be of the same type and quality as used for painting the pipe.

3.11 PROTECTIVE COATINGS

Painting and coatings shall conform to the applicable requirements of Section 09900, "Painting and Protective Coatings," and the schedule submitted with the shop and erection-drawings. It shall be the Contractor's responsibility to fully coordinate the protective coating requirements with the foregoing color code identification requirements to ensure compatibility of materials used.

3.12 TESTING

The Contractor shall perform hydrostatic, leakage, and operational tests as specified herein. The Contractor shall perform all excavation and other work required to locate and repair leaks and correct other defects which may be disclosed or develop under tests; the Contractor shall replace all coating, painting, backfill, or other permanent work removed in locating or repairing leaks and correcting defective piping. All gages and control devices connected to lines being tested must be disconnected for the duration of the test. Water shall not be used in testing air lines, chlorine lines, nitrogen lines, or other gas carrying pipes. High pressure air testing of PVC pipe in exposed or above ground installations is not permitted. The Contractor shall furnish and install a chart type recording meter for the pressure tests. The Contractor shall submit to the Owner before and after the test the gage and meter used so that these devices may be tested by the Owner.

A. Testing Requirements.

1. Drain Pipes or Other Pipelines Having Free Surface Flow Except Storm Drainage Pipelines. Pipe having free surface flow shall be given a water exfiltration test as specified herein. The Contractor has the option of using a low pressure air test in lieu of the water exfiltration test. If excessive groundwater is present which precludes use of the exfiltration test, the Contractor shall use either the low pressure air test or infiltration test.

2. Water Lines and Other Pressure Piping Carrying Liquids. Water lines, sewage force mains and other pressure piping carrying liquids having bell and spigot gasketed joints shall be given a pressure and leakage test as specified herein.

Pipe Material	Test Standard
Ductile Iron	AWWA C-600
PVC (AWWA C-900 or C905 Pipe)	AWWA C-605
Steel Pipe	AWWA C-200

3. Pressure Pipe, Flanged or Welded Joints. PVC, steel, ductile iron or other pipe material, with solvent welded, welded, threaded, flanged, grooved end or flexible couplings and joints shall be pressure tested as specified herein. No leakage shall be permitted.

4. Gravity Storm Drainage Pipe. No special pressure or leakage testing is required. Leakage shall be minimized by installed in a workmanlike manner with no visible sources of leakage in accordance with the manufacturer's recommendations.

5. Pressure Air and Gas Piping. All piping carrying air or other gasses under pressure shall be given a pressure test as specified herein. No leakage is permitted. Low pressure air piping shall be tested pneumatically. Air pressure of 20 pounds per square inch shall be applied to piping and fittings. High pressure air piping shall be tested to 200 psi. There shall be no drop in pressure in a 24-hour period. Leaks shall be located and repaired to the satisfaction of the Owner. Pressure drops due to thermal contraction are acceptable if the pressure returns to the original test pressure after 24 hours.

B. Pressure Tests.

1. General. All piping, including valves, shall be field-tested at a hydrostatic pressure of 50 psi above the pipe pressure class (unless specified otherwise in the Testing Schedule), corrected to the elevations of the test gage, with duration of two hours minimum, for each pressure test, except as otherwise specified in Testing Schedule. Piping conveying liquids between process tankage, not subject to pumping, shall be tested to the maximum possible pressure that can be obtained under static conditions. Air piping shall be tested using air or nitrogen.

2. Joint Exposure. All exposed pipe, fittings, valves, hydrants, and joints shall be carefully inspected before being cast in concrete and/or during the open

trench tests. All defects discovered shall be corrected by removal and replacement, as approved by the Owner, and the work then retested to demonstrate satisfactory performance. Where practical, no concrete encasement or backfilling of pipe joints will be permitted prior to the satisfactory completion of the tests in any given section.

3. Thrust Blocks. Temporary or permanent thrust blocks shall be placed as required prior to tests, and the Contractor shall provide all necessary braces, plugs, thrust blocks, caps, flanges, and other materials to permit proper performance of the pressure testing; tests shall not be conducted until the concrete thrust blocks are capable of withstanding the loads produced.

C. Leakage Tests.

1. General. Leakage tests shall be conducted concurrently with pressure test. The lowest pressure during the leakage test shall be no less than 5 psi below the pressure used in the pressure test. The allowable leakage for pipes conveying liquids between process tankage (not subject to pumping) shall be determined in accordance with AWWA C-600 Section 4.2 where in the equation, P is the maximum pressure occurring anywhere in the pipeline. The duration of the test shall be not less than two hours, and measurement shall be made by means of a calibrated suction tank showing the amount of water required by the test pump to accurately maintain the specified test pressure. Tests shall be performed only in the presence of the Owner, or, if scheduling of tests is such that the Owner cannot attend due to conflicting commitment, tests may be performed without the Owner's presence if the Contractor obtains written permission to do so from the Owner prior to initiation of testing. No test report will be accepted unless proof of compliance with the foregoing requirement accompanies the test report.

D. Exfiltration Test.

1. The test shall be conducted between successive manholes by closing the lower end of the pipe to be tested and the inlet pipe of the upper manhole with stoppers. The pipe and manhole shall be filled with water to a point 4 feet above the invert of the pipe at the center of the upper manhole; or if ground water is present, 4 feet above the average adjacent ground water level. Pipe shall be thoroughly wetted prior to start of test. Duration of test shall be determined based upon field conditions.

2. The allowable leakage will be computed by the formulae:

$E = 0.0001\ LD\ (H)^{1/2}$ for mortared joints.

$E = 0.00002\ LD\ (H)^{1/2}$ for all other joints.

Where:

L is length of sewer and house connections tested, in feet.

E is the allowable leakage in gallons per minute of sewer tested.

D is the internal diameter of the pipe in inches.

H is the difference in elevation, in feet, between the water surface in the upper manhole and the invert of the pipe at the lower manhole; or if ground water is present above the invert of the pipe in the lower manhole, the difference in elevation between the water surface in the upper manhole and the groundwater at the lower manhole.

3. The Contractor shall, at its expense, furnish all water, materials and labor for making the required test. All tests shall be made in the presence of the Owner.

E. Infiltration Test.

1. The end of the pipe at the upper structure shall be closed sufficiently to prevent the entrance of water, and the outlet of the lower manhole shall be closed to prevent the exit of water. Pumping of groundwater shall be discontinued for at least 3 days, after which the section shall be tested for infiltration.
2. The infiltration into each individual reach of pipe between adjoining manholes shall not exceed that allowed by the formula in Subsection "Exfiltration Test" where H is the difference in the elevation between the groundwater surface and the invert of the pipe at the downstream manhole.
3. Unless otherwise specified, infiltration will be measured by the Engineer using approved measuring devices furnished by the Contractor.

F. Low Pressure Air Test. Conduct in conformance with ASTM C-828.

3.13 FLUSHING

A. General. All piping shall be flushed clean of all dirt and foreign material following completion of the hydrostatic and leakage test. Air and gas piping shall be purged with air or inert gas as directed by the Owner.

B. Equipment and Supplies. The Contractor shall provide all equipment, and supplies for performing the work, and shall waste the water at locations or by procedures approved by the Owner, and in accordance with NPDES requirements in the Special Provisions. The Contractor shall be responsible for furnishing fittings and all special pipe taps required for injecting any required sterilizing solution.

3.14 DISINFECTION

Disinfection of the potable water lines shall be performed in accordance with AWWA Standard C651, and the WSSS.

END OF SECTION 15060

SECTION 15100

VALVES: GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Valving, actuators, and valving appurtenances.

B. Related Sections include but are not necessarily limited to:

1. Section 09900 - Painting.
2. Section 11005 – General Mechanical and Equipment Provisions.
3. Section 15060 – Piping and Appurtenances.
4. Section 15101 - Butterfly Valves.
5. Section 15103 - Ball Valves.
6. Section 15106 - Check Valves.
7. Section 15114 - Miscellaneous Valves.

1.02 QUALITY ASSURANCE

A. Referenced Standards:

1. American National Standards Institute (ANSI):
   a. B1.20.1, Pipe Threads, General Purpose.
   b. B16.1, Cast Iron Pipe Flanges and Flanged Fittings.
   c. B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
2. American Water Works Association (AWWA):
   a. C111, Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
   b. C207, Steel Pipe Flanges for Waterworks Service Sizes 4 IN through 144 IN.
   c. C500, Metal Seated Gate Valves for Water Supply Service.
   d. C504, Rubber-Seated Butterfly Valves.
   e. C509, Resilient-Seated Gate Valves for Water Supply Service.
   f. C540, Power-Actuating Devices for Valves and Sluice Gates.
   g. C550, Protective Epoxy Interior Coatings for Valves and Hydrants.
3. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).

1.03 SUBMITTALS

A. Shop Drawings:

1. See Special Provisions Section 2-13.
2. Product technical data including:
    a. Acknowledgement that products submitted meet requirements of standards referenced.
    b. Manufacturer's installation instructions.
    c. Valve pressure and temperature rating.
    d. Valve material of construction.
    e. Special linings.
    f. Valve dimensions and weight.
    g. Valve flow coefficient.
    h. Wiring and control diagrams for electric or cylinder actuators.
3. Test reports.

B. Operation and Maintenance Manuals:

1. See Special Provisions Section 1-09.09.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Refer to individual valve specification sections.

2.02 MATERIALS

A. Refer to individual valve specification sections.

2.03 VALVE ACTUATORS

A. Valve Actuators - General:

1. Provide actuators as shown on Drawings or specified.
2. Counter clockwise opening as viewed from the top.
3. Direction of opening and the word OPEN to be cast in handwheel or valve bonnet.
4. Size actuator to produce required torque with a maximum pull of 80 LB and withstand without damage a pull of 200 LB.

B. Buried Valve Actuators:

1. Provide screw or slide type adjustable cast iron box, 5 IN minimum diameter, and identifying cover.
2. Box base to enclose buried valve gear box or bonnet.
3. Provide 2 IN AWWA standard valve actuator nut.

4. Provide stem extension to grade with guide bushing to center extension.
5. Provide cast iron floor stands where shown on Drawings. Stands to be furnished by valve manufacturer with actuator.
    a. Stand or actuator to include thrust bearings for valve operation and weight of accessories.

C. Manual Actuators:

1. Provide for all exposed valves not having electric or cylinder actuators.
2. Provide handwheels for gate and globe valves.
    a. Size handwheels for valves in accordance with AWWA C500.
3. Provide lever actuators for plug valves, butterfly valves and ball valves 3-inch diameter and smaller.
    a. Lever actuators for butterfly valves to have a minimum of 5 intermediate lock positions between full open and full close.
4. Gear actuators required for plug valves, butterfly valves, and ball valves 4-inch diameter and larger.
5. Gear actuators to be totally enclosed, permanently lubricated and with sealed bearings.

2.04 FABRICATION

A. End Connections:

1. Provide the type of end connections for valves as required in the Piping Schedules presented in Section 15060 or as shown on the Drawings.
2. Comply with the following standards:
    a. Threaded: ANSI B1.20.1.
    b. Flanged: ANSI B16.1 Class 125 unless otherwise noted or AWWA C207.
    c. Bell and spigot or mechanical (gland) type: AWWA C111.
    d. Soldered: ANSI B16.18.

B. Refer to individual valve sections for specifications of each type of valve on Project.

C. Nuts, Bolts, and Washers:

1. Wetted or internal to be bronze or stainless steel. Exposed to be galvanized.

D. Epoxy Interior Coating:

1. Provide fusion-bonded epoxy interior coating for all ferrous surfaces in accordance with AWWA C550 for all valves on project.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Painting Requirements:

1. Comply with section 09900 for painting and protective coatings.

C. Support exposed valves and piping adjacent to valves independently to eliminate pipe loads being transferred to valve and valve loads being transferred to the piping.

D. For threaded valves, provide union on one side to allow valve removal.

E. Install valves accessible for operation, inspection, and maintenance.

3.02 ADJUSTING

A. Adjust valves, actuators and appurtenant equipment to comply with manufacturers recommendations and station operation. Provide fully functioning valves, operate valve, open and close at system pressures.

END OF SECTION 15100

SECTION 15103

BALL VALVES

PART 1 - GENERAL

1.01 SUMMARY

A. Related Sections include but are not necessarily limited to:

1. Section 15100 - Valves: General Requirements.

1.02 QUALITY ASSURANCE

A. Referenced Standards:

1. American Society for Testing and Materials (ASTM):
    a. A48, Gray Iron Castings (Class 35 Minimum).
    b. A126, Gray Iron Castings for Valves Flanges, and Pipe Fittings.
    c. D1784, Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
2. Federal Specification:
    a. WW-V-35B.

1.03 SUBMITTALS

A. Shop Drawings:

1. See Section 15100.

B. Operation and Maintenance Manuals:

1. See Special Provisions Section 1-09.09.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable articles below are acceptable.

B. Submit requests for substitution in accordance with Specification Section 13.

2.02 METALLIC BALL VALVES 1/4 TO 3 INCHES DIAMETER

A. Comply with Federal Specification WW-V-35B Type II, Class A.

B. Acceptable Manufacturers:

1. Apollo.
2. Jamesbury.
3. Watts.
4. Stockham.
5. or approved equal.

C. Materials:

1. Body: Bronze.
2. Stem, stem gland nut: Brass.
3. Ball: Brass, chrome plated.
4. Seats, stuffing box ring, and thrust washer: Reinforced Teflon.
5. Handle: Vinyl coated galvanized steel.

D. Design Requirements:

1. Rated for 400 psi and 250 DegF, for threaded end applications and 285 psi for flanged end applications.
2. Handles showing direction of opening.
3. Stuffing boxes capable of being repacked under pressure and adjustable for wear.
4. Stem with reinforced teflon stuffing box ring and blowout-proof design.
5. Renewable reinforced teflon seats.
6. Ball design which does not allow media contact with stem.
7. Balancing stop for all applications.
8. Bodies with mounting pad for applications requiring actuators.

2.03 PLASTIC BALL VALVES 1/2 TO 4 IN DIA

A. Acceptable Manufacturers:

1. Chemtrol.
2. ASAHI/America.
3. or approved equal.

B. Materials:

1. Body, stem, ball, handle, end connectors:
   a. PVC ASTM D1784-12454B or CPVC ASTM D1784-23477-B.
2. Seat: Teflon.
3. 0-rings: Viton.

C. Design Requirements:

1. Rated at 150 psi at 75 DegF.
2. Double or true union design.
3. Blocks both directions, upstream and downstream.
4. Union nut capable of compensating for seat adjustments.
5. Body with mounting pad for actuators where required.

2.04 ACCESSORIES

A. Refer to Drawings and valve schedule for type of actuators. Furnish actuator integral with valve.

B. Refer to Section 15100 for actuator requirements.

PART 3 - EXECUTION

3.01 INSTALLATION

A. See Section 15100.

END OF SECTION 15103

SECTION 15106

CHECK VALVES

PART 1 - GENERAL

1.01 SUMMARY

A. Related Sections include but are not necessarily limited to:

1. Section 15100 - Valves: General Requirements.

1.02 QUALITY ASSURANCE

A. Referenced Standards:

1. American National Standard Institute (ANSI):
    a. B16.1, Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800.
2. American Water Works Association (AWWA):
    a. C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
3. Manufacturer's Standardization, Society of the Valve and Fittings Industry, Inc (MSS):
    a. SP-9, Spot Facing for Bronze, Iron and Steel Flanges.
    b. SP-71, Cast Iron Swing Check Valves, Flanged and Threaded Ends.
    c. SP-80, Bronze Gate, Globe, Angle and Check Valves.

1.03 SUBMITTALS

A. Shop Drawings:

1. See Section 15100.

B. Operation and Maintenance Manuals:

1. See Section 14.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, manufacturers listed under the valve with types are acceptable.

B. Submit requests for substitution in accordance with Specification Section 13.

2.02 CHECK VALVES: 2 INCHES AND SMALLER

A. Class 125 Bronze Swing Check:

1. Comply with MSS SP-80.
2. Acceptable manufacturers:
    a. Nibco 413B.
    b. Stockham B319.
    c. Or approved equal.
3. Materials:
    a. Body, bonnet, disc: Bronze.
4. Design requirements:
    a. 200 psi WOG.
    b. Horizontal swing, renewable disc.

B. PVC Ball Check Valves:

1. Acceptable manufacturers:
    a. Hayward Industrial Products, Inc.
    b. Approved equal.
2. Materials:
    a PVC with threaded ends.
    b. Seals and seats shall be Viton
3. Design Requirements:
    a. True union design
    b. Maximum inlet pressure: 150 psi or greater.

2.03 SLANTING DISC CHECK VALVE:

A. Class 125.

B. Acceptable Manufacturers:

1. APCO Series 800-B.

C. Materials:

1. Body: Cast iron.
2. Disc: Ductile iron.
3. Seat: Stainless steel.
4. Seat ring and disc: Bronze or rubber (Buna-N).
5. Pivot pins and bushings: Stainless steel.

D. Design Requirements:

1. Seat ring: Hand replaceable.
2. Provide bottom mounted buffer.

PART 3 - EXECUTION

3.01 INSTALLATION

A. See Section 15100.

B. Install in accordance with manufacturer's instructions.

END OF SECTION 15106

SECTION 15114

MISCELLANEOUS VALVES

PART l - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Air release and vacuum relief valves.
   2. Automatic control valves:
      a. Pump Control Valve

B. Related Sections include but are not necessarily limited to:
   1. Section 11005 - General Mechanical and Equipment Provisions.
   2. Section 15100 - Valves: General Requirements.

1.02 SUBMITTALS

A. Shop Drawings:
   1. See Special Provisions Section 2-13.

B. Operation and Maintenance Manuals:
   1. See Special Provisions Section 1-09.09.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed under the specific valve types are acceptable.

B. Submit requests for substitution in accordance with Specification Section 01640.

2.02 AIR VALVES

A. Vertical Turbine Pump Combination Air Valve (Water)
   1. Acceptable manufacturers:
      a. APCO Series 146 DAT with Double Acting Throttling Device, Water Diffuser, and No. 50 Air Release Valve.
      b. Or approved equal.

2. Materials:
    a. Body and cover: Cast iron.
    b. Float: Stainless steel.
    c. Seat: Buna-N.
3. Design requirements:
    a. Line operating pressure: as shown on plans.
    b. Capacity 500 scfm at 5 psi differential.
    c. Provide butterfly isolation valve, APCO Series 903 or equal.
    d. Mount 6" min from pipe flange.

B. Combination Air Valve (Water)
1. Acceptable manufacturers:
    a. APCO Series 147C
    b. Or approved equal.
2. Materials:
    a. Body and cover: Cast iron.
    b. Float: Stainless steel.
    c. Seat: Buna-N.
3. Design requirements:
    a. Line operating pressure: as shown on plans.
    b. Capacity 500 scfm at 5 psi differential.
    c. Provide butterfly isolation valve, APCO Series 903 or equal.
    d. Mount 6" min from pipe flange.

2.03 WELL PUMP CONTROL VALVE

A. Control valve shall be a diaphragm-actuated hydraulically operated valve as follows:
1. Acceptable manufacturers:
    a. Cla-val, Model 61-02.
2. Materials:
    a. Body: Ductile iron.
    b. Seat insert: Renewable bronze.
    c. Disc: Buna-N.
    d. Diaphragm: Nylon fabric bonded with synthetic rubber.
    e. Trim: Stainless Steel.
    f. End Detail: Flanged end, 150 lb (125 lb ANSI bolt pattern)

3. Design requirements:
    a. Size and pattern: as shown on plans.
    b. Operating pressure:
        1) Maximum as shown on plans.
        2) Minimum 0 psi.
    c. Flow range:
        1) Normal maximum as shown on plans.
        2) Normal minimum 0 gpm.
    d. Operation:
        1) Valve fully open to atmosphere with pump off. When pump is started, valve closes slowly as main line check valve opens.
        2) Sequence reverses on pump shut off or power outage.
    e. Assembles all control features and hardware on basic valve at factory.
    f. Use 316 stainless steel for all valve tubing fitting, and exposed portions of the control valve.
    g. Include with control valve:
        1) Stop valves.
        2) Strainer.
        3) Valves for opening and closing speed control.
        4) Pilot valves.
        5) Solenoid valves.
        6) Pressure switches as necessary to provide control function.
        7) Valve position indicator.
    h. Electric components:
        1) 110 V, 1 phase.

2.04 PLUG VALVES

A. Construction: Lubricated plug valves shall be the tapered plug, top or bottom entry type, with flanged ends for sizes 3 inches and larger, and flanged or screwed ends for smaller valves, as indicated. The body and top plate shall be of cast iron. The plug shall be of steel or cast iron and the stem shall be of stainless steel or alloy steel, with weather seal and Teflon impregnated packing. The valve body and plug shall have smoothly finished water passages free from sharp corners when the plug is in the wide-open position. The valve shall be rated for ANSI class 150 or 300, or as indicated, between service temperatures of minus 20 to plus 100 degrees F.

Plug valves installed inside the vaults shall be short pattern (gate length) and have flange face to face lengths interchangeable with ANSI Class 125 and API 175 CWP Cast Iron Gate Valves.

B. Sealant System: The valves shall be provided with fittings designed to feed a sealant through a check-valve protected passage in the stem, through the side, or through a stainless steel tube for worm-gear actuated or buried valves. There shall be ducts or grooves in the face of the plug to insure the maintenance of a closed, pressurized sealant system between all contact surfaces of moving parts. All surfaces of the plug shall be coated with a dry film lubricant, such as polyfluoride, or equal to suit the service, permanently bonded to the metal surfaces. Sealant for LP gas service shall be the Manufacturer's recommended type. The plug shall be held toward the seat by factory-adjusted gland assemblies set for proper sealing and operating torque. The gland assemblies shall be adjustable from the valve exterior and shall utilize either spring washers or gland deflection to allow plug unseating when pressurized sealant is injected.

C. Actuators: Unless otherwise indicated, valves 3 inches and smaller shall be lever-actuated; larger valves shall be equipped with manual worm-gear actuators and flywheels for plug valves located inside the vault.

D. Lubricating Gun: Supply a manual lubricating gun for lubricated plug valves in sizes up to 6 inches, inclusive. For larger valves, the CONTRACTOR shall furnish a pneumatically operated lubricating gun and a manual lubricating gun. For installations of more than 6 lubricated plug valves, the number of guns furnished shall be doubled. The guns shall be of the same Manufacturer as the valves. They shall each be equipped with flexible connectors, pressure gauge, and safety valve, with operating instructions and be furnished in labeled tool boxes.

E. Coatings: The interior of the plug valve shall be factory coated with fusion bonded epoxy. Coating shall conform to AWWA Standard C550, “Protective Epoxy Interior Coating for Valves and Hydrants.”

The exterior of the plug valve shall be coated per the requirements in the Technical Specifications.

F. Manufacturers, or Equal:

Nordstrom – Audco Valves, Inc.

2.05 PRESSURE REGULATOR VALVES

A. Acceptable Manufacturers
   1. Hayward Industrial Products, Inc.
   2. Or approved equal.

B. Materials
   1. All PVC construction.
   2. No metal parts shall be in contact with the process fluid.

C. Design Requirements
   1. Maximum inlet pressure: 150 psi or greater (non-shock) at 70°F.
   2. Hand adjustable to regulate pressures to between 5 and 75 psi.

2.06 LINE STOP

Section 2-16 is hereby added to Section 2 of the WSSS

Where indicated on the Construction Drawings, a line stop shall be furnished and installed per the manufacturer's recommendations. The line stop shall include the tapping sleeve fitting (fusion bonded epoxy coating), line stop machine, the completion plug, and the blind completion flange. The line stop shall achieve a guaranteed 95% to 100% water stop at the point of application. At no time shall the existing water main be taken out of service. Once the new or existing water main is in operation, the line stop may be removed and the completion plug and blind completion flange installed. The line stop shall be manufactured by HYDRA-STOP, INC., IFT Inc. or an approved equal. The manufacturer of the line stop must have installed similar type line stops within Southern California for a period of not less than three years.

2.07 ACCESSORIES

A. Furnish any accessories required to provide a completely operable valve.

2.08 FABRICATION

A. Completely shop assemble unit including any interconnecting piping, speed control valves, control isolation valves and electrical components.

B. Provide internal fusion-bonded epoxy coating suitable for potable water for all iron body valves.

2.09 SOURCE QUALITY CONTROL

A. Shop hydrostatically test to unit test pressure.

2.10 MAINTENANCE MATERIALS

A. Provide one set of any special tools or wrenches required for operation or maintenance for each type valve.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:

1. See Sections 11005 and 15100.

B. Air Release, Vacuum Relief, and Pressure Relief Valves:

1. Pipe exhaust to a suitable disposal point.
2. Where exhausted to a trapped floor drain, terminate exhaust line 6 IN minimum above floor.

3.02 FIELD QUALITY CONTROL

A. Clean, inspect, and operate valve to ensure all parts are operable and valve seats properly.

B. Check and adjust valves and accessories in accordance with manufacturer's instructions and place into operation.

END OF SECTION 15114

Appendix H
Assembly Bill No. 626

Original Dated: September 2016

Assembly Bill No. 626 SECTION 1. Section 9204 or the latest version is added to the Public Contract Code, to read:

9204. (a) The Legislature finds and declares that it is in the best interests of the state and its citizens to ensure that all construction business performed on a public works project in the state that is complete and not in dispute is paid in full and in a timely manner.

(b) Notwithstanding any other law, including, but not limited to, Article 7.1 (commencing with Section 10240) of Chapter 1 of Part 2, Chapter 10 (commencing with Section 19100) of Part 2, and Article 1.5 (commencing with Section 20104) of Chapter 1 of Part 3, this section shall apply to any claim by a contractor in connection with a public works project.

(c) For purposes of this section:

(1) “Claim” means a separate demand by a contractor sent by registered mail or certified mail with return receipt requested, for one or more of the following:

(A) A time extension, including, without limitation, for relief from damages or penalties for delay assessed by a public entity under a contract for a public works project.

(B) Payment by the public entity of money or damages arising from work done by, or on behalf of, the contractor pursuant to the contract for a public works project and payment for which is not otherwise expressly provided or to which the claimant is not otherwise entitled.

(C) Payment of an amount that is disputed by the public entity.

(2) “Contractor” means any type of contractor within the meaning of Chapter 9 (commencing with Section 7000) of Division 3 of the Business and Professions Code who has entered into a direct contract with a public entity for a public works project.

(3) (A) “Public entity” means, without limitation, except as provided in subparagraph (B), a state agency, department, office, division, bureau, board, or commission, the California State University, the University of California, a city, including a charter city, county, including a charter county, city and county, including a charter city and county, district, special district, public authority, political subdivision, public corporation, or nonprofit transit corporation wholly owned by a public agency and formed to carry out the purposes of the public agency.

(B) “Public entity” shall not include the following:

(i) The Department of Water Resources as to any project under the jurisdiction of that department.

(ii) The Department of Transportation as to any project under the jurisdiction of that department.

(iii) The Department of Parks and Recreation as to any project under the jurisdiction of that department.

(iv) The Department of Corrections and Rehabilitation with respect to any project under its jurisdiction pursuant to Chapter 11 (commencing with Section 7000) of Title 7 of Part 3 of the Penal Code.

(v) The Military Department as to any project under the jurisdiction of that department.

(vi) The Department of General Services as to all other projects.

(vii) The High-Speed Rail Authority.

(4) “Public works project” means the erection, construction, alteration, repair, or improvement of any public structure, building, road, or other public improvement of any kind.

(5) “Subcontractor” means any type of contractor within the meaning of Chapter 9 (commencing with Section 7000) of Division 3 of the Business and Professions Code who either is in direct contract with a contractor or is a lower tier subcontractor.

(d) (1) (A) Upon receipt of a claim pursuant to this section, the public entity to which the claim applies shall conduct a reasonable review of the claim and, within a period not to exceed 45 days, shall provide the claimant a written statement identifying what portion of the claim is disputed and what portion is undisputed. Upon receipt of a claim, a public entity and a contractor may, by mutual agreement, extend the time period provided in this subdivision.

(B) The claimant shall furnish reasonable documentation to support the claim.

(C) If the public entity needs approval from its governing body to provide the claimant a written statement identifying the disputed portion and the undisputed portion of the claim, and the governing body does not meet within the 45 days or within the mutually agreed to extension of time following receipt of a claim sent by registered mail or certified mail, return receipt requested, the public entity shall have up to three days following the next duly publicly noticed meeting of the governing body after the 45-day period, or extension, expires to provide the claimant a written statement identifying the disputed portion and the undisputed portion.

(D) Any payment due on an undisputed portion of the claim shall be processed and made within 60 days after the public entity issues its written statement. If the public entity fails to issue a written statement, paragraph (3) shall apply.

(2) (A) If the claimant disputes the public entity’s written response, or if the public entity fails to respond to a claim issued pursuant to this section within the time prescribed, the claimant may demand in writing an informal conference to meet and confer for settlement of the issues in dispute. Upon receipt of a demand in writing sent by registered mail or certified mail, return receipt requested, the public entity shall schedule a meet and confer conference within 30 days for settlement of the dispute.

(B) Within 10 business days following the conclusion of the meet and confer conference, if the claim or any portion of the claim remains in dispute, the public entity shall provide the claimant a written statement identifying the portion of the claim that remains in dispute and the portion that is undisputed. Any payment due on an undisputed portion of the claim shall be processed and made within 60 days after the public entity issues its written statement. Any disputed portion of the claim, as identified by the contractor in writing, shall be submitted to nonbinding mediation, with the public entity and the claimant sharing the associated costs equally. The public entity and claimant shall mutually agree to a mediator within 10 business days after the disputed portion of the claim has been identified in writing. If the parties cannot agree upon a mediator, each party shall select a mediator and those mediators shall select a qualified neutral third party to mediate with regard to the disputed portion of the claim. Each party shall bear the fees and costs charged by its respective mediator in connection with the selection of the neutral mediator. If mediation is unsuccessful, the parts of the claim remaining in dispute shall be subject to applicable procedures outside this section.

(C) For purposes of this section, mediation includes any nonbinding process, including, but not limited to, neutral evaluation or a dispute review board, in which an independent third party or board assists the parties in dispute resolution through negotiation or by issuance of an evaluation. Any mediation utilized shall conform to the timeframes in this section.

(D) Unless otherwise agreed to by the public entity and the contractor in writing, the mediation conducted pursuant to this section shall excuse any further obligation under Section 20104.4 to mediate after litigation has been commenced.
(E) This section does not preclude a public entity from requiring arbitration of disputes under private arbitration or the Public Works Contract Arbitration Program, if mediation under this section does not resolve the parties' dispute.

(3) Failure by the public entity to respond to a claim from a contractor within the time periods described in this subdivision or to otherwise meet the time requirements of this section shall result in the claim being deemed rejected in its entirety. A claim that is denied by reason of the public entity's failure to have responded to a claim, or its failure to otherwise meet the time requirements of this section, shall not constitute an adverse finding with regard to the merits of the claim or the responsibility or qualifications of the claimant.

(4) Amounts not paid in a timely manner as required by this section shall bear interest at 7 percent per annum.

(5) If a subcontractor or a lower tier subcontractor lacks legal standing to assert a claim against a public entity because privity of contract does not exist, the contractor may present to the public entity a claim on behalf of a subcontractor or lower tier subcontractor. A subcontractor may request in writing, either on his or her own behalf or on behalf of a lower tier subcontractor, that the contractor present a claim for work which was performed by the subcontractor or by a lower tier subcontractor on behalf of the subcontractor. The subcontractor requesting that the claim be presented to the public entity shall furnish reasonable documentation to support the claim. Within 45 days of receipt of this written request, the contractor shall notify the subcontractor in writing as to whether the contractor presented the claim to the public entity and, if the original contractor did not present the claim, provide the subcontractor with a statement of the reasons for not having done so.

(e) The text of this section or a summary of it shall be set forth in the plans or specifications for any public works project that may give rise to a claim under this section.

(f) A waiver of the rights granted by this section is void and contrary to public policy, provided, however, that (1) upon receipt of a claim, the parties may mutually agree to waive, in writing, mediation and proceed directly to the commencement of a civil action or binding arbitration, as applicable; and (2) a public entity may prescribe reasonable change order, claim, and dispute resolution procedures and requirements in addition to the provisions of this section, so long as the contractual provisions do not conflict with or otherwise impair the timeframes and procedures set forth in this section.

(g) This section applies to contracts entered into on or after January 1, 2017.

(h) Nothing in this section shall impose liability upon a public entity that makes loans or grants available through a competitive application process, for the failure of an awardee to meet its contractual obligations.

(i) This section shall remain in effect only until January 1, 2020, and as of that date is repealed, unless a later enacted statute, that is enacted before January 1, 2020, deletes or extends that date.

SEC. 2.
The Legislature finds and declares that it is of statewide concern to require a charter city, charter county, or charter city and county to follow a prescribed claims resolution process to ensure there are uniform and equitable procurement practices.

SEC. 3.
If the Commission on State Mandates determines that this act contains costs mandated by the state, reimbursement to local agencies and school districts for those costs shall be made pursuant to Part 7 (commencing with Section 17500) of Division 4 of Title 2 of the Government Code.