# **INVITATION FOR BIDS**



# FOR CONSTRUCTING

# **PUMP STATION 15 UPGRADES**

CONTRACT NUMBER C01994

**ISSUED BY** 

CAPITAL PROJECTS ENGINEERING DIVISION CITY OF SANTA ROSA, CALIFORNIA

2020

Last Updated: March 1, 2016

A T T E N T I O N Prebid Conference See Page 1



## STATE OF CALIFORNIA

## INVITATION FOR BIDS

## CONTAINING:

NOTICE TO BIDDERS

SPECIAL PROVISIONS

**BID FORMS** 

CONTRACT

FOR

# **PUMP STATION 15 UPGRADES**

Contract No. C01994

# **PUMP STATION 15 UPGRADES**

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NOTICE TO BIDDERS
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#### CITY OF SANTA ROSA STATE OF CALIFORNIA

### NOTICE TO BIDDERS

A	For technical questions regarding this project, contact Eric Frye at (707) 543-3858.
~	For direct access to plans, specifications and planholders' lists, go to www.srcity.org/bids and click on Bid/Proposal Opportunities or call (707) 543-3800.
~	For direct access to bid results, go to <u>www.srcity.org/bids</u> . Under Link to Capital Projects, click on <u>Capital Projects Contracts</u> or call (707) 543-3835.

#### - IMPORTANT -

#### **Bid Acceptance Deadline**

Sealed bids will be accepted at the Transportation and Public Works Department, 69 Stony Circle, Santa Rosa, California 95401 <u>until</u> 2:00 p.m., February 25, 2020, for Pump Station 15 Upgrades, Contract No. C01994. (Engineer's Estimate: \$662,000.)

**Bids tendered after this deadline will not be accepted.** The official time clock for accepting bids will be an electric date and time stamping clock, located in the Transportation and Public Works Department, 69 Stony Circle, Santa Rosa, California. In order to be accepted, bids must be received <u>prior to</u> 2:00 p.m. Therefore, a bid stamped in at 1:59 p.m. will be accepted, but one delivered at or after 2:00 p.m. is late and <u>will not be accepted</u>.

### **Pre-Bid Meeting**

Prospective bidders, subcontractors, and material suppliers are invited to attend a pre-bid meeting scheduled to be held at 10:00 a.m., February 18, 2020, in the Transportation and Public Works Department located at 69 Stony Circle, Santa Rosa, California.

#### Subcontractor Information; Department of Industrial Relations Registration

Bidders shall provide the names, business addresses and license numbers of all subcontractors listed on bidder's List of Subcontractors. No contractor or subcontractor may be listed on a bid for this public works project unless registered with the Department of Industrial Relations (DIR) pursuant to Labor Code section 1725.5. No contractor or subcontractor may be awarded a contract for this public works project unless registered with the DIR pursuant to Labor Code section 1725.5. This public works project is subject to compliance monitoring and enforcement by the DIR.

#### Contract #: C01994

## Project Title: PUMP STATION 15 UPGRADES

Line #	Description	Units	Quantity
1	MOBILIZATION/DEMOBILIZATION	LS	1
2	DEMOLITION AND TEMPORARY WORK	LS	1
3	WIRING AND CONDUITS	LS	1
4	AUTOMATIC TRANSFER SWITCH & MTS PANEL	LS	1
5	SCADA MODIFICATION-ONSITE	LS	1
6	INSTRUMENTS	LS	1
7	PIPING AND VALVES	LS	1
8	MCC MODIFICATIONS	LS	1
9	CONTROL PANEL	LS	1
10	ULTRA-LOW HARMONICS VFD (50HP)	LS	1
11	GENERATOR ROOM MODIFICATION	LS	1
12	HYDROPNEUMATIC TANK RECOATING	LS	1
13	STANDBY GENERATOR WITH SUB-BASE TANK & SILENCER (100kW)	LS	1
14	FLOOR RECOATING	LS	1
15	TOUCH-UP AND POWER WASH CLEANING	LS	1
16	EXTERIOR PIPE RECOATING	LS	1
17	8' CHAIN-LINK FENCE	LF	400
18	SWING GATES	LS	1

The foregoing quantities are approximate only, being given as a basis for the comparison of bids, and the City of Santa Rosa does not expressly or by implication, agree that the actual amount of work will correspond therewith, but reserves the right to increase or decrease the amount of any class or portion of the work, as may be deemed necessary or expedient by the Engineer.

Bids shall be made in accordance with the prevailing hourly rate of per diem wages for this locality and project as determined by the Director of the DIR pursuant to Labor Code sections 1770 *et seq.* 

Contractor shall be responsible for compliance with the Immigration Reform Control Act of 1986.

If the project requires the employment of workers in any apprenticeable craft or trade, once awarded, Contractor and subcontractors must apply to the Joint Apprenticeship Council unless already covered by local apprentice standards (see Labor Code section 1777.5).

All bids are to be compared on the basis of the Engineer's estimate of the quantities of work to be performed. No bid will be awarded to a contractor who is not licensed in accordance with the provisions of Chapter 9 of Division 3 of the Business and Professions Code. Contractor must hold a Class A license for this project.

Project plans, bid and contract forms for C01994 Pump Station 15 Upgrades may be obtained through PlanetBids at <u>www.srcity.org/bids</u>. These documents can no longer be obtained at the Transportation and Public Works Department.

No bid will be accepted unless it is made on the contract bid forms furnished by the Transportation and Public Works Department through PlanetBids. The original of the completed bid forms bearing original signatures must be submitted. A bid will not be accepted unless the bidder registers as a vendor through PlanetBids at <u>www.srcity.org/bids</u>, downloads documents/attachments, and is added to the prospective bidders list for this project. If there is an addendum, bidders must log into PlanetBids and acknowledge the addendum to be eligible for bidding.

The successful bidder will be required to hold a current City of Santa Rosa business tax certificate issued pursuant to Chapter 6.04 of the Santa Rosa City Code before commencing work on this project. For information regarding the business tax, contact Revenue and Collections at (707) 543-3170.

For any moneys earned by Contractor and withheld by the City of Santa Rosa to ensure the performance of the Contract, Contractor may, at its request and expense, substitute securities equivalent to the amount withheld in the form and manner and subject to the conditions provided in Section 22300 of the California Public Contract Code.

The City of Santa Rosa reserves the right to reject any or all bids and the right to waive minor irregularities or informalities in any bid or bonds.

MARK KASRAIE, PE Supervising Engineer

Date 01/21/2020

## **SPECIAL PROVISIONS**

## **General Specifications**

## CITY OF SANTA ROSA, CALIFORNIA

## **PUMP STATION 15 UPGRADES**

## **1 GENERAL**

The work described herein shall be done in accordance with the "Contract Documents," which are the:

- 1. Special Provisions
- 2. Project Plans, consisting of 23 sheets entitled Pump Station 15 Upgrades, 2019-0020
- 3. City of Santa Rosa Design and Construction Standards (City Standards)
- 4. City of Santa Rosa Construction Specifications for Public improvements (City Specifications)
- 5. State of California Department of Transportation Standard Specifications 2010 (Standard Specifications), and
- 6. State of California Department of Transportation Standard Plans 2010 (Standard Plans).

In the event of a conflict in any of these documents, the order of precedence shall be determined by Section 5-1.02 of these Special Provisions.

Whenever the Standard Specifications use the terms State of California, Department of Transportation, Director, Engineer, or Laboratory, the following terms shall be substituted therefor, and any reference to any of the foregoing terms shall be understood and interpreted to mean and refer to such substituted terms as follows:

For State of California - the City of Santa Rosa;

For Department - the City of Santa Rosa Department of Transportation and Public Works or the City of Santa Rosa Water Department;

For Owner - the City of Santa Rosa Department of Transportation and Public Works or the City of Santa Rosa Water Department;

For City - the City of Santa Rosa Department of Transportation and Public Works or the City of Santa Rosa Water Department;

For Director - the City Engineer of the City of Santa Rosa;

For Engineer - the City Engineer of the City of Santa Rosa or the City Engineer's authorized agents;

For Laboratory – Materials Engineering of the City of Santa Rosa Transportation and Public Works Department, or such other laboratory as may be authorized by the City.

Unless otherwise provided, whenever in these Special Provisions attention is directed to specific provisions in the Standard Specifications, such direction shall not be interpreted as excluding other applicable provisions of the Standard Specifications.

Unless otherwise provided, when sections and subsections of the Standard Specifications are used in these Special Provisions, such use is not exclusive and shall not be interpreted as excluding other applicable provisions of said sections and subsections, but is only intended to add to or modify such sections or subsections.

Unless otherwise provided, full compensation for compliance with these Special Provisions is included in the contract price and no additional allowance will be made to Contractor therefor. The Standard Specifications are hereby modified to delete any reference or incorporation of provisions providing for or requiring arbitration of any and all claims and disputes arising under this contract.

# **2 BIDDING**

**<u>2-1.06 Bid Documents</u>**: Prospective bidders will be furnished with an Invitation for Bids which will state the location and description of the contemplated public works project and will show the approximate estimate of the various quantities and kinds of work to be performed and materials to be furnished with a schedule of items for which unit prices are requested.

**2-1.07 Approximate Estimate**: The quantities given in the Contract Documents are approximate only, being given as a basis for the comparison of bids, and the City does not, expressly or by implication, agree that the actual amount of work will correspond therewith, but reserves the right to increase or decrease the amount of any class or part of the work or to omit parts of the work, as may be deemed necessary or advisable by the Engineer.

**2-1.31 Examination of Project Plans, Specifications, City Standards, Invitation for Bids and Work Site**: Prior to submitting a bid, the bidder shall carefully examine the Project Plans, Invitation for Bids, City Standards and the proposed work site. If any person contemplating submitting a bid for this public works project is in doubt as to the meaning of any part of the Contract Documents, or finds discrepancies in or omissions from the Contract Documents, he or she may submit a <u>written</u> request for interpretation or correction to the Engineer. <u>The written request must be received by the</u> <u>Engineer a minimum of **96** hours prior to bid opening</u>. Any interpretation or correction of the Contract Documents prior to bid opening will be made only by written addendum issued by the City. A copy of such addendum will be mailed or faxed to each Planholder. The City will not be bound by any other explanations or interpretations of the Contract Documents.

**<u>2-1.33 Bid Document Completion</u>**: Any references to Opt Out of Payment Adjustments for Price Index Fluctuations in the Standard Specifications are deleted in their entirety.

**<u>2-1.33A Bid Forms</u>**: All bids shall be made on bid forms obtained from PlanetBids at <u>www.srcity.org/bids</u>. The bidder shall submit its bid on the original bid forms furnished by the City. Bids submitted on forms other than the forms furnished to the bidder by the City will not be considered.

The bid forms to be submitted at the time of and with the bid are:

- 1. Unit Price Schedule
- 2. List of Subcontractors
- 3. List of Previous Similar Jobs
- 4. Noncollusion Declaration
- 5. Bid Guaranty Information and Bidder's Information and Signature
- 6. Bid Guaranty (Bid Bond or alternate security)

All bids shall give the proposed prices and must bear the original signature of the bidder. Bidders shall fill in all blanks on the bid forms where required. A bid will not be accepted unless the bidder registers as a vendor through PlanetBids at <u>www.srcity.org/bids</u>, downloads documents/attachments, and is added to the prospective bidders list for this project. If there is an addendum, bidders must log into PlanetBids and acknowledge the addendum to be eligible for bidding.

**<u>2-1.33B Registration with DIR</u>**: No contractor or subcontractor may be listed on a bid for this public works project unless registered with the Department of Industrial Relations (DIR) pursuant to Labor Code section 1725.5. No contractor or subcontractor may be awarded a contract for this public works project unless registered with the DIR pursuant to Labor Code section 1725.5. This public works project is subject to compliance monitoring and enforcement by the DIR.

**2-1.33C Subcontractors**: The Subletting and Subcontracting Fair Practices Act, Public Contract Code sections 4100-4113, inclusive (the "Act") shall apply to all subcontracts in excess of one-half of one percent of the total amount of a bid. The Act requires subcontractors, if used for such work, to be listed in the contractor's bid and prohibits the substitution of subcontractors, except as authorized by the Act. Each bidder shall, with respect to the work of any subcontractor in excess of one-half of one percent of the total amount of the bid, include as part of the bid on the bid form provided:

- 1. The name, business address and DIR registration number of each subcontractor who will perform work or labor or render services to the Contractor in or about the construction of the work or improvement, or a subcontractor licensed by the State of California who, under subcontract to the Contractor, specially fabricates and installs a portion of the work or improvement according to detailed drawings contained in the Project Plans or other Contract Documents in an amount in excess of one-half of one percent of the Contractor's total bid; and
- 2. The portion of the work that will be done by each subcontractor. Only one subcontractor shall be listed for each portion.

The purchase of sand, gravel, crushed rock, batched concrete, aggregate, ready-mixed concrete, and/or any other materials produced and furnished by established and recognized commercial plants, together with the delivery of such materials to the work site by the source of the materials or by recognized commercial hauling companies, is not considered as subcontracting under this section.

**2-1.33E Rejection of Bids Containing Alterations, Erasures or Irregularities**: Bids may be rejected if they show any alterations of forms, additions not called for, conditional bids, incomplete bids, erasures or irregularities of any kind.

**<u>2-1.34 Bid Guaranty</u>**: All bids shall be presented under sealed cover and shall be accompanied by cash, cashier's or certified check, or by a bidder's bond made payable to the City of Santa Rosa and executed as surety by a corporate surety authorized and admitted to transact a surety business in the State of California in an amount equal to ten percent of the amount of the bid. No bid shall be considered unless such cash, cashiers or certified check, or bidder's bond is enclosed with the bid. Any bidder's bond shall contain provisions for forfeiture consistent with California Public Contract Code section 20172.

**<u>2-1.40</u>** Withdrawal of Bid: A bid may be withdrawn prior to, but not after, the hour fixed in the public notice for the opening of bids, provided that a written request to withdraw the bid, executed by the bidder or the bidder's authorized representative, is filed with the Engineer before this deadline. The withdrawal of a bid shall not prejudice the right of a bidder to submit a new bid.

<u>2-1.43 Public Opening of Bids</u>: Bids will be opened and read publicly at the time and place indicated in the Notice to Bidders. Bidders or their authorized agents are invited to be present.

**<u>2-1.46 Disgualification of Bidders</u>**: Serial bids from the same bidder will not be accepted. This section shall not be interpreted to mean that the same contractor may not be the contractor in one bid and listed as a subcontractor in another bid, provided that no collusion exists.

<u>2-1.48 Competency of Bidders</u>: No bid will be accepted from or contract awarded to a contractor that is not licensed in accordance with the law, that does not hold a license qualifying it to perform work under this contract, to whom a bid form has not been issued by the Engineer, or that has not successfully completed projects of similar character, scope and cost to the proposed project. Bidders will be required to provide a list of previous similar jobs with their bids.

## **3 CONTRACT AWARD AND EXECUTION**

**<u>3-1.04 Contract Award</u>**: The City reserves the right to reject any or all bids. Bids are required for the entire work described herein. All bids will be compared with the Engineer's estimate of the quantities of work to be completed. Contract award, if any, will be made to the lowest responsible bidder within sixty days from the date bids are opened.

<u>3-1.05 Contract Bonds</u>: Within ten days after receipt of the Notice of Award, the successful bidder shall provide the following bonds to the City:

- a. <u>Performance Bond</u>: A performance bond to guarantee the faithful performance of the terms and conditions of the Contract by Contractor, which shall be executed in a sum of not less than one-half of the Contract price;
- b. <u>Labor and Materials Bond</u>: A labor and materials bond (payment bond) in accordance with Part 6 of Division 4, sections 8000 *et seq*. of the California Civil Code, to guarantee against any and all claims of subcontractors or other third parties furnishing labor, materials, or supplies for the Contract, which shall be executed in a sum of 100% of the Contract price; and
- c. <u>Material Guaranty Bond</u>: A material guaranty bond (warranty bond) to serve as surety for the guarantee requirements outlined in Section 6-3.01B, which shall be executed in a sum of not less than one-half of the Contract price.

The bond(s) shall be provided in a form acceptable to the City and issued by a corporate surety in good financial standing and authorized and admitted to transact a surety business in the state of California for the purposes and in the amount(s) stated above.

Whenever the financial or legal status of any surety on any such bond(s) is/are unacceptable to the City, it may make a demand to Contractor for further bond(s) or additional surety, not exceeding the sums originally required. Thereafter, no payment shall be made upon the Contract to Contractor or any assignees of Contractor until such bond(s) or additional surety has/have been provided to the City.

3-1.07 Indemnification and Insurance: Indemnification: Contractor shall defend, hold harmless and indemnify City, its officers, agents and employees, and each and every one of them, from and against any and all actions, damages, costs, liabilities, claims, demands, losses, judgments, penalties, costs and expenses of every type and description, including, but not limited to, any fees and/or costs reasonably incurred by City's staff attorneys or outside attorneys and any fees and expenses incurred in enforcing this provision (hereafter collectively referred to as "Liabilities"). including but not limited to Liabilities arising from personal injury or death; damage to personal, real or intellectual property or the environment; contractual or other economic damages, or regulatory penalties, arising out of or in any way connected with the performance of or the failure to perform the Contract by Contractor, any subcontractor or agent, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, whether or not such Liabilities are caused in part by a party indemnified hereunder, or such Liabilities are litigated, settled or reduced to judgment; provided, that the foregoing indemnity does not apply to liability for any damage or expense for death or bodily injury to persons or damage to property to the extent arising from (i) the sole negligence, or willful misconduct of, or defects in design furnished by City, its agents, servants, or independent contractors who are directly responsible to City (excluding Contractor), or (ii) the active negligence of City.

The existence of any of the insurance policies or coverages described in this Contract shall not affect or limit any of City's rights hereunder, nor shall the limits of such insurance limit Contractor's liability to the City hereunder. The provisions of this section shall survive any expiration or termination of the Contract.

Insurance: Contractor shall maintain in full force and effect all of the insurance coverage described in and in accordance with the insurance requirements set forth below. Maintenance of such insurance coverage during the entire performance of the Contract is a material element of the Contract. Failure by Contractor to (i) maintain or renew coverage, (ii) provide notice of any changes, modifications, or reductions in coverage, or (iii) provide evidence of renewal, if necessary, may be deemed a material breach of the Contract by Contractor, whereas the City shall be entitled to all rights and remedies at law or in equity. Notwithstanding the foregoing, any failure by Contractor to maintain required insurance coverage shall not excuse or alleviate Contractor from any of its other duties or obligations under the Contract. In the event Contractor shall assure that any such subcontractor has first obtained, and shall maintain, all of the insurance coverage requirements herein set forth below.

#### Insurance Requirements:

A. Insurance Policies: Contractor shall maintain and keep in full force and effect, the following policies of insurance with minimum coverage as indicated below and issued by insurers with an AM Best rating of no less than A-:VI or a rating otherwise acceptable to the City.

	Insurance	Minimum Coverage Limits	Additional Coverage Requirements
1.	Commercial general liability	\$5 million per occurrence \$5 million aggregate	Coverage must be at least as broad as ISO CG 00 01 and must include products liability and completed operations coverage which shall continue for a period of three years after acceptance of the work by the City. If insurance applies separately to a project/location, aggregate may be equal to per occurrence amount. Coverage may be met by a combination of primary and umbrella or excess insurance but umbrella and excess shall provide coverage at least as broad as specified for underlying coverage. Completed Operations Coverage can be provided in the form of an endorsement to Contractor's insurance (at least as broad as ISO Form CG 20 37 04 13. See endorsements below for other Additional Insured Requirements. Coverage shall not exclude subsidence.
2.	Business auto coverage	\$3 million	Coverage at least as broad as ISO Form Number CA 00 01 covering any auto (Code 1). Insurance shall cover owned, non-owned and hired autos.
3.	Workers' compensation and Employer's Liability	\$1 million	As required by the State of California, with Statutory Limits and Employer's Liability Insurance with limit of no less than \$1 million per accident for bodily injury or disease. The Workers' Compensation policy shall be endorsed with a waiver of subrogation in favor of the City for all work performed by Contractor, its employees, agents and subcontractors.

4.	Contractor's pollution legal liability and/or asbestos legal liability and/or errors and omission	<ul><li>\$1 million per occurrence or claim</li><li>\$2 million aggregate</li></ul>	If the work involves lead-based paint or asbestos identification/remediation, the pollution liability policy must not contain lead- based paint or asbestos exclusions. If the work involves mold identification, the pollution liability policy must not contain a mold exclusion and a definition of "Pollution" in said policy shall include microbial matter including mold.
5.	Course of construction/ builders' risk	Amount of completed value of project without co- insurance	Required for construction projects over \$3 million. The City shall be named as loss payee.

#### B. Endorsements:

- 1. All policies shall provide or be endorsed to provide that coverage shall not be canceled by either party, except after prior written notice has been provided to the City in accordance with the policy provisions.
- 2. Liability policies shall provide or be endorsed to provide the following:

provisions

- a. For any claims related to this Contract, Contractor's insurance coverage shall be primary and any insurance or self-insurance maintained by City shall be in excess of Contractor's insurance and shall not contribute with it. Endorsements at least as broad as 20 01 04 13 or evidence of policy language will be required in non ISO CGL policies.
- b. The City of Santa Rosa, its officers, agents and employees are to be covered as additional insureds on the CGL policy. Additional Insured Endorsements at least as broad as 20 10 04 13 or 20 38 04 13 are required.
- C. Verification of Coverage and Certificates of Insurance: Contractor shall furnish City with original certificates and endorsements effecting coverage required above. Certificates and endorsements shall make reference to policy numbers. All certificates and endorsements are to be received and approved by the City before work commences and must be in effect for the duration of the Contract. The City reserves the right to require complete copies of all required policies and endorsements during the duration of the Contract and for a period of three years following City's acceptance of the work.

#### D. Other Insurance Provisions:

- 1. No policy required by this Contract shall prohibit Contractor from waiving any right of recovery prior to loss. Contractor hereby waives such right with regard to the indemnitees.
- 2. All insurance coverage amounts provided by Contractor and available or applicable to this Contract are intended to apply to the full extent of the policies. Nothing contained in this Contract limits the application of such insurance coverage. Coverage for an additional insured shall NOT be limited to the insured's vicarious liability. Defense costs must be paid in addition to coverage amounts.
- 3. Self-insured retentions above \$10,000 must be approved by the City. At the City's option, Contractor may be required to provide financial guarantees.
- 4. City reserves the right to modify these insurance requirements, including limits, based on the nature of the risk, prior experience, insurer, coverage, or other special circumstances.

<u>3-1.18 Contract Execution</u>: The fully executed Contract, original bonds and insurance certificates and endorsements required under the Contract shall be delivered to the City <u>within ten calendar days</u> of Contractor's receipt of the Notice of Award.

The Engineer will supply Contractor with up to ten sets of the Invitation for Bids and Project Plans. At least one complete set of the Invitation for Bids and Project Plans shall be kept at the construction site in good condition and made available to the Engineer at all times. Additional copies of the Invitation for Bids and Project Plans will be provided by the Engineer at Contractor's cost.

<u>3-1.20 Failure to Execute Contract</u>: Contractor's failure to deliver to the City the fully executed Contract within ten calendar days of Contractor's receipt of the Notice of Award shall be cause for the cancellation of the award and the forfeiture of the bid guaranty to the City. If the successful bidder refuses or fails to execute the Contract, the City may award the Contract to the second lowest responsible bidder. If the second lowest responsible bidder refuses or fails to execute the Contract to the third lowest responsible bidder. The refusal or failure by the second or third lowest responsible bidder to deliver to the City the fully executed Contract within ten calendar days of receipt of the Notice of Award to the respective bidder shall likewise be cause for the cancellation of the award and the forfeiture of the bid guaranty of the respective bidder. In its discretion, the City may then re-advertise the project or construct it by day labor.

<u>3-1.21 Return of Bid Guarantees</u>: Within ten days after the opening of bids, the City will return the bid guarantees to all bidders except the three lowest responsible bidders. The bid guarantees of the three lowest responsible bidders will be retained until the Contract has been fully executed. In the event all bids are rejected, all bid guarantees will be returned to the respective bidders.

<u>3-1.22 Subcontractors</u>: The successful bidder shall furnish a list of all subcontractors as required under Sections 2-1.33C. The list shall include the name, business address, DIR registration number and the state contractor's license number of each subcontractor on the list and the names of the responsible managing employees whose names appear on the subcontractors' licenses.

**<u>4-1.03 Description of Work</u>**: The proposed scope of work consists of furnishing all labor, materials, equipment, and services for the City of Santa Rosa Pump Station 15 Upgrades Project, including removal and replacement/installation of a new standby generator, a variable frequency drive, an automatic transfer switch, fences, gates, flow switches and SCADA interface control and instrumentation work, replace two existing meters with mag meters, and preparation and recoating of existing tank; and all miscellaneous work as shown, specified or required for a complete, operating installation.

<u>4-1.05 Changes and Extra Work</u>: All changes to the Contract shall be made by written change order only.

All extra work shall be recorded by Contractor on a daily report signed by both the City and Contractor. The "daily reports" shall thereafter be considered the true record of extra work performed. A copy of the daily reports will be furnished to Contractor. Contractor is directed to Section 9-1.04 of this Invitation for Bids.

**<u>4-1.05C Compensation for Altered Quantities</u>**: The quantity of each item may be increased, decreased or eliminated entirely as determined in the field by the Engineer and no adjustment in the contract bid price shall be made therefor. The provisions of Section 9-1.06, "Increased or Decrease Quantities" of the State Standard Specifications, shall not apply.

# **5 CONTROL OF WORK**

<u>5-1.02 Contractor's Copies of Contract Documents</u>: In the event of a conflict in any of the Contract Documents, the order of precedence from highest to lowest shall be as follows:

- 1. Special Provisions
- 2. Project Plans, consisting of 23 sheets entitled Pump Station 15 Upgrades, 2019-0020
- 3. City Standards
- 4. City Specifications
- 5. Standard Specifications
- 6. Standard Plans

**<u>5-1.05 Order of Work</u>**: The work as shown on the Project Plans and as specified in the Invitation for Bids shall be constructed in a sequence that is satisfactory to and approved by the Engineer.

Contractor shall prepare a CPM work schedule per Section 8-1.02C Level 2 Critical Path Method Schedule of the Standard Specifications. Section 8-1.02C(3) Computer Software of the Standard Specifications is deleted in its entirety.

There are components of Contract work that do not require long lead time for delivery of materials and therefore Contract work shall be coordinated and conducted in advance of the long lead time materials.

With the exception of trenching, all existing street, street light base, curb and gutter, storm drain, water line, and sewer line work shall be completed before any existing street paving is removed.

Full compensation for the conformance to the requirements of this section is included in the Contract price and no additional allowance will be made to Contractor for this work.

<u>5-1.17 Character of Workers</u>: Contractor is directed to Section 5-1.17 of the Standard Specifications which states:

"If any subcontractor or person employed by the Contractor shall appear to the Engineer to be incompetent or to act in a disorderly or improper manner, he shall be discharged immediately on the request of the Engineer, and such person shall not again be employed on the work."

No additional compensation shall be granted to Contractor in the event City exercises any part of its rights under this section and any and all costs related to such exercise shall be borne by Contractor.

**<u>5-1.20 Cooperation with Other Entities</u>**: Attention is directed to Section 5-1.20 of the Standard Specifications.

Other construction including but not limited to utility, power, and pipe line relocation, may be in progress by other forces within and adjacent to the project area at the same time work is being performed under this Contract by Contractor.

Contractor shall cooperate with the forces performing other work, to the end that such forces may conduct their operations with as little inconvenience and delay as possible. Contractor shall grant such forces access to the project area as is reasonable and necessary to transport materials and equipment to the site of operations by the other forces.

**<u>5-1.20B(4)(a)</u>** Offsite Staging Areas and Construction Yards</u>: Attention is directed to Santa Rosa City Code section 20-52.040, Temporary Use Permit.

A Temporary Use Permit shall be obtained for any offsite construction yard on private property to be used for any of the following:

a. Stockpiling of equipment and/or materials;

- b. Staging of construction;
- c. Placement of work trailers or mobile offices;
- d. Storage of trench spoils; or
- e. Other construction related activities not specifically enumerated above.

**<u>5-1.26 Lines and Grades</u>**: Contractor shall carefully preserve all bench marks, grade stakes, property corner markers, and all other survey markers. In the case of willful or careless destruction, Contractor shall bear the cost of replacing the markers.

Contractor shall contact the Engineer directly for coordination of survey staking. Written staking requests must be submitted at least two working days in advance of the date and time stakes are needed.

**5-1.27B Examination and Audit**: Pursuant to California Government Code section 8546.7, any contract with the City involving expenditures in excess of \$10,000 shall be subject to the examination and audit of the California State Auditor for a period of three years after final payment is made to Contractor by City under this Contract. Any such examination and audit will be confined to those matters connected with the performance of this Contract.

**5-1.30A Inspection**: Contractor shall bear all costs associated with the re-inspection of any defective, rejected or unauthorized work as determined by the Engineer in Engineer's sole discretion. Such costs of re-inspection, including any costs incurred by the City for additional staff time or fees for third-party consultant inspectors, will be deducted from one or more progress payments hereunder.

<u>5-1.36A Property and Facility Preservation</u>: Attention is directed to Section 5-1.36 of the Standard Specifications.

At Contractor's sole expense, all fences, gates, landscaping, drainage ditches, sidewalks, irrigation systems, and any other improvements that are damaged, removed or destroyed because of Contractor's operations, shall be replaced in accordance with City Standards at a minimum and restored to the same or better condition. Concrete surface treatment and score marks shall match adjacent existing concrete improvements.

**5-1.36E Obstructions**: Attention is directed to Section 5-1.36 of the Standard Specifications and to the possible existence of underground gas mains, high voltage lines, telephone ducts, storm drains and water and sewers systems, the locations of which are not shown on the Project Plans. The determination of the location of these facilities and the cost of repair or replacement in the event of damage to such facilities are the sole responsibility of Contractor.

Should Contractor alter any public utility or private improvements to facilitate its operations or for its sole benefit, which alteration would not be otherwise required, Contractor shall make whatever arrangements are necessary with the owner or controlling authorities, and shall bear all expenses in connection therewith. Any damages to any public utility or private improvement caused by Contractor shall be repaired by Contractor at its sole expense and to the full satisfaction of the Engineer or the controlling authority.

Any subsurface information and data furnished under any part of this Contract are not intended as a representation or warranty but are furnished for information only. It is expressly understood that the City will not be responsible for the accuracy thereof or for any deduction, interpretation or conclusion drawn therefrom by Contractor. The information is made available so that Contractor may have ready access to the same information available to the City and is not part of this Contract.

PRIOR TO STARTING ANY EXCAVATION, CONTRACTOR SHALL (AT LEAST TWO WORKING DAYS IN ADVANCE) CALL UNDERGROUND SERVICE ALERT (USA) toll free at (800) 227-2600 and provide USA with all necessary data relative to the proposed excavation. USA will accept calls and process information to participating agencies who have underground facilities in the area between the hours of 7:30 a.m. and 5:00 p.m. daily, except Saturdays, Sundays, and holidays.

Between the hours of 5:00 p.m. and 7:30 a.m., calls will be recorded and then processed after 7:30 a.m. For emergency situations, after hours, and on Saturdays, Sundays and holidays, Contractor shall contact the owner of the affected facility.

Contractor shall coordinate all work with the appropriate City field personnel. When City work forces are required at the job site to perform Contract items of work, Contractor shall give a minimum of two working days advanced notification to the appropriate field office:

Water Division:	(707) 543-4200
Sewer Division:	(707) 543-4200
Street Division:	(707) 543-3880
Survey Division:	(707) 543-3834

**5-1.43 Potential Claims and Dispute Resolution:** "Claim" means a separate demand by 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 the City under the Contract; (B) Payment by the City of money or damages arising from work done by, or on behalf of, Contractor pursuant to the Contract and payment for which is not otherwise expressly provided or to which the claimant is not otherwise entitled; or (C) Payment of an amount that is disputed by the City.

Upon receipt of a Claim, the City shall conduct a reasonable review of the Claim and, within a period not to exceed 45 days, shall provide Contractor a written statement identifying what portion of the Claim is disputed and what portion is undisputed, provided, the parties may extend the 45 day time period by mutual agreement.

If the City needs approval from the City Council to provide the claimant a written statement identifying the disputed portion and the undisputed portion of the Claim, and the Council does not meet within the 45 days or within the mutually agreed to extension of time following receipt of a Claim, the City shall have up to three days following the next duly publicly noticed meeting of the City Council after the 45-day period, or extension expires to provide Contractor a written statement identifying the disputed portion and the undisputed portion.

Any payment due on an undisputed portion of the Claim shall be processed and made within 60 days after the City issues its written statement. If the City fails to issue a written statement, the Claim shall be deemed rejected in its entirety.

If a Contractor disputes the City's written response, or if the City fails to respond to a Claim within the time prescribed, the Contractor 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 City shall conduct a meet and confer conference within 30 days for settlement of the dispute. 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 City shall provide the Contractor 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 City issues its written statement. Any disputed portion of the Claim, as identified by Contractor in writing, shall be submitted to nonbinding mediation, with the City and the Contractor sharing the associated costs equally. The City and Contractor 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 gualified 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.

# **6 CONTROL OF MATERIALS**

<u>6-2.01 Source of Supply and Quality of Materials</u>: All materials required to complete the work under the Contract shall be furnished by Contractor and shall be free of hazardous substances.

**<u>6-3.01 General</u>**: Statistical means will not be used by the City for determination of Standard Specification compliance. Whenever both operating range test results and Contract compliance requirements are specified in these special provisions, the operating range requirements shall apply to the individual test results.

**<u>6-3.01A</u>** Material Submittals: Upon award of the Contract by City, Contractor shall submit to the Engineer a list of all materials proposed to be used on this project and any supporting documentation and/or samples required and source of supply.

For material listed on the "Engineer's List of Approved Items" which is located in the Sewer and Water sections only of the City Standards, the Engineer shall be provided with the name of the manufacturer and model/part number for all material proposed for this project, unless that item has been replaced as shown on the Project Plans or in the Invitation for Bids.

For all other materials used on this project, regardless of the type of work, Contractor shall provide to the Engineer the name of the manufacturer and model/part number along with supporting documentation and/or samples that will allow the Engineer to determine the material's acceptability.

The Engineer reserves the right to reject any proposed material, whether on the City's "Engineer's List of Approved Items" or not. If the City obtains information indicating that a listed item is not performing satisfactorily or is found to be defective, that item will be rejected and Contractor shall submit a replacement for review at no additional cost to the City.

**6-3.01B Material Guarantee**: Before any contract is awarded, the bidder may be required to furnish samples of materials and detailed descriptions of equipment to be used in the construction of the project. The materials samples may be subjected to the tests provided for in the Standard Specifications or in this Invitation for Bids to determine their quality and fitness for the project. The successful bidder shall unconditionally guarantee project materials and workmanship for a period of one year from the date of recording of the Notice of Completion. The guarantee shall cover 100% of all costs of repairs within the one year period, including all costs of labor, materials, equipment, and incidentals. Except as may be otherwise provided in Section 3-1.05, the successful bidder shall provide a surety bond executed by a corporate surety authorized and admitted to transact a surety business in the state of California in the minimum amount of one-half of the Contract price to cover this guarantee.

**<u>6-3.05 Quality Assurance</u>**: California Test 216 (Relative Compaction) testing will be modified as follows: A mechanical compactor (Ploog Engineering Co. Model M 100 or equivalent) with 10-pound hammer and split compaction molds shall be used in lieu of the specified manual compaction equipment.

California Test 231 (Nuclear Gage Determination of In-Place Density) will be modified as follows: In-place density and relative compaction may be determined on the basis of individual test sites in lieu of the area concept, at the discretion of the Engineer.

#### 6-4 Water Utility

**<u>6-4.01A Construction Water</u>**: All water required for the performance of the work shall be provided by Contractor. Prior to obtaining water from the City's water system, Contractor shall obtain a Water

Use Permit from the City of Santa Rosa Water Department and rent a hydrant or bridge meter. Contractor is responsible for the cost of all water and the cost of all deposits, permits and fees.

#### Contractor is prohibited from operating gate valves or fire hydrants on the City system.

The acquisition of water from the City's water system through un-metered hydrants or other facilities is a violation of City ordinance and State law. The use of water from sources other than the City's water system must be approved by the Engineer in advance of the use.

Citations and fines will be levied for violation of these and other utility regulations and deductions will be made from payments consistent with Section 7-1.02A(1) of the Standard Specifications.

**<u>6-4.01B Water Utility Notification</u>**: Contractors or parties requiring work of any kind by the City of Santa Rosa Water Department forces shall request such services a minimum of 48 hours in advance of the time such services are desired. Work requests which will involve the City of Santa Rosa Water Department forces for more than eight hours or an extensive number of City parts shall be requested a minimum of seven calendar days in advance.

If it is necessary to terminate or disrupt utility service to any customer, Contractor shall make the request for such work by City forces an <u>additional</u> 72 hours (three additional working days for a total of five working days advance notice) in advance of the time such services are desired to allow affected customers a minimum of 72 hours' notice. Contractors who fail to keep field appointments will be billed for scheduled City of Santa Rosa Water Department crew standby time which was used and the Contractor shall bear the costs incurred by the City of Santa Rosa's Water Department for re-notification of customers.

City of Santa Rosa Water Department crews work a 9/80 schedule. This schedule may prohibit shutdowns for tie-ins on alternating Fridays. After hours work or weekend work may be performed if prior authorization from the Engineer is obtained.

Other than the hours specified in this Invitation for Bids, requests by Contractor for after hours or weekend work is to be avoided whenever possible. Any overtime costs incurred by City for such work shall be borne by Contractor.

Interruption of utilities service to commercial customers shall be coordinated with the customer to minimize disruption to the enterprise to the greatest extent practicable. After notification by the Contractor of the need, the City of Santa Rosa Water Department will contact all commercial customers and inform Contractor accordingly.

**<u>6-4.01C Water Facility Damage</u>**: All damage caused to the City's water system shall be immediately reported to the Engineer.

Damage caused to the City's water system by Contractor's operations shall be repaired by the Contractor at <u>Contractor's sole expense</u> in a manner satisfactory to the City of Santa Rosa Water Department. Such repairs shall <u>not</u> be charged to the City or any City project. All repair work shall be witnessed and approved by the City of Santa Rosa Water Department <u>prior to</u> backfilling the excavation. The City will require re-excavation if backfilling occurs prior to inspection, which costs shall be borne by Contractor.

Contractor is responsible for, at its sole cost and expense, the repair and remediation of damage to property and facilities caused by any of the following circumstances:

a. Contractor fails to make a written request for a markout or begins excavation without providing the City of Santa Rosa Water Department a reasonable opportunity to mark facilities;

- b. Contractor destroys markouts;
- c. Contractor fails to perform hand digging or probing for utilities near markouts; or
- d. Contractor fails to use reasonable caution, regardless of whether markouts are present or clear. Reasonable caution includes any efforts to avoid damaging existing facilities, such as when excavating in the vicinity of water mains.

City may, in its discretion, opt to make the repairs for which Contractor is responsible with its own forces. In such cases, the repairs will be made at Contractor's expense in accordance with the emergency repair rate schedule of the City of Santa Rosa Water Department. The City may make repairs whenever restoration of service requires extraordinary speed or special equipment. Contractor will be billed accordingly and City shall have the right and option to withhold payment hereunder, or a portion thereof, for any such costs billed but not promptly paid by Contractor.

**<u>6-4.02</u>** Salvage: All valves, hydrants, and other appurtenances of the water system that are the property of City and removed by Contractor shall be delivered to the City's Municipal Services Center (55 Stony Point Road) unless Contractor has obtained specific written approval from the City of Santa Rosa Water Department to otherwise dispose of the materials.

**6-4.03 Trade Names and Alternatives**: Unless otherwise specified, material and equipment specifications that identify a particular patent, trade name or manufacturer, may be satisfied through substitute materials and equipment accepted by the City. Contractor may offer substitute materials and equipment of equal or better quality to the City. Any such offer shall be made in writing to the Engineer at least four weeks in advance of the time Contractor wishes to order the materials or equipment. Contractor shall include sufficient data which, together with any other information the Engineer may require, will enable the Engineer to determine the acceptability of the materials and equipment. When the substitute materials or equipment necessitate changes to any part of the work, the information shall include drawings and details showing all such changes and Contractor shall perform these changes as a part of any acceptance of substitute materials or equipment. The use of substituted materials and equipment will be permitted only after written acceptance of the materials and equipment by the Engineer. Such acceptance shall not relieve the Contractor from full responsibility for the sufficiency, quality and performance of the substitute materials and equipment.

The City will not, under any circumstances, acknowledge or consider any offers to accept substitute materials or equipment between the dates of public notice of advertisement and the bid opening.

# 7 LEGAL RELATIONS AND RESPONSIBILITY TO THE PUBLIC

**7-1.02A(1)** Forfeitures for Health and Safety Violations: Contractor shall comply with all applicable provisions of the Santa Rosa City Code and any failure to do so shall constitute a breach of the Contract. In the event of any violation of the Santa Rosa City Code that may impact public health and safety, including, but not limited to Chapter 17-12, "Storm Water" and Chapter 13-04, "Street Encroachments," City shall have the right to impose a charge against Contractor in an amount equal to \$500.00 per violation per day. Prior to the imposition of any charge hereunder, City shall first provide a written notice to Contractor of the violation and setting forth a reasonable period of time for Contractor to cure the violation(s). In the event Contractor fails to cure any such violation within the time provided, City shall have the right, in addition to all other rights and remedies available to City, to deduct and withhold as a permanent forfeiture by Contractor the appropriate amounts from any payment otherwise due Contractor under this Contract.

**<u>7-1.02K(2) Wages</u>**: Pursuant to Labor Code sections 1770 *et seq.*, each laborer or mechanic of Contractor or any subcontractor engaged in work on the project under this contract shall be paid not less than the hourly wage rate of per diem wages set forth in the prevailing wage rate schedule published by the Director of Industrial Relations, regardless of any contractual relationship which may be alleged to exist between Contractor or any subcontractor and such laborers and mechanics. A copy of the schedule of prevailing wage rates can be obtained online at <u>www.dir.ca.gov</u> or from the Department of Transportation and Public Works at 69 Stony Circle, Santa Rosa.

Any laborer or mechanic employed to perform work on the public works project under this Contract, which work is not covered by any of the foregoing classifications, shall be paid not less than the prevailing wage rate of per diem wages specified herein for the classification which most nearly corresponds to the work to be performed by the worker.

The foregoing specified prevailing wage rates are minimum rates only, and Contractor may pay any wage rate in excess of the applicable rate.

Pursuant to Labor Code Section 1775, Contractor as a penalty to the owner shall forfeit not more than \$200.00 for each calendar day, or a portion thereof, for each worker paid less than the prevailing wage rate established by the Department of Industrial Relations for such work or craft in which such worker is employed. The difference between such prevailing wage rates and the amount paid to each worker for each calendar day or portion thereof for which the worker was paid less than the prevailing wage rate shall be paid to each worker by Contractor.

Contractor shall only provide prevailing wage reports upon written request from City.

**7-1.02K(4) Apprentices**: Contractor agrees to comply with Chapter 1, Part 7, Division 2, sections 1777.5 *et seq.* of the California Labor Code. These sections require contractors and subcontractors to employ apprentices in apprenticeable occupations in a ratio of not less than one hour of apprentice work for each five hours of journeyman work (unless an exception is granted in accordance with Section 1777.5), and the contractors and subcontractors shall not discriminate among otherwise qualified employees as apprentices solely on the ground of sex, race, religion, creed, national origin, ancestry, or color. Only apprentices as defined in Labor Code section 3077, who are in training under apprenticeship standards and who have written apprentice agreements will be employed on public works in apprenticeable occupations. The responsibility for compliance with these provisions is fixed with the prime contractor for all apprenticeable occupations.

<u>7-1.02K(6)(a)(1) Notice to Vendors</u>: Attention is directed to the current OSHA Standards. All equipment, tools and materials which are furnished and/or installed as part of this Contract shall meet or exceed the aforementioned standards in order to be considered acceptable.

<u>7-1.02K(6)(b) Excavation Safety</u>: When the digging or excavation occurs during project construction, Contractor shall:

- a. Promptly notify City in writing of the following conditions before any such conditions are disturbed:
  - Material that the Contractor believes may be hazardous waste as defined in Health and Safety Code section 25117 that is required to be removed to a Class I, Class II or Class III disposal site in accordance with provisions of existing law;
  - 2. Subsurface or latent physical conditions at the site differing from those indicated in the Invitation for Bids; and
  - 3. Physical conditions at the site of any unusual nature, materially different from those ordinarily encountered and generally recognized as inherent in the type of work under the Contract.
- b. The City will investigate the conditions and will issue a change order under the terms of the Contract if it finds that the conditions warrant it.
- c. If a dispute arises between City and Contractor as to whether a change order is warranted, Contractor shall not be excused from any scheduled completion date provided for in the Contract, but shall proceed with all work to be performed under the Contract.

<u>7-1.02K(6)(b)(1)</u> Trench Excavation Safety Plans: When the estimated cost for the excavation of any trench or trenches five feet or more in depth will exceed \$25,000.00, Contractor <u>shall</u> submit to the Engineer in advance of excavation a detailed plan showing the design of shoring, bracing, sloping or other provisions to be made for worker protection from the hazard of caving ground during the excavation of such trench or trenches. If such plan varies from the shoring system standards established by the construction safety orders, or if the trench is anticipated to be greater than 20 feet, the plan shall be prepared by a registered civil or structural engineer.

A permit to do the above described work shall be obtained from the State of California, Division of Industrial Safety. Proof of such permit shall be submitted to the Engineer prior to starting the trench work.

Full compensation for complying with the provisions of this section shall be considered as included in the Contract price and no additional allowance will be made for the work.

<u>7-1.02K(6)(d)</u> Confined Space Safety: Any confined space entry for this project, including but not limited to manhole or water storage tank entry, will require a confined space entry permit pursuant to Cal/OSHA regulations as set forth in title 8 California Code of Regulations (CCR) sections 5157 or 5158. Confined space entry shall have the meaning ascribed in title 8 CCR sections 5157 and 5158. For any confined space entry for construction operations regulated by title 8 CCR section 1502, Contractor shall comply with title 8 CCR section 5158, "Other Confined Space Operations." For any other confined space operations, Contractor shall comply with title 8 CCR section 5157, "Permit-Required Confined Spaces."

Attention is directed to the technical specifications in the Special Provisions for information regarding entry to any City maintained confined space. Pursuant to title 8 CCR section 5157, Contractor is required to obtain any available information regarding hazards and operations for any City maintained confined spaces. The City maintained Confined Space Entry Manual is available

for viewing at the City of Santa Rosa Water Department or Transportation and Public Works Department office at 69 Stony Circle, Santa Rosa.

Contractor shall immediately inform the Engineer of any previously unidentified hazards confronted or created during confined space entry.

**7-1.02L(2)(a)** Patents and Royalties: All fees, royalties, or claims for any patented invention, article, process or method that may be used upon or in any manner connected with the work under this Contract shall be paid by Contractor. Contractor and its sureties shall protect and hold harmless City and its officers, agents, and employees from any and all demands made for such fees royalties or claims brought or made by any third party, and before the final payment is made on the account of the Contract, Contractor shall, if requested by City, furnish acceptable proof of a proper release from all such claims and liabilities.

Should Contractor, its officers, agents, or employees, or any one of them be enjoined from furnishing or using any invention, article, material, or plans supplied or required to be supplied or used under the Contract, Contractor shall promptly substitute other articles, materials, or appliances in lieu thereof of equal efficiency, quality, finish, suitability, and market value, and satisfactory in all respects to the Engineer. In the event that the Engineer elects, in lieu of such substitution, to have supplied and to retain and use any such invention, article, materials, or plans as may be required to be supplied by the Contract, Contractor shall pay such royalties and secure such valid licenses as may be requisite and necessary for City, its officers, agents, and employees, or any one of them to use such invention, article, materials, or appliance without being disturbed or in any way interfered with by any proceeding in law of equity on account thereof. Should Contractor neglect or refuse to make the substitution promptly or to pay such royalties and secure such licenses as may be necessary, then in that event the Engineer shall have the right to make such substitutions or City may pay such royalties and secure such licenses and be necessary.

<u>7-1.02M(3)</u> Mined Materials: California Public Contract Code section 20676 prohibits surface mining operators which are subject to the Surface Mining and Reclamation Act of 1975 (SMARA) from selling California mined construction material to the City unless the operator is identified in a list referred as the **3098 List**. The List, which is maintained by the Department of Conservation's Office of Mine Reclamation (OMR), changes throughout the year and can be viewed at the OMR website: <u>http://www.consrv.ca.gov/OMR/ab 3098 list/index.htm</u>. To confirm whether or not a specific operator is on the List at any given time, Contractor shall call the OMR at (916)323-9198.

<u>7-1.03A Maintaining Traffic</u>: Attention is directed to Sections 7-1.04 of the Standard Specifications and to the following modifications thereof.

If construction is within City owned right-of-way, provisions shall be made for the safe passage of public traffic through the work site at all times consistent with the requirements of Santa Rosa City Code Chapter 13-04.

Except for projects to be performed under a minor contract, Contractor shall install and maintain project identification signs at each end of the project or as directed by the Engineer two weeks prior to any construction activity. City shall furnish the appropriate sign panels upon request from Contractor. To mount the sign panels, Contractor shall furnish and install 4" X 4" posts or mount by other appropriate methods as approved by the Engineer. These sign panels shall be returned to the City Corporation Yard at 55 Stony Point Road after completion of the project.

Two weeks prior to any construction activity, advance notice signs for road closures shall be furnished and installed by Contractor at each end of the project and shall remain in place throughout the duration of the subject closure. Details of panel construction and lettering shall be approved by the Engineer.

Contractor shall furnish, install, and maintain at its expense all barricades, signs, lights, and other devices necessary to adequately warn of any obstructions to the traveled and pedestrian way and provide flaggers as necessary for the safety of public traffic and pedestrians and to provide access to property adjacent to the work site and Contractor shall comply with the Americans with Disabilities Act of 1990 (42 U.S.C. 12101, *et seq.*) (ADA) and any regulations and guidelines issued pursuant to the ADA.

Contractor shall comply with the current edition of the California Manual of Uniform Traffic Control Devices (CA MUTCD) for all items related to traffic within the work site.

Rain and other occurrences that may cause the suspension or delay of the work shall in no way relieve Contractor of its responsibility to provide traffic control and public access through the work site as specified herein. At all times, Contractor shall keep at the work site such materials, forces and equipment as may be necessary to keep roads, streets, and driveways within the work site open to traffic and in good repair and shall expedite the passage of such traffic, using such forces and equipment as may be necessary.

Should Contractor fail, in the opinion of the Engineer, to provide all the materials, forces and equipment necessary to maintain traffic through the work site as set forth herein, City may take steps necessary to remedy any such failure, including but not limited to causing such work to be performed and/or suspending any further work under the Contract. Any such remedial cost and expense incurred by the City, plus an administrative charge of 15%, shall be immediately due and payable by Contractor and may be deducted from any amounts owed to Contractor hereunder. In the event there are insufficient sums owed to Contractor hereunder to cover the foregoing costs and charges, City shall have the right to pursue any other remedy to recover the same, including but not limited to, proceeding against any surety or bond in favor of City. City's rights under Section 7-1.02 are intended to be in addition to and not in lieu of any charges imposed by City against Contractor under Section 7-1.02A(1) above for violations of the Santa Rosa City Code.

Contractor shall be responsible for informing emergency response agencies operating within the area of the work of obstructions to either public or private roads caused by reason of Contractor's operations hereunder.

Contractor shall make provisions for the safe passage of pedestrians around the project work site at all times.

## 8 PROSECUTION AND PROGRESS

**<u>8-1.01A</u>** Assignments: Once awarded, this Contract shall not be transferred, assigned, or subcontracted, except as herein expressly provided without the prior written consent of the City in the City's sole and absolute discretion. See Section 5-1.12 of the Standard Specifications.

**<u>8-1.04B</u>** Standard Start: Contractor shall begin work within ten calendar days after the date authorized in the Notice to Proceed and shall diligently prosecute the Contract to completion before the expiration of:

#### 160 WORKING DAYS

**<u>8-1.05 Time</u>**: Working days will be counted beginning with the day the Contractor begins work or with the tenth day after the date authorized in the Notice to Proceed, whichever occurs first.

Contractor shall coordinate work and efficiently make use of working days for the long lead time components of this project and submittals for review. Contractor shall furnish the Engineer with a statement from the vendor(s) that the order for the materials required for this Contract has been accepted by the vendor(s) within ten calendar days after the contractor receives the Notice to Proceed. The statement shall include the date that the materials will be shipped and be delivered to the project site.

Unless otherwise directed by Engineer, Contractor shall not conduct any activities that generate noise earlier than 7:00 a.m. or later than 7:00 p.m.

**<u>8-1.10 Liquidated Damages</u>**: Contractor hereby agrees that Contractor shall pay to the City liquidated damages for each and every calendar day delay over and above the number of working days prescribed above for finishing the work in the amount shown in Section 8-1.10 of the Standard Specifications.

## 9 MEASUREMENT AND PAYMENT

**<u>9-1.04 Force Account Work</u>**: All work done on a force account basis shall be recorded daily on report sheets prepared by Contractor and signed by both the Engineer and Contractor. Such reports shall thereafter be considered the true record of force account work performed during the project. Such reports shall be furnished to the Engineer and a copy retained by Contractor.

All extensions of labor, equipment, and material costs shall be completed by Contractor and submitted to the Engineer within 30 days of the completion of the extra work. Completed and extended extra work reports received later than the times herein prescribed may be deemed invalid and rejected without payment at the discretion of the Engineer.

<u>9-1.07 Payment Adjustments For Price Index Fluctuations</u>: Any references to Opt Out of Payment Adjustments for Price Index Fluctuations in the Standard Specifications are deleted in their entirety.

**9-1.16 Progress Payments**: Once each month for progress pay purposes, the City will prepare a written estimate of the total amount of completed work and accepted materials purchased by Contractor but not installed. The City shall retain five percent of such estimated value of the completed work and the unused materials and pay Contractor the balance after deducting all previous payments and all sums to be retained under the provisions of the Contract. No such estimate or payment shall be required to be made when, in the judgment of the Engineer, the work is not proceeding in accordance with the provisions of the Contract or when, in the Engineer's judgment, the total value of the completed work since the last estimate is less than \$500.00. No such estimate or payment shall be construed to be an acceptance of any defective work or improper materials.

After Contract acceptance, the Engineer will prepare a written proposed final estimate of the proposed final quantities of work completed under the Contract and the value of such work and will submit such estimate to Contractor. The City shall retain five percent of such estimated value of the work done and shall pay to Contractor the balance after deducting all amounts to be retained under the provisions of the Contract.

The City may, at its option and at any time, retain out of any amounts due Contractor sums sufficient to cover any unpaid claims of City or others, provided that sworn statements of all non-City claims shall have been filed with the Director of Finance.

**9-1.16E(6)** Substitution of Securities for Withheld Amounts: Pursuant to Public Contract Code section 22300, securities may be substituted for any moneys withheld by City to ensure performance under this Contract, provided that substitution of securities provisions shall not be required in contracts in which there will be financing provided by the Farmer's Home Administration of the United States Department of Agriculture pursuant to the Consolidated Farm and Rural Development Act (7 USC sections 1921 *et seq.*), and where federal regulations or policies or both do not allow the substitution of securities. At the request and expense of Contractor, securities equivalent to the amount withheld shall be deposited with the City, or with a state or federally chartered bank as the escrow agent, which shall then pay such moneys to Contractor. The Director of Finance is authorized to execute substitution of securities agreements on behalf of the City. The City will return the securities to Contractor upon satisfactory completion of the Contract as determined by City in its sole discretion and the resolution of all outstanding claims against the securities. Contractor shall be the beneficial owner of any securities substituted for moneys withheld and shall receive any interest thereon.

Securities eligible for investment under this section shall include those listed in Government Code section 16430, bank or savings and loan certificates of deposit, interest bearing demand deposit accounts, standby letters of credit or any other security mutually agreed to by Contractor and the

City, provided that the substituted security is equal to or not less than five percent of the Contract amount.

Security substitutions must be submitted by Contractor and approved by City prior to the time of the first progress payment to be made under the Contract. No other method of substituting securities for retention will be accepted. The security substitution shall be done only upon execution of an agreement satisfactory to City which includes the following provisions:

- a. The amount of securities to be deposited;
- b. The terms and conditions of conversion to cash in case of the default of Contractor; and
- c. The procedure for return of securities upon completion of the Contract.

**<u>9-1.17D Final Payment and Claims</u>**: The processing of payment of the final estimate shall not be commenced less than 35 days after the date of recording of the Notice of Completion with the County Recorder's Office. Contractor is advised that it takes approximately ten days for a check to be issued following a request for payment.

Contractor shall submit its written statement of all claims for additional compensation under the Contract to the Engineer within 15 days after submission to Contractor of the proposed final estimate.

If Contractor does not file a claim within the 15 day period, or upon Contractor's approval, the Engineer will issue a final written estimate and the City shall pay to Contractor the entire sum due after deducting all previous payments, if any, and all amounts to be retained under the provisions of the Contract.

If Contractor files a claim within the 15 day period, the Engineer will furnish a semi-final estimate and pay the amount due under the semi-final estimate within 30 days. The semi-final estimate is conclusive as to the amount payable except as may be affected by claims and any amount retained. The Engineer shall then consider and investigate such claim, and shall make such revision in the final quantities as the Engineer may find to be due, and shall then make and issue a final written estimate. The City will pay the amount due, after deducting all previous payments, if any, and amounts to be retained under the provisions of the Contract.

Any and all prior partial estimates and payments shall be subject to correction in the final estimate and payment.

The final estimate shall be conclusive and binding against both parties to the Contract on all questions relating to the performance of the Contract and the amount of work done thereunder and compensation therefor, except in the case of gross error.

**9-1.17D(3)** Final Determination of Claims: Claims filed by Contractor shall be in sufficient detail to enable the Engineer to determine the basis and amount of the Claims. Contractor shall also furnish reasonable documentation to the City to support Claims. If additional information is required by the Engineer, Contractor shall provide such information to the Engineer no later than the 15<sup>th</sup> day after receipt of the written request from the Engineer. If the 15<sup>th</sup> day falls on a weekend, holiday, or day City offices are closed, then the information shall be provided to the Engineer no later than close of the next business day. Failure to submit the requested information to the Engineer within the time specified will be sufficient cause for denying the Claim.

Contractor shall keep full and complete records of the costs and additional time incurred for any work for which a claim for additional compensation is made. The Engineer or any designated Claim investigator or auditor shall have access to those records and any other records as may be reasonably required by the Engineer to determine the facts or contentions in each Claim. Failure to grant access to such records shall be sufficient cause for denying the Claims.

**<u>9-1.22 Arbitration</u>**: Any references to Arbitration in the Standard Specifications are deleted in their entirety.

Claims submitted by Contractor shall be accompanied by a notarized certificate containing the following language:

Under the penalty of law for perjury or falsification and with specific reference to the California False Claims Act, Government Code sections 12650 *et seq.*, the undersigned,

(Name)

of

(Title)

(Contractor)

hereby certifies that the claim for additional compensation made herein is supported by a true statement of the actual costs incurred and time expended on this project, and is fully documented by records maintained by Contractor.

Dated \_\_\_\_\_

/s/\_\_\_\_\_

Subscribed and sworn before me this \_\_\_\_\_ day of

Notary Public

My Commission Expires \_\_\_\_\_

Failure to submit the notarized certificate will be sufficient cause for denying the claim.

Any claim for overhead expenses, in addition to being certified as stated above, shall be supported by an audit report of an independent Certified Public Accountant. Any such overhead claim shall also be subject to audit by the City at its discretion.

Any costs or expenses incurred by the City in reviewing or auditing any claims that are not supported by Contractor's cost accounting or other records shall be deemed to be damages incurred by the City within the meaning of the California False Claims Act.



# **Special Provisions**

# For

# **PUMP STATION 15 UPGRADES**

# **FEBRUARY 2020**



# **12 TEMPORARY TRAFFIC CONTROL**

#### 12-1 General

**12-1.01 General:** The Contractor is made aware that Pump Station 15 is located just off State Highway 12 and traffic, in the vicinity and directly in front of the project site, may vary at times from high speeds to congested. Any reference to work zone herein shall include that area needed to comply with this section.

Construction area traffic control devices, when necessary for project operations, shall be installed and maintained in accordance with the applicable sections of these Special Provisions, the Standard Specifications, the current Edition of the California Manual on Uniform Traffic Control Devices (CA MUTCD), the Americans with Disabilities Act (ADA) and as directed by the Engineer. Traffic control devices shall only be set in place just prior to their need and removed when the need no longer exists.

**<u>12-1.03 Flagging Costs</u>**: The first paragraph of Section 12-1.03, "Flagging Costs" is amended to read:

The cost of furnishing all flaggers, including transporting flaggers, to provide for passage of public traffic through the work under the provisions in Section 7-1.03, "Public Convenience", and Section 7-1.04, "Public Safety", shall be considered as included in the contract lump sum price paid for traffic control and no additional allowance will be made therefor.

#### 12-3 Traffic-Handling Equipment and Devices

**12-3.01 General:** Prior to commencing construction which will affect existing vehicular (including bicycles) and pedestrian traffic, the Contractor shall submit for review by the Engineer, a Traffic Control Plan on an 11" x 17" sheet(s) of paper which contains only information specifically related to work zone vehicular and pedestrian traffic control. If the Contractor proposes to use the current edition of the CA MUTCD published by Caltrans in lieu of a traffic control plan, in specific work operations, they shall submit in writing for consideration which Typical Application Diagram will be used and how it will be applied for each work operation. Traffic Control Plans or proposals shall be submitted for review at least two weeks prior to implementation.

Traffic Control Plans shall contain a title block which contains the Contractor's name, address, phone number, project superintendent's name, contract name, dates and hours traffic control will be in effect, and a space for review acknowledgment.

The content of the Traffic Control Plan shall include, but is not limited to, the following:

- 1. Show location and limits of the work zone.
- 2. Give dimensions of lanes affected by traffic control that will be open to traffic.
- 3. Indicate signing, cone placement, and other methods of delineation and reference to appropriate City or Caltrans Standards.
- 4. Dimension location of signs and cone tapers.
- 5. Identify all driveways that may be affected by the Contractor's operations and show how they will be handled.
- 6. Show how bicycle and pedestrian traffic will be handled through the work zone. Although pedestrian traffic is not typical in this area, it is possible. If pedestrian traffic does occur while temporary traffic control is set up, the Contractor shall provide personal attention to their safe passage through the work zone.

No work except for installation of project identification signs will be allowed to commence prior to approval of the Work Zone Traffic Control Plan(s).

#### 12-4 Maintaining Traffic

### 12-4.01 Maintaining Traffic:

- 1. The Contractor shall conduct their operations so as to cause the minimum obstruction and inconvenience to traffic and nearby residents.
- 2. Both directions of traffic on Highway 12 shall not be closed at the same time, where one lane is temporarily closed, flaggers shall be placed, at a minimum, at both ends of the closure to safely direct and alternate traffic, maintaining flow in both directions through the the work zone.
- When construction activities may prevent vehicle access to individual driveways the Contractor shall notify and receive permission from the affected resident(s). Attention is directed to Section 7-1.03, "Public Convenience". Full access shall be provided to all driveways during non-working hours.

**12-4.01A Construction Traffic:** Existing pavement, on or off the project site, damaged by the Contractor's operations and not shown to be replaced shall be replaced at the Contractor's expense, per City Standards and to the satisfaction of the Engineer.

**<u>12-4.02 Closure Requirements</u>**: Attention is directed to Section 7-1.03, "Public Convenience", to Section 5-1.05, "Order of Work," of these Special Provisions.

The Contractor shall coordinate with the Engineer for the exact locations of Project Identification signs (7-1.03, "Public Convenience").

Temporary traffic control may only impact traffic for a maximum of 15 minuets at at time.

The Contractor shall not park construction vehicles, contractor employee vehicles, stage materials or stockpiles in front of any business or residential driveway access or on Highway 12.

The Contractor shall keep the City of Santa Rosa Fire Department informed regarding the closure of any traveled way. At a minimum, the Contractor shall call the Fire Department at 543-3535 **and** the Communications Center at 543-3666 **daily** to report any traveled way closure. This means immediately upon closure for that day and again immediately after removal of the closure. For closures over multiple days, the daily notification still applies. This requirement does not apply for single lane closures on multiple lane streets.

### 12-7 Temporary Pedestrian Walkways

**<u>12-7.01 Pedestrian Traffic Control:</u>** The Contractor is directed to Chapter 6D, Pedestrian and Worker Safety, in the CA MUTCD, the improvement plans and these Special Provisions.

Pedestrians shall be provided with a safe convenient and accessible path that, at a minimum, replicates the most desirable characteristics of the existing sidewalk, path or footpath.

Pedestrian routes shall not be impacted for the purposes of any non-construction activities such as parking of vehicles or equipment, or stock piling of materials. Pedestrians shall not be led into conflicts with work site vehicles, equipment or operations.

#### 12-9 Measurement and Payment

**12-9.01 Payment:** Full compensation for Traffic Control as specified herein shall be considered as included in the contract prices paid for various items of work, and no additional compensation will be allowed therefor. Such compensation shall include but not be limited to all labor, materials, tools and equipment, and doing all work involved in vehicular and pedestrian traffic control, including but not limited to, providing, placing, maintaining, and removal of temporary paths and/or ramps, temporary relocation of regulatory signs, changeable message boards, project and public notification signs, flagging, excavation, compaction, furnishing, and placement of asphalt concrete and/or PCC, barricades, toe-rails, hand rails, complying with CA MUTCD Standards for Pedestrian Safety, coordination efforts and any other items necessary for vehicle and pedestrian traffic control not specifically enumerated in the plans or these specifications.

# **13 WATER POLLUTION CONTROL**

#### 13-1 General

**<u>13-1.01A</u>**: Water Pollution Control shall be performed in accordance with Section 13, Water Pollution Control, of the Standard Specifications and these technical specifications. In addition, construction activities shall comply with:

The current California Water Quality Control Board, North Coast Region Order No. National Pollutant Discharge Elimination System Municipal Storm Water Permit, commonly referred to as the "<u>Storm Water Permit</u>". A copy of the Storm Water Permit is available for review at the City of Santa Rosa Transportation and Public Works Department, 69 Stony Circle, Santa Rosa, CA, and at <u>www.srcity.org/stormwaterpermit</u>.

The California Stormwater Quality Association Storm Water BMP Handbook for Construction (<u>CASQA Handbook</u>). BMPs shall be selected, installed and maintained in accordance with the latest edition. A copy of the handbook can be viewed at City of Santa Rosa Department of Transportation and Public Works office at 69 Stony Circle or downloaded from CASQA, <u>http://www.casqa.org/</u>.

In this technical specification the CASQA Handbook BMP numbers are appended to the associated Standard Specification sections. If a conflict occurs the CASQA Handbook BMP's shall govern.

#### 13-2 Water Pollution Control Program

**13-2.01B Submittals:** The program to control water pollution required to be submitted under this section of the Standard Specifications shall include a spill contingency plan that establishes clean-up procedures that will be followed in the event of a spill of potentially hazardous, toxic, or polluting materials.

**<u>13-2.04 Payment:</u>** Full compensation for Water Pollution Control as specified herein shall be considered as included in the contract prices paid for various items of work, and no additional compensation will be allowed therefor.

#### 13-3 Storm Water Pollution Prevention Plan

**13-3.01A Summary:** This project is exempt from the State Water Resources Control Board General NPDES Permit for the Discharge of Storm Water related to Construction Activities (Construction General Permit), and not required to have a Storm Water Pollution Prevention Plan (SWPPP), therefore Section 13-3, Storm Water Pollution Prevention Plan, of the Standard Specifications does not apply to this project.

#### 13-4 Job Site Management

#### <u>13-4.03B: Spill Prevention and Control/CASQA Spill Prevention and Control (BMP WM-4):</u>

If a spill occurs at the construction site and the contractor does not take immediate and adequate steps to contain and clean up the spill, especially if rain is threatening or if a discharge to a storm drain or creek could occur, the City shall have the right, in its sole and absolute discretion, to clean up the spill using City forces or an independent contractor. The cost of any such cleanup, in addition to recovery of any penalty or fine imposed upon the City, plus an administrative charge of fifteen percent (15%) of the costs incurred by the City, shall be deducted from any amounts owed to Contractor hereunder.

In the event there are insufficient amounts owed to Contractor hereunder to cover the foregoing costs and charges, the City shall have the right to pursue any other remedy to recover same, including, but not limited to, proceeding against any surety or bond in favor of the City. The City's

rights under this section are intended to be in addition to and not in lieu of any imposed by the City against Contractor for violations of City Code Chapter 17-12, "Storm Water".

#### 13-4.03C(2): Material Storage/CASQA Material Delivery and Storage (BMP WM-1)

13-4.03C(3): Stockpile Management/CASQA Stockpile Management (BMP WM-3): Do not block storm water flows.

**13-4.03D(1): Waste Management/CASQA Solid Waste Management (BMP WM-5):** The Contractor shall dispose of all trash, rubbish, and waste materials of any kind generated by the contractor, subcontractor, or any company hired by the Contractor on a <u>daily</u> basis.

**13-4.03D(3):** Concrete Waste/CASQA Concrete Waste Management (BMP WM-8): Ensure the containment of concrete washout areas and other washout areas that may contain pollutants so there is no discharge into the underlying soil and onto the surrounding areas.

**13-4.03D(4):** Sanitary and Septic Waste/CASQA Sanitary and Septic Waste <u>Management (BMP WM-9):</u> Sanitation facilities must be maintained periodically by a licensed service to keep them in good working order and prevent overflows. Portable toilets are required to have secondary containment.

# <u>13-4.03E(1): Water Control and Conservation/CASQA Water Conservation Practices (BMP NS-1 and NS-2)</u>

#### <u>13-4.03E(3): Vehicle and Equipment Cleaning/CASQA Vehicle and Equipment Cleaning</u> (BMP NS-8)

<u>13-4.03E(4): Vehicle and Equipment Fueling and Maintenance/CASQA Vehicle and Equipment Fueling (BMP NS-9), and CASQA Vehicle and Equipment Maintenance (BMP NS-10)</u>

**<u>13-4.03E(7)</u>**: Paving, Sealing, Sawcutting, Grooving, and Grinding Activities:</u> As listed in Part 9, sections 4 and 5 of the Storm Water Permit, the following additional BMPs shall be implemented for street paving, repaving, reconstruction, patching, digouts or resurfacing.

- 1. Restrict paving and repaving activity to exclude periods of rainfall or predicted rainfall unless required by emergency conditions;
- 2. Install BMPs at all susceptible storm drain inlets and manholes to prevent paving products and tack coat from entering;
- 3. Prevent the discharge of release agents including soybean oil, other oils, or diesel to the storm water drainage system or watercourses;
- 4. Clean equipment over absorbent pads, drip pans, plastic sheeting or other material to capture all spillage and dispose of properly
- 5. Collect liquid waste in a container, with a secure lid, for transport to a maintenance facility to be reused, recycled, or disposed of properly **13-4.03D(5)**;
- 6. Cover loads with tarp before haul-off to a storage site, ensuring that trucks are not overloaded;
- 7. Minimize airborne dust by using water spray during grinding **14-9.03**;
- 8. Protect stockpiles with a cover or sediment barriers during a rain event and;
- 9. Avoid stockpiling soil, sand, sediment, asphalt material and asphalt grindings materials or rubble in or near storm water drainage system or watercourses **13-4.03C(1)**,

#### 13-4.03F: Sweeping/CASQA Street Sweeping and Vacuuming (BMP SE-7)

**<u>13-4.04 Payment:</u>** Full compensation for Job Site Management as specified herein shall be considered as included in the contract prices paid for various items of work, and no additional compensation will be allowed therefor.

## **14 ENVIRONMENTAL STEWARDSHIP**

#### 14-11 Hazardous Waste and Contamination

**14-11.02F(3)** Hazardous Waste Transport and Disposal: All soil from excavations on this project shall be considered contaminated and shall be transported to and disposed of at an approved landfill.

You will furnish completely filled out hazardous waste manifests ready for the Engineer's signature.

You are responsible for disposal of contaminated soil, including trucking, disposal site fees, and additional testing if required by disposal sites. You shall comply with all disposal regulations, such as City, County, and/or State permits and licenses, as may be required.

Prior to disposal of any excess material from the work site, submit to the Engineer written authorization for such disposal and entry permission signed by the approved disposal site. You shall disclose in landfill applications the existing conditions and the written disposal and entry permission shall include acknowledgement of such disclosure.

Pre-construction soil sampling as described in section 14-11.06 of these Technical Specifications indicated the presence of petroleum hydrocarbons such as motor oil and diesel, heavy metals, and other contaminants. Based on these results the City has obtained letters of acceptance for disposal of soil from this project at the following landfills:

City obtained conditional letters of landfill acceptance are included in Section A, Fees and Permits, of these Technical Specifications for the Contractor's use and are not considered a part of the contract documents. You shall be aware of disposal limitations at the landfills based on weather, time of year, etc.

You shall be responsible for separating asphalt, concrete, base rock, asbestos cement pipe, and other non-contaminated debris from the soil prior to loading the soil for transport to disposal sites. Dispose of asphalt, concrete, and base rock at a recycler of these materials as specified in Section 124 of these Special Provisions. Dispose of asbestos cement pipe as specified in Section 15-2.02N of these Technical Specifications.

The Contractor shall provide 40-hour OSHA-HAZWOPER certified workers in the contaminated area and provide a field Site Safety Officer that is also an 8-hour OSHA-HAZWOPER Supervisor trained to directly oversee the contaminated materials removal and handling operation. All workers in this circumstance must have their initial and annual renewal refresher training, medical clearance and personal protection equipment in accordance with 8CCR Section 5192.

[Revised: 01/08/18-CDA STD2010]
**15-1.03A General:** Existing facilities disturbed by construction shall conform to the applicable provisions of Section 5-1.36. The Contractor shall be responsible for any damage caused by their operations and any needed repairs shall be completed to the Engineer's satisfaction.

Contractors attention is brought to protection of Monuments and more specifically property corners that could be encountered or damaged during fence removal and placement: The contractor shall be responsible for ensuring the preservation of monuments (which includes property corners, etc.) in accordance with Chapter 15 of the Business and Professions Code, (The Professional Land Surveyor's Act) Section 8771 (b), (c) & (d). The contractor shall immediately notify the City of any monuments that could be destroyed, damaged, covered, disturbed or otherwise obliterated, prior to the performance of any work that may affect said monuments. The City's Survey Section will be responsible for the survey actions necessary for the perpetuation of any monuments requiring such action and within a reasonable time to not create undue delay to the contractor. The Engineer shall be made aware of any circumstance where a monument may be found or damaged during construction.

**15-2.02P Selective Site Demolition:** Selective site demolition includes removal, disposal, salvage, reinstallation, and/or temporary installation of specific materials, and miscellaneous mechanical and electrical elements within the limits of work as shown on the plans.

Protect and maintain all existing site items and protect them against damage during selective demolition operations. Conduct demolition operations to prevent injury to people and damage to adjacent facilities, site improvements, and appurtenances that are to remain. Cover and protect equipment that has not been removed. Cover and protect Pump Room and Generator Room from weather, rodents and other animals and/or debris that could otherwise enter the building while open and exposed until the building is closed and sealed by the installation of the Louvers, Supply Fan, Muffler and sealing of all building penetrations.

Dispose of demolished materials promptly and legally; do not allow demolished materials to accumulate at the site.

All hazardous material encountered during site demolition shall be removed from the construction area by qualified personnel, placed in bins or receptacles designated specifically for hazardous materials, and disposed of in accordance with State Law.

The Contractor shall be responsible for and coordinate with PG&E for the abandonment and removal of the existing gas meter and gas service as required per the design plans.

Contractor is responsible for plugging/grouting existing/new holes and penetrations.

**15-3.03 Construction:** All removed concrete shall become the property of the Contractor and shall be immediately off-hauled. None of the removed concrete shall be dumped or stockpiled on the work site. The Contractor shall dispose of all removed concrete at a recycler for this material. Burying of broken concrete within the limits of the project will not be allowed.

Reinforcing steel may be encountered in portions of concrete to be removed and no additional allowance will be made for the removal of such steel.

Irrigation facilities may be encountered during concrete removal and replacement. The Contractor shall exercise care in this area and repair any damage done by their operations at no additional cost to the City.

Landscaping and other surfaces or structures shall be restored to original condition at no additional cost to the City.

**<u>15-3.04 Utility Clearances</u>**: The Contractor shall investigate, confirm and/or determine the exact locations of existing underground facilities that may impact the progress of work. Any determination from these investigations that may conflict with the Project Plans shall be brought to the Engineer's attention immediately.

**<u>15-3.05 Payment</u>**: Full compensation for complying with all requirements of this section during any phase of the work shall be included in the prices paid for various contract items of work and no additional allowance will be made therefor.

**<u>26-1.01 General:</u>** Aggregate base shall be Class 2 conforming to and placed in accordance with the requirements of Section 26 of the City of Santa Rosa Construction Specifications, with the following modifications and additional requirements.

Compaction shall commence immediately after spreading of the damp material and before the material has dried sufficiently to allow separation between the fine and coarse particles. If the Engineer determines that the aggregate base has dried excessively before compaction can be achieved, the aggregate base shall be removed and replaced, or moisture conditioned prior to resumption of compaction effort at the Engineer's direction and the Contractor's expense.

**<u>26-1.02B Class 2 Aggregate Base:</u>** The minimum sand equivalent shall be 31 for any individual test.

**<u>26-1.03D Compacting</u>**: Aggregate base compaction shall comply with the Plans and these additional requirements. The surface of the finished aggregate base shall be firm and unyielding. Any visible movement vertically or horizontally of the aggregate base under the action of construction equipment or other maximum legal axle loads shall be considered as evidence that the aggregate base does not meet this requirement.

**<u>26-1.06 Payment</u>**: Full compensation for aggregate base shall be considered as included in the prices paid for the various contract items of work and shall include all compensation for furnishing all labor, materials, tools and equipment, and doing all the work involved in furnishing and placing the base material as specified, including furnishing, hauling, and applying water as specified and directed by the Engineer, and no additional allowance will be made therefor.

# **39 HOT MIX ASPHALT**

#### 39-1.01 General:

<u>39-1.01A Summary</u>: Section 39 includes specific specifications for producing and placing Hot Mix Asphalt (HMA) by mixing aggregate and asphalt binder at a mixing plant and spreading and compacting the HMA mixture.

<u>39-1.01B Definitions:</u> For these specifications, HMA and asphalt concrete shall be the same.

At the Contractor's option, and at no additional expense to the City, a Cal-trans approved Warm Mix Asphalt (WMA) technology may be added to the HMA. However, the asphalt concrete shall be manufactured at HMA temperatures (300F +/- 25F) at a dosage rate approved by the Engineer. All other HMA project specifications shall be adhered to.

Use Section 39-3 Method construction process of these specifications for HMA production and construction.

#### 39-1.02 Materials

<u>39-1.02B Tack Coat:</u> Tack coat must comply with the specifications for asphaltic emulsion or asphalts. Tack coat shall be diluted SS1 or SS1h.

**<u>39-1.02C</u>** Asphalt Binder: Asphalt binder in HMA must comply with the specifications for asphalts.

Asphalt binder to be mixed with aggregate for asphalt concrete surface, leveling and base shall be PG64-16 grade paving asphalt.

The amount of asphalt binder to be mixed with the aggregate shall be specified by the Engineer at the time of paving. Different asphalt binder content may be specified for each lift and each location.

Liquid anti-stripping agent (LAS) shall be added to the asphalt binder at a rate of 0.5 to 1.0% by weight of asphalt binder. The LAS shall be AD-here LOF 65-00 or equivalent, and shall be stored, measured, and blended with the asphalt binder in accordance with the anti-stripping agent manufacture's recommended practice. The LAS can be added at the asphalt plant or at the refinery. When added at the asphalt plant, the equipment shall indicate and record the amount of LAS added. If added at the refinery, the shipping ticket from the refinery shall certify the type and amount of LAS added.

<u>39-1.02E Aggregate:</u> The aggregate grading of the various types of asphalt concrete shall conform to one of the following as directed by the Engineer:

Aggregates should be of high abrasion resistance and durability. Excessively soft and friable aggregates are not allowed.

The specified aggregate gradation must be determined before the addition of asphalt binder and includes supplemental fine aggregate.

The proposed aggregate gradation must be within the TV limits for the specified sieve sizes shown in the following tables:

### Aggregate Gradation (Percentage Passing) HMA Types A

3/4-inch HMA Type A			
Sieve sizes	TV limits	Allowable tolerance	
1"	100		
3/4"	95–100	TV ± 5	
3/8"	65–80	TV ± 5	
No. 4	49–54	TV ± 5	
No. 8	36–40	TV ± 5	
No. 30	18–21	TV ±5	
No. 200	2.0-8.0		

#### 1/2-inch Coarse HMA Type A

Sieve sizes	TV limits	Allowable tolerance
3/4"	100	—
1/2"	94–100	
3/8"	70–90	
No. 4	55–61	TV ± 5
No. 8	40–45	TV ± 5
No. 30	20–25	TV ± 5
No. 200	2.0-8.0	

#### 1/2-inch Medium HMA Type A

	<b>7</b> 1	
Sieve sizes	TV limits	Allowable tolerance
3/4"	100	
1/2"	95-100	
3/8"	80-95	
No. 4	59-66	TV ± 5
No. 8	43-49	TV ± 5
No. 30	22-27	TV ± 5
No. 200	2.0-8.0	

Before the addition of asphalt binder and lime treatment, aggregate must have the values for the quality characteristics shown in the following table:

Quality characteristic	Test method	HMA Type A
Percent of crushed particles		
Coarse aggregate (% min.)		
One fractured face		90
Two fractured faces	California Test 205	75
Fine aggregate (% min)		
(Passing no. 4 sieve		
and retained on no. 8 sieve.)		
One fractured face		70
Los Angeles Rattler (% max.)		
Loss at 100 rev.	California Test 211	10
Loss at 500 rev.		45
Sand Equivalent (min.) <sup>a</sup>	California Test 217	50 <sup>b</sup>
Fine aggregate angularity	California Test 234	45
(% min.)		
Flat and elongated particles	California Test 235	10
(% max. by weight @ 5:1)		

<sup>a</sup> Reported value must be the average of 3 tests from a single sample.

<sup>b</sup>Minimum Sand Equivalent of 45 for asphalt concrete base.

<u>39-1.02F Reclaimed Asphalt Pavement:</u> Reclaimed Asphalt Pavement (RAP) may be used at the Contractor's option. If RAP is used, the Contractor shall provide the proposed mix design and the quality control for all HMA that includes RAP, in accordance with the following requirements:

- 1. Contractor shall provide City with a mix design per California Test 384 for the proposed RAP HMA.
- 2. As part of City's evaluation of RAP HMA, Contractor and City shall perform bitumen ratio tests on at least six split samples of Contractor's RAP to establish correlation between respective binder ignition ovens.
- 3. RAP shall be processed from reclaimed Asphalt Concrete pavement only.
- 4. RAP pile(s) shall be separate from the stacker pile, not intermingled with other materials, and stored on smooth surfaces free from debris and organic material.
- 5. The project RAP pile shall be processed and mixed, identified, and of adequate quantity for the proposed project. "Live" piles shall not be permitted.
- 6. Contractor shall sample the RAP pile and determine the bitumen ratio (using same binder ignition oven used in #2 above) and provide the test results to the City at least one week prior to producing RAP HMA.
- 7. A minimum of three samples shall be tested for bitumen ratio for RAP pile of 1500 tons, or portion thereof.
- 8. RAP pile shall be mixed such that individual bitumen ratio test results of RAP pile so not vary more than +/- 0.5%.
- 9. During RAP HMA production, RAP shall be sampled by the Contractor off of the belt (into the batch plant), per method established by the City, and samples provided to the City.
- 10. Bitumen ratio of RAP sampled off of the belt shall be 4.0% minimum, as determined by City binder ignition oven. City shall select binder content for RAP HMA mix per Specifications.
- 11. RAP content shall be no more than 20% by dry aggregate mass in the HMA. If proposing a change in the RAP content, the Contractor shall notify the Engineer. If the content changes more than 5%, the Contractor shall submit a new mix design.
- 12. Moisture content of RAP pile shall be 4.0% maximum, and shall be tested the day prior to the day of paving and tested/monitored during each day of HMA production.
- 13. RAP pile(s) shall be protected from exposure to moisture.
- 14. RAP HMA shall comply with all the specifications for HMA.
- 15. If batch mixing is used, RAP shall be kept separate from the virgin aggregate until both ingredients enter the weigh hopper or pugmill. After introduction to the pugmill and before asphalt binder is added, the mixing time for the virgin aggregate and RAP shall not be less than five seconds. After asphalt binder is added, the mixing time shall not be less than 30 seconds.
- 16. If continuous mixing is used, the RAP shall be protected from direct contact with the burner flame with a device such as a shield, separator, or second drum.
- 17. If any of the above criteria are not satisfied, or if the RAP HMA test result determined by the City are inconsistent, RAP HMA production shall stop for City projects until the issue(s) are corrected.

# <u>39-1.03 HOT MIX ASPHALT MIX DESIGN REQUIREMENTS:</u>

# <u>39-1.03E Job Mix Formula Verification:</u> (Not Applicable)

## 39-1.08 Production

**<u>39-1.08A General</u>**: During production, with approval of the Engineer, you may adjust hot or cold feed proportion controls for virgin aggregate and RAP.

# 39-1.12 Smoothness

**39-1.12A General:** Determine HMA smoothness with a straightedge. The completed surfacing shall be thoroughly compacted, smooth and free from ruts, humps, depressions or irregularities. Any ridges, indentations or other objectionable marks left in the surface of the asphalt concrete by blading or other equipment shall be eliminated by rolling or other means. The use of any equipment that leaves ridges, indentations or other objectionable marks in the asphalt concrete shall be discontinued, and acceptable equipment shall be furnished by the Contractor.

<u>39-1.14 Miscellaneous Areas and Dikes:</u> The aggregate grading for asphalt concrete placed on miscellaneous areas shall conform to that specified for the asphalt concrete placed on the traveled way, unless otherwise directed by the Engineer.

Dikes shall be shaped and compacted with an extrusion machine or other equipment capable of shaping and compacting the material to the required cross section. **<u>39-3.02 Acceptance Criteria</u>** 

<u>39-3.02A Testing</u>: The acceptance testing requirement for Sand Equivalent shall be 50 (minimum) for asphalt concrete surface and 45 (minimum) for asphalt concrete base. HMA shall meet the following requirements.

Aggregate Micro-Deval (ASTM D6928-10) <sup>1</sup>	Tensile Strength Ratio, TSR (ASTM D7870) <sup>2</sup>
≤16.0%	Not Required
16.1-18.0%	70 (minimum)
18.1-21.0%	80 (minimum)

<sup>1</sup> Asphalt concrete with an aggregate Micro-Deval loss greater than 21.0% shall be removed and replaced at the Contractor's expense. In addition, no single source of asphalt concrete aggregate shall have a Micro-Deval loss greater than 21.0%.

<sup>2</sup>TSR testing shall be performed on re-compacted asphalt concrete (per ASTM D7870), obtained from field cores, and tested within 30 days of asphalt concrete placement. Specimens tested shall include 1 unconditioned sample, and 2 conditioned samples as follows:

a) 20.0 hour Adhesion cycle @ 60°C

b) 3500 cycles @ 40 psi and 60°C

A single TSR test shall not represent more than 750 tons of asphalt concrete. Asphalt concrete not meeting the above requirements shall be removed and replaced at the Contractor's expense.

**<u>39-6 Payment</u>**: Full compensation for furnishing and installing permanent and temporary paving asphalt shall be considered as included in the prices paid for the various contract items of work and no additional allowance will be made therefor.

# **39A ASPHALT CONCRETE TRENCH PAVING**

<u>39A-1.01 Description</u>: Asphalt concrete surfacing and asphalt concrete base and the placing thereof shall conform to the requirements of the Standard Specifications, Section 39 of the City Specifications and these Special Provisions.

<u>39A-2.01 Asphalts</u>: Temporary paving on all utility trenches and any other excavated areas shall be ½-inch maximum, medium grade aggregate hot mix asphalt concrete installed a minimum of two inches thick **placed each day** over the work, unless otherwise approved by the Engineer.

The amount of asphalt binder to be mixed with the aggregate will be specified by the Engineer at the time of paving. Different asphalt binder content may be specified for each lift and each location.

Cutback shall not be stockpiled or used anywhere on the job site.

<u>39A-5.01 Spreading Equipment</u>: When trench width is three feet or less, the asphalt concrete used for trench paving may be deposited directly from the haul vehicle into the trench. The asphalt shall then be raked smooth prior to compaction.

<u>39A-6.01 General Requirements</u>: Areas outside of reconstruction or overlay limits shall receive permanent trench paving per City STD-215, the modified detail on the Plans or as specified herein. The Engineer may require additional paving beyond the minimum dimensions shown in STD-215.

Areas requiring permanent trench paving per City STD-215 shall have a minimum A.C. thickness of 0.25 feet.

The Contractor shall provide compaction of backfill and base material as the job progresses.

Temporary and permanent asphalt trench paving shall be even, smooth and match existing pavement.

The Contractor shall monitor and maintain all temporary paving to the satisfaction of the Engineer.

Asphalt concrete used for temporary trench paving shall be removed and disposed of in accordance with Section 124 "Material Recycling".

<u>39A-6.03 Compacting</u>: Compaction shall be in accordance with Section 39-6.03 of the City Specifications, reprinted here for clarity.

The basis for approval shall be the attainment of 97% relative compaction and satisfactory surface condition following final rolling. The number of coverages required shall be the minimum number required to obtain 97% relative compaction.

**<u>39A-8.02 Payment</u>**: Full compensation for furnishing and installing permanent and temporary paving asphalt shall be considered as included in the prices paid for the various contract items of work and no additional allowance will be made therefor.

# **80 CHAIN LINK FENCE**

**80-1.01 General:** Chain link fence, gates, and appurtenances to be erected under this contract shall be constructed in accordance with these Special Provisions, the details shown on the Project Plans, Section 80 of the Standard Specifications and as directed by the Engineer.

Fence and gates shall be 8 feet high. Fences shall not be topped with barbed wire.

An approximate length of 400 linear feet of Chain Link Fence is provided for bidding purposes only, the actual quantity of chain link fence to be paid for will be determined from actual measurements in the field, such measurement is to be made parallel to the ground slope along the line of the completed fence.

**80-1.02 Clearing:** The Contractor may, at their discretion, either remove the existing fence entirely prior to construction of the new fence, or as needed during erection of the new fence.

Except where voids created are reused for new post footings, existing post footings shall be completely removed to a minimum 12 inches below grade, and the voids filled and compacted to 85% RC with native or other approved material.

All removed and unused fencing material shall become the property of the Contractor and shall be disposed of away from the construction site in compliance with all laws and regulations.

**80-1.07 Temporary Fences:** For site security purposes, there shall be a complete perimeter fence in place at all times consisting of existing, new and/or approved temporary fencing. No existing or temporary fencing material shall be reused on the new fence. Any additional temporary fencing required to maintain site security shall be provided, maintained, and removed by the Contractor at no additional charge to the City.

Temporary perimeter fence shall be a minimum of 6 feet with galvanized chain link fabric and either wood or steel posts.

**80-3.02** Materials: Visual inspection of all material shall be made prior to installation. Any material showing signs of damage shall not be used.

The strength of the bond between the coating material and the steel of the bonded vinylcoated chain link fabric or posts shall be equal to or greater than the cohesive strength of the polyvinyl chloride (PVC) coating material. <u>The color of the vinyl coatings shall be</u> <u>black</u>.

**80-3.02B Post and Braces**: All posts, gate frames, and rails shall be steel pipe galvanized and vinyl clad according to the specifications of AASHTO Designation M-111 and as specified on the Plans.

All line and corner posts shall be a minimum of 11 feet in length and gate posts a minimum of 12 feet in length.

All terminal and corner posts shall be truss braced from a first line post to the bottom of the terminal post with a 3/8" galvanized truss rod assembly.

**80-3.02C Fabric:** Chain link fence fabric shall be galvanized steel fabric conforming to the specifications of AASHTO Designation M-181. The fabric shall be #9 gauge, Type IV,

Class B bonded vinyl-coated, black. Fabric shall be woven into approximately a one-inch mesh.

**80-3.03 Construction:** The fence shall be installed by skilled and experienced fence erectors on lines and grades furnished by the Engineer or shown on the plans. Line and corner posts for perimeter fence shall be set in concrete foundations a minimum of 36" inches deep and gate posts a minimum of 48" deep. Concrete foundations shall be no less than three times the diameter of the posts. Line post spacing shall not exceed ten foot centers.

The existing fencing, gates and appurtenances shall become the property of the Contractor and shall be disposed of away from the construction site to the satisfaction of the Engineer.

**<u>80-1.06</u> Payment:** See Section 01010, Summary of Work, Bid Item 17, 8' Chain Link Fence

**80-10.03** Swing Gates: Two adjacent equal length swing gates which will provide a 24foot wide clear opening shall be provided by the Contractor at the driveway and as directed by the Engineer. Gates shall include catch and locking attachment of an approved design which will not rotate around the latch post. Stops to hold gates open and a center rest with catch shall also be included with gates. Gate hinges and stops shall provide a 90 degree (minimum) opening. All appurtenances, including the locking system as shown on the Project Plans shall be powder coated with a black finish.

80-10.04 Payment: See Section 01010, Summary of Work, Bid Item 18, Swing Gates

# **A - FEES AND PERMITS**

All electrical service charges or fees that may be required by Pacific Gas and Electric Company shall be paid for by an appropriate City department.

The Contractor shall obtain all necessary and required permits for the project. All required permits shall be obtained at the Contractor's expense.

See Section 16208 Standby Generator & Accessories for additional required permits 16208 -1.04 G Bay Area Air Quality Management District (BAAQMD) Permit and 16208 -1.04 H Santa Rosa Fire Department Permit

# SECTION 01010 SUMMARY OF WORK

## PART1- GENERAL

#### 1.01 Summary

A. The work to be done consists of furnishing all labor, materials, equipment, and services for the City of Santa Rosa Pump Station 15 Upgrades Project, including replacement of standby generator, VFD, ATS, fences, gates, control and instrumentation work, and tank coating; and all miscellaneous work as shown, specified or required for a complete, operating installation.

#### B. Project Contacts:

- 1. City's contact for coordination is:
  - a. Eric Frye: (707) 543-3858
- 2. Engineer's contact for coordination is:
  - a. Thinh Le: (916) 273-6305

#### 1.02 Project Site

Facility Name	Abbr.	Address
Pump Station 15	S-15	6348 Sonoma Hwy, Santa Rosa, CA

#### 1.03 Contractor Scope of Services:

A. The work comprises furnishing all labor, materials, equipment (unless otherwise excluded under "City Pre-purchases"), and services for pump station, including replacement of standby generator, VFD, ATS, fences, gates, control and instrumentation work, and tank coating; and all miscellaneous work as shown, specified or required for a complete, operating installation.

#### 1.05 Work Included

- A. The Contractor shall furnish all labor, superintendence, materials, temporary bypass pump, power, light, heat, fuel, water, tools, appliances, equipment, supplies, services, and other means of construction necessary or proper for performing and completing the work.
- B. The Contractor shall furnish and install all signage as shown on the project plans and as required.
- C. The Contractor shall obtain and pay for all required permits.
- D. Contractor shall perform and complete the work in the manner best calculated to promote rapid construction consistent with safety of life and property, to the satisfaction of the City's Representative and in strict accordance with the Contract Documents.
- E. The Contractor shall clean up the work site and maintain it during and after construction, until accepted, and shall do all of the work and pay all costs incidental thereto.
- F. The Contractor shall repair all structures and property that may be damaged or disturbed during performance of the work.
- G. The Contractor shall provide and maintain such modern tools, and equipment as may be necessary to perform in a satisfactory and acceptable manner all the work required by this Contract. Only equipment of established reputation and proven efficiency shall be used. The Contractor shall be solely responsible for the adequacy of his equipment.

# 1.06 Bid Items, Allowances, and Alternates

- A. Any Bid Item may be deleted from the Work and Contract Sum, in total or in part, prior to or after award of Contract without compensation in any form or adjustment of other Bid Items or prices therefore.
- B. Payment of all items is subject to provisions of Contract Documents, including without limitation Section 9 Measurement and Payment.
- C. For all Bid Items, furnish and install all work indicated and described in Specifications and all other Contract Documents, including connections to existing systems. Work and requirements applicable to each individual Bid Item, or unit of Work, shall be deemed incorporated into the description of each Bid Item (whether Lump Sum, or Unit Price).
- D. The items below are broken down into lump sum and unit price items. The Contractor shall provide bid prices based on the descriptions, plans, and specifications with the understanding that all work must be included in the stipulated items. Payment for lump sum items will be made at the contract lump sum price upon completion, unless otherwise specified. Payment for unit price items will be made at the contract unit price for each unit installed or completed.
- E. All items involving materials and installation are on a furnish and install basis.
- F. In underground installations no extra compensation will be made for removal of surface improvements, excavation regardless of material, over excavation shown or placement and removal of temporary asphalt as required, disposal of surplus material in a lawful manner, bedding, backfill, and compaction, testing, or any other work specified or shown.
- G. Compensation for safety measures, traffic control, cleanup and any site restoration necessary to pre-existing conditions shall be included in the prices of the various contract items of work unless specified elsewhere.
- H. The general description of bid items are as follows:
  - Bid Item 1 Mobilization/Demobilization: This bid item includes all labor, materials, and equipment necessary. Item will be paid for on a lump sum basis with a 50% payment of the lump sum upon the Contractors mobilization on site and 50% payment of the lump sum upon the Contractors demobilization from the project site. Items of mobilization include water pollution control, traffic control and equipment/materials onsite. Items of demobilization include, removing all equipment, performing site cleanup, submission of warranties, record drawings and acceptance of the entire project by the City.
  - 2. Bid Item 2 Demolition and Temporary Work: This bid item includes all work associated with removal, disposal and demolition of existing items on the site, including fencing and gate, including removing posts and footings and any excavation and backfill holes, removal of equipment pads, coordination with PG&E and the termination and abandonment of gas lines, removal of standby generator, coordination with Suburban Propane and the removal of propane tank, supply and operate temporary bypass pumping, and removal of electrical panel as shown on the plans. Payment will be made at the lump sum price given in the Bid Schedule and based on percent completion of demolition and temporary work required.
  - 3. **Bid Item 3 Wiring and Conduits**: This bid item includes all wiring, terminations, conduits, raceway and electrical testing as shown on the plans and specified herein. Payment will be made at the **lump sum** price given in the Bid Schedule and based on percent completion of site wiring and conduits installation.
  - 4. Bid Item 4 Automatic Transfer Switch and MTS Panel: This bid item includes all work at the site associated with furnishing all labor, materials, tools, and equipment and doing all work involved in replacing the existing ATS panel, including removal, installation, startup, testing, and

training as shown on the Project Plans, and as herein specified. Payment will be made at the **lump sum** price given in the Bid Schedule and based on percent completion of work required.

- 5. Bid Item 5 SCADA Modifications-Onsite: This bid item includes 40 hours minimum onsite at 35 Stony Point Road, Santa Rosa, Ca to test and modify City SCADA System as shown on the Project Plans, and as herein specified. Payment will be made at the **lump sum** price given in the Bid Schedule and based on percent completion of work required.
- 6. Bid Item 6 Instruments: This bid item includes all work at the site associated with furnishing all labor, materials, tools, and equipment and doing all work involved in replacing the existing instruments, including removal, installation, and calibration as shown on the Project Plans, and as herein specified. Payment will be made at the lump sum price given in the Bid Schedule and based on percent completion of work required.
- 7. Bid Item 7 Piping and Valves: This bid item includes all work at the site associated with furnishing all labor, materials, tools, and equipment and doing all work involved in replacing the existing interior valves, pipes, pipe supports, fittings including removal, installation, coating, and testing as shown on the Project Plans, and as herein specified. Payment will be made at the lump sum price given in the Bid Schedule and based on percent completion of work required.
- 8. Bid Item 8 MCC Modifications: This bid item includes all work at the site associated with furnishing all labor, materials, tools, and equipment and doing all work involved in modifying the existing MCC, including installation, and testing as shown on the Project Plans, and as herein specified. Payment will be made at the lump sum price given in the Bid Schedule and based on percent completion of work required.
- 9. Bid Item 9 Control Panel: This bid item includes all work at the site associated with furnishing all labor, materials, tools, and equipment and doing all work involved in modifying the existing Control Panel, including installation, programming, calibration and testing as shown on the Project Plans, and as herein specified. Payment will be made at the lump sum price given in the Bid Schedule and based on percent completion of work required.
- 10. Bid Item 10 Ultra-Low Harmonics VFD (50HP): This bid item includes all work at the site associated with furnishing all labor, materials, tools, and equipment and doing all work involved in the procurement and installation of the VFD, including installation, programming, and testing as shown on the Project Plans, and as herein specified. Payment will be made at the lump sum price given in the Bid Schedule and based on percent completion of work required.
- 11. Bid Item 11 Generator Room Modification: This bid item includes all work at the site associated with furnishing all labor, materials, tools, and equipment and doing all work involved in modifying the existing generator room, including installation of lever, coating, and wall repairs as shown on the Project Plans, and as herein specified. Payment will be made at the **lump sum** price given in the Bid Schedule and based on percent completion of work required.
- 12. Bid Item 12 Hydropneumatic Tank Recoating: This bid item includes all work at the site associated with furnishing all labor, materials, tools, and equipment and doing all work involved in surface preparation and recoating the existing Hydropneumatic tank as shown on the Project Plans, and as herein specified. Payment will be made at the lump sum price given in the Bid Schedule and based on percent completion of work required.
- 13. Bid Item 13 Standby Generator with sub-base tank & silencer (100kW): This bid item includes all work at the site associated with furnishing all labor, materials, tools, and equipment and doing all work involved in replacing the existing generator, including removal, installation, startup, testing, and training as shown on the Project Plans, and as herein specified. Payment will be made at the lump sum price given in the Bid Schedule and based on percent completion of work required.

- 14. Bid Item 14 Floor Recoating: This bid item includes all work at the site associated with furnishing all labor, materials, tools, and equipment and doing all work involved in recoating pump station building floors, including removal existing coating and repairs as shown on the Project Plans, and as herein specified. Payment will be made at the lump sum price given in the Bid Schedule and based on percent completion of work required.
- 15. Bid Item 15 Touch-up and Power Wash Cleaning: This bid item includes all work at the site associated with furnishing all labor, materials, tools, and equipment and doing all work involved in power washing pump station exterior surface and building roof, including repairs and touch-up as shown on the Project Plans, and as herein specified. Payment will be made at the lump sum price given in the Bid Schedule and based on percent completion of work required.
- 16. Bid Item 16 Exterior Pipe Recoating: This bid item includes all work at the site associated with furnishing all labor, materials, tools, and equipment and doing all work involved in surface preparation and recoating pump station exterior pipes, valves, and fittings as shown on the Project Plans, and as herein specified. Payment will be made at the lump sum price given in the Bid Schedule and based on percent completion of work required.
- 17. Bid Item 17 8" Chain-Link Fence: This bid item includes all work at the site associated with furnishing all labor, materials, tools, equipment and incidentals and doing all work involved in construction of the chain link fence in place, complete as shown on the Project Plans, and as herein specified including all necessary concrete, signage, and accessories. Payment will be made at the linear foot price given in the Bid Schedule and based on percent completion of work required.
- 18. Bid Item 18 Swing Gates: This bid item includes all work at the site associated with furnishing all labor, materials, tools, equipment and incidentals and doing all work involved in construction of the swing gates in place, complete as shown on the Project Plans, and as herein specified including all necessary concrete, signage, and accessories. Payment will be made at the lump sum price given in the Bid Schedule and based on percent completion of work required.

# PART 2 - PRODUCTS (NOT USED)

## PART 3 - EXECUTION (NOT USED)

# SECTION 01300 SUBMITTALS

# PART1- GENERAL

### 1.01 Summary

- A. Section Includes:
  - 1. Description of general requirements for project Submittals.

#### 1.02 Submittals

- A. Where required by the Specifications, and if requested by the Engineer, the Contractor shall submit descriptive information which will assist the Engineer in making an informed decision as to whether the Contractor's proposed materials, equipment or methods of work are in general conformance with the design concept and are in compliance with the drawings and specifications. The information to be submitted shall consist of drawings, specifications, descriptive data, certificates, samples, test results and other such information, all as specifically required in the Specifications or needed by the Engineer to make an informed decision.
- B. The following is a partial list of required submittals, additional project related submittals on items not listed may also be required Contractor shall submit the following items:
  - 1. Schedule of Submittals and Shop Drawings
  - 2. List of Submittals, Shop Drawings, Product Data and Materials
  - 3. Contractor's Safety Program
  - 4. Designated Safety Supervisor
  - 5. Designated "Competent Person(s)"
  - 6. Schedule of Values per Caltrans Standard Specification Section 9-1.16B
  - 7. Construction Schedule
  - 8. Substitutions List
  - 9. Shop Drawings
  - 10. Product Data
  - 11. Equipment CAD files
  - 12. Samples
  - 13. Material Safety Data Sheets
  - 14. Three (3) copies Operation and Maintenance Manuals for all equipment
  - 15. Project Closeout Information
  - 16. Warranty Data
  - 17. Manufacturer's Instructions
  - 18. Manufacturer's Certifications and Test Reports
  - 19. Temporary Bypass Pumping Plan
- C. Quantity of Submittals:
  - 1. Submit one (1) digital PDF format of all submittals.
    - a. PDF submittal shall be clear and readable.

- b. Provide searchable PDF file.
- c. Annotate or mark submittal to clearly show the item or model being submitted.
- d. Organization and Binding of Submittals: The initial and subsequent submittals of drawings and data for review shall be organized and bound with a Table of Contents so that eventually they may be used as guides for preparing the required maintenance manuals. PDF files shall have active links in the Table of Contents or they shall have bookmarks per the Table of Contents.
- 2. If paper copies are submitted:
  - a. Provide three (3) copies to the Engineer and a scanned electronic copy where feasible. The Contractor shall state the number of copies the Contractor wants to be returned where necessary.
- D. Where the Contractor is required by these Specifications to submit samples of products, the Contractor shall provide a sufficient number of physical samples to allow three (3) to be retained by the Engineer of all structural and architectural products involving color, finish, texture, or the like.
- E. List of Submittals:
  - 1. Within 10 calendar days from the Contract award, the Contractor shall submit a List of Submittals to the Engineer for review.
  - 2. The List shall include all items of equipment and materials for necessary project disciplines (Civil, Electrical, Mechanical etc.) and the names of manufacturers with whom purchase orders will be placed.
  - The List shall be arranged in the same order as the Specifications and shall contain sufficient data to identify all items of material and equipment the Contractor proposes to furnish. The List shall include Specification and/or Drawing references.
  - 4. After the submission is favorably reviewed and returned to the Contractor by the Engineer, it shall become the basis for the submission of detailed manufacturer's drawings, catalog cuts, curves, diagrams, schematics, data, and information on each separate item for review as set forth in the Specifications.
- F. The Contractor shall be responsible for the accuracy and completeness of the information contained in each submittal and shall ensure that the material, equipment or method of work shall be as described in the submittal.
  - 1. Submittals shall contain all required information, including satisfactory identification of items, units and assemblies in relation to the contract drawings and specifications.
  - 2. The Contractor shall verify that the material and equipment described in each submittal conforms to the requirements of the specifications and drawings.
  - 3. Unless otherwise approved by the Engineer, submittals shall be made only by the Contractor, who shall indicate by a signed stamp on the submittals that the Contractor has checked the submittals and that the work shown conforms to contract requirements and has been checked for dimensions and relationship with work of all other trades involved.
  - 4. If the information shows deviations from the specifications or drawings, the Contractor, by statement in writing accompanying the information, shall identify the deviations and state the reason(s) therefore.
  - 5. The Contractor shall ensure that there is no conflict with other submittals and shall notify the Engineer in each case where the Contractor's submittal may affect the work of another contractor or the City.
  - 6. The Contractor shall ensure coordination of submittals among the related crafts and subcontractors.

# **1.03** Submittal Transmittal Procedure

- A. General: Submittals regarding material and equipment shall be accompanied by a transmittal form from the Contractor. A separate form shall be used for each specific item, class of material, equipment, and items specified in separate, discrete specification sections for which a submittal is required. However, submittals for various items shall be made with a single form only when the items taken together constitute a manufacturer's package or are so functionally related that expediency indicates checking or review of the group or package as a whole.
- B. Submittal Identification: Each set of submittals or samples shall be attached to the submittal transmittal form.
  - 1. The submittal number shall be made up of two parts: XXX-ZZ. The XXX shall be sequential number 001 for the first item submitted, 002 for the second, etc. The ZZ shall be the sequential number of a specific submittal or resubmittal (01 for the first submittal, 02 for the first resubmittal, etc.).
  - 2. All submittals shall show the contract title, shall indicate the name of the vendor, and shall indicate when the equipment and/or material will be required by the construction schedule.
  - 3. The submittal must be adequate to permit a comprehensive review without further reference to the Contractor. The documents submitted must be separately identifiable on the Contractor's submittal transmittal form.
- C. Deviation from Contract: If the Contractor proposes to provide material or equipment which does not conform to the specifications and drawings, this shall be indicated under "deviations" on the submittal transmittal form accompanying the submittal copies.
  - 1. If the Engineer accepts such deviation, the Engineer shall issue an appropriate Contract Change Order, except that, if the deviation is minor, or does not involve a change in price or in time of performance, a Change Order need not be issued.
  - 2. If any deviations from the Contract requirements are not noted on the submittal, the review of the shop drawing shall not constitute acceptance of such deviations.
- D. Submittal Completeness: Submittals which do not have all the information required to be submitted, including deviations, shall be considered as not complying with the intent of the contract and are not acceptable and will be returned without review.
  - 1. A complete submittal shall contain sufficient data to demonstrate that the items comply with the Specifications, shall meet the minimum requirements for submissions cited in the technical specifications, shall include materials and equipment data and seismic anchorage certifications where required, and shall include any necessary revisions required for equipment other than first named.
- E. Review of Subsequent Resubmittals: It is considered reasonable that the Contractor shall make a complete and acceptable submittal to the Engineer at least by the second submission of data. At the discretion of the Engineer costs associated with the review of any subsequent resubmittals may be borne by the Contractor. The Contractor will be billed for these costs by the Engineer. Costs due may be deducted from progress payments due the Contractor by the Engineer.

## 1.04 Submittal Review

- A. The Contractor shall provide all submittals to the Engineer at the earliest feasible time possible to facilitate a comprehensive review that does not impact construction related progress.
- B. Within 14 calendar days after receipt of the submittal by the Engineer, the submittal will be reviewed by the Engineer and the Engineer will return the marked-up submittal. On complex drawings and equipment, the Engineer shall acknowledge receipt within 14

calendar days and advise the Contractor when the submittal will be returned. The returned submittal shall indicate one of the following actions.

- 1. If the review indicates that the material, equipment or work method is in general conformance with the design concept and complies with the drawings and specifications, submittal copies will be marked "NO EXCEPTIONS TAKEN". In this event, the Contractor may begin to implement the work method or incorporate the material or equipment covered by the submittal.
- 2. If the review indicates limited corrections are required, copies will be marked "MAKE CORRECTIONS NOTED". The Contractor may begin implementing the work method or incorporating the material and equipment covered by the submittal in accordance with the noted corrections. Where submittal information will be incorporated in operation and maintenance data, a corrected copy shall be provided. Otherwise, no resubmittal will be required.
- 3. If the review reveals that the submittal is insufficient or contains incorrect data, copies will be marked "REVISE AND RESUBMIT". The Contractor shall not undertake work covered by this submittal until the submittal has been revised, resubmitted and returned marked either 'NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED".
- 4. If the review indicates that the material, equipment or work method is not in general conformance with the design concept or in compliance with the drawings and specifications, copies of the submittal will be marked "REJECTED SEE REMARKS". Submittal with deviations which have not been identified clearly may be rejected. The Contractor shall not undertake work covered by such submittal until a new submittal is made and returned marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED".
- C. Review of drawings, methods of work, or information regarding materials or equipment the Contractor proposes to provide shall not relieve the Contractor of responsibility for errors therein and shall not be regarded as an assumption of risks or liability by the City, Engineer, or by any officer, employee or subcontractor thereof, and the Contractor shall have no claim under the contract on account of the failure or partial failure of the method of work, material, or equipment so reviewed.
  - 1. A mark of "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED" shall mean that the Engineer has no objection to the Contractor, upon its own responsibility, using the plan or method of work proposed, or providing the materials or equipment proposed.
  - 2. Favorable review of submittals does not constitute a change order to the Contract requirements.
  - 3. The favorable review of all submittals by the Engineer shall apply in general design only and shall in no way relieve the Contractor from responsibility for errors or omissions contained therein.
  - 4. Favorable review by the Engineer shall not relieve the Contractor of its obligation to meet safety requirements and all other requirements of laws, nor constitute a Contract Change Order.
  - 5. Favorable review by the Engineer will not constitute acceptance by the Engineer of any responsibility for the accuracy, coordination, and completeness of the submittals or the items of equipment represented on the submittals.
  - 6. The favorable review of shop drawings shall be obtained prior to the fabrication, delivery and construction of items requiring shop drawing submittal.
  - 7. If a favorable review by the Engineer appears, to the Contractor, to conflict or change the contract in any way, and that change was not anticipated as part of the submittal process, it shall be the Contractor's responsibility to request clarification prior to proceeding.

# SECTION 02055 DEMOLITION AND SITE PREPARATION

# PART 1 - GENERAL

### 1.01 Summary

A. Demolition and site preparation includes all clearing, grubbing and demolition Work.

#### **1.02** Job Conditions

A. The Contractor shall determine the actual condition of the site as it affects the Work.

#### 1.03 Quality Assurance

- A. General: All work shall be performed in accordance with contract documents, the local building codes, State Industrial Safety Orders and requirements of the Occupational Safety and Health Act requirements and to the satisfaction of the Engineer.
- B. Schedule: Demolition must be scheduled with the Engineer to minimize any necessary down times. No interruption in operation will be permitted without previous authorization from the Engineer.
- C. Protection
  - 1. Demolition shall be performed in such a manner as to not harm adjacent structures, equipment, existing landscaping or natural vegetation.
    - a. The Contractor shall assume full responsibility for such disturbance.
    - b. All costs of any such repair, rehabilitation, or modifications shall be borne by the Contractor.
  - 2. The Contractor shall provide such protection as may be required to transfer material to the ground.
    - a. Throwing, dropping or permitting the free fall of material and debris from heights which would cause damage to other work, existing structures, or equipment; undue noise or nuisance; or excessive dust will be expressly prohibited.

## PART 2 - PRODUCTS (NOT USED)

## PART 3 - EXECUTION

#### 3.01 General

A. The Contractor shall notify the Engineer when demolition of existing facilities is completed and dispose of refuse materials in an appropriate manner.

#### 3.02 Performance

- A. Equipment and Piping Removal
  - 1. All equipment and piping to be removed shall be properly disconnected from structures, piping, electrical, and instrumentation systems.
  - 2. The Contractor shall do all resurfacing and other work as necessary to comply with the above requirements, and to the satisfaction of the Engineer.
- B. Pavement Removal

- 1. All pavement and concrete pads shall be saw-cut on a neat line at right angles to the curb or concrete face. Saw cutting "over-cuts" shall be avoided where possible. Where over-cuts do occur, they shall be filled with new material that matches the material that was cut, leaving a smooth, level finish.
- C. Utility Interference
  - 1. Where existing utilities interfere with the progress of the work and direction hasn't already been provided herein or on the Plans, the Contractor shall seek direction from the Engineer prior to proceeding. Temporarily relocate the utilities out of the construction project's right of way and restore in kind prior to final backfilling efforts.

## 3.03 Salvage

- A. The Engineer has the right to salvage any items identified within the project vicinity.
- B. The Contractor shall notify the City's Representative five days prior to any salvage or demolition work.
  - 1. The Engineer will mark items to be salvaged.
  - 2. The Contractor shall be responsible for properly disconnecting, removal from their foundations, cleaning and storing salvaged items. Salvaged items shall be delivered by the Contractor to a storage location designated by the Engineer.

### 3.04 Removed Material and Debris

- A. Where Contractor is directed on the Drawings to "Demolish" or "Remove" material or facilities it is understood that the material will be removed and disposed of offsite unless specifically stated otherwise or directed by the Engineer.
- B. All removed material not designated for salvage and all debris shall become the property of the Contractor and shall be removed from the site.
- C. Materials and debris generated by demolition activities shall not be allowed to accumulate. Debris shall be removed daily and disposed of in a manner allowed by law.

### 3.05 Backfill

A. Holes or depressions in the ground remaining after demolition of structures, pipelines, or equipment shall be filled with compacted backfill materials. At the Engineer's discretion, holes and depressions may be surfaced with temporary asphalt at no additional cost to the City.

#### 3.06 Restoration

A. Restore adjacent structures and facilities damaged during demolition or other construction to original or better condition.

# SECTION 09900 PROTECTIVE COATING SYSTEMS

# PART1- GENERAL

#### 1.01 Summary

- A. Scope:
  - 1. The Contractor shall furnish all labor, materials, equipment and incidentals required to provide painting as shown and specified. The work includes; protecting items that are not to be coated; surface preparation of items to be coated, recoated or overcoated as specified or directed; coating and finishing from bare metal of one 4,000 gallon steel hydropneumatic potable water pressure tank, interior and exterior and appurtenances; coating of various items such as; equipment enclosures, metal pipe and building surfaces throughout the project, <u>except</u> as otherwise shown or specified. Surface preparation, priming and coatings may be in addition to shop priming and surface treatment specified under other Sections.

For the purpose of this contract the interior of the hydropneumatic tank shall be considered a confined space and treated as such. The Contractor shall provide and require the use of protective life saving equipment for persons working on the interior of the tank as well as the full project site in accordance with requirements set forth by regulatory agencies applicable to the construction industry and manufacturers printed instructions and appropriate technical bulletins and manuals. The Contractor shall furnish, maintain and remove prior to departing the job site, a compressor and/or compressed air bottles capable of providing NIOSH-approved Class D breathing air for use when necessary.

- 2. Where items are factory-coated, repair or touch-up the factory coating and/or apply additional field coatings to achieve a complete coating system complying with the type and thickness of the coatings specified in this Section.
- 3. The term "coating" as used herein means all coating system materials, which includes but is not necessarily limited to pretreatments, primers, intermediate coats, finish coats, emulsions, enamels, varnishes, stains, sealers, fillers, and other applied materials whether used as prime, intermediate or finish coats.
- 4. The term "exposed" as used herein means all items not covered with concrete, plaster, fireproofing or similar material.
- 5. Where items or surfaces are not specifically mentioned, coat these items or surfaces the same as adjacent similar materials or surfaces.
- 6. "Typical Examples" of items to be coated are provided on each coating system description sheet. These examples are intended to show the general scope of items to be coated are not intended to be exhaustive of all items to be coated by that particular coating.
- 7. Items which must be coated under this section include but are not necessarily limited to the following:
  - a. All other surfaces not otherwise excluded herein.
- B. Coordination
  - 1. Review installation procedures under other Sections and coordinate the installation of items that must be field coated or painted.
  - 2. Coordinate the coating of areas to be coated that will be inaccessible once equipment has been installed.
  - 3. Provide finish coats that are compatible with the primers used. Contractor shall be responsible for the compatibility of all shop primed and field coated items in this Contract. Barrier coats shall be provided over incompatible primers or primers shall be removed and re-primed as required.

- C. Pre-Finished Items: Unless otherwise shown or specified, coating shall not be included when factory finishing such as baked-on enamel, porcelain, polyvinylidene fluoride, fusion bonded epoxy, or other similar finish is specified for such items.
  - 1. Touch up factory-finished items only with coatings supplied by the item manufacturer per the requirements and instructions of the manufacturer.
  - 2. If a factory-finished coating is applied to an item, which is not specified to receive a factory finish coat, acceptance of the factory finish coat shall be at the discretion of the Engineer. The color shall be noted with the equipment submittals.
- D. <u>Items Not to be coated</u>: The following items are excluded from coating unless otherwise specified or shown and are protected during the painting of adjacent areas:
  - 1. Ducts, conduits and other materials with corrosion resistant surfaces that are in chases or other inaccessible areas unless specified or shown on drawings.
  - 2. Moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sensing devices, motor and fan shafts unless otherwise specified.
  - 3. Code-required labels, such as UL and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates.
  - 4. Stainless steel
  - 5. Aluminum
  - 6. Fiberglass
  - 7. Mortar-coated pipe and fittings?
  - 8. Pipe supports except those installed in submerged or splash zone areas
  - 9. Instrumentation and galvanized instrument supports
  - 10. Electrical switchgear, motor control centers, panels, transformers and other similar equipment.
  - 11. Grease Fittings
  - 12. Rubber Material

## 1.02 References

A. <u>Reference Standards</u>: Applicable provisions and recommendations of the following shall be complied with, except where otherwise shown or specified:

<u>Reference</u>	<u>Title</u>
ANSI A13.1	Scheme for the Identification of Piping Systems
Ten States Standards	Great Lakes - Upper Mississippi River Board of State Sanitary Engineers, Recommended Standards for Waste Treatment Works - Latest Edition, Recommended Color Scheme for Piping
OSHA 1910.144	Safety Color Code for Marking Physical Hazards
SSPC Volume 2	Systems and Specification, Surface Preparation Guide and Paint Application Specifications

# 1.03 Submittals

- A. Submit the approved manufacturer's data sheets at least 30 days prior to the start of coating operations. The Contractor shall keep a copy for all accepted materials readily available on site during coating operations at all times. Data sheet shall detail coating and surface preparation work including the following:
  - 1. Coating manufacturer's technical data on product and recommended use. Include the brand name and series number of all coatings to be used.

- 2. Coating manufacturer's surface preparation criteria, including recommended surface profile range after abrasive blasting.
- Coating manufacturer's application instructions, equipment recommendation, temperature and humidity limitations, pot life and induction requirements, drying and curing times, and recoat cycle times. Recoat times and final cure shall be listed at 35° F., 45° F., 55° F., 65° F. and 75° F. substrate temperatures. Provide manufacturer's maximum and minimum material and substrate temperatures for proper application.
- 4. Contractor's written program for over spray prevention.
- 5. Coating manufacturer's Material Safety Data Sheets (MSDS) for all Product to be used on the project, including solvents, additives, cleaners and thinners.
- 6. Abrasive supplier's certification that the abrasive blast material to be provided complies with the State of California Environmental Protection Agency, Air Resources Board (CARB) and local Air Quality Management District (AQMD) requirements for dry outdoor blasting as project requires.
- 7. Abrasive blast cleaning and application equipment list and complete procedures for its use.
- 8. Contractor's safety program to be employed on this project complying with the current requirements of Cal/OSHA, OSHA and these Standards.

# 1.04 Qualifications

- A. The coating contractor shall hold a valid State of California Contractor's Class C-33 Painting and Decorating Contractors license for performing all coating related work. The Contractor's coating applicator(s) shall have a minimum of five (5) years practical experience and successful history in the application of the approved coating system on like projects. The Contractor shall substantiate this requirement by furnishing the Engineer and receiving approval of a written list of references that includes a list of projects with verifiable coating inspection reports prior to beginning work.
- B. The Contractor's coating applicator shall:
  - Provide a coating supervisor/lead at the work site during cleaning and coating operations That
    has the authority and ability to coordinate work, make decisions pertaining to the fulfillment of
    the Contract and communicate effectively with the Engineer, Inspector and City personnel for
    all coating related work. The General Contractor shall not utilize this person to oversee noncoating related operations unless they work directly for the Prime Contractor. No substitution
    of this supervisor shall be allowed without prior authorization from the Engineer.
  - 2. Provide skilled personnel qualified to perform the required work in a manner comparable with the best standards of practice and safety.
  - 3. Maintain continuity of personnel and coordinate transfer of personnel with the Engineer.

## 1.05 Delivery, Storage, and Handling

- A. <u>Delivery of Materials</u>: All materials shall be delivered to the job site in original, new and unopened packages and containers bearing manufacturer's name and label, and the following information.
  - 1. Name or title of material
  - 2. Manufacturer's stock number and date of manufacture
  - 3. Manufacturer's name
  - 4. Contents by volume, for major pigment and vehicle constituents
  - 5. Thinning instructions where recommended
  - 6. Application instructions
  - 7. Color name and number
- B. Storage of Materials
  - 1. Only acceptable project materials shall be stored on project site.

- 2. Store materials in compliance with manufacturer's requirements in a location approved by the Engineer that is protected from the weather and excessive heat or cold. Area shall be kept clean and accessible.
- 3. Storage shall be restricted to coating materials and related equipment only.
- 4. Flammable coatings shall be stored in conformance with County, State and/or Local Codes for flammable materials.
- 5. All coating materials shall be stored in a safe, secure, and environmentally responsible manner and shall be kept above manufacturer's minimum storage temperature or 35 degrees Fahrenheit, whichever is higher, at all times. Coating materials that are <u>found or suspected</u> to have dropped below this temperature shall not be used to fulfill the requirements of this Contract. All empty or discarded coating containers or other surface preparation or coating debris / waste / garbage shall be stored in a covered, watertight dumpster or equivalent container immediately after being generated and shall be disposed of legally. In general, the jobsite shall be maintained free of coating related refuse at all times.

# PART 2 - PRODUCTS

## 2.01 Manufacturers:

A. Products manufactured by one of the following shall be provided:

- 1. Tnemec
- 2. Carboline
- 3. Pittsburgh Paint
- 4. ICI
- 5. Global Eco Technologies
- B. Substitutions
  - 1. No substitutions shall be considered that decrease the film thickness, the number of coats, the surface preparation or the generic type of coating specified. Approved manufacturers must furnish the same color selection as the manufacturers specified, including accent color in all coating systems.

## 2.02 Materials

- A. All materials of a specified system including primer, touch-up, intermediate, and finish coats shall be provided by the same manufacturer. Thinners, cleaners and other additives shall be as recommended in writing by the coating manufacturer for the specified system. Materials handling and application shall conform at a minimum with manufacturers' requirements. Materials exceeding storage life recommended by the manufacturer, or one year (whichever is shorter) shall be rejected. Materials shall be mixed as full kits. All materials shall have a batch number and date of manufacture on each container.
- B. Coating materials including additives to be used in interior potable water contact surfaces must be currently listed on the NSF.org website under ANSI/NSF Standard 61 "Listing of Certified Drinking Water System Components- Health Effects". They shall conform to regulations and applicable requirements of local, State and federal air quality and health regulatory agencies.
- C. Coating materials specified are those which have been evaluated for the specific service. Specific products have been listed to establish a standard of quality. Equivalent coating systems by other manufacturers may be acceptable upon approval by the Engineer. Only the best grade of the various types of coating suitable for use in water and wastewater treatment plants, as regularly manufactured by acceptable coating material manufacturers, shall be provided. Material not displaying the manufacturer's identification as a best-grade product will not be acceptable.
- D. Primers shall be produced by the same manufacturer as the intermediate and finish coats. Use only thinners recommended by the manufacturer and use only to recommended limits.

- E. Coatings and pipe markers of durable and washable quality shall be provided. Materials that will withstand normal washing as required to remove grease, oil, chemicals, etc., without showing discoloration, loss of gloss, staining, or other damage shall be used.
- F. All coatings used on this project shall be asbestos free, lead free, cadmium free, and chromate free.
- G. Coating products shall conform to local AQMD rules and regulations.

# 2.03 Colors and Finishes

- A. Surface treatments, and finishes, are shown under Coating Systems below. All substrates indicated shall be coated whether or not shown on the Drawings, or in Schedules, unless an item is specifically scheduled as not requiring coating.
- B. Color Selection
  - Colors used shall be selected by the Engineer from the approved manufacturer's standard and custom color charts. The Contractor shall provide color samples on drawdown cards to the Engineer for review along with coating material submittals. The Engineer reserves the right to select non-standard colors for all coating systems specified within the ability of the manufacturer to produce such non-standard colors. Selection of non-standard colors shall not be cause for the Contractor rejecting the Engineer's color selections and the Contractor shall supply such colors at no additional expense to the City.
- C. Piping Color Code:
  - 1. To be selected by the Engineer.
- D. <u>Color Pigments</u>: Pure, non-fading, applicable types to suit the substrates and service indicated.

# 2.04 Coating Systems

- A. Refer to the following Coating System Sheets.
- B. The Contractor shall coat all items, which fall into the categories described. The examples given on the coating system sheets are presented for the Contractor's convenience and may not include all items which require coating. In general, all exposed ferrous materials shall be coated. This includes galvanized materials and shop primed material unless specifically excluded elsewhere.

# Coating System for Hydroneumatic Pressure Tank

A. <u>Interior:</u>

Interior coating systems shall be similar to AWWA D102-14 Inside Coating System No. 3 and as further specified. Any other work to take place on tank interior or exterior shall be complete prior to coating.

To be considered as an equivalent to the coating materials listed hereinafter for interior tank coating use, a material shall be of the generic classification specified, shall be approved by the NSF and listed on their website as an acceptable coating for potable water tanks and shall meet or exceed the following performance criteria:

Zinc-Rich Primer: Adhesion Method: ASTM D 4541, Type V) Requirement: No less than 2,083 psi (14.36 MPa) adhesion, average of three tests

Prohesion Method: ASTM G 85

Requirement: No blistering, cracking or delamination of film. No more than 1/64 inch rust creepage at scribe after 15,000 hours exposure

Salt Spray Method: ASTM B 117

<u>Requirement:</u> No blistering, rusting or delamination of film. No more than 1/8 inch creepage at scribe and no more than 1% rusting on plane after 50,000 hours exposure.

Cathodic Disbondment Method: ASTM G8, Method A

Requirement: No blistering, cracking, rusting or delamination and no undercutting at holiday after 30 days exposure.

Recoat Time / Immersion Method: Panels coated with one coat zinc-rich primer were exposed to direct sunlight for one, three, six and twelve months prior to topcoating (without scarification) with a two-component epoxy. The panels were then placed in potable water immersion for 12 months.

Requirement: No rusting, blistering, delamination or any other film defects after 12 months eimmersion. No less than 5B adhesion rating per ASTM D 3359.

Epoxy Intermediate / Finish:

<u>Abrasion Method:</u> ASTM D4060, CS-17 wheel, 1,000 gram load. Requirement: Not more than 140 mg loss after 1,000 cycles.

<u>Adhesion:</u> ASTM D4541 (Type V) Coating System: Two coats epoxy applied to SSPC-SP10/NACE No.2 Near White Metal Blast Cleaned steel and cured 14 days at 75 degrees Fahrenheit.

Requirements: No less than 1,943 psi (13.40 MPa) pull, average of three tests.

<u>Fresh Water Immersion Method:</u> ASTM D870, Coating System: One coat zinc/two coats epoxy applied to SSPC-SP10/Nace No.2 Near-White Blast Cleaned steel.

<u>Requirements:</u> No blistering, delamination or other loss of film integrity after 24 months.

<u>Salt Spray Method:</u> ASTM B117, Coating System: One coat zinc/two coats epoxy applied to SSPC-SP10/NACE No.2 Near-White Metal Blast Cleaned steel and cured 14 days at 75 degrees Fahrenheit.

<u>Requirements:</u> No blistering, cracking or delamination of film. No more than 1/16-inch rust creepage at scribe and not more than 1 percent rusting at the edges after 10,000 hours of exposure. No more than 1/4-inch rust creepage at scribe and no more than 1% rusting on plane after 20,000 hours exposure.

Coatings matching the approved system shall be applied to all interior appurtenances unless otherwise specified.

Coatings for tank interiors shall be equivalent to the following coating system:

- Prime Coat: Zinc Rich Aromatic Urethane, 2.5 to 3.5 mils DFT. Standard of Quality: Tnemec Hydro-Zinc, 91-H20 in accordance with ANSI/NSF Standard 61.
- Intermediate Coat: Polyamidoamine Epoxy, 4.0 to 6.0 mils DFT Standard of Quality: Tnemec Pota-Pox Plus, Series V140F - 1255 Beige
- Finish Coat: Polyamidoamine Epoxy, 4.0 to 6.0 mils DFT Standard of Quality: Tnemec Pota-Pox Plus, Series V140F – 15BL Tank White

Minimum DFT shall be 10.5 mils, maximum DFT shall be 15.5 mils.

The interior finish color of the tank shall be uniformly white or off-white. Any bleed through of the subsequent intermediate coats of another color will not be allowed. Repair will be performed at the Contractor's expense.

B. Exterior:

Coating systems for the exteriors of welded steel tanks shall be similar to AWWA Outside Coating System No. 6, with the exception of the finish coat, as further specified.

To be considered as an equivalent to the coating materials listed hereinafter for exterior tank coating use, a material shall be of the generic classification specified and shall meet or exceed the following performance criteria:

Zinc-Rich Primer: Adhesion Method: Requirement:	ASTM D 4541 (Type V) No less thatn 2,083 psi (14.36 MPa) adhesion, average of three tests			
Prohesion Method: Requirement:	ASTM G 85 No blistering, cracking or delamination of film. No more than 1/64 inch rust creepage at scribe after 15,000 hours exposure			
Salt Spray Method: Requirement:	ASTM B 117 No blistering, rusting or delamination of film. No more than 1/8 inch creepage at scribe and no more than 1% rusting on plane after 50,000 hours exposure.			
Cathodic Disbondment Method: ASTM G8, Method A Requirement: No blistering, cracking, rusting or delamination and no undercutting at holiday after 30 days exposure. Epoxy Intermediate: Adhesion Method: ASTM D 4541 (Type V) Requirement: No less than 1,909 psi pull (13.16 MPa), average of three tests.				
Cyclic Salt Fog/UV Exposure Method: ASTM D 5894 Requirement: No blistering, cracking, rusting or delamination of film after 10,000 hours.				
Humidity Method: ASTM D 4485 Requirement: No blistering, cracking, rusting or delamination of film after 10,000 hours exposure.				
High Dispersion Pure Acrylic Finish: Abrasion Method:  ASTM D 4060, (CS17 Wheel, 1,000 grams load) Requirement:  No more than 142 mg loss after 1,000 cycles, average of three tests.				

Adhesion Method: ASTM D 4541 (Type V) Requirement: No less than 2,213 psi (16.29 MPa) pull, average of three tests.

Fungal/Mold/Mildew Resistance Method: ASTM D 5590 Requirement: No more than traces of fungal growth (less than 10%) after four weeks continuous exposure.

QUV Exposure Method: ASTM D 4587 (UVA-340 bulbs, 8 hours UV, 4 hours condensation) Requirement: No blistering, cracking or delamination from film. No less than 100% gloss retention, no more than 0.45 DE00 color change and no units gloss loss after 3,000 hours. Fluoropolymer Finish: Abrasion Method: ASTM D 4060 (CS17 Wheel, 1,000 grams load) Requirement: no more than 134 mg loss after 1,000 cycles, average of three tests.

Exterior Exposure Method: ASTM D 4141, Method C (EMMAQUA) Requirement: No blistering, cracking or chalking and no less than 80% gloss retention (8.2 units gloss change) and 0.29 DED Hunter Lab Scale color change after 1,260 MJ/m2 EMMAQUA exposure, average of five tests in five colors.

Harddness Method: ASTM D 3363 Requirement: No gouging with an 8H or less pencil.

QUV Exposure Method: ASTM D 4587 (UVA-340 bulbs, Cycle 4: 8 hours UV/4 hours condensation)

Requirement: No blistering, cracking or chalking. No less than 86% gloss retention (7.3 units gloss change) and 0.54 DED FMCII (MacAdam units) color change after 3,000 hours exposure, average of five tests in five colors.

Coating systems sha	I be equivalent to the following:
Prime Coat:	Zinc Rich Aromatic Urethane, 2.5 to 3.5 mils DFT.
Standard of Quality:	Tnemec Tnemec-Zinc, 90-97
Intermediate Coat:	Polyamide Epoxy, 4.0 to 6.0 mils DFT.
	Standard of Quality: Tnemec Hi-Build Epoxoline Series 66HS-33GR Gray
Finish Coat:	High Dispersion Pure Acrylic, 2.0 to 3.0 mils DFT Standard of Quality: Tnemec HydroFlon Low VOC Series V701

Color: To be determined by the Engineer as specified herein

Minimum DFT shall be 7.5, maximum DFT shall be 11.5 mils.

C. Tank Coating Application: (does not exclude application instructions specified elsewhere as they apply)

All hydropneumatic tank surfaces shall be coated by spray application and shall be free from lap marks.

Each succeeding coat of paint shall have a slightly different color to readily distinguish between coats.

Particular care must be taken to obtain a uniform, unbroken coating over all bolts, threads, nuts, welds, edges, and corners. On tank interior surfaces, all of these listed features, or similar unlisted features, shall receive an additional coat of the approved coating system applied between the primer and finish coat applications.

Coating application shall conform to the requirements of the Society for Protective Coatings Paint Application Specification SSPC-PA1, latest revision, for "Shop, Field and Maintenance Painting" and recommended practices of the National Association of Corrosion Engineers and the Manufacturer of the coating materials. All materials shall be applied as specified.

No coating shall be applied:

- 1. When the surrounding air temperature as measured in the shade or the temperature of the surface to be coated is below 50 degrees F., or is less than 5 degrees above the dew point, except as recommended by manufacture and approved by Engineer;
- 2. When the temperature is expected to be less than 5 degrees F. above the dew point within eight (8) hours after application of coating,
- 3. When the surface temperature exceeds 125 degrees F., dew point shall be measured by use of an instrument such as a Sling Psychrometer and the use of US Weather Bureau Psychrometric Tables.
- 4. When wind velocities are anticipated to mobilize local debris or dust that may become entrapped in uncured coated surfaces.

Application of the first coat shall follow immediately after surface preparation and cleaning and within an eight (8) hour working day. Any cleaned areas not receiving first coat within an eight (8) hour period shall be recleaned prior to application of first coat.

The Contractor shall provide continuously operated dehumidification, heating, and ventilation equipment for all interior surface preparation, coating application and complete cure cycle, unless otherwise approved by the Engineer and coating system manufacturer. A minimum dew point spread of 17 degrees is required 24 hours per day for the duration of the interior coating portion of the contract. The Contractor shall provide shop drawings and a written plan for the methods to be employed for dehumidification, heating and ventilation for review and approval. The equipment shall be of a capacity deemed appropriate by the Manufacturer to permit unrestricted production through project duration. Forced ventilation shall be introduced at the bottom of the tank to facilitate removal of solvents as they evaporate during curing. The equipment shall be on the job site location and in operation from the first day of interior production until the interior coating is completely cured. Such equipment costs will be borne entirely by the Contractor.

Dehumidification shall comply with the following minimum performance requirements or the coating system manufacturer's requirements, whichever are more stringent:

1. Continuously deliver air with a maximum relative humidity of 11 percent.

2. Supply sufficient dry air to ensure the air adjacent to the surfaces to be blasted or coated does not exceed 35 percent relative humidity, or lower of determined by the coating manufacturer, at any time during the blasting, coating, or curing. Interior dew point shall be at least 15 degrees above the surface temperature. If the dew point falls below the 15 degree limit for more than 8 hours, all bare blasted areas shall be reblasted prior to prime coat application.

3. Minimum ventilation capacity of 1.2 tank volume air changes per hour to permit unrestricted application through the duration of the coating, but higher if necessary to maintain proper environmental conditions.

4. Dehumidification and temperature equipment shall be capable of depressing the dew point in the tank 10 degrees below ambient air temperature within 20 minutes.

5. Noise shall not exceed 76 decibels at 10 feet from the dehumidification and temperature control equipment.

The Contractor shall provide and maintain a record of dew point, inside air dry bulb temperature, inside air wet bulb temperature, inside air humidity, surface temperature, outside dry bulb temperature, outside air wet bulb temperature, outside air humidity, and equipment run times at 1 hour intervals throughout the required dehumidification, temperature control, and entire curing period. The chart recorders or data loggers shall be placed to monitor temperature on the tank's interior and exterior. Daily recorded temperature and humidity conditions will be delivered to the ENGINEER every morning for the previous 24 hours. Daily records shall be mandatory while the dehumidification and temperature control equipment is operating.

D. <u>Surface Preparation</u>: Without limiting the general aspects and other requirements of these Specifications, all surface preparation and coating of surfaces shall conform to the applicable requirements of the National Association of Corrosion Engineers (NACE), the Society for Protective Coatings (SSPC), and the Manufacturer's printed instructions. The Engineer's decision shall be final as to interpretation and/or conflict between any of the reference Specifications and Standards contained herein.

All surfaces to be coated shall be prepared in a workmanlike manner with the objective of obtaining a clean and dry surface. No coating shall be applied before the prepared surfaces are inspected by the Engineer. On the first day of any coating, the Contractor shall establish with the inspector a schedule so that all surface preparation may be inspected and approved prior to application of any coating, for the duration of the project.

Surface preparation of steel items shall conform with specifications set forth in the Society for Protective Coatings "SSPC Painting Manual, Volume 2, 2005 Edition", or as specified by the Engineer.

Surface preparation shall be based upon comparison with: "Pictorial Surface Preparation Standards for Painting Steel Structures" (SSPC-Vis 1), "NACE" Standard TM-01-70, or as described below. Anchor profile for prepared surfaces shall be measured by use of a non-destructive instrument such as a Keane-Tator Surface Profile Comparator, Testex Press-O-Film System or Clemtox Anchor Pattern Comparator.

To facilitate inspection, the Contractor shall on the first day of abrasive blast cleaning operations, blast clean a set of metal panels to the standard specified. These panels shall be equivalent to the plate stock which is to be coated and shall have minimum measurement of 8-1/2 inches by 11 inches (216 mm x 280 mm). After agreeing that a specific panel meets the requirements of the specification, it shall be initialed by the Contractor and Engineer and coated with a clear non-changing finish. Panels shall be utilized for inspection purposes throughout the duration of blast cleaning operation.

All surfaces to be coated shall be prepared in strict conformance with the coating manufacturer's surface preparation requirements. The Contractor shall submit the surface preparation proposed and product data sheets containing the manufacturer's surface preparation requirements.

Steel surfaces on the interior of the tank shall be sandblasted to near white blast condition in accordance with SSPC-SP-10/NACE No. 2 Near-White Blast Clean method, or an approved equivalent method.

The Contractor is advised that the project site is within residential neighborhoods and in close proximity to highly trafficked streets. Abrasive blasting and coating operations on tank exteriors and interiors shall be fully contained to prevent windblown abrasives, overspray, and odors from traveling offsite and onto neighboring properties and streets. To

accomplish this, the Contractor shall provide all the necessary equipment, tools, labor and materials required to construct, maintain, and operate blasting and overspray containment facilities around the tank. The Contractor shall be responsible for furnishing, erecting and removing the sealed structures, respirators, and other such equipment as may be required for the safety of personnel and safe operations during blasting and coating within the containment facility. Forced ventilation and air filtration, if anticipated to be necessary in order to achieve all safety requirements, shall be included in the cost for coating the hydropneumatic tank.

The Contractor shall keep particulates, overspray, and odors below levels that are detectable to the Engineer or general public at the perimeter of the jobsite. This includes keeping overspray below detectable levels on adjacent houses and cars traveling or parked on adjacent streets. The Contractor shall be solely responsible for any claims arising from lack of sufficient containment.

The Contractor shall keep the area of his work in a clean condition and shall not permit blasting materials to accumulate as to institute a nuisance or hazard to the performance of the work or the operation of the existing facilities. Blast materials should be disposed of daily and kept separate from other debris. Abrasive blast waste materials containing hazardous substances shall be kept in sealed containers on site until they can be picked up and removed by a licensed transporter.

No coating shall be applied over damp or moist surfaces. The air and surface temperature shall be no less than 5°F above the dew point during coating application and initial cure. All surfaces with condensation or other moisture shall be blown or wiped dry. If rust is present, all surfaces shall be re-blasted per specification. Climatic conditions and surface conditions shall be measured, recorded and approved by the Engineer prior to the application of any coatings.

All surfaces shall be pressure washed as per SSPC-SP12 and shall be cleaned to an SSPC-SP12/NACE No. 5, WJ-3 Thorough Cleaning condition with no flash rusting apparent at the time of painting. All surfaces must be clean, dry and free of any dirt, dust, rust, grease, oils, salts or other deleterious materials prior to primer or paint application.

The levels of hazardous substances in the existing coatings on some surfaces of the tank may require classification as hazardous waste during and after removal. Prior to blasting operations, and in a timely manner, the Contractor shall tank representative coating samples from the interior and exterior of the tank. These samples shall be sent to an appropriate testing laboratory for results.

Coating removal from tank surfaces with hazardous concentrations of chromium or zinc shall be by conventional methods with total containment of the tank, or by grit blasting with total containment and recovery of abrasive. Containment enclosures must use heat welded seams and be inspected by the Engineer prior to any abrasive blast operations. Adhesives and Adhesive tapes will not be allowed for seams of enclosures.

Alternate methods of complete coating removal, which remove the coating without any abrasive may be submitted by the Contractor for review and potential approval by the Engineer. All hazardous materials restrictions shall apply.

Any alternate methods for coating removal must be first approved by the Engineer and may either leave no surface profile or an irregular surface profile. Abrasive blast cleaning of the surface with a conventional abrasive after completion of the alternative coating removal method shall be required. Abrasive blast cleaning shall comply with SSPC-SP10/NACE No. 2 Near White Blast Clean. Abrasive blasting shall not be performed outside of a 100% containment area.

Upon completion of coating removal from tank surfaces, a representative sample of the spent abrasive containing the removed coating particles shall be collected and sent to an approved testing laboratory for testing under Title 22 and Land Ban requirements.

If tests indicate the spent abrasive with removed coating particles is not hazardous, the wastes can be disposed of in a local Class III or unclassified landfill, regardless of the presence of heavy metal coating particles. The local Regional Water Quality Control Board, which has jurisdiction over the landfill site, may require further testing to ensure the waste does not violate any of their local regulations. This could result in the waste being classified as a Designated Waste, which requires disposal at a Class II landfill site.

If tests indicate levels of chromium or zinc exceeding the maximum allowable contaminant level, spent abrasives must be placed in approved containers, be removed to an approved Class I landfill site via a licensed hazardous waste transporter, and disposed of in strict conformance with Title 22 and Land Ban regulations. Incineration, encapsulation in concrete or other binder-type materials are also acceptable methods of disposal.

Waste sludge from chemical removal methods shall be considered hazardous with no further testing. Waste sludge shall be removed to an approved Class I landfill site via a licensed hazardous waste transporter and disposed of in strict conformance to Title 22 and Land Ban regulations.

The Contractor shall be additionally responsible for:

- 1. Obtaining all permits
- 2. Processing all related project paperwork
- 3. Sampling and testing of waste as required
- 4. Bulking, packaging and storing waste at jobsite
- 5. Using licensed hazardous waste transporters to deliver the hazardous wastes to their ultimate legal disposal site
- 6. Arranging for and paying for all laboratory testing

Preparing a summary report for the City to be reviewed and approved by the Engineer describing the required work, sampling requirements, testing results, permits, landfill requirements, characterization of the waste and ultimate disposition of the waste.

E. <u>Tank Inspection Testing</u>: All coated surfaces will be inspected for the following defects:

Pinholes	Orange-peel	Holidays, missed areas
Blisters	Mud cracking	Over spray
Bubbling	Sanding Scratches	Contaminants, including spent abrasives
Fish eyes	Runs,sags, curtains	Mechanical damage – chipping, chips, scratches
Unmatched colors	Sand lines	Excessive or insufficient gloss

Contractor shall manage spent abrasives sufficiently to avoid damaging recently applied coatings or from contaminating previously cleaned areas. Defects in any coat of multiple coat applications must be repaired prior to application of subsequent coats. Coating defects may only be rectified after the coating in which the defect occurred has dried/cured sufficiently, unless approved otherwise by the Engineer. Usage of rollers to mask or obliterate defects in sprayed coatings will result in rejection of the work. In case of numerous or significant defects, the Engineer may require complete removal and replacement of all coatings applied by the Contractor. All defects shall be corrected by the Contractor at the Contractor's expense.

Thickness of coatings on metal surfaces shall be checked with a properly calibrated, non-destructive type thickness gauge. Each coat shall be checked for correct thickness. No measurements shall be taken within 8 hours after coating application.

The finish coating on all interior surfaces shall be completed without defects permitting moisture penetration when tested according to the low voltage, wet sponge method. Deficiencies in the continuity of the coating shall be corrected by applying additional finish coats, at the expense of the Contractor. The Contractor shall furnish a low voltage, wet sponge type holiday detector for use in inspecting the finished coating job. All pinholes shall be marked, repaired in accordance with the manufacturer's recommendations and retested. No pinholes or other irregularities will be permitted in the final coating. Dry film thickness gauges and holiday detectors shall be made available to the Engineer for use at all times until final acceptance of the project. The inspection devices shall be in good working condition. The Contractor shall 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 of holiday detectors. Holiday detectors shall not exceed the voltage recommended by the manufacturer of the coating system.

Whenever required by the Engineer, the Contractor shall provide additional illumination and necessary supports to cover all areas to be inspected. The level of illumination for inspection purposes shall be determined by the Engineer. Temporary ladders and scaffolding shall conform to applicable safety requirements and shall be erected when requested by the Engineer to facilitate inspection and be removed by the Contractor to locations requested by the Engineer.

Dry-film thickness gages and holiday detectors shall be made available for the Engineer's use at all times until final acceptance of application. Holiday detection devices shall be operated only in the presence of/or by the Engineer.

Acceptable devices for ferrous metal surfaces include, but are not limited to, Tinker-Rasor Model M-1 holiday detector for coatings up to 20 mils. dry film thickness and DeFelsko PosiTest or PosiTector 2000 units for dry-film thickness gauging. Non-ferrous metal surfaces shall be checked with an instrument such as an Elcometer "Eddy Current" Tester or DeFelsko PosiTector 3000.

F. <u>Tanks Disinfection and Volatile Organic Testing:</u> Upon completion of all modifications and complete curing and drying of the interior (and exterior) tank coating system and touch-up coatings, all interior surfaces shall be cleaned, to the satisfaction of the Engineer, prior to starting disinfection procedure. Water used for cleaning shall be from a City approved source and must be supplied with enough force and volume to fully remove all dirt, blast sand and foreign material from all interior surfaces without damaging the coating. All water, dirt and foreign material accumulated prior to or during the cleaning operation shall be removed from the tank and piping and disposed of in an appropriate manner approved by the Engineer.

Due to the preparatory work and staff time required by the City's Water Distribution staff disinfection and filling shall begin on a Monday. The Contractor shall submit a written request, at least 5 working days in advance of proposed date to the Engineer to schedule disinfection and filling. The City's Water Distribution staff will attempt to facilitate requested dates; however, extenuating circumstances may result in adjustments to requested dates, and under such conditions, no claims related to delays shall be considered.

Just prior to disinfection of the tank the Contractor shall remove any debris and "wall residue" that may have accumulated. Once this is complete the Contractor shall notify the City's Inspector and allow for their visual verification and approval that the tank is ready for disinfection operations.

Disinfection shall be accomplished similar to AWWA C652-11, Section 4.3, Chlorination Method 2, using a liquid solution only. A solution of 200 mg/L available chlorine shall be applied to all interior surfaces of the tank and shall include those surfaces that will be above the water level when tank is full. The chlorine solution shall remain in contact with all interior surfaces for a minimum of 30 minutes, after which the tank shall be filled with potable water from the City's water distribution. The residual chlorine level when the tank is full shall be between 0.8ppm and 1.2ppm. All applications of disinfectant must be witnessed by the Engineer or their designee.

At no time shall water trucks or any other unapproved vessel be used in the application of cleaning or filling of tanks or pipes unless first approved of by the Engineer in writing. Equipment and methods for cleaning and filling must be submitted for review and approval.

NOTE: The Contractor shall exercise special precautions to insure the safety of his/her employees during disinfection.

The interior coating work shall be deemed accepted when the coatings have substantially cured and the reservoir has been disinfected, filled for water sampling by the City and has passed all testing. Failure of the interior coating system to pass the California Department of Health Services Sanitation and Radiation Laboratory guidelines for potable water storage facilities will extend the date of acceptance.

After the tank is filled, samples shall be collected by the City in the presence of the Contractor for bacteriological, volatile organic compounds (VOC) and odor testing. Bacteriological samples shall be collected on days 2, 4 and 7, and an odor sample collected on day 7 after tank filling at each site. Testing for VOCs shall be according to the State Resources Control Board Sanitation and Radiation Laboratory guidelines set forth in "Collection, Pretreatment, Storage and Transportation of Water and Wastewater Samples", most current edition. The VOC sample shall be collected after the tank has been full for at least 7 days. Filling of the tank and the first set of all samples specified shall be conducted by City personnel and at the City's expense. If the test results are satisfactory, the tank may be placed into service without replacing the water. If the bacteriological test results are unsatisfactory, additional disinfection procedures approved by the Engineer shall take place until satisfactory results are obtained. If the volatile organic test results are unsatisfactory, additional curing or other corrective action will be required. Should any of the test results prove unsatisfactory, the costs of subsequent testing and corrective actions will be borne by the Contractor, including proper disposal of all water not meeting testing requirements and refilling of the tank. For scheduling purposes, the Contractor shall note that samples will not be taken on Weekends or City Holidays unless first approved by the Engineer.

The Contractor's attention is directed to AWWA Standards C652-11 Appendix C, and C655-09, or any updated revisions, for the disposal of chlorinated water. No water containing chlorine shall be discharged to the waters of the State.

Disposal of all liquids drained from the tank shall be the responsibility of the Contractor and shall be performed in accordance with a plan that has been prepared and submitted by the Contractor to the North Coast Regional Water Quality Control Board for approval. No water may be discharged to the storm drain system without an approved plan. At a minimum the plan shall address the separation of solids from the water and the neutralization of chemicals to acceptable concentrations. Disposal to the City's Sanitary Sewer system may be possible if approved by the Engineer.

G. <u>Tanks Acceptance</u>: Acceptance by the City of the completed tank coating work, and all interior tank work, as specified is subject to a guarantee by the Contractor to complete any needed repairs due to leaks or damage caused by defective workmanship or materials furnished by Contractor for a period of two years after Notice of Acceptance has been issued.

<u>Tank Warranty Inspection</u>: The City will conduct a warranty inspection as outlined in AWWA D102-14, Section 5, within 24 months following completion and written acceptance of coating work. Along with tank coatings and related items, this inspection shall also cover all non-coating specific interior tank improvements that took place as part of this contract. The City shall notify the Contractor and schedule a date for the inspection and notify the Contractor for scheduling of the work. Any work found to be defective shall be repaired at this time and in accordance with the manufacturer's recommendations, this specification, and to the satisfaction of the Engineer. Repairs shall be completed at the City's convenience and shall be performed within the time periods designated by the City. Repairs, if any, shall be performed in accordance with these specifications. The Contractor shall supply lighting, tools and materials, acceptable to the Engineer, for inspection by the City and the Engineer during the warranty inspection.

# Coating System 1

- A. <u>Service</u>:
  - 1. Exposed metal, atmospheric weathering and corrosive environment
- B. Typical Examples:
  - 1. For use with metal structures or pipes subjected to water condensation and chemical fumes, such as hydrogen sulfide, or atmospheric weathering.
- C. Surface Preparation:
  - 1. Previously painted steel: SSPC SP-12 (scarify any remaining coating with 80-100 grit sandpaper.)
  - 2. Galvanized components: SSPC SP-7
  - 3. Bare steel: SSPC SP-3
- D. <u>Product and Manufacturer</u>: One of the following shall be provided:
  - 1. Semi-Gloss polyamidoamine epoxy (min. 43% solids)
    - a. Tnemec
      - 1) <u>Spot Prime</u>: Field-apply, two-component epoxy at 4.0 to 6.0 dry mils to all bare steel, overlapping adjacent coating by 2 to 4 inches.
      - 2) <u>Prime Coat</u>: Field-applied, two-component epoxy applied at 4.0 to 6.0 dry mils.
      - 3) <u>Finish Coat</u>: Field-applied, semi-gloss polyurethane applied at 2.0 to 3.0 dry mils.
    - b. Or equal

# Coating System 2

- A. Service:
  - 1. Concrete, interior
- B. <u>Typical Example:</u>
  - 1. All concrete surfaces including equipment pads, floor, finished floor, and/or concrete steps.
- C. Surface Preparation:
  - 1. Concrete surface shall be prepared in accordance with SSPC SP-13.
- D. <u>Product and Manufacturer</u>: One of the following shall be provided:
  - 1. Tnemec
    - a. Primer: Series 201 Epoxoprime, 6.0-8.0 total dry mil thickness
    - b. Intermediate: Series 239SC ChemTread, 68.0-92.0 total dry mil thickness
    - c. Finish: Series 282 Tneme-Glaze, 6.0-8.0 total dry mil thickness
  - 2. Or equal

- E. Service:
  - 1. Exposed Metal Galvanized
- F. Typical Examples:
  - 1. Surfaces shall be galvanized surfaces before applying topcoat.
- G. Surface Preparation:
  - 1. SSPC SP-1 followed by SSPC SP-7 (surface profile of 1.5 2.0 mils for interior surfaces, 1.0 1.5 mils for exterior surfaces)
- H. <u>Product and Manufacturer</u>: One of the following shall be provided:
  - 1. Synthetic resin primer (phosphoric acid or vinyl butyral acid)
    - a. Tnemec
      - 1) Prime Coat: 4.0-6.0 dry mils
    - b. Or equal

# **Coating System 4**

- A. Service:
  - 1. Buried Metal
- B. <u>Typical Examples</u>:
  - 1. Buried metal, including valves, flanges, bolts, nuts, structural steel, fittings and metal piping in vaults
- C. Surface Preparation:
  - 1. SSPC SP-6.
- D. <u>Product and Manufacturer</u>: One of the following shall be provided:
  - 1. Coal tar or coal-tar epoxy (68 percent solids min.)
    - a. Tnemec
      - 1) Prime Coat: 15 mils.
      - 2) Topcoat: 15 mils
    - b. Or equal

- A. <u>Service:</u>
  - 1. Structural steel, miscellaneous metals, and steel, ductile iron, or cast iron piping
  - 2. Interior exposure
  - 3. Non-submerged applications (greater than 3' above highest possible water level).
- B. <u>Typical Examples:</u>
  - 1. Equipment including but not limited, valves, and other process equipment, and equipment guards.
  - 2. Steel, ductile, or cast iron piping not otherwise coated as specified in piping sections.

# C. Surface Preparation:

- 1. Shop: SSPC-SP 6 Commercial Blast, as specified in herein.
- 2. Field: Sandblasting of field welds and other imperfections. The Engineer may require all areas to be blasted at his discretion, SSPC-SP 6, commercial blast as specified in herein.
- D. <u>Product and Manufacturer</u>: One of the following shall be provided:
  - a. Tnemec
    - 1) <u>Primer</u>: Series V69 Hi-Build Epoxoline II one or more coats, 3.0 5.0 total dry mils thickness
    - 2) <u>Finish</u>: Series 435 Perma Glaze one or more coats, 15.0 20.0 total dry mils thickness
  - b. Or equal

# **Coating System 6**

- E. Service:
  - 1. Structural steel, miscellaneous metals, and steel, ductile iron, or cast iron piping
  - 2. Exterior exposure
  - 3. Non-submerged applications (greater than 3' above highest possible water level)
- F. Typical Examples:
  - 1. All exposed structural steel including but not limited to columns, beams, roof joists, purlins and other supporting members.
  - 2. Equipment including but not limited to pumps, blowers, air compressors, valves, other process equipment, motors, gear reducers, and equipment guards.
  - 3. Bridge crane, trolleys, hoist, motor, brackets, and underhung girders.
  - 4. Overhead coiling and man doors if not specified door elsewhere.
  - 5. Steel, ductile, or cast iron piping not otherwise coated as specified in piping sections.
- G. Shop Surface Preparation:
  - 1. Shop: SSPC-SP 6 Commercial Blast as specified in herein
  - 2. Field: Sandblasting of field welds and other imperfections. Engineer may require all areas to be blasted at his discretion, SSPC-SP 6, commercial blast as specified in herein.
- H. <u>Products and Manufacturer</u>: One of the following shall be provided:

- a. Tnemec
  - 1) <u>Primer</u>: Series V69 Hi-Build Epoxoline II one or more coats, 3.0 5.0 total dry mil thickness
  - 2) <u>Intermediate</u>: Series V69 Hi-Build Epoxoline II one or more coats, 3.0 5.0 total dry mil thickness
  - 3) Finish: Series 1075 Endura-Shield one or more coats, 3.0 5.0 total dry mil thickness
- b. Or equal

- A. Service:
  - 1. Structural steel, miscellaneous metals and steel, ductile iron, or cast iron piping
  - 2. Submerged, intermittently submerged, or splash zone applications (within 3' of highest possible water level).
- B. Typical Examples:
  - 1. Structural steel
  - 2. Steel, ductile, or cast iron piping not otherwise coated as specified in piping sections.
  - 3. Pump base elbows, pumps, mixers and other process equipment
  - 4. Pipe supports
- C. Surface Preparation:
  - 1. Shop: SSPC-SP 10 Near-White Blast Cleaning
  - 2. Field: Sandblasting of field welds and other imperfections. Engineer may require all areas to be blasted at his discretion, SSPC-SP 6, commercial blast as specified in herein.
- D. <u>Product and Manufacturer</u>: One of the following shall be provided:
  - 1. All systems described in Paragraph B except pumps
    - a. Tnemec
      - 1) <u>Primer</u>: Series V69 Hi-Build Epoxoline II one or more coats, 3.0 5.0 total dry mil thickness
      - 2) <u>Intermediate</u>: Series V69 Hi-Build Epoxoline II one or more coats, 3.0 5.0 total dry mil thickness
      - 3) <u>Finish</u>: Series V69 Hi-Build Epoxoline II one or more coats, 3.0 5.0 total dry mil thickness
    - b. Or equal
  - 2. Pumps
    - a. Tnemec
      - 1) <u>Primer</u>: Series V69 Hi-Build Epoxoline II one or more coats, 3.0 5.0 total dry mil thickness
      - 2) <u>Finish</u>: Series V69 Hi-Build Epoxoline II one or more coats, 3.0 5.0 total dry mil thickness
    - b. Or equal

# A. Service:

- 1. Plastics including PVC and CPVC Piping
- 2. Interior or exterior exposure
- 3. Non-submerged applications

# B. <u>Typical Example:</u>

- 1. Exposed PVC and CPVC piping.
- 2. Notable Exceptions:
  - a. Do not coat submerged or partially submerged plastic piping.
  - b. Do not coat plastic valves, unions, valve handles or other similar plastic items.
  - c. Do not coat exposed PVC conduit or exposed rigid steel with PVC coating conduit.
- C. Surface Preparation:
  - 1. Plastic shall be prepared in accordance with SSPC SP-1 (Solvent Cleaning) followed by SSPC-SP 2 (Hand Tool cleaning). Contractor shall use a solvent compatible with the specified coating and roughen surfaces by sanding.
- D. <u>Product and Manufacturer</u>: One of the following shall be provided:
  - 1) Finish: Carbothane 134VOC two coats, 5.0 total dry mil thickness
  - 2) Finish: Tnemec Series 1075 two coats, 5.0 total dry mil thickness
  - 3) Finish: ICI Devoe Devthane 378H two coats, 5.0 total dry mil thickness
  - 4) Or equal

# PART 3 - EXECUTION

# 3.01 Examination

- A. The Contractor and his applicator shall examine the areas and conditions under which painting work is to be performed, including air temperature and humidity, and notify the Engineer in writing of conditions detrimental to the proper and timely completion of the Work. The Contractor shall not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable per the Manufacturer's recommendations and instructions, and to the Engineer. During coating operations on the hydroneumatic tank, the coating contractor shall have a psychrometer, satisfactory to the Engineer, available on the job for measuring relative humidity and dew point. Contractor shall also have on site a method to convert temperature readings and variance to dew point such as the US Weather Bureau Psychrometric Tables. A means to measure the temperature of the surface is also necessary.
- B. The Contractor shall not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to the formation of a durable paint film.

# 3.02 Preparation

- A. Coordination:
  - 1. The Contractor shall review installation procedures under other Sections and coordinate the installation of items that must be field painted in this Section.

- 2. The Contractor shall coordinate the painting of areas to be painted that will be inaccessible once equipment has been installed.
- 3. The Contractor shall provide finish coats that are compatible with the prime paints used.
- 4. The Contractor shall review other Sections of these Specifications in which prime paints are to be provided to ensure compatibility of the total coatings system for the various substrates.
- 5. The Contractor shall be responsible for the compatibility of all shop primed and field painted items in this Contract.
- 6. The Contractor shall furnish information on the characteristics of the finish materials proposed to use, to ensure that compatible prime coats are used. Barrier coats shall be provided over incompatible primers or primers shall be removed and re-primed as required.

# B. Protection:

- 1. Finished Work of other trades and surfaces not being painted concurrently or not to be painted shall be covered or otherwise protected.
- 2. Work of other trades shall be protected, whether to be painted or not, against damage by the painting and finishing work. All such work shall be left undamaged. All damage shall be corrected by cleaning, repairing or replacing, and repainting, as acceptable to the Engineer.
- 3. Wet Paint signs shall be provided as required to protect newly painted finishes. All temporary protective wrapping provided for protection of this Contract shall be removed after completion of painting operations.
- C. Surface Preparation
  - 1. General:
    - a. All preparation and cleaning procedures shall be performed as specified herein and in strict accordance with the paint manufacturer's instructions for each particular substrate and atmospheric condition.
    - b. Do not blast or prepare more surface area than can be coated in 1 day. Remove all sharp edges, burns, and weld spatter. Do not blast PVC, CPVC, or FRP piping or equipment. Do not blast epoxy-or enamel-coated pipe that has already been factory-coated.
    - c. All hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish painted shall be removed or provided surface applied protection prior to surface preparation and painting operations. The Contractor shall remove, if necessary, for the complete painting of the items and adjacent surfaces. Following completion of painting of each space or area, the removed items shall be reinstalled by workmen skilled in the trades involved.
    - d. Surfaces to be painted shall be cleaned before applying paint or surface treatments. Oil and grease shall be removed with clean cloths and cleaning solvents prior to mechanical cleaning. The cleaning and painting shall be programmed so that dust and other contaminants from the cleaning process will not fall in wet, newly painted surfaces.
    - e. All surfaces that were not shop painted or that were improperly shop painted, and all abraded or rusted shop painted surfaces, which are to be painted, as determined by the Engineer, shall be prepared as specified below.
  - 2. Concrete and Masonry Surfaces:
    - a. Surfaces of concrete, precast concrete, and concrete block to be coated and sealed with clear finish shall be prepared by removing all existing coating, efflorescence, chalk, dust, dirt, grease and oils with soap and water.
    - b. The alkalinity and moisture content of the surfaces to be painted shall be determined by performing appropriate tests. If the surfaces are found to be sufficiently alkaline to cause blistering and burning of the finish paint, this condition shall be corrected before application of paint. The Engineer shall be provided with suitable testing materials to carry out alkalinity and moisture tests.
    - c. The Contractor shall not paint over surfaces where the moisture content exceeds 8 percent, unless otherwise permitted in the manufacturer's printed directions.

- d. Concrete and concrete block surfaces that cannot be adequately cleaned by soap and water shall be acid etched. Exceedingly dense concrete may require a second etching.
- e. Brush blast clean shall be equivalent to SSPC-SP 7, to open bug holes and remove all non-adhering concrete. All areas so prepared shall be thoroughly cleaned before beginning coating work.
- 3. Ferrous Metals:
  - a. Non-submerged ferrous surfaces, including structural steel and miscellaneous metal to be shop primed, shall be cleaned of all oil, grease, dirt, mill scale and other foreign matter by commercial blast cleaning complying with SSPC-SP 6.
  - b. Submerged ferrous surfaces, including structural steel and miscellaneous metal to be shop primed, shall be cleaned of all oil, grease, dirt, mill scale and other foreign matter by near-white blasting complying with SSPC-SP 10.
  - c. Non-submerged, ferrous surfaces that have not been shop-coated shall be cleaned of all oil, grease, dirt, loose mill scale and other foreign substances by commercial blasting, complying with SSPC-SP 6.
  - d. Submerged ferrous surfaces that have not been shop-coated or that, in the opinion of the Engineer, have been improperly shop-coated, shall be cleaned of all oil, grease, dirt, mill scale and other foreign matter by near-white blasting complying with SSPC-SP 10.
  - e. Bare and blasted or pickled clean metal shall be treated with metal treatment wash coat, prior to priming only if recommended by the paint manufacturer.
  - f. Shop applied prime coats that have damaged or bare areas shall be touched-up with primer recommended by the coating manufacturer after commercial blasting complying with SSPC-SP 6.
  - g. Weld Preparation: Remove weld spatter and slag by chipping or grinding. Grind all sharp edges and corners to a smooth contour. Welds to be ground free from undercuts, recesses and pinholes.
- 4. Non-Ferrous Metal Surfaces:
  - a. Non-ferrous metal surfaces shall be cleaned in accordance with the coating system manufacturers instructions for the type of service, metal substrate, and application required.
- 5. Galvanized Surfaces:
  - a. The Contractor shall clean free of oil and surface contaminants with solvent or other methods recommended by the coating manufacturer, complying with SSPC-SP 1.
  - b. All coated galvanized ferrous metal, interior and exterior, shall be cleaned of all oil, grease, dirt, mill scale and other foreign matter by a brush-off blast cleaning complying with SSPC-SP 7 with 1.5 to 2.0 mils profile.
- D. Materials Preparation
  - 1. General:
    - a. Painting materials shall be mixed and prepared in strict accordance with the manufacturer's directions.
    - b. Coating materials produced by different manufacturers shall not be mixed, unless otherwise permitted by the manufacturer's instructions.
    - c. Materials not in actual use shall be stored in tightly covered containers. Containers used in storage, mixing, and application of paint shall be maintained in a clean condition, free of foreign materials and residue.
    - d. All materials shall be stirred before application to produce a mixture of uniform density, and as required during the application of the materials. Any film that may form on the surface shall not be stirred into the material. The film shall be removed and, if necessary, the material shall be strained before using.
    - e. Brush stripe edges and corners to achieve specified coating thickness and coverage.

- 2. Tinting:
  - a. Each undercoat shall be tinted a lighter shade to facilitate identification of each coat where multiple coats of the same material are to be applied. Undercoats shall be tinted to match the color of the finish coat but provide sufficient difference in shade of undercoats to distinguish each separate coat. A code number shall be provided to identify material tinted by the manufacturer.
- 3. Mixing:
  - a. The Contractor shall mix only in mixing pails placed in a suitably sized non-ferrous or oxide resistant metal pans to protect concrete floor from splashes or spills which could stain exposed concrete or react with subsequent finish floor material.
  - b. Paint shall be mixed and applied only in containers bearing accurate product name of material being mixed or applied.

# 3.03 Application

- A. General:
  - Paint shall be applied by mechanical application techniques such as roller, brush, trowel, air spray, or airless spray in accordance with the manufacturer's directions and recommendations of Paint Application Specifications No. 1 in SSPC Vol. 2, where applicable, or as required in these Specifications. Brushes best suited for the type of material being applied shall be used. Where approved by the Engineer, rollers of carpet, velvet back, or high pile sheep's wool shall be used, as recommended by the paint manufacturer for material and texture required. Application to hydropneumatic tank shall be by spray method.
  - 2. The number of coats and paint film thickness required is the same regardless of the application method. Succeeding coats shall not be applied until the previous coat has completely dried.
  - 3. Where multiple coats of the same material is used, tint prime and intermediate coats in order to distinguish each coat.
  - 4. Additional coats shall be applied when undercoats, stains, or other conditions show through the final coat of paint, until the paint film is of uniform finish, color and appearance. This is of particular importance regarding intense primary accent colors. The Contractor shall insure that all surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a film thickness equivalent to that of flat surfaces.
  - 5. Surfaces not exposed to view do not require color coding but require the same coating systems specified for exposed surfaces. Exposed to view surfaces are defined as those areas visible when permanent or built-in fixture, convector covers, covers for finned tube radiation, grilles, etc., are in place in areas scheduled to be painted.
  - 6. The backs of access panels and removable or hinged covers shall be painted to match the exposed surfaces.
  - 7. Aluminum parts in contact with dissimilar materials shall be painted as specified with appropriate finish.
  - 8. Brush stripe welds; bolts; nuts; edges and corners to achieve proper coating thicknesses.
- B. Electrical Work:
  - 1. Electrical items to be painted include, but are not limited to, the following:
    - a. Conduit and fittings.
    - b. Miscellaneous panels, junction boxes, motors and accessories.
- C. Minimum / Maximum Coating Thickness:
  - 1. The Contractor shall apply each material at not less than the manufacturer's recommended spreading rate and provide total dry film thickness as specified. Extra coat shall be applied if required to obtain specified total dry film thickness or uniform opacity. If the recommended

maximum coating thickness is exceeded, the excess amount will be removed and repaired as specified.

- D. System Coating Thickness:
  - 1. The system total dry mil thickness shall be the sum of the Primer, Intermediate and Finish Coats specified.
- E. Scheduling Painting:
  - 1. The first-coat material shall be applied to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration. Abrasive blasted ferrous metal surfaces shall be coated within eight (8) hours on the same day of abrasive blasting.
  - 2. Subsequent coats shall be applied as per manufacturer's written recoat parameters as detailed on their product data sheet. Sufficient time between successive coating shall be allowed to permit proper drying. The Contractor shall not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and the application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.
- F. Prime Coats:
  - 1. Primed and sealed walls and ceilings shall be recoated where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects caused by insufficient sealing.
- G. Pigmented (Opaque) Finish:
  - 1. The Contractor shall completely cover to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage.
- H. Brush Application:
  - 1. All brush coats shall be brushed-out and worked onto the surfaces in an even film. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable. All glass and color break lines shall be neatly drawn.
- I. Mechanical Applicators:
  - 1. Mechanical methods shall be used for paint application as suggested by the paint manufacturer. Conduct spray coating under controlled conditions. Protect adjacent structures and surfaces from overspray, drips and spatter.
  - 2. For spray application, apply coating to thickness not greater than suggested in paint manufacturer's instruction.
  - 3. Wherever spray application is used, each coat shall be applied to provide the equivalent hiding of brush-applied coats. Do not double back with spray equipment for the purpose of building up film thickness of 2 coats in one pass.

# 3.04 Field Quality Control

- A. The right is reserved by the Engineer to invoke the following material testing procedure at any time, and any number of times during the period of field painting:
  - 1. Engage the service of an independent testing laboratory to sample any of the paint being used. Samples of materials delivered to the project site will be taken, identified and sealed, and certified in the presence of the Contractor.
  - 2. The testing laboratory will perform appropriate tests for any or all of the following characteristics: Abrasion resistance, apparent reflectivity, flexibility, washability, absorption, accelerated weathering, dry opacity, accelerated yellowness, recoating, skinning, color retention, alkali resistance and quantitative material analysis.
  - 3. If the test results show that the material being used does not comply with the specified requirements, the Contractor may be directed to stop the painting Work, and remove the non-

complying paint; pay for testing; repaint surfaces coated with the rejected paint; remove rejected paint from previously painted surfaces if, upon repainting with the specified paint, the two coatings are non-compatible.

B. Prior to initial coat and after completion of each successive coat of paint, the Contractor shall notify the Engineer. After inspection, checking of film thickness and approval by the Engineer, proceed with the succeeding coat. Contractor shall supply the Engineer for their use a Gardner dry-film thickness gage.

# 3.05 Cleaning

- A. During the progress of the Work, all discarded paint materials, rubbish, cans and rags shall be removed from the site at the end of each work day.
- B. Upon completion of painting work, all paint-spattered surfaces shall be cleaned. Spattered paint shall be removed by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.
- C. At the completion of work of other trades, all damaged or defaced painted surfaces shall be touched-up and restored, as determined by the Engineer.

### Demonstration

- D. Completed Work:
  - 1. The Contractor shall match approved samples for color, texture and coverage.
  - 2. Work not in compliance with specified requirements shall be removed, refinished or repainted, as required by the Engineer.

# SECTION 15062 DUCTILE IRON PIPE

#### PART1- GENERAL

#### 1.01 Summary

A. This section specifies ductile iron pipe, ductile iron fittings and gaskets. Ductile iron pipe and installation shall be per City of Santa Rosa Standards. Gray iron shall not be used unless approved by the Engineer for specific installations.

#### 1.02 References

A. This section contains references to some or all of the following documents, most recent edition. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
ANSI/ASME B1.20.1	Pipe Threads General Purpose
ANSI/ASME B16.5	Pipe Flanges and Flanged Fittings
ANSI/ASME B18.2.1	Square and Hex Bolts and Screws (Inch Series)
ANSI/ASME B18.2.2	Square and Hex Nuts (Inch Series)
ANSI/AWWA C104/A21.4	Cement Mortar Lining for Ductile Iron Pipe and Fittings
ANSI/AWWA C110/A21.10	Ductile Iron and Fittings (3-in through 48-in)
ANSI/AWWA C115/A21.15	Flanged Ductile Iron Pipe with Ductile Iron or Threaded Flanges
ANSI/AWWA C150/A21.50	Thickness Design of Ductile Iron Pipe
ANSI/AWWA C151/A21.51	Ductile Iron Pipe, Centrifugally Cast, for Water (3-in through 64-in)
ANSI/AWWA C153/A21.53	Ductile Iron Compact Fittings for Water Service
ANSI/AWWA C600	Installation of Ductile Iron Water Mains and their Appurtenances
ANSI/AWWA C606	Grooved and Shouldered Joints
ANSI B18.2.1	Square and Hex Bolts and Screws
ASTM A377	Index of Specifications for Ductile Iron Pressure Pipe
ASTM A193	Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications
ASTM A194	Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both

# 1.03 Drinking Water System Components

A. All water system components with wetted parts in contact with drinking water shall be in conformance with the U.S. Safe Drinking Water Act, the California State Waterworks Standards, and local Health Department Standards, including the requirements stated in the latest or most current version of NSF/ANSI 61 Annex G, NSF/ANSI 372 for "lead free" plumbing.

# 1.04 Submittals

- A. The Contractor shall submit the following in accordance with Section 01300 Submittal Procedures:
  - 1. Manufacturers' Affidavits of compliance with applicable references.
  - 2. Manufacturer's product data to include size, type, weight, gasket materials, materials standards and installation requirements for pipe, connections and fittings.

# 1.05 Quality Assurance

- A. Testing
  - 1. Factory testing shall conform to the requirements of all applicable references.

# PART 2 - PRODUCTS

### 2.01 Pipe

A. Pipe design, materials, and manufacture shall comply with the latest revision of the following documents:

Item	Document
Thickness Design	ANSI/AWWA C150/A21.50
Pressure Pipe (Water and Other Liquids)	ANSI/AWWA C151/A21.51
Threaded Flange	ANSI/AWWA C115/A21.15
Fittings	ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53
Rubber Gaskets <sup>1</sup>	ANSI/AWWA C111/A21.11

<sup>1</sup> Manufactured in accordance with the applicable requirements of the AWWA standard, material specified below

B. Pressure Class shall be 350

# 2.02 Connections and Fittings

# A. Connections

- 1. Joints shall not be required
- 2. Flange Assemblies
  - a. Flanges shall be faced in accordance with ANSI B16.1
- 3. Gaskets: Neoprene
- 4. Mechanical Joint/Coupling Gaskets: Nitrile or Neoprene

- 5. Bolts:
  - a. General
    - 1) Bolt Threads shall be ANSI B.1.1, standard coarse thread series;
    - 2) Bolts shall be Class 2A,
    - 3) Nuts shall be Class 2B.
    - 4) Bolt length shall conform to ANSI B16.5.
  - b. Material:
    - 1) Unless otherwise specified, bolts and nuts shall be 304 or 316 stainless steel per ASTM F193 heavy hex head.
      - a) Length such that after installation, end of bolts projects 1/8-inch to 3/8 inch beyond outer face of nut. Nuts shall comply with ASTM A194 heavy hex pattern.
      - b) Galvanized or cadmium steel bolts are not acceptable substitutes for stainless steel, regardless of any other protective coatings.
    - 2) Flange assembly bolts for other installations shall be SAE Grade 5, ANSI B18.2.1 standard square or hexagon head carbon steel machine bolts with ANSI B18.2.2 standard hot pressed hexagon nuts.

# B. Fittings

1. Ends shall be flanged, mechanical joint, or as shown in the Drawings.

# 2.03 Pipe and Fitting Protection

- A. Lining
  - 1. Unless otherwise shown or specified, lining shall be cement mortar lining conforming to ANSI/AWWA C104/A21.4. Mortar lining seal shall be asphaltic coating per ANSI/AWWA C151/A21.51 for pipe and ANSI/AWWA C110/A21.10 for fittings.
- B. Coating (per coating section)
  - a. Coat per Section 09900 Protective Coating Systems.

# PART 3 - EXECUTION

# 3.01 General

- A. Piping runs shown on the drawings shall be followed as closely as possible. Proposed deviations shall be submitted in accordance with Section 01300 Submittal Procedures.
- B. Pipe shall be installed in accordance with AWWA C600. Cuts on DIP pipe shall be coated with an acceptable bituminous material. Cut ends on lined pipes shall be coated in accordance with the approved/specified coating manufacturer's recommendations.
- C. Connections to existing structures shall be made so that the finished work will conform as nearly as practicable to the requirements specified, including necessary concrete work, cutting and shaping. Concrete mortar shaping on any structure shall be as specified.
- D. The Contractor shall conduct the tests in the presence of the Construction Manager.

# 3.02 Connections

A. General

- 1. Flanged coupling adapter shall be installed in accordance with the coupling manufacturer's installation recommendations.
- B. Flanged:
  - 1. Pipe cutting, threading and jointing shall conform to the requirements of ANSI B31.1, and the fitting manufacturer's installation recommendations.
  - 2. Where a metallic nonferrous pipe or appurtenance is connected to ferrous pipe or appurtenance, an insulating section shall be provided as specified.
  - 3. Welding of flanges shall be made prior to applying lining.

# 3.03 Anchorage

A. Anchorage shall be provided as specified. Calculations and drawings for proposed alternative anchorage shall be submitted.

# 3.04 Acceptance Testing

A. Hydrostatic pressure and leakage tests shall be conducted and acceptability determined in accordance with City of Santa Rosa Standards.

# SECTION 15090 PIPE SUPPORTS

### PART1- GENERAL

#### 1.01 Summary

A. The work of this Section includes designing and providing pipe supports, hangers, guides, and anchors.

#### 1.02 References

A. This section contains references to some or all of the following documents, most recent edition. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
ANSI/ASME B31.1	Power Piping
ANSI/MSS SP-58	Standard Pipe Support Components

#### 1.03 System Description

- A. Design Requirements
  - 1. More stringent of
    - a. California Building Code
    - b. Applicable National Code
  - 2. Supports shall be capable of supporting the pipe for all service and testing conditions.
  - 3. Supports shall allow free expansion and contraction of the piping throughout the full operating temperature range to prevent excessive stress.
  - 4. Supports and hangers shall be designed to allow for proper pitch of pipes.
  - 5. For chemical and waste piping, design, materials of construction and installation of pipe hangers, supports, guides, restraints, and anchors shall meet the following standards, except as modified by this Specification:
    - a. ANSI B31.3
    - b. MSS SP-58 and SP-69
  - 6. For hot and cold water piping, design, materials of construction and installation of pipe hangers, supports, guides, restraints, and anchors shall meet the following:
    - a. ANSI B31.1
    - b. MSS SP-58 and SP-69
  - 7. All physical clearances between piping, support system and structure shall be checked and the supports shall allow for vertical adjustment after erection.
  - 8. Vertical pipe runs in pipe chases shall be supported at base of riser. Pipes shall be supported for lateral movement with clamps or brackets.

- 9. Galvanized 20-gauge steel pipe saddle shall be provided for plastic support points to ensure minimum contact width of 4 inches.
- 10. Pipe Support Spacing
  - a. General
    - 1) For conditions not detailed on the drawings, Contractor is responsible for a complete pipe support system.
    - 2) Pipe supports shall be designed by the Contractor. In all cases pipe supports shall not exceed maximum spacing scheduled unless otherwise shown.
    - 3) All piping shall be supported to prevent undue strain on any valve, fitting or piece of equipment.
    - 4) Locations
      - a) All changes in direction
      - b) All changes in elevation
      - c) Adjacent to flexible couplings
      - d) At least one support shall be provided for each length of pipe and each valve
  - b. Each length and every fitting shall be supported as follows:
    - 1) Bell and spigot piping
      - a) At least one hanger
      - b) Applied at bell
    - 2) Compression sleeve joints:
      - a) Hanger shall be within 2 feet of each side of fittings to keep pipes in alignment.
  - c. Supports shall be spaced for soil and waste pipe and other piping systems not included above every 5 feet.
  - d. Continuous support shall be provided for nylon tubing

#### 1.04 Submittals

- A. The Contractor shall submit the following in accordance with Section 01300 Submittals Procedures:
  - 1. Shop drawings for all fabricated pipe supports
  - 2. If there are locations where the Contractor deviates from the pipe supports shown on the Contract Drawings; including details of concrete inserts, the Contractor shall submit a drawing showing the deviations.
- B. Submit pipe support design calculations, including seismic calculations per Section 01300 Submittals Procedures and as follows in this section.

# PART 2 - PRODUCTS

# 2.01 Materials

- A. Pipe supports shall be fabricated from the following materials:
  - 1. Stainless steel (Type 304L or 316L):

- a. Use in all submerged locations or in tanks above the water level but below the top of the structure and where specifically indicated on the Drawings.
- 2. Hot-dip galvanized steel:
  - a. Use in areas other than above or where specifically indicated on the Drawings.
  - b. Hot-dip galvanize pipe supports after fabrication.
- 3. Plastic, FRP and Other Miscellaneous Materials:
  - a. Use where indicated on the Drawings.

# 2.02 Manufactured Units

- A. Products listed in this section refer to products manufactured by Anvil International. Equivalent units manufactured by Tolco, B-Line, or equal, may be substituted.
- B. Supports and Anchors
  - 1. For exposed, non-submerged conditions, hot-dipped galvanized steel shall be used.
  - 2. For submerged conditions, stainless steel, Type 304L, shall be used except as noted.
- C. Contact between dissimilar metals shall be prevented by the use of copper plated, rubber, vinyl coated, or stainless steel hangers or supports.
- D. Modular Framing Strut Systems and Accessories for Pipe Support
  - 1. Galvanized steel or stainless steel as specified
  - 2. 12-gauge channels
  - 3. Unistrut, Globestrut, Anvil-strut, Powerstrut, or equal

# PART 3 - EXECUTION

# 3.01 Installation

- A. Piping systems exhibiting pulsation, vibration, swaying, or impact shall be provided with suitable constraints to correct the condition. Included in this requirement are movements from:
  - 1. Trap discharge
  - 2. Water hammer
  - 3. Similar internal forces
- B. Weld Supports
  - 1. AWS D1.1
  - 2. Anchors shall be welded to pipe in accordance with ANSI B31.3
- C. Piping and pipe supports shall be located so as to not interfere with open accesses, walkways, platforms, and with maintenance or disassembly of equipment.
- D. Hangers shall be inspected for:
  - 1. Design offset
  - 2. Adequacy of clearance for piping and supports in the hot and cold positions
  - 3. Guides to permit movement without binding
  - 4. Adequacy of anchors

- E. Hangers shall be inspected after erection of piping systems and prior to pipe testing and flushing.
- F. Individual or continuous slot concrete inserts for use with hangers for piping and equipment shall be installed as concrete forms are installed.
- G. Field painting shall comply with Section 09900 Protective Coating Systems.
- H. All piping shall be braced for seismic forces in accordance with CBC.
- I. All galvanized pipe supports used to support stainless steel piping shall be provided with a rubber bushing material to isolate the galvanized supports from the stainless steel pipe.

### SECTION 15100 VALVES AND MISCELLANEOUS COMPONENTS

### PART1- GENERAL

#### 1.01 Summary

A. This Section includes valves and miscellaneous components.

### 1.02 Submittals

- A. <u>Product Data, Shop Drawings, Samples</u>: The following information shall be submitted in accordance with the requirements of Section 01300- Submittal Procedures:
  - 1. Gate Valves: Annotated Product Bulletins
  - 2. Swing Check Valves: Annotated Product Bulletins
  - 3. Mechanical/ Flexible Pipe Couplings: Annotated Product Bulletins

### 1.03 WARRANTY

A. Provide manufacturer's written warranty, issued in the City's name, to cover the equipment supplied against defects in workmanship and material for a period of one (1) year from the date of acceptance under normal use and service. Warranty shall include all materials and labor required.

#### PART 2 - PRODUCTS

#### 2.01 Drinking Water System Components

A. All water system components with wetted parts in contact with drinking water shall be in conformance with the U.S. Safe Drinking Water Act, the California State Waterworks Standards, and local Health Department Standards, including the requirements stated in the latest or most current version of NSF/ANSI 61 Annex G, NSF/ANSI 372 for "lead free" plumbing.

#### 2.02 Manufacturers

- A. <u>Gate Valves</u>: Per City of Santa Rosa Standards.
- B. Swing Check Valves: Swing-Flex Check Valve, Val-Matic, No Substitutions.
- C. <u>Mechanical/ Flexible Pipe Couplings</u>: Series 2100 MEGAFLANGE or approved equal.

#### 2.03 Gate Valves

- A. Per City of Santa Rosa Standards.
- B. Provide installed handwheels.
- C. Construction:

- 1. Gate valve end connections shall be flanged as specified. End flanges shall be integral with the gate valve body and be faced and drilled in accordance with ANSI B16.1 for 125-pound flanges.
- 2. Unless specified otherwise, valves 6-inches and less shall be provided with handwheels.

# 2.04 Swing Check Valves

- A. <u>Type</u>: Swing-Flex check valves shall be constructed of ductile iron body with a bronze seat ring. The seat ring shall be locked in place with stainless steel lock screws and be field replaceable without special tools. The shaft shall be one piece Hi-strength stainless steel 17-4PH and be fully extended from the body.
- B. Materials of construction shall be as follows:

<u>Components</u>	<u>Material</u>
Body, cover	Ductile Iron
Disc, Disc Arm	Ductile Iron, ASTM A536
Seat	Stainless steel
Disc Seat	Buna-N
Pivot Shaft	Stainless steel, Type 17-4PH

- C. Valve shall comply with AWWA C508 and be full waterway per MSS SP-71.
- D. Valve shall be coated on the interior and exterior with fusion bonded epoxy in accordance with AWWA C550, 12 mil DFT minimum. Coatings shall conform to AWWA C550 for all interior and exterior ferrous surfaces. If valve is to be installed above ground, Contractor shall prep surface as required, and paint exterior of valve to match piping system color, or color per Owner's approval.

# 2.05 Valve Operators

A. All valves, except check valves, shall be provided with manual operators unless otherwise specified. The direction of rotation of the handwheel or lever to open the valve shall be counterclockwise. Each valve body shall have cast thereon the word OPEN and an arrow indicating the direction to open. Ball valves (if we're installing any, shall be the 1/4 turn type)

# 2.06 MECHANICAL/ FLEXIBLE PIPE COUPLINGS

- A. Restrained flange adapters shall be used in lieu of threaded, or welded, flanged spool pieces. Flange adapters shall be made of ductile iron conforming to ASTM A536 and have flange bolt circles that are compatible with ANSI/AWWA C110/A21.10.
- B. Restraint for the flange adapter shall consist of a plurality of individual actuated gripping wedges to maximize restraint capability. Torque limiting actuating screws shall be used to insure proper initial set of gripping wedges.

- C. The flange adapter shall be capable of deflection during assembly, or permit lengths of pipe to be field cut, to allow a minimum of 0.6" gap between the end of the pipe and the mating flange without affecting the integrity of the seal.
- D. For ductile iron pipe, the flange adapter shall have a safety factor of 2:1 minimum.

# PART 3 - EXECUTION

### 3.01 Installation

- A. <u>General</u>: Valves shall be installed in accordance with the manufacturer's instructions. Valves shall be independently supported to prevent stressed on pipe.
- B. <u>Access</u>: Valves shall be installed to provide easy access for operation, removal and maintenance and to prevent interferences between the valve operators and structural members or other obstructions.

### 3.02 Coating

A. Exposed valves shall receive final field coating as specified or in accordance with Section 09900 – Protective Coating Systems to match adjacent piping.

# SECTION 16010 GENERAL ELECTRICAL PROVISIONS

# PART1- GENERAL

### 1.01 Summary

- A. This division includes the provisions for all material, labor, tools, equipment, testing and services necessary to provide a complete and operable electrical system.
- B. The provisions of this Section shall apply to all electrical items specified in the various sections of Division 16 (Electrical), Division 17 (Instrumentation) and all other Divisions specifying electrical items of these Specifications, except where otherwise specified or shown on the Contract Documents.
- C. Furnish all necessary labor, materials, equipment and incidentals required to install a complete and operational electrical system according to the intent of this specification and the accompanying drawings, whether itemized or not.
- D. Examine the specification and drawings for mechanical equipment and provide all starters, circuit breakers, switches, pushbuttons and appurtenances, which are not specified to be with the mechanical equipment. Erect all electrical equipment not definitely stated to be erected by others, furnish and install conduit, wire and cable and make connections required to place all equipment in complete operation.
- E. Following installation, protect materials and equipment from corrosion, physical damage, and the effects of moisture on insulation. When equipment intended for indoor installation is installed at the Contractor's convenience in areas where it is subject to dampness, moisture, dirt, or other adverse atmosphere until completion of construction; ensure that adequate protection from these atmospheres is provided that is acceptable to the City's Representative. Cap conduit runs during construction. Energize all space heaters furnished with equipment.
- F. Interpretation of Drawings:
  - 1. Any error or omissions of detail in either the drawings or the specifications shall not relieve the Contractor from correctly installing all materials necessary for complete and operating electrical system.
  - 2. The Contractor shall inspect the site and verify all measurements and conditions and shall be responsible for the correctness of same. No extra compensation will be allowed because of differences between work shown on the drawings and measurements at the site.
  - 3. The electrical drawings are diagrammatic, but shall be followed as closely as existing conditions and work of other contractors will permit. All deviations from the drawings required to make the work conform to structures as constructed, and to the work of others, shall be made at the Contractor's expense.
  - 4. The Contractor shall examine the architectural, structural, mechanical and manufacturer's drawings for the various equipment in order to determine exact routing and final terminations for all conduits and cables. Conduits shall be stubbed up as near as possible to equipment enclosure.
  - 5. All equipment shall be located and installed so that it will be readily accessible for operation and maintenance. The reserves the right to require minor changes in location of outlets or equipment, prior to roughing in, without incurring any additional costs or charges.
  - 6. Existing Conditions:

- a. The electrical drawings were developed from past record drawings and information supplied by the .
- b. Carry out any work involving the shutdown of existing services to any piece of equipment now functioning or the tie-in of equipment to the existing system at such time as to provide the least amount of inconvenience to the . Provide such work when directed by the City's Representative.
- c. After award of Contract, confer with Engineer to verify at each area of construction activity the location of existing underground utilities. Protect all existing underground utilities during construction.
- d. NO work shall be started that involves the existing electrical system without first obtaining and completing all coordination forms required by the City.
- e. Prior to staring any underground work the Contractor shall obtain all the information of the underground utilities or obstructions from the Engineer and take proper precautions to locate the utilities by potholing or other approved means in accordance with Special Provisions.
- G. Substitutions No Substitutions shall be allowed unless specifically noted as "or equal" or as "or approved equal."
  - 1. The contract documents were developed using the first named manufacturer to determine physical space requirements, conduit and wiring requirements, capacities/ratings and implementation of the contract electrical and instrumentation. When indicated in the contract documents, the contractor may elect to use one of the other named manufacturers, or where allowed, provide equivalent previously unnamed manufacturers. Any deviations from the contract documents that result from using a manufacturer other that the first named manufacturer are the responsibility of the contractor.
  - 2. Specific brand names and catalog numbers are used to describe materials in order to establish standards of performance and quality.
  - 3. The decision of the Engineer shall govern as to what is equal to the item specified. Equality will be judged on the basis of the following:
    - a. Conformance with description or performance required
    - b. Equal in quality
    - c. Comparable in appearance and artistic effect where these are considerations
    - d. Comparable operation, maintenance and performance
    - e. Equal in longevity and service under conditions of climate and usage
    - f. Conformance with space allocations and requirements for operations from mechanical or electrical services provided without necessitating changes in details and construction or related work
  - 4. If the Engineer considers it necessary, tests to determine the quality of the proposed materials shall be made, at the expense of the Contractor, by an unbiased laboratory, satisfactory to the Engineer.
  - 5. Any material, article, or method judged by the Engineer equal to that specified will be approved, provided the Contractor submits a single written request to the Engineer, per Special Provisions Section, with the following information for each item:
    - a. Name of manufacturer or supplier
    - b. Trade or brand name

- c. Type, model, style, and/or catalog number
- d. Size or capacity rating
- 6. The Contractor assumes full responsibility for including complete, correct data in this one request and shall also attach completely referenced diagrams descriptive and technical data sheets for the Engineer's determination of equality or suitability of appearance of any substitution item. Only one such request may be submitted. The Engineer's rejection of any substitute shall automatically require the Contractor to furnish the specified item without further discussion or delay.

# 1.02 REFERENCES

A. Electrical work, including connection to electrical equipment integral with mechanical equipment described elsewhere in these specifications, shall be performed in accordance with the latest published regulations of the following codes and standards:

<b>Reference</b>	Title
	Federal Standards
	State Codes and Ordinances and Inspecting Authorities
	Local Codes and Ordinances and Inspecting Authorities
	The National Board of Fire Underwriters
NFPA	National Fire Protection Association
UL	Underwriters Laboratories
NEMA	National Electrical Manufacturers' Association
ANSI	American National Standards Institute
IEEE	Institute of Electrical and Electronic Engineers
IPCEA	Insulated Power Cable Engineers Association
OSHA	State Department of Industrial Safety
	State Public Utilities Commission
NEC	National Electrical Code (NEC) for all items not specifically covered the state and local ordinance.
NFPA 79	Electrical Standard for Industrial Machinery
AHJ	Authority Having Jurisdiction, City of Santa Rosa

- B. Nothing in these special provisions or on the drawings shall be interpreted as permission or direction to violate any governing code or ordinance.
- C. Materials and equipment used in the performance of the electrical construction shall be fully UL approved for the class of service for which they are intended prior to submittal of shop drawings.
- D. Without limiting the generality of other requirements of these specifications, all work specified herein shall conform to or exceed the applicable requirements of the National Electric Code (NEC); provided, that where a local code or ordinance is in conflict with the NEC, the provisions of said local code ordinance shall take precedence.
- E. The construction and installation of all electrical equipment and materials shall comply with all applicable provisions of the Cal OSHA Safety orders (Title 8, CCR), State Building Standards, and applicable local codes and regulations

# 1.03 System Description

- A. The general extent of the electrical work includes, among others, the furnishing and installing of the following items:
  - 1. Demolition of the existing systems indicated on the Drawings.
  - 2. New standby generator, automatic transfer switch, manual transfer switch, MCC modifications, and PLC control panel.
  - 3. Complete circuiting and connections for all motors, including their remote control and indicating devices
  - 4. All supports, bases, anchors, sleeves, hangers, conduit seals, and the like, all electrical work shown and/or specified, not particularly mentioned above
  - 5. Complete grounding systems
  - 6. Instruction, maintenance and overhaul manuals
  - 7. Installation of vendor supplied panels
  - 8. Installation of conduit and conductors between vendor supplied field equipment and vendor supplied panels including termination of conductors within the vendor-supplied panels based on vendor-supplied documentation
  - 9. Conduit, wire, cable terminations, and equipment mounting associated with the Instrumentation System
  - 10. Interconnection wiring diagrams
  - 11. Hardware, software and programming at the station to allow the pump station to transmit and receive data, alarms and commands from the City existing SCADA system.
  - 12. Programmable controller and programming
  - 13. Operator Interface Terminal and programming
  - 14. Electrical connections to all Mechanical equipment and instruments
  - 15. Electrical Tests
- B. Manufacturer's Directions: Manufacturer's directions shall be followed in all cases where manufacturers furnish instructions covering points not shown on the drawings or herein specified.

# 1.04 Submittals

- A. General: Submittals for all electrical equipment provided under this project manual shall be prepared and submitted within 60 calendar days after notice to proceed.
- B. Materials and Equipment Schedules: The Contractor shall deliver to the Engineer a complete list of all materials, equipment, apparatus, and fixtures which it proposes to use. The list shall include sizes, names of manufacturers, catalog numbers, and such other information required to identify the items.
- C. The submittal package for each individual equipment or groups of related equipment shall be complete and in accordance with this Section. As a condition precedent to the review of submittals and with the requirements of Special Provisions, the Contractor shall furnish the manufacturer's statements accepting unit responsibility. The purpose of this provision is to ensure compatibility of all components specified under the specific technical specification and to provide sole source responsibility for system performance and maintenance. Not withstanding these provisions, however, the Contractor is not relieved of his responsibility for the indicated portions of the work. The following, as a minimum, shall be submitted:

- 1. Manufacturer and manufacturer's type and designation
- 2. Manufacturer's catalog data indicating rated capacity, efficiency, rated output and other characteristics
- 3. Manufacturer's catalog cut sheets shall be annotated to indicate all relevant items to the Project
- 4. Any exception to these specifications along with justification for each exception shall be clearly stated on the first page of the submittal
- 5. Shop drawings
- 6. Parts list with material of construction
- 7. Installation requirements, showing various clearances required
- 8. Details of all appurtenances to be furnished with the specified item
- D. Shop drawings are required for materials and equipment listed in this and other sections. Shop drawings shall provide sufficient information to evaluate the suitability of the proposed material or equipment for the intended use, and for compliance with these Specifications. The following shall be included:
  - 1. Front, side, and rear elevations, footprints and top views, with dimensions
  - 2. Location and size of conduit entrances and access plates
  - 3. Component data
  - 4. Connection diagrams, terminal diagrams, schematic wiring diagrams, conductor size, and type, etc.
  - 5. Method of anchoring and embedded structural members; weight
  - 6. Finish
  - 7. Nameplates
  - 8. Temperature limitations, as applicable
  - 9. Rating of equipment as per specifications and drawings
  - 10. NEMA rating of enclosures
  - 11. Approved listing
- E. Catalog data shall be submitted to supplement all shop drawings. Catalog cuts, bulletins, brochures, or the like or photocopies of applicable pages thereof shall be submitted for mass produced, non-custom manufactured material. These catalog data sheets shall be stamped to indicate the project name, applicable Specification section and paragraph, model number, and options. This information shall be marked in spaces designated for such data in the stamp.
- F. Record Drawings: In addition to the Record Drawings as a part of the record drawing requirements specified in the General Requirements, the Contractor shall show depths and routing of all concealed below-grade electrical installations. Said set of record drawings shall be available to the Engineer and the Inspector during construction. After final inspection, the Contractor shall transfer all record drawing information to a set of reproducible vellums which shall then be delivered to the Engineer. In addition, the Record Drawings shall show all variations between the work as actually constructed and as originally shown on the Drawings, based upon information supplied by the Contractor.
- G. Manufacturer's Drawings: One set of equipment manufacturer's drawings shall be submitted to the Engineer for its records.

- H. The Contractor shall obtain and submit from the manufacturer a list of suggested spare parts for each piece of equipment according to the provisions of spare parts of the General Requirements. After approval, Contractor shall furnish such spare parts suitably packaged, identified with the equipment number, and labeled. Contractor shall also furnish the name, address, and telephone number of the nearest distributor for each piece of equipment. All spare parts are intended for use by the , only. Any spare parts which the Engineer permits the Contractor to use for startup activities shall be replaced by the Contractor prior to the 's acceptance of beneficial use of the equipment.
  - 1. During the term of this Contract the Contractor shall notify the Engineer in writing about any manufacturer's modification of the approved spare parts, such as part number, interchangeability, model change or others. If the Engineer determines that the modified parts are no longer applicable to the supplied equipment, the Contractor at its expense shall provide applicable spare parts.

### 1.05 Quality Assurance

- A. Performance and Design Requirements
  - 1. Manufacturer's Qualifications: The equipment furnished under this division shall be the product of firms regularly engaged in the design and manufacture of the type of item specified, possessing the required technical competence, skill, resources and ability to complete the work specified herein with the requisite degree of quality in a timely and efficient manner. The Contractor shall be prepared to adequately document the qualifications of the manufacturers nominated to provide the equipment specified under this division. All documentation shall be submitted to the City's Representative prior to design fabrication and shipment of any component specified herein. Nothing contained within these provisions shall be construed as relieving the Contractor of his responsibility for any portion of the work covered by this Section.
  - 2. Arrangement: The drawings are generally diagrammatic and the location of outlets and equipment terminals are approximate unless detailed or dimensioned. The exact locations and routing of cables and conduits shall be governed by structural conditions, physical interferences and the location of electrical terminations on equipment.
  - 3. The Contractor shall examine the structural and mechanical plans and shop drawings for the various equipment to determine exact routing and final terminations for all raceways and cables. Conduits shall be stubbed up as near as possible to equipment terminals and shall be within the concrete base for the equipment or a separate concrete curb.
  - 4. All conduit and equipment shall be installed in such a manner as to avoid all obstructions and to preserve head room and keep openings and passageways clear. Lighting fixtures, switches, convenience outlets, and similar items shall be located within finished rooms, as shown. Where the Drawings do not indicate exact locations, the Contractor shall submit proposed locations to the Engineer for review. Where equipment is installed without instruction and must be moved, it shall be moved without additional cost to the .
  - 5. All work, including installation, connection, calibration, testing, and adjustment, shall be accomplished by qualified, experienced personnel working under continuous, competent supervision. The completed installation shall display competent work, reflecting adherence to prevailing industrial standards and methods.
  - 6. Allowance has been made in the design for the number of raceways, cables and conductors considered adequate for feeding the various drives and equipment. These circuits and diagrams are based on available data pertaining to the particular design of equipment and portray the systems, which the has chosen to effect the required operation and level of control. Equipment provided by the Contractor (even though of the make and model specified) may differ in detail, arrangement, or connections from that shown. If the Contractor uses

equipment which differs from the equipment shown in major aspects and requires modifications to power, control or other electrical service, the 's acceptance of the equipment will be based upon the Contractor providing the modifications required, and they shall be of the same quality as shown and shall be provided at no additional cost to the .

- 7. Protection of Equipment and Materials: The Contractor shall provide adequate means for and shall fully protect all finished parts of the materials and equipment against damage from any cause during the progress of the work and until acceptable by the Engineer and the Inspector.
- 8. All materials and equipment, both in storage and during construction, shall be covered in such a manner that no finished surfaces will be damaged, marred, or splattered with water, foam, plaster, or paint. All moving parts shall be kept clean and dry.
- 9. The Contractor shall replace or have refinished by the manufacturer, all damaged materials or equipment, including face plates of panels and switchboard sections, at no expense to the .
- 10. Tests: The Contractor shall make all tests required by the Engineer or the Inspector or other authorities having jurisdictions as per applicable standards. All such tests shall be performed in the presence of the Engineer or the Inspector. The Contractor shall furnish all necessary testing equipment and pay all costs of tests, including all replacement parts and labor necessary due to damage resulting from damaged equipment or from test and correction of faulty installation. Operational testing shall be performed on all equipment furnished and/or connected in other Sections of Division 16. Electrical and all other divisions specifying electrical items including furnishing of support labor for testing.
- 11. Standard test reports for mass-produced equipment shall be submitted along with the shop drawing for such equipment. Test reports on testing specifically required for individual pieces of equipment shall be submitted to the Engineer and the Inspector for review prior to final acceptance of the project.
- 12. Any test failure shall be corrected in a manner satisfactory to the Engineer and Inspector.
- 13. The Contractor shall furnish without extra charge any additional material and labor which may be required for compliance with these laws, rules, and regulations, even though the work is not mentioned in these particular specifications or shown on the drawings.
- 14. The Contractor shall apply and pay for all permits required by any of the legally constituted public authorities for the installation or construction of the work included under this Division. The Contractor shall arrange and pay for any inspections or examinations so required and deliver certificates of all such inspections to the City's Representative. When these specifications call for materials or construction of a better quality or larger sizes than required by the above mentioned rules and regulations, the provisions of the specifications shall take precedence.
- B. Operating Requirements:
  - 1. Permits: The Contractor shall pay for permits, inspections and other costs incidental to providing electrical installations.
  - 2. Contractor's Record Drawings: The Contractor shall maintain a neatly marked set of record drawings showing the installed location and routing of conduits, trays, cables, junction boxes, pull boxes, outlets, and interconnection circuits, etc., and the current status of control circuits as reflected on the control diagrams to the satisfaction of the Engineer
  - 3. Inspection: The Contractor shall cooperate with the Engineer and shall provide assistance at all times for the inspection of the electrical work performed under this contract. The Contractor shall remove covers, operate machinery, or perform any reasonable work which, in the opinion of the Engineer, is necessary to determine the quality and adequacy of the work.
- C. Quality of Materials

- 1. All electrical materials used on this project shall be new and free from defects.
- 2. All electrical materials used on this project shall conform where applicable, to the following standards, unless otherwise noted:
  - a. NEMA National Electrical Manufacturers Association
  - b. ANSI American National Standards Institute
  - c. UL Underwriters Laboratories, Inc
- 3. Each type of material shall be of the same manufacturer and quality throughout the work.

### 1.06 Delivery, Storage, and Handling

- A. Throughout this Contract, provide protection for materials and equipment against loss or damage in accordance with provisions elsewhere in these Contract Documents. Throughout this Contract, follow manufacturer's recommendations for storage. Protect everything from the effects of weather. Prior to installation, store items in indoor locations that are clean and dry. Items subject to corrosion under damp conditions, and items containing electrical insulation, such as transformers, conductors, motors, and controls store in clean, dry, indoor, heated locations. Energize all space heaters furnished with equipment. Provide temporary heating, sufficient to prevent condensation, in transformers, switchgear, switchboards, motors, and motor control centers which do not bare space heaters.
- B. Shipment: The major equipment items listed in this provision and furnished under this contract shall be shipped in sealed, weather-tight, enclosed conveyances in a manner designed to protect the equipment against damaging stresses during transport.
- C. Inspection
  - 1. The Contractor shall cooperate with the Engineer and shall provide assistance at all times for the inspection of the electrical work. Remove covers, operate machinery, or perform any reasonable work which, in the opinion of the Engineer, will be necessary to determine the quality or adequacy of the work.
  - 2. If any material does not conform to these specifications the Contractor shall, within three days after being notified by the Engineer, remove the materials from the premises.
  - 3. Work shall not be closed in or covered before inspection and approval by the Engineer. Cost of uncovering and making repairs where un-inspected work has been closed in shall be borne by the Contractor.
- D. Supervision and Workmanship
  - 1. The Contractor shall employ a competent electrical foreman with good English communication skills on the job throughout the entire period of construction to see that his work is carried on without delay and completed as rapidly as possible.
- E. Cooperative Work with Others
  - 1. The Contractor shall cooperate with others, with due regard to their work, towards promotion of rapid completion of project. If any cooperative work must be altered due to lack of proper supervision of such, or failure to make proper provision in time by Contractor, then he shall bear expense of such changes as necessary to be made in work of others.
  - 2. Labor and materials, including templates, sleeves, anchors, concrete inserts and the like shall be furnished in ample quantities at such times as necessary to ensure uninterrupted progress of work.

- 3. Contractor shall cease work at any particular point temporarily and transfer his operations to such points or execute such portions of work as directed, when in the judgment of the Engineer it is necessary to do so.
- F. Cleanup
  - 1. In addition to the requirements of Special Provisions, in all parts of the materials and equipment shall be thoroughly cleaned. Exposed parts shall be thoroughly clean of cement, plaster, and other materials. All oil and grease spots shall be removed with a non-flammable cleaning solvent. Such surfaces shall be carefully wiped and all cracks and corners scraped out.
  - 2. During the progress of the work, the Contractor shall clean the premises and shall leave the premises and all portions of the site free of debris

### 1.07 **Project/Site Conditions**

- A. General: For purposes of delineating electrical enclosure and electrical installation requirements of this project, certain areas have been classified in the Contract Documents as defined below. Electrical installations within these areas shall conform to the referenced code requirements for the area involved.
- B. Seismic Consideration
  - 1. All structures shall be designed in accordance with the requirements for Site Class D in accordance with Section 1613.3.2 of the 2013 CBC and Table 20.3-1 of ASCE 7-10.
  - 2. Before any concrete pours associated with electrical equipment anchoring can begin, seismic calculations and submittals shall be approved by the Engineer.
  - 3. Each piece of equipment installed shall be anchored as required for Site Class D in accordance with Section 1613.3.2 of the 2013 CBC and Table 20.3-1 of ASCE 7-10. No equipment shall be anchored to vertical structural elements without written approval of the Engineer. Vibration isolated equipment shall be provided with snubbers capable of retaining the equipment in its designated location without any material failure or deformation of the snubbers when exposed to a vertical or horizontal force at the contact surface equal to 100 percent of the operating weight of the equipment. Air gaps between retainer and equipment base shall not exceed 1/4 inch.
  - 4. Vibration isolated equipment shall be provided with snubbers capable of retaining the equipment in its designated location without any material failure or deformation of the snubbers when exposed to a vertical or horizontal force at the contact surface equal to 100 percent of the operating weight of the equipment. Air gaps between retainer and equipment base shall not exceed 1/4 inch.
  - 5. All raceways, ductwork, accessories, and appurtenances, furnished with equipment shall be anchored to resist a lateral seismic force of 40 percent of its operating weight without excessive deflection. This force shall be considered acting at the center of gravity of the piece under consideration.
  - 6. Calculations and shop drawings shall be submitted for all anchorage details. All calculations shall be made and signed by a registered engineer in California. In as much as all anchorage of equipment is to be made of cast-in-place concrete elements, it is imperative that types of anchorage be coordinated with the concrete contractor so that anchorage may be installed at the time of concrete placement. If calculations and anchorage details are not submitted prior to placement of the concrete, the Contractor shall be responsible for any strengthening of concrete elements because of superimposed seismic loading.
- C. Unclassified Field Locations

- Field equipment located in interior areas which have not been classified as hazardous locations as defined by the National Electrical Code, Article 500, may be subjected to ambient temperatures varying from 10 degrees F and 115 degrees F and relative humidity ranging from 10 to 90 percent. Incidental quantities of hydrogen sulfide gas and dust also may be present.
- 2. In exterior areas, ambient temperatures may vary from 10 degrees F and 115 degrees F with strong direct radiation from the sun. Relative humidity in all exterior field areas will vary from 10 to 100 percent with condensation and icing occurring. All areas may have trace quantities of hydrogen sulfide gas with wind blown dust, sand, hail, and rain occurring.
- 3. In exterior locations, exposed conduits shall be PVC coated Rigid Steel entrances shall be threaded; and fittings shall have gasketed covers. Provisions shall be made to drain the fitting or conduit system. Threaded fastening hardware shall be stainless steel. Mounting brackets shall be galvanized. Attachments or welded assemblies shall be galvanized after fabrication. Instruments and control cabinets, panels, switchboards and motor control centers shall be "Weatherproof NEMA Type 3R." Enclosures shall be mounted 1/4-inch from walls to provide an air space, unless specifically shown otherwise.
- D. Damp Location: Locations which are indoors and 2 feet below grade elevation or which are classified as damp locations on the Drawings shall have electrical installations which conform to the requirements for outdoor locations; except, that the air space from walls may be less than 1/4-inch and enclosures shall be NEMA Type 2. "Damp locations" shall include pipe galleries, tunnels, and basements. All rooms housing liquid handling equipment are also classified as damp locations regardless of grade elevation.
- E. Splash Locations: Areas shown as splash-proof shall have electrical installations as described for "outdoor locations"; except, that NEMA Type 4 enclosures shall be provided for instruments and controls, panels, switchboards, and motor control centers.
- F. Classified Field Locations
  - 1. Field equipment located in hazardous areas shall comply with the National Electrical Code, Article 500.
  - Hazardous Locations: Areas shown as hazardous shall have electrical installations suitable for Class 1, Division 1, Group C and D locations as required under NFPA 820 and Cal/OSHA Safety orders (Title 8, CCR). Enclosures shall be NEMA type 7.
  - 3. For this project, hazardous areas of the facility are as follows:
    - a. None designated
- G. Corrosive Locations
  - 1. Field equipment located in areas subject to ammonia, corrosive fumes, or liquid chemical spills shall utilize materials and equipment specifically for corrosive areas.
  - 2. Corrosive locations shall have stainless steel threaded hardware; all other electrical hardware, fittings, and raceway systems shall be PVC-coated. Enclosures shall be of fiberglass reinforced polyester or 316 stainless steel and meet NEMA Type 4X requirements.
- H. Electrical Equipment Enclosures
  - Remote electrical units located in electrical equipment enclosures will be subjected to environmental conditions where temperatures may vary from 10 degrees F and 115 degrees F; relative humidity may range from 10 to 100 percent; and dust and trace quantities of chlorine may be present.
  - 2. In exterior areas, ambient temperatures may vary from 10 degrees F and 115 degrees F with strong direct radiation from the sun. Relative humidity in all exterior field areas will vary from

10 to 100 percent with condensation and icing occurring. All areas may have wind blown dust, sand, hail, and rain occurring

# 1.08 Sequencing and Scheduling

A. Sequencing and scheduling plan shall be provided that minimizes station downtime. Note that the station must remain operational during all phases of construction.

# 1.09 Warranty

A. Refer to Section 17506 for requirements

### 1.10 Maintenance

A. Information to be provided:

- a. Wiring and interconnection diagrams which show terminal blocks of all distribution and control assemblies; all power, control and signal raceways; junction and pull boxes; all devices; and all interconnecting wiring. Diagrams shall show conductor tag numbers, control wire color code as applicable and power wire and cable sizes.
- b. The outgoing power and control wires shall be run as single lines representing the raceways and shall show any junction boxes or ancillary control devices that may be located in the raceway system or tapped off the raceway along the route. All raceways shall be appropriately identified showing the proposed tag inscription. Wires are to be fanned out and labeled at each point showing the terminal number of the wire and typical wire tags. For factory wired equipment, both the factory terminal numbers as well as the terminal numbers shown on the contract control diagrams shall be shown. If additional space is required, more than one sheet may be used for the connection diagram.
- c. Operation and maintenance data
- d. Maintenance manuals
- e. Installation certificates

# PART 2 - PRODUCTS

#### 2.01 Equipment and Materials

- A. All material and equipment shall be new, free from defects, of current manufacture, and of the quality specified or shown, and shall be listed by the Underwriters Laboratories Inc. (UL) for the purpose for which it is to be used where such listing has been applied by UL to similar products. Each type of material shall be of the same manufacture and quality throughout the work.
- B. Where more than one unit of the same class of material or equipment are required, provide products of a single manufacture. Component parts of materials or equipment of the same manufacturer are preferred.
- C. All electrical equipment shall be approved by a testing laboratory recognized by the City and shall conform to all applicable requirements of the latest edition of the California Building Code. In lieu of such approval, the Contractor must submit the equipment for approval to the independent NETA certified electrical testing laboratory. This shall include the plant preferred list of equipment and components specified in the plans and specifications. Contractor shall also include in his delivery schedule the approval time required by the independent NETA certified electrical testing laboratory for equipment without UL listing.

- D. Unless otherwise indicated, provide materials and equipment which are the standard products of manufacturers regularly engaged in the production of such materials and equipment. Provide the manufacturers' latest standard design that conforms to these Specifications.
- E. Equipment Finish: Provide materials and equipment with manufacturers' standard finish system, in accordance with Division 9 Finishes. Provide manufacturers' standard finish color, except where specific color is indicated. If manufacturer has no standard color, finish equipment in accordance with Division 9 Finishes with ANSI No. 61, light gray color.

# 2.02 Fabrication

- A. Corrosion Protection
  - Unless otherwise noted, all equipment and appurtenances provided under this section shall be treated with zinc phosphate, bonderized or otherwise given a rust-preventive treatment, then primed and painted with a durable enamel finish. Minimum dry film thickness shall be 3 mils. The Contractor shall ensure that all panels or enclosures specified to be painted in this section shall match in color Plymouth Rock Gray on all exterior surfaces and flat white on all interior surfaces. Nonconforming panels shall be repainted.
  - 2. Field painting of all equipment shall conform to the procedure or outline in applicable sections of the specifications that specify painting and finishing.
  - 3. Galvanizing, where specified, shall conform to the applicable division of the specifications. Galvanized equipment and appurtenances shall not be shop primed or painted but shall be field painted and touched up as specified and directed by the Engineer.
- B. Special Tools: The Contractor shall provide all special tools required for operation and maintenance of the equipment. The tools shall be considered as part of the product and become the property of the City

# 2.03 Source Quality Control

A. Hazardous Locations: Provide materials and equipment acceptable to the regulatory authority having jurisdiction for the Class, Division, and Group of hazardous area indicated.

# PART 3 - EXECUTION

# 3.01 Preparation

A. Maintain continuity of electric service to all functioning portions of the process or buildings during hours they are normally in use. Temporary outages will be permitted during cutover work at such times and places as can be prearranged with Engineer and the electric utility company providing service to the facility. Such outages shall be kept to a minimum number and minimum length of time. Make no outages without prior written authorization of the Engineer and notification of the City's Representative. Include all costs for temporary wiring and overtime work required in the Contract price. Remove all temporary wiring at the completion of the work.

# 3.02 Installation

- A. For all areas designed as hazardous areas, install all materials and equipment in a manner acceptable to the regulatory authority have jurisdiction for the Class, Division and Group of hazardous area indicated.
- B. Follow manufacturers' installation instructions explicitly, unless otherwise indicated. Wherever any conflict arises between the manufacturers' instructions, codes and regulations, and these Contract Documents, follow Engineer's decision. Keep copy of manufacturers' installation instructions on the jobsite available for review at all times.

- C. Use appropriate conduit and conductor entry fittings with enclosures which maintain the specified enclosure environmental capability after proper installation.
- D. Relocation or Removal of Materials and Equipment:
  - 1. For existing materials and equipment that are to be relocated, remove all materials no longer used such as studs, straps, conduits and wire. Where not required for used in the relocation, remove or cut off concealed or embedded conduit, boxes or other materials and equipment to a point at least 3/4-inch below the final finished surface.
  - 2. For existing materials and equipment that are to be remove, remove all materials no longer used such as studs, straps, conduits and wire. Remove or cut off concealed or embedded conduit, boxes or other materials and equipment to a point at least 3/4-inch below the final finished surface. Any equipment to be removed that is currently is working condition, shall be returned to the unless otherwise noted in the Contract Documents.
  - 3. Repair affected surfaces to conform to the type, quality, and finish of the surrounding surface in a neat and workmanlike manner. Follow any specific instructions given under Division [9], Finishes. Utilize skilled craftsmen of the trades involved.
- E. Cutting and Patching
  - Lay out work carefully in advance. Do not cut or notch any structural member or building surface without specific approval of Engineer or the Inspector. Carefully carry out any cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, paving, or other surfaces required for the installation, support, or anchorage of conduit, raceways, or other electrical materials and equipment. Following such work, restore surfaces neatly to original condition. Utilize skilled craftsmen of the trades involved.

### 3.03 Field Quality Control

- A. Each item of equipment provided as a part of this project shall be installed, aligned and tested by skilled workmen to the tolerances recommended by the equipment manufacturer. Provide work which has a neat and finished appearance. Carry out work in accordance with NECA Standard of Installation unless otherwise specified.
- B. Allow materials, equipment, and workmanship to be inspected at any time by the Engineer or the City's Representative. Correct work, materials, or equipment not in accordance with these Contract Documents or found to be deficient or defective in a manner satisfactory to the Engineer and the City's Representative.
- C. Testing and Start-Up
  - 1. General
    - a. The Contractor shall furnish all labor, materials, instruments and tools to make all connections for testing. All electric power, fuel, water, supplies, and utilities required for all tests shall be provided by the Contractor.
    - b. During checkout and startup of the various plant systems, provide a crew of skilled craftsmen to be available for checkout and troubleshooting activities as required by the ENGINEER. Since coordination with other crafts and Contractors will often be required, the craftsmen assigned to checkout must be available outside normal working hours when necessary.
    - c. All equipment shall be demonstrated as operating properly prior to the acceptance of the work.
    - d. These tests shall be made in the presence of the City's Representative and the results will be recorded by the City's Representative. All deficiencies or unsatisfactory conditions, as

determined by the City's Representative or inspecting authorities, shall be corrected by the Contractor in a satisfactory manner at the Contractor's expense.

- 2. Protective Devices: All protective devices shall be properly set and operative during the testing period. Before testing and energizing a system, all necessary precautions shall be taken to ensure the safety of personnel and equipment. All conductors and all electrical equipment shall be properly insulated and enclosed. All enclosures for conductors and equipment shall be properly grounded. Insulation resistance measurements must have been made and approved on all conductors and energized parts of electrical equipment.
- 3. Inspection of Joints: Joints and connections in conductors No. 6 AWG and larger shall be inspected by the City's Representative after the joints have been made and prior to application of any tape.
- 4. Preliminary Testing: After the visual inspection of joints and connections and the application of tape and other insulating materials, all sections of the complete system of wiring shall be thoroughly tested for shorts and grounds. The Contractor shall correct all defects.
- 5. Insulation Resistance Tests:
  - a. Wire and Cable: All wires and cables to be used as feeders, branch circuit wiring, control circuits and other wiring shall be tested with an insulation resistance tester rated 1000 volts D.C. and capable of measuring 2000 megohms. Single-conductor wires and cable shall have a resistance to ground not less than 200 megohms, and conductors of multiple-conductor cables shall have a resistance to ground not less than 100 meg-ohm. Solid state device circuits shall not be meggered directly. Solid state devices shall be disconnected prior to resistance tests.
  - b. Tests: The insulation resistance of each circuit phase-to-phase and phase-to-ground shall be measured for the following:
    - 1) Motor feeders shall be measured with the motor disconnected.
    - 2) Control circuits shall be measured with pushbuttons, interlocking relays, instruments, overcurrent devices, and the like connected.
    - 3) Lighting feeders to panelboards shall be measured with the branch circuit breakers open.
    - 4) The test shall be made with the branch breakers closed, and with receptacles and fixtures mounted, but before lamping.
    - 5) Power feeders shall be measured with switches and circuit breakers in place.
- 6. Equipment Tests
  - a. Motor Control Centers/Switchboards -The following tests shall be performed
    - 1) The main bus and all power and control circuits shall be meggered.
    - 2) The wire terminals shall be checked and the connections shall be cleaned.
    - 3) All control switches, alarm devices, and indicating instruments shall be checked for proper operation under normal and simulated abnormal conditions.
    - 4) The thermal-overload heaters and the reset mechanism for each motor shall be checked.
    - 5) The motor nameplate full-load current shall be checked as the basis for checking the heater selection.
    - 6) The thermal-overload heaters shall be in accordance with the starter manufacturer's heater tables for motor enclosure and starter enclosure.

- b. VFD Testing shall be per manufacturers requirements and by the manufacturer's representative as required by the extended warranty requirements.
- 7. Phase Rotation: The connections of all equipment shall be checked for correct phase rotation. Coordinate motor phasing checks with the Engineer's Representative and the Contractor responsible for the driven equipment. Submit a written report to the Engineer for each motor verifying that phasing has been checked and corrected.
- 8. Circuit Breakers: The following tests shall be performed:
  - a. Inspect each circuit breaker.
  - b. Check for loose connections.
  - c. Operate each circuit breaker manually.
  - d. Set the adjustable trips to the values specified.
- 9. Motor Insulation Testing: Each polyphase motor shall have its insulation resistance to ground measured with 1000 volt "Megger" prior to connection. Values of resistance of less than 100 megohms shall be cause for equipment rejection.
- 10. Thermal Overload Protective Devices
  - a. For each motor, the Contractor shall compile the following data in neatly tabulated form. Data shall be obtained from the equipment provided on the job:
    - 1) Equipment driven
    - 2) Nameplate amperes
    - 3) Service factor
    - 4) Overload device catalog number. Overload device current range and setting

### 3.04 Adjusting / Cleaning / Protection

- A. All equipment shall be located and installed so that it will be readily accessible for operation and maintenance. The reserves the right to require minor changes in location of outlets or equipment, prior to roughing in, without incurring any additional costs or charges.
- B. Throughout this Contract, provide protection for materials and equipment against loss or damage in accordance with provisions elsewhere in these Contract Documents. Throughout this Contract, follow manufacturers' recommendations for storage. Protect everything from the effects of weather. Prior to installation, store items in clean, dry, indoor locations. Store in clean, dry, indoor, heated locations items subject to corrosion under damp conditions, and items containing electrical insulation, such as transformers, conductors, motors, and controls. Provide temporary heating, sufficient to prevent condensation, in transformers, switchgear, switchboards, motors, and motor control centers which do not have space heaters.
- C. Following installation, protect materials and equipment from corrosion, physical damage, and the effects of moisture on insulation. When equipment intended for indoor installation is installed at the Contractor's convenience in areas where it is subject to dampness, moisture, dirt, or other adverse atmosphere until completion of construction, ensure that adequate protection from these atmospheres is provided that is acceptable to the Engineer and the Inspector. Cap conduit runs during construction with manufactured seals. Keep openings in boxes or equipment closed during construction. Energize all space heaters furnished with equipment.
- D. Cleaning and Touchup Painting: Keep the premises free from accumulation of waste material or rubbish. Upon completion of work, remove all materials, scraps, and debris from premises and from interior and exterior of all devices and equipment. Touch up scratches, scrapes, or chips in interior and exterior surfaces of devices and equipment with finishes matching as nearly as possible the type, color, consistency, and type of surface of the original finish. If extensive damage is done to equipment paint surfaces, refinish the entire equipment in a manner that provides a finish equal to or better than the factory finish, that meets the requirements of the Specifications, and that is acceptable to the Engineer and the Inspector.

# SECTION 16011 PROTECTIVE DEVICE COORDINATION STUDY & ARC FLASH ANALYSIS

# PART1- GENERAL

#### 1.01 Summary

- A. The System Integrator (SI) furnishing the electrical panels, or a qualified power system study engineering firm (EF) specified in Section 1.06B hereinafter contracted by the General Contractor (Contractor), shall provide the following electrical power system studies for the project:
  - 1. Arc Flash Hazard Analysis
- B. The Contractor shall be responsible for all notification, coordination and scheduling with PG&E. The Contractor shall also be responsible to ensuring that all parties involved in the studies have the necessary information and data to carry out the studies. The SI or EF shall obtain the required information and data from the Electric Utility Company (PG&E), the Engineer and the manufacturers of the equipment and materials.
- C. Upon request by the Contractor, the Engineer shall provide the PG&E's contact information to the SI or EF in a timely manner to allow the SI or EF to obtain the required information from PG&E to perform the power study.
- D. The Contactor shall be responsible for ensuring that the Arc Flash Hazard Analysis is completed by the SI or EF and approved by the ENGINEER prior to final approval of the electrical panels.
- E. If during the studies, the SI or EF finds any inadequacies in the equipment or protective devices, the SI or EF shall make recommendations for improvements as soon as they are identified.
  - 1. All electrical cabinets and disconnects must be rated Arc Flash Hazard Risk Category 2 or less.
  - 2. Any locations noted as greater than Arc Flash Hazard Risk Category 2 shall be immediately brought to ENGINEER's attention. Provide recommendation for any corrective measures that can be made to reduce the Arc Flash Hazard Risk Category to 2 or less.

#### 1.02 References

A. All work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these specifications:

<u>Reference</u>	<u>Title</u>
IEEE 141	Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
IEEE 241	Recommended Practice for Electric Power systems in Commercial Buildings
IEEE 242	Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
IEEE 399	Recommended Practice for Industrial and Commercial Power System Analysis
IEEE 1015	Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems
IEEE 1584	Guide for Performing Arc Flash Hazard Calculations
<u>Reference</u>	Title
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ANSI C57.12.00	Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
ANSI C37.13	Standard Application Guide for AC High Voltage Circuit Breakers Used in Enclosures
ANSI C37.010	Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
ANSI C37.41	Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single Pole Air Switches, Fuse Disconnecting Switches and Accessories
NFPA 70	National Electrical Code, Latest Edition
NFPA 70E	Standard for Electrical Safety in the Workplace

#### 1.03 Definitions

- A. Arc Flash Boundary: The distance from exposed live parts within which a person could receive a 2nd degree burn.
- B. Bus Bolted Fault Current (kA): The current flowing to a bus fault that occurs between two or more conductors or bus bars, where the impedance between the conductors is zero.
- C. **Bus Name:** Fault location for bus report. For line side and load side report options the bus refers to the equipment where the line side and load side protective devices are connected.
- D. **Breaker Opening Time:** The time required for a breaker to open after receiving a signal from the trip unit to operate. The combination of the Trip/Delay time and the Breaker Opening time determines the total time required to clear the fault. For low voltage circuit breakers, the total clearing time displayed on the Manufacturer's drawing is assumed to include the breaker opening time.
- E. **Equipment Type:** Indicates whether the equipment is Switchgear, Panel, Cable or Open Air. The equipment type provides a default Gap value and a distance exponent used in the IEEE incident energy equations.
- F. Gap: Defines the spacing between bus bars or conductors at the arc location.
- G. **Ground:** Indicates whether the fault location includes a path to ground. Systems with high-resistance grounds are assumed to be ungrounded in the Arc Flash calculations.
- H. Incident Energy: The amount of energy on a surface at a specific distance from a flash.
- I. **Protective Device Arcing Fault Current (kA):** The current flowing through each protective device feeding the electric arc fault. Note that the total arc fault current may flow through several parallel sources to the arc location.
- J. **Protective Device Bolted Fault Current (kA):** The portion of the total bolted fault current that flows through a given protective device.

- K. **Protective Device Name:** Refers to the protective device that clears the arcing fault or portion of the total arcing fault current.
- L. **Required Protective FR Clothing Class (PPE):** Indicates the Personal Protective Equipment (PPE) required to prevent an incurable burn at the working distance during an arcing fault.
- M. **Trip / Delay Time:** The time required for the protective device to operate for the given fault condition. In the case of a relay, the breaker opening time is entered separately from the relay trip time. For low voltage breakers and fuses, the trip time is assumed to be the total clearing curve or high tolerance of the published trip curve.
- N. Working Distance: The distance between the arc source and the worker's face or chest.

## 1.04 System Description

A. The scope of the studies shall include all new electrical equipment and generator supplied by the Contactor under this Contract.

## 1.05 Submittals

- A. Submit a report in PDF format for review by the Engineer. The report shall include the following as further described in Part 3.
  - 1. Summary of the results of the short circuit and the protective device evaluation and coordination studies as required by Arc Flash Hazards Analysis
  - 2. Description, purpose, basis and scope of the study
  - 3. Single line diagram on 11x17 generated by the selected computer program with node identification
  - 4. Tabulations of electrical capacities and characteristics of the equipment and protective devices
  - 5. Table comparing the calculated short circuit and the equipment ratings
  - 6. Coordination curves showing the proposed settings with the characteristics of the equipment and protective devices shown graphically on industry standard graph paper
- B. Submit a subsequent report for review by the Engineer. The report shall include the following as further described in Part 3.
  - 1. Engineer Comments from the preliminary submittal shall be incorporated in the following documents.
    - a. Summary of the results of the short circuit and the protective device evaluation and coordination studies as required by Arc Flash Hazards Analysis.
    - b. Description, purpose, basis and scope of the study
    - c. Single line diagram generated by the selected computer program with node identification
    - d. Tabulations of electrical capacities and characteristics of the equipment and protective devices
    - e. Table comparing the calculated short circuit and the equipment ratings
    - f. Coordination curves showing the proposed settings with the characteristics of the equipment and protective devices shown graphically on industry standard graph paper
  - 2. Arc Flash Hazard Analysis to include computed incident energy levels and flash protection boundary distances.

- C. Submit study report within 30 days after shop drawings have been returned for the electrical panels. These shop drawings may have / may have not been approved by the ENGINEER.
- D. Submit subsequent study report based on the APPROVED shop drawings for the electrical panels. It may be necessary to modify the design of the electrical panels based on the recommendations included in the Final study report.
- E. The electrical panels shall not be constructed until approval of the Final study report.
- F. The final version of the Arc Flash Hazard Study and Arc Flash Warning Labels shall be submitted at least 30 days prior to energizing the electrical equipment.
- G. Provide three (3) hard copies of the final power system studies, one electronic copy of the final power system studies, software modeling & library files, and one (1) set of warning labels to be affixed on the electrical panels.

#### 1.06 Quality Assurance

- A. The Contractor shall have the study prepared by SI's or EF's qualified engineer. The SI's or EF's engineer shall be a California Registered Professional Electrical Engineer who has at least five years of experience and specializes in performing power system studies.
- B. By the ENGINEER's approval, the Contractor may contract with an independent power system study engineering firm who shall demonstrate experience with Power System Studies to perform the Arc Flash Analysis. This engineering firm shall submit to the ENGINEER its qualifications and names of at least five clients who this engineering firm has performed Power System Studies in the last three years.
- C. The studies shall be performed using computer software from a single software company, SKM PowerTools for Windows, or approved equal.

## PART 2 - PRODUCTS (NOT USED)

## PART 3 - EXECUTION

#### 3.01 Preparation

- A. The SI or EF to furnish short-circuit and protective device coordination studies as required by Arc Flash Hazards Analysis shall collect all required data and information in coordination with PG&E, equipment manufacturers, Contractor, and Owner. Certain information may be available from the ENGINEER upon request by the SI or EF
- B. Contractor shall ensure that all data as required by the power system studies is furnished to the SI or EF in a timely manner. The Engineer performing the Arc Flash Hazard Analysis shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the electrical equipment shop drawings and/or prior to the release of the equipment for manufacturing.
- C. The Arc Flash Hazard Analysis shall be per NFPA 70E- Standard for Electrical Safety in the Workplace, reference Article 130.3, and Annex D

#### 3.02 Execution

#### A. Short-Circuit Analysis

1. Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standard 141-1993.

- 2. Transformer design impedances shall be used when test impedances are not available.
- 3. Calculation of the maximum rms symmetrical three-phase short-circuit current at each significant location in the electrical system shall be made using a commercially available computer program.
- 4. Appropriate motor short-circuit contribution shall be included at the appropriate locations in the system so that the computer calculated values represent the highest short-circuit current the equipment will be subjected to under fault conditions.
- 5. A tabular computer printout shall be included which lists the calculated short-circuit currents, X/R ratios, equipment short-circuit interrupting or withstand current ratings, and notes regarding the adequacy or inadequacy of the equipment.
- 6. The study shall include a computer printout of input circuit data including conductor lengths, number of conductors per phase, conductor impedance values, insulation types, transformer impedances and X/R ratios, motor contributions, and other circuit information as related to the short-circuit calculations.
- 7. The system one-line diagram shall be computer generated and will clearly identify individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location and other information pertinent to the computer analysis.
- 8. The computer printout shall identify the maximum available short-circuit current in rms symmetrical amperes and the X/R ratio of the fault current for each bus/branch calculation.
- 9. A comprehensive discussion section evaluating the adequacy or inadequacy of the equipment must be provided and include recommendations as appropriate for improvements to the system.
  - a. Evaluate equipment and protective devices and compare to short circuit ratings.
  - b. Adequacy of switchgear, automatic transfer switch, enclosed circuit breaker, motor control center and panelboard bus bars to withstand short-circuit stresses.
  - c. Notify Engineer in writing, of circuit protective devices improperly rated for the calculated available fault current.
- B. Protective Device Time-Current Coordination Analysis
  - 1. Perform a protective device coordination study to select fuse ratings, ratios and characteristics of associated voltage and current transformers, breaker trip characteristics and settings. Include all voltage classes of equipment from the utilities incoming line protective device down to and including all Main Service Breaker, Enclosed Circuit Breaker (for Stationary Generator Connection), main breakers for all motor control centers, main breakers for all control panels, and, at each motor control center provide the motor circuit breaker for each motor size that is greater than 20 HP. Include a description, purpose, basis, and scope of the study and a single line diagram of the portion of the power system which is included within the study. Note inadequacies found during the study.
  - 2. The time-current coordination analysis shall be performed with the aid of a commercially available computer program. It shall include the determination of settings, ratings, or types for the protective devices supplied.
  - 3. Where necessary, an appropriate compromise shall be made between system protection and service continuity with system protection and service continuity considered to be of equal importance.

- 4. A sufficient number of computer generated log-log plots shall be provided to indicate the degree of system protection and coordination by displaying the time-current characteristics of series connected overcurrent devices and other pertinent system parameters.
- 5. Provide time-current curves graphically indicating the coordination proposed for the system, centered on conventional, full size log-log forms. Include with each curve sheet a complete title and one line diagram with legend identifying the specific portion of the system covered by that particular curve sheet. Include a detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics. Include the following on the curve sheets, where applicable:
  - a. Power Company relay and fuse characteristics
  - b. Low-voltage equipment circuit breaker trip device characteristics
  - c. Low-voltage fuse characteristics
  - d. Pertinent transformer characteristics
  - e. Pertinent motor and generator characteristics
  - f. Characteristics of other system load protective devices
  - g. Show transformer full load and 150%, 400%, or 600% currents, transformer magnetizing inrush, ANSI transformer withstand parameters, and symmetrical and asymmetrical fault currents at each switchgear and panelboard
  - h. Motor overload characteristics
  - i. Conductor damage curves
- 6. Include with the report the manufacturer's time-current curves for all protective devices.
- 7. Computer printouts shall accompany the log-log plots and will contain descriptions for each of the devices shown, settings of the adjustable devices, the short-circuit current availability at the device location when known, and device identification numbers to aid in locating the devices on the log-log plots and the system one-line diagram.
- 8. The study shall include a separate, tabular computer printout containing the suggested device settings of all overcurrent protective devices, the equipment where the device is located, and the device number corresponding to the device on the system one-line diagram.
- 9. A computer generated system one-line diagram shall be provided which clearly identifies individual equipment buses, bus numbers, device identification numbers and the maximum available short-circuit current at each bus when known.
- 10. A discussion section which evaluates the degree of system protection and service continuity with overcurrent devices, along with recommendations as required for increasing system protection or device coordination.
- 11. Significant deficiencies in protection and/or coordination shall be called to the attention of the engineer and recommendations made for improvements as soon as they are identified. Report shall also include suggestions to:
  - a. Improve coordination between upstream and downstream devices
  - b. Reduce fault current clearing times of upstream devices
  - c. Identify equipment protection boundary and inrush current conflicts
- C. Arc Flash Hazard Analysis
  - 1. Per NEC 110.16, perform an arc-flash analysis according to IEEE Standard 1584, "IEEE Guide for Performing Arc Flash Hazard Calculations," based upon results from the short circuit current

analysis and optimized overcurrent protective device settings provided in the overcurrent protective device coordination study. Determine the following:

- a. Flash Hazard Protection Boundary
- b. Limited Approach Boundary
- c. Restricted Boundary
- d. Incident Energy Level
- e. Required Personal Protective Equipment Class
- f. Type of Fire Rated Clothing
- 2. The arc flash hazard study shall include the electrical distribution system equipment shown on the single line diagrams of the contract documents. The arc flash hazard study shall be used in conjunction with the approved short circuit and protective device coordination studies. The results of the power system studies shall be present in a report format that includes the following sections:
  - a. Introduction, executive summary and recommendations, assumptions, reduced copy of the single line diagram
  - b. Arc Flash Evaluations Summary Spreadsheet
  - c. Bus Details Sheets
  - d. Arc Flash Warning Labels printed in color on adhesive backed labels
- 3. A detailed arc-flash hazard analysis report with computed incident energy levels (Calories per square inches) and flash protection boundary distances at equipment indicated above to insure adequate protection and safety of personnel working in the vicinity of electrical equipment.
- 4. Arc Flash Hazard warning stickers, sized a minimum of 3.5" x 5" with the seven items listed in paragraph A above shall be located so as to be clearly visible to qualified persons on the existing and new electrical equipment including switchboards, motor control centers, power distribution panels, and panelboards. The labels shall include the bus name; upstream Protective Device Name, Type and Settings; bus line to line voltage and printed in color on adhesive backed Avery Labels.
  - a. For each 600, 480, 240, and applicable 208 volt panelboard, one arc flash label shall be provided
  - b. For each low voltage switchboard section and drives, one arc flash label shall be provided

#### 3.03 Implementation

- A. General: Analyze the short circuit, protective device coordination, and arc flash calculations and highlight any equipment that is determined to be underrated or causes an abnormally high incident energy calculation. Propose approaches to reduce the energy levels Proposed major corrective modification will be taken under advisement by the Engineer, and the Contractor will be given further instructions.
- B. Adjust relay and protective device settings according to the recommended settings table provided by the coordination study.
- C. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
- D. Notify Engineer in writing of any required major equipment modifications.
- E. Arc Flash Training: The SI or EF shall train the Owner's qualified electrical personnel of the potential Arc Flash Hazards and Shock Hazards associated with working on energized equipment (minimum of 4 hours). The training shall be certified for continuing education units (CEUs) by the International Association for Continuing Education Training (IACET) or equivalent.

# SECTION 16030 ELECTRICAL TESTS

#### PART1- GENERAL

#### 1.01 Summary

- A. This Section specifies the work necessary to test, commission and demonstrate that the electrical work satisfies the criteria of these Specifications and functions as required by the Contract Documents.
- B. The work of this Section includes furnishing the labor, equipment and power required to support the testing specified in other Divisions of these Specifications. Electrical testing specified herein, and functional testing of all power and controls not tested under Division 17, Instrumentation and Control shall be completed before commencement of plant start-up. This scope may require the Contractor to activate circuits, shutdown circuits, and run equipment, make electrical measurements, replace blown fuses, install temporary jumpers, etc.

#### 1.02 References

A. NETA Latest Edition

#### 1.03 Submittals

A. Test procedures, test data and test reports upon completion of each phase of testing.

#### 1.04 Quality Assurance

- A. The following test requirements are intended to supplement test and acceptance criteria that may be stated elsewhere.
  - 1. Lighting:
    - a. Switching, including remote control, as shown.
    - b. Circuitry is in accordance with panel schedules.
    - c. Lighting fixtures located to minimize obstruction of illumination by mechanical equipment or building structural elements.
  - 2. Power Metering:
    - a. Demonstrate that voltmeter and ammeter switches are functional.
    - b. Demonstrate that meters are within catalog accuracy as installed with specific reference to kilowatt meters.
    - c. Demonstrate that meters are properly programmed to display all parameters.
  - 3. Demonstrate mechanical and/or electrical interlocking by attempting to subvert the intended sequence.
  - 4. Activate ground fault tripping by operating test features provided with ground current protective systems and by injecting a known, and reasonable, current in the ground current sensor circuit. In general, ground fault tripping should occur at a ground current equivalent to 20 percent of phase current. Current injection is not required of circuit 400 amperes or less.
  - 5. Cable Testing:
    - a. Cables for 480-volt circuits shall be tested for insulation resistance applying 1000-volt DC to the cables.

- b. Cables shall be tested phase-to-phase and phase-to-ground for all phases.
- c. Testing shall be done before the cables are terminated.
- d. Test results shall be submitted for review 30 days prior to plant operation and any system testing. Equipment which may be damaged during this test shall be disconnected.
- e. Perform tests with all other equipment connected to the circuit. In order to be acceptable, the cable must withstand the test high voltage without breakdown, have steady or decreasing leakage current during the high potential test, and have satisfactory comparable megger readings in each megger test.
- f. Test results shall be submitted to the engineer and shall state equipment used and time of test
- g. Cable testing and report submittal shall be performed by an organization sanctioned by the Manufacturer of the cable to be tested.
- h. Testing shall verify the quality of cable terminations
- 6. Test ground fault interrupter (GFI) receptacles and circuit breakers for proper operation by methods sanctioned by the receptacle Manufacturer.
- 7. A functional test and check of all electrical components is required prior to performing subsystem testing and commissioning. Components and equipment shall be cleaned as required by other provisions of these Specifications before commencement of functional testing. Functional testing shall comprise:
  - a. Visual and physical check of cables, buss work, circuit breakers, transformers, and connections associated with all new and modified equipment.
  - b. Setting of protective relays in conformance with results of the Protective Devices Coordination Study and testing of relays to assure that relays will operate at the current value and time required by the Study.
  - c. Circuit breakers which are specified with adjustable time or pick-up settings for ground current, instantaneous overcurrent, short-time overcurrent, or longtime overcurrent, shall be field adjusted by a representative of the circuit breaker Manufacturer. Time and pickup setting shall correspond to the recommendations of the Protective Devices Coordination Study. Setting shall be tabulated and proven for each circuit breaker in its installed position; test results shall be certified by the tester and transmitted to the Engineer (7 copies).
- 8. Complete ground testing of all grounding electrodes and grid prior to testing the equipment.
- B. Subsystem testing shall occur after the proper operation of alarm and status contacts has been demonstrated or otherwise accepted by the Engineer and after process control devices have been adjusted as accurately as possible. It is intended that the Contractor will adjust limit switches and level switches to their operating points prior to testing and will set pressure switches, flow switches, and timing relays as dictated by operating results.
- C. After initial settings have been completed, each subsystem shall be operated in the manual mode and it shall be demonstrated that operation is in compliance with the Contract Documents. Once the manual mode of operation has been proven, automatic operation shall be demonstrated to verify such items as proper start and stop sequence of pumps, proper operation of valves, proper speed control, etc.
- D. Motor operated valves shall be tested after having been phased and tested for correct motor rotation and after travel and torque limit switches have been adjusted by a representative of the valve Manufacturer. Tests shall verify status indication, proper valve travel, and correct command control from local and remote devices.

- E. Subsystems, in the context discussed here, shall mean individual and groups of pumps, conveyor systems, chemical feeders, air conditioning units, ventilation fans, air compressors, etc.
- F. Start-up commissioning shall not be attempted until all subsystems have been found to operate satisfactorily. Start-up shall only be attempted as a function of normal plant operation in which plan process flows and levels are routine and equipment operates automatically in response to flow and level parameters shall be considered only upon receipt of a written request by the Contractor.
- G. The motor current tabulation required by Section 16011, "Short Circuit and Coordination Report", shall reflect the values occurring during start-up. The indications of all switchboard ammeters and kilowattmeters shall be recorded every half-hour during commissioning.

## PART 2 - (NOT USED)

## PART 3 - EXECUTION

#### 3.01 Field Quality Control

A. Conductors Field Test, Conductors Rated 600 Volts or Less:

- 1. Perform insulation resistance testing of all power and control circuits 600 volts and less with a 2000-volt megger.
- 2. Prepare a written test report of the results and submit to the Engineer prior to final inspection.
- 3. Minimum acceptable value for insulation resistance of cables is 1 mega-ohm.
- 4. Disconnect equipment that might be damaged by this test. Perform tests with all other equipment connected to the circuit.
- B. Conductors Field Test, Instrumentation Cables
  - 1. After instrumentation cable installation and conductor termination by the instrumentation and control supplier, perform tests witnessed by the Engineer to ensure that instrumentation cable shields are isolated from ground, except at the grounding point. Remove all improper grounds.
  - 2. Test instrumentation cables applying 500VDC.
- C. Grounding, Field Tests:
  - 1. Test in the Engineer's presence the ground resistance of the grounding system. Ground resistance value shall be 5.0 ohms or less.
  - 2. Test all ground fault interrupter (GFI) receptacles and circuit breakers for proper connection and operation with methods and instruments prescribed by the manufacturer.
  - 3. Provide copies of reports of all grounding system tests for inclusion in Technical Manuals and for review by the Engineer.
  - 4. Provide ground resistance tests in the presence of the Engineer and submit results. Utilize a ground resistance megger "Earth" tester with a minimum resistance capacity range of 0-5000 megohms at 1000 VDC. Utilize the full potential method or the three terminal method as described by Biddle or NETA national electrical test association
- D. Motor Control, Factory Tests:
  - 1. The motor control centers and their components shall be given manufacturer's standard electrical and mechanical production tests and inspections with complete test reports; submitted to the Engineer for approval. These tests shall be conducted in conformance with

the requirements of IEEE, NEMA, UL and ANSI Standards. The results of tests shall verify that the complete motor control centers with their components comply with all performance requirements specified.

- 2. As a minimum, motor control centers and their components shall be subjected to the following tests.
  - a. All motor control centers shall be tested in accordance with NEMA ICS-2.
  - b. Production dielectric tests on motor control center assemblies shall be made at the power frequency in accordance with NEMA ICSI-109.
  - c. Motor control center performance tests shall meet the requirements of NEMA ICS 2-324.
  - d. Mechanical operation tests to assure proper functioning of components and the interchange ability of all identical components and plug-in modules within and between motor control centers.
  - e. Each motor control center shall be given factory standard inspection and tests which shall include, but not be limited to electrical continuity check, dielectric tests for each circuit and inspection for proper functioning of all components, including control protective, monitoring, metering, and alarm devices.
  - f. All system components shall be tested in accordance with the procedures and requirements of the following standards; NEMA SG-2, NEMA FU-1, NEMA ICS-2, and ANSI-C37.20.
- E. Motor Control, Field Tests:
  - 1. Functional Test: Prior to plant startup, all equipment shall be inspected for proper alignment, proper connection, proper operation of control and instrumentation, proper rotation, and satisfactory starting operation of the indicated motor.
    - a. Test all starters for proper contactor action, proper interlocks and permissives operation, and proper indication prior to applying power to motor.
    - b. Approval of Engineer prior to energizing motors is required;
  - 2. All functional and field tests are required to be performed in the presence of the Engineer or City Representative.
- F. Transformers, Field Tests
  - 1. The transformer manufacturer shall provide an authorized service representative for field installation, testing, and start-up assistance and for the instruction of City operation personnel in the proper operation, service, and maintenance of the transformers, in accordance with MANUFACTURER'S FIELD SERVICES of the General Requirements. The manufacturer's representative shall certify in writing to the Engineer that the equipment has been correctly installed and shall submit certified copies of the field test results. No equipment is to be energized until testing has been completed to the satisfaction of the Engineer. The following minimum tests and checks shall be made before the transformers are energized:
    - a. Insulation resistance tests shall be performed between each winding to every other winding, and to ground.
    - b. Insulating oil shall be sampled. Sample shall be laboratory tested for:
      - 1) Moisture Content
      - 2) Dielectric strength
      - 3) Acid neutralization
      - 4) Interfacial tension

- 5) Color
- 6) Power Factor
- 7) Moisture Content
- c. Test Values
  - 1) Absorption test polarization index shall be above 2.0 unless an extremely high value is obtained at the end of one minute, that when doubled will not yield a meaningful value with the available test equipment
  - 2) Turns ratio test result shall not deviate more that one-half of one percent (0.5%) from calculated ratio
  - 3) Pattern of exciting-current test data; two similar current readings for outside phases and a lower current reading for the center of a three-phase unit
  - 4) Care must be taken to avoid the influence of residual magnetism on test data. (Sources include impulse and winding resistance tests)
  - 5) Dielectric fluid shall comply with the following:
    - a) Dielectric breakdown (ASTM D 877)
    - b) Neutralization number (ASTM D 974)
    - c) Interfacial tension (ASTM D 971)
    - d) Color (ASTM D 1500) 1.0 maximum
    - e) PPM Water (refer to vendor's specifications
    - f) Power factor at 25<sup>°</sup> 0.1 percent maximum
  - 6) Winding resistance test results shall compare within 1% of the design value
  - 7) AC high-potential test voltage shall not exceed 75% of the factory test voltage for a one minute duration. Evaluation shall be on a go/no-go basis, per ANSI C57.98.
  - 8) Impedance test results shall be within <u>+</u>7.5% of design value for 2-winding transformers
- G. Surge Arrestors
  - 1. The manufacturer shall provide copies of design test data on the arrester provided showing that the arrestors are in compliance with: IEEE C62.2 Guide for application of Gapped Silicon Carbide Surge Arrestors for AC systems.
    - a. IEEE C62.11 Standard for Metal Oxide Surge Arrestors for AC Power Circuits
    - b. IEEE CC2.22 Guide for Application of Metal Oxide Surge Arrestors for AC Systems
  - 2. The following tests shall be made on each arrester in conformance with ANSI 62.1:
    - a. Power frequency spark over
    - b. Radio influence voltage
    - c. Sealing
  - 3. The design test data and the individual arrester test results shall be certified and submitted.
- H. Uninterruptible Power System, Factory Tests
  - 1. The UPS shall be tested in accordance with the following test procedures. A test report showing that the equipment has passed the factory tests and has demonstrated the capability to support the load, as required by this specification, shall be available promptly after

completion of the tests. A test battery shall be available for assuring proper operation of the UPS with a battery.

- 2. System Log: Establish a log to record all tests performed and results, and record any failures and corrections made during test, should any occur
- 3. Visual Inspection:
  - a. Check for all Quality Assurance Stamps
  - b. Inspect Interior
- 4. Dielectric Tests:
  - a. Check for charger shorts
  - b. Check for dc shorts
- 5. Efficiency Test: Measure module efficiency by dividing inverter output power by the charger input power with a fully charged battery connected and float charger. Verify compliance with specifications under the following loads:
  - a. Half load, 1.0 power factor
  - b. Full load, 1.0 power factor
- I. Uninterruptible Power System, Field Tests
  - 1. Demonstrate that upon finish of initial charge, that individual cells, or monoblocks (each individual battery), are within the manufacturer's specifications
  - 2. Demonstrate that the DC bus is supplying voltage within manufacturer's specifications and is compatible with battery manufacturer's specifications
  - 3. Demonstrate the external bypass switch removes the UPS from the system without dropping out any loads
  - 4. Same as #3 above with the internal bypass switch
  - 5. Demonstrate the UPS will remain on line under full load conditions without tripping to static bypass
  - 6. Demonstrate, upon removal of AC input power, the UPS will power all UPS loads automatically, without interruption
  - 7. Measure the run time of the UPS, with loss of AC input power, under full rated load conditions until lower battery limit is reached. This time shall comply with battery size and rating. If connected load is less than UPS full rated load contractor shall provide external loads.
- J. Standby Engine Generator Set, Factory Test
  - 1. The engine generator unit shall be tested at the manufacturer's plant before shipment. The test shall consist of a steady load run of at least 60 minutes duration at 100 percent full-rated load. Complete test reports shall be made which shall show the engine fuel consumption and kW output. Test results shall be reviewed by the Engineer prior to shipment.
- K. Standby Engine Generator Set, Field Test
  - 1. Upon completion of the engine installation, running tests shall be carried out. The engine shall be operated for a period of not less than 2 hours and all necessary adjustments made by a factory representative of the engine manufacturer. The test shall demonstrate the ability of the engine generator to carry the specified loads. Upon completion of the tests, final adjustments shall be made to the equipment, fuel and oil filters shall be replaced, belt drive tensions checked, and the proper operation of all equipment demonstrated to the Engineer. The Engineer shall be instructed in the maintenance and operation of the equipment.

- 2. Load starting capability: The engine shall be able to start out under 1/2; 3/4 and full load
- 3. The engine shall maintain voltage and frequency regulation during starting of ½: 3/4 and full load
- 4. Automatic starting feature upon loss of regular source of power
- L. Standby Power System Transfer Switch, Factory Test
  - 1. Alarm and Status indicating devices shall be factory checked for proper operation.
- M. Standby Power System Transfer Switch, Field Test
  - 1. Protective and control relays shall be Field Calibrated and Tested based on set values of the Coordination Study at the stand by system and or manufacturers recommendation
  - 2. Alarms and status indicating services shall be field checked for proper operation. Instrumentation loops shall be field checked-calibrated as indicated in Instrumentation section.

## 3.02 ELECTRIC MOTORS

A. Tests shall be performed as per ANSI/IEEE standard 112-1978 "IEEE Standard Test Procedure for poly phase Instruction Motors and Generates".

## 3.03 ADJUSTABLE FREQUENCY DRIVES

- A. A warning nameplate shall be provided on each drive to warn the operator to trip the circuit breaker prior to performing any maintenance.
- B. Testing: The drive manufacturer shall conduct all standard test in accordance with NEMA and ANSI standards to ensure conformance to specification requirements. All power switching components shall be prerun under temperature and load conditions.
- C. Factory Testing: After the system has been assembled at the drive manufacturer's facility, a system test shall be performed before the drive package is shipped to the manufacturer of the driven equipment. The system test shall be not less than 24 hours in duration. The drive package shall be free of faults following the test.
  - 1. The complete drive system, including all peripherals, shall be factory tested under simulated operating conditions. Normal operating sequences and fault conditions shall be simulated during the testing. Contact closure inputs and simulated driven-outputs shall be connected to the system input/output modules.
  - 2. A test report summary, indicating satisfactory final test results, shall be submitted to the Engineer prior to shipment of the equipment.
- D. Secondary Factory Testing: The drive manufacturer shall provide the services of a qualified representative to work with the equipment manufacturer at the equipment manufacturer's facility to advise and assist in assembly of the equipment and drive unit packages and the performance of the specified tests.
  - 1. Personnel conducting the tests shall be competent authorized representatives of the equipment and drive unit packages and the performance of the specified tests.
  - 2. Personnel conducting the tests shall be competent authorized representatives of the equipment and drive manufacturers who are familiar with operation of the equipment furnished and who have previous satisfactory experience in conducting similar tests.
  - 3. Qualified personnel shall perform the tests, record the data, make the required calculations, and prepare a report on the results; five copies of the report shall be submitted to the Engineer. The Engineer may observe the tests and collect a copy of the recorded data. The

information collected will be used as a basis for determining acceptability of the manufacturer's results. In case of conflict, interpretations and calculations made by the Engineer will govern.

- 4. Testing shall be performed in a manner acceptable to the Engineer. At least 2 weeks prior to the proposed testing date, the Contractor shall notify the Engineer of the testing date and shall submit a report from the equipment manufacturer detaining the proposed performance testing.
- E. Field Acceptance Testing: After installation of the system at the site of the work and checkout by the drive manufacturer, a field acceptance test shall be performed by the drive manufacturer in conjunction with the manufacturer of the driven equipment.
  - 1. The field acceptance test shall consist of a repeat of the factory testing procedure and an additional 5 days of similar testing during which the system shall run continuously without loss of basic functions.
  - 2. Functional tests shall demonstrate satisfactory operation to all interlocks, alarms, and normal operation sequences.
  - 3. The supplier shall use suitable test equipment to locate the source of trouble or malfunction.
  - 4. Failure of redundant equipment will not be considered as downtime, provided automatic fail over occurs as specified herein and, in the opinion of the Engineer, the failure was not caused by deficiency in design or installation.
  - 5. Repeated failure of any component shall cause the acceptance test to be terminated and restarted.
- F. Harmonic Distortion Test:
  - 1. The Contractor shall provide temporary four-channel power line monitoring equipment for a period of at least 30 calendar days to graph record the harmonic line distortion for ac voltage, dc voltage, and current, and to compute individual harmonic values up to the 17th harmonic as well as total harmonic distortion (THD).
  - 2. The monitoring equipment shall include a four-channel power line monitor, temperature and humidity compensation probes, a recorder, and additional options required to compute harmonic values and THD. The equipment shall be Basic Measuring Instruments, Dranetz or equal.
  - 3. Measurements shall include phase-to phase, phase-to-neutral, neutral-to-ground, and dc power. The harmonic distortion shall be monitored at the connection point of each drive, at motor control center buses common to more than one drive, at the service entrance, and at other locations as directed by the Engineer.
  - 4. The test shall be run for the full range of drive operation as is practicable under utility and generator power. The test shall be conducted by a qualified individual acceptable to the Engineer.

# SECTION 16110 RACEWAYS, FITTINGS, AND SUPPORTS

# PART1- GENERAL

#### 1.01 Summary

- A. Scope: This section provides specifications for all raceways, wire ways, raceway supports, cable trays and concrete encased ducts.
- B. Type:
  - 1. All conduits shall be polyvinyl chloride (PVC), Schedule 40 for under concrete slabs and raceway duck banks.
  - 2. All direct buried conduits in earth shall be polyvinyl chloride (PVC), Schedule 80.
  - 3. All conduits installed exposed and non-corrosive areas shall be Galvanized Rigid Steel (GRS).
  - 4. All conduits installed in corrosive areas shall be PVC coated Rigid Steel Conduit (PVC-RSC).
  - 5. All conduits for VFD power feeders and VFD controlled motors, where VFD type cable is not used, shall be either RSC or PVC-RSC as specified above.
  - 6. All conduits for VFD power feeders and VFD controlled motors, where VFD type cable is used, shall be either PVC or PVC-RSC as specified above.

#### 1.02 References

A. All work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these specifications.

Reference	<u>Title</u>
ANSI C80.1	Electrical Rigid Steel Conduit
UL 1	Flexible Metal Conduit
UL 5	Surface Metal Raceway and Fittings
UL 6	Electrical Rigid Metal Conduit – Steel
UL 514B	Conduit, Tubing and Cable Fittings
UL 651	Schedule 40 and 80 Rigid PVC Conduit and Fittings
NEMA RNI-2005	PVC Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC-2-2003	Electrical PVC Tubing and Conduit
NEMA TC-3-2004	PVC Fittings for Use With Rigid PVC Conduit and Tubing
ANSI/UL 467	Grounding and Bonding Equipment
NEC	National Electric Code, latest edition

## 1.03 Submittals

- A. Submittals shall include the following data, drawings, and description of materials.
  - 1. Manufacturer and manufacturer's type and designations for each equipment item

- 2. List of construction material for all conduits, fittings, supports and accessories
- 3. The Contractor shall furnish copies of the manufacturer's certified test reports for the material being supplied to establish compliance with NEMA RN-1

## 1.04 Quality Assurance

- A. Performance and Design Requirements: The conduits and fittings shall be premium quality and suitable for installation in water facilities. The PVC used for Schedule 40 and 80 conduits and the PVC coating on rigid steel conduit shall be made from virgin material.
- B. Inspection: All raceway duct banks shall be inspected by the Engineer prior to backfill. The Engineer shall inspect for drainage slope, spacers, conduit condition, and joints.
- C. All equipment furnished by the Contactor shall be listed by and bear the label of Underwriters' Laboratories, (UL) or of an independent testing laboratory acceptable to the Engineer.

## 1.05 Delivery, Storage, and Handling

A. Deliver materials and equipment to project site in manufacturer's original packaging with labeling showing product name, brand, model, project name, address, and Contractor's name. Store in a location as agreeable with Site Engineer, and secure from weather or accidental damage.

# PART 2 - PRODUCTS

## 2.01 Manufacturers

A. The use of a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired only.

## 2.02 Equipment and Materials

- A. All raceways shall be as specified in Section 1.01B.
- B. Flexible metal conduit shall be employed for connections to lighting fixtures. Final raceway runs to electrical equipment on machinery requiring flexibility or that is subject to vibration shall be liquid-tight flexible metal conduit.
- C. All fittings and supports shall match the conduit types specified in Section 1.01B.
- D. Minimum size of all conduits shall be 3/4-inch.
- E. Rigid Steel Conduit
  - 1. Comply with Underwriter's Laboratories UL-6 specification, ANSI C80.1-77 and Federal specification WW-C-581E (77 APR 04) or latest revisions. Rigid steel conduit shall be zinc coated both inside and outside after fabrication by hot-dip galvanizing. The threads shall also be hot-dip galvanized.
  - 2. Use rigid steel conduit, including bushings, couplings, elbows, nipples, and other fittings, galvanized by hot-dipping, and meeting the requirements of ANSI C80.1 and ANSI C80.4, UL.
  - 3. Do not use setscrew type couplings, bushings, bends, nipples, and other fittings, unless approved by the ENGINEER. Factory bends are not permitted unless approved by the ENGINEER. Conduit bending radius shall not be less than the minimum cable bending radius of the cable to be installed.
- F. PVC Conduit:
  - 1. Nonmetallic conduit shall be high impact polyvinyl chloride (PVC), Schedule 40 or 80 as specified. The nonmetallic conduit shall be corrosion resistant. Minimum tensile strength shall

be 6000 psi, and minimum compressive strength shall be 9000 psi. The material shall have a smoke emission rate of not more than 5.1 grams/100 grams by the Arapahoe smoke chamber test.

- 2. Use rigid PVC Schedule 40 conduit, UL listed for concrete-encased and under concrete slabs.
- 3. Use rigid PVC Schedule 80 conduit, UL listed for underground direct burial for use with conductors having 90 degrees C insulation.
- 4. Use conduits, couplings, bushings, elbows, nipples, and other fittings meeting the requirements of NEMA TC 2 and TC 3, Federal Specification W-C-1094, UL, NEC, and ASTM specified tests for the intended use.
- G. PVC Coated Rigid Steel
  - PVC coated conduit shall be hot-dip galvanized including the threads. The interior and exterior surfaces shall be coated with 2 mils thick urethane. The exterior of the conduit shall be PVC coated to a minimum 40-mil thickness. The PVC coating shall be permanently bonded to the conduit. The coating shall have a minimum tensile strength of 3500 psi. The interior shall be coated with a urethane coating no more than 7 mils thick.
  - 2. A PVC coated coupling shall be furnished with each length of conduit. The PVC sleeve of the coupling shall equal the outside diameter of the coated conduit and shall extend 1-1/2 inches from each end of the coupling.
  - Prior to coating, the galvanized conduits and fittings shall be UL listed. Use PVC coated fittings with the same interior and exterior coating requirements. PVC coated fittings and sleeves shall be completely watertight to prevent moisture from penetrating the interior of the conduits and fittings.
  - 4. The PVC coating shall be resistant to ultra-violet rays when installed outdoors. The conduit and fittings shall meet all the requirements of NEMA RN-1 1989.
- H. Flexible Metal Conduit
  - 1. Flexible metal conduit shall be formed from spirally wound galvanized steel strip with successive convolutions that are securely interlocked. Minimum size of the flexible metal conduit shall be 3/4 inch. Fittings shall be of the compression type. Lengths shall not exceed 60 inches. Flexible metal tubing shall include a code size insulated green ground conductor.
- I. Flexible Metal Conduit, Liquid-Tight
  - 1. Use UL listed liquid-tight flexible metal conduit consisting of galvanized steel flexible conduit covered with an extruded PVC jacket and terminated with nylon bushings or bushings with steel or malleable iron body and insulated throat and sealing O-ring.
  - 2. Provide external grounding connector and appropriately sized grounding conductor to assure ground continuity.
  - 3. Minimum size shall match the connecting non-flexible conduit.
- J. Wireways
  - 1. All wireways and auxiliary gutters shall be JIC sectional flange oil-tight type with hinged covers. Minimum size shall be 8 inches by 8 inches unless otherwise noted. All wireways shall be painted.
  - 2. Provide outdoor, rain-tight steel-enclosed wireway and auxiliary gutter where indicated. Utilize wireways and fittings that are UL listed, and have a cover that can easily be removed. Manufacturers and types: Square D Square-Duct; General Electric Type HS; or equal.

## 2.03 Components and Accessories

- A. Fittings in Hazardous Areas: In hazardous areas, use only fittings approved for the atmosphere involved.
- B. Use cable sealing fittings forming a watertight nonslip connection to pass cords and cables into conduit. Size cable sealing fitting for the conductor OD. For conductors with OD's of ½-inch or less, provide a neoprene bushing where the conductor enters the connector. Use Crouse-Hinds CGBS, Appleton CG Series, or equal, cable sealing fittings.
- C. Fittings for Rigid Steel
  - Fittings used with rigid galvanized steel conduit shall be hot-dip galvanized. Locknuts shall be extra heavy galvanized steel for sizes through 2 inches. Locknuts larger than 2 inches shall be galvanized malleable iron. Bushings shall be galvanized malleable iron with insulating collar. Grounding bushings shall be of the locking type and shall be provided with feedthrough compression lugs for securing the ground cable. Unions shall be galvanized ferrous alloy types UNF or UNY. Thread-less fittings shall not be utilized with rigid galvanized steel conduits.
  - 2. Expansion fittings in embedded runs shall be of the watertight type and shall be provided with an internal bonding jumper. The expansion material shall be neoprene and shall allow for 3/4-inch movement in any direction.
  - 3. Use insulated throat bushings of metal with integral plastic bushings rated for 105 degrees C.
  - 4. For insulated throat bushings for rigid steel conduit, use Thomas & Betts Nylon Insulated Metallic Bushings, or O.Z. Gedney Type B, or equal.
  - 5. Use Myers Scru-Tite, or equal hubs for rigid steel conduit.
  - 6. Use conduit bodies for rigid steel conduit of metal and sized as required by the NEC (NFPA 70-2008). Use Appleton Form 35 threaded Unilets; Crouse-Hinds Mark 9 or Form 7 threaded condulets; Killark Series O Electrolets; or equal, for normal conduit bodies for rigid steel conduit. Where conduit bodies for rigid steel conduit are required to be approved for hazardous (classified) locations, use conduit bodies manufactured by Appleton, Crouse-Hinds, or Killark, or equal.
  - 7. Use only couplings for rigid steel conduit supplied by the conduit manufacturer.
  - Use Appleton Type EYF, EYM, or ESU; Crouse-Hinds Type EYS or EZS; Killark Type EY or EYS; or equal, sealing fittings for rigid steel conduit. Where condensate may collect on top of a seal, provide a drain by using Appleton Type SF Crouse-Hinds Type EYD or EZD, or equal Drain Seal.
  - 9. Use Appleton Type ECDB, Crouse-Hinds ECD, or equal drain fittings for rigid steel conduit.
- D. Fittings for PVC Conduit
  - 1. Fittings used with PVC conduits shall be of the PVC solvent-weld type and shall be of the same material as the conduit.
  - 2. Expansion fittings shall be provided as recommended by the manufacturer.
- E. Fittings for PVC Coated Rigid Steel Conduit
  - 1. Fittings with PVC coated rigid steel conduit shall be PVC coated in a manner similar to the conduit. The exterior of the fittings shall be coated with 2-mil thick urethane prior to the application of the 40-mil exterior PVC coat. Interior of the fittings shall have a 2-mil urethane finish. The fittings shall have ribbed finish to assist in the installation of fittings.
  - 2. Thread-less fittings shall not be used with PVC coated rigid steel conduit.

- 3. Bushings and ground bushings shall be as specified for rigid galvanized steel conduits.
- F. Fittings for Flexible Metal Conduit
  - 1. Fittings used with flexible metal conduit shall be compression type, cadmium-plated malleable iron body with locknut and bushing
  - 2. Where applicable, 45- and 90-degree fittings shall be used
- G. Fittings for Liquid-Tight Flexible Conduit
  - Fittings used with liquid-tight conduit shall have cadmium-plated malleable iron body and gland-nut, brass grounding ferrule threaded to engage conduit. These fittings shall also use spiral and "O" ring seals around the conduit, the box connection and insulated throat. The insulated throat connectors for liquid-tight flexible metal conduit of metal will have an integral plastic bushing rated for 105 degrees C, and of the long design type extending outside of the box or other device at least 2-inches.
  - 2. Use Thomas & Betts Super-Tite Nylon Insulated Connectors or equal
  - 3. Where applicable, 45- and 90-degree fittings shall be used
- H. Raceway Supports
  - 1. General: Raceway support systems shall be designed to provide a factor of safety of no less than five.
  - 2. Conduit Supports: Conduit supports shall be one-hole galvanized malleable iron pipe straps used with galvanized clamp backs and nesting backs where required. When used with PVC coated rigid steel conduit, the conduit supports shall be 40 mils thick PVC coated.
  - 3. Ceiling Hangers: Ceiling hangers shall be adjustable galvanized carbon steel, PVC coated 40 mils thick, pipe hangers. Straps or hangers of plumber's perforated type will not be acceptable. Hanger rods shall be 2-inch minimum galvanized all-thread rod and shall meet or exceed ASTM A193-B7 and ASME Boiler and Pressure Vessel Code specifications. Trapeze, rod type hangers shall not be loaded in excess of 700 pounds per rod. Where loading exceeds this value, rigid frames shall be provided.
  - 4. Racks: Racks shall be constructed from framing channel. Channels and all associated hardware shall be steel, hot-dip galvanized after fabrication of the channel. Field cuts shall be painted with zinc-rich paint. Channels attached directly to building surfaces shall be 14-gage minimum material 1-5/8 inches wide by 13/16 inch deep. All other channels shall be 12-gage minimum material 1-5/8 inch wide by 1-5/8 inch minimum depth. Racks shall be designed to limit defection to 1/360 of span. All exposed ends of framing channel shall be covered with manufacturer's standard plastic inserts. The racks shall be PVC coated to 40 mil thickness.
- I. Raceway Tags
  - 1. Provide permanent, nonferrous metal markers with raceway designations pressure stamped, embossed, or engraved onto the tag.
  - 2. Tags relying on adhesives or taped-on markers are not acceptable.
  - 3. Attach tags to raceways with noncorrosive wire.
- J. Warning Tape:
  - 1. Provide heavy-gauge, yellow plastic tape of 6 -inch minimum width for use in trenches containing electric circuits. Utilize tape made of material resistant to corrosive soil. Use tape with printed warning that an electric circuit is located below the tape. Manufacturers and types: ITT Blackburn Type YT or RT; Griffolyn Co. Terra-Tape; or equal

# PART 3 - EXECUTION

## 3.01 Preparation

- A. Store all products specified in this section in a dry location.
- B. Minimum Raceway Size: 3/4-inch.
- C. Preparation for pulling in conductors:
  - Do not install crushed or deformed raceways. Avoid traps in raceways where possible. Take care to prevent the lodging of plaster, concrete, dirt, or trash in raceways, boxes, fittings, and equipment during the course of construction. Make raceways entirely free of obstructions or replace them. Ream all raceways, remove burrs, and clean raceway interior before introducing conductors or pull wires.
  - 2. Immediately after installation, plug or cap all raceway ends with watertight and dust-tight seals until the time for pulling in conductors.

#### 3.02 Installation

- A. All conduits shall be as specified in Section 1.01B.
- B. Each conduit shall be identified at each end with a permanent non-corrosive metal marker. Designation shall be pressure stamped into the tag. The conduit identification shall be the designated conduit number as shown.
  - 1. Final Connection to Certain Equipment
    - a. Make final connection to motors, wall or ceiling mounted fans and unit heaters, dry type transformers, valves, local instrumentation, and other equipment where flexible connection is required to minimize vibration or where required to facilitate removal or adjustment of equipment, with 36-inch maximum length liquid-tight, PVC-jacketed, flexible steel conduit.
    - b. The flexible conduit shall be long enough to allow the item to which it is connected to be withdrawn or moved off its base. Use liquid-tight flexible metal conduit in outside areas, process areas exposed to moisture, and areas required to be oil free and dust-tight.
  - 2. Special Locations:
    - a. Use rigid steel conduit:
      - 1) Where conduit changes from underground and/or concrete embedded to exposed
      - 2) Under equipment mounting pads
      - 3) In exterior light pole foundations
- C. Location, Routing, and Grouping:
  - 1. Conceal or expose raceways as indicated. Group raceways in same area together. Locate raceways at least 12-inches away from parallel runs of heated piping for other utility systems.
  - 2. Run exposed raceways parallel or perpendicular to walls, structural members, or intersections of vertical planes to provide a neat appearance. Follow surface contours as much as possible. Conduit supports spaced not more than 8 feet apart.
  - 3. No conduit shall approach closer than 6 inches to any object operating above the rated temperature of its cable temperature.
  - 4. Conduit supported directly from the concrete structure shall be spaced out at least 1/4 inch using one-hole hot-dip galvanized malleable iron straps with nesting backs or, if three or more conduits are located in a parallel run, they shall be spaced out from the wall approximately 5/8 inch to 1 inch by means of framing channel. Runs of individual conduit suspended from the

ceiling shall be supported with galvanized wrought steel pipe hangers. Where three or more conduits are suspended from the ceiling, suitable steel racks shall be constructed subject to submittal to the Engineer for review.

- 5. Conduit rack and tray supports shall be secured to concrete walls and ceilings by means of cast-in-place anchors in accordance with the structural section of these specifications. Individual conduit supports may be similar to cast-in-place anchors, die-cast, rustproof alloy expansion shields or cast flush anchors. Wooden plugs, plastic inserts or gunpowder-driven inserts shall not be used as a base to secure conduit supports.
- 6. All conduit entering sheet steel boxes or cabinets shall be secured by locknuts on both the interior and exterior of the device and shall have an insulating bushing constructed over the conduit end. All conduit entering NEMA 12 boxes shall be terminated with a rain-tight hub having an insulated liner. All surface mounted cast boxes and plastic enclosures shall have threaded hubs. All joints shall be made with standard threaded couplings or specified unions. Metal parts of plastic control stations and coated boxes shall be bonded to the conduit system. Running threads shall not be used in lieu of conduit nipples, nor shall excessive thread be used on any conduit. The ends of all conduits shall be cut square, reamed and threaded with straight threads. Rigid steel conduit shall be made up tight and without thread compound. Male threads on rigid steel conduit shall be coated with electrically conductive zinc rich paint. Threading shall be done with dies, with the guide sleeve bored out to allow for increased diameter or the PVC coated conduit. Conduit shall be made with the next larger bend or next larger shoe bushed for proper fit.
- 7. Avoid obstruction of passageways. Run concealed raceways with a minimum of bends in the shortest practical distance considering the building construction and other systems.
- 8. In block walls, do not run raceways in the same horizontal course with reinforcing steel.
- 9. In outdoor, underground, or wet locations, use watertight couplings and connections in raceways. Install and equip boxes and fittings so as to prevent water from entering the raceway.
- 10. Paint all threads of galvanized conduits with UL approved zinc-rich paint or liquid galvanizing compound before assembling. Touch up after assembly to cover nicks or scars.
- 11. Do not notch or penetrate structural members for passage of raceways except with prior approval of the Engineer.
- 12. Do not run raceways in equipment base foundations.
- 13. Locate above ground raceways concealed in poured concrete so that the minimum concrete covering is not less than 1-1/2-inches.
- 14. Except at raceway crossings, separate raceways in slabs not less than six times the raceway outside diameter
- 15. Raceways installed under slab floors shall lie completely under the slab with no part of the horizontal run of the raceway embedded within the slab.
- 16. Install concealed, embedded, and buried raceways so that they emerge at right angles to the surface. Provide support during pouring of concrete to ensure that raceways remain in position.
- 17. Allow a minimum of 7 feet headroom for conduit passing over walkways.
- 18. Communication and instrumentation conduits crossing power circuits shall be separated from such circuits by the minimum distance stipulated by the IEEE standards.
- 19. Welding, brazing or otherwise heating of the conduit is not allowed. Plumber's perforated tape shall not be used for any purpose.

- 20. Where required for ease of pulling and as necessary to meet code, the Contractor shall provide cast junction or pullboxes even though not shown on the drawings. The Contractor shall limit the number of equivalent 90-degree bends to three in any run between pull boxes. Runs shall be limited to 400 feet, less 100 feet for each equivalent 90-degree bend in the run. Bends and offsets shall be avoided where possible, but where necessary, shall be made with an approved hickey or conduit bending machine, or shall be factory preformed bends.
- 21. All conduit entering sheet steel boxes or cabinets shall be secured by locknuts on both the interior and exterior of the device and shall have an insulating bushing constructed over the conduit end. All conduit entering NEMA 12 boxes shall be terminated with a rain-tight hub having an insulated liner. All surface mounted cast boxes and plastic enclosures shall have threaded hubs. All joints shall be made with standard threaded couplings or specified unions. Metal parts of plastic control stations and coated boxes shall be bonded to the conduit system. Running threads shall not be used in lieu of conduit nipples, nor shall excessive thread be used on any conduit. The ends of all conduits shall be cut square, reamed and threaded with straight threads. Rigid steel conduit shall be made up tight and without thread compound. Male threads on rigid steel conduit shall be coated with electrically conductive zinc rich paint. Threading shall be done with dies, with the guide sleeve bored out to allow for increased diameter or the PVC coated conduit. Conduit shall be made with the next larger bend or next larger shoe bushed for proper fit.
- 22. Conduit constructed in concrete slabs or walls shall be placed in the middle third of the slab or wall. Conduit rising through a slab shall be protected by a formed concrete pad approximately 6 inches in diameter and 4 inches above the finished floor or the conduit shall come up through the equipment pad. Clearances equal to the conduit trade diameter, but not less than 1-1/2 inches, shall be maintained between conduits encased in slabs. Clearances of less than 1-1/2 inches at conduit crossing and terminating locations may be allowed at the discretion of the Engineer.
- 23. Flexible conduit shall not be used as a general purpose raceway but shall be provided in locations requiring flexibility with the approval of the Engineer.
- 24. Liquid-tight conduit shall be used for all motor connections as detailed. Where flexibility is required for electrical raceways on equipment, liquid-tight conduit shall be used in accordance with JIC standards, these specifications, and the local codes. The maximum length of flexible, liquid tight conduit shall be 36-inches. The terminating fitting and sealing shall be as shown in the motor details.
- 25. The Contractor shall exercise the necessary precautions to prevent the lodging of dirt, concrete or trash in the conduit, fittings and boxes during the course of construction.
- D. Support:
  - Support raceways at intervals not exceeding NEC requirements unless otherwise indicated. Support multiple raceways adjacent to each other by ceiling trapeze. Support individual raceways by wall brackets, strap hangers, or ceiling trapeze, fastened by toggle bolts on hollow masonry units, expansion shields on concrete or brick, and machine screws or welded thread studs on steelwork.
  - 2. Threaded studs driven in by a powder charge shall not be accepted.
  - 3. Support all raceways from building structural members only.
  - Do not use nails anywhere or wooden plugs inserted in concrete or masonry as a base for raceway or box fastenings. Do not weld raceways or pipe straps to steel structures. Do not use wire in lieu of straps or hangers.
- E. Bends:

- 1. Make changes in direction of runs with symmetrical bends. Make bends and offsets of the longest practical radius. Do not heat metal raceways to facilitate bending.
- 2. Make bends in parallel or banked runs of raceways from the same center or centerline so that bends are parallel and of neat appearance. Make field bends in parallel runs.
- 3. For PVC conduits, use factory made elbows for all bends 30 degrees or larger. Use acceptable heating methods for forming smaller bends.
- 4. Make no bends in flexible conduit that exceed 90 degrees or allowable bending radius of the cable to be installed or that significantly restricts the conduits flexibility.
- F. Bushing and Insulating Sleeves:
  - 1. Where metallic conduit enters metal equipment enclosures through conduit openings, install a bonding bushing on the end of each conduit. Install a bonding jumper from the bushing to any equipment ground bus or ground pad.
  - 2. If neither exists, connect the jumper to a threaded bolt connection to the metallic enclosure.
  - 3. Use manufacturer's standard insulating sleeves in all metallic conduits or insulated bushings terminating at an enclosure.
- G. Expansion Joints:
  - 1. Provide suitable expansion fittings for raceways crossing expansion joints in structures or concrete slabs, or provide other suitable means to compensate for expansion and contraction.
  - 2. Provide for the high rate of thermal expansion and contraction of PVC conduit by providing PVC expansion joints as recommended by the manufacturer and as required.
- H. PVC Conduit:
  - 1. Solvent weld PVC conduit joints with solvent recommended by the conduit manufacturer. Follow manufacturer's solvent welding instructions and provide watertight joints.
  - 2. Use acceptable PVC terminal adapters when joining PVC conduit to metallic fittings.
  - 3. Use acceptable PVC female adapters when joining PVC conduit to rigid metal conduit.
- I. PVC Coated Rigid Steel Conduit:
  - 1. Install in strict accordance with the manufacturer's Instructions.
  - 2. Touch up any damage to the coating with conduit manufacturer acceptable patching compound.
  - 3. PVC boot shall cover all threads.
  - 4. Where belled conduits are used, bevel the un-belled end of the joint before joining. Leave no metallic threads uncovered.
  - 5. PVC coated conduit shall be tightened, with strap wrenches, and the plastic overlap shall be coated and sealed in accordance with the manufacturer's recommendations. Pipe wrenches and channel locks shall not be used for tightening plastic coated conduits. All damaged areas shall be patched, using manufacturer's recommended material. The area to be patched shall be built up to the full thickness of the coating. Joints in multiple conduit runs shall be staggered.
  - 6. Threading:
    - a. Plasti-Bond can be threaded with any standard threading tool. Larger model power threaders with open die heads require no modification beyond optional grip inserts for PVC coated conduit.

- b. If a threader with a tight-fitting die head is to be used, like many hand-held models, it is necessary to machine out the interior diameter of the stationary guide approximately 12/100ths of an inch to allow for clearance of the PVC coating. Prior to machining the pipe guide take note of the sequence in which the dies are removed; then replace dies in the proper sequence.
- c. If conduit is to be threaded manually it must be pencil cut before threading to enable the die teeth on the threader to engage the conduit. In the same manner as sharpening a pencil with a knife, cut away 1/4" of the exterior coating from the end to be threaded. This allows the pipe guide to ride up and over the PVC coating enabling the removal of the coating and threading in one operation.
- d. Before threading, by any method, a series of cuts should be made in the PVC coating along the longitudinal axis of the conduit. The thread protector attached to one end of the conduit can be used to gauge the length of the cuts. Make a slit up one side of the thread protector with a knife and remove it from the conduit. Push the thread protector over the cut end of the conduit to be threaded and place a mark on the PVC coating at the end of the protector. With a knife, cut around the circumference of the conduit at the mark, through the PVC coating, to the metal. This cut will indicate the starting point for the longitudinal cuts and it will give an even ending to the PVC coating removed during threading. The longitudinal cuts will allow the PVC coating to be removed in small pieces instead of long strips that can foul the die head causing the conduit to collapse.
- e. Use a good quality thread cutting oil to flush away the metal and PVC chips. After threading use a degreasing spray to thoroughly clean the threads and the interior of the pipe. Use care not to contaminate the cutting oil with the degreasing spray. Degreasing is important in order to insure that the touch up compound will adhere to the unprotected steel. Bare steel is the most vulnerable area to corrosion in any conduit system, therefore, touch up compound must be used on all field cut threads and internal reams. These specially formulated interior and thread touch-up compounds are available in 4 ounce and quart cans. When an access fitting or coupling is attached to the newly threaded conduit a colored band red for Plasti-Bond), will form at the end of the sleeve. This indicates proper installation procedures have been followed
- J. Penetrations:
  - Seal the interior of all raceways entering structures at the first box or outlet with electrical duct sealant per NEC 505.17, (D)(2) to prevent the entrance into the structure of gases, liquids, or rodents.
  - 2. Dry pack with non-shrink grout around raceways that penetrate concrete walls, floors, or ceilings aboveground, or use one of the methods specified for underground penetrations.
  - 3. Where an underground conduit enters a structure through a concrete roof or a membrane waterproofed wall or floor, provide an acceptable, malleable iron, watertight, entrance sealing device. When there is no raceway concrete encasement specified or indicated, provide such a device having a gland type sealing assembly at each end with pressure bushings which may be tightened at any time. When there is raceway concrete encasement specified or indicated, provide such a device with a gland type sealing assembly on the accessible side. Securely anchor all such devices into the masonry construction with one or more integral flanges. Secure membrane waterproofing to such devices in a permanently watertight manner.
  - 4. Wherever conduits penetrate concrete wall panels to outdoors or as shown, the Contractor shall detail the required mountings. He shall locate and use a galvanized pipe sleeve for passage of the conduit. A compression type seal shall be used to form a complete watertight installation. The installation design shall be submitted to the Engineer.

- 5. Where an underground raceway without concrete encasement enters a structure through a non-waterproofed wall or floor, install a sleeve made of Schedule 40 galvanized pipe. Fill the space between the conduit and sleeve with a suitable plastic expandable compound, or an oakum and lead joint, on each side of the wall or floor in such a manner as to prevent entrance of moisture. A watertight entrance sealing device as specified may be used in lieu of the sleeve.
- 6. Where raceways penetrate fire-rated walls, floors, or ceilings, fire stop openings around electrical penetrations to maintain the fire-resistance rating
- 7. Raceways passing through roofs shall be flashed.
- 8. Provide conduit seals where required by Article 500 of the NEC.
- K. Underground Conduits, Direct Burial raceways:
  - 1. Unless otherwise indicated, all underground conduits shall PVC coated rigid steel.
  - 2. Coordinate installation of underground raceways with other outside and building construction work. Maintain existing outside utilities in operation unless otherwise authorized by the Engineer.
  - 3. Remove entirely and properly reinstall all raceway installations not in compliance with these requirements.
  - 4. Do not use union type fittings underground.
  - 5. Provide a minimum cover of 2-feet over all underground raceways unless otherwise indicated. Warning tape as specified in Article 2.11A shall be placed no less than 12 inches above conduit and duct bank.
  - 6. Do not backfill underground direct burial raceways until they have been inspected by the Engineer.
  - 7. Warning Tapes: Bury warning tapes approximately 8-inches below grade and above all underground conduit runs or duct banks. Align parallel to and within 12-inches of the centerline of runs.
  - 8. When the contract drawings indicate underground PVC conduits then a transition shall be provided. The transition shall be made from PVC Schedule 80 conduit to PVC coated rigid galvanized steel conduit at all stub-ups and when entering equipment. The transition shall consist of a PVC coated rigid galvanized conduit. Conduits shall be laid with a minimum grade of 2 inches per 100 feet from structure to manhole or from high point to manholes.
  - 9. Ducts shall be of the dimensions and materials and with reinforcing as shown. They shall have a uniform continuous slope with no low points to entrap water. All duct runs shall be placed on an undisturbed excavated soil base wherever possible. Where duct runs pass through backfilled areas, the soil base shall be a backfill of loam, placed in layers. Each layer shall be solidly tamped or rolled, as required, to obtain complete compaction to the elevation and pitch of the bottom of the duct run shown. The compaction shall be as specified in the structural section of these specifications.
  - 10. Plastic spacers shall be manufactured by the conduit supplier and shall be located 5 feet on centers. Wire ties shall be made at each spacer location and shall be securely anchored. Duct runs shall be watertight. When the termination of duct is not detailed on the duct run drawing, a coupling shall be installed.
  - 11. The ends of all conduits shall be suitably plugged, capped and protected from damage during construction. Ends of conduits which are not to be used for long periods shall be protected from dirt, rodents, etc., by plugging at the ends with manufactured plugs. A non-setting

compound may be used on the plug to make it adhere to the conduit end. A 1/4-inch hole shall be drilled in the lower portion of the plug to provide drainage of the plugged conduit.

- 12. A No. 5/8 mule tape shall be pulled through each high voltage, 480-volt power feeder, and branch feeder conduits as the conduit sections are laid and the tape shall be securely fastened at each end of the finished duct run. When ducts are reserved for future use, the mule tape shall also be used and secured.
- 13. A mule tape shall always be attached to the rear end of the swab or mandrel to replace the wire being pulled out. When not in use, this tape shall be securely fastened at both ends of the duct.
- 14. Each conduit in a manhole, handhole, or pull box shall be identified with a stamped aluminum or brass tag bearing the conduit number. The tags shall be permanently attached to conduits by means of 316 stainless steel or nylon tie wrap. Install conduit couplings and cap ends of all spare underground conduits at each handhole/manhole.
- 15. Each conduit shall be identified at each end with a permanent non-corrosive metal marker. Designation shall be pressure stamped into the tag. The conduit identification shall be the designated conduit number as shown.
- 16. Separation and Support:
  - a. Separate parallel runs of two or more raceways in a single trench with preformed, nonmetallic spacers designed for the purpose. Install spacers at intervals not greater than that specified in the NEC for support of the type raceways used, and in no case greater than 10-feet.
  - b. Support raceways installed in fill areas to prevent accidental bending until backfilling is complete. Tie raceways to supports, and raceways and supports to the ground, so that raceways will not be displaced when concrete encasement or earth backfill is placed.
- 17. Arrangement and Routing:
  - a. Arrange multiple conduit runs substantially in accordance with any details shown on the Drawings. Locate underground conduits where indicated on the Drawings.
  - b. Make minor changes in location or cross-section as necessary to avoid obstructions or conflicts. Where raceway runs cannot be installed substantially as shown because of conditions not discoverable prior to digging of trenches, refer the condition to the Engineer for instructions before further work is done.
  - c. Where other utility piping systems are encountered or being installed along a raceway route, maintain a 12-inch minimum vertical separation between raceways and other systems at crossings. Maintain a 12-inch minimum separation between raceways and other systems in parallel runs. Do not place raceways over valves or couplings in other piping systems. Refer conflicts with these requirements to the Engineer for instructions before further work is done.
  - d. Provide insulated grounding bushings on all metallic raceways entering manholes. Provide bell-ends flush with manhole walls on all nonmetallic raceways entering manholes.
  - e. In multiple conduit runs, stagger raceway coupling locations so that couplings in adjacent raceways are not in the same transverse line.
  - f. Provide markers at grade to indicate the direction of underground conduits provided under this Contract. Provide markers consisting of double-ended arrows, straight for straight runs and bent at locations where runs change direction. Provide markers at all bends and at intervals not exceeding 100-feet in straight runs. Use markers made of sheet bronze not less than 1/4-inch thick embedded in and secured to the top of concrete posts. Use

markers not less than 10-inches long and 3/4-inch wide and marked ELECTRIC CABLES in letters 1/4-inch high incised into the bronze to a depth of 3/32-inch.

- g. All conduits shall enter maintenance holes and structures at right angles.
- 18. Raceway Coating:
  - a. At couplings and joints, coat metallic underground direct-burial conduits with Koppers Bitumastic No. 505 or equal, or wrap with Scotchwrap No. 51, or equal plastic tape with 1/2-inch overlap.
- 19. Direct Earth Burial Conduit Zone Backfill Installation:
  - a. Backfill material for the conduit zone of direct burial conduit trenches may be selected from the excavated material if it is free from roots, foreign material, and oversized particles.
  - b. Use material with 3/4-inch maximum particle size and suitable gradation for satisfactory compaction. Remove material if necessary to meet these requirements.
  - c. Imported 3/4-inch minus gravel or sand may be used in lieu of material from the excavation.
  - d. After conduits have been properly installed, backfill the trench with specified material placed around the conduits and carefully tamped around and over them with hand tampers. Final, tamped conduit cover shall be 4-inches minimum.
- 20. Backfill Installation above Conduit Zone of Direct Burial Conduit:
  - a. Backfill material above the conduit zone of direct burial conduit may be selected from the excavated material, if it contains no particles larger than 3-inches in diameter and is free from roots or debris. Imported material meeting these same requirements may be used in lieu of material from the excavation. Compact backfill in maximum 12-inch layers to at least 95 percent of the maximum density at optimum moisture content as determined by ASTM D 1557.
- L. Wireways:
  - 1. Mount wireways securely in accordance with the LAEC and manufacturer's instructions. Locate removable cover or hinged cover on accessible vertical face of wireway unless otherwise indicated.
- M. Empty Raceways
  - 1. Certain raceways will have no conductors pulled in as part of this Contract. Identify with tags at each end and at any intermediate pull point the origin and destination of each such empty raceway. Where a raceway has been identified with a name (number) in the Raceway Schedule, use that name on the tag in lieu of origin and destination. Provide a removable permanent cap over each end of each empty raceway. Mandrel and provide a nylon pull cord in each empty raceway.
- N. Firestops:
  - 1. The Contractor shall furnish adequate firestops and seals for cables, conduits, trays, and wireways, etc., passing through building floors or wall openings.
  - 2. Products which utilize intumescent compounds capable of being leached out by water shall not be used.
  - 3. Flamenastic 71A, Vimasco No. 1-A, or equal, shall be used for this purpose and shall be applied in accordance with manufacturer's recommendations.
- O. Painting

1. Paint raceway systems in accordance with and as specified in Section 09900 - Protective Coating Systems.

## 3.03 Field Quality Control

A. Provide raceway systems meeting or exceeding the requirements of the NEC.

## 3.04 Adjusting / Cleaning / Protection

A. Following installation, protect products from the effects of moisture, corrosion, and physical damage during construction. Keep openings in conduit and tubing capped with manufactured seals during construction.

## SECTION 16120 WIRE AND CABLES, 600 VOLTS AND BELOW

## PART1- GENERAL

#### 1.01 Summary

- A. Scope: This section provides specifications for all wire and cable used for electrical current conductors.
- B. Type: All conductors shall be copper, type B stranded, unless otherwise noted. The minimum size of conductors shall be No. 12 AWG.

#### 1.02 References

A. All work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these specifications.

<u>Reference</u>	<u>Title</u>	
ICEA S-61-402/NEMA WC-5	Thermoplastic - Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy	
ICEA S-19/NEMA WC-3	Rubber - Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy	
S-68-524/NEMA WC-7	Cross Linked Thermosetting Polyethylene Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy	
S-68-516/NEMA WC-8	Ethylene Propylene Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy	
NFPA	National Fire Protection Association	
UL 62	Flexible Cord and Fixture Wire	
UL 83	Insulated Wires and Cables	
UL 486A	Wire Connectors and Soldering Lugs for use with Copper Conductors	
UL 486B	Wire Connectors for use with Aluminum Conductors	
UL 510	Insulating Tape	
UL 1277	Electric Power and Control Tray Cables with Optical Fiber Members	
UL 1449	Safety Transient Voltage Surge Suppressors	
NEMA WC-55	Instrumentation Cables and Thermocouple Wire	
NEMA WC-57	Control Cables	
ASTM B8	Standard Specifications from Concentric Lay Standard Copper Conductors, Hard, Medium-Hard or Soft	
Title 8	Industrial Relations, Subchapter 5, Electrical Safety Orders, California Code of Regulations	

# 1.03 Definitions

- A. Cable: Multi-conductor, insulated, with outer sheath.
  - 1. May contain either building wire or instrumentation wire
- B. Instrumentation Cable: Multiple conductors, insulated, twisted with outer sheath, intended for transmission and distribution of low current (4-20 mA DC) or low voltage (0-10 V DC) analog signals, No. 16 AWG and smaller. Commonly used types are defined in the following:
  - 1. TWP: Twisted pair without shield.
  - 2. TWSP or TSP: Twisted shielded pair.
  - 3. TWST: Twisted-shielded triad.
- C. Wire: Single conductor, insulated, with or without outer jacket depending upon type

## 1.04 Submittals

- A. Shop Drawings shall include:
  - 1. Product technical data including:
    - a. Acknowledgement that submitted products meet requirements of standards
    - b. Catalog cuts and other brochures depicting conductor characteristics
    - c. Manufacturer's recommended splicing, testing, and installation procedures and practices and Manufacturer's installation instructions
  - 2. Manufacturer's certified test records, factory test procedures and test Reports.
  - 3. Samples
- B. Field testing using attached Cable Test Data Form, HI-POT and Megger tests including certified test reports. Also, include splicing personnel qualifications.

## 1.05 Quality Assurance

- A. The wire and cable shall be of premium quality suitable for installation in Water facilities.
- B. All Conductors furnished by the Contractor shall be listed by and shall bear the label of Underwriters' Laboratories, Incorporated, (UL).
- C. The construction and installation of all electrical equipment and materials shall comply with all provisions of the CAL OSHA Safety Orders Title 8 CCR, as applicable), State Building Standards, and applicable local codes and regulations

## 1.06 Delivery, Storage, and Handling

A. Deliver materials and equipment to project site in manufacturer's original packaging with labeling showing product name, brand, model, project name, address, and Contractor's name. Store in a location as agreeable with City Representative, secure from weather or accidental damage.

# PART 2 - PRODUCTS

## 2.01 Manufacturers

A. The use of a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired only. Products of other manufacturers will be considered in accordance with the General Requirements.

- B. Building wire, power and control cable:
  - 1. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
    - a. Alpha Wire Corporation
    - b. American Insulated Wire Corporation
    - c. Belden Wire and Cable
    - d. Carol Cable Company
    - e. General Cable
  - 2. Conform to UL 444, Communications Cable, NEC type CMP, tinned copper conductors, 100 percent shield coverage, single TSP, Teflon insulated with Teflon jacket in all applications except small diameter.
  - 3. Multiple conductor, small diameter instrumentation cable shall be used where existing conduits limit conduit space as called out on drawings:
    - a. Plenum type single or multi paired, twisted pairs, overall shield with drain wire
    - b. FEP or FPR insulation and jacket
    - c. Moisture and flame resistance
    - d. Jacket thickness 0.015 IN minimum
    - e. Maximum outside diameter:
      - 1) 1 PR 0.125 IN
      - 2) 2 PR 0.180 IN
  - 4. Telephone cable:
    - a. Solid conductors, tinned copper, No. 24 AWG
    - b. 150 volt, vinyl insulated
    - c. UL listed 2576

#### 2.02 Equipment and Materials

- A. Unless otherwise indicated, provide stranded conductors, except provide solid conductors where No. 10 AWG and No. 12 AWG are designated for branch circuit power wiring in lighting and receptacle circuits.
- B. For all direct burial and aerial conductors and cables, provide conductors with UL labeling "TYPE USE" and RHW insulation with heavy-duty, black, neoprene sheath meeting the physical requirements and minimum thickness requirements of ICEA S-19-81 and NEMA WC 3.
- C. Where flexible cords and cables are specified, provide Type SO, 600-volt, with the number and size of copper conductors indicated.
- D. Insulation
  - 1. All conductors shall be rated at 600 Volts unless noted otherwise within this specification section.
  - 2. No. 10 AWG conductors or smaller shall be type THWN unless otherwise noted within this specification section.
  - 3. No. 8 AWG conductors or larger shall be type XHHW unless otherwise noted within this specification section.

- 4. All conductors shall be sized for operation at 75 degrees C maximum operating temperature.
- 5. For power conductors, provide all single conductors and individual conductors of multiconductor power cables with integral insulation pigmentation of the designated colors, except conductors larger than No. 6 AWG may be provided with color coding by applying a heat shrink tube of the appropriate color.
- E. Conductors
  - 1. Unless specifically noted otherwise herein, all conductors for general wiring shall be a minimum of 98% conductivity, stranded, soft drawn copper. Aluminum or aluminum alloys are not acceptable.
  - 2. 120 Volt control, indicator, signal and metering conductors may be #14 AWG, and shall be stranded.
- F. Instrumentation Signal Cables
  - 1. Instrumentation signal cables shall be of the type used for process control with twisted shielded pairs or triads with polyvinyl jacket an overall shield over the multiple pairs or triads.
  - 2. The instrumentation cable shall be rated 600 Volts at 90 degrees C or better.
  - 3. The size of the instrumentation cable shall be AWG No. 16 with seven strands minimum.
  - 4. All instrumentation cables shall be UL listed. Belden 8719 (Pairs), Belden 8618 (Triads) or equal.
- G. PLC Communications Cables
  - 1. Communication cables for remote I/O connections and for PLC high speed data communications shall be as recommended by the manufacturer of the PLC equipment.
- H. Ethernet Communications Cables
  - 1. Ethernet communication cables shall be Industrial Grade Cat 6, shielded Twisted Pair (STWP) for building interiors, Belden DataTuff or equal
  - 2. Ethernet communication cables shall be Industrial Grade gel filled outdoor rated Cat 6, shielded Twisted Pairs for site and building exteriors and no more than 50 feet into building interiors, Belden DataTuff or equal
- I. Portable Cable:
  - 1. Cord shall be NEMA Type SOW-A flexible cord rated at -50 deg C to 105 deg C. All cords shall contain an equipment grounding conductor. Cord shall be rated for use as a fully submersible cable.
  - 2. Conductors: Bunch or rope stranded, uncoated annealed copper conforming to UL and CSA requirements. A suitable separator is applied over the conductor.
  - 3. Insulation: Ethylene Propylene (EPDM) conforming to UL Standard 1581 and CSA requirements. Minimum average wall thickness is 45 mils for 14 AWG, 12AWG, and 10 AWG; and 50 mils for sizes 8 AWG through 2 AWG.
  - 4. Color code: Insulation colored as follows:
    - a. 2 Conductors Black, White
    - b. 3 Conductors Black, White, Green
    - c. 4 Conductors Black, White, Red, Green
    - d. 5 Conductors Black, White, Red, Green and Orange

- 5. Cable assembly: The applicable number of insulated conductors are cable together with elastomeric fillers, as necessary, and with a suitable lay.
- 6. Jacket: Black or Yellow special thermosetting compound conforming to UL and CSA requirements.
- 7. Marking: Jacket surface is printed in accordance with requirements of UL, CSA and MSHA.
- 8. Portable cord for supply to permanent installations, such as pumps, cranes, hoists and portable equipment shall have a wire mesh cord grip of flexible stainless steel wire to take the tension from the cable termination. Weatherproof strain relief fittings shall be used for all connections. To prevent unnecessary strain on cords, 45-degree and 90-degree connectors shall be used where applicable. Flexible cords feeding submersible non-wicking neoprene construction.
- 9. Manufacturer shall be American Mustang, York Wire & Cable or equal.
- J. VFD Cable:
  - 1. The cable shall be 600V/1000V rated, with stranded tinned copper conductors, shielded, suitable for use with Variable Frequency Drives.
  - 2. The insulation shall be rated 90 degrees Celsius Wet/Dry operating temperature.
  - 3. Terminations shall have rating that are at least equal to those of the cable.
  - 4. The conductor shall be annealed stranded tinned copper per ASTM B3, B8 and B33.
  - 5. The insulation shall have a minimum average wall thickness of 30 mils with the insulation mater XLPE with a XHHW-2 listing per UL 44. The insulated conductors shall be cabled together with a minimum of one ground wire with a minimum circular mil area equivalent to one circuit conductor. Fillers shall be included as necessary to make the cable round.
  - 6. The cabled assembly shall be shielded with helically two 2-mil copper tapes that provide 100% coverage over the assembly or with a a 80% minimum coverage tinned copper braid shield used in conjunction with an Aluminum foil shield tape.
  - 7. All cables shall have a continuous overall outer sheath of polyvinyl chloride suitable for 90 degree Celsius use.
  - 8. Manufacturer shall be Belden VFD cable, Lapp Group Olflex VFD, Lapp Group Olflex VFD Symmetrical or equa.
- K. Control Cable:
  - 1. Control cable shall be Type SO extra flexible and shall consist of No. 16 copper conductors insulated for 600 volt service. The overall jacket shall consist of 7/64-inch neoprene minimum. The number of conductors shall be as shown on the drawings.
- L. Grounding Wire
  - 1. Ground wires, no. 1/0 AWG or larger tinned stranded bare copper cable. All smaller ground wires shall be insulated with green color insulation.

#### 2.03 Components and Accessories

- A. Connections
  - 1. Wire nuts for joints, splices and taps for conductors #8 and smaller shall consist of a cone shaped expandable coil spring insert, insulated with a teflon or plastic shell. Threaded or crimp types will not be accepted. Use "Skotchlock", "Hydent", or equal.
  - 2. Terminals for stranded conductors #8 and smaller shall be a pre-insulated crimp type.

- 3. Lugs and connectors for conductors #6 and larger shall be compression types of one piece tubular construction with flat rectangular tongues. Two hole lugs shall be used for sizes 4/0 and larger. Fittings for copper conductors shall be tin-plated copper.
- B. Wire and Cabling Termination and Splicing
  - 1. Subject to compliance with Contract Documents, the following manufacturers are acceptable.
    - a. Burndy Corporation
    - b. Ideal
    - c. Minnesota Mining and Manufacturing Co
    - d. Penn Union
    - e. Thomas and Betts
    - f. Or Equal
  - 2. Splicing of cables and wires in the manholes and handholes shall be kept at a minimum. Where it is possible to pull cables or wires directly through the manholes or handholes, splicing shall be moisture-proof and encapsulated using insulating sealing compound. Splicing kits similar to 3M Company 82A or 8500 Series shall be utilized.
- C. Labeling
  - 1. Provide complete power and control conductor identification system so that after installation, circuits can be easily traced from origin to final destination.
  - 2. Conductor labels shall be white PVC tubing with machine printed black marking. Tubing shall be sized to fit conductor insulation. Adhesive strips are not acceptable. Machine printed markings, directly on conductors, will be accepted. Panduit, Thomas & Betts, or equal.
  - 3. Tag conductors using a three-segment conductor numbering scheme which defines the origin of the conductor, the function of the conductor, and the destination of the conductor.
    - a. Example: MCCA-P-MCCB where MCCA is the origin, P is the function identification (P = power, C = control, S = signal, etc.), and MCCB is the destination.
    - b. For conductors with one point of origin and two or more destinations, expand the function identification number, e.g., PA, PB, etc.
    - c. Make the origin and destination identification the specific names for the equipment used in the Contract Documents. Make the instrumentation and control identification names exactly as designated, i.e., FT-S-121.
  - 4. Sleeves shall be yellow or white tubing, sized to fit the conductor insulation, with machine printed black marking capable of accepting 24 machine printed character per sleeve label. Adhesive strips are not acceptable.
- D. Pulling Lubricant
  - 1. All cables shall be properly coated with pulling compound recommended by the cable manufacturer before being pulled into conduits so as to prevent mechanical damage to the cables during installation.
  - 2. Other lubricants to be substituted must be accompanied by a statement from the cable manufacturer as to its acceptable use with the cable being installed.
- E. Electrical Tape
  - 1. Pressure sensitive vinyl
  - 2. Premium grade

- 3. Heat, cold, moisture, and sunlight resistant
- 4. UL listed
- 5. Thickness, depending on use conditions: 7, 8.5. or 10 mil
- 6. For cold weather or outdoor location, tape must also be all-weather rated
- 7. Comply with UL 510

# 2.04 Fabrication

- A. Electrical conductors shall be delivered to the job site plainly marked or tagged on 24 inch centers as follows:
  - 1. Underwriters' Label
  - 2. Gauge
  - 3. Voltage
  - 4. Kind of Insulation
  - 5. Name of Manufacturer
  - 6. Trade Name

## 2.05 Source Quality Control

A. Phase A, B, C implies the direction of positive phase rotation.

# PART 3 - EXECUTION

## 3.01 Examination

## 3.02 Preparation

A. Color Coding and Labeling. Provide color coding throughout the entire network of feeders and circuits (600 volts and below) as follows:

DESCRIPTION	PHASE/CODE LETTER	WIRE OR TAPE COLOR
480 V, 3 PHASE	A	BROWN
	В	ORANGE
	С	YELLOW
208/120 V, 3 PHASE, 4 WIRE	А	BLACK
	В	RED
	С	BLUE
240/120V, 3 PHASE. 4 Wire	А	BLACK
	В	ORANGE (if High Leg)
	С	BLUE
240 / 120 V, 1 PHASE	L1	BLACK
	L2	RED

DESCRIPTION	PHASE/CODE LETTER	WIRE OR TAPE COLOR
120 VAC UPS POWER	L1	ORANGE
DC CONTROL		LIGHT BLUE
NEUTRAL	Ν	WHITE
GROUND	G	GREEN
SHIELDED PAIR	+	BLACK
	-	CLEAR
PLC DI AND DO, 120 VAC		BLUE (NOTE 1)
LOW VOLTAGE CONTROL		VIOLET (NOTE 2)

Note 1 - Low voltage control electrically direct connected to PLC DI or DO points. Only the wire between the PLC DI or DO and its first landing point shall be BLUE. Wire between this point and other terminations or field devices shall be VIOLET. Note 2 - Low voltage control <u>not</u> electrically direct connected to PLC DI or DO points. Low voltage includes 120 volts AC or DC and below. Control wiring includes wires, which follow control devices such as switches, or relays and which are not directly connected to power sources, fuses or circuit breakers.

- B. In addition to color coding, all power, control, and alarm wiring shall be numbered and identified by means of wire markers at all service pedestals, motor control centers, panelboards, auxiliary gutters, junction boxes, pull boxes, receptacle outlets, light outlets, manholes, disconnect switches, and circuit breakers. These markers shall correspond to numbers on shop drawings, wiring diagrams and interconnection wiring diagrams. Wire markers shall consist of machine engraved numbers applied by an approved marking device.
- C. Care shall be exercised in pulling wire and cable into conduit or trays so as to avoid kinking, putting undue stress on the cables, or otherwise abrading them. Do not exceed cable manufacturer's recommendations for maximum pulling tensions and minimum bending radii. No grease will be permitted in pulling wire or cable. Where pulling compound is used, use only UL listed compound compatible with the cable outer jacket and with the raceway involved. contractor shall perform and submit pulling calculation per manufacturers recommendation to ascertain that there is no overstrain to the cable. The raceway construction shall be complete and protected from the weather before cable is pulled into it.
- D. Single conductors and cables in manholes, handholes, vaults, cable trays, and other indicated locations shall be wrapped together by arc and fireproofing tapes, and shall be bundled throughout their exposed length with nylon, self-locking, releasable, cable ties placed at intervals not exceeding 18 inches on centers.
- E. Incoming wire in service pedestals, panels, and motor control centers, No. 6 AWG and smaller, shall be bundled and laced at intervals not greater than 6 inches, and neatly spread into tees and connected to their respective terminals. Sufficient slack shall be allowed in cables for alterations in terminal connections. Lacing shall be done with plastic cable ties or linen lacing twine. Where plastic panel wiring duct is provided for wire runs, lacing is not necessary when the wire is properly installed in the ducts. Slack shall be provided in junction and pull boxes and in handholes and manholes. Amount of slack shall be equal to the largest perimeter dimension of the box.
- F. Wires crossing hinges shall be made up into groups not exceeding 12 and shall be so arranged that they will be protected from chafing when the hinged member is moved.
- G. Electrical Tape Usage:
  - 1. For insulating connections of #8 AWG wire and smaller: 7 mil vinyl tape.
  - 2. For insulating splices and taps of #6 AWG wire or larger: 10 mil vinyl tape.
- 3. For insulating connections made in cold weather or in outdoor locations: 8.5 mil, all weather vinyl tape.
- H. Pulling:
  - 1. No oil, grease or similar substances shall be used to facilitate the pulling in of conductors. Use a specifically approved wire pulling compound.
  - 2. No wire or cable shall be pulled in until all construction which might damage insulation or fill conduit with foreign material is completed.
  - 3. Wire shall be pulled into conduits with care to prevent damage to insulation, using basket pulling grips to avoid slipping of insulation on conductors. Nylon rope or other "soft" surfaced cable must be used for pulling in conduits other than steel.
- I. Connections:
  - 1. Stranded conductors #8 and smaller shall be terminated with terminals of appropriate size where connected to screw type lugs.
  - 2. Joints, splices and taps in dry locations for conductors #8 and smaller shall be made with twist-on connectors suitably sized for the number and gauge of the conductors.
  - 3. Furnish and install proper lugs in all service pedestals, panelboards, motor control centers and gutters as required to properly terminate every cable. Where paralleled conductors, or conductors of large size are to terminate on a breaker, a short length of copper cable (of capacity of the breaker) shall be connected to the breaker, and the proper compression type lug installed to connect this cable to the feeder cable. The cutting of cable strands to fit the breaker will not be permitted.
  - 4. Only crimping tools approved by the manufacturer of the terminals or lugs shall be used.
  - 5. Uninsulated lugs and wire ends shall be insulated with layers of plastic tape equal to insulation of wire and switchboards, with all irregular surfaces properly padded with insulating putty prior to application of tape. Wire in service pedestals, panels, cabinets, pullboxes and wiring gutters shall be neatly grouped together and laced with #12 standard lacing twine, or cable ties.
  - In underground location, joints, splices and taps shall be insulated by the "Skotchcast" epoxy-resin method. In-line splices may be insulated by approved waterproof "shrink tube" method.
  - 7. In service pedestals, panels, pull boxes, gutter, etc. conductor shall be neatly fanned out and tagged with wire markers.
  - 8. At outlets, junction boxes, pull-boxes, fittings, etc., conductors shall be looped or pigtailed to extend at least six inches without splice beyond such wiring enclosures, and where used, pigtails added to loops for connection to fixtures or devices shall be at least six inches long.
  - 9. Conduit shall be capped during construction by means of manufactured conduit seals or caps to prevent entrance of water or debris, and shall remain closed until ready for use.

# 3.03 Installation

- A. Install all wiring in raceway unless otherwise indicated on the drawings.
- B. Power Feeder, power branch, control and instrumentation circuits shall be not combined in conduit, wireway, junction or pull boxes; except as permitted in the following:
  - 1. Where specifically indicated on the drawings or field conditions dictate and written permission is obtained from the Engineer.

- a. Feeder and branch circuits shall be isolated from each other and from all control and instrumentation circuits.
- b. Control circuits shall be isolated from feeder, branch and instrumentation circuits.
- c. 12 VDC, 24 VDC and 48 VDC may utilize a common raceway.
- d. 125 VDC shall be isolated from all other AC and DC circuits.
- e. AC control circuits shall be isolated from all DC circuits.
- C. Instrumentation circuits shall be isolated from feeder, branch and control circuits.
- D. Ground the drain wire of shielded cables at one end only.
- E. Maintain electrical continuity of the shield when splicing twisted shielded conductors.
- F. Make splices and taps only at pull or junction boxes.
- G. Terminate instrumentation and control wiring, including spare wires, at control panels and motor control centers on terminal boards mounted inside the equipment.
  - 1. Contractor shall supply terminal boards as required.
  - 2. Do not field wire directly to devices.
  - 3. Ground both ends of spare wires.
- H. All conduits containing conductors shall be sealed as the conduit enters pull boxes and electrical vaults and manholes. Power conductor, control conductors, and instrumentation conductors shall be bundled and supported separately and independently in pullboxes, vaults and manholes.
- I. Cables:
  - 1. Do not splice without permission of the Engineer. Locate splices, when permitted, only in readily accessible cabinets or junction boxes using terminal strips. Splices will not be permitted unless deemed necessary by approved pulling tension calculations.
  - 2. Where connections of cables installed under this section are to be made under Division Instrumentation and Controls, leave pigtails of adequate length for neat bundled type connections.
  - 3. Instrumentation, computer, and control cables run under infinite access floors in control rooms may be installed under the floor without protection. Run individual wires, pairs, or triads in flex conduit under the floor or grouped into bundles at least ½ inch in diameter.
  - 4. Maintaining the integrity of shielding of instrumentation cables is essential to the operation of the control systems. Take special care in cable installation to ensure that grounds do not occur because of damage to the jacket over the shield.
  - 5. Cables entering manholes, handholes or vaults shall be sealed using an expanding foam product approved for the purpose.
- J. Conductor Arc and Fireproofing Tapes
  - 1. Use arc and fireproofing tapes on all 600-volt single conductors and cables except those rated Type TC at splices in all maintenance holes, handholes, vaults, cable trays, and other indicated locations. Wrap together as a single cable all conductors entering from each conduit.
  - 2. Follow tape manufacturer's installation instructions. Secure the arc and fireproofing tape at frequent intervals with bands of the specified glass cloth electrical tape. Make each band of at least two wraps of tape directly over each other.
  - 3. Wrap together as far as possible, conductors carrying phases A, B, and C of the same feeder. Do <u>not</u> wrap together conductors carrying only two of the three phases.

- 4. The cables shall be trained as closely as possible to their final positions.
- 5. The cables shall be cleaned of all oil, grease, and cable pulling compounds using suitable solvents and cleaners non-injurious to cable and then wiped completely dry.
- 6. Any projecting surfaces such as fittings, ground connectors or bonding connections shall be covered with an insulating compound to present a smooth continuous surface for taping.
- 7. Fireproofing tapes shall be submitted as shop drawings for approval. Tapes shall be 3-inch width half-lapped and extend a minimum of 6-inches into the raceway. Use <sup>3</sup>/<sub>4</sub>" glass tape at three foot intervals to hold tape in place.
- K. Labeling
  - 1. Each power and control circuit conductor shall be identified as shown at each terminal to which it is connected with a legible permanent coded marking sleeve. This includes all wring terminations whether field terminations or interior wiring within switchboards, motor control centers, control panels, equipment, and junction panels and boxes.
  - 2. In each manhole, handhole and pull box, each conductor shall be similarly marked with a split sleeve, machine marked so the identification can be made using groups of letters and numbers.
  - 3. Each wire and conductor shall be labeled with a wire label that corresponds and matches the wire labels shown on the approved interconnect drawings, loop drawings or elementary wiring diagrams.
  - 4. For neutral wires such as jumpers between adjacent relay coil neutral terminal that are less than 7 inches in length, the wire label may be omitted if there isn't sufficient space for the labels.
  - 5. Wire numbering shall be compatible and consistent with existing system and shall be approved by the engineer.
  - 6. For general lighting and 120 volt powered receptacles, the wire labels shall be installed at each device with a label that consists of the panelboard name and the circuit number. For example, the Circuit Breaker located in the number 1 position of Panelboard "OPL2 would have its associated wiring labeled as "PNLOPL2-L1 (line power) and "PNLOPL2-N1 (Neutral).
- L. Wire and Cabling Termination and Splicing
  - 1. Power and control conductors shall be terminated in terminal blocks with solderless box lugs. Signal leads shall be terminated in terminal blocks with saddle-type pressure connectors capable of receiving two No. 16 AWG or smaller conductors on each point.
  - 2. Splices in power wiring shall be made with two compression lugs bolted together. Splices in stranded control wiring or lighting circuits may be made with compression connectors. Splices in signal wiring shall be soldered. Splicing shall not be considered as a normal method of construction. Splicing shall be used only when no practical alternative exists to using terminals or point-to-point wiring. When utilized, splicing of 600 V or less insulated wire shall be made only in junction boxes. No splicing shall be permitted in conduit fittings.
  - 3. Solid wire shall not be lugged nor shall electrical spring connectors be used on any wiring. Lugs and connectors shall be installed with a compression tool recommended by the lug manufacturer for the particular lug used. Pulling tensions shall not exceed the cable manufacturer's recommendations.
  - 4. All conductors shall be tagged at each end in motor control centers, control panels, service pedestals and control stations with a legible permanent coded wire-marking sleeve. All conductors shall be identified in each manhole, handhole or pull box. Field conductors shall be similarly tagged at each end, except that each conductor termination shall have its marking

sleeve imprinted with terminal identification for both ends of the conductor. A schedule shall be provided with the record drawings correlating these wire markings.

5. All splices and terminations for No. 1/0 AWG cable, and larger, shall be inspected by the Engineer prior to and after insulation is applied. Terminations at polyphase motors shall be made by bolt connecting the lugged conductors and then applying rubber filler tape and two 2-lapped layers of vinyl tape to equal or exceed the thickness of conductor insulation.

#### M. Grounding

- 1. A grounding system shall be installed in accordance with the National Electrical Code and specification section 16450. All grounding surfaces shall be thoroughly cleaned before connecting the grounding electrodes. All conduit shall be grounded directly or through equipment frames and ground buses to the grounding system.
- 2. In addition to the conduit system, all equipment having 480 volt, 120/208 volt or 120/240 volt supply shall be grounded to the supply source ground bus by a green insulated code sized ground conductor installed in the conduit with the phase cables. Ground conductors for small panels and equipment shall be of same size as associated conductors.

## 3.04 Adjusting / Cleaning / Protection

- A. Tighten all screws and terminal bolts using torque type wrenches and/or drivers to tighten to the inch-pound requirements of the NEC and UL.
- B. All debris and moisture shall be removed from both new and existing raceways, boxes, and cabinets before installing wire or cable

# SECTION 16200 OVERCURRENT PROTECTIVE DEVICES

# PART1- GENERAL

#### 1.01 Summary

- A. Scope: This section provides specifications for all molded case overcurrent protective devices including circuit protective devices, ground fault circuit interrupters, and motor circuit protectors.
- B. Type: The overcurrent protective devices shall be molded case type with adjustable trip settings.

#### 1.02 References

A. All work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these specifications.

<u>Reference</u>	<u>Title</u>
FS W-C-375	Federal Standard – Circuit Breakers, Molded Case, Branch Circuit and Molded Case Switches
NEMA AB 1	Molded Case Circuit Breakers

#### 1.03 Submittals

A. Submittals shall comply with the provisions set forth in 16010.

#### 1.04 Quality Assurance

- A. Performance Requirements
  - 1. The frame sizes for overcurrent protective devices shall be as indicated on the contract drawings. The overcurrent protective devices shall be either thermal magnetic or fully magnetic depending on whether the device is protecting a feeder or a motor starter.
  - 2. The circuit breakers shall be shall be UL listed. An electronic trip unit shall be provided.
    - a. Manual Transfer Switch (MTS)
    - b. Genearator
  - 3. Molded case circuit breakers shall be provided with current ratings and pole combinations as indicated on the contract drawings.
  - 4. The molded case circuit breakers for protecting feeders shall be thermal magnetic type that provides inversed time delay overload and instantaneous short circuit protection. The molded case circuit breakers in combination type starters shall be fully magnetic type that provides instantaneous short circuit protection. In addition, the circuit breakers shall be ambient temperature compensated. The minimum interrupting rating of the breakers shall be at least equal to the available short circuit current at the line terminal.
- B. Operating Requirements: The interrupting ratings for circuit breakers shall be in accordance and meet or exceed the minimum requirements established by the Short Circuit Study. Lighting panel circuit breakers shall have an interrupting rating of no less than 22,000 amperes rms (symmetrical) at the applied voltage. All other molded case circuit breakers shall be rated at 600 volts, shall meet or exceed the minimum requirements established by the Short Circuit Study and provide the selective coordination requirements demonstrated by the Protective Device Evaluation. For any

circuit breakers not covered by Protective Device and Coordination Study, the following minimum interrupting ratings shall be met:

Frame Designation (b)		Maximum Continuous Amperes	Minimum Interrupting Rating		
СН	GE		at 480 volts sym. amps	at 240 volts sym. Amps	
HFD HFD HLD HMC HNC PB	TEL TEL THFK THJK4 TPSS TPSS TPSS	100 150 225(a) 400(a) 800(a) 1,200(a) 1,600(a)	65,000 65,000 65,000 65,000 65,000 65,000 100,000	100,000 100,000 100,000 100,000 100,000 100,000 100,000	

Notes:

Interchangeable trips shall be provided.

Frame sizes as shown are Cutler Hammer (CH), General Electric (GE), or equal

# 1.05 Equipment and Materials

- A. Circuit breakers shall be of the frame sizes indicated and their ratings shall not be less than the sum of the continuous load plus the non-continuous load. The trip ratings shall be based on the total minimum loads that are summation of the continuous load and non-continuous load. The wire used shall be 90 degree C applied at the 75 degree C capacity. Feeder conductor ampacity shall be equal to or greater than the non-continuous load plus 125% of the continuous load. The circuit breaker units shall have an auxiliary set of double throw contacts to indicate the status of the circuit breakers. Circuit breakers shall be Cutler-Hammer, or approved equal.
- B. The unit shall have solid state trips, current monitors, long time delay, short time delay ground fault trips and instantaneous trip. The circuit breaker shall have an auxiliary set of double throw contacts to indicate the status of the circuit breakers. For mechanical testing, a push-to-test button shall be provided
- C. Molded Case Circuit Breakers
  - 1. Molded case circuit breakers shall be fully enclosed in a molded case and circuit breakers with non-interchangeable trips shall have their covers sealed. Contacts shall be made from a non-welding silver alloy. Arc extinction shall be accomplished by means of arc chutes that consist of a metal grid mounted in an insulated support.
  - 2. Molded case circuit breakers with current limiting fuses shall be one complete assembly consisting of a molded circuit breaker and current limiting fuse. The above current limiting fuses shall be coordinated with the circuit breaker element for selective operation. The circuit breaker shall not reset until current limiters which have functioned have been replaced and covers fastened. The current limiters shall have visual indicators to indicate which unit needs replacement.
  - 3. The fully magnetic type circuit breakers shall be adjustable trip magnetic type designed to meet NEC requirements for such devices. The adjustment shall provide instantaneous trip settings in the range of 700 percent to 1300 percent of the lowest full load current for which the unit is rated. Each unit shall be adjusted to the circuit breaker manufacturer's recommended

setting for the particular motor full load current. All other characteristics shall be in accordance with the specifications for molded case circuit breakers. The interrupting rating shall be not less than 65,000 amperes symmetrical. Where short circuit current exceeds 65,000 amperes an integrally mounted current limiter shall be provided. Refer to one-line diagrams for available short circuit duties.

- D. Ground Fault Circuit Interrupters
  - Ground fault circuit interrupters (labeled GFI on diagrams) shall be provided in the locations as shown in the panelboards. The circuit interrupters shall be UL listed for the application and shall trip at 5 milli-amperes to protect personnel from electrical shock hazard. The unit shall be of the plug-in type and shall be of the same manufacturer and shall match the other circuit breakers in the panelboard in space requirements and general appearance, except that a test pushbutton shall be provided on the face of each unit and be accessible from the front (similar to the accessibility of the circuit breaker toggle handle).
  - 2. The neutral for each circuit that is ground fault protected shall be individually brought back with the live leg of the circuit and connected to the neutral pigtail or terminal of the interrupter unit. All wiring in GFI circuits shall be 3/64-inch insulated THWN/XHHW No. 12 AWG minimum. In general, the GFI monitored circuits will be those feeding receptacles in the shop, laboratory, restrooms, operating and outdoor areas of the plant or station and as otherwise noted.

## PART 2 - EXECUTION

#### 2.01 Installation

A. Testing: After the completion of installation, each protective device shall be individually tested to ensure that the device is properly installed, connected and operates as specified and as required.

# SECTION 16208 STANDBY GENERATOR & ACCESSORIES

# PART1- GENERAL

### 1.01 Summary

- A. Scope: This specification covers requirements for providing a factory built, factory tested, field tested, complete and operable standby power generating system including all devices and equipment specified hereinafter. All materials and equipment shall be new and of current production of a national firm which manufactures the engine-generator set as a matched unit. The manufacturer, together with its authorized representative, shall have full responsibility for the performance of the generator set and accessories.
- B. Type: The generator shall be EPA Tier 3 emissions compliance capable of producing a continuous source of power for the duration of any normal power interruption. The system shall include diesel powered engine driven electric generator with rail-mounted engine-driven radiator fan, sub-base fuel tank, microprocessor based controller, starting batteries, battery charger, battery racks, circuit breaker with electronic trip, cables, a complete exhaust system, and all other required items for a complete system including the full fill of the diesel fuel tank prior to acceptance. The exhaust system shall include type 316 stainless steel critical muffler, type 316 stainless steel exhaust piping, vent pipes, and flexible exhaust connectors. The unit shall be designed for indoor installation.

#### 1.02 References

A. Codes and Standards: All equipment and materials, including their fabrication, assembly testing and installation shall meet the applicable requirements of the following codes and regulations.

<u>Reference</u>	<u>Title</u>
AIEE Standard 606	Speed Governing of Engine Generator Units
CAC, Title 19	California Administrative Code Title 19, Public Safety
IEEE 446	Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
NEMA MG1	Motors and Generators
NFPA 37	Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbine
NFPA 70	National Electrical Code. Equipment suitable for use in systems compliant to Articles 700, 701 and 702
NFPA 110	Standard for Emergency and Standby Power Systems, Latest Edition
BAAQMD	Bay Area Air Quality Management District Standard for Steel Above Ground Tanks for Flammable and combustible Liquids

UL 142

# 1.03 Submittals

- A. Submittals shall be prepared as specified in Section 01300.
- B. Performance Data: The following performance related documents shall be submitted:

- 1. Manufacturer's standard specification sheets
- 2. Horsepower curves
- 3. Generator curves
- 4. Fuel Consumption curves showing 75% and 100% load
- 5. Torsional stress analysis and mass elastic system
- 6. Motor starting curves
- 7. Radiator cooling curves
- 8. Warranty certificates
- C. Documents and Shop Drawings: The following equipment descriptive data, operation and installation data, and shop drawings shall be submitted in accordance with the provisions set forth in Section 16010 within 60 days of contract award.
  - 1. Complete Bill of Materials listing equipment furnished and vendor catalog numbers.
  - 2. Catalog sheets of every major component, marked in such a manner that it identifies the equipment.
  - 3. Outline drawings of the standby generator showing overall dimensions, air intakes and exhaust openings, door dimensions, total weight and the sound rating design criteria.
  - 4. Assembly drawing detailing the following:
    - a. Overall width, length and height
    - b. Fuel connections
    - c. Fuel tank dimensions
    - d. Fuel tank instrumentation
    - e. Electrical connections including breaker location
    - f. Total weight of the engine-generator set
    - g. Exhaust piping and connections
  - 5. Complete electrical schematics, description of operation, and control schematics of the automatic operation-manual operation, including the following:
    - a. All A.C. and D.C. schematics
    - b. Control panel layout
  - 6. A copy of the procedure that will be followed for field testing. The temperature and rating of this equipment is required by the purchaser.
  - 7. Seismic calculation and anchoring requirements as specified in Section 16010, 1.07B.
  - 8. Vibration Isolators
  - 9. All warranty sheets
- D. The operation and maintenance manual shall include:
  - 1. Complete As-Built drawings of the submittal package.
  - 2. Complete Bill of Materials with all applicable part numbers listed.
  - 3. Complete operator's guide book(s) detailing engine-generator / load bank operation and maintenance procedure required including a lubrication and maintenance chart.

- 4. Complete maintenance, calibration, and repair instruction manuals on all major components, electrical schematic, and trouble shooting guide.
- 5. Complete parts book detailing all components of the engine-generator set and load bank.
- 6. A complete list of recommended consumable parts, their availability and current cost
- 7. List of special tools, instruments, accessories, and special lifting devices required for periodic maintenance repair, calibration, and adjustment.
- 8. Complete technical and catalog data including product brochures, giving specified information on performance and operating curves, ratings, capacities, characteristics, efficiencies and other data to fully describe items such as the engine, generator, batteries, battery charger, exhaust components, cooling system, jacket water heater, and output circuit breaker. Vendor shall include the name, address, and telephone number of the service organization for the electric generating equipment.
- E. Certified Data: The Vendor shall submit certified copies of factory test reports of the generator. Copies of the factory test reports shall be certified by the manufacturer

# 1.04 Quality Assurance

- A. Unit Responsibility: The engine-generator and all ancillary equipment shall be manufactured by manufacturers currently engaged in the production of such equipment. All materials and parts in the unit shall be new and unused, of current manufacture and of the highest grade. The equipment shall be manufactured by a single manufacturer who has been regularly engaged in the production of engine-generator sets for a minimum of ten (10) years for this package (radiator, engine, generator, and control panel configuration). The electric generating system shall be factory built, factory tested, and shipped by a single manufacturer so there is one source of supply and responsibility for warranty, parts, and service.
- B. Manufacturer's Qualifications: The manufacturer is herein defined as a company that offers standard production equipment assembled, tested and supported by authorized dealers. The manufacturer shall have available actual test data on the same configuration of the major components of the package and shall provide, upon request by the Engineer, a list of five (5) installations of such model equipment with the same major components.
- C. Service Location: The manufacturer shall have a local authorized dealer located in City or within 150 mile radius from the project site that can provide factory trained service representatives, required stock of replacement parts, and technical assistance. The dealer must have a service department with twenty-four hour, seven days per week availability.
- D. Safety Standard: The electric generator system provided must meet all requirements of NFPA 110-2016 including design specifications, prototype tests and one step full load pickup. The responsibility for performance of this specification in the entirety cannot be split among individual suppliers of components comprising the system but must be solely assumed by the supplier of the system. The manufacturer shall furnish schematic and wiring diagrams for the engine-generator set.
- E. Standard of the Manufacturer: The engine generator set shall be the manufacturer's standard commercial product with any added features needed to comply with the requirements. All controls shall be the standard of the manufacturer and control parts shall be identified by numbers of the manufacturer. Control systems that are supplied by a sub-vender or subcontractor and not incorporated in the documentation drawings of the generator manufacturer are not acceptable. Additional or better features which are not specifically prohibited by this specification, but which are part of the manufacturers' standard commercial product shall be included in the generator set being furnished.

- F. Torsional Vibration and Critical Speeds: The mass electric system consisting of engine, flywheel, generator, intermediate couplings and accessories attached to the power train as well as all associated supports and frames shall be designed to be free of dangerous torsional vibrations and critical speeds from 15 percent below idling to 15 percent above the units operating synchronous speed. In addition, the system will have no first, second, third, or half-order critical speeds within plus of minus 20 percent of governed speed. All necessary torsional calculations and evaluations of the mass elastic system shall be under the supervision of a registered professional engineer routinely engaged in this type of work. The engineer shall produce a report providing the results of the analysis and recommendations, if any, for controlling torsional vibration and critical speeds or prototype test results for unit of same type.
- G. Bay Area Air Quality Management District (BAAQMD) Permit
  - The engine generator shall be equipped with all necessary devices to meet current BAAQMD requirements for the operation of a standby diesel engine-generator. The vendor shall obtain engine data from the manufacturer to provide to the Contractor and do all the necessary work to help the Contractor to submit a complete permit application. The vendor shall coordinate with the Contractor to begin the permit application process as soon as the Engineer has approved the System submittal.
  - 2. The Contractor shall pay permit fees and coordinate with the vendor to obtain "Authority to Construct" and "Permit to Operate" (in City's name) from BAAQMD. Contractor shall include the permit fees in its original Bid Price.
    - a. Vendor shall provide engine emissions data sheets demonstrating compliance with the current standards of the BAAQMD.
    - b. Vendor shall assist the Contractor in obtaining the "Authority to Construct" and "Permit to Operate" application forms from BAAQMD and fill in all information pertaining to emissions and engine-generator set. The Contractor shall forward original copy of partially completed application to the City. The City shall complete remaining portion of the application and return to the Contractor.
    - c. Contractor shall pay for and obtain BAAQMD approval and shall forward original copies of the "Authority to Construct" and "Permit to Operate" to the City prior to delivery of enginegenerator set to the project site.
    - d. Contractor shall install engine-generator set in compliance with conditions in permits, pay any remaining fees, and obtain field approval of BAAQMD inspector. Contractor shall forward original copies of the "Authority to Construct" and "Permit to Operate" to the City. Contractor shall coordinate and verify if any additional BAAQMD requirements for new generator is required. No additional compensation shall be made for delays.
- H. Santa Rosa Fire Department Permit
  - 1. A separate fire department permit is required from the Santa Rosa Fire Department for this proposed diesel fuel generator conversion. Submit complete plans to the Santa Rosa Fire Department for review and approval prior to issuance of fire department permit.

## 1.05 Delivery, Storage, and Handling

- A. Refer to Section 16010 General Electrical Provisions, 1.06 for requirements.
- B. The standby generator system shall be installed as shown on the Drawing.

# 1.06 **Project / Site Conditions**

A. The generator shall be suitable for use up to 500 feet above mean sea level. The ambient temperature of the area is expected to vary between 10 degrees F and 110 degrees F and the relative humidity is expected to range between 20 and 100 percent.

# 1.07 Warranty

A. The standby power engine-generator unit, and all other equipment items provided under this section shall be guaranteed by the vendor against defects in materials and workmanship, covering 100 percent parts, labor, and travel expenses for a period of five (5) years. The vendor shall be capable of administering the warranty service on all components of the emergency generator system specified herein.

#### 1.08 Maintenance

- A. The generator set manufacturer and its distributor shall maintain a 24-hour parts and service organization. This organization shall regularly engage in maintenance contract programs to perform preventive maintenance and service on equipment similar to that specified. A service agreement shall be available and shall include system operation under simulated operating conditions; adjustment to the generator set, transfer switch, and switchgear controls as required, and certification in the maintenance log of repairs made and function tests performed on all systems.
- B. Spare Parts
  - 1. Provide the following new spare parts in the manufacturer's original packaging for future maintenance requirements. Deliver all spare parts to City when the operational startup testing is conducted. Group related parts together in an organized manner. Provide a "Bill of Material" type inventory transmittal form.
  - 2. Provide a separately tabbed section in the O & M Manual with a "Bill of Materials" listing of all common field replaced spare parts. Provide the following spare parts:

<u>Quantity</u>	Description
2 Replacement Sets	Air Filter(s)
2 Replacement Sets	Fuel Filter(s)
2 Replacement Sets	Oil Filter(s)
2 Replacement Sets	All light bulbs, or indicating lamps
2 Replacement Sets	All belts
1 Replacement Set	Radiator Cap, Thermostat & Gasket

# PART 2 - PRODUCTS

### 2.01 Manufacturers

A. Caterpillar, No Substitution.

## 2.02 Equipment and Materials

- A. Engine Generator Set
  - 1. The system shall include the following:
    - a. The generator shall be rated for a minimum continuous standby operation at 100 kW (125KVA), 0.8 PF, 60 HZ, 3 phase, 4 wire, 480VAC on a continuous standby basis at 1800 RPM.
    - b. Fuel tank shall be sub-base double walled fuel tank.
  - 2. The engine generator set as described with all the accessories in place and operating shall meet the following performance requirements:
    - a. The steady state voltage shall be within 15% of 480 volts under all loads and ambient conditions.
    - b. The steady state frequency shall be within 1.5 % of 60 Hz under all load and ambient conditions.
    - c. The voltage shall remain within plus and minus a percentage value, as listed below, of 480 volts when starting motors as required by the specifications and drawings. The voltage shall recover to and remain within the steady state value in 5 seconds after any transient.
    - d. The frequency shall remain within plus or minus 10% of 60 Hz under all load conditions when starting motors as required by the specifications and drawings. The frequency shall recover to and remain within the steady state value in 5 seconds after any transient.
    - e. The engine generator set shall be capable of providing power for the following starting scenario (refer to single line diagram for any specific electrical requirements):

Steps and Loads (Listed in Starting Sequence)	Starting Method	<u>Code</u> Letter
Step 1		
Control Panel UPS		
Site and Building Lighting		
Misc Power		
Step 2		
First Booster Pump	VFD	
Step 3		
Second Booster Pump	VFD	
High Flow Pump		

- B. Engine
  - 1. The engine-generator driver shall be a liquid-cooled, diesel fueled engine designed for use with No. 2 diesel fuel. The engine shall be capable of driving the generator with all accessories in place and operating at rated kW at project site conditions.
  - 2. The design shall be 4 cycle compression ignition diesel, direct injection, turbocharged, and intercooled. Two cycle engines will not be considered. The engine shall be equipped with fuel,

lube oil, and intake air filters, lube oil cooler, fuel transfer pump, fuel priming pump, service meter and gear-driven water pump.

- 3. The engine shall be capable of driving the generator at this rating on a continuous basis for the duration during the normal utility source interruptions per SAE J1349 conditions.
- 4. The engine shall be certified by the engine manufacturer as capable of developing the required horsepower at 1800 RPM and driving a generator yielding a kW rating as specified herein.
- 5. The engine equipment shall include the following:
  - a. An electric starter(s) as required by the manufacturer.
  - b. Gear type, positive displacement, full pressure lubrication oil pump; full flow spin on lubrication oil filters with replaceable spin on canister elements; dipstick oil level indicator.
  - c. Fuel filter with replaceable spin on canister elements and an engine driven mechanical, positive displacement fuel pump all mounted on the engine.
  - d. The engine speed shall be governed by an electronic governor to maintain governed by an electronic governor to maintain governed speed at precise isochronous control for rated frequency operation. The frequency at any constant load, including no load, shall remain within a steady band width of plus or minus 0.25% of rated frequency.
  - e. Engine protection devices shall have sensing elements located on the engine to initiate the following preliminary and engine shutdown alarms:
    - 1) Low coolant temperature alarm
    - 2) Low lubrication oil pressure alarm
    - 3) High coolant temperature alarm
    - 4) Low lubrication oil pressure shutdown
    - 5) High coolant temperature shutdown
    - 6) Overspeed shutdown
    - 7) Overcrank lockout
    - 8) Engine running time hour meter
  - f. Provide low coolant level shutdown which will activate high engine temperature lamp and shutdown.
  - g. Engine starter battery charging alternator, with solid state voltage regulator
  - h. Provide engine mounted, thermostatically controlled water jacket heater for engine to aid in quick starting. For the Generator, heater shall be rated 120V single phase and 90 to 120 degrees F. Water heater shall include UL label and be readily accessible.
  - i. Vendor shall provide a valved oil drain line with hose extension for ease of routine oil changes.
- C. Engine Cooling System
  - 1. The generator set shall be equipped with a rail-mounted, engine-driven radiator with blower fan and all accessories. The cooling system shall be sized to operate at full load conditions and 85 degree F ambient air without derating the unit and 50/50 anti-freeze mixture.
  - 2. The engine cooling system shall be filled with a minimum concentration of 50% ethylene glycol upon delivery. Flexible cooling water connections shall be furnished for each cooling connection to the engine.

- 3. The radiator shall be provided with a duct adaptor flange permitting the attachment of an air discharge duct.
- D. Engine Fuel System
  - 1. Generator set supplier shall provide all fuel system, which shall be flexible hose for connection and shall be sized for proper fuel flow to engine.
  - 2. The generator set supplier shall provide a UL listed, painted double-wall skid mounted fuel tank with tank capacity to supply fuel to the engine for a minimum of 24 hours operation at 100% of rated load.
  - 3. Supply piping connections for fuel suction/return lines to fuel storage tank, fuel supply/return lines to engine, and emergency vent. Include local fuel fill, tank drain connection, removable inspection plate with gasket, 'press to test", switch, and fuel level gauge. The following accessories shall be provided; steel rupture basin to contain 150% capacity, fuel in rupture basin switch, high/low fuel level switches for remote annunciation & PLC Input, fuel level transmitter with 4-20mA output, UL 508 control module and fuel strainer.
  - 4. Fuel Filter In addition to the standard fuel filters provided by the engine manufacture, there shall also be installed a primary fuel filter/water separator in the fuel inlet line to the engine.
  - 5. All fuel piping shall be black iron or flexible fuel hose rated for this service. No galvanized piping shall be permitted.
  - 6. Flexible fuel lines shall be rated 300 degrees F and 100 PSI.
- E. Engine Exhaust System
  - Vendor shall provide exhaust silencer of the critical type sized to assure full load operation without excessive back pressure. It shall be mounted exterior of the generator building. Maximum noise level allowed is 75 dBA at 23 feet
  - 2. The manufacturer shall provide test data certifying that the furnished silencer is in compliance with this performance criteria.
  - 3. The silencer shall be arranged for horizontal mounting with side or end inlet and end outlet. Vendor shall provide a 316 stainless steel bellows type flexible exhaust connector at the engine exhaust outlet to allow for pipe expansion and contraction. Exhaust piping shall be 316 stainless steel.
    - F. Exhaust System Accessories:
      - 1. 2- inch thick heat jackets on all exposed surfaces of the exhaust piping.
      - 2. Exhaust stack rain cap.
      - 3. Condensation drain trap with manual valve.
      - 4. The engine exhaust manifold, turbocharger, and turbocharger elbow shall be provided with an insulating blanket supplied and installed by the generator set manufacturer.
      - 5. Brackets, rods, fasteners, and other items to secure the silencer in place. Insulation shall be provided at points of contact with combustible materials to prevent heat radiated by any hanger rods from posing a fire hazard.
- G. Generator
  - 1. The AC generator shall be brushless, revolving field type, coupled to the engine flywheel through a flexible deriving disc for positive alignment. The generator housing shall bolt directly to the engine flywheel housing. The generator housing shall have a single ball bearing support for the rotor. The rotor shall be dynamically balanced up to 25% overspeed. The generator shall be 12 lead synchronous, four pole, drip-proof, and air cooled.

- 2. The stator windings shall have skewed laminations of electrical grade steel. The stator winding shall be of 2/3 pitch design to eliminate the third harmonic wave form distortion and minimize the harmful neutral circulating current when operating in parallel. The wave form harmonic distortion shall not exceed 5 percent total RMS measured line to line at rated load and single harmonic maximum of 3 percent of rated voltage.
- 3. The rotor shall be layer wound mechanically wedged winding construction with thermo-setting epoxy between each layer plus a final coat of epoxy for moisture and abrasion resistance. Amortisseur windings shall be integral with the rotor support. The rotor shaft bearing shall be shielded type with provisions for easy servicing through grease pipes which extend to the exterior of the generator frame. The bearing shall be designed for a minimum B-10 bearing life of 40,000 hours.
- 4. The rotating brushless exciter shall incorporate a full wave, three phase, rotating rectifier with hermetically sealed, metallic type, silicon diodes to supply the main field excitation. A multiplate selium surge protector shall be connected across the diode network to protect it against transient conditions.
- 5. Sub-transient reactance shall not exceed 10 percent.
- 6. Radio interference: Alternator and voltage regulator shall meet the provisions of BS 800 and VDE Class G and N.
- 7. All system components including the rotor, stator, and exciter shall be Class H as recognized by NEMA. The temperature rise measured by resistance at full load shall not exceed 80 degree's F. The main generator and exciter insulation shall be suitably impregnated for operation in severe environments of sand, salt water, and sea spray.
- 8. A manual reset exciter circuit breaker sensing overload or short circuit in each of the generator output legs shall be mounted on the generator to protect the generator from any over-current condition.
- 9. Current boost: Provide Permanent Magnet Generator (PMG) for excitation power, isolation and 300% current for 10 seconds.
- 10. If a short circuit occurs, the generator shall be capable of supporting 300% rated current for 10 seconds for selective tripping of down line protection devices. A current sensing magnetic breaker will protect the exciter and trip after 10 seconds during the current boost condition. Current boost systems using electronic means or CT's are not acceptable.
- 11. AC output leads shall be brought out to the field connection bus bars through removable plates on either side of sheet metal output box and terminated on the output circuit breaker.
- 12. The generator shall be furnished with an end mounted, ventilated load connection box such that the load connectors can enter the bottom of the junction box.
- H. Voltage Regulator
  - The voltage regulator shall be of solid state construction, with three phase RMS sensing, asynchronous pulse width modulated, temperature compensated with over-voltage and over excitation protected. Over-voltage protection shall shut down the regulator output on a sustained over voltage of one (1) second. Over-excitation protection shall shut the regulator output if overloads exceed ten (10) seconds. The regulator shall allow frequency output to decline to 58-59 Hertz before correcting the output voltage. It shall be mounted inside the generator terminal box or in the control cabinet. A built in voltage adjusting rheostat shall provide 5% voltage adjustment.
  - 2. The voltage regulation shall be plus or minus 0.5% of rated voltage for any constant load from no load to rated load. The regulator printed circuit board and power control diodes shall be hermetically sealed for moisture protection.

- 3. For any addition of load up to and including a 75 HP code G motor, the voltage dip shall not exceed of rated voltage. The voltage shall recover to and remain within the steady bank in not more than 4.5 seconds.
- 4. The frequency regulation from no load to rated load shall be in accordance with that defined by the engine governor performance. For any addition of load up to 90% of rated load, the frequency shall recover to the steady state frequency band within 7.0 seconds.
- 5. The balanced telephone influence factor (TIF) shall not exceed 50

# 2.03 Components and Accessories

- A. Generator Control Panel
  - The generator NEMA 1 control panel shall be mounted on the generator complete with: recessed front panel hinged at the bottom, rubber isolation vibrators, and grommeted control wire exit hole. The control panel shall have surge suppression for protection of solid state components. Vendor shall supply a front control panel illumination lamp with ON/OFF switch, alarm horn and silence switch. Control panel accessories shall include the following instruments:
    - a. A.C. voltmeter, 2% accuracy, 2-1/2", 0-480 V
    - b. A.C. ammeter, 2% accuracy, 2-1/2", 0-600 A
    - c. Dial type frequency meter, 0.5% accuracy.
    - d. Ammeter, voltmeter phase selector switch with OFF position.
    - e. Phase selector switch with OFF position for meter display of current and voltage in each generator phase.
    - f. D.C. running time meter, non resettable
    - g. D.C. battery charging voltmeter
    - h. Engine water temperature gauge
    - i. Shutdown indicators for low oil pressure
    - j. High water temperature
    - k. Engine over-speed
    - I. Solid state voltage adjustment with +/- 5%
  - 2. The engine-generator control shall have automatic remote start capability. A three position switch (RUN-STOP-AUTO) shall start the engine in the RUN position, stop the engine in the STOP position, and allow the engine to start and run by closing a remote contact, and stop when opening the remote contact in the AUTO position.
  - 3. The engine-generator control shall include a cranking cycle consisting of three cranking cycles with rest periods. Failure to start after three attempts (75 seconds) shall shut down and lock out the engine.
  - 4. The engine-generator control shall shut down and lockout the engine upon:
    - a. Overcrank
    - b. Overspeed
    - c. Low oil pressure
    - d. High engine temperature
  - 5. The control panel shall be provided with a DC powered twelve light monitor labeled as follows:

a.	Run:	Red
b.	Low oil pressure (pre-alarm):	Amber
c.	High engine temperature (pre-alarm):	Amber
d.	Low engine temperature:	Amber
e.	Low oil pressure (shutdown):	Red
f.	High temperature (shutdown):	Red
g.	Overcrank:	Red
h.	Overspeed:	Red
i.	Not in automatic:	Red
j.	Circuit breaker trip/open:	Red
k.	High battery voltage:	Red
I.	Low battery voltage:	Red

- 6. Panel mounted switches shall be provided which will reset the engine-generator monitor and test all lamps, operation of the shut down circuits shall be independent of the pre-alarm circuits.
- B. Starting and Utilities
  - 1. The engine shall be equipped with a 24 Volt electric starting system of sufficient capacity to crank the engine-generator unit at a speed which will allow satisfactory starting of the engine.
  - 2. Lead acid batteries shall be furnished having sufficient capacity for nine (9) cranking attempts and capable of craning the engine for at least 40 seconds at firing speed in the ambient temperature of 110 degree F. A battery rack and necessary gravity of the fully charged battery "acid" shall not exceed 1.220 at 77 degree F. Provide insulated stranded copper conductors connecting the battery to the generator electric starting motor.
  - 3. An automatic float/equalize type battery charger shall be provided, installed, and wired on the generator set. Connections to the battery shall be solid wired (clip on type not acceptable). Input voltage shall be 120 volts AC. Charger shall be UL listed. Output capacity shall be 10amps at 24 volts DC. Features shall include the following:
    - a. Low battery voltage alarm contacts, set to close if the battery voltage drops below 24 volts
    - b. Neon light to indicate the selector switch is in the "equalize" range
    - c. DC voltmeter
    - d. DC ammeter
    - e. AC circuit breaker on input line
    - f. DC circuit breaker on output
    - g. Battery failure alarm contacts, set to close if AC power is lost to charger. Battery charger enclosure shall be NEMA 1 construction and arranged for convection cooling.
    - h. Battery disconnect switch
  - 4. Provide 100% rated main output circuit breaker, amp rating as shown on the single line diagram, UL, 65,000 AIC, 600 Volt, molded-case, solid state type with inverse time delay trip overload and instantaneous trip on overcurrent. Circuit breaker shall be installed and wired include breaker trip and breaker open contacts.

- 5. Air Restriction Indicator: The air cleaner restriction indicator shall indicate the need for maintenance of the air cleaners.
- 6. Block Heater: The block heater shall be thermostatically controlled and sized to maintain manufacturers recommended engine coolant temperature to meet the start-up requirements of NFPA 99 and NFPA 110, Level 1.
- 7. Crankcase Emission Canister: The engine shall have a crankcase emission canister. The emission canister prevents crankcase oil vapor from escaping into the air to prevent environmental pollution and fouling of the radiator.
- 8. Dry Contact Kit: The 10 Dry Contact Kit shall provide normally open and normally closed, goldplated contacts in a form C configuration to activate warning devices and other customerprovided accessories allowing remote monitoring of the generator set. Typically, lamps, audible alarms, or other devices signal faults or status conditions.
- 9. Duct Flanges: A radiator duct flange to provide a convenient connection to duct work for the radiator discharge air shall be included.
- 10. Failure Relay:
  - a. The common failure relay shall remotely signal auxiliary faults, emergency stop, high engine temperature, low oil pressure, overcrank, and overspeed via one single-pole, double-throw relay with 10 amps at 120 VAC contacts.
  - b. The relay contacts shall be gold flashed to allow use of low current draw devices (100ma @ 28VDC min.).
  - c. Once energized the relay shall remain latched until the system is reset by the main controller switch

#### 2.04 Fabrication

- A. Fuel Storage System
  - 1. The Fuel Storage System shall be capable of supplying 24 hours of continuous full load operation. The fuel storage tank shall be no larger than 230 gallons.
  - The Contractor shall provide a UL listed double containment skid mounted fuel storage tank with fuel level transmitter, low fuel level switch and fuel storage tank leak sensor for monitoring by the pump station control panel. Fuel Tank Instrumentation shall terminate in the generator control panel with terminal blocks for each signal for connection to the pump station control panel PLC.

## PART 3 - EXECUTION

#### 3.01 Preparation

- A. To ensure that the equipment has been designed and built to the highest reliability and quality standards, the manufacturer and/or local representative shall be responsible for three separate tests: design prototype tests, final production tests, and site tests.
- B. Design Prototype Tests Components of the emergency system, such as the engine/generator set, transfer switch, and accessories, shall not be subjected to prototype tests because the tests are potentially damaging. Rather, similar design prototypes and preproduction models shall be subject to the following tests:
  - 1. Maximum power (kW)
  - 2. Maximum motor starting (kVA) at 35% instantaneous voltage dip

- 3. Alternator temperature rise by embedded thermocouple and/or by resistance method per NEMA MG1-32.6.
- 4. Governor speed regulation under steady-state and transient conditions
- 5. Voltage regulation and generator transient response
- 6. Harmonic analysis, voltage waveform deviation, and telephone influence factor
- 7. Three-phase short circuit tests
- 8. Alternator cooling air flow
- 9. Torsional analysis to verify that the generator set is free of harmful torsional stresses
- 10. Endurance testing
- C. Factory Testing
  - 1. Perform factory tests prior to shipment to jobsite. Include the following:
    - a. Demonstrate proper operation of all safety devices and test alarm and shutdown circuits by simulating fault conditions.
    - b. Conduct load tests utilizing resistive load banks as follows:

LOAD	HOURS
1/2	1
3/4	1
Full	4

- c. At the end of two hours at full load, the engine-generator shall be block loaded from no load to full load a total of two times, and the voltage dip and frequency dip shall be recorded by a strip chart recorder. Record current, voltage, frequency, water temperature, lube oil pressure, and lube oil temperature every 15 minutes.
- 2. The Engineer shall witness the factory test of engine-generator set. The Contractor will be responsible for all travel costs for personnel witnessing factory tests that are required outside of a 100 mile radius from the project site. Provide a written notification to the Engineer at least ten (10) working days in advance of the factory test. Written notice shall include a written test procedure.
- 3. Submit three copies of the Factory test report to Engineer

# 3.02 Installation

- A. The unit shall be installed in accordance with the manufacturer's directions.
- B. The Contractor shall provide field disassemble and reassemble of engine-generator set by a manufacture authorized service provider as required. The work shall not cause any change or interruption of the original manufacturer warranty coverage.
- C. The Contractor shall be responsible to install the engine-generator set utilizing the existing structure and structure's opening. Any modification to the existing structure to accommodate the installation shall be at the Contractor's expense.
- D. The Contractor shall coordinate the construction of engine-generator set foundations and piping systems with the generator set manufacturer's written requirements.
- E. Foundation, anchor bolt layouts, and piping may have to be modified from those shown on the plans. Such work shall be at the Contractor's expense. Anchor bolts and support for exhaust system shall be determined by the required structural calculations.

- F. Installed location of unit shall comply with the required working clearances in front of circuit breakers, load bank controls and other electrical equipment that will require service while energized per the NEC.
- G. Load bank design and installed position shall allow the removal and replacement of individual elements without removal of radiator, or ductwork.
- H. Grounding and bonding shall be completed as required by applicable sections of the NEC.
- I. Battery cables shall be sized by calculations or catalog data showing wire gauge and maximum length of battery cables for the cold cranking amp rating of the engine-generator set.
- J. Installation of exhaust system shall be coordinated to avoid conflict or heat exposure to lights and fire detection or suppression systems. Exhaust insulation blankets shall be installed.
- K. Check torque of bolted connections.
- L. Check electrical connections for proper phase relationship.
- M. Fill cooling system with an antifreeze and water solution per the manufacturer's recommendation.
- N. Fill the tank with No. 2-D diesel fuel meeting ASTM 975-60T. After field testing is complete, refill the tank.
- O. Piping Pitch horizontal runs of exhaust pipe away from the engine. Provide condensate traps with petcocks or valves at low spots in the exhaust system.
- P. Contractor shall provide an installation report stating that all installation items noted under Section 3.02 are complete including copy of structural calculations, battery cable calculations, torque settings used for bolted connections, and proper phase relationship.

#### 3.03 Field Quality Control

- A. Manufacturer's Representative
  - 1. The services of a qualified representative of the manufacturer shall be furnished to inspect the installation, place it in operation, make any necessary adjustments, and instruct the plant personnel in its operation and maintenance. A minimum of four hours training shall be provided.
- B. Start-Up and Field Testing
  - 1. Submit operation and maintenance manuals to Engineer at least ten (10) working days prior to the start-up and field testing.
  - 2. Schedule: Provide written notice to the Engineer of the scheduled start-up and field test date at least ten (10) working days prior to test date. Startup and field testing shall be conducted only on a Tuesday, Wednesday, or Thursday. All field tests shall be witnessed by Engineer. Written notice shall include a written test procedure.
  - 3. On completion of the installation the manufacturer's distribution representative shall perform an installation check, startup, and building load test and who shall thoroughly inspect, operate, test, and adjust the equipment. The inspection shall include the soundness of all parts, the completeness of all details, proper operation of all components with special emphasis on safety devices, the correctness of settings, proper alignments, and correct phase rotation to match other sources. Provide a report of all necessary adjustments, corrections, or findings. The engineer, regular operators, and the maintenance staff shall be notified of the time and date of the site test. The tests shall include:
    - a. Fuel, lubricating oil, and antifreeze shall be checked for conformity to the manufacturer's recommendations, under the environmental conditions present and expected.

- b. Accessories that normally function while the set is standing by shall be checked prior to cranking the engine. These shall include: block heaters, battery chargers, alternator strip heaters, etc.
- c. Generator set startup under test mode to check for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting and stopping, vibration during operation, normal and emergency line-to-line voltage and frequency, and phase rotation.
- d. Automatic start by means of a simulated power outage to test remote-automatic starting, transfer of the load, and automatic shutdown. Prior to this test, all transfer switch timers shall be adjusted for proper system coordination. Engine coolant temperature, oil pressure, and battery charge level along with generator set voltage, amperes, and frequency shall be monitored throughout the test
- 4. Emissions Cold Start Test: Test time and conditions shall be coordinated to include exhaust emissions startup test witnessed by Field Inspector from local Air Quality Management District. Emissions test shall be done first to be at cold start conditions.
- 5. Inspection Report: On completion of the installation, the initial start-up shall be performed by a factory-trained service representative of the engine supplier, who shall thoroughly inspect, operate, test, and adjust the equipment. The inspection shall include the soundness of all parts, the completeness of all details, proper operation of all components with special emphasis on safety devices, the correctness of settings, proper alignments, and correct phase rotation to match other sources. Inspection shall also be conducted by City Inspector per Fire Code. Provide a report of all necessary adjustments, corrections, or findings.
- 6. Field Power Failure and Transfer Test: Simulate power failure by tripping the main breaker and demonstrate complete manual and automatic start, load, unload, and stop sequence of the engine-generator. Conduct test 2 times.
- 7. The Generator Field Test Checklist in Appendix A shall be filled out by the Generator manufacturer and given to the Engineer at the end of the field test.
- C. Training
  - 1. Provide 4 hours of training conducted by factory-trained service representative of the engine supplier. Provide written notice to the City of the scheduled training date and including an agenda of training topics at least five (5) working days prior to test date.

# **APPENDIX A**

# **GENERATOR FIELD TEST CHECKLIST**

### The Following (minimum) Installation Checks Must Be Made by Service Representative Before Start-Up in addition to those recommended by Generator Manufacturer:

### NOTE:

This form is to be used as a general guide, follow the manual supplied with generator along with reference to any applicable codes or standards. Ultimate compliance must be with applicable generator manual and codes and standards.

- \_\_\_\_ 1. Equipment installed in dedicated room?
- \_\_\_\_ 2. Adequate clearance on all sides to allow ease of maintenance?
- \_\_\_\_ 3. Proper construction and leveling of mounting bases?
- 4. Adequate incoming and outgoing air (louver motors adjusted and of proper voltage)?
- 5. Radiator duct flange properly sized and connected?
- \_\_\_\_\_ 6. Cooling system properly filled?
- \_\_\_\_ 7. Proper level of specified oil in crankcase?
- \_\_\_\_\_ 8. Adequate/dedicated fuel supply?
- 9. Flexible sections installed in cooling water lines?
- 10. Manually-operable fuel and cooling water valves installed, allowing manual operation of, or bypass of solenoid valves, when used?
- \_\_\_\_\_ 11. Flexible fuel lines installed between engine and fuel piping?
- 12. Fuel tanks and piping installed in accordance with applicable codes and standards?
- 13. Adequate fuel transfer tank pump lift and pump motor properly wired?
- \_\_\_\_\_ 14. Proper size exhaust line and flexible connector(s)? Flexible connector(s) should not be bent.
- \_\_\_\_\_ 15. Exhaust line condensate trap with drain installed?
- \_\_\_\_\_ 16. Exhaust line installed with proper downward outgoing incline?
- \_\_\_\_ 17. Proper-specified muffler installed with hangers and mounts tight?
- 18. Exhaust line free of excessive bends and restrictions? Back pressure under specified limit?
- 19. Exhaust line protected from entry by rain, snow, and animals?
- \_\_\_\_ 20. Approved heat-isolating thimble(s) installed at points where exhaust line passes through combustible wall(s) or partition(s)?
- \_\_\_\_ 21. Exhaust system termination located to prevent entry of exhaust gases into structures?
- \_\_\_\_ 22. Battery(ies) of proper size and voltage?
- \_\_\_\_ 23. Battery(ies) filled with electrolyte and properly connected to charger?
- \_\_\_\_ 24. Battery charger AC circuit properly connected and charger operational?
- \_\_\_\_ 25. Battery(ies) properly mounted with adequate ventilation?
- \_\_\_\_ 26. Starting cables of proper length and gauge?
- \_\_\_\_ 27. Battery disconnect switch installed?
- \_\_\_\_ 28. Starting cables properly connected to battery(ies)?
- 29. Generator load conductors of proper ampacity, and properly connected to circuit breakers, and/or emergency side of transfer switch?
- \_\_\_\_\_ 30. Load conductors, engine start leads, battery and heater power source leads installed in separate conduits?

31	. Nameplate voltage and frequency of both generator set and transfer switch matching normal/utility source ratings?
32	. Transfer switch AC conductors properly connected (Normal to NL1, NL2, NL3; Emergency to EL1, EL2, EL3; Load to LL1, LL2, LL3)?
33	. Transfer switch switching mechanism free from binding? NOTE: Disconnect all AC sources and operate manually to check.
34	All other wiring, including customer added options, connected properly?
35	. Equipment room clean with all material not related to Generator Supply System operation removed?
36	. Earthquake rated anchoring adequate for equipment and support systems?
Tested by	: Witnessed by:
Date of Te	est:

# SECTION 16261 AUTOMATIC TRANSFER SWITCH

# PART1- GENERAL

#### 1.01 Summary

- A. Scope: Furnish and install an automatic transfer switch (ATS) with number of poles, amperages, and voltages, withstand and close-on ratings in a NEMA 3R enclosure as shown on the Contract Drawings (Drawings). The automatic transfer shall consist of a mechanically held power transfer switch unit and a microprocessor controller, interconnected to provide complete automatic operation. The transfer switch and control panel shall be the product of the same manufacturer.
- B. The ATS shall be mounted as shown on the Drawings.

### 1.02 References

A. The automatic transfer switches and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of UL and NEMA as follows:

<u>Reference</u>	<u>Title</u>		
UL 508	Industrial Control Equipment		
UL 1008	Transfer Switches		
UL 991	Test for Safety-Related Controls Employing Solid State Devices		
NFPA 70	National Electrical Code		
NFPA 99	Essential Electrical Systems of Health Care Facilities		
NFPA 110	Emergency and Standby Power Systems		
NEMA ICS 10	AC Transfer Switch Equipment		
IEEE 446	Recommended Practice for Emergency and Standby Power Systems		
IEC 947-6-1	Low-voltage Switchgear and Controlgear; Multifunction equipment; Automatic Transfer Switching Equipment		
IEC 60801-2	Electromagnetic Compatibility for Industrial-Process Measurement and Control Equipment, Electrostatic Discharge Requirements		
IEC 60801-3	Electromagnetic Compatibility for Industrial-Process Measurement and Control Equipment, Radiated Electromagnetic Field Requirements		
IEC 60801-4	Electromagnetic Compatibility for Industrial-Process Measurement and Control Equipment, Electrical Fast Transient/Burst Requirements		
IEC 60801-5	Electromagnetic Compatibility for Electrical and Electronic Equipment, Surge Immunity Requirements		
CISPR 11	Industrial, Scientific, and Medical Radio-Frequency Equipment – Electromagnetic Disturbance Characteristics – Limits and Methods of Measurement		
	Compliant with FCC Part 15, Subpart B, Class A		

# 1.03 Submittals

- A. Submittals shall be as specified in Sections 16010 and 01300.
- B. The following information shall be submitted to the Engineer:
  - 1. Front view and plan view of the assembly
  - 2. Schematic diagram
  - 3. Conduit space locations within the assembly
  - 4. Assembly ratings including:
    - a. Withstand and Closing rating
    - b. Voltage
    - c. Continuous current rating
    - d. Short-Time rating if applicable
    - e. Short-circuit rating if ordered with integral protection
  - 5. Cable terminal sizes
  - 6. Product Data Sheets
  - 7. Wiring diagrams
  - 8. Certified production test reports
  - 9. Installation information
  - 10. Seismic certification as specified.

## 1.04 Quality Assurance

- A. Qualifications
  - 1. The manufacturer of the assembly shall be the manufacturer of major components and control modules installed within the assembly.
  - 2. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
  - 3. The equipment and major components shall be suitable for and certified to meet all applicable seismic requirements of Section 16010, 1.07B.
  - 4. The manufacturer of the ATS shall also have a national service organization that is available throughout the contiguous United States and is available on call 24 hours a day, 365 days a year.
  - 5. The manufacturer shall maintain records of each switch, by serial number, for a minimum of 20 years
- B. Manufacturer's Certification
  - 1. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.
  - 2. The Contractor shall provide three (3) copies of the manufacturer's representative's certification.

- C. Withstand and Closing Ratings
  - 1. The ATS shall be rated to close on and withstand the available RMS symmetrical short circuit current at the ATS terminals with the type of overcurrent protection shown on the plans.
  - 2. The ATS shall be UL listed in accordance with UL 1008 and be labeled in accordance with that standard's 1½ and 3 cycle, long-time ratings. ATSs which are not tested and labeled with 1½ and 3 cycle (any breaker) ratings and have series, or specific breaker ratings only, are not acceptable
- D. Tests and Certification
  - 1. The complete ATS shall be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements.
  - 2. Upon request, the manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards, and withstand and closing ratings. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.
  - 3. The ATS manufacturer shall be certified to ISO 9001 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation and servicing in accordance with ISO 9001

# 1.05 Delivery, Storage, and Handling

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment

# 1.06 Warranty

A. Refer to Section 17506 for requirements

## 1.07 Maintenance

- A. Refer to Section 17506 for requirements.
- B. Equipment operation and maintenance manuals shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.

# PART 2 - PRODUCTS

## 2.01 Manufacturers

- A. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.
  - a. ASCO 7000 Series, Automatic Delayed Transition. No substitutes allowed.

# 2.02 Equipment and Materials

A. General

- 1. The transfer switch shall be rated for the voltage and ampacity as shown on the plans and shall have 600 volt insulation on all parts in accordance with NEMA standards
- 2. The current rating shall be a continuous rating when the switch is installed in an unventilated enclosure, and shall conform to NEMA temperature rise standards
- 3. The unit shall be rated based on all classes of loads, i.e., resistive, tungsten, ballast and inductive loads. Switches rated 400 amperes or less shall be UL listed for 100% tungsten lamp load.
- 4. As a precondition for approval, all transfer switches complete with accessories shall be listed by Underwriters Laboratories, under Standard UL 1008 (automatic transfer switches) and approved for use on emergency systems
- 5. The withstand current capacity of the main contacts shall not be less than 20 times the continuous duty rating when coordinated with any molded case circuit breaker established by certified test data. Refer to required withstand and close ratings as detailed in this specification.
- 6. Temperature rise tests in accordance with UL 1008 shall have been conducted after the overload and endurance tests to confirm the ability of the units to carry their rated currents within the allowable temperature limits.
- 7. Transfer switches shall comply with the applicable standards of UL, cUL, CSA, ANSI, NFPA, IEEE, NEMA.
- 8. The transfer switches shall be supplied with a microprocessor based control panel as detailed further in these specifications
- B. Sequence of Operation
  - 1. The ATS shall incorporate adjustable three phase under and over-voltage and three phase under and over-frequency sensing on the normal source.
  - 2. When the voltage of any phase of the normal source is reduced to 80% or exceeds 110% nominal voltage, or frequency is displaced 2 Hz from nominal, for a period of 0-10 seconds (programmable) a pilot contact shall close to initiate starting of the engine generator.
  - 3. The ATS shall incorporate adjustable three phase under and over-voltage and three phase under and over-frequency sensing on the emergency source.
  - 4. When the emergency source has reached a voltage value within +/- 10% of nominal and achieved frequency within +/- 5% of the rated value, the load shall be transferred to the emergency source after a programmable time delay.
  - 5. When the normal source has been restored to not less than 90% of rated voltage on all phases, the load shall be re-transferred to the normal source after a time delay of 0 to 30 minutes (programmable). The generator shall run unloaded for 5 minutes (programmable) and then automatically shut down. The generator shall be ready for automatic operation upon the next failure of the normal source.
  - 6. If the engine generator should fail while carrying the load, retransfer to the normal source shall be made instantaneously upon restoration of proper voltage (90%) on the normal source.
  - 7. Inspection and operational tests shall be conducted by the contractor in the presence of the Engineer, to indicate that the switch satisfies the specifications.
  - 8. The transfer switch shall be equipped with a microprocessor based control panel. The control panel shall perform the operational and display functions of the transfer switch. The display functions of the control panel shall include ATS position and source availability

- 9. The digital display shall be accessible without opening the enclosure door and shall be provided with a 4 line by 20 character LCD display screen with touch pad function and display menus. The programming functions shall be pass code protected.
- 10. The control panel shall be provided with menu driven display screens for transfer switch monitoring, control and field changeable functions and settings.
- 11. The control panel shall be opto-isolated from electrical noise and provided with the following inherent control functions and capabilities:
  - a. Multipurpose display for continuous monitoring and control of the ATS functions and settings. All field changeable functions shall be pass code protected and accessible through the keypad.
  - b. Built-in diagnostic display that includes the capturing of historical data, such as number of transfers and time on emergency power source, for ease of troubleshooting.
  - c. Capability for external communication and network interface.
  - d. Touch pad test switch with Fast Test/Load/No Load positions to simulate a normal source failure.
  - e. Time delay to override momentary normal source failure prior to engine start. Field programmable 0-10 seconds (adjustable by increments of 0.1 second) factory set at 3 seconds.
  - f. Time delay on retransfer to normal source, programmable 0-60 minutes (adjustable by increments of 0.1 minute) factory set at 30 minutes. If the emergency source fails during the retransfer time delay, the transfer switch controls shall automatically bypass the time delay and immediately retransfer to the normal position.
  - g. Time delay on transfer to emergency, programmable 0-5 minutes, factory set at 1 second.
  - h. Time delay on transfer in either direction in the center-off position, programmable 0-2 minutes, factory set at 5 seconds.
  - i. Terminals for remote test/peak shave operation and transfer inhibit to the emergency source.
  - j. Auxiliary contacts (1 N.O.) shall be provided to indicate normal and emergency source availability.
  - k. A load/no load clock exerciser shall be incorporated within the microprocessor and shall be programmable to start the engine generator set and transfer the load (when selected) for exercise purposes on a weekly basis. The exerciser shall contain a lithium battery for memory retention during an outage.
  - I. A timed auxiliary contact (1 N.C.) adjustable 0-60 seconds shall be provided to allow motor loads to be disconnected prior to transfer in either direction.
  - m. Provide a momentary pushbutton to bypass the time delays on transfer and retransfer and programmable commit/no commit control logic.
- C. Construction and Performance
  - 1. The automatic transfer switch shall be a double throw switch operated by a reliable dual electrical mechanism momentarily energized.
  - 2. The transfer switch shall incorporate a timed, center-off position for motor load decay. Transfer time shall be adjustable from 0-10 seconds. A mechanical interlock shall be provided to ensure that both sets of contacts cannot be closed at the same time.

- 3. For switches installed in systems having ground fault protective devices, and/or wired so as to be designated a separately derived system by the NEC, a 4th pole shall be provided. This additional pole shall isolate the normal and emergency neutrals. The neutral pole shall have the same withstand and operational ratings as the other poles and shall be arranged to break last and make first to minimize neutral switching transients. Add-on or accessory poles that are not of identical construction and withstand capability are not acceptable.
- 4. The contact structure shall consist of a main current carrying contact which is a silver alloy with a minimum of 50% silver content. The current carrying contacts shall be protected by silver tungsten arcing contacts on all sizes above 400 Amps.
- 5. The transfer switch manufacturer shall submit test data for each size switch, showing it can withstand fault currents of the magnitude and the duration necessary to maintain the system integrity. Minimum UL listed withstand and close into fault ratings shall be as follows:

	Any Molded Case Breaker*
Size (Amps)	(RMS Symmetrical)
Up to 100	22,000
101 - 260	30,000
261 - 400	35,000
401 - 1200	50,000
1201 - 4000	100,000
	Specific Coordinated
Size (Amps)	Molded Case Breaker
Up to 100	22,000
101 - 260	42,000
261 - 400	50,000
401 - 800	65,000
801 - 1200	85,000
1201 - 4000	100,000
Size (Amps)	Current Limiting Fuse
Up to 4000	200,000

\*All values 480 volt, RMS symmetrical, less than 20% power factor.

- 6. A dielectric test at the conclusion of the withstand and closing tests shall be performed.
- 7. The automatic transfer switch manufacturer shall certify sufficient arc interrupting capabilities for 50 cycles of operation between a normal and emergency source that are 120 degrees out of phase at 480 volts, 600% of rated current at .50 power factor. This certification is to ensure that there will be no current flow between the two isolated sources during switching.
- 8. All relays shall be continuous duty industrial type with wiping contacts. Customer interface contacts shall be rated 10 amperes minimum. Coils, relays, timers and accessories shall be readily front accessible. The control panel and power section shall be interconnected with a harness and keyed disconnect plugs for maintenance.
- 9. Main and arcing contacts shall be visible without major disassembly to facilitate inspection and maintenance.
- 10. A manual handle shall be provided for maintenance purposes with the switch de-energized. An operator disconnect switch shall be provided to defeat automatic operation during maintenance, inspection or manual operation.

- 11. The switch shall be mounted in a NEMA 3R enclosure unless otherwise indicated on the plans. The enclosure shall include strip heater to two both compartments.
- 12. Switches composed of molded case breakers, contactors or components thereof not specifically designed as an automatic transfer switch will not be acceptable.
- 13. The automatic transfer switch must be equipped with a solenoid protection scheme that removes any attempts of operating the solenoids after (3) consecutive trials until manual intervention by an operator

#### PART 3 - EXECUTION

#### 3.01 Installation

- A. The Contractors shall install all equipment per the manufacturer's recommendations and the contract drawings.
- B. All necessary hardware to secure the assembly in place shall be provided by the Contractor.
- C. The equipment shall be installed and checked in accordance with the manufacturer's recommendations.

#### 3.02 Field Quality Control

- A. Provide the services of a qualified factory-trained manufacturer's representative to assist the contractor in installation and start-up of the equipment specified under this section for a period of two working days. The manufacturer's representative shall provide technical direction and assistance to the contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.
- B. The Contractor shall provide three (3) copies of the manufacturer's field start-up.
- C. Performance Tests
  - 1. Field test and calibrate timing and monitoring logic. All adjustment shall be within 5% of the previously specified set points.
  - 2. Field test the transferring of loads between normal and emergency power sources as follows:
    - a. Start loads located downstream of the ATS.
    - b. De-energize the normal power source. Verify that the standby generator starts and the load is transferred to the standby source.
    - c. Energize the normal source. Verify that after the selected time delay, the load is transferred to the normal power source. Verify that after the load is switched the generator continues to operate unloaded for the time specified. At the end of the period verify that the generator shuts off.
  - 3. Field test and calibrate the in-phase monitor. Demonstrate that the switch transfers when source phase differences are within 20 degrees under varying generator speeds.
  - 4. Notify the Engineer in writing 48 hours in advance of testing for witness.

#### 3.03 Adjusting / Cleaning / Protection

- A. Training
  - 1. The contractor shall provide a training session for up to five (5) City's representatives for one 4-hour training at a jobsite location determined by the Engineer.
  - 2. The training session shall be conducted by a manufacturer's qualified representative. The training program shall consist of the instruction on the operation of the assembly, circuit breakers and major components within the assembly

# SECTION 16320 SURGE PROTECTIVE DEVICES

## PART1- GENERAL

### 1.01 Summary

A. Scope: The Contractor shall furnish and install the Surge Protective Device (SPD) equipment having the electrical characteristics, ratings, and modifications as specified herein and as shown on the contract drawings. To maximize performance and reliability and to obtain the lowest possible let-through voltages, the ac surge protection shall be integrated into electrical distribution equipment such as switchgear, switchboards, panelboards, ATS, busway (integrated within bus plug), or motor control centers (MCC).

## 1.02 References

A. SPD units and all components shall be designed, manufactured, and tested in accordance with the latest applicable standards:

<u>Reference</u>	Title
ANSI/IEEE C62.62	Test Specifications for Surge Protection Devices for Low Voltage AC Power Circuits
ANSI/IEEE C62.41	Recommended Practice on Surge Voltages in Low Voltage AC Power Circuits
ANSI/IEEE C62.45	Recommended Practice on Surge Testing for Equipment Connected to Low Voltage (1000V and Less) AC Power Circuits
IEEE C62.43	Guide for the Application of Surge Protectors Used In Low –Voltage Data, Communications, and Signaling Circuits
IEEE C62.48	IEEE Guide on Interactions Between Power System Disturbances and Surge-Protective Devices
FIPS Pub 94	Guideline on Electrical Power for ADP Installations
NEMA LS-1	Low Voltage Surge Protective Devices
NFPA 70	National Electrical Code
NFPA 780	Standard for the Installation of Lightning Protection Equipment
UL 96A	Installation Requirements for Lightning Protection Systems
UL 1449	Surge Protective Devices
UL 1283	Electromagnetic Interference Filters

- B. International Standards Organization (ISO) Company certified ISO 9001 for manufacturing, design and service.
- C. The systems individual units shall be UL Listed and labeled under UL 1449 Standard for Surge Protective Devices (SPD) and the surge ratings shall be permanently affixed to the SPD. The units shall also be listed and labeled to UL1283 Standard for Electromagnetic Interference Filters, and CSA Listed.
- D. The specified system shall be thoroughly factory-tested before shipment. Testing of each system shall include but shall not be limited to quality control checks, "Hi-Pot" tests at two times rated

voltage plus 1000 volts per UL requirements, IEEE C62.41 Category B surge tests, UL ground leakage tests, and operational and calibration tests.

# 1.03 System Description

- A. 480 Volt Connections
  - 1. These specifications are based on the Eaton's SPD Series or equal for use on the 480V power connection points indicated on the contract documents. Other manufacturers shall provide detailed compliance or exception statements to all provisions of this specification to allow consideration.
- B. 120/208 Volt Connections
  - 1. These specifications are based on the Eaton's SPD Series or equal for use on the 120/208 V power connection points indicated on the contract documents. Other manufacturers shall provide detailed compliance or exception statements to all provisions of this specification to allow consideration.

## 1.04 Submittals

- A. Submittals shall comply with the provisions set forth in Sections 01300 and 16010.
- B. Documentation
  - 1. Equipment Manual: The manufacturer shall furnish an installation manual with installation, start-up, and operating instructions for the specified system.
  - 2. Drawings: Electrical and mechanical drawings shall be provided by the manufacturer which show unit dimensions, weights, component and connection locations, mounting provisions, connection details, and wiring diagram.
  - 3. UL 1449 Ratings: Provide verification that the SPD complies with the required ANSI/UL 1449 4th Edition or later listing by Underwriters Laboratories (UL). Compliance may be in the form of a file number that can be verified on UL's website <u>www.ul.org</u>, the website should contain the following information at a minimum: model number, SPD Type, system voltage, phases, modes of protection, Voltage Protection Rating (VPR), and Nominal Discharge Current In.
  - 4. Spare Parts: A list of recommended spare parts shall be supplied at the customer's request

## 1.05 Quality Assurance

- A. The specified system shall be tested at the component and fully assembled level, under surge conditions with AC power applied for a minimum of 1 hour. Testing shall include but not be limited to quality control checks, dielectric voltage withstand test per UL and CSA requirements, UL ground continuity tests and operational and calibration tests.
  - 1. The manufacturer of the electrical distribution equipment shall be the manufacturer of the SPD within the listed electrical distribution equipment.
  - 2. For the equipment specified herein, the manufacturer shall be ISO 14001 and ISO 9001 or 9002 certified.
  - 3. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of twenty-five (25) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
  - 4. The SPD shall be compliant with the Restriction of Hazardous Substances (RoHS) Directive 2011/65/EU and have a visible label showing compliance.

5. The SPD shall be UL 1449 current edition listed, 20 kA In Type 1 or Type 2 for use in UL 96A systems

# 1.06 Delivery, Storage, and Handling

- A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of manufacturer's instructions shall be included with the equipment at time of shipment.
- B. Refer to Section 16010, 1.07 for additional requirements.

# 1.07 Warranty

A. The manufacturer shall provide a ten (10) year warranty (15 year warranty with registration) that covers replacement of the complete unit, including lightning, from the date of shipment against any SPD part failure when installed in compliance with manufacturer's written instructions and any applicable national or local electrical code..

## 1.08 Maintenance

A. Refer to Section 17506 for requirements

# PART 2 - PRODUCTS

### 2.01 Manufacturers

- A. Eaton SPD Series, Liebert or approved equal.
  - The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features, and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

## 2.02 Voltage Surge Suppression – General

- A. Electrical Requirements
  - 1. Unit Operating Voltage Refer to drawings for operating voltage and unit configuration.
  - 2. Maximum Continuous Operating Voltage (MCOV) The MCOV shall not be less than 115% of the nominal system operating voltage.
  - 3. The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards. End of life mode to be open circuit. Unit with end of life short-circuit mode are not acceptable.
  - 4. Unit shall operate without the need for an external overcurrent protection device (OCPD), and be listed by UL as such. Unit must not require external OCPD or replaceable internal OCPD for the UL Listing.
  - 5. Protection Modes The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

	Protection Modes			
Configuration	L-N	L-G	L-L	N-G
Wye	•	•	•	•
Delta	N/A	•	•	N/A
Single Split Phase	•	•	٠	٠
High Leg Delta	•	•	٠	٠

- 6. Nominal Discharge Current (In) All SPDs applied to the distribution system shall have a 20kA In rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an In less than 20kA shall be rejected.
- ANSI/UL 1449 4<sup>th</sup> Edition Voltage Protection Rating (VPR) The maximum ANSI/UL 1449 4<sup>th</sup> Edition VPR for the device shall not exceed the following:

Modes	208Y/120	480Y/277	600Y/347
L-N; L-G; N-G	700	1200	1500
L-L	1200	2000	3000

# B. SPD Design

- Maintenance Free Design The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable single-mode modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.
- Balanced Suppression Platform The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable SPD modules shall not be accepted.
- Electrical Noise Filter Each Type 2 unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted.
  - a. Type 2 units with filtering shall conform to UL 1283 5<sup>th</sup> Edition
  - b. Type 1 units shall not contain filtering or have a UL 1283 5<sup>th</sup> Edition Listing.
- 4. Internal Connections No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.
- 5. Monitoring Diagnostics Each SPD shall provide the following integral monitoring features:
  - a. Protection Status Indicators Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.

- For wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also contain an additional green / red solid-state indicator light that reports the status of the protection elements and circuitry in the N-G mode. SPDs that indicate only the status of the L-N and L-G modes shall not be accepted.
- 2) For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes.
- 3) The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.
- b. Remote Status Monitor The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.
- c. Audible Alarm and Silence Button– The SPD shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.
- d. Surge Counter The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location. The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of 50 ± 20A occurs. A reset pushbutton shall also be standard, allowing the surge counter to be zeroed. The reset button shall contain a mechanism to prevent accidental resetting of the counter via a single, short-duration button press. In order to prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of 2 seconds in order to clear the surge count total.
  - The ongoing surge count shall be stored in non-volatile memory. If power to the SPD is completely interrupted, the ongoing count indicated on the surge counter's display prior to the interruption shall be stored in non-volatile memory and displayed after power is restored. The surge counter's memory shall not require a backup battery in order to achieve this functionality.
- 6. Thermal MOV Protection.
  - a. The unit shall contain thermally protected MOVs. These self-protected MOVs shall have a thermal protection element integrated with the MOV and a mechanical disconnect with arc quenching capabilities in order to achieve overcurrent protection of the MOV. The thermal protection assembly shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.
- Fully Integrated Component Design All of the SPD's components and diagnostics shall be contained within one discrete assembly. The use of plug in single-mode modules that must be ganged together in order to achieve higher surge current ratings or other functionality shall not be accepted.
- 8. Safety Requirements:
  - a. The SPD shall minimize potential arc flash hazards by containing no single-mode plug in user serviceable / replaceable parts and shall not require periodic maintenance. SPDs containing items such as replaceable single-mode plug in modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort
such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

b. SPDs designed to interface with the electrical assembly via conductors shall require no user contact with the inside of the unit. Such units shall have any required conductors be factory installed.

## 2.03 System Application:

- A. The SPD applications covered under this section include distribution and branch panel locations, busway, motor control centers (MCC), switchgear, and switchboard assemblies. All SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments.
- B. Surge Current Capacity The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table.

Minimum surge current capacity based on ANSI / IEEE C62.41 location category				
Category	Application	Per Phase	Per Mode	
С	Service Entrance Locations	250 kA	125 kA	
	(Switchboards, Switchgear, MCC,			
	Main Entrance)			
В	High Exposure Roof Top Locations	160 kA	80 kA	
	(Distribution Panelboards)			
A	Branch Locations (Panelboards,	120 kA	60 kA	
	MCCs, Busway)			

## 2.04 Switchgear, Switchboard, ATS, MCC and Busway Requirements

- A. The SPD application covered under this section is for switchgear, switchboard, MCC, and busway locations. Service entrance located SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C environments.
- B. Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.
- C. The SPD shall be connected through a disconnect (circuit breaker). The disconnect shall be located in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.
- D. The SPD shall be integral to switchgear, switchboard, MCC, and/or bus plug as a factory standardized design.
- E. All monitoring and diagnostic features shall be visible from the front of the equipment.

## 2.05 Service Entrance Requirements:

A. Service entrance located SPDs shall be tested and designed for applications within ANSI/IEEE C62.41 Category C environments.

# PART 3 - EXECUTION

## 3.01 Installation

- A. The installation of the SPD shall be factory installed integral to the distribution equipment. The Contractor shall install all distribution equipment per the manufacturer's recommendations, applicable electrical codes and the contract drawings.
- B. 480 volt SPD units shall be provided for the automatic transfer switch panel noted on the contract drawings

## SECTION 16330 VARIABLE FREQUENCY DRIVES

## PART 1 - GENERAL

### 1.01 SUMMARY

- A. Scope: This section provides specifications for variable frequency drive (VFD) units as indicated in the contract drawings.
- B. This specification describes a complete Variable Frequency Drive (VFD) used to control the speed of NEMA design B induction motors used in areas where low harmonic content is desired or mandated.
- C. The VFD shall be open type to be mounted in the existing MCC section with the HMI to be mounted on the MCC door.

### 1.02 References

A. All work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these specifications.

<u>Reference</u>	Title
EIA, TIA: 359-1	Special Colors
IEEE 112	Standard Test Procedure for Polyphase Induction Motors and Generators
IEEE 519	Recommended Practices and Requirements for Harmonic Control in Electric Power Systems
IEEE C62.41	Recommended Practice on Surge Voltages in Low Voltage AC Power Circuits
NEMA CP 1	Shunt Capacitors
NEMA MG 1	Motors and Generators
NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA WC-57	Control Cables
NFPA	Electrical Standard for Industrial Machinery

# 1.03 SUBMITTALS

- A. The Submittals shall include the following information:
  - 1. Outline Dimensions and Weight.
  - 2. Customer connection and power wiring diagrams.
  - 3. Complete technical product description including a complete list of options provided.
  - 4. Compliance to IEEE 519-2014 Harmonic analysis for particular jobsite including total voltage harmonic distortion and total current distortion. In case an alternative low harmonics solution is offered, the drive manufacturer shall provide calculations, specific to this installation, showing total harmonic current distortion (TDD), at the Point of Common Coupling (PCC), is less than required.
  - 5. Product Data Sheets
  - 6. Wiring diagrams
  - 7. Certified production test reports
  - 8. Installation information

# PART 2 - PRODUCTS

## 2.01 Manufacturers

- A. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.
  - a. ABB 880-31 Ultra Low Harmonic (ULH) drive, open type and mountable in MCC section. No substitutes allowed.

# 2.02 DESIGN

- A. The VFD shall be solid state AC to AC inverter controlled device utilizing the latest isolated gate bipolar transistor (IGBT) technology.
- B. The drive shall be an Ultra Low Harmonic Adjustable Speed AC Drive that is designed to comply with standard IEEE 519-2014 when installed into system that already is in compliance with the standard.

## 2.03 HARMONICS

- A. The Ultra Low Harmonic construction of the VFD shall not contribute any significant harmonics at the input terminals of the VFD, and shall maintain harmonics levels at the VFD's input terminals to levels at or below those listed in "Harmonic Control in Electrical Power Systems, IEEE Std. 519-2014." in the system that already is in compliance with the said standard.
- B. All harmonic management devices must be internal to the VFD enclosure and supplied as a complete solution.
- C. The VFD shall have an active line supply unit which controls the waveform of the input current and reduces the low order harmonic current drawn from the power line. Line currents and voltages shall be nearly sinusoidal. IGBTs shall be used in the rectified and inverter circuits.

- D. Each input phase of the VFD shall incorporate a symmetrical LCL filter arranged in a Tconfiguration. The inductors are to be series power components that carry the full current of the VFD.
- E. The input current to the VFD shall have a total harmonic content less than 5% of full rated capability at the input terminals of the VFD on power system sized according to IEEE 519-2014 at line voltage unbalance up to 3% and under all motor load conditions.
- F. The VFD shall operate at fundamental power factor 1.0 on the supply side under all motor load conditions.
- G. The input power factor shall be programmable from 0.8 lagging to 0.8 leading, allowing the VFD to be used as a compensating device for installations that are excessively inductive or excessively capacitive in reactive power. The reactive power required by other loads connected to the same distribution system may be compensated for by the providing that VFD has sufficient capacity for reactive and active loads.
- H. The VFD's design shall not compensate for existing harmonic content in the distribution system.

## 2.04 RATINGS

- A. The VFD shall be rated to operate from 3-phase power at 380 VAC to 500 VAC +10/-10% / (600 VAC, UL and CSA) +10/-10%. The overvoltage trip level shall be a minimum of 30% over nominal, and the undervoltage trip level shall be a minimum 35% under the nominal voltage.
- B. The VFD shall be rated to operate at the following environmental operating conditions: ambient temperature 0 to 40°C continuous. VFDs that can operate at 40° C intermittently (during a 24 hour period) are not acceptable and must be oversized. Altitude 0 to 3300 feet above sea level without derating, less than 95% humidity, non-condensing.
- C. The VFD shall be rated to operate from input power from 48 Hz to 63 Hz.
- D. Output voltage and current ratings shall match the adjustable frequency operating requirements of standard NEMA design A or NEMA design B motors.
- E. The normal duty overload current capacity shall be 110% of rated current for one (1) minute out of five (5) minutes.
- F. The heavy duty overload current capacity shall be 150% of rated current for one (1) minute out of five (5) minutes.
- G. The VFD efficiency shall be 97% or better of the full rated capability of the VFD at full speed and load. In case an alternative low harmonics solution is offered, the overall efficiency of the VFD and the harmonic mitigation components shall meet the efficiency requirement.

## 2.05 CONSTRUCTION

- A. The latest, most efficient IGBT power technology shall be used. This technology shall be used for all power and voltage ranges offered by the manufacturer.
- B. The VFD shall offer microprocessor based control logic that is isolated from power circuitry.
- C. The VFD shall use the same main control board for all ratings.
- D. Control connections shall remain consistent for all power ratings.
- E. The VFD shall employ an active AC to DC rectifier (commonly referred to as an active supply unit).
- F. Cicuit breaker for disconnect and fast acting fues shall be provided.

## 2.06 OPERATOR INTERFACE

- A. The VFD shall be equipped with a front mounted operator control panel consisting of a four- (4-) line by 20-character back-lit alphanumeric LCD display and a keypad with keys for Run/Stop, Local/Remote, Increase/Decrease, Reset, Menu navigation and Parameter select/edit.
- B. The keypad shall be removable, capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs.
- C. The display of the control unit shall have the following features:
- D. The LCD display shall have contrast adjustment provisions to optimize viewing at angle.
- E. All parameter names, fault messages, warnings and other information shall be displayed in complete American English words or standard American English abbreviations to allow the user to understand what is being displayed without the use of a manual or cross-reference table.
- F. During normal operation, one (1) line of the control panel shall display the speed reference, and run/stop forward/reverse and local/remote status. The remaining three (3) lines of the display shall be programmable to display the values of any three (3) operating parameters. The selection shall include at least the following values:
  - 1. Speed/torque in percent (%), RPM or user-scaled units
  - 2. Output frequency, voltage, current and torque
  - 3. Input voltage, power and kilowatt hours
  - 4. Heatsink temperature and DC bus voltage
  - 5. Status of discrete inputs and outputs
  - 6. Values of analog input and output signals
  - 7. Values of PID controller reference, feedback and error signals
- G. The keypad shall be used for local control, for setting all parameters, and for stepping through the displays and menus.
- H. A copy function to upload and store parameter settings from an VFD and download stored parameter settings to the same VFD or to another VFD shall exist.
- I. An intelligent start-up assistant shall be provided as standard. The Start-up routine will guide the user through all necessary adjustments to optimize operation.
- J. The Start-Up routine shall include "plug and produce" operation, which automatically recognizes the addition of options and fieldbus adapters and provides the necessary adjustment assistance.
- K. The Start-Up routine shall prompt the user for Motor Nameplate Data including power, speed, voltage, frequency and current.
- L. An auto-tune function shall identify the optimal motor tuning parameters for typical applications.
- M. An auto-tune function shall also be available to tune the PID speed regulator loop. Manual adjustments shall also be allowed.
- N. A selection of at least six (6) preprogrammed application macro parameter sets shall be provided to minimize the number of parameter adjustments required during start-up. Macros offered shall include Factory Default, Hand/Auto, PID Control, and Torque Control. A selection of two (2) user defined macros shall are also be available.

## 2.07 PROTECTIVE FEATURES

- A. For each programmed warning and fault protection function, the VFD shall display a message in complete English words or Standard English abbreviations. The five (5) most recent fault messages and times shall be stored in the VFD's fault history.
- B. The VFD shall include internal MOV's for phase to phase and phase to ground line voltage transient protection.
- C. Output short circuit and ground fault protection rated for 100,000 amps without relying on line fuses shall be provided per UL508C.
- D. Motor phase loss protection shall be provided.
- E. The VFD shall provide electronic motor overload protection qualified per UL508C.
- F. Protection shall be provided for AC line or DC bus overvoltage at 130% of maximum rated voltage or undervoltage at 65% of min. rated voltage.
- G. The VFD shall protect itself against input phase loss.
- H. A power loss ride through feature shall allow the VFD to remain fully operational after losing power as long as kinetic energy can be recovered from the rotating mass of the motor and load.
- I. Stall protection shall be programmable to provide a warning or stop the VFD after the motor has operated above a programmed torque level for a programmed time limit.
- J. Underload protection shall be programmable to provide a warning or stop the VFD after the motor has operated below a selected underload curve for a programmed time limit.
- K. Over-temperature protection shall provide a warning if the power module temperature is less than 5°C below the over-temperature trip level.
- L. Input terminals shall be provided for connecting a motor thermistor (PTC type) to the VFD's protective monitoring circuitry. An input shall also be programmable to monitor an external relay or switch contact.

# 2.08 CONTROL INPUTS AND OUTPUTS

- A. Discrete Inputs
  - 1. A minimum of six (6) discrete inputs shall be provided.
  - 2. A minimum of six (6) of the inputs shall be independently programmable with function selections (run/stop, hand-off-auto, etc.).
  - 3. Inputs shall be designed for use with either the VFD's internal 24 VDC supply or external 24 VDC supply.
- B. Discrete outputs
  - 1. Minimum of two (2) form C relay contact outputs shall be provided.
  - 2. All outputs shall be independently programmable to activate with at least 30 function selections including;
  - 3. Operating conditions such as drive ready, drive running, reversed and at set speed
  - 4. General warning and fault conditions
  - 5. Adjustable supervision limit indications based on programmed values of operating speed, speed reference, current, torque and PID feedback.
  - 6. Relay contacts shall be rated to switch 2 Amps at 24 VDC or 115/230 VAC.
- C. Analog Inputs

- 1. Minimum of two (2) analog inputs shall be provided:
- 2. At least one (1) must support bi-polar voltage input.
- 3. Resolution of analog inputs must be at least 11 bit total resolution.
- D. All inputs shall be independently programmable with input function selections.
- E. A differential input isolation amplifier shall be provided for each input.
- F. Analog input signal processing functions shall include scaling adjustments, adjustable filtering and signal inversion.
- G. If the input reference is lost, the VFD shall give the user the option of the following. The VFD shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus.
  - 1. Stopping and displaying a fault
  - 2. Running at a programmable preset speed
  - 3. Hold the VFD speed based on the last good reference received
  - 4. Cause a warning to be issued, as selected by the user.
- H. When inputs are used as speed references, reference signal processing shall include increase/decrease floating point control and control of speed and direction using a "joystick" reference signal. Two (2) analog inputs shall be programmable to form a reference by addition, subtraction, multiplication, minimum selection or maximum selection.
- I. Analog Outputs
  - 1. Minimum of two (2) 4 to 20 mA analog outputs shall be provided.
  - 2. Outputs shall be independently programmable to provide signals proportional to output function selections including output speed, frequency, voltage, current and power.

# 2.09 COMMUNICATIONS

- A. The VFD shall be capable of communicating with other VFDs or controllers via a serial communications link or Ethernet. A variety of communications interface modules for the typical overriding control systems shall be available.
- B. Interface modules shall mount directly to the VFD control board or be connected via fiber optic cables to minimize interference and provide maximum throughput.
- C. I/O shall be accessible through the serial communications adapter. Serial communication capabilities shall include, but not be limited to:
  - 1. Run-Stop control
  - 2. Hand-Off-Auto Control
  - 3. Speed Adjustment
  - 4. PID (proportional/integral/derivative) control adjustments
  - 5. Current Limit
  - 6. Accel/Decel time adjustments
- D. The VFD shall have the capability of allowing the overriding controller to monitor feedback such as process variable feedback, output speed/frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), relay outputs, and diagnostic warning and fault information.

E. A connection shall also be provided for personal computer interface. Software shall be available for VFD setup, diagnostic analysis, monitoring and control. The software shall provide real time graphical displays of VFD performance.

## 2.10 CONTROL FUNCTIONS AND ADJUSTMENTS

- A. Output frequency shall be adjustable between 0 Hz and 300 Hz. Operation above motor nameplate shall require programming changes to prevent inadvertent high-speed operation.
- B. Stop mode selections shall include coast to stop and ramp to stop.
- C. The VFD shall be capable of controlling deceleration of a load without generating an overvoltage fault caused by excessive regenerated energy. Overvoltage control on deceleration shall extend the ramp time beyond the programmed value to keep the amount of regenerated energy below the point that causes overvoltage trip.
- D. The VFD shall be capable of starting into a rotating load (flying start) regardless of motor direction. It should then accelerate or decelerate to the active reference without tripping on fault or causing component damage. The VFD shall also be capable of flux braking at start to stop a reverse spinning motor prior to ramp.
- E. The VFD shall have the ability to automatically restart after an overcurrent, overvoltage, undervoltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between reset attempts shall be programmable.
- F. Control functions shall include two (2) sets of acceleration and deceleration ramp time adjustments with linear and an s-curve ramp time selection.
- G. Speed control functions shall include:
  - 1. Adjustable min/max speed limits.
  - 2. Selection of up to 15 preset speed settings for external speed control.
  - 3. Three sets of critical speed lockout adjustments.
- H. A built-in PID controller to control a process variable such as pressure, flow or fluid level.
- I. Functions shall include flux optimization to limit the audible noise produced by the motor and to maximize efficiency by providing the optimum magnetic flux for any given speed operating point.
- J. The VFD shall be capable of sensing a loss of load (broken belt / broken coupling) and signal the loss of load condition. The VFD shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. Relay output shall include programmable time delays that will allow for VFD acceleration from zero speed without signaling a false underload condition.
- K. Three (3) programmable critical frequency lockout ranges shall be provided to prevent the VFD from operating the load continuously at an unstable speed.
- L. The VFD shall offer software to select the VFDs action in the event of a loss of the primary speed reference.
- M. The VFD shall have fifteen (15) internal adaptive programming blocks capable of twenty (20) different functions. These blocks shall be connectable to VFD's actual signals and functions allowing the user to tailor the VFD to the specific application requirements without additional hardware. These blocks shall be programmable through the standard operator panel and through the use of programming software.

## PART 3 - EXECUTION

## 3.01 Preparation

A. The drive manufacturer shall provide adequate drawings and instruction material to facilitate installation of the Drive by qualified electrical and mechanical personnel employed by others.

## 3.02 Factory Testing

- A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of UL and NEMA standards.
  - 1. All printed circuit boards shall be functionally tested via automatic test equipment prior to unit installation.
  - 2. All inverter power sub-assemblies shall undergo a burn-in test.
  - 3. After all pre-tests have been performed, each complete VFD shall undergo a burn-in test. The drive shall be burned in with a motor load without an unscheduled shutdown.
- B. The manufacturer shall provide three (3) certified copies of complete VFD final test reports

### 3.03 Installation

- A. Variable frequency drives shall be located in separate free-standing enclosures as indicated on the contract drawings.
- B. The system integrator shall employ personnel that are skilled and experience in the installation, testing and startup of VFDs along with accessories. All installation labor shall be performed by qualified personnel who have had experience on similar projects.
- C. The Contractor shall ensure that all equipment and materials fit properly in their installation.
- D. Any work or rework required to correct improper installations shall be performed at no additional costs to the City.
- E. All manufacturers' instructions shall be followed regarding the handling, receiving, installation, and pre-check requirements prior to energization.
- F. Once the VFD units are energized, all manufacturers' instructions shall be followed regarding programming, set-up and calibration of equipment.

#### 3.04 Field Quality Control

- A. The services of a qualified representative of the VFD manufacturer shall be furnished to inspect the installation, place it in operation, make any necessary adjustments, and instruct the plant personnel in its operation and maintenance. A minimum of eight hours training shall be provided.
- B. The Manufacturer's Representative shall provide start-up service including site inspection, final adjustments, operational checks, functional checks, and a startup record. The start-up engineer shall measure actual harmonics on the system on both the utility and generator with a Dranetz or BMI harmonic spectrum analyzer.
- C. The Contractor under the technical direction of the manufacturer's service representative shall perform the following minimum work.
  - 1. Inspection and final adjustments.
  - 2. Operational and functional checks of VFD and spare parts.
  - 3. The contractor shall certify that he has read the drive manufacturer's installation instructions and has installed the VFD in accordance with those instructions.

4. The Contractor shall provide three (3) copies of the manufacturer's field start-up report before final payment is made.

## 3.05 Maintenance/Warranty Service:

A. Warranty to commence 12 months from the date of start-up, not to exceed 18 months from the date of shipment.

## 3.06 Field Testing

- A. The VFD manufacturer shall perform harmonic measurements at the point where the utility feeds multiple customers (PCC) to verify compliance with IEEE519-2014. A report of the voltage THD and current TDD shall be sent to the engineer. The contractor shall provide labor, material, and protection as needed to access the test points. The readings shall be taken with all drives and all other loads at full load, or as close as field conditions allow.
- B. After the installation of the pumps, VFD's and all controls and appurtenances, the pumps shall be subjected to a field running test under actual operating conditions. The field tests shall be made in the presence of the Contract Manager. The field tests shall demonstrate that under all conditions of operation the unit:
  - 1. Has not been damaged by transportation or installation.
  - 2. Has been properly installed.
  - 3. Has no mechanical defects.
  - 4. Has been properly connected.
  - 5. Is in proper alignment.
  - 6. Is free of overheating of any parts.
  - 7. Is free of all objectionable vibration.
  - 8. Is free of excessive noise.
  - 9. Is free of overloading of any parts.
  - 10. Shall operate as specified with the control system.
- C. Record all VFD parameter setting as configured in the field. Data shall be included in the O& M Manual.

# SECTION 16450 GROUNDING

## PART1- GENERAL

#### 1.01 Summary

A. Type: The equipment and material supplied under this section shall include ground rods, electrodes, conductors, and ground wires, to make a complete ground system.

#### 1.02 References

A. All work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these specifications.

<u>Reference</u>	<u>Title</u>
IEEE C2	National Electrical Safety Code
NFPA 70	National Electrical Code

#### 1.03 Submittals

A. Submittals shall comply with the provisions set forth in 16010.

#### 1.04 Quality Assurance

- A. Performance and Design Requirements: The grounding system shall bond together and effectively ground all exposed non-energized metal surfaces containing energized parts, devices or conductors, all building steel, all metallic electrical raceways and the neutrals of all transformers.
- B. Inspection: All ground connection shall be inspected by the Engineer prior to backfill or placing of the concrete

#### PART 2 - PRODUCTS

#### 2.01 Equipment and Materials

- A. Ground Rods: Ground rods shall be one piece, 3/4-inch in diameter by 10 feet in length and shall be copper clad steel. The copper exterior shall be molten welded to the steel core. The rod heads shall be chamfered to prevent mushrooming during driving.
- B. Ground Wires: Ground wires shall be bare copper wires with Class B stranding. Size shall be as shown.
- C. Connections
  - All ground connections below grade for copper shall be made by the exothermic weld process. They shall be Cadweld, Thermoweld, or equal, made with Cadweld, Thermoweld, or equal, molds and clamps. All connections in the ground wells shall be made with a bolted ground clamp and shall be Copperweld Type "AB" with hex head set screw, Weaver Type W, or equal.
  - 2. All connections above grade to equipment ground buses and flat copper bars shall have a 2 bolt pad and shall be bolted with nonferrous hexagon head bolts and nuts with spring lock

washers. They shall be Burndy Type "QA-B," Thomas & Betts Lock-Tite, or equal. All connections to motor shall be as shown.

- 3. Connections to miscellaneous boxes, cabinets, panels, etc., shall be Burndy type "KC" servitposts, Thomas & Betts split bolt connector, or equal.
- D. The utility service entrance switchboard ground bus shall be tied to an area ground grid consisting of a ground ring with ground rods as shown on the contract drawings.
- E. The grounding system shall be as shown and as required by codes and regulations and shall include the following as applicable:
  - 1. Metallic conduits supplemented with a ground wire installed in the conduit for all circuits except control circuits.
  - 2. An equipment grounding conductor installed in all nonmetallic conduit carrying power to any equipment.
- F. All ground conductors entering handholes, manholes, pull boxes, terminal boxes, or any other enclosure shall be bonded together and shall be bonded to the enclosure if it is metallic and to all metallic raceways within or terminating at the enclosure. An insulated grounding bushing shall be installed with a code size equipment grounding conductor bonded to the equipment frame for all conduits terminating under an enclosure containing no metal floor plate, or at sheet metal panels which are not fastened to the equipment frame solidly enough to provide an effective ground connection. This will commonly be the case with switchgear, switchboards and MCCs.
- G. Cable shielding, metallic conduits, wireways, metal enclosure of bus ways, cable boxes, electrical equipment housings, and all noncurrent-carrying metallic parts of the installation shall be grounded. The conduit system shall be used for equipment and enclosure grounding but not as a system ground conductor. A code sized green insulated copper grounding conductor shall be included in all nonmetallic and flexible conduits.
- H. System neutral conductors shall be grounded at the point of service ahead of the main disconnect to a grounding electrode and to a domestic cold water main as required by code. Transformer neutral shall be grounded from the neutral bushing and solidly grounded to earth. If metallic domestic water system is greater than 100 feet remote, furnish a system ground conductor in conduit to the established system grounding electrode.
- I. All conduit stub-ups shall be grounded, and where multiple stub-ups are made within an equipment enclosure, such as a service pedestal, they shall be equipped with grounding bushings and bonded together and to the enclosure and the enclosure ground bus.
- J. All services and feeder runs (and branch circuit wiring excluding light circuits) in nonmetallic or flexible conduit shall carry one green THWN/XHHW insulated code sized ground conductor per conduit.
- K. Bonding devices, fittings, or jumpers shall be provided at expansion fittings, isolation sections, or wherever continuity of ground is broken.

## 2.02 Fabrication

- A. Grounding Techniques
  - 1. The grounding electrode shall consist of a combination of the following systems as required to accomplish a resistance to ground not to exceed 5 ohms.
    - a. The utility service entrance switchboard ground bus shall be tied to an area ground grid consisting of a ground ring with ground rods as shown on the contract drawings.
    - b. Bare Wire under Foundations

1) The preferred method shall be a 20-foot length of bare No. 4/0 copper wire extended its full length below ground level and embedded along the bottom of the concrete foundation footing which is in direct contact with the earth and supported in such a manner that it cannot be less than 3 inches from the bottom or side of the concrete when the foundation concrete is poured. A loop at the approximate center of this grounding electrode shall be brought out at the top of the foundation and a No. 4/0 copper ground conductor shall be connected to this loop with a pressure-type solderless connector and extended to the service equipment and to the metallic cold water system and properly connected thereto.

## PART 3 - EXECUTION

#### 3.01 Examination:

A. The existing grounding system shall be evaluated and tested by the contractor. Where deemed acceptable, the existing grounding system components may be used to used to meet criteria required by this specification where approved in writing by the Engineer. As a minimum, the existing grounding system shall be connected with the new grounding system components required by this specification.

### 3.02 Installation

- A. All grounding system components shall be installed in accordance with the contract drawings, NEC, and the manufacturer's recommendations and instructions.
- B. Provide a separate grounding conductor in each raceway, securely grounded to equipment at each end of the raceway.
- C. Contractor shall not cover or conceal any ground connections until the Engineer has established that every grounding connection conforms to the Contract Drawings and Specifications. Contractor shall provide a form to sign off each grounding connection and shall obtain signature from the Engineer.
- D. Electrical Equipment Grounding
  - 1. Metal conduits shall be bonded together to the enclosure grounding bus.
  - 2. Lightning arresters or suppressors shall be directly connected to the ground system using copper conductors sized in accordance with NEC requirements.
  - 3. The secondary neutrals of transformers shall be directly connected to the ground system using copper conductors sized as per NEC or as indicated on the contract drawings.
  - 4. All motors shall be grounded by bonding the grounding conductor within the raceway to the motor frame. Motors as shown on the contract drawings shall also have a supplemental grounding conductor bonded to the ground grid in the immediate area of the motor.
- E. Each panelboard shall have a ground bus that is secured to the interior of the enclosure. The bus shall be equal to panelboard neutral bus amp rating and shall have adequate lug quantity of lugs. No more than two grounding conductors shall be installed per lug.

## 3.03 Field Quality Control

- A. Performance Tests
  - 1. The existing and new grounding system components shall be tested per this specification section.

- 2. The Contractor shall test each ground rod, ground mat and water pipe, structure or other major system grounding connection to determine the ground resistance. The grounding check shall be made by the "fall of potential" method utilizing a commercial ground test instrument such as the Biddle Model 593 "megger" ground check or the Associated Research Vibroground Model 225, or equal. A plot of ground resistance readings for each isolated ground rod or ground mat shall be submitted to the Engineer. The current reference rod shall be driven at least 100 feet from the ground rod or grid under test, and the measurements shall be made at 10-foot intervals beginning 15 feet from the test electrode and ending 75 feet from it, all in direct line between the ground rod or center of grid and the current reference electrode.
- 3. Any grounding system that shows greater than 5 ohms resistance for the flat portion of the plotted data shall be considered inadequately grounded. The Contractor shall add additional parallel connected ground rods and/or deeper driven rods until the ground resistance measurements meet the 5 ohms requirement. Use of salts, water or compounds to attain the specified ground resistance is forbidden.

## 3.04 Adjusting / Cleaning / Protection

A. At no additional expense to the City, provide any necessary work to correct improper installations.

## SECTION 17010 GENERAL REQUIREMENTS, INSTRUMENTATION

## PART1- GENERAL

#### 1.01 Summary:

- A. Scope: General requirements for Instrumentation and Control System (ICS) design, procurement, delivery, and implementation as shown on the Contract Drawings (Drawings) and as specified in these Specifications.
- B. The contactor shall retain the service of a System Integrator. The System Integrator will purchase, assemble, configure, prepare submittal material and prepare Operations and Maintenance Manuals all of the components that make up the ICS. In addition, the System Integrator will purchase, assemble, configure, prepare submittal material and prepare Operation and Maintenance Manuals for Station Control Panel. The System Integrator shall conduct associated Factory Acceptance Testing and Site Acceptance Testing noted.
- C. The following System Integrators have been pre-approved and pre-qualified for this project:
  - 1. Tesco Controls, Sacramento, CA
  - 2. or Approved System Integrator prior to Bid Opening and as noted by Addendum.
- D. Approved System Integrator Prior to Bid Opening:
  - Prior to Bid Opening, the Contractor may submit the qualifications of a System Integrator not listed as pre-approved and pre-qualified for consideration by the City. If the City accepts the System Integrators qualifications and issues an addendum prior to bid, then the System Integrator is considered acceptable for the project. The qualifications must be submitted 10 days prior to Bid Opening to be considered.
  - 2. The Contactor may submit qualifications package for a System Integrator for approval by the City. Any qualifications package that does not include all of the following information will automatically be considered unresponsive and will be rejected. Only one submission per System Integrator shall be allowed.
  - 3. To be considered the System Integrator must meet the following pre-conditions.
    - a. System Integrator Facility is located within 150 miles of the project site.
    - b. System Integrator is certified by Control System Integrators Association (CSIA)
  - 4. The qualifications package shall include the following:
    - a. An introduction letter including the following:
      - 1) Actual distance from project site not to exceed 150 miles
      - 2) Copy of CSIA certification
      - 3) System Integrator Company Information
        - a) Company Name
        - b) Company Address
        - c) Company Internet Website
        - d) Company Telephone Number
        - e) Company Fax Number
        - f) Project Contact Name, E-mail address and telephone number

- Number of years in business the system integrator shall have been in business performing control, integration, and configuration and programming activities for at least 15 years.
- b. Provide the names and resumes of the System Integrator's programmer or programming team that have a minimum of 5 years experience in the design, coordination, and supply of computer-based monitoring, control and data acquisitions systems.
  - 1) Shall have programming and configuration experience with Tesco PLC
  - 2) The submitted and approved programmer(s) shall provide all programming associated with this project. The programmers assigned to perform the scope outlined in this contract may not be replaced without submitting additional qualified resumes and obtaining written approval from the Engineer
- E. System Integrator must be pre-approved by the Engineer in order to submit a bid for this project. Any bid listing a System Integrator that has not been pre-approved will be automatically disqualified.
- F. Interpretation of Drawings
  - 1. General: Any error or omissions of details in either the Drawings or Specifications shall not relieve the System Integrator from correctly installing all materials necessary for a complete and operating ICS.
  - 2. Site Verification: The System Integrator shall inspect the project site and verify all measurements and conditions and shall be responsible for the correctness of final installation. No extra compensation will be allowed because of differences between work shown on the Drawings and measurements at the site.
  - 3. Drawings: The Instrumentation Drawings are diagrammatic but shall be followed as closely as existing conditions and work of OTHERS will permit. All deviations from the Drawings required to make the work conform to structures as constructed, and to the work of OTHERS, shall be made at the System Integrator's own expense.
  - 4. Coordination: The System Integrator shall examine the architectural, structural, mechanical and manufacturer's drawings for all equipment to coordinate and determine the exact routing and final terminations of all conduits and cables. Conduits shall be stubbed up as near as possible to equipment enclosure.
  - 5. Accessibility: The Drawings do not show the exact locations of equipment. All equipment shall be located and installed so that it will be readily accessible for operation and maintenance. The Engineer reserves the right to require minor changes in location of outlets or equipment, prior to roughing in, without incurring any additional costs or charges.
- G. Manufacturer's Directions
  - 1. Manufacturer's directions shall be followed in all cases where manufacturers furnish instructions covering points not shown on the Drawings or specified in these Specifications.
- H. Inspection
  - 1. The System Integrator and Contractor shall cooperate with the Construction Manager and shall provide assistance at all times for the inspection of the instrumentation work. Remove covers, or perform any reasonable work, which in the opinion of the Construction Manager will be necessary to determine the quality or adequacy of the work.
  - 2. If any material does not conform to these Specifications the Contractor shall, within three (3) days after being notified by the Construction Manager, remove the materials from the premises.

- 3. Work shall not be closed in or covered before inspection and approval by the Construction Manager. Cost of uncovering and making repairs where un-inspected work has been closed in shall be borne by the Contractor.
- I. Supervision and Workmanship
  - 1. The Contractor shall employ a competent instrumentation foreman on the job throughout the entire period of construction to see that his work is carried on without delay and completed as rapidly as possible.
  - Before the start of construction and in conjunction with the schedule of others, the Instrumentation Sub-Contractor shall furnish to the General Contractor a tentative construction schedule showing the order of the work, the process control panel shop drawings submittal dates and the anticipated delivery dates of all instrumentation equipment.
- J. Cooperative Work with Others
  - The System Integrator and Contractor shall cooperate with others, with due regard to their work, towards promotion of rapid completion of project. If any cooperative work must be altered due to lack of proper supervision of such, or failure to make proper provision in time by System Integrator or the Contractor, then it shall bear expense of such changes as necessary to be made in work of others.
  - 2. Labor and materials, including templates, sleeves, anchors, concrete inserts and the like shall be furnished in ample quantities at such times as necessary to ensure uninterrupted progress of work.
  - 3. The Contractor shall cease work at any particular point temporarily and transfer its operations to such points or execute such portions of work as directed, when in the judgment of the Construction Manager it is necessary to do so.
- K. Quality of Materials
  - 1. All instrumentation components used on this project shall be new and free from defects.
  - 2. All instrumentation components used on this project shall conform where applicable, to the Codes and Standards in Section 1.02, References.
  - 3. Each type of material shall be of the same manufacturer and quality throughout the work.
- L. Substitutions
  - 1. No Substitutions shall be allowed unless specifically noted as "or equal" or as "or approved equal." Specific brand names and catalog numbers are used to describe materials in order to establish standards of performance and quality.
  - 2. The decision of the Engineer or Construction Manager shall govern as to what is equal to the item specified. Equality will be judged on the basis of the following:
    - a. Conformance to description or performance required
    - b. Equality in quality
    - c. Comparable in appearance and artistic effect where these are considerations
    - d. Comparable operation, maintenance and performance
    - e. Equal in longevity and service under conditions of climate and usage
    - f. Conformance with space allocations and requirements for operations from mechanical or electrical services provided without necessitating changes in details and construction or related work

- 3. If the Engineer considers it necessary, tests to determine the quality of the proposed materials shall be made, at the expense of the Contractor, by an unbiased laboratory, satisfactory to the Engineer.
- 4. Any material, article, or method judged by the Engineer equal to that specified will be approved, provided the Contractor submit a single written request, in triplicate, to the Construction Manager, within 30 days after contract award, with the following information for each item:
  - a. Complete data substantiating compliance of proposed substitution with Contract Documents.
  - b. Product Identification including trade or brand name including type, model, style, and/or catalog number
  - c. Manufacturer's literature marked to indicate specific model, type, size, and options to be considered
  - d. Size or capacity rating
  - e. Names and addresses of a minimum of three (3) references for similar installations to this Contract
  - f. Manufacturers' statements that proposed products are equal or superior in all respects to that specified.
- 5. The System Integrator assumes full responsibility for including complete and correct data in its request for substitution. The System Integrator shall also attach complete referenced diagrams and technical data sheets for the Engineer's review and determination of equality or suitability of any substitution item. Only one such request may be submitted. The Engineer's rejection of any substitute shall automatically require the System Integrator furnish the specified item without further discussion or delay.

#### 1.02 References

A. General: The work shall comply with the most recent Codes and Standards as published at the date of the Contract and as listed in the Specifications.

<u>Reference</u>	<u>Title</u>
NFPA 70	National Electrical Code – Latest Edition
NFPA 101	Life Safety Code - Latest Edition
UBC	Uniform Building Code - Latest Edition
ANSI	American National Standard Institute
ASTM	American Society for Testing and Materials
ASME	American Society of Mechanical Engineers
IEEE	Institute of Electrical and Electronic Engineers
ISA	Instrument Society of America
JIC	Joint Industrial Council
NEMA	National Electrical Manufacturers Association
OSHA	Occupational Safety and Health Administration

<u>Reference</u>	<u>Title</u>
SAMA	Scientific Apparatus Makers Association
UL	Underwriters' Laboratories, Inc
EIA	Electronic Industries Association
	Local Mechanical and Electrical Codes
	Any additional codes effective at the job site

- B. Additional Requirements: The System Integrator shall furnish without extra charge any additional material and labor which may be required for compliance with these laws, rules, and regulations, even though the work is not mentioned in the Specifications or shown on the Drawings.
- C. Permit Requirements: The Contractor shall apply and pay for all permits required by any of the legally constituted public authorities for the installation or construction of the work included in these Specifications. The Contractor shall arrange and pay for any inspections or examinations so required and deliver certificates of all such inspections to the Construction Manager. When these Specifications call for materials or construction of a better quality or larger sizes than required by the above mentioned rules and regulations, the provisions of the Specifications shall take precedence.

## 1.03 System Description

- A. General: Furnish all necessary labor, materials, equipment and incidentals required to install a complete and operational Instrumentation and Control System in accordance to the intent of these Specifications and Drawings.
- B. Itemized Work: The following list shall be considered major work items, but not an inclusive and complete description of the scope of work. The Drawings in conjunction with the Specifications shall be used to determine the complete ICS work. The general scope of work includes the furnishing, installing, programming, testing, and commissioning of the following items:
  - 1. Instrumentation and Control System. This Item includes:
    - a. Programming and configuration of the Programmable Logic Control (PLC) systems, Operator Interface, and updating City SCADA system.
    - b. 8 (eight) hours of Historical Database training for Pump Station 15.
    - c. 40 (forty) hours (minimum) onsite at 35 Stony Point Road, Santa Rosa, CA to test and modify City SCADA system.
    - d. Coordination with City to update station control strategy.
    - e. Programming and configuration of the instruments, power monitor, ATS, and VFD.
    - f. Rework of the two existing VFD's analog controls.
  - 2. Coordination with vendors or subcontractors (others) to interface with the control systems provided by others. This Item includes all interconnection wiring required for interfacing with such control systems to the pump station PLC as shown on the contract drawing.
  - 3. All supports, bases, anchors, sleeves, hangers, conduit seals, and the like.
  - 4. Shop Drawings and Operation and Maintenance (O&M) manuals.
  - 5. Control Panels including all control components required for proper operation of the control system.

- 6. All power supplies, transformers, pushbuttons, pilot lights and selector switches.
- 7. Instrumentation system including but not limited to level transmitters, level switches, pressure transmitters, pressure switches, pressure gauges, flow meters, flow switches, smoke detectors and intrusion switches.
- 8. Interconnection wiring diagrams.
- 9. Factory Acceptance Tests
- 10. Site Acceptance Tests
- 11. Throughout this Contract, provide protection for materials and equipment against loss or damage in accordance with provisions specified elsewhere in these Specifications.
- 12. Throughout this Contract, follow manufacturer's recommendations for storage. Protect everything from the effects of weather. Prior to installation, store items in indoor locations that are clean and dry. Items that are subject to corrosion under damp conditions and items containing electrical insulation, such as control panels, conductors, instrumentation and controls, shall be stored in clean, dry, indoor, heated locations. Energize all space heaters furnished with equipment. Provide temporary heating, sufficient to prevent condensation, in control panels, and instrumentation which do not have space heaters.
- 13. Following installation, protect materials and equipment from corrosion, physical damage, and the effects of moisture on insulation. Energize all space heaters furnished with equipment

### 1.04 Submittals

- A. Requirements: The submittal package for each individual equipment or groups of related equipment shall include all the required data and information and shall be complete. As a condition to the review of submittals required under these specifications, the System Integrator shall furnish the manufacturer's statement for the equipment accepting the unit responsibility. The purpose of this provision is to ensure compatibility of all components specified under the specific Technical Specifications; and to provide sole source responsibility for system performance and maintenance. Notwithstanding these provisions, however, the System Integrator is not relieved of his responsibility for the indicated portions of the work. The following submittal data shall be provided for each item of equipment. Additional data specific to individual equipment specified under individual Specifications shall be submitted in addition to the following.
- B. Contract Drawings: The Drawings are generally diagrammatic unless detailed or dimensioned. Structural conditions, physical interference and locations of terminations of equipment shall govern the exact locations and routing of wiring, conduit and pipe. The Contractor and System Integrator shall examine the architectural, structural, mechanical, electrical and instrumentation plans and shop drawings for the equipment to determine the exact routing and final terminations of conduit, cables and pipes. Conduits and pipes shall be stubbed as near as possible to equipment terminals.
- C. Deviations from Specifications: Should the System Integrator's proposed system specifications deviate from these Specifications, such deviation shall be documented and submitted to the Engineer for approval. All deviations shall be stated on the submittal transmittal sheet.
- D. Organization and Binding of Submittals: The initial and subsequent submittals of drawings and data for review shall be organized and bound so that eventually they may be used as guides for preparing the required maintenance manuals. The submittal shall be organized in three (3) parts, not including preliminary administrative material such as table of contents, as follows:
  - 1. Part 1 shall consist of a series of sections, one for each process control system. Each section shall be divided by a tab and shall include the material specified below.

- 2. Part 2 shall include outline dimension drawings for panels, cabinets, consoles and the like, as specified below.
- 3. Part 3 shall include data on miscellaneous parts and accessories not included in Part 1.
- E. Data Sheets: Data sheets shall be in a standardized format and shall include the following:
  - 1. Components name used herein and on the drawings,
  - 2. Manufacturer's model number or other product designation,
  - 3. Project tag number,
  - 4. System of which the component is a part,
  - 5. Location or assembly at which the component is to be installed,
  - 6. Input and output characteristics,
  - 7. Scale range and units (if any) and multiplier (if any),
  - 8. Requirements for electric supply (if any),
  - 9. Requirements for air supply (if any),
  - 10. Materials of component parts to be in contact with, or otherwise exposed to, process media,
  - 11. Reference to manufacturer's descriptive technical bulletin or brochure,
  - 12. References to other features so that all specified features are stated on the data sheet,
  - 13. Following each data sheet, a technical product bulletin, or brochure (or clear photocopy thereof) shall be inserted; this shall provide amplifying technical information on the construction, characteristics, and capabilities of the component described in the related data sheet. Elaborate and extensive technical details shall not accompany these bulletins. All bulletins shall be of the most recent issue,
  - 14. Part 2 of the submittal shall include outline and dimension drawings for all enclosed assemblies including cabinets, panels, consoles and the like. These drawings shall show the arrangements of panel-mounted and internally mounted components to scale and shall include enough details to clearly establish the style and overall appearance of each assembly, and
  - 15. Part 3 of the submittal shall consist of a series of data sheets for accessory components together with supporting catalog pages or bulletins (or clear photocopies thereof). These shall be arranged in a logical sequence and shall cover such items as:
    - a. Control circuit devices, components and wiring
    - b. Pneumatic components, fittings and tubing
  - 16. Operation and Maintenance Manuals
    - a. General: The System Integrator shall provide Operation and Maintenance (O&M) manuals in accordance with Section 01300.
    - b. Content: A set of manuals shall include all the drawings and required data and shall be organized and bound as specified for the review submittals. These drawings and data shall be supplemented with installation, connection, operation, troubleshooting, maintenance and overhaul instructions in complete detail. This shall provide the City with comprehensive information on all systems and components to enable operation, service, maintenance and repair. Exploded or other detailed views of all instruments, assemblies and accessory components shall be included together with complete parts lists and ordering instructions.

- c. Format: In addition to the requirements set forth elsewhere, the O&M manuals shall consist of at least the following:
  - 1) Table of contents,
  - 2) Manufacturer's or its representative's contact information,
  - 3) Equipment complete model number for ordering,
  - 4) Spare parts with model numbers,
  - 5) Special tools with model numbers,
  - 6) System block and schematic diagrams,
  - 7) Component schematic diagrams, and
  - 8) Written step-by-step operating, troubleshooting and calibrating instructions for each of the systems and each of the components of each system

## 1.05 Quality Assurance

- A. Performance and Design Requirements
  - 1. Manufacturer's Qualifications: The equipment furnished under this division shall be the product of firms regularly engaged in the design and manufacture of the type of item specified, possessing the required technical competence, skill, resources and ability to complete the work specified herein with the requisite degree of quality in a timely and efficient manner. The Contractor shall be prepared to adequately document the qualifications of the manufacturers nominated to provide the equipment specified under this division. All documentation shall be submitted to the Engineer prior to design fabrication and shipment of any component specified herein. Nothing contained within these provisions shall be construed as relieving the Contractor of his responsibility for any portion of the work covered by this Section.
  - 2. Arrangement: The drawings are generally diagrammatic and the location of instruments and control panels are approximate unless detailed or dimensioned. The exact locations and routing of cables and conduits shall be governed by structural conditions, physical interferences and the location of electrical terminations on equipment.
  - 3. The Contractor shall examine the structural and mechanical plans and shop drawings for the various equipment to determine exact routings and final terminations for all raceways and cables. Conduits shall be stubbed up as near as possible to field instruments and shall be within the concrete base for the equipment or a separate concrete curb.
  - 4. All conduit, instruments and control panels shall be installed in such a manner as to avoid all obstructions and to preserve head room and keep openings and passageways clear. Control Panels, metering, transmitters and similar items shall be located within finished rooms, as shown. Where the Drawings do not indicate exact locations, the Contractor shall submit proposed locations to the Engineer for review. Where equipment is installed without instruction and must be moved, it shall be moved without additional cost to the City.
  - 5. All work, including installation, connection, calibration, testing, and adjustment, shall be accomplished by qualified, experienced personnel working under continuous, competent supervision. The completed installation shall display competent work, reflecting adherence to prevailing industrial standards and methods.
  - 6. Allowance has been made in the design for the number of raceways, cables and conductors considered adequate for feeding the various instruments and control panels. These circuits and diagrams are based on available data pertaining to the particular design of equipment and portray the systems, which the City has chosen to affect the required operation and level of control. Equipment provided by the Contractor (even though of the make and model specified)

may differ in detail, arrangement, or connections from that shown. If the Contractor uses equipment which differs from the equipment shown in major aspects and requires modifications to power, control or other electrical service, the Engineer's acceptance of the equipment will be based upon the Contractor providing the modifications required, and they shall be of the same quality as shown and shall be provided at no additional cost to the City.

- 7. Protection of Equipment and Materials: The Contractor shall provide adequate means for and shall fully protect all finished parts of the materials and equipment against damage from any cause during the progress of the work and until acceptable by the Engineer.
- 8. All materials and equipment, both in storage and during construction, shall be covered in such a manner that no finished surfaces will be damaged, marred, or splattered with water, foam, plaster, or paint. All moving parts shall be kept clean and dry.
- 9. The Contractor shall replace or have refinished by the manufacturer, all damaged materials or equipment, including face plates of instruments and control panels, at no expense to the City.
- 10. Tests: The Contractor shall make all tests required by Engineer or other authorities having jurisdictions as per applicable standards. All such tests shall be performed in the presence of the Engineer. The Contractor shall furnish all necessary testing equipment and pay all costs of tests, including all replacement parts and labor necessary due to damage resulting from damaged equipment or from test and correction of faulty installation. Operational testing shall be performed on all equipment furnished and/or connected in other Sections of Division 16. Electrical and all other divisions specifying electrical items including furnishing of support labor for testing.
- 11. Standard test reports for mass-produced equipment shall be submitted along with the shop drawing for such equipment. Test reports on testing specifically required for individual pieces of equipment shall be submitted to the Engineer for review prior to final acceptance of the project.
- 12. Any test failure shall be corrected in a manner satisfactory to the Engineer.
- 13. The Contractor shall furnish without extra charge any additional material and labor which may be required for compliance with these laws, rules, and regulations, even though the work is not mentioned in these particular specifications or shown on the drawings.
- 14. The Contractor shall apply and pay for all permits required by any of the legally constituted public authorities for the installation or construction of the work included under this Division. The Contractor shall arrange and pay for any inspections or examinations so required and deliver certificates of all such inspections to the Engineer. When these specifications call for materials or construction of a better quality or larger sizes than required by the above mentioned rules and regulations, the provisions of the specifications shall take precedence.

## 1.06 Delivery, Storage, and Handling

- A. Throughout this Contract, provide protection for materials and equipment against loss or damage in accordance with provisions elsewhere in these Contract Documents. Throughout this Contract, follow manufacturer's recommendations for storage. Protect everything from the effects of weather. Prior to installation, store items in clean, dry, indoor locations. Store in clean, dry, indoor, heated locations items subject to corrosion under damp conditions, and items containing electrical insulation, such as instruments, conductors, and control panels. Energize all space heaters furnished with equipment. Provide temporary heating, sufficient to prevent condensation, in control panels which do not bare space heaters.
- B. Shipment: The major equipment items listed in this provision and furnished under this contract shall be shipped in sealed, weather-tight, enclosed conveyances in a manner designed to protect the equipment against damaging stresses during transport.

- C. Inspection
  - 1. The Contractor shall cooperate with the Engineer and shall provide assistance at all times for the inspection of the electrical work. Remove covers, operate machinery, or perform any reasonable work which, in the opinion of the Engineer, will be necessary to determine the quality or adequacy of the work.
  - 2. If any material does not conform to these specifications, the Contractor shall, within three days after being notified by the Engineer, remove the materials from the premises.
  - 3. Work shall not be closed in or covered before inspection and approval by the Engineer. Cost of uncovering and making repairs where un-inspected work has been closed in shall be borne by the Contractor.

## 1.07 Field Quality Control

- A. Tests and Instrument Calibration
  - 1. Individual Component Calibration: Each instrument and final element shall be field calibrated in accordance with the manufacturer's recommended procedure.
  - 2. Loop Tests: Each instrument loop shall be treated as an integrated system. This test shall be designed to verify that all components within the loop operate correctly and that the loop functions correctly.
  - 3. Notify City in writing 48 hours in advance of testing for witness by Engineer.
  - 4. Submit written report of testing results to the Engineer
- B. System Start-Up
  - 1. General: When all systems and components have been successfully calibrated and tested, a date for the Plant start-up involving the Engineer shall be scheduled and agreed upon.
  - 2. Procedure: The ICS shall be rechecked to verify proper operation. Final adjustments shall be made as required.
  - 3. Report: Provide a written report to the Engineer verifying the operation of the ICS. Note any problems or concerns in this report.
- C. Operator Training
  - 1. General: Operator training shall be provided for the ICS after the System Startup has been successfully executed.
  - Format: The Plant operating personnel shall be instructed in the functions and operation of each system and shall be shown the various adjustable and set point features which may require readjustment, resetting, or checking and re-calibration by them from time to time. The O&M manuals in addition to the System Integrator's prepared materials shall be used for this training.
- D. Duration: The training shall consist of a two (2) day course, a minimum of 16 hours total instruction, for up to five (5) students. This course shall be conducted at the jobsite on an agreed upon date independent of any testing or startup dates. A detailed outline of this course shall be submitted to the Engineer at least 10 days in advance of the training start date. The class shall be scheduled a minimum of 2 weeks in advance of the week it is to be held. Submit a course syllabus.

## SECTION 17110 INSTRUMENTATION AND CONTROL SYSTEMS

### PART1- GENERAL

#### 1.01 Summary

- A. Scope: This section provides specifications for all instrumentation and control system equipment, panels, and necessary appurtenances for an integrated control system. These Specifications and Drawings include descriptions of functional operation and performance, as well as standards, but does not necessarily enumerate detailed specifications for all components and devices which are necessary. However, all components and devices shall be furnished and installed as required to provide complete and operable systems capable of providing the functions and meeting the performance set forth hereinafter.
- B. The work of this section shall be performed by a qualified System Integrator. The contractor shall retain the services of a System Integrator to provide complete, assembled, installed, setup and testing of all instrumentation and control system components. The System Integrator shall provide for the PLC System, ATS/MTS, Industrial Control Panels, VFD, and field instrumentation.

#### 1.02 References

A. General: The work shall comply with the most recent Codes and Standards as published at the date of the Contract and as listed in the Specifications.

<u>Reference</u>	<u>Title</u>
NFPA 70	National Electrical Code – Latest Edition
NFPA 101	Life Safety Code - Latest Edition
UBC	Uniform Building Code - Latest Edition
ANSI	American National Standard Institute
ASTM	American Society for Testing and Materials
ASME	American Society of Mechanical Engineers
IEEE	Institute of Electrical and Electronic Engineers
ISA	Instrument Society of America
JIC	Joint Industrial Council
NEMA	National Electrical Manufacturers Association
OSHA	Occupational Safety and Health Administration
SAMA	Scientific Apparatus Makers Association
UL	Underwriters' Laboratories, Inc
EIA	Electronic Industries Association
	Local Mechanical and Electrical Codes

## 1.03 Submittals

- A. Submittals for all ICS equipment shall be prepared and submitted in accordance with Section 16010 and as described in Section 17010.
- B. Operation and Maintenance Manuals

### 1.04 General:

A. The CONTRACTOR shall provide Operation and Maintenance (O&M) manuals in accordance with Section 01300 and as described in Section 17010.

#### 1.05 Quality Assurance

- A. Performance and Design Requirements: For the purpose of standardization, all components shall be manufactured or furnished by one manufacturer, except as noted or approved.
- B. Equipment Surge Protection:
- 1. All electronic equipment shall successfully withstand surges in AC power circuits as specified in IEEE C62.41. Successfully withstanding transients requires that none of the following conditions occur as a result of the transient:
  - a. Erroneous output
  - b. Component failure
  - c. Calibration change exceeding normal tolerances

## PART 2 - PRODUCTS

#### 2.01 Manufacturers

- A. These specifications describe equipment of a specific manufacturer and are not designed to limit competition. Unless noted as a "sole source." "no or equal," or "No substitutions allowed"; the naming of the manufacturer on which the specifications and plans are based is not an endorsement of that manufacture, but is instead intended to describe a level of quality and demonstrate the functionality of the system.
- B. The ICS components specified in these Specifications and shown on the Drawings are based upon the use of equipment, devices and panels manufactured by the companies specified in the following Sections of these Specifications.
- C. The use of substitute or "or ENGINEER approved equal" equipment will be considered. Such equipment will be acceptable only on the basis that any revisions in the engineering, design and/or construction of the structure, piping, appurtenant equipment, electrical work, etc., required to accommodate such a substitution, shall be made at no additional cost to the City

#### 2.02 Equipment and Materials

- A. All products shall be new and approved for the specific applications shown on Contract Drawings or specified in these Specifications.
- B. Same products shall be of a single manufacturer.
- C. Products furnished for modification of existing control panels, except for the PLCs, shall be compatible with the existing products and from the same manufacturer, unless the existing products are no longer available

- D. Products installed in classified areas shall be approved for that classification and meet all the pertinent Standards and Code requirements.
- E. Programmable Logic Controllers:
  - The Programmable Controller shall be installed as an integral part of the Motor Control Center and shall reside in the motor control center instrument control section. The installer of the programmable logic controller will be a registered ISO-9001 system integrator specializing in process control and industrial automation systems. Each component shall have passed testing and be certified in writing by the manufacturer to be acceptable for use in water treatment environments. The PLC shall meet the following standards NEMA standard publications part ICS 1-180 and NEMA standard publications 250 and IEC publication 529. The PLC shall include a minimum of 15% spare I/O's
  - 2. Two field wiring terminal blocks that shall support the following listed characteristics:
    - 1. Pull-apart two piece terminal wiring blocks
    - 2. Internal or external selectable analog power
    - 3. Digital outputs via socket type 10A relays with LED "ON" indicators
    - 4. Class A lightning protection consisting of
      - a) MOVs at each AI/AO
      - b) Fused AI/AO power source
      - c) Fused DI source and common with clamping diodes
      - d) Class AA lightning protection, in addition to Class A, include
      - e) Class AAA lightning protection
  - 3. PLC shall include six serial ports with separate baud-rate generators. Five serials ports shall be configurable to support full handshake RS-232. The de facto standard ModBus protocol shall be supported and shall be included in an associated module as required to run. One serial communication ports shall be configured with an Ethernet/IEEE 802.3 protocol. These protocols shall be able to coexist simultaneously within the controller, while in operation.
  - 4. A copy of the native language programming software shall be produced, provided and supported directly from the installer of the programmable logic controller. The programmable controller shall be programmable using an IEC 1131-3 standard for automation programming language.
  - 5. Programmable controller communications shall be capable of independent control, to the extent that it is normal used in the event that communications is lost with the central computer the programmable controller shall be able to poll needed data from other remote programmable controllers with or without the central computer system in operation to keep the system running without going to a default mode.
  - 6. Programmable controller shall provide the ability to route received messages that are destined for another unit. Routed message can be received and sent using the controllers ability to transfer messages between two or more units.
  - 7. The Programmable Controller shall have the capability to represent all analog input and analog output values directly in engineering units. Engineering units are defined to be "real world" IEEE 754 standard floating point numbers corresponding to physical measurements.
  - 8. Manufacturer: Tesco L3000e series manufactured by TESCO Controls. No Substitution is allowed.

- F. Operator Interface:
  - 1. The Operator interface shall be installed as an integral part of the Motor Control Center and shall reside in the motor control center instrument control section in the front panel door. The unit shall be by the same manufacture as the programmable logic controller. The programmable controller shall be connected to a remote compact operator interface unit with an associated module as required and a factory fitted multi-conductor cable. The unit housing shall be made of sheet steel with a polycarbonate bezel trim, site specific nomenclature and labels in the face and shall be completely impervious to corrosive atmospheres and wash-down environments., IEC529-IP65, NEMA 250 Type 4. The operator interface display shall have at least the following attributes:
  - 2. LED display
  - 3. Multiple function keypad with programmable user keys
  - 4. UL listed, CSA certified and with CE markings
  - 5. The operator shall be able to access other PLC's in the communications network to perform the following remote functions:
  - 6. Examine and change setpoints
  - 7. Examine analog input and output registers
  - 8. Examine and change timers and counters
  - 9. Force digital outputs on and off
  - 10. Override analog inputs and outputs
  - 11. Manufacturer: Tesco L3000 OIT LED, Full Sized. No Substitution is allowed.
  - G. Ethernet Switch
  - 1. Ports: Six (6) RJ45 copper, 10/100Mb
  - 2. Switching and Management: DLR, VLANs, STP/RSTP/MST, DCHP, NAT, PTP
  - 3. Security: IEEE802.1x, SSH/SNMPv3/HTTPS
  - 4. Power: 24VDC
  - 5. Mounting: DIN
  - 6. Operating Temperature: -40 to 60 degree C
- H. Power Supplies:
  - 1. The control system power supply shall operate 18-32 VDC (24VDC nominal).
  - 2. A single main power supply shall have the capability of supplying power to the CPU and local input/output modules. Other power supplies shall provide power to remotely located racks.
  - 3. The power supply shall automatically shut down the PLC system whenever its output power is detected as exceeding 125% of its rated power.
  - 4. The power supply shall provide surge protection, isolation, and outage carry-over of up to 6 cycles of the AC line (120-240VAC, 50/60Hz) or 40ms @ 24VDC.
  - 5. Design features of the PLC power supply shall include a diagnostic indicator mounted in a position to be easily viewed by the user. This indicator shall provide the operator with the status of the DC power applied to the backplane.
  - 6. At the time of power-up, the power supply shall inhibit operation of the Controller and I/O modules until the DC voltages of the backplane are within specifications.

- 7. In addition to the electronic protection described above the power supply shall offer a failsafe fuse that is accessible by the user.
- I. Uninterruptible Power Supply (UPS)
  - 1. Load voltage and bypass line voltage will be 120 VAC, single phase 2 wire. Input voltage will be 120 VAC, single phase, 2 wire
  - 2. The battery shall support the UPS at 100% of rated load for at least 7 minutes at 25° C at startup
  - 3. Modes of Operation: The UPS system shall operate as an on-line reverse transfer system in the following modes:
  - 4. Normal: The critical AC load is 100% continuously powered by the UPS inverters. The rectifier/chargers derive power from the utility AC source and supply DC power to the inverters, while simultaneously float charging the battery.
  - 5. Emergency: Upon failure of utility AC power, the critical AC load is powered by the inverters which, without any switching, obtain power from the battery plant. There shall be no interruption in power to the critical load upon failure or restoration of the utility AC source.
  - 6. Recharge: Upon restoration of the utility AC source, the rectifier/chargers power the inverters and simultaneously recharge the battery. This shall be an automatic function and shall cause no interruption to the critical AC load.
  - 7. Bypass: If the UPS system must be taken out of service for maintenance or repair, the static bypass switch shall transfer the load to the bypass source. The transfer process shall cause no interruption in power to the critical AC load.
  - 8. Off-Battery: If the battery only is taken out of service for maintenance, it is disconnected from the rectifier/chargers and inverters by means of external disconnect breakers. The UPS shall continue to function and meet all of the specified steady-state performance criteria, except for the power outage back-up time capability.
  - 9. Performance Requirements
    - a. Voltage Range: +10%, -20% of nominal
    - b. Frequency Range: ±5%
    - c. Rectifier Walk-In/Current Limiting: 20% to 100% of full rated load over 15 seconds
    - d. Magnetizing Sub-cycle Inrush: Not to exceed 1.1 times normal full load input current in standard configuration.
    - e. Power Factor: Minimum 0.95 lagging at full load with nominal input voltage
    - f. Current Distortion: Less than 10% THD at full load
    - g. Unit Output
      - 1) Overload capability:
      - 2) 125% for ten minutes (without bypass source)
      - 3) 150% for one minute (without bypass source)
      - 4) 1000% for 1 cycles
    - h. Voltage Regulation:  $\pm 0.5\%$  for balanced load,  $\pm 1\%$  for 100% unbalanced load
    - i. Voltage Adjustment Range: ±5% manually
    - j. Frequency Regulation: 0.1%

- k. Efficiency: Defined as output kW/input kW at a load power factor of 0.8 lagging. Input/output; Not less than 92.5% for 120/120 VAC input/output.
- I. Voltage Transient Recovery Time:
  - 1) To within 1% of output voltage within one electrical cycle (16 milliseconds)
- m. Voltage Harmonic Content:
  - 1) 1% total harmonic distortion (THD) for linear loads
  - 2) 2.5% THD for 100% nonlinear loads (3:1 crest factor) without KVA/KW de-rating
- J. Electromagnetic Flow Measuring Systems:
  - 1. Instrument
    - a. Magnetic flow meter system shall be of the microprocessor-based, high impedance electromagnetic induction type and produce a DC pulsed signal directly proportional to and linear with the liquid flow rate. Complete zero stability shall be an inherent characteristic of the flow meter system. The magnetic flow meter system shall include a metering tube, factory signal cable (length to be determined by the Contractor), and signal converter/transmitter. The magnetic flow metering system shall conform to the following technical specifications:
      - 1) Flow Tube: IP68/NEMA 6X Designed for continuous submergence. Suitable for remote mounted flow transmitter. The flow tube signal cable shall be installed and potted at the factory.
      - 2) Transmitter: IP65/NEMA 4X Remote signal converter. Suitable for panel mounted
      - 3) Accuracy: 0.20% of reading or +/- 0.003 ft/sec up to a maximum velocity of 49ft/sec
      - 4) Repeatability: 0.05% or +/- 0.008ft/sec.
      - 5) Temperature: Up to 80°C.
      - 6) Power: 24VDC. Power consumption <20VA with transmitter
      - 7) Output: 4 to 20mA into 800ohms. Isolated and fully programmable
      - 8) Two pulse/frequency outputs
  - 2. Flow Metering Tube
    - a. The flow meter tube shall be constructed of rolled carbon steel. The magnetic field generating coils shall be located within the metering tube. The coils shall be potted with an epoxy-base compound. An insulating interior liner of elastomer shall be inserted and turned out against the flange faces. The metering tube shall be capable of withstanding a test pressure of at least 75 PSI. The flow meter shall have 150 pound ANSI or AWWA Class D flanges and built in grounding electrodes. The flow meter shall be rated for continuous submergence to a depth of 30 feet in accordance with the requirements of IP68. The metering tube shall be of the protruding self-cleaning design made of type 316L stainless steel. 316L stainless steel grounding rings shall be included with the flow metering system. The grounding rings shall insert between both flanges and shall not interfere with the internal flow profile. All gaskets for proper metering tube installation shall be included. The gaskets shall be made of a material suitable for water service and shall not be affected by any petroleum products or byproducts.
    - b. The flow meter shall be hydraulically calibrated in a laboratory that is internationally accredited by an agency such as NIST or NAMAS. The method of the initial calibration shall utilize volume and weight testing. All components of the device being provided as a

result of these specifications shall be tested as a complete system. The results of this testing shall be certified by the agency and documentation of the test shall be provided with the equipment.

- c. The flow meter accuracy shall be guaranteed with no more than five straight unobstructed pipe diameters upstream and three pipe diameter downstream of the flow meter. The accuracy of the flow meter as a system shall be three tenths (0.3) percent of the flow rate regardless of flow direction. The repeatability of the flow meter shall be a minimum of five one-hundredths (0.05) percent of the flow rate.
- 3. Flow Transmitter
  - a. The signal converter electronics shall be microprocessor based. The converter shall provide an output of 4 to 20 milliamps at impedances of zero to 800 ohms. This output signal shall be directly proportional to the rate of flow through the meter. The signal converter shall have a second output for remote totalization. This output shall be a pulsed open collector capable of 800 HZ, at less than 35 VDC and 250 milliamps. The pulse width shall be software adjustable to match the input requirements of the totalizer. The range of the pulse width shall be from thirty-two one-thousandths (0.032) to two thousand (2000) milliseconds with a weighing factor range from one one-thousandths (0.001) to one thousand (1000).
  - b. The range setting of the signal converter shall be adjustable through its entire range from zero to one hundred (100) percent of the flow meter's capacity. This range and other adjustable settings shall be represented on the local display screen.
  - c. The signal converters software shall include an integral self-diagnostic program. This program shall continuously monitor operational modes and alarms, as well as, electrode reference voltage for indications of flow meter coil failures. Failure of the flow meter as detected by this software shall trigger the zero return function and the remote alarm contact. The software shall also include an algorithm for the reduction of noise that is generated by any other process equipment.
  - d. The signal converter shall have an operating temperature range from 30 to 150 degrees Fahrenheit. A one degree Fahrenheit change in the ambient temperature shall result in a change in the output reading of the flow meter that is less than one one-hundredths (0.01) percent of the flow reading. A 10% change in the supply voltage shall result in less than a two tenths (0.2) percent change in the output reading of the flow meter.
- 4. The flow meter system, including the flow elements and remote signal converter (transmitter) shall be Rosemount 8750W flow meter tube and Rosemount 8712 flow transmitter with Advanced diagnostics Suite 1 (DA1). No substitutes allowed.
- K. Pressure Transmitter (Gauge\Differential):
- Measure capacitance changes in the sensor as pressure varies and produces a linear DC output proportional to the pressure. The unit shall have self-diagnostic capability and a nonvolatile memory; ROM memory module for monitoring of events, configuration changes and periodic recording of temperature/pressure values.
- 2. Display shall be an integrally mounted 4-line LCD scaled with engineering units.
- 3. Transmitter shall have a static pressure limit at least 1.5 times the nominal pressure range. Unit shall be loop-powered with self-diagnostic capability and a non-volatile memory.
- 4. Sensor shall be a high purity aluminum oxide ceramic element with no oil fill and an elastomer seal.

- The unit shall be rated for a maximum process temperature range of minus 40°F to 266°F [process connection dependent] in an ambient environment of minus 40 degrees F to 185 degrees F.
- 6. Reference accuracy capability shall be up to +/- .075% of URV including hysteresis and nonreproducibility in accordance with IEC 60770. Total performance accuracy including hysteresis and non-reproducibility in addition to thermal change of the zero point shall be up to +/- .5% URL.
- 7. The transmitter shall be programmable via the integral LCD display, personal computer or hand held device.
- 8. Unit shall have NSF 61, ATEX, FM, CSA or IEC Ex approvals as required.
- 9. The pressure transmitter shall conform to the following technical specifications:
  - 1) Enclosure: IP65/NEMA 4X, Aluminum
  - 2) Isolating Diaphragm: 316L Stainless Steel
  - 3) Power: 24VDC loop-powered.
  - 4) Operating range: 0 to 150 PSI
  - 5) Output: 4 to 20mA. Isolated and fully programmable.
- 10. The pressure transmitter shall be a Rosemount 3051C Coplanar with Stainless Steel Drain/Vent valves. No substitutes allowed.
- L. Pressure Gauge:
  - 1. Pressure Gauges shall be 4" diameter, bottom connected with white laminated dials and black graduations.
  - Gauges shall have a blowout disc and safety glass, encased in phenolic, steel or cast iron. Measuring element shall be a stainless steel bourbon tube with welded, stress-relieved joints. Socket shall have wrench flats.
  - 3. Movement shall be rotary geared, all stainless steel material.
  - 4. Case shall be liquid filled.
  - 5. Accuracy shall be ½ percent of range.
  - 6. All pressure gauges shall be provided with pulsation snubbers constructed of 316 stainless steel, pressure diaphragm seal, an isolation valve and a drain valve as shown on the Contract Drawings.
  - 7. The pressure gauge shall be:
    - a. Ashcroft T6500 Model No. SL02L 100#XMPAJ [100 PSI Gauge for Suction Pressure]
    - b. Ashcroft T6500 Model No. SL02L 200#XMPAJ [200 PSI Gauge for Suction Pressure]
    - c. Ashcroft T6500 Process Pressure Gauge, No Substitutions.

## 2.03 Components and Accessories

- A. Pilot Devices:
- Indicating lights, pushbuttons, and selector switches shall be miniature oil-tight units. Time clocks in control circuits shall be NEMA IC1, B150, rated 5 amperes inductive at 120 volts AC. Contact blocks for signal circuits shall be rated at 0.06 amperes at 30 volts AC or DC and shall be hermetically sealed reed switches. Pilot lights for 120 volt AC circuits shall be full voltage

LED type. Pilot lights of 24 volt circuits shall be rated 28 volts. Individual pilot light assemblies shall be "push-to-test" type.

B. Relays:

- 1. All relays used for instrumentation work shall be plug-in types utilizing EIA standard tube socket configuration plugs. Sockets shall be heavy-duty, surface mounted, industrial type with barrier protected screw type terminals and shall be a one-piece melamine plastic molding. Sockets shall be rated not less than 5 amperes at 125 RMS working volts.
- 2. As a minimum, relays for general purpose use shall have double-pole, double-throw (DPDT) contacts. They shall bear ratings of 10 amperes at 120 volts AC and 28 volts DC. Relay frames shall be constructed of laminated phenolic and shall be provided with a clear polycarbonate dust cover. Relays for switching high level signal circuits (4 to 20 mA) shall be similar to the above; except the contacts shall be rated 3 amperes and the relays shall be hermetically sealed.
- 3. Relays for switching power or control loads with in-rush currents in excess of 5 amperes shall be similar to the above except the contacts shall be single-pole, single-throw (SPST), double-break, rated 20 amperes at 120 volts AC and 28 volts DC, and 1 horsepower at 120 volts AC.
- 4. Relays shall be IDEC, or an approved equivalent.
  - C. Signal Isolator:
- Signal isolators shall have complete isolation of input, output and power input. Signal input shall be 4-20 mA into 50 ohms maximum, signal output shall be 4-20 mA into 1000 ohms minimum. Power input shall be 24VDC. Span and zero shall be adjustable. Accuracy shall be plus or minus 0.1 percent of span. Units shall be surface or rack mounted. Signal isolators shall be Moore Industries Model SCT, Rochester Instrument Systems, AGM Electronics TA-4000, or equal.
  - D. Current Alarm Trip (Switches):
- 1. Current alarm trips shall be single- or multi-channel type as required. Units shall accept voltage or current input signals. Dead band shall be factory set at 1 percent of full span for single trips. Alarm trips shall be equipped with 10 AMP DPST contacts.
- 2. Alarm trips shall include setpoint dials calibrated 0-100 percent for each trip point. Single alarm trips shall include a dead band adjustment dial calibrated 0-100 percent.
- 3. Alarm trips shall be AGM Electronics Model TA-4030, Moore Industries Model DCA, or equal.
  - E. I/I Converters:
- 1. Current to Current (I/I) converters shall accept one 4-20 mA signal and convert to two (2) 4-20 mA DC signals with an uncertainty not exceeding 0.25 percent of full scale. Each output signal shall be independent of each other, and isolated from input signal. The units shall be AGM Series 4000 or equal.
  - F. DC Power Supplies:
- 1. Twenty-four volt units shall be used to supply instrument controls and loops as required in the plans and detailed specification schedules. Power output shall be free of noise, have negligible ripple, and remain stable under varying system load conditions.
  - G. TERMINAL BLOCKS AND WIRING
- 1. Terminal blocks shall be screw terminal type with box-clamp type pressure plates. Terminal blocks shall be rated minimum 300 volts. Each terminal block shall be identified by a distinct number (TB-1, TB-2, etc.) designated by the panel manufacturer. All terminal points shall be assigned a distinct number. All terminal points for "Common" bus shall be designated by

"COM." Terminal points dedicated for 120 VAC buses shall be identified by L-1, L-2, etc. Terminal points for the ground wires shall be labeled "GND."

- 2. All interconnecting wiring between panels or between panels and field devices shall be connected to terminal blocks. All panel internal wiring shall be installed in plastic raceways (Panduit). Unless otherwise shown on the Drawings, all 120 VAC wiring shall be No. 14 AWG. All wiring for analog signals shall be No. 16 AWG. All wiring for 24 VDC discrete signals shall be No. 16 AWG. All wire shall be standard copper. Conductors shall be individually identified using colored thermoplastic insulation or distinct labels.
- 3. Conductor Identifications: Identify each conductor by a consecutive unique number, letter, or number-letter combination. Each conductor shall have the same identification at all terminals and tie points. Conductors connected to the same terminal or tie point shall have the same identification. Conductor identification shall be as shown below with modifications necessary to provide a unique conductor number for each interconnecting conductor:
  - a. OPNLTB #T #/DPNLTB #T #/C #, where
    - 1) OPNL is Origination Control Panel, TB # is Terminal Block Number, T # is Terminal Number, DPNL is destination Control Panel, and C # is the three digit conductor sequential number. The following example is shown as the guidance for clarification:
      - a) BBCPTB01T12/ASCPTB01T12/100, where
        - (i) BBCP is Blower Building Control Panel, TB01 is Terminal Block 01, T12 is Terminal Point 12, ASCP is Activated Sludge Control Panel, and 100 is the conductor unique number.
        - (ii) Use filed device Tag Numbers for connections between two filed devices and between a field device and a panel.
- 4. All relay contacts which will be connected to external panels or devices shall be wired to terminal blocks,
  - H. Accessories
- 1. Provide instruments with manufacturer's identification nameplate showing:
  - a. Manufacturer's model number
  - b. Manufacturer's serial number
  - c. Range (English units)
  - d. Power supply requirement
    - I. Nameplates
- 1. Machine engraved laminated phenolic nameplates shall be provided for all panel mounted equipment. Nameplate engraving shall be as shown on the Drawings. The nameplates shall also include the instrument tag number in small size lettering on the last line of the nameplates. Nameplates shall be attached to the panel with a minimum of two self-tapping stainless steel sheet metal screws. Adhesive attachment is not acceptable. The Engineer reserves the right to review and change nameplates wording at no additional cost prior to the engraving. Machine embossed adhesive labels shall identify the tag number of instruments inside panels. All nameplates shall be included in CONTRACTOR's submittal for review and approval
- J. Door Intrusion Switches
- 1. Door intrusion switches shall be Sentrol Model 2507A or approved equal.
- K. PRV limit Switches

- 1. PRV limit switches shall be Cla-Val Model X105L or approved equal.
- L. Power Meter
  - 1. The power meter shall be an Shark 200 Power Monitor, No Substitutions.
  - 2. The meter shall support a power supply of 480 Volts AC
  - 3. The meter shall be UL listed and CE marked.
  - 4. The meter shall be designed for Multifunction Electrical Measurement on 3 phase power systems. The meter shall perform to spec in harsh electrical applications in high and low voltage power systems.
    - a. The meter shall support 3-Element Wye, 2.5 Element Wye, 2 Element Delta, 4 wire Delta systems.
    - b. The meter shall accept universal voltage input.
    - c. The meter's surge withstand shall conform to IEEE C37.90.1.
    - d. The meter shall be user programmable for voltage range to any PT ratio.
  - 5. The meter shall be a traceable revenue meter, which shall contain a utility grade test pulse allowing power providers to verify and confirm that the meter is performing to its rated accuracy.
  - 6. The Option Cards shall provide the following features:
    - 1) 2 Relay outputs
    - 2) V3 option pack- Power Quality Harmonics
  - 7. The meter shall have transformer loss, line loss, and total substation loss compensation.
    - a. Substation losses shall be programmable for Watts and VARs, and for Ferris and Copper losses.
    - b. The meter shall have CT and PT compensation to set compensation factors for errors in CTs and PTs connected to the meter.
  - 8. Power meter shall be able to be stored in (-20 to +70) degrees C.
    - a. Operating temperature shall be (-20 to +70) degrees C.
    - b. The front of the power meter shall provide IP65, NEMA 4X protection degree.

# PART 3 - EXECUTION

## 3.01 Installation

A. Field instruments shall be mounted on 2-inch pipe stands unless shown adjacent to a well or otherwise noted. Instruments attached directly to concrete shall be spaced minimum two inches from the mounting surface by use of phenolic spacers or framing channel. Expansion shields or cast-in-place inserts shall be used for securing equipment or supports to concrete surfaces. Unless otherwise noted, field instruments shall be mounted between 48 and 60 inches above the floor or work platform. All instruments shall be installed so that taps, parts, and the like, are available for in-place calibration and test without removal.

## 3.02 Field Quality Control

- A. The instruments shall be field calibrated and tested. Field testing shall be provided for verification of contract requirements and pertinent manufacturer published performance specifications for performance parameters essential to the proper operation of the system. As required by the Engineer, any instrument of suspicious operation shall be recalibrated and retested until proved satisfactory to the Engineer at no addition cost.
- B. Elements such as controllers, electronic function modules, and the like, shall be tested and exercised to demonstrate correct operation, first individually and then collectively as part of a functional network system.
# SECTION 17506 EXTENDED WARRANTY & MAINTENANCE

## PART1- GENERAL

#### 1.01 Summary:

A. Scope: The requirements for extended warranties and maintenance for equipment that is placed into operation prior to final completion.

## 1.02 References

- A. General: Refer to equipment manufacturers' approved and certified documentations for the Extended Warranty and Maintenance (EW&M) agreements to provide EW&M for equipment installed.
- B. Related Sections: Refer to General Requirements of Divisions "0" and "1" for the pertinent references addressing the EW&M requirements.

#### 1.03 Submittals

- A. General: Submittals shall be provided for all EW&M agreements for review and approval.
- B. Related Sections: Refer to General Requirements of Divisions "0" and "1" and Divisions "16" and "17" for submittal requirements for the EW&M.
- C. The Contractor shall include documentation in the submittal that EW&M's have been obtained for all equipment. The documentation shall include a "TABLE" listing all equipment tag numbers, manufacturer's contact information, EW&M effective date, EW&M expiration date, renewal requirements, and a comments column for general notes as specified below:

<u>Equipment</u>	<u>iipment Manufacturer EW&amp;M</u>	EW&M Expiration	<b>Renewal</b>	Commonts	
Tag	Contact Info.	Effective Date	Date	<b>Requirements</b>	Comments

## 1.04 Quality Assurance

- A. Extended Warranty and Maintenance Requirements
  - 1. As a minimum, provide the EW&M for all hardware supplied under this CONTRACT for a period of one year after the manufacturers' Standard Warranty (SW) has expired. The SW shall become effective after the Final Commissioning and Acceptance (FCA).
  - 2. All failed parts during the EW&M period shall be repaired or replaced without any cost to the City including labor, material, and shipping charges.
  - 3. Warrant all software, including layered software, supplied by the CONTRACTOR against any defect for a period of two (2) years after the FCA. Correct any defect in the software, without charge, during the warranty period. If necessary, make the corrections and test the revised software on site without any charges to the City during this period.
  - 4. Warrant PLC and all PLC related components, supplied by the CONTRACTOR against any defect for a period of ten (10) years after the FCA.
- B. Properly maintain operating equipment throughout the course of the EW&M without any charges to the City.

- C. Perform preventive maintenance in accordance with the manufacturer's recommendations. Include inspection, testing and calibration, cleaning, lubricating, and replacement of worn or defective parts.
- D. Keep maintenance service records with the equipment and make them immediately available to the City during the course of the EW&M.
- E. Provide maintenance contracts that are renegotiable and expandable yearly, at the City's option, for a minimum period of ten (10) years.

# SECTION 17510 FACTORY ACCEPTANCE TESTS

## PART 1 - GENERAL

#### 1.01 Summary:

- A. Scope: This section describes the minimum requirements for Factory Acceptance Test (FAT).
- B. Conduct a formal FAT prior to shipment of equipment to the project site. The purpose of the FAT is to verify compliance with the design specifications and correct deficiencies at the Contractor's facility to prevent extensive field tests.
- C. The Contractor shall prepare a FAT Plan (FATP) for review and approval by the Engineer prior to scheduling the FAT. The Contractor shall dry run all tests prior to the FAT to expedite the process. All costs including test equipment, hardware and software of the FAT shall be included in the Contractor's original bid price.

## 1.02 System Description

- A. The purpose of this test is to qualify each system, insofar as practical, as having met the functional, performance, and interface requirements. Verify the performance and functional integrity of the individual subsystems, including active interfaces between subsystems, and demonstrate the operation of the subsystems on an integrated system basis.
- B. Supervise and assist in the tests. The Engineer shall be notified to actively participate in the tests.
- C. Application software developed by the Control System Integrator will be installed on the system during FAT. The Control System Integrator may add, modify and delete application software during testing to simulate normal operating conditions.
- D. The Engineer reserves the right to test any specified function, whether or not explicitly stated in the test submittal.
- E. Provide knowledgeable personnel capable of explaining procedures and test results to the understanding and satisfaction of the Engineer.
- F. Meet the following criteria prior to the start of the tests:
  - 1. Complete submittals and resolve disputes.
  - 2. Have approved test procedure.
  - 3. Set a test date that is agreeable to all.

#### 1.03 Submittals

- A. Test Plan Submittals
  - 1. Prepare and submit FAT procedures to the Engineer for approval at least thirty (30) days prior to the scheduled test date.
  - 2. Notify the Engineer at least fifteen (15) days prior to the scheduled start of the FAT. All Control Panels and Motor Control Center equipment shall be, in the opinion of the Contractor, ready for the formal FAT prior to scheduling.
  - 3. Submit dry run test results at least three (3) days prior to the scheduled start of the FAT.
  - 4. Submit completed FAT procedures document with signatures, dates, test results, and notes.
    - a. Factory Acceptance Test Procedures Document shall:

- 1) Include individual ID number, name, description and date of each test,
- 2) List the logical step by step procedure with expected response at each step and provide space for recording results,
- 3) Provide space for approval for each test,
- 4) Provide space for hand written comments,
- 5) Include checkpoints at critical points in logic,
- 6) Provide minimal reference to other documents,
- 7) Be written such that City personnel can use it during site testing,
- 8) And describe steps necessary to simulate inputs required by the test.
- b. Include the following in the FAT submittal:
  - 1) Location of FAT,
  - 2) FAT procedures,
  - 3) A schedule of daily activities indicating that the FAT will be completed in the allotted time,
  - 4) Configuration, cabling and wiring diagrams locating and identifying all equipment used for the test,
  - 5) A hardware inventory including manufacturers, model numbers, serial numbers, and item descriptions,
  - 6) A software inventory organized by computer on which it is installed including Contractor's names, software name and version, and
  - 7) A list of documentation that will be on hand during testing including manufacturers' or Contractor's names, document descriptions and document numbers

## PART 2 - PRODUCTS (NOT USED)

#### PART 3 - EXECUTION

#### 3.01 Installation

- A. Authorization to Ship
  - 1. The Engineer will issue the Authorization to Ship (ATS) after successful completion of the FAT, and resolution of deficiencies. The ATS will list all known system deficiencies, and what modifications are required to allow shipment.
  - 2. The Contractor shall agree to the conditions and schedule in the ATS and acknowledge this agreement with an authorized signature before the ATS will be issued.
  - 3. No equipment will be accepted at the City's sites until an ATS has been issued.
- B. City/Engineer Involvement
  - 1. The Engineer shall witness all testing activities.
- C. Expenses
  - 1. Pay costs for (3) representatives from the City to attend each test and retest if a test fails. Provide the following:
    - a. Meals
    - b. Accommodations (if the Factory Test Site is more that 150 miles from the project site)

- D. Testing Aids and Equipment
  - 1. Provide the following documentation:
    - a. One copy of submittals applicable to the equipment to be tested
    - b. One copy of the Drawings and Specifications together with addenda and change orders
    - c. One master copy of the test procedure
    - d. A complete inventory of the equipment to be tested and any special test equipment including make, model and serial number
  - 2. Provide the following support facilities:
    - a. Meeting room access
    - b. Copy machine access
    - c. Telephone for local and long distance service
    - d. FAX machine access
    - e. Internet access
  - 3. Provide the following test equipment:
    - a. Off line diagnostic and test programs.
    - b. Maintenance and test equipment including, but not limited to, serial data analyzer, electrician tool set, electrical continuity tester, analog loop amp meter.
- E. Retest
  - 1. If a test, or portion of a test, defined in the FAT procedures fails and needs to be rescheduled, pay expenses of City personnel for retesting.

## 3.02 Field Quality Control

- A. Conduct the FAT in accordance with plan and procedures documented in the submittal for this section.
- B. Testing shall be conducted Monday through Friday for no more than 8 hours per day. Testing at other times requires the approval of the Engineer.
- C. Provide simulation of the PLC network to duplicate loading to the SCADA system.
- D. Programmable Logic Controller (PLC) Testing
  - 1. Provide written proof of coordination of data transfers between the Pump Station PLC and the Telemetry System
  - 2. Download Vendor, Control System Integrator supplied control strategies and execute. Test functionality and performance of all strategies.
  - 3. Provide hardware and software required for simultaneously simulating all the inputs/outputs.
  - 4. Perform the following functional tests:
    - a. Demonstrate proper operation of I/Os.
    - b. Demonstrate that analog points are within the specified accuracy when the inputs/outputs are at 25, 50, 75, and 100 percent of full scale. Demonstrate proper operation of analog inputs with the required signal levels.
    - c. Test operation under power failure conditions.
    - d. Demonstrate that the control strategies are functioning as specified.

- e. Conduct other tests as required and directed by the Engineer.
- E. System Factory Acceptance Test
  - 1. The System Factory Acceptance Test includes, but is not limited to, the tests described in the following subsections.
    - a. Test each hardware component individually.
    - b. Verify inventory, model numbers and serial numbers.
    - c. Run standard hardware diagnostic programs, plus all special diagnostic programs used by the Contractor to demonstrate that the hardware development is complete.
    - d. Test include, but are not limited to, the following:
      - 1) Verify the correct functional operation of hardware and software.
      - 2) Verify scanning and data acquisition of all data points from the PLC.
      - 3) Verify control operations to ensure that they result in the correct communication protocol and operation.
      - 4) Test operator interface functions.
      - 5) Verify on line programming of the PLC.
      - 6) Verify the operation of historical data storage, displays, and trends
      - 7) Test the behavior of the System in various failure modes, including I/O point failure, I/O module failure, communication channel failure, and peripheral and hardware component failures. Switch power off and on to hardware components. Reboot computers.
      - 8) Demonstrate that the spare capacity and expansion requirements have been met.
      - 9) Test on line display generation and modification functions.
      - 10) Verify that the System meets all the performance requirements, under simulated loading.
      - 11) Test custom software written specifically for this project.
      - 12) Test control strategy generation.
      - 13) Perform backup and reload of operating system, SCADA software, historical data, and applications.
      - 14) Test control strategy generation.
      - 15) Demonstrate the modification of logs, displays and database.
      - 16) Test alarm conditions for analog and discrete points
      - 17) Conduct other tests as instructed by the Engineer.

## 3.03 Adjusting / Cleaning / Protection

- A. Correction of Deficiencies
  - 1. Document all discrepancies found during the Factory Acceptance Test and maintain in a record file. Describe subsequent corrections. The Engineer will verify proper operation.
  - 2. Faulty or incorrect operation of major functions (i.e., major discrepancies) may be cause for suspension or restarting of the entire test, pending the correction of the problem. Minor discrepancies noted may be corrected and retested.

- 3. The system will not be shipped until the successful completion of the FAT certified by the Engineer. Delay in shipment of the system due to failure to pass FAT will not be considered an unavoidable delay and justification for later delivery.
- 4. System performance testing will not be started until approved by the Engineer

# SECTION 17512 SITE ACCEPTANCE TESTS

## PART1- GENERAL

#### 1.01 Summary:

- A. Scope: This section describes the requirements for the Site Acceptance Testing (SAT) at the project site.
- B. Conduct a formal SAT prior to final commissioning of the project. The purpose of the SAT is to verify operation of the Instrumentation and Control System (ICS) to ensure that the ICS perform in compliance with the design specifications and control strategies and correct deficiencies.
- C. The Contractor shall prepare a SAT Plan (SATP) for review and approval by the Engineer prior to scheduling the SAT. The Contractor shall correct any deficiencies from the field tests performed prior to the SAT to expedite the SAT process. All costs including test equipment, hardware and software of the SAT shall be included in the Contractor's original bid priced.

## 1.02 Submittals

- A. Submittals shall be in accordance with Special Provisions, Section 17010 and requirements of this Section. All submittals of this Section shall be the responsibility of the Contractor.
- B. Submit a SAT Plan (SATP) at least 30 days prior to the start of testing for review and approval by the Engineer. The SATP shall include all procedures, equipment, detailed schedule, Standards, personnel or subcontractors responsible for testing and Test Forms necessary for a complete SAT.
- C. Within 15 days following completion of the site tests, submit the SAT report to the Engineer.
- D. Include the following information in the submittal.
  - 1. Calibration and testing information for all instruments throughout the Pump Station including the existing and new instruments
  - 2. All instrument loop checkout schedule
  - 3. Loop checkout procedures including sign-off forms
  - 4. Loop tuning procedures
  - 5. Control strategy test schedule arranged by unit process
  - 6. Control strategy test procedures and sign off forms
  - 7. Procedures and sign-off forms for all other tests specified

## PART 2 - PRODUCTS (NOT USED)

## PART 3 - EXECUTION

#### 3.01 Field Quality Control

- A. Perform field-testing to verify the automation operations associated with the control systems and manual operations with the PLC systems disabled. Perform field-testing sequentially and organize by unit process within each process area. Field tests shall include:
  - 1. Power failure tests including utility and UPS,

- 2. Control loop tests,
- 3. Control loop tuning,
- 4. Control strategy tests,
- 5. Integrated system test,
- 6. Manual operation tests
- B. The Contractor shall be responsible for the following tests which shall be completed prior to joint Contractor Engineer loop and end-to-end tests:
  - 1. Calibration of all instruments and final control elements, except those not provided by the Contractor
  - 2. All field wiring tests, including continuity, insulation resistance, and others specified elsewhere.
  - 3. Basic analog and discrete loop checkout of hardwired circuits, including:
    - a. Verification that each field instrument is connected to the correct, tagged wires at each control panel
    - b. Verification at each control panel that every field signal has correct voltage polarity
    - c. Verification that the local panels and packaged systems supplied by the Contractor are completely and properly installed, and that all associated logic works properly
- C. After the completion of instrument calibration as applicable, but prior to Integrated System Testing, perform the loop and end-to-end tests. To the extent practical, begin testing promptly after installation of each major subsystem. A subsystem is an integrated, fully operational subset of the control system and includes:
  - 1. Programmable logic controller (PLC)
  - 2. Communications equipment required for operation of the subsystem
  - 3. Field instruments, panels, termination cabinets, control devices and related interconnections provided for the plant area
  - 4. Each and every control and instrumentation circuit modified or replaced by the Contractor shall be tested
  - 5. These tests shall include all signals that are connected to the PLCs through digital networks. The test shall also include all hardwired input/output loops
- D. Meet the following conditions prior to the start of any testing:
  - 1. Correct deficiencies noted during the factory testing
  - 2. Have documentation on-site pertinent to the part of the system being tested
  - 3. Have on-site, labeled, and properly stored spare parts, expendables and test equipment pertinent to the part of the system being tested
  - 4. Have Engineer approved test schedules and test procedures
- E. Provide written notice 48 hours in advance of intent to commence the SAT procedures.
  - 1. Clearly identify sections of the SAT procedure to be conducted
  - 2. Failure to properly notify the Engineer of anticipated testing activities would not be considered an unavoidable delay or justification for compensation
  - 3. Process operational constraints, personnel availability, and other's work are valid reasons for re-scheduling testing.

- F. Coordinate all field-testing through the Engineer on a daily basis
  - 1. The Engineer may redirect testing from one unit process to another. Pre-negotiated price shall include, as a minimum, redirection of testing as follows:
    - a. The redirection does not cause more than a two-hour interruption to the testing to move test equipment and test personnel to the new unit process.
    - b. There is no change in the amount of test equipment or personnel requirements.
    - c. The redirection is not arbitrary. Process operational constraints, personnel availability, and other's work are valid reasons for redirection.
    - d. The redirection does not occur more than once in any workday subsequent to the daily scheduling meeting.
    - e. Perform no testing that may affect plant operation without City concurrence.
- G. Perform tests by following the operation and maintenance manuals word-for-word unless approved otherwise by the Engineer. Lack of complete, detailed manuals will be a cause for declaring the test to have failed regardless of the actual test results.
- H. Make available for City's use loops and control strategies that have been verified to operate properly immediately subsequent to conclusion of the respective test.
- I. The Engineer will witness all testing activities.
- J. Loop Tests
  - The Contractor shall be responsible for loop tests. The Contractor shall provide full-time staff to support and conduct these tests. The Contractor shall operate all field equipment, inject simulated field signals, record results observed in the field, check the proper operation of field equipment, and promptly correct any deficiencies or problems found with the Contractorsupplied equipment or work. The Contractor shall be responsible for performing all testing activities including test plans, test forms, test documentation, test reporting, and other test activities specified below.
  - 2. Check each loop from the end element to the respective control display. Include instruments, control devices, panels, termination cabinets, input/output cards and other devices in the loop to ensure proper operation and linkage to control station displays.
    - a. Analog inputs shall be tested at a 0 percent, 25 percent, 50 percent, 75 percent and 100 percent of scale for proper receipt within tolerances.
    - b. Discrete inputs shall be tested to verify proper state when the field device is switched between states.
    - c. Discrete outputs shall be tested to verify equipment respond properly (start, stop, etc.).
    - d. Verify the proper operation of each discrete control loop to insure the proper operation of motors, hand switches, interlocks, solenoid valves, other auxiliary devices, stratus lights, operator interfaces, and alarms.
    - e. Test operation of the final control element through panels and through control stations for new or modified equipment. If a final control element is out of service or not released by the Engineer for testing simulate operation at the final control element location.
    - f. Each analog network shall be tested by applying simulated analog or discrete inputs to the first element of an analog network. For networks that incorporate analog elements, simulated sensor inputs corresponding to 0, 25, 75, and 100% of span shall be applied, and the resulting element outputs monitored to verify compliance to calculated root-mean-square-summation accuracy tolerance requirements.

- g. Verify the proper operation of each discrete control loop to insure the proper operation of motors, hand switches, interlocks, solenoid valves, other auxiliary devices, status lights, operator interfaces, and alarms.
- 3. Document loop checks and submit to the Engineer for review. The submittal shall include:
  - a. Test Date
  - b. Loop number
  - c. Loop description
  - d. Termination information
  - e. Loop drawing reference
  - f. Type of test(s) performed
  - g. Problem description, if any
  - h. Signature of tester and date
  - i. Signature of Engineer and date
- 4. Summarize loops found to contain defective or inoperable equipment on separate sheets and submit to the Engineer.
  - a. Correct and recheck these loops.
- K. Control Loop Tuning
  - 1. Control loop tuning including existing and new control loops is the responsibility of the Contractor.
  - 2. Complete loop and end-to-end testing and problem correction prior to loop tuning. Perform preliminary loop tuning prior to strategy testing. Perform final loop tuning during the SAT.
  - 3. Derive initial tuning parameters from open loop tests. Make final tuning parameter adjustments based on closed loop tests.
  - 4. Submit loop tuning documentation to the Engineer which shall include:
    - a. Date
    - b. Loop number and description
    - c. Problem description, if any
    - d. Signature of tester and date
    - e. Signature of Engineer and date
  - 5. Operate tuned loops for a minimum of 24 hours prior to finalizing loop tuning documentation.
- L. Control Strategy Tests
  - Control strategy testing is the responsibility of the Contractor. The Contractor shall provide fulltime staff to support and conduct these tests. The Contractor shall operate all field equipment, inject simulated field signals, record results observed in the field, check the proper operation of field equipment, and promptly correct any deficiencies or problems found with Contractorsupplied equipment or work. The Contractor is responsible for performing all testing activities including test plans, test forms, test documentation, test reporting, and other test activities specified below.
  - 2. Fully test control strategies to ensure specified operation. Include:
    - a. Sequences

- b. Alternate control modes
- c. Dynamic gain adjustments
- d. Contingency responses to device failures, where possible
- e. Display and keyboard interaction
- f. Messages
- 3. Prior to use on the process equipment, compare strategies with approved submittals to verify that as-built linkages and control logics agree with the documentation. Note and correct discrepancies.
- 4. Test as much of the logic as possible using process equipment.
- 5. Document strategy tests and submit to the Engineer. Include:
  - a. Date
  - b. Strategy identification
  - c. Tests performed
  - d. Logics which could not be tested and reasons
  - e. Copies of messages, displays and trends which verify operation
  - f. Problem description, if any
  - g. Signature of tester and date
  - h. Signature of Engineer and date
- 6. Annotate changes made during testing on the documentation to reflect final as-built conditions.
- M. Integrated System Testing
  - 1. Integrated system testing shall be the responsibility of the Contractor
  - 2. The Engineer will monitor and participate in the test
  - 3. Perform integrated system testing to verify the operation and performance of the complete, integrated control system
  - 4. Begin integrated system testing after all other field tests have been completed
  - 5. Provide full-time, on-site assistance during the business days and within four hours after call in for the test duration
  - 6. Demonstrate the availability of 99.0 percent or better for the system. Percent availability is equal to:

(Test Duration - Downtime) / Test Duration] x 100

- 7. The system is down if:
  - a. An on-line PLC is not polled
  - b. Operator commands cannot be carried out to the PLC
  - c. Failure of equipment due to improper operation by the City or failures of equipment not supplied under this Contract shall not be counted as downtime
  - d. Failover to a backup device shall not be counted as downtime provided the backup device promptly assumes proper operation.
- 8. With coordination with the Engineer operate the entire pump station processes for 10 consecutive days, 24 hours per day prior to full acceptance by the Engineer. If deficiencies are

found, the Contractor shall correct the deficiencies and retest the affected systems until all deficiencies are proved to be corrected. All deficiencies shall be promptly corrected within 24 hours of notice by the Engineer. The retest shall be started as soon as possible or within not more than two (2) days. Testing shall continue until ten consecutive days of proper operation can be demonstrated. Commissioning shall take place after the entire station processes are proved to operate properly as determined by the Engineer

## **BID FORMS**

# **CITYOFSANTA ROSA**

# STATE OF CALIFORNIA

# PUMP STATION 15 UPGRADES

The work to be performed and referred to herein is in the City of Santa Rosa, California and consists of improvements to be constructed in accordance with the provisions of the Invitation for Bids, containing the Notice to Bidders, the Special Provisions, the Project Plan(s), the Bid Forms and the Contract, all of which are by reference incorporated herein, and each Addendum, if any is issued, to any of the above which is also incorporated by reference herein.

## TO THE AWARD AUTHORITY OF THE CITY OF SANTA ROSA

The undersigned, as bidder, declares that the only person or parties interested in this bid as principals are those named herein; that this bid is made without collusion with any other person, firm, or corporation; that Contractor has carefully examined the Project Plans, Invitation for Bids and conditions therefor, and is familiar with all bid requirements, that Contractor has examined this Contract and the provisions incorporated by reference herein, and Contractor hereby proposes, and agrees that if its bid is accepted by the City, Contractor will provide all necessary machinery, tools, apparatuses, and other means of construction, and to do all the work and furnish all the materials and services required to complete the construction in accordance with the Contract, the Special Provisions, the Project Plan(s), and Addenda to any of the above as incorporated by reference, in the time stated herein, for the unit prices and/or lump sum prices as follows:

#### NAME OF BIDDER: \_\_\_\_\_

Contract #:	C01994
Project Title:	PUMP STATION 15 UPGRADES

Line
------

Line #	Description	Units	Quantity	/ Unit Price	Total Price
1	MOBILIZATION/DEMOBILIZATION	LS	1	\$	\$
2	DEMOLITION AND TEMPORARY WORK	LS	1	\$	\$
3	WIRING AND CONDUITS	LS	1	\$	\$
4	AUTOMATIC TRANSFER SWITCH & MTS PANEL	LS	1	\$	\$
5	SCADA MODIFICATION-ONSITE	LS	1	\$	\$
6	INSTRUMENTS	LS	1	\$	\$
7	PIPING AND VALVES	LS	1	\$	\$
8	MCC MODIFICATIONS	LS	1	\$	\$
9	CONTROL PANEL	LS	1	\$	\$
10	ULTRA-LOW HARMONICS VFD (50HP)	LS	1	\$	\$
11	GENERATOR ROOM MODIFICATION	LS	1	\$	\$
12	HYDROPNEUMATIC TANK RECOATING	LS	1	\$	\$
13	STANDBY GENERATOR WITH SUB-BASE TANK & SILENCER (100kW)	LS	1	\$	\$
14	FLOOR RECOATING	LS	1	\$	\$
15	TOUCH-UP AND POWER WASH CLEANING	LS	1	\$	\$
16	EXTERIOR PIPE RECOATING	LS	1	\$	\$
17	8' CHAIN-LINK FENCE	LF	400	\$	\$
18	SWING GATES	LS	1	\$	\$
				Т	otal: \$

In the case of any discrepancy between the unit price and the total set forth for the item, the unit price shall prevail; provided, however, that if the amount set forth as a unit price is ambiguous, unintelligible or uncertain for any reason, or is omitted, or in the case of lump sum items, is not the same amount as the entry in the "Total" column, then the amount set forth in the "Total" column for the item shall prevail in accordance with the following:

- 1. As to lump sum items, the amount set forth in the "Total" column shall be the unit price;
- 2. As to unit basis items, the amount set forth in the "Total" column shall be divided by the estimated quantity for the item and the price thus obtained shall be the unit price.

The Total Base Bid shall be the sum of the "Total" column. In case of discrepancy between the sum of the "Total" column and the amount entered as Total Base Bid, the sum of the "Total" column shall prevail. The bid comparison will be based on the sum of the "Total" column for each bidder.

If this Contract Bid is accepted by the City and the undersigned fails to execute the Contract and to give all the bonds required under the Contract, with a surety satisfactory to the Award Authority of the City of Santa Rosa, within ten calendar days after bidder has received the Notice of Award from the Engineer, then the Award Authority may, at its option, determine that the bidder has abandoned the Contract, and thereupon this bid and the acceptance thereof shall be null and void, and the forfeiture of the security accompanying this bid shall be in accordance with California Public Contract Code section 20172.

The undersigned understands and agrees that the City is not responsible for any error or omissions on the part of the undersigned in making this bid.

The bidder to whom the Contract is awarded agrees to execute the Contract in favor of the City, in the form attached, and to deliver any and all required bond(s) and insurance certificates within ten calendar days from the date of Contractor's receipt of the Notice of Award. Following the award of the Contract, Contractor shall commence work within ten calendar days from the day authorized in the Notice to Proceed and diligently prosecute the same to completion in accordance with Section 8-1.04.

# LIST OF SUBCONTRACTORS

#### NAME OF BIDDER:

The following is a list of each subcontractor who will perform work or labor or render services to the undersigned for the construction of the project in an amount in excess of  $\frac{1}{2}$  of 1% of the total amount of this bid.

The undersigned agrees that any portion of the work in excess of ½ of 1% of the total amount of this bid and for which no subcontractor is designated herein will be performed by the undersigned.

SUBCONTRACTOR NAME	SUBCONTRACTOR LICENSE NUMBER	SUBCONTRACTOR DIR REGISTRATION NUMBER	SUBCONTRACTOR BUSINESS ADDRESS	DESCRIPTION OF WORK (ITEM NO.)

# LIST OF PREVIOUS SIMILAR JOBS

NAME OF BIDDER:

#### NONCOLLUSION DECLARATION TO BE EXECUTED BY BIDDER AND SUBMITTED WITH BID

The undersigned declares:

I am the \_\_\_\_\_\_\_\_ of \_\_\_\_\_\_\_, the party making the foregoing bid. The bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation. The bid is genuine and not collusive or sham. The bidder has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid. The bidder has not directly or indirectly colluded, conspired, connived, or agreed with any bidder or anyone else to put in a sham bid, or to refrain from bidding. 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. All statements contained in the bid are true. 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, to any corporation, partnership, company, association, organization, bid depository, or to any member or agent thereof, to effectuate a collusive or sham bid, and has not paid, and will not pay, any person or entity for such purpose.

Any person executing this declaration on behalf of a bidder that is a corporation, partnership, joint venture, limited liability company, limited liability partnership, or any other entity, hereby represents that he or she has full power to execute, and does execute, this declaration on behalf of the bidder.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct and that this declaration is executed on \_\_\_\_\_ [date], at \_\_\_\_\_ [city], \_\_\_\_\_ [state].

NOTE: The above Noncollusion Declaration is part of the Contract Bid. Signing this Bid on the signature portion thereof shall also constitute signature of this Noncollusion Declaration.

#### BID BOND AFFIDAVIT AND BIDDER'S SIGNATURE PAGE

Accompanying this bid is a guaranty in the form of (Notice: Insert the words "cash \$," "Cashier's Check," "Certified Check," or "Bidder's Bond" as the case may be):

in an amount equal to at least ten percent of the total of this bid.

The undersigned further agrees that if Contractor does not execute the Contract and deliver the necessary bonds to the City within the period of time specified in this Invitation for Bids, the proceeds of the security accompanying this bid shall become the property of the City of Santa Rosa, California, and this bid and the acceptance thereof may, at the option of the City, be considered null and void.

The undersigned is licensed in accordance with an act providing for the registration of Contractors, License No. \_\_\_\_\_, Class \_\_\_\_\_, expiration date \_\_\_\_\_.

The undersigned in registered with the Department of Industrial Relations, Registration No.

IMPORTANT NOTICE: If bidder or other interested person is a corporation, state legal name of corporation, also names of the president, secretary, treasurer, and manager of the corporation; if a partnership, state true name of partnership, also the names of all partners in the partnership; if the bidder is a sole proprietor, state the business name and the proprietor's name in full.

Secretary of State Business Entity Number: \_\_\_\_\_\_.

Business Address

**Telephone Number** 

I declare under penalty of perjury that the foregoing is true and correct.

BIDDER'S SIGNATURE:

TITLE:

DATE:

## CONTRACT

## **CITY OF SANTA ROSA**

#### CALIFORNIA

#### CONTRACT NO. C01994 PUMP STATION 15 UPGRADES

This Contract is made and entered into as of <u>date to be added upon award</u> at Santa Rosa, California, between the City of Santa Rosa ("City") and \_\_\_\_\_\_ of \_\_\_\_\_ ("Contractor").

ARTICLE I - For and in consideration of the payment and agreement hereinafter mentioned, to be made and performed by City, and under the conditions expressed in the required bonds hereunto annexed, Contractor agrees that for the benefit of City, at its own cost and expense, to do all the work and furnish all the materials, except such as are mentioned in the Special Provisions to be furnished by City, necessary to construct and complete the work herein described in a good, workmanlike, and substantial manner. The work embraced herein shall be done in accordance with the Standard Specifications of the State of California Department of Transportation, dated 2010, insofar as the same may apply (Standard Specifications); in accordance with the City of Santa Rosa Construction Specifications for Public Improvements (City Specifications); in accordance with the State of California Department of Transportation emitted the City of Santa Rosa Design and Construction Standards, (City Standards); in accordance with the State of California Department of Transportation emitted the State of California Department of Transportation emitted the City of Santa Rosa Design and Construction Standards, (City Standards); in accordance with the State of California Department of Transportation Standard Plans, dated 2010 (Standard Plans), (collectively, "Contract Documents") and in accordance with the Special Provisions hereinabove set forth, all of which are hereby incorporated into and made part of this Contract.

The work to be performed is further shown upon a plan consisting of 23 sheets entitled, Pump Station 15 Upgrades, File Number 2019-0020, approved by the Deputy Director of Transportation and Public Works, hereinafter referred to as the Project Plan(s).

ARTICLE II - Contractor agrees to receive and accept the following prices as full compensation for furnishing all materials and doing all the work contemplated and embraced in this Contract; also for all loss or damages arising out of the nature of the work aforesaid, or from the acts of the elements, or from any unforeseen difficulties or obstructions which may arise or be encountered in the prosecution of the work until its acceptance by City and for all expenses incurred by or in consequence of the suspension or discontinuance of work, and for well and faithfully completing the work, and the whole thereof in the manner and according to the Project Plans and Invitation for Bids therefor, and the requirements of the Engineer under them to wit:

ITEM NUMBER	QUANTITY	DESCRIPTION	U	TOTAL
			\$	\$ 
TOTAL BASE BID	(SUM OF "TO	TAL" COLUMN)	\$	

## BID ITEMS IN THIS SECTION WILL BE INSERTED UPON AWARD OF THE CONTRACT AND SHALL BE THE SAME AS THOSE BID UPON.

ARTICLE III - City and Contractor hereby promise and agree that Contractor shall provide the materials and do the work according to the terms and conditions herein contained and referred to, for the prices aforesaid, and City hereby agrees to pay for the same at the time, in the manner, and upon the conditions set forth; and the parties for themselves, their heirs, executors, administrators, successors, and assigns, do hereby agree to full performance of the covenants herein stated.

ARTICLE IV - By execution of this Contract, Contractor hereby represents and certifies that Contractor is aware of the provisions of Labor Code section 3700 which require every employer to be insured against liability for Workers' Compensation or to undertake self-insurance in accordance with the provisions of that Code, and Contractor hereby agrees to comply with such provisions before commencing the performance of the work of this Contract.

ARTICLE V - It is further expressly agreed by and between the parties hereto that the Invitation for Bids, containing the Notice to Bidders including any required Bonds, the Contract Documents, and any Addenda are all essential parts of this Contract and are specially referred to and by such reference made a part hereof. In the event of any conflict in the provisions thereof, the terms of said documents shall control each over the other, in the following order:

- 1. Special Provisions
- 2. Project Plans
- 3. City Standards
- 4. City Specifications
- 5. Standard Specifications
- 6. Standard Plans

ARTICLE VI - Contractor agrees to commence work pursuant to this Contract within ten calendar days from the date authorized in the Notice to Proceed and to diligently prosecute the same to completion in accordance with Section 8-1.04C of the Special Provisions.

This Contract shall not be transferred or assigned without the prior written consent of City, which may be withheld by City in its sole and absolute discretion.

If Contractor is a corporation, two corporate officers of Contractor, one from each of the following two groups shall execute this Contract: a) the chairman of the board, president or any vice-president; b) the secretary, any assistant secretary, chief financial officer, or any assistant treasurer. The name and title of the corporate officers shall be printed under the signature.

In witness whereof, the parties hereto have executed this Contract as of the date first written above.

City:	Contractor:
City of Santa Rosa, a Municipal corporation	Name of Contractor, Type of entity
Ву:	Ву:
Title:	Name:
ATTEST:	Title:
Title:	Ву:
Approved as to form:	Name:
By:	Title:
Office of City Attorney	