City of SACRAMENTO

City Council Report

915 I Street, 1st Floor
Sacramento, CA 95814
www.cityofsacramento.org

File ID: 2019-01813 | January 14, 2020 | **Consent Item 16**

Title: Contract: City College Reservoir Electrical Improvements

Location: District 5

Recommendation: Adopt a Resolution: 1) approving the contract plans and specifications for the City College Reservoir Electrical Improvements Project; 2) awarding the contract to Koch & Koch, Inc. for an amount not-to-exceed $546,000; and 3) approving a budget transfer from the Base Water CIP Contingency Program (Z14000700) Water Fund (Fund 6005) to the Reservoir Rehabilitation Program (Z14130500) Water Fund (Fund 6005) in the amount of $210,000.

Contact: Paul Barnes, Project Manager (916) 808-1442; Dave Hansen (916) 808-1421; Tony Bertrand, Engineering & Water Resources Division Manager, (916) 808-1461; Department of Utilities

Presenter: None

Attachments:
1-Description/Analysis
2-Contract
3-Resolution

Description/Analysis

Issue Detail: Staff recommends Council award a construction contract to Koch & Koch, Inc. (Koch) to install electrical improvements at City College Reservoir. The new electrical switchgear will increase the reliability of the facility. In addition, the existing regulating valve, butterfly valves, and actuators will also be replaced. These improvements will reduce the amount of maintenance and improve reliability at this facility.

City College Reservoir is a 3 million-gallon reservoir operated by the City of Sacramento (City) to provide storage and pressure to the City water distribution system. This facility was built in 1936 and is located near Sacramento City College.

The Department of Utilities best practice guidelines are to replace existing electrical switchgear on a 30-year cycle. Since the existing switchgear and control systems were installed in 1962, this switchgear is 27 years past its expected life cycle replacement. Because of its age, the electrical equipment is difficult to maintain, and replacement parts are no longer available.

Policy Considerations: City Council approval is required to award construction contracts of $100,000 or more. The action requested conforms with City Code Chapter 3.60, Articles I and III, which provide for award of competitively bid contacts to the lowest responsible bidder. The installation of the electrical improvements is consistent with the criteria set forth in the Department of Utilities Capital Improvement Programming Guide to ensure the reliability and safety of the City's drainage system.

Economic Impacts: This project is expected to create 2.18 total jobs (1.26 direct jobs and 0.92 jobs through indirect and induced activities) and create $337,120 in total economic output ($212,489 of direct output and another $124,631 of output through indirect and induced activities).

The indicated economic impacts are estimates calculated using a calculation tool developed by the Center for Strategic Economic Research (CSER). CSER utilized the IMPLAN input-output model (2009 coefficients) to quantify the economic impacts of a hypothetical $1 million of spending in various construction categories within the City of Sacramento in an average one-year period. Actual impacts could differ significantly from the estimates and neither the City of Sacramento nor CSER shall be held responsible for consequences resulting from such differences.

Environmental Considerations: The Community Services Department, Environmental Planning Services Division has reviewed the project and has determined that this project is exempt from the California Environmental Quality Act (CEQA) under CEQA Guidelines

Sections 15301(b) and 15302(c). The project consists of the operation, repair and minor alteration of existing facilities and mechanical equipment used to provide public utility services involving negligible expansion of use, and the replacement of existing utility systems and facilities involving negligible or no expansion of capacity.

Sustainability: The proposed project is consistent with the 2035 General Plan as it will improve infrastructure reliability.

Commission/Committee Action: Not applicable.

Rationale for Recommendation: The project was advertised, and three bids were received and opened on November 13, 2019. Koch was the lowest responsible bidder. The bid results are as follows:

Contractor	Amount
Koch & Koch, Inc.	$546,000
D. L. Payne, Inc.	$667,951
Lords Electric Inc.	$833,800

The Engineer's construction cost estimate was $525,000.

Financial Considerations: The total estimated cost for this project is $715,000 and includes design, engineering, inspection, construction and project management costs. To provide sufficient funding for this project, staff recommends transferring $210,000 from the Base Water CIP Contingency Program (Z14000700) Water Fund (Fund 6005) to the Reservoir Rehabilitation Program (Z14130500) Water Fund (Fund 6005).

There are no General Funds allocated planned or for this project.

Local Business Enterprise (LBE): Koch & Koch Inc. is not an LBE but has partnered with Platt Electric Supply to exceed the minimum LBE participation requirement. Platt Electric Supply will provide the electrical materials.

City of SACRAMENTO
Department of Utilities

ENGINEERING SERVICES DIVISION

CONTRACT SPECIFICATIONS
FOR

CITY COLLEGE RESERVOIR ELECTRICAL IMPROVEMENTS

PN: Z14130505

B20141321005

Engineer's Estimate: $525,000

Non-Mandatory Pre-Bid Site Walk: Thursday, October 31, 10:00 AM
Site Walk Location: 3581 23rd Street, Sacramento CA 95818
Near Sacramento City College

For Pre-Bid Information Call:	Separate Plans
Paul Barnes Senior Engineer (916) 808-1442	Bid to be received before 2:00 PM **November 13, 2019** New City Hall, Office of the City Clerk 915 I Street, 5th Floor, Mayor's Reception Desk Sacramento, CA 95814

LBE PROGRAM PARTICIPATION

For information on meeting the City of Sacramento's Local Business Enterprise (LBE) project goals, please contact Procurement Services at (916) 808-6240, or visit the City of Sacramento's small business web site at: http://portal.cityofsacramento.org/Finance/Procurement/Bid-Information#bidding-options

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CALIFORNIA LABOR CODE RELATING TO APPRENTICES
http://www.dir.ca.gov/dlse/dlsePublicWorks.html

TAX FORMS (REQUIRED UPON AWARD)

W-9 https://www.irs.gov/pub/irs-pdf/fw9.pdf
CA Form 590 https://www.ftb.ca.gov/forms/2019/19_590.pdf
CA Form 587 https://www.ftb.ca.gov/forms/2019/19_587.pdf

SPECIAL PROVISIONS

LBE INFORMATION

The City of Sacramento's Local Business Development program establishes an annual local business enterprise (LBE) participation goal for City contracts and authorizes City departments to require minimum LBE participation levels in individual contracts. Under City Code section 3.60.270, all bidding contractors must meet or exceed the minimum LBE participation requirement specified in the contract's bid specifications to qualify as a responsive bidder.

For information on meeting the City of Sacramento's Local Business Enterprise (LBE) project goals, please contact Procurement Services at (916) 808-6240, or visit the City of Sacramento's small business web site at: http://portal.cityofsacramento.org/Finance/Procurement/Bid-Information#bidding-options

NOTICE TO CONTRACTORS

CITY OF SACRAMENTO

Sealed Proposals will be received by the City Clerk of the City of Sacramento at the Office of the City Clerk, New City Hall, located at 915 I Street, 5th Floor, Mayor's Reception Desk, up to the hour of 2:00 p.m. on **November 13, 2019** and opened at and read after 2:00 p.m. on **November 13, 2019**, or as soon thereafter as business allows, in the Hearing Room, 2nd Floor Room, in Historic City Hall, for construction of:

CITY COLLEGE RESERVOIR ELECTRICAL IMPROVEMENTS

(PN: Z14130505) (B20141321005)

as set forth in the Contract Documents.

Proposals received and work performed thereunder shall comply with the requirements of Chapter 3.60 of the Sacramento City Code. Each Bid Proposal shall be accompanied by bid security of at least 10% of the sum the Bid Proposal. The City reserves the right to reject proposals or to waive any error or omission in any Bid Proposal received. Signed proposals shall be submitted on the printed forms contained herein and enclosed in an envelope marked:

SEALED PROPOSAL FOR
CITY COLLEGE RESERVOIR ELECTRICAL IMPROVEMENTS
(PN: Z14130505) (B20141321005)

You can view and download the plans and Contract Documents from:

PLANET BIDS
http://www.planetbids.com/portal/portal.cfm?CompanyID=15300#

The contractor and all subcontractors shall comply with the rates of wages currently established by the Director of Industrial Relations under provisions of Sections 1773 of the Labor Code of the State of California, a copy of which is on file in the office of the City Clerk and available to any interested party on request. In accordance with Sacramento City Code Section 3.60.180 and Section 1771.5 of the California Labor Code, the payment of the general prevailing rate of per diem wages or the general prevailing rate of per diem wages for holiday and overtime is not required for any construction project of $25,000 or less, or an alteration, demolition, repair, and maintenance project of $15,000 or less. The City of Sacramento has an approved Labor Compliance Program. **The City uses an electronic system for the submission of Labor Compliance Reports, which became effective May 1, 2007.** The contractor and every lower-tier subcontractor shall submit certified payrolls and labor compliance documentation electronically at the discretion of and in the manner specified by the City of Sacramento.

Electronic submittal is via a web-based system, accessed on the World Wide Web by a web browser. Each contractor and subcontractor is given a Log On identification and password to access the City of Sacramento's reporting system.

Use of the system may entail additional data entry of weekly payroll information including employee identification, labor classification, total hours worked and hours worked on this project, wage and benefit rates paid, etc. The contractor's payroll and accounting software might be capable of generating a 'comma delimited file' that will interface with the software.

Department of Industrial Relations Registration and Reporting Requirements (SB 854)

Labor Code Section 1725.5 (enacted by SB 854) requires all contractors bidding on this contract, all subcontractors listed in a bid for this contract, and any contractor or subcontractor performing any work under this contract, to be currently registered with the California Department of Industrial Relations (DIR), as specified in Labor Code Section 1725.5. Labor Code Section 1771.1 (enacted by SB 854) provides that a contractor or subcontractor shall not be qualified to bid on, be listed in a bid proposal (subject to the requirements of Section 4104 of the Public Contract Code), or engage in the performance of any contract for public work, unless currently registered and qualified to perform public work pursuant to Labor Code Section 1725.5. Every bidding contractor shall list the contractor's current DIR registration number, and the current DIR registration number of all listed subcontractors, on the Subcontractor and Local Business Enterprise (LBE) Participation Verification Form included in the contractor's bid.

Pursuant to Labor Code Section 1771.1(b): (1) any bid received from a contractor that is not currently registered and qualified to perform public work pursuant to Labor Code Section 1725.5 **shall be rejected as non-responsive**; and (2) any bid listing one or more subcontractors on the bidder's Subcontractor and Local Business Enterprise (LBE) Participation Verification Form that are not currently registered and qualified to perform public work pursuant to Labor Code Section 1725.5, **shall be rejected as non-responsive**, unless the listing was an inadvertent error and any of the conditions specified in Labor Code Section 1771.1(c) apply.

This contract also is subject to compliance monitoring and enforcement by the DIR. For all contracts awarded on or after April 1, 2015, California Labor Code Section 1771.4 (enacted by SB 854) requires the contractor and all subcontractors to furnish electronic payroll records directly to the Labor Commissioner (in addition to City staff via the City's electronic system).

A Fact Sheet summarizing the provisions of SB 854 is attached. This is provided solely for informational purposes, and does not in any way affect the contractor's and subcontractors' obligation to comply in all respects with the provisions of SB 854, including the provisions referenced above, as well as all other applicable laws and regulations.

The contractor shall disseminate these provisions to every lower-tier subcontractor and vendor required to provide labor compliance documentation.

All questions regarding the City's Labor Compliance Program should be directed to the Department's contracts staff or the Labor Compliance Officer at (916) 808-4011.

Pursuant to Sacramento City Code Section 3.60.190, all contractors and subcontractors shall comply with Section 1777.5 et seq., of the California Labor Code governing the employment of apprentices. Pursuant to Sacramento City Code Section 3.60.250 and Public Contract Code Section 22300, any contract awarded pursuant to this invitation to bid shall contain a provision permitting the substitution of securities for monies withheld to ensure performance under the contract, in accordance with the requirements and form specified by the City.

Bid protests must be filled and maintained in accordance with the provisions of Sections 3.60.460 through 3.60.560 of the Sacramento City Code. Bid protests that do not comply with Sections 3.60.460 through 3.60.560 of the Sacramento City Code shall be invalid and shall not be considered. A bid protest fee of $750.00 is required at the time of filing. The term "bid protest" includes any bid protest that (1) claims that one or more bidders on this contract should be disqualified or rejected for any reason, (2) contests a City staff recommendation to award this contract to a particular bidder, or (3) contests a City staff recommendation to disqualify or reject one or more bidders on this contract. A copy of Sections 3.60.460 through 3.60.560 of the Sacramento City Code may be obtained from the Project Manager, or from the City Clerk, located at 915 I Street, 5th Floor, Sacramento, CA 95814.

The Project Manager's contact information is:

Paul Barnes, Department of Utilities, Engineering & Water Resource Division
1395 35th Avenue, Sacramento, CA 95822
Phone: (916) 808-1442 / Fax: (916) 808-1497/Email pbarnes@cityofsacramento.org

BAN-THE-BOX REQUIREMENTS

INTRODUCTION

On September 6, 2016, the City of Sacramento enacted an ordinance regarding criminal conviction information in the employment application process (the "Ban-the-Box Ordinance"), which added Chapter 3.62 to the Sacramento City Code and amended Section 2.40.050 of the Sacramento City Code. The Ban-the-Box Ordinance prohibits "covered employers" from asking an applicant for employment to disclose, orally or in writing, information concerning the criminal conviction history of the applicant, including any inquiry about criminal conviction history on any employment application, until the employer has determined the applicant meets the minimum employment qualifications stated in any notice issued for the position.

APPLICATION

"City Contract"

The Ban-the-Box Ordinance applies to all "city contracts." The term "city contract" means a contract awarded after January 1, 2017 to a "covered employer" for services or a public project in return for compensation of $100,000 or more. The term "city contract" includes contracts for services or public projects that were awarded for an amount less than $100,000, but were amended to increase the total compensation to $100,000 or more. The Ban-the-Box Ordinance also applies when the aggregate value of all contracts for services or public projects the City has awarded to the same "covered employer" within the previous 12 months is $100,000 or more.

The Ban-the-Box Ordinance does not apply to: (1) contracts awarded by the City Manager in response to an emergency; and (2) contracts for the purchase or lease of equipment, supplies, or other personal property, even if they include incidental services such as delivery, installation, or maintenance.

"Covered Employer"

The Ban-the-Box Ordinance only applies to "covered employers." The term "covered employer" means a person who is a party to a "city contract" and has at least 20 employees working either full or part time. The number of employees that a contractor has is determined by adding the contractor's employees and the employees of any "related person." A person is a "related person" when any of the following circumstances exists:

(1) The person and the person that is a party to a "city contract" are both corporations and:

   (a) Share a majority of members of their governing boards; or
   (b) Have two or more officers in common; or
   (c) Are controlled by the same majority shareholder or shareholders (control means more than 50% of the corporation's voting power); or
   (d) Are in a parent-subsidiary relationship (such a relationship exists when one corporation directly or indirectly owns shares possessing more than 50% of another corporation's voting power).

(2) The person otherwise controls and directs, or is controlled and directed by, the person that is a party to a city contract, as determined by the City Manager, or City Manager designee.

The term "covered employer" includes a subcontractor providing services under a "city contract" if the subcontractor has at least 20 employees, whether full- or part-time, or the amount of the subcontract is at least 25% of the amount of the "city contract."

The term "covered employer" does not include any unit of federal, state or local government.

Exceptions

The Ban-the-Box Ordinance provisions do not apply to: (1) a position for which a "covered employer" is otherwise required by law to conduct a criminal conviction history background check; or (2) a position that will not involve work pursuant to a "city contract." Additionally, the Ban-the-Box Ordinance does not prevent a "covered employer" from conducting a criminal conviction history background check in subsequent stages of the application process after initially determining whether the applicant meets the minimum employment qualifications.

COMPLIANCE

It is the contractor's responsibility to determine whether the aggregate value of $100,000 or more has been met, and to notify the City in writing whenever this is the case. It is also the contractor's responsibility to ensure that all of its subcontractors who are covered by the Ban-the-Box Ordinance comply with the provisions of the Ban-the-Box Ordinance by including these requirements in all subcontracts covered by the Ban-the-Box Ordinance.

VIOLATIONS AND MONITORING

The Ban-the-Box Ordinance provides that any violation of the Ban-the-Box Ordinance by a "covered employer" constitutes a material breach of the contract, and authorizes the City to terminate the contract. The City may also enforce the Ban-the-Box Ordinance by investigating any alleged violation (but any failure of the City to investigate does not create a right of action against the City). The City may further require "covered employers" to verify compliance.

ADDITIONAL INFORMATION

For a complete description of the Ban-the-Box Ordinance provisions related to City contracts, refer to the Ban-the-Box Ordinance, codified at Sacramento City Code Chapter 3.62. The Sacramento City Code is available on the internet at www.cityofsacramento.org.

For more information on the City's Ban-the-Box Ordinance, contact Procurement Services at 916-808-6240.

NOTICE REGARDING ASSEMBLY BILL 626

Assembly Bill 626 (AB 626), signed into law September 29, 2016, established a new claim resolution process for public works project contracts entered into on or after January 1, 2017. AB 626 is codified in Section 9204 of the California Public Contract Code. Section 9204 remains in effect until January 1, 2020, and as of that date will be repealed unless another statute extends or deletes this sunset date.

Public Contract Code Section 9204 applies to any "claim," as defined in Section 9204, which is presented by the Contractor to the City. Section 9204 defines a "claim" as a separate demand by the Contractor sent by registered mail or certified mail with return receipt requested, for one or more of the following: (1) a time extension, including, without limitation, for relief from damages or penalties for delay assessed by the City; (2) payment by the City of money or damages arising from work done by, or on behalf of, the Contractor pursuant to the Contract and payment for which is not otherwise expressly provided or to which the claimant is not otherwise entitled; or (3) payment of an amount that is disputed by the City.

If Contractor presents a claim to the City in accordance with the provisions of Public Contract Code Section 9204 (hereafter referred to as a "Claim"), the process specified in Section 9204 will be followed, and the provisions of Section 4-8 (Disputed Claims) and Section 4-9 (Review by Claim Review Committee and Issuance of Decision by Department Director) of the City's Standard Specifications for Public Construction will not apply to the Claim. Contractor's Claim shall comply with the provisions of Section 4-7 (Notice of Claims for Additional Compensation or Damages) of the City's Standard Specifications or Contractor shall give a separate written notice of potential claim that complies with the requirements specified in Section 4-7, except in any case where compliance with the requirements specified in Section 4-7 would conflict with Public Contract Code Section 9204.

Subsection (e) of Public Contract Code Section 9204 requires that the text of Section 9204 or a summary be set forth in the plans or specifications for any public works project that may give rise to a claim under Section 9204.

The full text of Public Contract Code Section 9204 is as follows:
9204.
(a) The Legislature finds and declares that it is in the best interests of the state and its citizens to ensure that all construction business performed on a public works project in the state that is complete and not in dispute is paid in full and in a timely manner.
(b) Notwithstanding any other law, including, but not limited to, Article 7.1 (commencing with Section 10240) of Chapter 1 of Part 2, Chapter 10 (commencing with Section 19100) of Part 2, and Article 1.5 (commencing with Section 20104) of Chapter 1 of Part 3, this section shall apply to any claim by a contractor in connection with a public works project.
(c) For purposes of this section:
(1) "Claim" means a separate demand by a contractor sent by registered mail or certified mail with return receipt requested, for one or more of the following:
(A) A time extension, including, without limitation, for relief from damages or penalties for delay assessed by a public entity under a contract for a public works project.
(B) Payment by the public entity of money or damages arising from work done by, or on behalf of, the contractor pursuant to the contract for a public works project and payment for which is not otherwise expressly provided or to which the claimant is not otherwise entitled.
(C) Payment of an amount that is disputed by the public entity.

(2) “Contractor” means any type of contractor within the meaning of Chapter 9 (commencing with Section 7000) of Division 3 of the Business and Professions Code who has entered into a direct contract with a public entity for a public works project.
(3) (A) “Public entity” means, without limitation, except as provided in subparagraph (B), a state agency, department, office, division, bureau, board, or commission, the California State University, the University of California, a city, including a charter city, county, including a charter county, city and county, including a charter city and county, district, special district, public authority, political subdivision, public corporation, or nonprofit transit corporation wholly owned by a public agency and formed to carry out the purposes of the public agency.
(B) “Public entity” shall not include the following:
(i) The Department of Water Resources as to any project under the jurisdiction of that department.
(ii) The Department of Transportation as to any project under the jurisdiction of that department.
(iii) The Department of Parks and Recreation as to any project under the jurisdiction of that department.
(iv) The Department of Corrections and Rehabilitation with respect to any project under its jurisdiction pursuant to Chapter 11 (commencing with Section 7000) of Title 7 of Part 3 of the Penal Code.
(v) The Military Department as to any project under the jurisdiction of that department.
(vi) The Department of General Services as to all other projects.
(vii) The High-Speed Rail Authority.
(4) “Public works project” means the erection, construction, alteration, repair, or improvement of any public structure, building, road, or other public improvement of any kind.
(5) “Subcontractor” means any type of contractor within the meaning of Chapter 9 (commencing with Section 7000) of Division 3 of the Business and Professions Code who either is in direct contract with a contractor or is a lower tier subcontractor.
(d) (1) (A) Upon receipt of a claim pursuant to this section, the public entity to which the claim applies shall conduct a reasonable review of the claim and, within a period not to exceed 45 days, shall provide the claimant a written statement identifying what portion of the claim is disputed and what portion is undisputed. Upon receipt of a claim, a public entity and a contractor may, by mutual agreement, extend the time period provided in this subdivision.
(B) The claimant shall furnish reasonable documentation to support the claim.
(C) If the public entity needs approval from its governing body to provide the claimant a written statement identifying the disputed portion and the undisputed portion of the claim, and the governing body does not meet within the 45 days or within the mutually agreed to extension of time following receipt of a claim sent by registered mail or certified mail, return receipt requested, the public entity shall have up to three days following the next duly publicly noticed meeting of the governing body after the 45-day period, or extension, expires to provide the claimant a written statement identifying the disputed portion and the undisputed portion.
(D) Any payment due on an undisputed portion of the claim shall be processed and made within 60 days after the public entity issues its written statement. If the public entity fails to issue a written statement, paragraph (3) shall apply.
(2) (A) If the claimant disputes the public entity’s written response, or if the public entity fails to respond to a claim issued pursuant to this section within the time prescribed, the claimant may demand in writing an informal conference to meet and confer for settlement of the issues in dispute. Upon receipt of a demand in writing sent by registered mail or certified mail, return receipt requested, the public entity shall schedule a meet and confer conference within 30 days for settlement of the dispute.
(B) Within 10 business days following the conclusion of the meet and confer conference, if the claim or any portion of the claim remains in dispute, the public entity shall provide the claimant a written statement identifying the portion of the claim that remains in dispute and the portion that is undisputed. Any payment due on an undisputed portion of the claim shall be processed and made within 60 days after the public entity issues its written statement. Any disputed portion of the claim, as identified by the contractor in writing, shall be submitted to nonbinding mediation, with the public entity and the claimant sharing the associated costs equally. The public entity and claimant shall mutually agree to a mediator within 10 business days after the

disputed portion of the claim has been identified in writing. If the parties cannot agree upon a mediator, each party shall select a mediator and those mediators shall select a qualified neutral third party to mediate with regard to the disputed portion of the claim. Each party shall bear the fees and costs charged by its respective mediator in connection with the selection of the neutral mediator. If mediation is unsuccessful, the parts of the claim remaining in dispute shall be subject to applicable procedures outside this section.
(C) For purposes of this section, mediation includes any nonbinding process, including, but not limited to, neutral evaluation or a dispute review board, in which an independent third party or board assists the parties in dispute resolution through negotiation or by issuance of an evaluation. Any mediation utilized shall conform to the timeframes in this section.
(D) Unless otherwise agreed to by the public entity and the contractor in writing, the mediation conducted pursuant to this section shall excuse any further obligation under Section 20104.4 to mediate after litigation has been commenced.
(E) This section does not preclude a public entity from requiring arbitration of disputes under private arbitration or the Public Works Contract Arbitration Program, if mediation under this section does not resolve the parties' dispute.
(3) Failure by the public entity to respond to a claim from a contractor within the time periods described in this subdivision or to otherwise meet the time requirements of this section shall result in the claim being deemed rejected in its entirety. A claim that is denied by reason of the public entity's failure to have responded to a claim, or its failure to otherwise meet the time requirements of this section, shall not constitute an adverse finding with regard to the merits of the claim or the responsibility or qualifications of the claimant.
(4) Amounts not paid in a timely manner as required by this section shall bear interest at 7 percent per annum.
(5) If a subcontractor or a lower tier subcontractor lacks legal standing to assert a claim against a public entity because privity of contract does not exist, the contractor may present to the public entity a claim on behalf of a subcontractor or lower tier subcontractor. A subcontractor may request in writing, either on his or her own behalf or on behalf of a lower tier subcontractor, that the contractor present a claim for work which was performed by the subcontractor or by a lower tier subcontractor on behalf of the subcontractor. The subcontractor requesting that the claim be presented to the public entity shall furnish reasonable documentation to support the claim. Within 45 days of receipt of this written request, the contractor shall notify the subcontractor in writing as to whether the contractor presented the claim to the public entity and, if the original contractor did not present the claim, provide the subcontractor with a statement of the reasons for not having done so.
(e) The text of this section or a summary of it shall be set forth in the plans or specifications for any public works project that may give rise to a claim under this section.
(f) A waiver of the rights granted by this section is void and contrary to public policy, provided, however, that (1) upon receipt of a claim, the parties may mutually agree to waive, in writing, mediation and proceed directly to the commencement of a civil action or binding arbitration, as applicable; and (2) a public entity may prescribe reasonable change order, claim, and dispute resolution procedures and requirements in addition to the provisions of this section, so long as the contractual provisions do not conflict with or otherwise impair the timeframes and procedures set forth in this section.
(g) This section applies to contracts entered into on or after January 1, 2017.
(h) Nothing in this section shall impose liability upon a public entity that makes loans or grants available through a competitive application process, for the failure of an awardee to meet its contractual obligations.
(i) This section shall remain in effect only until January 1, 2020, and as of that date is repealed, unless a later enacted statute, that is enacted before January 1, 2020, deletes or extends that date.

THE FOLLOWING DOCUMENTS

ARE TO BE COMPLETED AND

SUBMITTED WITH THE BID PACKAGE

Contractor's Name: KOCH & KOCH, INC.
(Please print)

CITY OF SACRAMENTO

SEALED PROPOSAL

(MUST BE SIGNED BY BIDDER)

The Sealed Proposal will be received not later than **November 13, 2019**, at the Office of the City Clerk, New City Hall, at 915 I Street, 5th Floor, Mayor's Reception Desk, Sacramento, California and opened at 2:00 PM, or as soon thereafter as business allows, on **November 13, 2019**, by the Office of the City Clerk, 915 I Street, Historic City Hall, 2nd Floor, Hearing Room, Sacramento, California.

TO THE HONORABLE CITY COUNCIL:

The undersigned hereby proposes and agrees to furnish any and all required labor, material, transportation, and services for

CITY COLLEGE RESERVOIR ELECTRICAL IMPROVEMENTS
(PN: Z14130505) (B20141321005)

in the City and County of Sacramento, California.

TOTAL BID: Five hundred forty-six thousand ($ 546,000.).

The work herein described is to be performed in strict conformity with the Plans, City of Sacramento Standard Specifications (Resolution No. 89-216) and these Special Provisions, all as on file in the Office of the City Clerk, at the following unit prices.

Item No.	Description	Estimated Quantity	Unit	Unit Price	Total
1	Install New 1" RGS Conduit	100	LF	$ 80	$ 8000
2	Install New Switchboard	1	LS	$ 70,000	$ 70,000
3	Install New MCC and PLC	1	LS	$ 200,000	$ 200000
4	Electrical Improvements	1	LS	$ 87,000	$ 87000
5	Install New Altitude Valve	1	EA	$ 113,000	$ 113000
6	Install New Motor Actuator Valve	4	EA	$ 17,000	$ 68000

TOTAL BID: $ 546,000

The undersigned agrees to execute the Agreement and provide City the executed Agreement, the required insurance certificates, endorsements, and waivers of subrogation, and the required surety bonds within ten (10) calendar days after the undersigned's receipt of the City's notice that the undersigned will be recommended for Contract award and prior to award of the Contract by the City Council.

In determining the amount bid by each bidder, City shall disregard mathematical errors in addition, subtraction, multiplication and division that appear obvious on the face of the Proposal. When such a mathematical error appears on the Proposal, the City shall have the right to correct such error and to compute the total amount bid by said bidder on the basis of the corrected figure or figures.

When the unit price of an item is required to be set forth in the Proposal, and the total for the item set forth separately does not agree with a figure derived by multiplying the item unit price times the Engineer's estimate of the quantity of work to be performed for said item, the item unit price shall prevail over the sum set forth as the total for the item unless, in the sole discretion of the City, such a procedure would be inconsistent with the policy of the City's bidding procedures. The total paid for each such item of work shall be based upon the item unit price and not the total price.

Should the Proposal contain only a total price for an item and the item unit price is omitted, the City shall determine the item unit price by dividing the total price of the item by the Engineer's estimate of the quantity of work to be performed for the item of work.

If the Proposal contains neither the item price nor the total price for the item, then it shall be deemed incomplete and the Proposal shall be disregarded.

It is understood that this bid is based upon completion of the work within a period **of 130 working days** commencing on the date specified in the Notice to Proceed.

The amount of liquidated damages to be paid by the Contractor for failure to complete the work by the completion date (as extended, if applicable) shall be **Five Hundred Dollars ($500.00) for each calendar day**, continuing to the time at which the work is completed. Such amount is the actual cash value agreed upon as the loss to the City resulting from the default of the Contractor.

The undersigned represents and warrants that he/she has examined the location of the proposed work and is familiar with the conditions at the place where the work is to be done. The undersigned further represents that he/she has reviewed and understands the Plans, Special Provisions, and other contract documents, and the undersigned is satisfied with all conditions for the performance of the work

The undersigned has carefully checked all of the above figures and understands that the City of Sacramento will not be responsible for any errors or omissions on the part of the undersigned in making up this bid.

This proposal shall not be withdrawn for the time periods specified in Section 3-2 of the City of Sacramento Standard Specifications for award of contract to respective low bidders. This proposal is submitted in accordance with Chapter 3.60 of the Sacramento City Code and Sections 1, 2, and 3 of the City of Sacramento Standard Specifications.

In accordance with Standard Specification Section 3-2, the City shall award this contract to the lowest responsible bidder, if such award is made, within sixty (60) working days after opening of the Proposals. The City reserves the right to reject any and all bids.

REQUIRED DOCUMENT IN SEALED BID PROPOSAL

BID DEPOSIT ENCLOSED IN THE FOLLOWING FORM:

$_____ not less than ten (10) percent of amount bid.

_____CERTIFIED CHECK

_____MONEY ORDER

_____CASHIERS' CHECK

__✓__BID BOND

FOR CITY USE ONLY

TYPE OF DEPOSIT

X Bid Bond

☐ Cashier/Certified Check

☐ Other_____

Reviewer's Initials: MR

CONTRACTOR

Addendum No. 1 _____

Addendum No. 2 _____

Addendum No. 3 _____

Addendum No. 4 _____

KOCH & KOCH, INC.

By: _____ (Signature)

Title PRESIDENT

Address 16510 SOUTHRIDGE RD

No PO Box – Physical Address ONLY

PENN VALLEY CA 95946

City STATE Zip Code

Telephone No. 530-432-4000

Fax No. 530-432-4099

Email MK@KOCHINC.COM

(Federal Tax ID # or Social Security #)

Under penalty of perjury, I certify that the Taxpayer Identification Number and all other information provided here are correct.

94-3391116

DIR Registration Number: 1000005771

Valid Contractor's License No. 793724 Classification A, B, C10, C21, HAZ is held by the bidder.

Expiration date 4/30/2021 Representation made herein are true and correct under penalty of perjury

PN: Z14130505 (B20141321005)

CITY OF SACRAMENTO
Department of Utilities
Engineering Services Division

BID PROPOSAL GUARANTEE

KNOW ALL MEN BY THESE PRESENTS,

That we, _____

as Principal, and _____

a corporation duly organized under the laws of the State of _____and duly licensed to become sole surety on bonds required or authorized by the State of California, as Surety, are held and firmly bound unto the City of Sacramento, hereinafter called the City, in the penal sum of ten percent (10%) of the (BASE OR LUMP SUM) Proposal of the Principal above named, or other amount as set forth in the Invitation to Bidders, submitted by said Principal to the City for the Work described below, for the payment of which sum in lawful money of the United States, well and truly to be made, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH

That whereas the Principal has submitted the above mentioned proposal to the City, for which Proposals are to be opened by the Office of the City Clerk, Historic City Hall, Hearing Room, 2nd Floor, 915 I Street, Sacramento, California, on **November 13, 2019** for the Work specifically described as follows:

CITY COLLEGE RESERVOIR ELECTRICAL IMPROVEMENTS

(PN: Z14130505) (B20141321005)

NOW, THEREFORE, if the aforesaid Principal is award the Agreement and within the time and manner required under the Contract Documents, enters into a written Agreement, in the prescribed form, in accordance with the Proposal, and files two (2) bonds with the City, one to guarantee faithful performance and the other to guarantee payment for labor and materials, and files the required insurance policies with the City, all as required by the Contract Documents or by law, then the obligation shall be null and void; otherwise it shall be and remain in full force and effect.

In the event suit is brought upon this bond by the Obligee and judgment is recovered, the Surety shall pay all costs incurred by the Obligee in such suit, including a reasonable attorney's fee to be fixed by the court, which sums shall be additional to the principal amount of this bond.

IN WITNESS THEREOF, We have hereunto set our hands and seal this _____day of _____, 2019.

PRINCIPAL Seal	SURETY Seal
By: _____	By _____
Title	Title
	Agent Name and Address
	Agent Phone #
	Surety Phone #
	California License #

SACRAMENTO

Subcontractor and Local Business Enterprise Participation Form
For Public Projects over $100,000
THIS FORM MUST BE SUBMITTED WITH THE SEALED BID PROPOSAL

To be eligible for award of this contract, the bidder shall list the business entities used to attain the 5% LBE requirement. Additionally, the bidder shall list all other subcontractors who perform work, render service, or provide materials in an amount in excess of one-half of 1 percent of the total bid amount. In the case of bids for the construction of streets and highways, including bridges, subcontractors whose subcontract value exceeds one-half of 1 percent of the total bid or ten thousand dollars ($10,000), whichever is greater, shall be listed. Estimated dollar values shall be provided for all work / services listed. The failure to attain the 5% LBE participation or the inclusion of false information or the omission of required information will render the bid non-responsive.

Prime Contractor Name	KOCH & KOCH, INC.
Prime Contractor Address	PO BOX 909, PENN VALLEY, CA 95946
(REQUIRED) Prime Contractor DIR Registration #	1000005771

Date	11/13/19
Bid Amount	$ 546,000
Is Prime LBE?	☐ Yes ☑ No

		Subcontractor DIR Registration # (subject to verification)	**LBE?**	**Type of Work, Services, or Supplies to be provided to complete contract**	**Estimated Dollar Value of Work, Services or Supplies to be Performed of Provided**
Business Name	PLATT ELECTRIC	N/A	☑ Yes ☐ No	Electrical supplies	$ 30,000
License Number	N/A				
Address	4201 S. Market Ct #1				
City, State, Zip	Sacramento, CA 95834				
Contact Person					
Phone	916-928-0929				
Business Name		**Subcontractor DIR Registration # (subject to verification)**	**LBE?**	**Type of Work, Services, or Supplies to be provided to complete contract**	**Estimated Dollar Value of Work, Services or Supplies to be Performed of Provided**
License Number			☐ Yes ☐ No		$
Address					
City, State, Zip					
Contact Person					
Phone					
Business Name		**Subcontractor DIR Registration # (subject to verification)**	**LBE?**	**Type of Work, Services, or Supplies to be provided to complete contract**	**Estimated Dollar Value of Work, Services or Supplies to be Performed of Provided**
License Number			☐ Yes ☐ No		$
Address					
City, State, Zip					
Contact Person					
Phone					

COPY AND ATTACH ADDITIONAL SHEETS AS NECESSARY

I hereby certify that each subcontractor listed on this Subcontractor and LBE Participation Form has been notified that it has been listed and has consented in writing to its name being submitted for this contract. The Prime Contractor also certifies that it will notify each subcontractor listed on this Form in writing if the contract award is made to the Prime Contractor, and will make all documentation relevant to the subcontractor and LBE participation available to City of Sacramento upon request. The Prime Contractor further certifies that all of the information contained in this Form is true and correct and acknowledges that the City will rely on the accuracy of this information in awarding the contract.

PRINCIPAL OF FIRM:

Signature	**Title** PRESIDENT	**Date** 11/13/19

Form Revised 12/21/18

DRUG-FREE WORKPLACE POLICY AND AFFIDAVIT

BID MAY BE DECLARED NONRESPONSIVE IF THIS FORM (COMPLETED) IS NOT ATTACHED.
Pursuant to City Council Resolution CC90-498 dated 6/26/90 the following is required.

The undersigned contractor certifies that it and all subcontractors performing under this contract will provide a drug-free workplace by:

1. Publishing a "Drug-Free Workplace" statement notifying employees that the unlawful manufacture, distribution, dispensing, possession or use of a controlled substance is prohibited in the contractor's workplace and specifying the actions that will be taken against employees for violations of such prohibition.

2. Establishing a Drug-Free Awareness Program to inform employees about:

   a. The dangers of drug abuse in the workplace.
   b. The contractor's policy of maintaining a drug-free workplace.
   c. Any available drug counseling, rehabilitation, and employee assistance program.
   d. The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace.

3. Notify employees that as a condition of employment under this contract, employees will be expected to:

   a. Abide by the terms of the statement.
   b. Notify the employer of any criminal drug statute conviction for a violation occurring in the workplace.

4. Making it a requirement that each employee to be engaged in the performance of the contract be given a copy on the "Drug-Free Workplace" statement.

5. Taking one of the following appropriate actions, within thirty (30) days of receiving notice from an employee or otherwise receiving such notice, that said employee has received a drug conviction for a violation occurring in the workplace:

   a. Taking appropriate disciplinary action against such an employee, up to and including termination; or
   b. Requiring such employee to participate satisfactorily in a drug abuse assistance or rehabilitation program approved for such purposes by a federal, state, or local health, law enforcement or other appropriate agency.

* I certify that no person employed by this company, corporation, or business has been convicted of any criminal drug statute violation on any job site or project where this company, corporation, or business was performing work within three (3) years of the date of my signature below.

EXCEPTION:

Date | Violation Type | Place of Occurrence

If additional space is required use back of this form.

*The above statement will also be incorporated as a part of each subcontract agreement for any and all subcontractors selected for performance on this project.

IN THE EVENT THIS COMPANY, CORPORATION, OR BUSINESS IS AWARDED THIS CONSTRUCTION CONTRACT, AS A RESULT OF THIS BID; THE CONTRACTOR WITH HIS/HER SIGNATURE REPRESENTS TO THE CITY THAT THE INFORMATION DISCLOSED IN THIS DOCUMENT IS COMPLETE AND ACCURATE. IT IS UNDERSTOOD AND AGREED THAT FALSE CERTIFICATION IS SUBJECT TO IMMEDIATE TERMINATION BY THE CITY.

The Representations Made Herein On This Document Are Made Under Penalty Of Perjury.

CONTRACTOR'S NAME: KOCH & KOCH, INC.

BY: _____ PRESIDENT Date: 11/13/19
Signature Title

Effects of violations: a. Suspension of payments under this contract. b. Suspension or termination of the contract. c. Suspension or debarment of the contractor from receiving any contract from the City of Sacramento for a period not to exceed five years.
FM 681 7/10/9

MINIMUM QUALIFICATIONS QUESTIONNAIRE

Sacramento City Code Section 3.60.020 authorizes the Sacramento City Council to adopt standard minimum qualifications for bidders on competitively bid public works construction projects, and requires, among other provisions, that a bidder meet such minimum qualifications at the time of bid opening in order to bid. On July 31, 2007, the City Council adopted Resolution No. 2007-574 establishing these standard minimum qualifications. Pursuant to City Code section 3.60.020, a bidder failing to meet these minimum qualifications at the time of bid opening shall not be considered a responsible bidder for purposes of bidding on the subject project.

All bidders must demonstrate compliance with the minimum qualifications established by Resolution No. 2007-574 by completing all of the questions contained in this questionnaire. Bidder responses shall be limited to those operating business units, offices, branches and/or subsidiary divisions of the bidder that will be involved with the performance of any project work if awarded the contract**.** If a bidder answers "yes" to any single question, fails to submit a fully completed questionnaire, or submits false information, this will result in a determination that the minimum qualifications are not met, and the bidder shall not be considered a qualified bidder for purposes of bidding on this contract. If two or more entities submit a bid on a contract as a Joint Venture, each entity within the Joint Venture must separately meet these minimum qualifications for the Joint Venture to be considered a qualified bidder.

The City of Sacramento ("City") shall make its determination on the basis of the submitted questionnaire, as well as any relevant information that is obtained from others or as a result of investigation by the City. While it is the intent of this questionnaire to assist the City in determining whether bidders possess the minimum qualifications necessary to submit bids on the City's competitively bid public works construction contracts, the fact that a bidder submits a questionnaire demonstrating that it meets these minimum qualifications shall not in any way limit or affect the City's ability to: (1) review other information contained in the bid submitted by the bidder, and additional relevant information, and determine whether the contractor is a responsive and/or responsible bidder; or (2) establish pre-qualification requirements for a specific contract or contracts.

By submitting this questionnaire, the bidder consents to the disclosure of its questionnaire answers: (i) to third parties for purposes of verification and investigation; (ii) in connection with any protest, challenge or appeal of any action taken by the City; and (iii) as required by any law or regulation, including without limitation the California Public Records Act (Calif. Gov't Code sections 6250 et seq.). Each questionnaire must be signed under penalty of perjury in the manner designated at the end of the form, by an individual who has the legal authority to bind the bidder submitting the questionnaire. If any information provided by a bidder becomes inaccurate, the bidder shall immediately notify the City and provide updated accurate information in writing, under penalty of perjury.

QUESTIONNAIRE

NOTICE: **For firms that maintain other operating business units, offices, branches and/or subsidiary divisions that will not be involved with the performance of any project work if the firm is awarded the contract, references hereafter to "your firm" shall mean only those operating business units, offices, branches and/or subsidiary divisions that will be involved with the performance of any project work.**

All of the following questions regarding "your firm" refer to the firm (corporation, partnership or sole proprietor) submitting this questionnaire, as well as any firm(s) with which any of your firm's owners, officers, or partners are or have been associated as an owner, officer, partner or similar position within the last five years

The firm submitting this questionnaire shall not be considered a responsible bidder if the answer to any of these questions is "yes", or if the firm submits a questionnaire that is not fully completed or contains false information.

1. **Classification & Expiration Date(s) of California** Contractor's License Number(s) held by firm:

---

2. Has a contractor's license held by your firm and/or any owner, officer or partner of your firm been revoked at any time in the last five years?

   ☐ Yes ☑ No

3. Within the last five years, has a surety firm completed a contract on your firm's behalf, or paid for completion of a contract to which your firm was a party, because your firm was considered to be in default or was terminated for cause by the project owner?

   ☐ Yes ☑ No

4. At the time of submitting this minimum qualifications questionnaire, is your firm ineligible to bid on or be awarded a public works contract, or perform as a subcontractor on a public works contract, pursuant to either California Labor Code section 1777.1 (prevailing wage violations) or Labor Code section 1777.7 (apprenticeship violations)?

   ☐ Yes ☑ No

5. At any time during the last five years, has your firm, or any of its owners, officers or partners been convicted of a crime involving the awarding of a contract for a government construction project, or the bidding or performance of a government contract?

   ☐ Yes ☑ No

6. Answer either subsection A or B, as applicable:

A. Your firm has completed three or more government construction contracts in Sacramento County_within the last five years: Within those five years, has your firm been assessed liquidated damages on three or more government construction contracts in Sacramento County for failure to complete contract work on time?

NOTE: If there is a pending administrative or court action challenging the assessment of liquidated damages on a government contract within the last five years, you need not include that contract in responding to this question.

☐ Yes ☐ No ☑ Not applicable

OR

B. Your firm has not completed at least three government construction contracts in Sacramento County within the last five years: Within the last three years, has your firm been assessed liquidated damages on three or more government construction contracts for failure to complete contract work on time?

NOTE: If there is a pending administrative or court action challenging an assessment of liquidated damages on a government contract within the last three years, you need not include that contract in responding to this question.

☐ Yes ☑ No ☐ Not applicable

7. In the last three years has your firm been debarred from bidding on, or completing, any government agency or public works construction contract for any reason?

NOTE: If there is a pending administrative or court action challenging a debarment, you need not include that debarment in responding to this question.

☐ Yes ☑ No

8. Has CAL OSHA assessed a total of three or more penalties against your firm for any "serious" or "willful" violation occurring on construction projects performed in Sacramento County at any time within the last three years?

NOTE: If there is a pending administrative or court action appealing a penalty assessment, you need not include that penalty assessment in responding to this question.

☐ Yes ☑ No

9. Answer either subsection A or B, as preferred:

A. In the last three years has your firm had a three year average Workers' Compensation experience modification rate exceeding 1.1?

☐ Yes ☑ No

OR

B. In the last three years has your firm had a three-year average incident rate for total lost workday cases exceeding 10?

NOTE: Incident rates represent the number of lost workday cases per 100 full-time workers and is to be calculated as: (N/EH) x 200,000, where

N = number of lost workday cases (as defined by the U.S. Dept. of Labor, Bureau of Labor Statistics)

EH = total hours worked by all employees during the calendar year

200,000 = base for 100 equivalent full-time working (working 40 hours per week, 50 weeks per year)

☐ Yes ☐ No

10. In the past three years, has the federal EPA, Region IX or a California Air Quality Management District or Regional Water Quality Control Board assessed penalties three or more times, either against your firm, or against the project owner for a violation resulting in whole or in part from any action or omission by your firm on a project on which your firm was a contractor in Sacramento County?

NOTE: If there is a pending administrative or court action appealing a penalty assessment, you need not include that penalty assessment in responding to this question.

☐ Yes ☑ No

11. In the past three years, has the federal EPA, Region IX or a California Air Quality Management District or Regional Water Quality Control Board assessed a single penalty of $100,000 or more, either against your firm, or against the project owner for a violation resulting in whole or in part from any action or omission by your firm on a project on which your firm was the contractor in Sacramento County?

NOTE: If there is a pending administrative or court action appealing a penalty assessment, you need not include that penalty assessment in responding to this question.

☐ Yes ☑ No

12. In the past three years, have civil penalties been assessed against your firm pursuant to California Labor Code 1777.7 for violation of California public works apprenticeship requirements, three or more times?

NOTE: If there is a pending administrative or court action appealing a penalty assessment, you need not include that penalty assessment in responding to this question.

☐ Yes ☑ No

13. In the past three years, has a public agency in California withheld contract payments or assessed penalties against your firm for violation of public works prevailing wage requirements, three or more times?

NOTE: If there is a pending administrative or court action appealing a withholding or penalty assessment, you need not include that withholding or penalty assessment in responding to this question.

☐ Yes ☑ No

14. Has your firm been assessed penalties for violation of public works prevailing wage requirements in California, in an aggregate amount for the past three years of $50,000 or more?

NOTE: If there is a pending administrative or court action appealing a penalty assessment, you need not include that penalty assessment in responding to this question.

☐ Yes ☑ No

VERIFICATION AND SIGNATURE

I, the undersigned, certify and declare that I have read all the foregoing answers to this Minimum Qualifications Questionnaire, and know their contents. The matters stated in these Questionnaire answers are true of my own knowledge and belief, except as to those matters stated on information and belief, and as to those matters I believe them to be true. I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct.

Signed at PENN VALLEY, CA (Location), on 11/13/19 (Date)

Signature: _____

Print name: MEI-LUNG FORE KOCH

Title: PRESIDENT

NOTE: If two or more entities submit a bid on a contract as a Joint Venture, each entity within the Joint Venture must submit a separate Minimum Qualifications Questionnaire.

REQUIREMENTS OF THE NON-DISCRIMINATION IN EMPLOYEE BENEFITS CODE

INTRODUCTION

The Sacramento Non-Discrimination In Employee Benefits Code (the "Ordinance"), codified as Sacramento City Code Chapter 3.54, prohibits City contractors from discriminating in the provision of employee benefits between employees with spouses and employees with domestic partners, and between the spouses and domestic partners of employees.

APPLICATION

The provisions of the Ordinance apply to any contract or agreement (as defined below), between a Contractor and the City of Sacramento, in an amount exceeding $100,000.00. The Ordinance applies to that portion of a contractor's operations that occur: (i) within the City of Sacramento; (ii) on real property outside the City of Sacramento if the property is owned by the City or if the City has a right to occupy the property; or (iii) at any location where a significant amount of work related to a City contract is being performed.

The Ordinance does not apply: to subcontractors or subcontracts of any Contractor or contractors; to transactions entered into pursuant to cooperative purchasing agreements approved by the Sacramento City Council; to legal contracts of other governmental jurisdictions or public agencies without separate competitive bidding by the City; where the requirements of the ordinance will violate or are inconsistent with the terms or conditions of a grant, subvention or agreement with a public agency or the instructions of an authorized representative of any such agency with respect to any such grant, subvention or agreement; to permits for excavation or street construction; or to agreements for the use of City right-of-way where a contracting utility has the power of eminent domain.

DEFINITIONS

As set forth in the Ordinance, the following definitions apply:

"Contract" means an agreement for public works or improvements to be performed, or for goods or services to be purchased or grants to be provided, at the expense of the City or to be paid out of moneys deposited in the treasury or out of the trust money under the control or collected by the City. "Contract" also means a written agreement for the exclusive use ("exclusive use" means the right to use or occupy real property to the exclusion of others, other than the right reserved by the fee owner) or occupancy of real property for a term exceeding 29 days in any calendar year, whether by singular or cumulative instrument, (i) for the operation or use by others of real property owned or controlled by the City for the operation of a business, social, or other establishment or organization, including leases, concessions, franchises and easements, or (ii) for the City's use or occupancy of real property owned by others, including leases, concessions, franchises and easements.

"Contract" shall not include: a revocable at-will use or encroachment permit for the use of or encroachment on City property regardless of the ultimate duration of such permit; excavation, street construction or street use permits; agreements for the use of City right-of-way where a contracting utility has the power of eminent domain; or agreements governing the use of City property that constitute a public forum for activities that are primarily for the purpose of espousing or advocating causes or ideas and that are generally protected by the First Amendment to the United States Constitution or that are primarily recreational in nature.

"Contractor" means any person or persons, firm, partnership, corporation, company, or combination thereof, that enters into a Contract with the City. "Contractor" does not include a public entity.

"Domestic Partner" means any person who has a currently registered domestic partnership with a governmental entity pursuant to state or local law authorizing the registration.

"Employee Benefits" means bereavement leave; disability, life, and other types of insurance; family medical leave; health benefits; membership or membership discounts; moving expenses; pension and retirement benefits; vacation; travel benefits; and any other benefit given to employees. "Employee benefits" shall not include benefits to the extent that the application of the requirements of this chapter to such benefits may be preempted by federal or state.

CONTRACTOR'S OBLIGATION TO PROVIDE THE CITY WITH DOCUMENTATION AND INFORMATION

Contractor shall provide the City with documentation and information verifying its compliance with the requirements of the Ordinance within ten (10) days of receipt of a request from the City. Contractors shall keep accurate payroll records, showing, for each City Contract, the employee's name, address, Social Security number, work classification, straight time pay rate, overtime pay rate, overtime hours worked, status and exemptions, and benefits for each day and pay period that the employee works on the City Contract. Each request for payroll records shall be accompanied by an affidavit to be completed and returned by the Contractor, as stated, attesting that the information contained in the payroll records is true and correct, and that the Contractor has complied with the requirements of the Ordinance. A violation of the Ordinance or noncompliance with the requirements of the Ordinance shall constitute a breach of contract.

EMPLOYER NOTICE REQUIREMENTS

(a) The Contractor shall give each existing employee working directing on a City Contract, and (at the time of hire), each new employee, a copy of the notification provided as Attachment "A."

(b) Contractor shall post, in a place visible to all employees, a copy of the notice provided as Attachment "B."

Attachment A

YOUR RIGHTS UNDER THE CITY OF SACRAMENTO'S NON-DISCRIMINATION IN EMPLOYEE BENEFITS CODE

On …….. (date), your employer (the "Employer") entered into a contract with the City of Sacramento (the "City") for …….. (contract details), and as a condition of that contract, agreed to abide by the requirements of the City's Non-Discrimination In Employee Benefits Code (Sacramento City Code Section 3.54).

The Ordinance does not require the Employer to provide employee benefits. The Ordinance does require that if certain employee benefits are provided by the Employer, that those benefits be provided without discrimination between employees with spouses and employees with domestic partners, and without discrimination between the spouse or domestic partner of employees.

The Ordinance covers any employee working on the specific contract referenced above, but only for the period of time while those employees are actually working on this specific contract.

The included employee benefits are:

- Bereavement leave
- Disability, life and other types of insurance
- Family medical leave
- Health benefits
- Membership or membership discounts
- Moving expenses
- Pension and retirement benefits
- Vacation
- Travel benefits
- Any other benefits given to employees

(Employee Benefits does not include benefits that may be preempted by federal or state law.)

If you feel you have been discriminated or retaliated against by your employer in the terms and conditions of your application for employment, or in your employment, or in the application of these employee benefits, because of your status as an applicant or as an employee protected by the Ordinance, or because you reported a violation of the Ordinance, and after having exhausted all remedies with your employer,

You May . . .

- Submit a written complaint to the City of Sacramento, Contract Services Unit, containing the details of the alleged violation. The address is:

  City of Sacramento
  Procurement Services Division
  915 I Street, Second Floor
  Sacramento, CA 95814

- Bring an action in the appropriate division of the Superior Court of the State of California against the Employer and obtain the following remedies:

  - Reinstatement, injunctive relief, compensatory damages and punitive damages

  - Reasonable attorney's fees and costs

YOUR RIGHTS UNDER THE CITY OF SACRAMENTO'S NON-DISCRIMINATION IN EMPLOYEE BENEFITS CODE

If your employer provides employee benefits, they must be provided to those employees working on a City of Sacramento contract without discriminating between employees with spouses and employees with domestic partners.

The included employee benefits are:

- Bereavement leave
- Disability, life and other types of insurance
- Family medical leave
- Health benefits
- Membership or membership discounts
- Moving expenses
- Pension and retirement benefits
- Vacation
- Travel benefits
- Any other benefits given to Employees

If you feel you have been discriminated against by your employer . . .

You May . . .

○ Submit a written complaint to the City of Sacramento, Contract Services Unit, containing the details of the alleged violation. The address is:

City of Sacramento
Procurement Services Division
915 I Street, Second Floor
Sacramento, CA 95814

○ Bring an action in the appropriate division of the Superior Court of the State of California against the employer and obtain reinstatement, injunctive relief, compensatory damages, punitive damages and reasonable attorney's fees and costs.

Discrimination and Retaliation Prohibited.

If you feel you have been discriminated or retaliated against by your employer in the terms and conditions of your application for employment, or in your employment, because of your status as an applicant or as an employee protected by the Ordinance, or because you reported a violation of this Ordinance . . .

You May Also . . .

Submit a written complaint to the City of Sacramento, Contract Services Unit, at the same address, containing the details of the alleged violation.

LOCAL BUSINESS ENTERPRISE (LBE) PARTICIPATION REQUIREMENTS

(For City Contracts without federal funds)

I. LBE PARTICIPATION REQUIREMENT

On April 3, 2012, the Sacramento City Council adopted a Local Business Enterprise (LBE) Preference Program to provide enhanced opportunities for the participation of LBEs in the City's contracting and procurement activities. On November 19, 2013, City Council increased the LBE preference percentage from 2% to 5% and authorized City departments to require minimum LBE participation levels in specific contracts. Under City Code section 3.60.270, when the bid specifications for a City contract establish a minimum participation level for LBEs, no bidder on the contract shall be considered responsive unless its bid meets the minimum LBE participation level required by the bid specifications.

The City has established **a minimum 5% participation level for LBEs on certain contracts of $100,000 or more as illustrated below.**

When Does the LBE Program Apply?

	Contracts Under $100,000			Contracts $100,000 or More			
	Supplies / Non-Professional	Professional	Public Projects	Supplies	Non-Professional	Professional	Public Projects
5% LBE Preference Applies to Bid Evaluation?	Yes	Yes	Yes	No	No	Yes	No
5% Minimum Participation Requirement? *	No	No	No	No	Yes	Yes	Yes

* Requirement may be waived by the City Manager or the City Manager's designee (e.g. Department Directors)

II. LBE QUALIFICATION

A. To meet the LBE participation requirement, bidders must meet the requirements for an LBE prior to the deadline for submission of bids.

B. Local Business Enterprise means a business enterprise, including but not limited to, a sole proprietorship, partnership, limited liability company, corporation, or other business entity that has a legitimate business presence in the City or unincorporated areas of Sacramento County. Proof of legitimate business presence in the City or unincorporated areas of Sacramento County shall include:

1. Be an established business entity operating in the City or unincorporated County of Sacramento for at least twelve (12) consecutive months prior to submission of bid; and
2. Having either :
    a. a principal business office or workspace; or
    b. regional, branch, or satellite office with at least one full-time employee located and operating legally in the city or unincorporated county of Sacramento.

III. LBE PARTICIPATION LEVEL REQUIREMENTS

A. LBE Participation: The percentage of LBE participation is determined based on the dollar value of the work to be performed. LBE credit may be obtained by utilizing LBE qualified subcontractors or suppliers as outlined below.

B. Participation Credit: To receive credit for participation: (1) an LBE subcontractor must be responsible for the execution of a distinct element of the work, must possess any license or certification required for the work, and must actually perform, manage, or supervise the work without subcontracting or otherwise shifting any portion of the work to another subcontractor; and (2) an LBE supplier must furnish materials or equipment that the supplier sells as a recurring, although not necessarily primary, part of its business, and that are necessary for performance of the work.

C Suppliers: Credit for an LBE supplier of materials or equipment is counted as 100% of the amount paid to the supplier for the materials or equipment. To receive this credit, LBE suppliers must be listed on the bidder's Subcontractor and LBE Participation Verification Form.

D. Subcontractors (including truckers): To receive credit for an LBE subcontractor, the subcontractor must be listed on the bidder's Subcontractor and LBE Participation Verification Form.

- Truckers: Credit for an LBE trucker is counted as 100% of the amount paid to the trucker for trucking services, not including any amount paid to the trucker for the cost of any materials or equipment being transported by the trucker.

IV. LBE REQUIREMENTS FOR CONTRACTOR

A. LBE Records: The Contractor shall maintain records of all subcontracts with verified LBE subcontractors and records of materials purchased from verified LBE suppliers for one year after receiving final payment from the City. Such records shall show the name and business address of each LBE subcontractor or supplier and the total dollar amount actually paid to each LBE subcontractor or supplier.

No later than 30 days after completion of the work performed under the contract, a summary of these records shall be prepared, certified correct by the Contractor's authorized representative and furnished to the City. The Contractor shall provide such

other information, records, reports, certifications or other documents as may be required by the City, to determine compliance with any provision of the LBE program or these specifications.

B. Performance of LBE Subcontractors and Suppliers: The LBEs listed by the Contractor shall perform the work and supply the materials or equipment for which they are listed, unless the Contractor has received prior written authorization from the City to perform the work with other forces or to obtain the materials or equipment from other sources. Reasons for requesting such authorization would include:

1. The listed LBE fails to execute a written contract based upon the general terms, conditions, plans, and specifications for the project.

2. The listed LBE becomes bankrupt or insolvent.

3. The listed LBE subcontractor fails to meet the bond requirements of the Contractor.

4. The work performed or the materials or equipment provided by the listed LBE are unsatisfactory or are not in accordance with the plans and specifications, or the listed LBE fails to perform its contractual obligations.

5. It would be in the best interest of the City.

C. Subcontractor Substitution: No substitution of an LBE subcontractor shall be made at any time without compliance with the Subletting and Subcontracting Fair Practices Act. If an LBE subcontractor is unable to perform successfully and is to be replaced, the Contractor shall make reasonable efforts to replace the original LBE subcontractor with another verified LBE subcontractor. The new LBE subcontractor must be verified at the time of substitution.

D. Reporting and Utilization Requirements and Sanctions: Failure to provide specific information, records, reports, certifications, or any other documents required for compliance with these specifications, or failure to utilize one or more LBEs in substantial compliance with the LBE utilization indicated in the Contractor's bid (unless otherwise authorized by the City as provided herein, or when such failure results from changes to the work approved by the City), shall be considered a breach of the contract. A deduction may be made from the contract amount and the deduction shall be not more than 10% of the value of the work or materials or equipment that the subject LBE(s) were listed to perform or provide in the Contractor's bid, and shall also be deducted from any payment due to the Contractor. This is in addition to any deduction that may be made under any other provision of the contract, the Sacramento City Code, or State law.

E. Hearing and Review of Division Manager Decision: Prior to making a deduction pursuant to Section IV (D), above, the City shall provide written notice of the proposed

deduction to the Contractor. The Contractor may, no later than five working days after receiving such notice, provide a written request to the City for a hearing to contest the proposed deduction. Upon receipt of a timely written request from the Contractor, the City shall schedule a hearing before the Division Manager (as defined in the City's Standard Specifications for Public Construction), and written notice of the date, time and location of the hearing shall be provided to the Contractor not less than five working days prior to the date of the hearing. The hearing shall be conducted in the manner specified in Section 4-8 of the Standard Specifications, and the Division Manager shall prepare and forward to the Contractor a written decision as soon as practicable after the hearing. The Division Manager's decision shall be subject to review in accordance with the provisions of Section 4-9 of the Standard Specifications. Failure to request such review in compliance with the requirements set forth in Section 4-9 shall constitute acceptance of the Division Manager's decision by the Contractor.

The written notices and requests described above shall be provided by registered or certified mail (return receipt requested), by facsimile, by personal delivery, or by any other method that provides reliable evidence of the date of receipt. Written notice provided by facsimile shall be deemed received on the date that it is transmitted and transmission is confirmed by the transmitting machine. Written notice provided by personal delivery shall be deemed received on the date of delivery.

V. DEFINITIONS

A. Local Business Enterprise (LBE): A business enterprise, including but not limited to, a sole proprietorship, partnership, limited liability company, corporation, or any other business entity that has a legitimate business presence in the city or unincorporated county of Sacramento.

B. Contractor: The sole proprietorship, partnership, limited liability company, corporation, or any other business entity entering into a contract with the City of Sacramento.

C. Subcontractor: The sole proprietorship, partnership, limited liability company, corporation, or other business entity entering into a contract with the prime contractor to perform a portion of the work.

D. Supplier: The sole proprietorship, partnership, limited liability company, corporation, or other business entity to provide materials, equipment, or supplies necessary for performance of the work.

E. Proposal: Any response to a City solicitation for Proposals or Qualifications.

F. Bid: Any response to a City solicitation for bids.

G. Waiver: Request to department director to waive or reduce LBE participation requirement.

FOLLOWING FORMS TO BE FILLED OUT AND SIGNED

ONLY

IF AWARDED CONTRACT

WORKER'S COMPENSATION INSURANCE CERTIFICATION

TO THE CITY OF SACRAMENTO:

The undersigned does hereby certify that he is aware of the provisions of Section 3700 et seq. of the Labor Code which require every employer to be insured against liability for worker's compensation claims or to undertake self-insurance in accordance with the provisions of said Code, and that he/she will comply with such provisions before commencing the performance of the work on this contract.

Koch & Koch, Inc.
Bidder

By: _____

Title: President

Address: 16510 Southridge Rd, P.O. Box 909

Penn Valley, CA 95946

Date: 12/10/19

PLEASE READ CAREFULLY BEFORE SIGNING

To be signed by authorized corporate officer or partner or individual submitting the bid. If bidder is: (example)

1. An individual using a firm name, sign: "John Doe, and individual doing business as Blank Company".
2. An individual doing business under his own name, sign: Your name only.
3. A co-partnership, sign: "John Doe and Richard Doe, co-partners doing business as Blank Company, by, John Doe, Co-Partner".
4. A corporation, sign: "Blank Company, by John Doe, Secretary". (Or other title)

AGREEMENT
(Construction Contract Over $25,000)

THIS AGREEMENT, dated for identification _____, 20__, is made and entered into between the CITY OF SACRAMENTO, a municipal corporation ("City"), and
Koch & Koch, Inc., 16510 Southridge Rd, Penn Valley, CA 95946 ("Contractor").

The City and Contractor hereby mutually agree as follows:

1. CONTRACT DOCUMENTS

The Contract Documents, sometimes also referred to as the "Contract," consist of the following items, which are hereby incorporated by reference as if set forth in full in this Agreement:

Notice to Contractors
Proposal Form submitted by the Contractor
Instructions to Bidders
Subcontractor and Local Business Enterprise Participation Form
Drug-Free Workplace Policy and Affidavit
Construction and Demolition (C&D) Debris Recycling Requirements
Workers' Compensation Insurance Certification
Federal or State funding requirements (if applicable)
Local Business Enterprise (LBE) Requirements
Requirements of the Non-Discrimination in Employee Benefits Code
Ban-The-Box Requirements
Notice Regarding Assembly Bill 626
Addenda, if any
This Agreement
Standard Specifications
Special Provisions
Plans and Technical Specifications
The drawings and other data and all developments thereof prepared by City pursuant to the Contract
Any modifications of any of the foregoing made or approved by City, including but not limited to duly authorized change orders

Unless specifically noted otherwise, references to the "Standard Specifications" shall mean and refer to the Standard Specifications for Public Construction of the City of Sacramento approved by the Sacramento City Council on June 4, 2007 (Resolution No. 2007-350), and any subsequent amendments thereto approved by the Sacramento City Council or the Sacramento City Manager. Work called for in any one Contract Document and not mentioned in another is to be performed and executed as if mentioned in all Contract Documents. The table of contents, titles and headings contained in the Contract Documents are provided solely to facilitate reference to various provisions of the Contract Documents and in no way affect or limit the interpretation of the provisions to which they refer.

2. DEFINITIONS

Unless otherwise specifically provided herein, all words and phrases defined in the Standard Specifications shall have the same meaning and intent in this Agreement.

3. AGREEMENT CONTROLS

In the event of a conflict between any of the terms and conditions set forth in this Agreement and the terms and conditions set forth in other Contract Documents, the terms and conditions set forth in this Agreement shall prevail, except that the provisions of any duly authorized change order shall prevail over any conflicting provisions of this Agreement.

4. SCOPE OF CONTRACT

Contractor agrees to furnish all tools, equipment, apparatus, facilities, labor, material and transportation necessary to perform and complete in a good and workmanlike manner to the satisfaction of City, all the Work called for in the Contract Documents entitled:

CITY COLLEGE RESERVOIR ELECTRICAL IMPROVEMENTS (PN: Z14130505)

Including the Work called for in the following alternative bid items described in the Proposal Form:
_____

Contractor agrees to perform such Work in the manner designated in and in strict conformity with the Contract Documents.

5. CONTRACT AMOUNT AND PAYMENTS

City agrees to pay and Contractor agrees to accept, as complete payment for the above Work, in accordance with the schedule and procedures set forth in the Contract Documents and subject to deductions, withholdings and additions as specified in the Contract Documents, a total sum that shall not exceed the total bid amount set forth in Contractor's Proposal Form. In addition, subject to deductions, withholdings and additions as specified in the Contract Documents, payment for individual items of the Work shall be computed as follows:

A. For items of the Work for which a lump sum price is specified in Contractor's Proposal Form, Contractor shall be paid the lump sum price(s) specified in Contractor's Proposal Form; and

B. For items of the Work for which a unit price is specified in Contractor's Proposal Form, Contractor shall be paid the sum computed at such unit price, or computed at a different price if such different price is determined by City in accordance with the Standard Specifications, based on the actual amount of each such item performed and/or furnished and incorporated in the Work; provided that in no event shall the total sum for a unit price item exceed the total bid amount set forth for such item in the Contractor's Proposal Form, unless authorized by Change Order.

6. PROGRESS PAYMENTS

Subject to the terms and conditions of the Contract, City shall cause payments to be made upon demand of Contractor as follows:

A. On or about the first of the month, the Engineer shall present to the Contractor a statement showing the amount of labor and materials incorporated in the Work through the twentieth (20) calendar day of the preceding month. After both Contractor and Engineer approve the

statement in writing, and the City's labor compliance officer provides written approval, the City shall issue a certificate for ninety-five (95) percent of the amount it shall find to be due, subject to any deductions or withholdings authorized or required under the Contract or any applicable Laws or Regulations.

B. No inaccuracy or error in said monthly estimates shall operate to release Contractor from damages arising from such Work or from enforcement of each and every provision of the Contract Documents, and City shall have the right subsequently to correct any error made in any estimate for payment.

C. Contractor shall not be paid for any defective or improper Work.

D. The remaining five (5) percent of the value of the Work performed under the Contract, if unencumbered and subject to any deductions or withholdings authorized or required under the Contract or any applicable Laws or Regulations, shall be released not later than sixty (60) days after completion and final acceptance of the Work by City. Acceptance by Contractor of the final payment shall constitute a waiver of all claims against the City arising under the Contract Documents, except for disputed claims in stated amounts that the Contractor specifically reserves in writing, but only to the extent that the Contractor has complied with all procedures and requirements applicable to the presentation and processing of such claim(s) under the Contract Documents. Contractor shall be entitled to substitute securities for retention or to direct that payments of retention be made into escrow, as provided in Public Contract Code Section 22300, upon execution of the City's Escrow Agreement for Security Deposits in Lieu of Retention.

E. The parties agree that, for purposes of the timely progress payment requirements specified in Public Contract Code Section 20104.50, the date that the City receives a statement jointly approved by the Contractor and the Engineer as provided above shall be deemed to constitute the date that City receives an undisputed and properly submitted payment request from the Contractor. Progress payments not made within 30 days after this date may be subject to payment of interest as provided in Public Contract Code Section 20104.50.

F. This Contract is subject to compliance monitoring and enforcement by the California Department of Industrial Relations, as specified in California Labor Code section 1771.4.

7. RETENTION OF SUMS CHARGED AGAINST CONTRACTOR

When, under the provisions of this Contract or any applicable Laws or Regulations, City is authorized or required to withhold, deduct or charge any sum of money against Contractor, City may deduct and retain the amount of such charge from the amount of the next succeeding progress estimate(s), or from any other moneys due or that may become due Contractor from City. If, on completion or termination of the Contract, sums due Contractor are insufficient to pay City's charges, City shall have the right to recover the balance from Contractor or its Sureties.

8. COMMENCEMENT AND PROSECUTION OF WORK

Contractor shall commence the Work not later than fifteen (15) working days after the date of the written Notice to Proceed from City to Contractor and shall diligently prosecute the Work to final

completion. The phase "commence the Work" means to engage in a continuous program on-site including, but not limited to, site clearance, grading, dredging, land filling and the fabrications, erection, or installation of the Work. The Notice to Proceed shall be issued within fifteen (15) calendar days following execution of the Agreement by the City and the filing by Contractor of the required Bonds and proof of insurance, provided that the Engineer may delay issuance of the Notice to Proceed if the Engineer determines in the Engineer's sole discretion that conditions on the site of the Work are unsuitable for commencement of the Work. After the Notice to Proceed is issued, the continuous prosecution of Work by Contractor shall be subject only to Excusable Delays as defined in this Agreement.

9. TIME OF COMPLETION

The entire Work shall be brought to completion in the manner provided for in the Contract Documents on or before **130 working days** from the date of the Notice to Proceed (hereinafter called the "Completion Date") unless extensions of time are granted in accordance with the Contract Documents.

Failure to complete the entire Work by the Completion Date and in the manner provided for in the Contract Documents shall subject Contractor to liquidated damages as provided in this Agreement. Time is and shall be of the essence in the performance of the Contract and the Work.

10. PAYMENTS DO NOT IMPLY ACCEPTANCE OF WORK

The payment of any progress payment, or the acceptance thereof by Contractor, shall not constitute acceptance of the Work or any portion thereof and shall in no way reduce the liability of Contractor to replace unsatisfactory work or material, whether or not the unsatisfactory character of such work or material was apparent or detected at the time such payment was made.

11. ACCEPTANCE NOT RELEASE

Contractor shall correct immediately any defective or imperfect work or materials that may be discovered before final acceptance of the entire Work, whether or not such defect or imperfection was previously noticed or identified by the City. The inspection of the Work, or any part thereof, shall not relieve Contractor of any of its obligations to perform satisfactory work as herein specified.

Failure or neglect on the part of City or any of its officers, employees or authorized agents to discover, identify, condemn or reject defective or imperfect work or materials shall not be construed to imply an acceptance of such work or materials, if such defect or imperfection becomes evident at any time prior to final acceptance of the entire Work, nor shall such failure or neglect be construed as barring City from enforcing Contractor's warranty(ies) or otherwise recovering damages or such a sum of money as may be required to repair or rebuild the defective or imperfect work or materials whenever City may discover the same, subject only to any statutes of limitation that may apply to any such claim.

12. CITY'S RIGHT TO TAKE POSSESSION OF THE WORK IN WHOLE OR IN PART

The City shall have the right at any time to enter upon the Work and perform work not covered by this Contract, or to occupy and use a portion of the Work, prior to the date of the final acceptance

of the Work as a whole, without in any way relieving Contractor of any obligations under this Contract.

13. NO WAIVER OF REMEDIES

Neither the inspection by City, its officers, employees or agents, nor any certificate or other approval for the payment of money, nor any payment for, nor acceptance of the whole or any part of the Work by City, nor any extensions of time, nor any position taken by City, its officers, employees or its agents shall operate as a waiver of any provision of the Contract Documents nor of any power herein reserved to City or any right to damages herein provided, nor shall any waiver of any breach of this Agreement be held to be a waiver of any other or subsequent breach. All remedies provided in the Contract Documents shall be taken and construed as cumulative; in addition to each and every other remedy herein provided, the City shall have any and all equitable and legal remedies that it would in any case have.

14. WARRANTY

Except as otherwise expressly provided in the Contract Documents, and excepting only items of routine maintenance, ordinary wear and tear and unusual abuse or neglect by City, Contractor warrants and guarantees all Work executed and all supplies, materials and devices of whatsoever nature incorporated in or attached to the Work, or otherwise provided as a part of the Work pursuant to the Contract, to be absolutely free of all defects of workmanship and materials for a period of one year after final acceptance of the entire Work by the City. Contractor shall repair or replace all work or material, together with any other work or material that may be displaced or damaged in so doing, that may prove defective in workmanship or material within this one year warranty period without expense or charge of any nature whatsoever to City.

In the event that Contractor shall fail to comply with the conditions of the foregoing warranty within ten (10) days after being notified of the defect in writing, City shall have the right, but shall not be obligated, to repair, or obtain the repair of, the defect and Contractor shall pay to City on demand all costs and expense of such repair. Notwithstanding anything herein to the contrary, in the event that any defect in workmanship or material covered by the foregoing warranty results in a condition that constitutes an immediate hazard to public health or safety, or any property interest, or any person, City shall have the right to immediately repair, or cause to be repaired, such defect, and Contractor shall pay to City on demand all costs and expense of such repair. The foregoing statement relating to hazards to health, safety or property shall be deemed to include both temporary and permanent repairs that may be required as determined in the sole discretion and judgment of City.

In addition to the above, the Contractor shall make a written assignment of all manufacturer's and other product warranties to the City, prior to completion and final acceptance of the Work by City.

The Contractor's Performance Bond shall secure the performance of the Contractor's obligations under this Section 14, and the Contractor and its Surety shall be jointly and severally liable for these obligations.

15. LIQUIDATED DAMAGES IF WORK NOT COMPLETED ON TIME

A. The actual fact of the occurrence of damages and the actual amount of the damages that City would suffer if the entire Work, and/or any specified portion thereof, were not completed within the time(s) specified herein are dependent upon many circumstances and conditions that could prevail in various combinations, and for this reason, it is impracticable and extremely difficult to fix the actual damages. Damages that City would suffer in the event of such delay include: loss of the use of the project; expenses of prolonged assignment to the project of an architectural and/or engineering staff; prolonged costs of administration, inspection, and supervision; increased operational expenses and/or impaired operation of other facilities dependent upon completion of the project; and the loss and inconvenience suffered by the public within the City of Sacramento by reason of the delay in the completion of the project or portion thereof. Accordingly, the parties agree, and by execution of this Agreement, Contractor acknowledges that it understands and agrees, that the amount(s) set forth herein as liquidated damages reflect the parties' best efforts at the time of entering into the Contract to estimate the damages that may be incurred by City and the public due to the Contractor's delay in completion of the Work and/or any specified portion thereof, and shall be presumed to be the amount of damages sustained by the failure of Contractor to complete the entire Work and/or any specified portion thereof within the time(s) specified herein.

B. Contractor shall pay liquidated damages to City for failure to complete the entire Work by the Completion Date (as extended in accordance with the Contract Documents, if applicable) in the amount of five Hundred Dollars ($500.00) for each calendar day after the Completion Date (as extended in accordance with the Contract Documents, if applicable), continuing to the time at which the entire Work is completed. Such amount is the actual cash value agreed upon by the City and Contractor as the loss to City and the public resulting from Contractor's default.

The parties agree, and by execution of this Agreement, Contractor acknowledges that it understands and agrees, that the foregoing provisions provide for the imposition of liquidated damages from the Completion Date (as extended in accordance with the Contract Documents, if applicable) until the date of completion of the entire Work as determined by the Engineer in accordance with Section 8-4 of the Standard Specifications, whether or not the Work or any portion thereof is claimed or determined to be substantially complete prior to such date of completion.

CONTRACTOR'S ACKNOWLEDGMENT:_____

C. In the event Contractor shall become liable for liquidated damages, City, in addition to all other remedies provided by law, shall have the right to withhold any and all payments that otherwise would be or become due Contractor until the liability of Contractor under this section is finally determined. City shall have the right to use and apply such payments, in whole or in part, to reimburse City for all liquidated damages due or to become due to City. Any remaining balance of such payments shall be paid to Contractor only after discharge in full of all liability incurred by Contractor under this section or otherwise under any provision of the Contract Documents or any applicable Law or Regulation. If the sum so retained by City is not sufficient to discharge all such liabilities of Contractor, Contractor shall continue to remain liable to City until all such liabilities are satisfied in full. No failure by City to withhold any payment as specified above shall in any manner be construed to constitute a release of any such liabilities nor a waiver of the City's right to withhold payment for such liabilities.

16. INDEMNITY AND HOLD HARMLESS

A. Contractor shall defend, hold harmless and indemnify the City, its officers, employees, and agents, 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, whether arising on or off the site of the Work, 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 performance of or failure to perform the Work by the 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 (i) such Liabilities are caused in part by a party indemnified hereunder, or (ii) such Liabilities are litigated, settled or reduced to judgment; provided that the foregoing indemnity does not apply to liability for damages for death or bodily injury to persons, injury to property, or other loss, damage or expense 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, or (ii) the active negligence of City.

B. The existence or acceptance by City of any of the insurance policies or coverages described in this Agreement shall not affect or limit any of City's rights under this Section 16, nor shall the limits of such insurance limit the liability of Contractor hereunder. The provisions of this Section 16 shall survive any expiration or termination of the Contract.

17. CONTRACTOR SHALL ASSUME RISKS

Until the completion and final acceptance by City of all Work under this Contract, the Work shall be under Contractor's responsible care and charge, and Contractor, at no cost to City, shall rebuild, repair, restore and make good all injuries, damages, re-erections, and repairs occasioned or rendered necessary by accidental causes of any nature, to all or any portions of the Work.

18. GENERAL LIABILITY OF CONTRACTOR

Except as otherwise herein expressly stipulated, Contractor shall perform all the Work and furnish all the labor, materials, tools, equipment, apparatus, facilities, transportation, power and light, and appliances, necessary or proper for performing and completing the Work herein required in the manner and within the time herein specified. The mention of any specific duty or liability of Contractor shall not be construed as a limitation or restriction of any general liability or duty of Contractor, and any reference to any specific duty or liability shall be construed to be solely for the purpose of explanation.

19. INSURANCE

During the entire term of the Contract, Contractor shall maintain the insurance coverage described in this Section 19.

Full compensation for all premiums that Contractor is required to pay for the insurance coverage described herein shall be included in the compensation specified for the Work performed by Contractor under this Contract. No additional compensation will be provided for Contractor's insurance premiums. Any available insurance proceeds in excess of the specified minimum limits and coverages shall be available to the City.

It is understood and agreed by the Contractor that its liability to the City shall not in any way be limited to or affected by the amount of insurance coverage required or carried by the Contractor in connection with this Contract.

A. Minimum Scope & Limits of Insurance Coverage

(1) Commercial General Liability Insurance providing coverage at least as broad as ISO CGL Form 00 01 on an occurrence basis for bodily injury, including death, of one or more persons, property damage, and personal injury, arising out of activities performed by or on behalf of Contractor and its subcontractors, products and completed operations of Contractor and its subcontractors, and premises owned, leased, or used by Contractor and its subcontractors, with limits of not less than one million dollars ($1,000,000) per occurrence. The policy shall provide contractual liability and products and completed operations coverage for the term of the policy.

(2) Automobile Liability Insurance providing coverage at least as broad as ISO Form CA 00 01 for bodily injury, including death, of one or more persons, property damage, and personal injury, with limits of not less than one million dollars ($1,000,000) per accident. The policy shall provide coverage for owned, non-owned, and/or hired autos as appropriate to the operations of the Contractor.

No automobile liability insurance shall be required if Contractor completes the following certification:

> "I certify that a motor vehicle will not be used in the performance of any work or services under this agreement." _____ (Contractor initials)

(3) Excess Insurance: The minimum limits of insurance required above may be satisfied by a combination of primary and umbrella or excess insurance coverage; provided that any umbrella or excess insurance shall contain, or be endorsed to contain, a provision that it shall apply on a primary basis for the benefit of the CITY, and any insurance or self-insurance maintained by CITY, its officials, employees, or volunteers shall be in excess of such umbrella or excess coverage and shall not contribute with it.

(4) Workers' Compensation Insurance with statutory limits, and Employers' Liability Insurance with limits of not less than one million dollars ($1,000,000). The Workers' Compensation policy shall include a waiver of subrogation in favor of the City.

No Workers' Compensation insurance shall be required if Contractor completes the following certification:

> "I certify that my business has no employees, and that I do not employ anyone. I am exempt from the legal requirements to provide Workers' Compensation insurance." _____ (Contractor initials)

B. Additional Insured Coverage

(1) Commercial General Liability Insurance: The City, its officials, employees, and volunteers shall be covered by policy terms or endorsement as additional insureds as respects general liability arising out of: activities performed by or on behalf of Contractor and its subcontractors; products and completed operations of Contractor and its subcontractors; and premises owned, leased, or used by Contractor and its subcontractors.

(2) Automobile Liability Insurance: The City, its officials, employees, and volunteers shall be covered by policy terms or endorsement as additional insureds as respects auto liability.

C. Other Insurance Provisions

The policies are to contain, or be endorsed to contain, the following provisions:

(1) Contractor's insurance coverage, including excess insurance, shall be primary insurance as respects City, its officials, employees, and volunteers. Any insurance or self-insurance maintained by City, its officials, employees, or volunteers shall be in excess of Contractor's insurance and shall not contribute with it.

(2) Any failure to comply with reporting provisions of the policies shall not affect coverage provided to City, its officials, employees, or volunteers.

(3) Coverage shall state that Contractor's insurance shall apply separately to each insured against whom claim is made or suit is brought, except with respect to the limits of the insurer's liability.

(4) City will be provided with thirty (30) days written notice of cancellation or material change in the policy language or terms.

D. Acceptability of Insurance

Insurance shall be placed with insurers with a Bests' rating of not less than A:VI. Self-insured retentions, policy terms or other variations that do not comply with the requirements of this Section 3 must be declared to and approved by the City in writing prior to execution of this Contract.

E. Verification of Coverage

(1) Contractor shall furnish City with certificates and required endorsements evidencing the insurance required. Copies of policies shall be delivered to the City on demand. Certificates of insurance shall be signed by an authorized representative of the insurance carrier.

(2) For all insurance policy renewals during the term of this Contract, Contractor shall send insurance certificates reflecting the policy renewals directly to:

City of Sacramento
c/o EXIGIS LLC
P.O. Box 4668 ECM- #35050
New York, NY 10168-4668

Insurance certificates also may be faxed to (888) 355-3599, or e-mailed to: certificates-sacramento@riskworks.com

(3) The City may withdraw its offer of contract or cancel this Contract if the certificates of insurance and endorsements required have not been provided prior to execution of this Contract. The City may withhold payments to Contractor or cancel the Contract if the insurance is canceled or Contractor otherwise ceases to be insured as required herein.

F. Subcontractors

Contractor shall require and verify that all subcontractors maintain insurance coverage that meets the minimum scope and limits of insurance coverage specified in subsection A, above.

20. FAILURE TO MAINTAIN BONDS OR INSURANCE

If, at any time during the performance of this Contract, Contractor fails to maintain any item of the bonds and/or insurance required under the Contract in full force and effect, Contractor shall immediately suspend all work under the Contract and notify City in writing of such failure. After such notice is provided, or if City discovers such failure and notifies Contractor, the City thereafter may withhold all Contract payments due or that become due until notice is received by City that such bonds and/or insurance have been restored in full force and effect and that the premiums therefor have been paid for a period satisfactory to the Division of Risk Management. Contractor shall not resume work until notified by City to do so, and the City shall have no responsibility or liability for any costs incurred by Contractor as a result of such suspension of Work.

In addition to the foregoing, any failure to maintain any item of the required bonds and/or insurance at any time during the performance of this Contract will be sufficient cause for termination of the Contract by City.

The Contractor shall be solely responsible for, and shall defend, indemnify and hold harmless the City, its officers, employees and agents against and from, any and all damages, claims, losses,

actions, costs or other expenses of any kind incurred by any party as a direct or indirect result of any suspension of Work or termination of the Contract under the provisions of this Section.

21. EXCUSABLE DELAYS

For the purpose of these Contract Documents, the term "Excusable Delay" shall mean, and is limited to, delay caused directly by: acts of God; acts of a public enemy; fires; inclement weather as determined by the Engineer; riots; insurrections; epidemics; quarantine restrictions; strikes; lockouts; sitdowns; acts of a governmental agency; priorities or privileges established for the manufacture, assemble, or allotment of materials necessary in the Work by order, decree or otherwise of the United States or by any department, bureau, commission, committee, agent, or administrator of any legally constituted public authority; changes in the Work ordered by City insofar as they necessarily require additional time in which to complete the Work; the prevention of Contractor from commencing or prosecuting the Work because of the acts of others, excepting Contractor's subcontractors or suppliers; or the prevention of Contractor from commencing or prosecuting the Work because of a Citywide failure of public utility service.

The term "Excusable Delay" shall specifically not include: (i) any delay that could have been avoided by the exercise of care, prudence, foresight and diligence on the part of Contractor; (ii) any delay in the prosecution of any part of the Work that does not constitute a Controlling Operation, whether or not such delay is unavoidable; (iii) any reasonable delay resulting from time required by City for review of any Contractor submittals and for the making of surveys, measurements and inspection; and, (iv) any delay arising from an interruption in the prosecution of the Work on account of reasonable interference by other Contractors employed by City that does not necessarily prevent the completion of the entire Work within the time specified. Excusable Delays, if any, shall operate only to extend the Completion Date (not in excess of the period of such delay as determined by City) and shall not under any circumstances increase the amount City is required to pay Contractor except as otherwise provided in these Contract Documents.

22. CONTRACTOR TO SERVE NOTICE OF DELAYS

Whenever Contractor foresees any delay in the prosecution of the Work, and in any event as soon as possible (not to exceed a period of ten (10) calendar days) after the initial occurrence of any delay that Contractor regards as or may later claim to be an Excusable Delay, the Contractor shall notify the Engineer in writing of such delay and its cause, in order that the Engineer: (i) may take immediate steps to prevent if possible the occurrence or continuance of the delay; or (ii) if this cannot be done, may determine whether the delay is to be considered excusable, how long it continues, and to what extent the prosecution and completion of the Work are delayed thereby. Said written notice shall constitute an application for an extension of time only if the notice requests such an extension and sets forth the Contractor's estimate of the additional time required together with a full description of the cause of the delay relied upon.

After the completion of any part or whole of the Work, the Engineer, in estimating the amount due Contractor, will assume that any and all delays that may have occurred in its prosecution and completion were not Excusable Delays, except for such delays for which the Contractor has provided timely written notice as required herein, and that the Engineer has found to be excusable. Contractor shall not be entitled to claim Excusable Delay for any delay for which the Contractor failed to provide such timely written notice.

23. EXTENSION OF TIME

If the Contractor complies with Section 22, above, and the Engineer finds a delay claimed by the Contractor to be an Excusable Delay, the Contractor shall be allowed an extension of time to complete the Work that is proportional to the period of Excusable Delay determined by the Engineer, subject to the approval by City of a change order granting such time extension. During a duly authorized extension for an Excusable Delay, City shall not charge liquidated damages against the Contractor for such delay.

If the City extends the time to complete the Work as provided herein, such extension shall in no way release any warranty or guarantee given by Contractor pursuant to the provisions of the Contract Documents, nor shall such extension of time relieve or release the sureties of the Bonds provided pursuant to the Contract Documents. By executing such Bonds, the Sureties shall be deemed to have expressly agreed to any such extension of time. The granting of any extension of time as provided herein shall in no way operate as a waiver on the part of City of its rights under this Contract, excepting only extension of the Completion Date for such period of Excusable Delay as may be determined by the Engineer and approved by a duly authorized change order.

24. NO PAYMENT FOR DELAYS

No damages or compensation of any kind shall be paid to Contractor or any subcontractor because of delays in the progress of the Work whether or not such delays qualify for extension of time under this Agreement; except that this provision shall not preclude the recovery of damages for a delay caused by the City that is unreasonable under the circumstances and that is not within the contemplation of the parties, provided that the Contractor timely submits all such written notice(s) and fully complies with such other procedures as may be specified in the Contract Documents or any Laws or Regulations for Contractor to claim damages for such delay.

25. CHANGES IN THE WORK

Changes in the Work authorized or directed in accordance with the Contract Documents and extensions of time of completion made necessary by reason thereof shall not in any way release any warranty or guarantee given by Contractor pursuant to the provisions of the Contract Documents, nor shall such changes in the Work relieve or release the Sureties on Bonds provided pursuant to the Contract Documents. By executing such Bonds, the Sureties shall be deemed to have expressly agreed to any such change in Work and to any extension of time made by reason thereof.

26. TERMINATION AFTER COMPLETION DATE

In addition to any other rights City may have, if any services or work required under the Contract (including but not limited to punch list items) are not completed as of the Completion Date (as adjusted by any extensions of time for Excusable Delays granted pursuant to the Contract Documents), City may terminate the Contract at any time after the Completion Date (as adjusted by any extensions of time for Excusable Delays granted pursuant to the Contract Documents), by providing a written notice to Contractor specifying the date of termination. Such notice also may specify conditions or requirements that Contractor must meet to avoid termination of the Contract on such date. If Contractor fails to fulfill all such conditions and requirements by such termination date, or, if no such conditions or requirements are specified, Contractor shall cease rendering services and performing work on such termination date, and shall not be entitled to receive any

compensation for services rendered or work performed after such termination date. In the event of such termination, Contractor shall remain liable to City for liquidated damages incurred for any period of time prior to the termination date.

In addition to any other charges, withholdings or deductions authorized under the Contract or any Laws or Regulations, if City terminates the Contract pursuant to this section, City may withhold and deduct from any payment and/or retention funds otherwise due Contractor any sum necessary to pay the City's cost of completing or correcting, or contracting for the completion or correction of, any services or work under the Contract that are not completed to the satisfaction of the City or that otherwise are deficient or require correction as of such termination date, including but not limited to incomplete punch list items. Such costs shall include all of the City's direct and indirect costs incurred to complete or correct such services or work, including the City's administrative and overhead costs. If the amount of payment(s) and/or retention funds otherwise due the Contractor are insufficient to pay such costs, City shall have the right to recover the balance of such costs from the Contractor and/or its Surety(ies).

27. TERMINATION FOR CONVENIENCE

Upon written notice to the Contractor, the City may at any time, without cause and without prejudice to any other right or remedy of the City, elect to terminate the Contract for the convenience of City. In such case, the Contractor shall be paid (without duplication of any items, and after deduction and/or withholding of any amounts authorized to be deducted or withheld by the Contract Documents or any Laws or Regulations):

A. For Work executed in accordance with the Contract Documents prior to the effective date of termination and determined to be acceptable by the Engineer, including fair and reasonable sums for overhead and profit on such Work;

B. For reasonable claims, costs, losses, and damages incurred in settlement of terminated contracts with subcontractors, suppliers, and others; and

C. For reasonable expenses directly attributable to termination.

Contractor shall not be paid for any loss of anticipated profits or revenue for any Work not performed prior to termination, nor for any economic loss arising out of or resulting from such termination, except for the payments listed in this section. Contractor's warranty under Section 14 of this Agreement shall apply, and Contractor shall remain responsible for all obligations related to such warranty, with respect to all portions of the Work performed prior to the effective date of the termination for convenience pursuant to this section. The City shall be entitled to have any or all remaining Work performed by other contractors or by any other means at any time after the effective date of a termination for convenience pursuant to this section.

28. TERMINATION FOR BREACH OF CONTRACT

If Contractor abandons the Work under this Contract, or if the Contract or any portion of the Contract is sublet or assigned without the consent of the City, or if the Engineer determines in the Engineer's sole discretion that the conditions of the Contract in respect to the rate of progress of the Work are not being fulfilled or any part thereof is unnecessarily delayed, or if Contractor violates or breaches, or fails to execute in good faith, any of the terms or conditions of the Contract,

or if Contractor refuses or fails to supply enough properly skilled labor or materials or refuses or fails to make prompt payment to subcontractors for material or labor, or if Contractor disregards any Laws or Regulations or proper instruction or orders of the Engineer, then, notwithstanding any provision to the contrary herein, the City may give Contractor and its Sureties written notification to immediately correct the situation or the Contract shall be terminated.

In the event that such notice is given, and, in the event such situation is not corrected, or arrangements for correction satisfactory to the City are not made, within ten (10) calendar days from the date of such notice or within such other period of time as may be specified by the City in the notice, the Contract shall upon the expiration of said period cease and terminate. In the event of any such termination, City may take over the Work and prosecute the Work to completion, or otherwise, and the Contractor and its Sureties shall be liable to City for any cost occasioned City thereby, as hereinafter set forth.

In the event City completes the Work, or causes the Work to be completed, no payment of any kind shall be made to Contractor until the Work is complete. The cost of completing the Work, including but not limited to, extra costs of project administration and management incurred by City, both direct or indirect, shall be deducted from any sum then due, or that becomes due, to Contractor from City. If sums due to Contractor from City are less than the cost of completing the Work, Contractor and its Sureties shall pay City a sum equal to this difference on demand. In the event City completes the Work, and there is a sum remaining due to Contractor after City deducts the costs of completing the Work, then City shall pay such sum to Contractor. The Contractor and Contractor's Sureties shall be jointly and severally liable for all obligations imposed on Contractor hereunder.

No act by City before the Work is finally accepted, including, but not limited to, exercise of other rights under the Contract, actions at law or in equity, extensions of time, payments, assessments of liquidated damages, occupation or acceptance of any part of the Work, waiver of any prior breach of the Contract or failure to take action pursuant to this section upon the happening of any prior default or breach of Contractor, shall be construed to be a waiver or estoppel of the City's right to act pursuant to this Section upon any subsequent event, occurrence or failure by Contractor to fulfill the terms and conditions of the Contract. The rights of City to terminate the Contract pursuant to this Section and pursuant to Sections 26 and 27 are cumulative and are in addition to all other rights of City pursuant to the Contract and at law or in equity.

29. CONTRACTOR BANKRUPT

If Contractor should commence any bankruptcy proceeding, or if Contractor is adjudged a bankrupt, or if Contractor makes any assignment for the benefit of creditors, or if a receiver is appointed on account of Contractor's insolvency, then the City may, without prejudice to any other right or remedy, terminate the Contract and complete the work by giving notice as provided in Section 28 above.

30. SURETIES' OBLIGATIONS UPON TERMINATION

If the City terminates the Contract pursuant to Section 28 or Section 29 above:

A. The Surety under Contractor's performance bond shall be fully responsible for all of the Contractor's remaining obligations of performance under the Contract as if the Surety were a party to the Contract, including without limitation Contractor's obligations, as provided

in the Contract Documents, to complete and provide a one-year warranty of the entire Work, pay liquidated damages and indemnify, defend and hold harmless City, up to the full amount of the performance bond.

B. The Surety under Contractor's payment bond shall be fully responsible for the performance of all of the Contractor's remaining payment obligations for work, services, equipment or materials performed or provided in connection with the Work or any portion thereof, up to the full amount of the payment bond.

31. ACCOUNTING RECORDS OF CONTRACTOR

During performance of the Contract and for a period of three (3) years after completing the entire Work, Contractor shall maintain all accounting and financial records related to the Contract and performance of the Work in accordance with generally accepted accounting practices, and shall keep and make such records available for inspection and audit by representatives of the City upon reasonable written notice.

32. USE TAX REQUIREMENTS

During the performance of this Agreement, CONTRACTOR, for itself, its assignees and successors in interest, agrees as follows:

A. Use Tax Direct Payment Permit: For all leases and purchases of materials, equipment, supplies, or other tangible personal property used to perform the Agreement and shipped from outside California, the Contractor and any subcontractors leasing or purchasing such materials, equipment, supplies or other tangible personal property shall obtain a Use Tax Direct Payment Permit from the California State Board of Equalization ("SBE") in accordance with the applicable SBE criteria and requirements.

B. Sellers Permit: For any construction contract and any construction subcontract in the amount of $5,000,000 or more, Contractor and the subcontractor(s) shall obtain sellers permits from the SBE and shall register the jobsite as the place of business for the purpose of allocating local sales and use tax to the City. Contractor and its subcontractors shall remit the self-accrued use tax to the SBE, and shall provide a copy of each remittance to the City.

C. The above provisions shall apply in all instances unless prohibited by the funding source for the Agreement.

33. NON-DISCRIMINATION IN EMPLOYEE BENEFITS

This Agreement may be subject to the requirements of Sacramento City Code Chapter 3.54, Non-Discrimination in Employee Benefits by City Contractors. The Contract Documents include a summary of the requirements of Sacramento City Code Chapter 3.54, entitled "Requirements of the Non-Discrimination in Employee Benefits Code." By signing this Agreement, Contractor acknowledges and represents that Contractor has read and understands these requirements and agrees to fully comply with all applicable requirements of Sacramento City Code Chapter 3.54. If requested by City, Contractor agrees to promptly provide such documents and

information as may be required by City to verify Contractor's compliance. Any violation by Contractor of Sacramento City Code Chapter 3.54 constitutes a material breach of this Agreement, for which the City may terminate the Agreement and pursue all available legal and equitable remedies.

34. CONSIDERING CRIMINAL CONVICTION INFORMATION IN THE EMPLOYMENT APPLICATION PROCESS

This Agreement may be subject to the requirements of Sacramento City Code Chapter 3.62, Procedures for Considering Criminal Conviction Information in the Employment Application Process. The Contract Documents include a summary of the requirements of Sacramento City Code Chapter 3.62, entitled "Ban-The-Box Requirements." By signing this Agreement, Contractor acknowledges and represents that Contractor has read and understands these requirements and agrees to fully comply with all applicable requirements of Sacramento City Code Chapter 3.62. If requested by City, Contractor agrees to promptly provide such documents and information as may be required by City to verify Contractor's compliance. Any violation by Contractor of Sacramento City Code Chapter 3.62 constitutes a material breach of this Agreement, for which the City may terminate the Agreement and pursue all available legal and equitable remedies. Contractor agrees to require its subcontractors to fully comply with all applicable requirements of Sacramento City Code Chapter 3.62, and include these requirements in all subcontracts covered by Sacramento City Code Chapter 3.62.

IN WITNESS WHEREOF, the parties hereto have signed this Agreement on the date set for opposite their names.

CONTRACTOR

Under penalty of perjury, I certify that the taxpayer identification number and all other information provided here are correct.

DATE 12/10/19

BY _____

Meilung Fore Koch
Print Name

President
Title

BY _____

Print Name

Title

1000005771
DIR Registration #

94-3391116
Federal ID#

471-61606-6
State ID#

1042854
City of Sacramento Business Operation Tax Certificate No. (City will not award contract until Certificate Number is obtained)

Type of Business Entity *(check one)*:

_____ Individual/Sole Proprietor
_____ Partnership
__✓__ Corporation
_____ Limited Liability Company
_____Other (*please specify:*_____)

CITY OF SACRAMENTO
a municipal corporation

DATE _____

BY _____
For: Howard Chan, City Manager

Original Approved As To Form:

_____
City Attorney

Attest:

_____
City Clerk

Form approved by City Attorney 1-11-17

CITY OF SACRAMENTO
PERFORMANCE BOND
Department of Utilities

Bond No.: _____
Premium: _____

WHEREAS, the City of Sacramento, State of California, hereinafter called City, has conditionally awarded to

Koch & Koch, Inc.
16510 Southridge Rd
Penn Valley, CA 95946

as principal, hereinafter called Contractor, a contract for construction of:

City College Reservoir Electrical Improvements
(PN: Z14130505) (B20141321005)

which contract is by reference incorporated herein and made a part hereof as if the Surety named below were a party to the contract, and is hereinafter referred to as the Contract; and

WHEREAS, under the terms of the Contract, Contractor is required to furnish a bond for the faithful performance of the Contract.

NOW, THEREFORE, we the Contractor and *(here insert full name and address of Surety)* :_____
_____,
a corporation duly authorized and admitted to transact business and issue surety bonds in the State of California, hereinafter called Surety, are held and firmly bound unto the City, as oblige, in the sum of: **Five Hundred Forty Six Thousand ($546,000.00)** for the payment of which sum well and truly to be made, we the Contractor and Surety bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally. The condition of this obligation is such that, if the Contractor, Contractor's heirs, executors, administrators, successors or assigns, shall in all things stand to and abide by, and well and truly keep and fully perform all covenants, conditions and agreements required to be kept and performed by Contractor in the Contract and any changes, additions or alterations made thereto, to be kept and performed at the time and in the manner therein specified, and in all respects according to their true intent and meanings, and shall indemnify and save harmless the City, its officers, employees and agents, as therein provided, then the Surety's obligations under the Contract and this bond shall be null and void; otherwise they shall be and remain in full force and effect. This obligation shall remain in full force and effect through the end of the Contract warranty period, which will expire one year after the completion of work date specified in the Notice of Completion filed for the above-named project.

As part of the obligations secured hereby and in addition to the sum specified above, there shall be included all costs, expenses and fees, including attorney's fees, reasonably incurred by City in successfully enforcing such obligations, all to be taxed as costs and included in any judgment rendered.

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

IN WITNESS WHEREOF, this instrument has been duly executed by authorized representatives of the Contractor and Surety. SIGNED AND SEALED on _____, 2019.

_____
(Contractor) (Seal)
By: _____
Title: _____

ORIGINAL APPROVED AS TO FORM:
City Attorney
_____

_____
(Surety) (Seal)
By_____
Title _____
Agent Name and Address: _____
_____
Agent Phone #: _____
Surety Phone #: _____
California License # _____
Surety Email: _____

CITY OF SACRAMENTO
PAYMENT BOND
Department of Utilities

Bond No.: _____
Premium: _____

WHEREAS, the City of Sacramento, in the State of California, hereinafter called City, has conditionally awarded to:

Koch & Koch, Inc.
16510 Southridge Rd
Penn Valley, CA 95946

hereinafter called Contractor, a contract for construction of:

City College Reservoir Electrical Improvements
(PN: Z14130505) (B20141321005)

Which contract is by reference incorporated herein and made a part hereof, and is hereinafter referred to as the Contract; and

WHEREAS, under the terms of the Contract and pursuant to Chapter 5 of Title 3 of Part 6 of Division 4 of the California Civil Code (commencing with Civil Code Section 9550), Contractor is required to furnish a good and sufficient payment bond to secure payment of the claims to which reference is made in Civil Code Section 9554.

NOW, THEREFORE, we the Contractor and (*here insert full name and address of Surety*):
_____, a corporation duly authorized and admitted to transact business and issue surety bonds in the State of California, hereinafter called Surety, are held and firmly bound unto the City, and unto all persons or entities entitled to assert a claim against a payment bond under any of the aforesaid Civil Code provisions in the sum of **Five Hundred Forty Six Thousand ($546,000.00)** on the condition that if Contractor shall fail to pay for any materials or equipment furnished or used in performance of the Contract, or for any work or labor thereon of any kind, or for amounts due under the Unemployment Insurance Act with respect to such work or labor, or for any amounts required to be deducted, withheld, and paid over to the Franchise Tax Board or the Employment Development Department from the wages of employees of the Contractor and all subcontractors with respect to such work or labor, then the Surety shall pay the same in an amount not exceeding the sum specified above. If suit is brought upon this bond, Surety shall pay, in addition to the above sum, all costs, expenses and fees, including attorney's fees, reasonably incurred by any party in successfully enforcing the obligation secured hereby, all to be taxed as costs and included in any judgment rendered. Should the condition of this bond be fully performed, then this obligation shall become null and void, otherwise it shall be and remain in full force and effect, and shall bind Contractor, Surety, their heirs, executors, administrators, successors and assigns, jointly and severally.

It is hereby stipulated and agreed that this bond shall inure to the benefit of all persons, companies, corporations, political subdivisions, State agencies and other entities entitled to assert a claim against a payment bond under any of the aforesaid Civil Code provisions, so as to give a right of action to them or their assigns in any suit brought upon this bond. The Surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the Contract or to the work to be performed thereunder or to the specifications accompanying the same shall in any way affect its obligations on this bond, and it does hereby waive notice of any such change, extension, alteration or addition.

IN WITNESS WHEREOF, this instrument has been duly executed by authorized representatives of the Contractor and Surety. SIGNED AND SEALED on _____, 2019.

_____
(Contractor) (Seal)
By: _____
Title: _____

ORIGINAL APPROVED AS TO FORM:
City Attorney
_____

_____
(Surety) (Seal)
By _____
Title _____
Agent Name and Address: _____
_____
Agent Phone #: _____
Surety Phone #: _____
California License # _____
Surety Email: _____

Effective 7-1-12

Construction and Demolition (C&D) Debris Recycling Requirements

As a condition of receiving this Contract, Contractor agrees to fully comply with the requirements specified herein for all demolition projects, as well as projects with a valuation of $250,000 or more:

1. **Definitions**. For purposes of this section, the following terms, words and phrases shall have the following meanings:

"Certified C&D sorting facility" means a facility that receives C&D debris and/or processes C&D debris into its component material types for reuse, recycling, and disposal of residuals and possesses a valid certificate as a C&D sorting facility from the Sacramento Regional County Solid Waste Authority.

"Construction and demolition debris" or "C&D debris" means used or commonly discarded materials resulting from construction, repair, remodel or demolition operations on any pavement, house, building, or other structure, or from landscaping that are not hazardous as defined in California Health and Safety Code section 25100 et seq. Such materials include, but are not limited to, concrete, asphalt, wood, metal, brick, dirt, sand, rock, gravel, plaster, glass, gypsum wallboard, cardboard and other associated packaging, roofing material, ceramic tile, carpeting, masonry, plastic pipe, trees, and other vegetative matter resulting from land clearing and landscaping.

"Divert" or "diversion" means to use materials for any purpose other than disposal in a landfill or transformation facility. Methods to divert materials include on-site reuse of the materials, delivery of materials from the project site to a certified C&D sorting facility or a recycling facility, or other methods as approved in regulations promulgated by the City Department of Utilities.

"Franchised waste hauler" means a person who possesses a valid commercial solid waste collection franchise issued by the Sacramento Regional County Solid Waste Authority.

"Mixed C&D debris" means loads that include commingled recyclable and non-recyclable C&D debris generated at a project site.

"Recyclable C&D debris" means C&D debris required to be diverted from landfills as specified in the Waste Management Plan and returned to the economic mainstream in the form of raw material for new, reused or reconstituted products that meet the quality standards necessary to be used in the marketplace.

"Recycling facility" means a facility or operation that receives, processes, and transfers source-separated recyclable materials.

"Source-separated C&D debris" means recyclable C&D debris that is separately sorted and containerized at the site of generation by individual material type and segregated from mixed C&D debris prior to collection and transporting.

"Waste log" means a record detailing the management of C&D debris generated by the covered project, including the date and weight/volume of material by type that was salvaged, reused, recycled or disposed.

2. **Waste Management Plan**. A completed WMP (see **Attachment 1**) must be submitted to and approved by the City prior to commencing any work on the project. The WMP must specify the types of C&D debris that will be generated from the project; the manner in which C&D debris will be managed and/or stored on the project site; the manner in which recyclable C&D debris generated from the project will be recycled or reuse; the person who will haul, collect or transport the recyclable C&D debris from the project site; and the certified C&D sorting facility or recycling facility where recyclable C&D debris will be delivered. The WMP must be approved by the City prior to commencing any work on the project.

3. Contractor shall be solely responsible for diverting the recyclable C&D materials specified on the WMP. Mixed C&D debris shall be delivered to a SWA-certified C&D sorting facility only. Only the permit holder, the person who generates the waste, a franchised waste hauler, or the City of Sacramento can transport or haul mixed C&D debris. Source-separated C&D debris may be delivered by any person to any recycling facility that accepts such materials. (See **Attachment 2** for list of C&D Debris Haulers and Facilities).

4. During the course of the project, Contractor shall maintain a waste log (see **Attachment 3**), and keep all weight tickets or weight receipts, for all C&D debris hauled away from the project. At a minimum, the waste log shall specify the C&D debris generated by the project; the manner in which C&D debris was recycled or re-used; and the facility where the C&D debris was delivered.

5. Within 30 days after submitting the project completion report, Contractor shall submit to the City a completed waste log, along with copies of supporting weight tickets. Contractor shall maintain and keep accurate and complete records of al bills, weight receipts or weight tickets that were issued for the collection, transport or disposal of C&D debris for a period of one-year after submittal of the waste log. The records shall be made available for inspection, examination and audit by the City during the one-year retention period to validate the information provided in the WMP and in the waste log. If the City determines noncompliance by the Contractor after an audit has been conducted, Contractor shall reimburse the City for all costs incurred in performing the audit.

6. Failure by Contractor to comply with any provisions specified herein will subject Contractor to possible suspension and/or termination of this Contract for cause; repayment of any or all of the Contract amount disbursed by the City; imposition of a penalty, payable to the City ($50-$250 for first offense, $251-$500 for second offense, and $501-$1500 for subsequent offenses); and/or submission of a performance security deposit fee when submitting a permit application to the City for a project within one year of imposition of the penalty.

For questions or to obtain more information about the Recycling Requirements for C&D debris, contact the City of Sacramento, Solid Waste Services Division, 2812 Meadowview Road, Building 1, Sacramento, CA 95832, or telephone (916) 808-4833, or email C&D@cityofsacramento.org

Construction & Demolition Waste Management Plan

C&D Debris Waste Management Plan
City of Sacramento Solid Waste Services
2812 Meadowview Road, Building 1
Sacramento, CA 95832
Phone: (916) 808-0965 / Fax: (916) 808-4999
C&D@cityofsacramento.org

Building Permit Numbers	
	Please put all known permit numbers related to this project.
Form submitted by:	
	Please attach a business card, or put your name with a phone number and/or an email address.

This Waste Management Plan (WMP) must be submitted and approved before your building permit(s) will be issued. Only one WMP is required if a project has multiple building permits associated to it (i.e., multiple houses in a subdivision, or multiple related permits at one address). The administration fee and security deposit (if applicable) must be submitted for this form to be approved. Administration fee is 0.04% of project valuation (min $40, max $800); security deposit is 1% of valuation (max $10,000). **The accompanying Waste Log must be submitted within 30 days of final inspection (or permit expiration) of the project, or a fine may be imposed.** Approval may also be delayed if the waste log from a previous project is due.

Building Project Information:

Job Address: _____

Contractor: _____ Phone: _____

Address: _____ Email: _____

Owner: _____ Phone: _____

Address: _____ Email: _____

Briefly describe the project:

_____

_____

Materials Required to be Recycled

50% of all debris must be recycled if generated during the course of your project. You can either **source-separate** them, which may be hauled by anyone, or mix them in one container and send the **mixed C&D debris** load to a **Certified Mixed C&D Sorting Facility**. Mixed C&D loads can only be hauled by a franchised hauler or self-hauled. Please see the Definitions section, on the next page, for more information.

50%
of all debris must be recycled

Material Management

How the C&D debris will be stored on the project site: ☐ Mixed C&D ☐ Source-Separated

Company to haul away debris: _____

Facilities to receive debris: _____

Waste Log and tickets must be submitted within 30 days of permit being finaled.

Office Use Only: Received by: _____ On date: _____

☐ Logged ☐ Approved ☐ Scanned ☐ Payment Processed ☐ Filed Fee amount: $_____

Construction & Demolition Waste Management Plan

C&D Debris Waste Management Plan
City of Sacramento Solid Waste Services
2812 Meadowview Road, Building 1
Sacramento, CA 95832
Phone: (916) 808-4839 / Fax: (916) 808-4999
C&D@cityofsacramento.org

Definitions.

Please read and understand these terms. Call Solid Waste at (916) 808-0965 if these terms are not clear to you. More information is also available online at http://www.sacrecycle.org/.

1. **Self-haul or self-hauling**: This is when the permit holder, general contractor, or a subcontractor *who is doing work on the project* hauls their own waste materials for recycling or disposal. Note that a *jobsite cleanup crew is not doing other work on the project and is not self-hauling*. Jobsite cleanup crews need to be franchised in order to haul mixed C&D debris away.

2. **Franchised hauler**: See Solid Waste web site (http://www.sacrecycle.org/) for a list of these haulers. These companies are the only companies in Sacramento who can legally collect and haul mixed C&D debris for a fee.

3. **Source separation**: This is achieving compliance with the recycling requirement by keeping wood, metal, cardboard, or other recyclables in separate containers, and sending it to an authorized recycler. (A list of recyclers is on the Solid Waste web site at http://www.sacrecycle.org/.) Source-separated material may be hauled by anyone.

4. **Mixed C&D debris**: This is achieving compliance with the recycling requirement by putting all recyclable (and a small amount of unrecyclable) debris into one container. Mixed material must be sent to a certified mixed C&D sorting facility to have the recyclable material extracted and recovered. Mixed material also must be either self-hauled, or hauled by a franchised hauler. If your job site is crowded, this option saves the most space.

5. **Certified Mixed C&D Sorting Facility**: See the Solid Waste web site for a list. These facilities have been certified by the Sacramento Regional Solid Waste Authority to extract recyclable materials from mixed C&D debris. If you achieve compliance by mixed recovery, your debris must go to a certified mixed sorting facility.

Terms and Conditions

- Your approved Waste Management Plan and Waste Log must be kept on the job site in the permit folder for the duration of the project.
- City of Sacramento staff may enter the jobsite to inspect waste collection areas.
- Only SWA-Certified Mixed C&D Sorting Facilities may be used to recycle these materials if mixed with other materials.
- Only SWA-Franchised Haulers or self-haulers (as defined above) may collect and transport trash or mixed C&D material from the jobsite.
- Construction and Demolition Debris may not be burned or dumped illegally.

- Your Waste Log must be completed and submitted within 30 days of your permit being finaled or expired. All waste hauling and disposal or recycling activity must be entered on the Waste Log, including information from any subcontractors who self-hauled their own debris off-site. *Enter your Permit Number on your Waste Log now!*
- You must keep all receipts or weight-tickets from your project for a period of one year from the submittal of your waste log.
- Failure to comply with these terms and conditions may result in a fine and a security deposit on future projects.

C&D Debris Haulers & Facilities

C&D Debris Waste Management Plan
City of Sacramento Solid Waste Services
2812 Meadowview Road, Building 1
Sacramento, CA 95832
Phone: (916) 808-4833 / Fax: (916) 808-4999
C&D@cityofsacramento.org

Certified Mixed C&D Facilities

Allied Waste / Elder Creek Transfer and Recovery	(916) 387-8425
Florin-Perkins Public Disposal	(916) 443-5120
L&D Landfill	(916) 737-8640
Waste Management / K&M Recycle America	(916) 452-0142

Franchised Haulers

ACES Waste Services, Inc.	(866) 488-8837	Elk Grove Waste Management, LLC	(916) 689-4052
Allied Waste Services	(916) 631-0600	Mini Drops, Inc.	(916) 686-8785
All Waste Systems, Inc.	(916) 456-1555	Norcal Waste Services of Sacramento	(916) 381-5300
Atlas Disposal Industries, LLC	(916) 455-2800	North West Recyclers	(916) 686-8575
California Waste Recovery Systems	(916) 441-1985	Waste Management of Sacramento	(916) 387-1400
Central Valley Waste Services, Inc.	(209) 369-8274	Waste Removal & Recycling	(916) 453-1400
City of Sacramento Solid Waste	(916) 808-4839	Western Strategic Materials, Inc.	(916) 388-1076

Recyclers*

Bell Marine	(916) 442-9089
C & C Paper Recycling	(916) 920-2673
EBI Aggregates	(916) 372-7580
International Paper	(916) 371-4634
Modern Waste Solutions	(916) 447-6800
PRIDE Industries, Inc.	(916) 640-1300
Recycling Industries, Inc.	(916) 452-3961
Sacramento Local Conservation Corps	(916) 386-8394
Smurfit-Stone Container Corporation	(916) 381-3340
Southside Art Center	(916) 387-8080
Spencer Building Maintenance, Inc.	(916) 922-1900

Recovery Stations & Landfills

Elder Creek Recovery & Transfer Station	(916) 387-8425
Kiefer Landfill	(916) 875-5555
L & D Landfill	(916) 383-9420
North Area Recovery Station	(916) 875-5555
Sacramento Recycling & Transfer Station	(916) 379-0500
Waste Management Recycle America	(916) 452-0142

More updated information can be found online at:
http://www.cityofsacramento.org/utilities/

* Please note that any facility may receive source-separated recyclable materials as long as it is authorized to do so by the State of California. This is not meant to be a complete list.

Construction & Demolition Waste Log

C&D Debris Waste Management Plan
City of Sacramento Recycling and Solid Waste
2812 Meadowview Road, Building 1
Sacramento, CA 95832
Phone: (916) 808-0965 / Fax: (916) 808-4999
C&D@cityofsacramento.org

Building Permit _____

Please put all known permit numbers related to this project.

This waste log must be submitted to Solid Waste within 30 days of the building permit being finaled (or expired). This waste log, and the supporting weight tickets, must also be kept on file for one year after project completion.

Date	Hauler	Material	Destination	Weight*

Hauler: Indicate the Franchisee, Self-Hauler, City of Sacramento, or other hauler who removed the material offsite.
Material: Indicate appropriate category: Scrap Metal, Inert Materials, Cardboard, Wooden Pallets, or Clean Wood Waste.
Destination: Indicate the facility that received the material for disposal or recycling
*** Weight**: Indicate the weight. If weight is not known, put volume. Example: "3.2 tons" – or – "10 yards"

Office Use Only: Received by: _____ On date: _____

□ Logged □ Approved □ Scanned □ Filed

Total Diversion: _____%

CALIFORNIA LABOR CODE RELATING TO APPRENTICES
ON PUBLIC WORKS PROJECTS

See following links: www.dir.ca.gov and/or www.leginfo.ca.gov

http://www.dir.ca.gov/dlse/dlsePublicWorks.html

TAX FORMS AS APPLICABLE

Refer to the links below:
W-9 ..... https://www.irs.gov/pub/irs-pdf/fw9.pdf
CA Form 590 https://www.ftb.ca.gov/forms/2018/18_590.pdf
CA Form 587 ... https://www.ftb.ca.gov/forms/2018/18_587.pdf

SPECIAL PROVISIONS

ITEMS OF THE PROPOSAL

All Items shall be constructed as shown on the Plans in accordance with the Special Provisions whether or not they are included in the following list of bid items. There will be no separate compensation for items shown on the Plans or where Contractor is directed in the Special Provisions but not included in the following list of bid items and the price thereof shall be included in whatever bid items the Contractor deems appropriate.

Item No. 1 - Install New 1" RGS Conduit

The work to be performed for this item includes, but is not limited to, furnishing and installing all necessary equipment and materials to install new 1" RGS conduit as directed by the Engineer and called for in these Special Provisions. This item includes RGS 1" conduit, RGS conduit straps, and RGS anchors. This item of work will only be used if there are problems utilizing the existing conduits within the reservoir.

Payment shall be at the unit price per lineal foot and shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all work involved in installing the new 1" RGS conduit in accordance with the Special Provisions.

Item No. 2 - Install New Switchboard

The work to be performed for this item includes, but is not limited to, furnishing and installing all necessary equipment and materials for the main switchboard and all appurtenances as indicated on the Plan sheets and called for in these Special Provisions.

Payment shall be at the lump sum price bid and shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all work involved in furnishing and installing the main switchboard in accordance with the Plans and these Special Provisions.

Item No. 3 - Install New MCC and PLC

The work to be performed for this item includes, but is not limited to, furnishing and installing all necessary equipment and materials for the motor control center (MCC), control panel, PLC equipment, and all appurtenances as indicated on the Plan sheets and called for in these Special Provisions.

Payment shall be at the lump sum price bid and shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all work involved in furnishing and installing the MCC, control panel, PLC equipment, and all

appurtenances in accordance with the Plans and these Special Provisions.

Item No. 4 - Electrical Improvements

The work to be performed for this item includes, but is not limited to, furnishing and installing all necessary equipment and materials for the instrumentation, Liebert cabinet with accessories, lighting fixtures, conduits, conductors, level pressure switches, pressure transducers, booster pump receptacle, magnetic door switch, load centers, UPS, power supplies, redundant power supply, radio, fiber patch cord, switch, and all appurtenances as indicated on the Plan sheets and called for in these Special Provisions.

This item of work also includes the removal of the existing wiring and installation of new wiring to all new and existing devices.

Payment shall be at the lump sum price bid and shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all work involved in constructing the electrical improvements in accordance with the Plans and these Special Provisions.

Item No. 5 - Install New Altitude Valve

The work to be performed for this item includes, but is not limited to, furnishing and installing all necessary equipment and materials for the altitude valve, butterfly valve, spools, reducers, and all appurtenances as indicated on the Plan sheets and called for in these Special Provisions.

This item of work also includes the removal and relocation of the existing staircase, the routing of the existing water line to the altitude valve, and the installation of the new 3" galvanized pipe. This item of work includes all work as shown on plan sheet M-1 and E-9. The electrical connections to the altitude valve shall be paid for under bid item number 4.

Payment shall be at the unit price per each and shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all work involved in installing the new altitude valve in accordance with the Plans and these Special Provisions.

Item No. 6 - Install New Motor Actuator Valve (MOV)

The work to be performed for this item includes, but is not limited to, furnishing and installing all necessary equipment and materials for the installation of four MOVs and all appurtenances as indicated on the Plan sheets and called for in these Special Provisions.

This item of work also includes the removal and salvage of the existing MOVs. The

electrical conduit and conductors to each MOV shall be paid for under bid item number 4.

Payment shall be at the unit price per each and shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all work involved in installing the new MOVs in accordance with the Plans and these Special Provisions.

CITY COLLEGE RESERVOIR

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SECTION 01105

GENERAL INFORMATION AND REQUIREMENTS

PART 1 - GENERAL

1.01 GOVERNING DOCUMENTS

A. All work performed under this Contract shall be in accordance with the following General Conditions:

1. Sealed Proposal
2. Agreement
3. City of Sacramento Standard Specifications, June 2007 (hereinafter CSSS) Sections 1 through 8 and as noted otherwise.

B. All work performed under this Contract, unless noted otherwise, shall be in accordance with the following:

1. Technical Specifications
2. Contract Drawings
3. CSSS - Sections 10 through 38
4. Payment Bond
5. Performance Bond
6. California Labor Code, Chapter 4 of Division 3.

C. In the event of a conflict in the Contract Documents, priorities, as appropriate, set forth below shall govern:

1. General Conditions
2. Technical Specifications
3. Drawings
4. CSSS
5. Conflicts
   a. In case of conflict between drawings and Special Provisions, the drawings shall govern in matters of quantity and the Special Provisions shall govern in matters of quality.
   b. In case of conflict within the drawings involving quantities, furnish the greater quantity.
   c. In case of conflict within the Special Provisions involving quality of

material or procedure, furnish the higher quality material and procedure.

d. Where provisions of codes, safety orders, Contract Documents, referenced manufacturer's specifications or industry standards are in conflict, the more restrictive and higher quality shall govern.

1.02 DEFINITIONS

A. For definitions not found herein, refer to CSSS, Section 1.

B. "City" shall mean the City of Sacramento.

C. "Engineer" shall mean the director of Utilities or his designated representative.

D. "Calendar Day" shall mean every day shown on the calendar, Sundays and holidays included.

E. "Working Day" shall mean a "day" unless otherwise expressly defined in the Special Provisions.

F. "Contract Documents" shall mean the General Conditions identified in Paragraph 1.01.A and the Special Provisions identified in Paragraph 1.01.B of this Section.

G. "Drawings" shall mean the Contract Drawings.

H. "Provide" shall mean furnish and install, in accordance with the contract documents.

I. "Addenda" shall mean a written or graphic instrument issued prior to the execution of the Contract, which modify or interpret the Contract Documents, Drawings, and Specifications, by additions, deletions, clarifications, or corrections.

J. "Proposed Change Order" shall mean a written request for the Contractor's Cost and Time Estimate covering an addition, deletion, or revision in the work, within the General Scope of the Contract.

K. "Change Order" shall mean a written order to the Contractor authorizing an addition, deletion, or revision in the work, within the General Scope of the Contract Documents, or authorizing an adjustment in the Contract Price or Contract Time.

L. "Field Order" shall mean a written order from the Engineer to the Contractor, directing an addition or revision in the work.

1.03 CSSS CHANGES

A. All references in Section 8 of the Standard Specifications to actions by the "City Council" shall be amended to read action by the "City".

B. Wherever reference is made to City Manager, Director of Utilities, Engineer, Finance Director, Inspector, or other specifically identified individuals, it shall include their designated representative.

C. In Section 2-9 SUBCONTRACTORS, delete the statement reading "Contractor shall perform with his own organization and with the assistance of workers under his immediate superintendence, work of a value not less than fifty percent (50%) of the value of all work in the contract."

1.04 EXCAVATIONS AND TRENCHING

A. Excavations or trenches crossing roadways, walks, or traffic ways shall be provided with suitable traffic bearing steel plate or wood planking temporary covers. Contractor shall verify location of all underground facilities prior to excavating and shall perform the work to avoid damage to existing underground facilities. Contractor shall repair at no additional cost to the City and to prior condition, any existing utility damaged due to work of this contract.

B. If unusual amounts of bone, stone or artifacts are uncovered, work within 50 meters of the area shall cease immediately and a qualified archaeologist shall be consulted to develop, if necessary, mitigation measure to reduce any archaeologist impact to a less than significant effect before construction resumes in the area.

1.05 SPECIFICATIONS

A. The specifications are those bound and enumerated in the Table of Contents. The bidding Requirements, "Items of the Proposal", General Conditions, and Division 1 of the specifications apply to all work of this contract.

1.06 HOURS OF WORK

A. Contractor shall perform the work of this contract on normal work days and within normal work hours, except after hours work, and work on Saturdays, Sundays, and holidays may be permitted if prior approval is obtained from the City. Overtime pay required to perform the work shall be included in the Contractor's bid prices, and no additional compensation to the Contractor will be made for overtime work.

1.07 CONTRACTOR'S SET OF PLANS AND SPECIFICATIONS

A. City Furnished Plans and Specifications:

Upon award of contract, the City will provide plans and specifications as follows:

1. Plans: 5 sets

2. Specifications: 5 sets

B. The Contractor is responsible for providing copies of the plans and specifications to all subcontractors as required for construction. Additional Sets of the plans and specifications may be obtained from the City. The cost charged the Contractor for additional copies obtained from the City shall cover all associated City procurement costs. City will not be responsible for incomplete information in the event partial sets are ordered.

1.08 INTERPRETATION OF DRAWINGS

A. The Contract Drawings consist of all of the plan sheets.

B. The data given herein, and on the drawings, are as exact as could be secured, but their absolute accuracy is not guaranteed. The Technical Specifications and drawings are for the assistance and guidance of the Contractor; exact locations, distance, elevation, etc., will be governed by the various structures, and Contractor shall use same with this understanding.

C. The drawings are diagrammatic, but shall be followed as closely as existing conditions will permit. Prior to submitting their sealed Proposal, 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.

D. Catalog numbers on the drawings and in the Technical Specifications are from the best available information and are for guidance and assistance. The Contractor shall verify all catalog numbers and install only suitable materials.

1.09 REFERENCED PUBLICATIONS

A. The publications referred to hereinafter form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. The latest edition of referenced publications in effect at the time of the bid shall govern.

1.10 QUESTIONS PRIOR TO BID OPENING

A. Prior to the opening of the sealed proposals, all questions concerning the Contract Documents shall be submitted to planet bids.

1.11 START OF WORK

A. The Contractor shall commence work on the day the NOTICE TO PROCEED is issued.

B. Any work performed by the Contractor in advance of receipt of the NOTICE TO PROCEED shall be considered as having been done by him at his own risk and as a volunteer unless NOTICE TO PROCEED is issued by the Owner.

1.12 COMPLETION OF WORK

A. In addition to the requirements of Section 9 of the Agreement of these bid documents, the Contractor shall pay to the City the sum of $500.00 per day, for each and every calendar day delay in finishing the work in excess of the number of working days prescribed in these bid documents. The sum of $500.00 per calendar days will be assessed for the first 15 Calendar days after the 15 Calendar days is exceeded Contractor shall pay to the City the sum of $1,000 per day, each and every calendar days delay in finishing the work in excess of the number of working days prescribed in these bid documents.

1.13 FACILITY ACCESS

A. The City will provide one (1) set of combination padlocks with an agreed upon combination. Contractor shall be responsible for all subsequent replacements. The Contractor shall be responsible for securing the facility after each work day and at all times during the contract.

1.14 NOTIFICATIONS

A. The Contractor will be responsible for notifying residents and businesses of the proposed construction. Notifications shall be distributed to residents and businesses within a 500 feet radius of the job limits, including residents and businesses located on streets adjacent to the construction.

The contractor shall notify the affected residents and businesses of the upcoming construction through the use of "door hanger" type formatted notifications. The notification shall state the street name, the working hours, and the anticipated begin and completion dates for each street. A sample of the required notification will be provided to the Contractor and the Pre-Construction meeting. The Contractor shall provide the Engineer a copy of the proposed notification letter for

acceptance to the City 10 (ten) working days prior to the start of work. The Contractor shall distribute the door hanger notifications a minimum of 5 (five) working days in advance of the start of work.

Notifications shall be tucked neatly in doorjambs, handles, or partially under mats. Notifications shall not be glued, stapled, tacked, or otherwise attached to property. The Contractor shall take care to stay on designated walkways during delivery of notifications and be polite to citizens encountered.

Full compensation for conforming to all requirements specified in this section shall be considered as included in.

1.15 COOPERATION

A. In addition to the requirements of CSSS, the Contractor shall cooperate with other forces constructing, relocating, and/or modifying facilities within the project limits. The Contractor shall coordinate his/her work with that of others, including utility companies, to prevent delays.

It is understood and agreed that the Contractor has considered in his/ her bid all of the permanent and temporary utility appurtenances in their present and/or relocated positions as shown on the plans or as described in the specifications, and that no additional compensation will be allowed for any delays, inconvenience, or damages sustained due to any interference from said appurtenances or the operation of moving them.

Five (5) days prior to beginning work, the Contractor shall provide to the Engineer, in writing, the name and telephone number of a representative who is directly involved with this project, and under the supervision of the Contractor. The Contractor's representative may be contacted by City staff during non-working hours including nights, weekends and holidays in the case of any public inconvenience and/or emergency relating to the Contractor's operations. The contact representative shall not be replaced by another company employee for the duration of the project without a written explanation from the Contractor which has been approved by the Engineer. Should a new representative be used, he/she shall be knowledgeable of the project, the events, and/or revisions that may be occurring.

Full compensation for conforming to all requirements specified in this section shall be considered as included in

PART 2 - PRODUCTS

2.01 CONSTRUCTION SCHEDULE

A. Contractor shall submit a Construction Schedule for the entire project. Construction Schedule shall be in the Critical Path Method (CPM) format. The proposed dates of commencement and completion of each of the various subdivisions of work required under these Specifications. Include submittals, procurement, disposal, delivery, installation, testing, and final inspection. CPM shall be arranged in work weeks and shall show manpower. No Progress Payments will be made until the CPM schedule has been received and approved by the Engineer.

PART 3 - EXECUTION

3.01 PRE-JOB CONFERENCE

A. Pre-Construction Conference

1. The Contractor, after delivery of the Contract and at least three (3) working days before beginning work, shall notify Renee Graves at rgraves@cityofsacramento.org and arrange a pre-job conference. At this conference, the Contractor shall deliver appropriate submittals and a Construction Schedule as detailed below. The Contractor is responsible to provide plans and special provisions to subcontractors.

3.02 CONTRACTOR COMMUNICATIONS

A. All official communications between the Contractor and the City of Sacramento shall be made through the Engineer.

3.03 SUPERINTENDENT

A. Contractor shall assign a competent Superintendent to supervise all work and to represent the Contractor on site. Superintendent shall cooperate with the Owner and shall provide assistance at all times for inspection of the work including: removing covers, operating machinery, or performing any reasonable work which, in the opinion of the Engineer, is necessary to determine the quality or adequacy of the work. Superintendent shall also furnish material shipping labels and packing slips to the Engineer to verify that the material conforms with approved submittals and Specifications.

B. Contractor shall lay out all work in advance of fabrication and shall be responsible for coordination of all related work.

~~C. Contractor shall be responsible for scheduling sump and equipment shutdowns necessary to complete the work. Two (2) days prior to the proposed shutdown, the Superintendent shall obtain approval for the shutdown from the Engineer.~~

~~The Engineer shall be given the following information:~~

~~1. Date and time of shutdown~~

~~2. Work to be accomplished during shutdown~~

~~3. Number of persons working during shutdown~~

~~4. Time of re-energization~~

D. Contractor shall monitor and assure that:

1. Shall remove spillage resulting from hauling operations along, or across, any public traveled way, at least daily, at Contractor's expense.
2. Conduct construction operations in such a manner as to cause as little inconvenience as possible to abutting property owners.
3. Water or dust palliative shall be applied, if ordered by the Engineer, for the alleviation or prevention of dust nuisance and shall be done at Contractor's expense.
4. Contractor shall contact the Engineer for a visual inspection 48 hours prior to covering any underground conduit.
5. Full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all work involved maintenance of traffic and public safety shall be considered as included in the prices paid for various Contract items of work, and no additional compensation will be allowed, therefore.

3.04 PERMITS

A. Contractor may want to use private property beyond that already owned by the City for storage and/or access. Contractor shall be responsible to the individual owner(s) to obtain and pay for any private property easements and/or right of entry permit, and for repair of any associated damage.

~~3.05 TRENCH SAFETY~~

~~A. Contractor's work shall conform to the provisions of Section 6705 of the Labor Code of the State of California.~~

~~B. Excavation for any trench five (5) feet, or more, in depth shall not begin until the City has received the Contractor's detailed plan for worker protection from the hazards of caving ground in and around trenches. Such plan shall be submitted at least five (5) days before the Contractor intends to begin trench excavation. Show details of the design of shoring, bracing, sloping, or other provisions to be made for worker protection. No such plan shall allow the use of shoring, sloping, or a protective system less effective than that required by the Construction Safety Orders of the Division of Industrial Safety. If such plan varies from the shoring system standards established by the Construction Safety Orders, the plan shall~~

~~be prepared and signed by an engineer who is registered as a Civil or Structural Engineer in the State of California.~~

~~C. In addition, the Contractor shall obtain, pay for, and comply with all provisions of the permit required by Section 6500 of the California Occupational Safety and Health Act of 1973.~~

3.06 PUBLIC SAFETY AND CONVENIENCE AND MAINTENANCE OF TRAFFIC

A. Contractor's attention is directed to Sections 6-6, 6-7, 6-8, and 6-9 of the CSSS.

B. Contractor shall be responsible for traffic control and public safety at all times. Vehicle and pedestrian traffic must be allowed to traverse all streets and alleys.

C. Contractor shall furnish, install, and maintain temporary construction warning signs, flaggers, barricades, and other devices necessary to safeguard the general public and the work, and to provide for the safe and proper routing of all vehicular and pedestrian traffic within, and through, the limits of the project during the performance of the work.

D. Maintenance of traffic shall apply continuously, and shall not be limited to normal working hours. The use of flaggers, barricades, and construction warning signs shall comply with the current edition of *"Work Area and Traffic Control Handbook" (WATCH)*, available for review at the City of Sacramento, Department of Transportation, Traffic Engineering Division, located at 915 I Street in Sacramento.

E. All lanes of traffic on adjacent street(s) shall remain open at all times during the course of construction unless otherwise approved in writing by the Engineer.

~~F. Contractor shall be required to establish traffic scheduling and control measures acceptable to the Engineer prior to starting any work. The Contractor shall submit to the Engineer for review and approval a plan showing proposed traffic control measures and/or detours for vehicles and pedestrians affected by the construction work. This plan shall be submitted a minimum of ten (10) working days prior to the scheduled commencement of any work by the Contractor.~~ **~~Contractor will not be allowed to begin work until an approved plan is on file with the Engineer.~~** ~~All advance warning and traffic delineation shall conform to the latest edition of "Work Area and Traffic Control Handbook", (WATCH). The approved traffic control plan shall be made available to the Engineer on site at all times.~~

G. Construction operations shall be conducted in such a manner as to cause as little inconvenience as possible to abutting property owners.

3.07 PRE-CONSTRUCTION PHOTOGRAPHS

A. Pre-construction photographs shall be provided and shall conform to Section 11 of the Standard Specifications.

3.08 EXISTING UTILITIES

A. Locations of both underground and overhead utilities are shown on the drawings to the extent known. The actual location and elevation of the utilities may vary from the locations shown. Unless the drawings or specifications identify that the Contractor is responsible for relocating utilities, utilities requiring relocation will be by the governing agency or their representatives. The Contractor shall coordinate relocations requested for the Contractor's convenience with the Engineer and the owner of the utility. The Contractor will cooperate with the relocation and/or protection of existing utilities.

B. The Contractor shall contact Mike Wasina of Sacramento at 916-798-7579 two (2) working days prior to performing excavation work within existing City facilities. The City will mark locations of existing City utilities.

3.09 MAINTAINING EXISTING FACILITY

~~A. The Contractor shall ensure that Sump 115 has the ability to pump any drainage into the adjacent canal during the entire construction period.~~

B. Contractor shall allow City O&M access to the facility 24 hours a day, 7 days a week.

C. The City will provide one (1) set of combination padlocks with an agreed upon combination. Contractor shall be responsible for all subsequent replacements.

3.10 PROJECT SIGN

A. Prior to beginning any onsite work, the contractor shall install a total of 1 project sign. The sign shall be supplied by the City and are approximately thirty (30) inches by fifty-four (54) inches. Location and height of sign installation shall be as directed by the Engineer. In general, the signs shall be installed a minimum of seven (7) feet and maximum of ten (10) feet above surrounding grade. If acceptable to the Engineer an existing sign post may be used, otherwise, the Contractor shall be required to install a new post for each sign. Signs shall be maintained in a good condition throughout construction, shall not be bent and shall remain legible to traffic. Any damage shall be repaired by the Contractor. The sign and post installed by the contractor shall be removed at the end of the project and the sign returned to the City.

3.11 COMPLETION AND FINAL INSPECTION

A. The work shall be so performed, that upon Contract completion, the project shall be ready for use. Included in the work shall be the furnishing of all labor, materials, tools, equipment, and incidentals necessary for completing the work, in accordance with the Contract Documents.

B. Contractor shall notify the Engineer when the project is completed. Following notification, City representatives will perform a walk through and, if required, develop and list of deficient work items.

C. Contractor shall then correct all noted deficiencies to the satisfaction of the Engineer, after which a final walk through will be scheduled with City Operation and Maintenance personnel. During the walk through, the City will develop a final punch list of deficient work items and present it to Contractor after the walk through.

D. Following correction of all deficiencies to the satisfaction of the Engineer, a completion report will be prepared by the Engineer.

3.12 WARRANTY

A. The term of the Contractor's warranty shall begin upon the date the job is accepted by the City.

3.13 LADDER SAFETY

A. The contractor shall follow current ladder safety requirements from Cal OSHA and OSHA when using any ladder within the facility.

3.14 SCAFFOLD SAFETY

A. The contractor shall follow current scaffold safety requirements from Cal OSHA and OSHA when using any scaffolds within the facility. In addition, the Contractor shall provide the City will a written plan showing how the scaffolds will be used within the facility.

3.15 MANWELL SAFETY

A. The facility contains a manwell with a ladder that extends from the 6th floor up into the actual reservoir. At the top of the manwell the City has installed a self-retracting lanyard. The contractor shall use appropriate fall protection/harness when using this ladder and self-retracting lanyard.

3.16 INDEMNIFY

A. As part of the contract between the City and the Contractor to construct the improvements at the City College Reservoir. The contractor shall indemnify and

hold harmless the City when using any City equipment including the self-retracting lanyard within City College Reservoir.

**** END OF SECTION ****

SECTION 01110

SUMMARY OF WORK

PART 1 - GENERAL

1.01 DESCRIPTION

A. This project consists of replacing the existing switchgear and low voltage motor control center at City College Reservoir. This work consists of removing the existing switchgear, motor control centers, PLC, conductors, and conduits as identified on the plans; installing new switchgear, PLC, conduit and conductors; and all the appurtenances as shown on the plans and in these special provisions. City College Reservoir is located near Sacramento City College.

B. The project also consists of mechanical work. This work will includes removing the existing regulating valve, motor operated butterfly valve, spool pieces, and hydraulically operated butterfly valve. Then installing a new altitude valve, butterfly valve, spool pieces, and pipe supports. The existing staircase will need to be removed and then reinstalled. The new altitude valve will need to be connected to the existing reservoir, drain, and PLC. The mechanical work also includes the installation of four new MOVs. The four existing MOVs shall be removed and salvaged.

C. The work shall be in conformance with the plans and specifications hereinafter identified, including furnishing all material, labor, plant, tools, equipment, and services necessary to complete this project.

D. The Contractor is encouraged to order the switchgear and conductors for this project as soon as possible as the production lead time for this gear may be several months.

E. This facility is a reservoir owned and operated by the City of Sacramento, Department of Utilities.

F. Portions of the work will involve the following, for which no separate payment will be made, except as provided for in the items of the bid:

1. Mobilization: Supply and transport of construction equipment, materials, supplies, appurtenances, etc., to perform the work.

2. Demobilization: Demobilization of construction plant and equipment, removal thereof and final cleanup and restoration of the site.

3. Demolition: Remove and dispose of indicated materials at an approved off-site recycling or disposal facility.

4. Electrical: Installation of new switchgear, conduit, and conductors.

5. Storage of Materials and Equipment: Provide necessary equipment to unload, and temporarily store materials and equipment, in accordance with the manufacturer's requirements.

6. Miscellaneous: Construction of concrete house-keeping pads for the new switchgear.

7. Test and make site ready for operation.

8. Coordinate work activities with the City.

9. Provide project supervision and management to meet the project schedule.

1.02 BID ITEMS

A. See "Items of the Proposal" in the Bid Proposal Package of these Contract Documents.

1.03 CONTRACTOR'S BID STRUCTURE AND SCOPE OF THE WORK

A. Payment for this work will be made on a lump sum basis and/or unit price basis, as indicated in the proposal.

B. The Scope of Work is defined in the Technical Specifications, the drawings, and the referenced publications that are made a part hereto.

1.04 MEASUREMENT AND PAYMENT

A. Full compensation for furnishing all labor, materials, tools, equipment and incidentals and for doing all work involved in each item of the proposal as described in these Specifications, as shown on the drawings and/or as required for a complete and operational facility, shall be considered as included in the bid price and no additional compensation will be made therefor.

B. Quantities shown on the City's estimate are approximate. The City does not expressly or by implication agree that actual quantity of work will correspond therewith, but reserves the right to increase or decrease quantities of any item or to omit portions of the work as may be deemed necessary or advisable by the City; also to make such alternatives or deviations, additions to, or omissions from

the Plans and Specifications as may be determined during progress of work to be necessary and advisable for proper completion.

C. The total bid amounts shall include, without limitation, all the work shown on the drawings and as described elsewhere in these Specifications. If a specific activity of work is not called out in the bid proposal, the Contractor shall include the cost for such work in the bid item that is deemed appropriate to the Contractor as indicated in Section 8 of the CSSS.

D. Progress Payments for the work shall be made as provided in Section 8 of the CSSS.

1.05 WORK NOT INCLUDED

A. The following work is NOT included in this contract.

1. Work shown, but marked "NIC" (Not In Contract) or shown as Existing (E).

2. Any work otherwise designated to be done by others.

1.06 CONTRACTOR FURNISHED EQUIPMENT AND MATERIALS

A. All equipment and materials furnished by the Contractor that are to remain a part of the constructed facility shall be new and unused and shall conform to the requirements of these specifications. Where manufactured materials and equipment are specified, the same brand manufacturer for each class of material or equipment shall be used wherever possible.

B. The manufacturer's warranty shall pass to the City and shall extend for a period of one year after project acceptance by the City.

1.07 POWER DISRUPTIONS

A. No long term electrical disruptions shall be permitted by the City during Contractor's performance of the work without prior written approval of the City. The Contractor shall furnish, install, and operate all resources required for temporary power, see Section 01920. All short-term outages necessary for change over to temporary power, to make connection, or other activity shall be scheduled with the City at least three weeks in advance and will be subject to cancellation at any time by the City.

1.08 PROSECUTION AND PROGRESS OF THE WORK:

A. The Contractor shall be responsible for planning, scheduling, and reporting the progress of the work to ensure timely completion of the work called for in the

contract. The Contractor shall prepare and submit a detailed plan as specified.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Materials are specified in these Technical Specifications, and in Sections 10 through 38 of the CSSS.

B. Submit and obtain approval for all Submittals before commencing fabrications or moving construction materials onto the job site.

C. All equipment shall be complete, ready for installation, and tested to the satisfaction of the Engineer at the time of acceptance of the work.

D. Unless specifically excluded in the Contractor's Proposal, all incidental parts which are not shown on the Plans, or specified herein, and which are necessary to have complete and operable facilities shall be furnished by the Contractor.

E. Manufactured articles, material, and equipment shall be applied, installed, connected, erected, adjusted, tested, used, cleaned, and conditioned as recommended by the manufacturer unless specified to the contrary. Copies of the manufacturer's installation instructions and procedures shall be submitted prior to the installation of manufacturer's articles, material, and equipment.

F. Materials and equipment shall be stored so as to insure the preservation of their quality and fitness for the work. Stores of equipment and materials shall be located to facilitate inspection. The Contractor shall be responsible for all damages that occur in connection with the care and protection of all materials and equipment until the completion of work and final acceptance by the City.

G. If any material does not conform with these specifications the Contractor shall, within three days after being notified by the Engineer, remove the materials from the project site or storage area.

2.02 MATERIAL PROVIDED BY THE CITY

A. Equipment that is not specifically identified as being provided by the City will be provided and installed by the Contractor.

2.03 CONTRACTOR ESTIMATES

A. Contractor shall provide a written estimate for all proposed changes to the work. The estimate shall be on tabular pre-printed estimating sheets. The estimate shall list all items of deletion and addition to the Contract. Each item shall have

material, equipment, and labor units extended and summed. Contractor shall apply the allowable overhead and profit (CSSS 8-16) for a total estimated cost of the proposed change order.

PART 3 - EXECUTION

3.01 CONTRACTOR'S PLANT AND EQUIPMENT

A. Security: The Contractor shall be responsible for the security of their plant and equipment. The City will not take any responsibility for missing or damaged equipment, tools, or personal belongings. The Contractor shall provide temporary security fencing and otherwise provide for the security of the existing facilities. These sites are particularly subject to vandalism. Materials left on-site are at the Contractor's risk and, if lost, at the Contractor's expense. The Contractor shall be responsible for the salvaged materials and equipment owned by the City and removed, or relocated, until the City has taken possession of such materials and equipment.

B. Workshop and Storage Facilities: The Contractor shall provide storage facilities for the protection from weather of materials and supplies, and shall keep the facilities clean and in proper order at all times. The project site has limited space for a storage yard. Additional property may need to be leased, at the Contractors expense, for storage facilities. Materials and equipment shall be stored so as to insure the preservation of their quality and fitness for the work and located so as to facilitate inspection. The Contractor shall be responsible for all damages that occur in connection with the care and protection of all materials and equipment, including existing equipment, until completion and final acceptance of the work by the City.

C. Parking Facilities: Parking areas at the project location are limited for the automobiles used by the Contractor's construction employees and Contractors own vehicles. A parking area shall be designated by the Contractor and approved by the Engineer.

3.02 CONTRACTOR'S UTILITIES

A. Electrical Power

1. See section 01920 for temporarily electrical power.

2. The Contractor shall attain approval from Mike Wasina of the City of Sacramento, (916) 798-7579 two (2) working days before installing the new switchgear and motor control centers.

3. Power outage requests shall be made 48 hours in advance and shall be

approved by the Engineer before proceeding.

B. Sanitary Facilities: The Contractor shall make arrangement for the maintenance of adequate toilet facilities at, or near, the work site and shall pay the costs thereof.

C. Temporary Heating: The Contractor shall provide temporary heating, covering, and enclosures, as necessary, to protect all work and material against damage by dampness and cold and to facilitate completion of the work. The Contractor shall supply all the fuel, power, equipment, and materials required for temporary heating.

3.03 LANDS PROVIDED BY CITY

A. Any additional land required for the construction of the work under this Contract, except that already owned by the City, shall be the Contractors responsibility to obtain.

3.04 FIELD ENGINEERING

A. The Contractor shall provide and pay for the following field engineering services required for this job:

1. Laying out the work.

2. Civil, structural, electrical, surveying, or other professional services specified, or required, to execute the work.

B. The Contractor is responsible for determining the exact location of all existing utilities and for the protection of and repair of damage to them. Contact Underground Service Alert at 1-800-227-2600, 48 hours before work is to begin. Contractor shall also contact the City Department of Utilities Plant Services Division, Mike Wasina at (916) 798-7579 to identify City underground facilities on site.

C. The Contractor shall be responsible for the protection of all existing survey monuments or markers during construction.

D. The Contractor shall be responsible for maintaining As-Built drawings for all underground work throughout the course of construction. Such drawing shall record the location and grade (City Datum) of all underground improvements constructed and shall be delivered to the construction inspector prior to, and, in consideration of the City's acceptance of work.

3.05 SHIPPING AND PROTECTION OF EQUIPMENT

A. Definition: For the purpose of this paragraph, "equipment" means: all mechanical devices, all electrical devices, all items supplied by the City, all items removed by Contractor for later reinstallation, and all items with one or more moving parts.

B. Packing and Markings: All equipment shall be adequately and effectively protected against damage from moisture, dust, handling or other cause during transport from manufacturer's or supplier's premises to job site. Each item or package shall be clearly marked with a fitting or distinguishing mark, which shall be shown on the packing list. Stiffeners shall be used, where necessary, to maintain shapes and to give rigidity. Parts of equipment shall be delivered in assembled or sub-assembled units, where possible.

C. Identification of Equipment: Each item of equipment shall have firmly affixed to it a nameplate, label, or tag with its equipment number or other discrete identifying mark.

D. Storage of Equipment: Contractor shall provide storage for equipment for the entire interval between receiving and installation, and for the entire interval between being removed and reinstalled. Equipment shall be stored in a enclosed space affording protection from weather, dust, and mechanical damage and providing favorable temperature, humidity and ventilation conditions, as required, to ensure against equipment deterioration. For equipment that is not intended and prepared for outdoor installation, the storage container shall be heated above dew point temperature.

E. Protection of Equipment After Installation: After installation, all equipment shall be protected, as required. During construction, and until final acceptance by the City, all equipment that may be affected must be completely covered. All equipment shall be cleaned and vacuumed inside and outside prior to acceptance.

F. Delivery of Equipment: City personnel will not accept materials or equipment deliveries for the Contractor.

G. Security: Security of equipment stored by the Contractor is the Contractors responsibility. All losses or damage shall be replaced or repaired at the Contractor's expense.

3.07 TESTING

A. The City will field test earth work and cast-in-place concrete materials.

B. Notification: As an exception to requirements that may be stated elsewhere in the Contract, the Engineer shall be given two (2) working days notice prior to each test. The Contractor shall perform all other testing and submit written copies of all test results to the Engineer.

C. Failure to Meet Test: Any system material or workmanship which is found defective, on the basis of acceptable tests, shall be reported to the Engineer. Contractor shall replace the defective material or equipment and have test repeated until test proves satisfactory to the Engineer, without additional cost to the City.

D. Operational Testing: Operational testing consists of electrical testing specified in Section 1750, **TESTING, TRAINING AND FACILITY START-UP**.

E. Demonstration Testing: After all operational tests specified in Section 1750 are satisfactorily completed, the Contractor shall perform a demonstration test.

3.08 SAFETY

A. Contractor shall execute and maintain all work to avoid injury or damage to any person or property. All work shall be done in conformance with the State of California, Division of Industrial Safety and OSHA Standards. Safety precautions, as applicable, shall include, but not be limited to, confined space procedures, adequate fume protection; adequate illumination for underground and night operation; instruction in accident prevention for all employees; such machinery guards, walkways, scaffolds, ladders, bridges, and other safety devices, equipment and wearing apparel as are necessary or lawfully required to prevent accidents or injuries; and the proper inspection and maintenance of all safety measures. Contractor shall have emergency phone numbers and addresses posted on the job site.

3.09 PROTECTION OF EXISTING IMPROVEMENTS

A. The provisions of this Section shall supplement the provisions of CSSS Section 13.

B. Existing facilities, utilities, and property shall be protected from damage resulting from the Contractor's operations. All trees, shrubbery, fences, walls, asphalt, and other improvements, including existing pavements, sidewalks, street improvements, and underground utilities, and other improvements not shown on the drawings shall be protected from damage by the Contractor throughout the

construction period. Existing roadways and other improved surfaces shall be protected from damage by vehicles with tracks or lugs.

C. Any damage resulting from the Contractor's operations shall be repaired by the Contractor to the condition which existed prior to the damage, and to the satisfaction of the Engineer, at no additional cost to the City.

D. The Engineer may deduct from payments otherwise due the Contractor, the estimated cost of repairing any damage created by the Contractors operation, until such time that repairs are made by the Contractor to the Engineers satisfaction.

E. The Contractor shall be responsible for unlocking and locking the gates at the project site each work day to enter and exit the work area. During the construction period, the Contractor shall be responsible, 24 hours per day, for the security and integrity of existing project facilities, including replacing stolen materials.

3.10 MATERIAL NONCONFORMANCE

A. If any material does not conform with these Specifications, the Contractor shall, within three (3) days after being notified by the Engineer, remove the materials from the project site or storage area.

3.11 RESTORATION OF STRUCTURES AND SURFACES

A. Structures, Equipment and Pipework: The Contractor shall remove such existing structures, equipment, and pipework as may be necessary for the performance of the work, and shall rebuild, or replace, the items thus removed in as good a condition as found. Contractor shall repair any existing structures which may be damaged as a result of the work.

B. Curbs, Gutters, Driveways and Sidewalks: All curbs, gutters, driveways, sidewalks, and similar structures that are broken or damaged by the installation of the work shall be reconstructed by the Contractor. Reconstruction shall be of the same kind of materials with the same finish and in not less than the same dimensions as the original work. Repairs shall be made by removing and replacing the entire portions between joints or scores, and not merely refinishing any damaged part. All work shall match the appearance of the existing improvements, as nearly as possible.

C. Roads and Streets: All roads and streets in which the surface is removed, broken, or damaged, or in which the ground has caved, or settled, due to work under this Contract, shall be completely resurfaced and brought to the original grade and crown section, unless otherwise indicated. Before resurfacing

material is placed, edges of pavements shall be trimmed back far enough to provide clean, solid, vertical faces, and shall be free of any loose material. Roadways used by the Contractor for hauling materials, equipment, supplies, etc., shall be cleaned and repaired if the condition of the roadway is damaged, or otherwise affected, due to the Contractor's operations.

D. Cultivated Areas and Other Surface Improvements: All cultivated and natural areas, either agricultural or lawns, and other surface improvements which are damaged by actions of the Contractor shall be restored, including roadside drainage ditches, as nearly as possible, to their original condition.

E. In addition to the CSS, all existing utilities are to remain in service during construction. The Contractor shall be required to work around existing utilities that will remain in place within the project area. The Contractor shall also be required to work around existing utilities that are not within the project area. Minor changes in alignment shall be made to avoid direct conflict that will interfere with the intended purpose of the facility.

Existing landscaping irrigation systems, trees, shrubs and other plants, that are not to be removed as shown on the plans or specified in these special provisions and are injured or damaged by reason of the Contractor's operations, shall be replaced by the Contractor. The minimum size of tree replacement shall be 24-inch box and the minimum size of shrub replacement shall be 15 gallon. Replacement ground cover plants shall be from flats and shall be planted 12 inches on center. Replacement of ground cover plants shall be from cuttings and shall be planted 12 inches on center. Replacement planting and irrigation systems shall conform to the requirements of the CSSS.

Full compensation for conforming to all requirements specified in this section shall be considered as included in.

3.12 EROSION, SEDIMENT, AND POLLUTION CONTROL

A. **General**

Contractor shall be responsible for controlling erosion and sedimentation within the limits of the project at all times during the course of construction including evenings, weekends and holidays in addition to normal working days. The Contractor shall prevent sediment and construction debris from entering the City of Sacramento storm drain system.

At a minimum, the Contractor shall provide protection around any drain inlets located within the project area and any cross streets which receive runoff from the limits of the construction zone. The Contractor shall also exercise care during trench excavation so that excessive sediments are not tracked into the gutters and ultimately, the storm drain. Upon completion of the project, all areas

within the limits of the project shall be cleaned and free of sediments.

The Contractor will not be allowed to clean the sediments from the street by means of using a water truck to spray the streets down into the storm drain via curb and gutter. The streets will be allowed to be sprayed by a water truck only when sediment barriers have been placed at drainage inlets to catch all sediments from the streets. Refer to the City of Sacramento's Administrative and Technical Procedures Manual for Grading, Erosion and Sediment Control dated January 1994, for information relating to sediment control measures and prevention. This Manual is available from the City of Sacramento, Department of Utilities, 1395 35th Avenue, Sacramento, CA 95822.

The Contractor shall prepare and submit to the Engineer for review and approval a drawing showing the placement of sediment control barriers, drop inlet protection, housekeeping practices, CIPP water catchments, and any other measures proposed to be used to prevent sediment and other sources of pollution from entering the City storm drainage system. The erosion, sediment and pollution control plan shall be submitted a minimum of ten (10) calendar days prior to start of the work. The Contractor will not be allowed to begin work until an approved erosion, sediment and pollution control plan is on file with the Engineer.

B. **Housekeeping Practices**

Contractor shall, during the construction of this project, implement, at a minimum, the following housekeeping practices: solid waste management, material storage and delivery area, concrete waste management, and spill prevention and control.

Solid Waste Management: Contractor shall maintain a clean construction site. Contractor shall provide designated areas for waste collection. The waste collection areas shall be leak-proof containers with lids or covers. Site trash shall be collected daily and placed in the disposal containers. The Contractor shall make arrangements for regular waste collection. The Contractor shall also regularly inspect the waste disposal areas to determine if potential pollutant discharges exist.

Material Storage and Delivery Area: Contractor shall provide one central material storage and delivery area for the duration of the project. This area shall be fenced and protected such that runoff will not be allowed to leave the material storage area. The Contractor shall regularly inspect the site to ensure that any hazardous or non-hazardous materials have not spilled.

Concrete Waste Management: The Contractor shall arrange for concrete wastes to be disposed of off-site or in one designated area. Concrete wastes, including left-over concrete and material from washing out the concrete truck, shall not be disposed to the storm drain system. If a designated area is provided,

the site shall be bermed to allow the concrete to dry. The dried concrete waste shall be removed and disposed of properly at the Contractor's expense.

Spill Prevention and Control: The Contractor shall be responsible for instructing employees and sub-contractors about preventing spills of hazardous materials and controlling spills if they occur. Proper spill control and cleanup materials shall be kept on site near the storage area and updated as materials change on site.

More information about Housekeeping Practices can be obtained by referring to the City of Sacramento's Administrative and Technical Procedures Manual for Grading, Erosion and Sediment Control dated January 1994, available at 1395 35th Avenue, Sacramento, CA 95822. (Revised 5\30\96)

~~C. **Dewatering**~~

~~Groundwater levels in the project area fluctuate with the water level of the adjacent creeks and downstream rivers. The Contractor shall be responsible for the control, removal, and disposal of any groundwater that may be encountered in the course of excavating, trenching, placing pipe, or constructing any other improvements associated with the project. Any water containing chlorine or sediments shall not be discharged to the City storm drain system unless the water is free from such constituents. No separate payment will be made to the Contractor for dewatering.~~

D. **Dust Control**

Contractor shall be responsible for the control of dust within the limits of the project at all times including weekends and holidays in addition to normal working days. The Contractor shall take whatever steps are necessary or required by the Engineer to eliminate the nuisance of blowing dust.

Contractor shall keep all streets as well as all grounds adjacent to the project site clean and free of dust, mud, and debris resulting from the Contractor's operations. Daily clean up throughout the project shall be required as the Contractor progresses with the work. Extra precautions and clean up efforts shall be made prior to weekends and holidays.

Spillage of earth, gravel, concrete, asphalt, or other materials resulting from hauling operations along or across any public traveled way shall be removed immediately by the Contractor at his expense.

No separate payment will be made to the Contractor for dust control. The cost of such work shall be included in whatever bid item the Contractor deems appropriate.

3.13 CONSTRUCTION INSPECTIONS

A. All work is subject to inspection and approval by the Engineer. The Contractor shall notify the Engineer, along with all affected utility companies, two (2) working days in advance of the start of work to coordinate and schedule inspection staff.

The Contractor shall provide a competent person during normal working hours to assist the Engineer, when required, in checking the Contractor's layout and for measuring quantities for payment purposes. The Contractor shall cooperate with the Engineer so that checking and measuring may be accomplished with the least interference to the Contractor's operations.

No additional compensation will be made to the Contractor for fulfilling these requirements.

3.14 CONTROL OF MATERIALS

A. In addition to the requirements of Section 5 Control of Work and Materials of the CSSS, the following shall apply:

Material testing for this project will be provided by the Contractor as set forth in these bid documents and the most current City of Sacramento's Quality Assurance Program. The Contractor shall perform all testing to verify compliance with the Specifications of any and all materials furnished by the Contractor. The Contractor shall submit and receive the Engineer's approval of all compliance test results prior to incorporating materials into the project.

Samples, certificates of compliance, lists of materials and material sources, access to facilities, requests for testing and all other data relating to material testing shall conform to these bid documents and the City of Sacramento's Quality Assurance Program Contractor shall provide the Engineer with five (5) working days notice of the need for material testing.

Full compensation for conforming to all requirements specified in this section, "Control of Materials," shall be considered as included in the contract price paid for other items of work and no additional compensation will be allowed.

****END OF SECTION****

SECTION 01330

SUBMITTALS

PART 1 - GENERAL

1.01 STANDARD COMPLIANCE

A. When materials or equipment must conform to the standards of organizations such as, but not limited to, the American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA) and Underwriter's Laboratories (UL) documents showing, or proving, conformance shall be submitted.

B. If an organization uses a label or listing to indicate compliance with a particular standard, the label or listing will be acceptable evidence, unless otherwise specified in the individual Sections. In lieu of the label or listing, the Contractor shall submit a certificate from an independent testing organization, which is competent to perform acceptable tests, and is approved by the City. The certificate shall state that the item has been tested in accordance with the specified organization's standard. For materials and equipment whose compliance with organizational standards or specifications is not regulated by an organization using its own listing or label as proof of compliance, a certificate of compliance from the manufacturer shall be submitted for approval. The certificate shall identify the manufacturer, the product, and the referenced standard and shall state that the manufacturer certifies that the product conforms to all requirements of the project Specification and of the referenced standards listed.

1.02 REVIEW OF CONTRACTOR'S INFORMATION

A. The City of Sacramento will promote the formation of a "Partnering" relationship with the Contractor in order to effectively complete the submittal process to the benefit of both parties. The purpose of this relationship will be to maintain cooperative communication and mutually resolve conflicts at the lowest possible management level. The City will provide the Contractor with up to two submittal revisions for each submittal required for contract work. If the submittal revisions exceed two (2) reviews by the Engineer, the Contractor shall reimburse the City in the amount of $200.00 per hour, for the cost of the Engineer's time to review the additional submittals. The City reserves the right to make changes to the submittals at any time, when this occurs at the City's direction the submittal process will start over and the City shall provide the Contractor with up to two more revisions.

B. When review and checking for acceptance is required of any drawing, or information regarding materials and equipment, the Contractor shall prepare or secure, and submit for review, one PDF file and one hard copy of each submittal. The Engineer, after taking appropriate action, will return two (2) marked copies to the Contractor.

Within a reasonable time after receipt of said submittal copies, the Engineer will return the marked copies indicating one of the following four (4) actions:

1. If review and checking indicates no exceptions, copies will be returned marked "NO EXCEPTIONS TAKEN" and work may begin immediately on incorporating the material and equipment covered by the submittal into the work.

2. If review and checking indicates limited corrections are required, copies will be returned marked "MAKE CORRECTIONS NOTED". Work may begin immediately on incorporating into the work the material and equipment covered by the corrected submittal.

3. If review and checking indicates insufficient, or incorrect data, has been submitted, copies will be returned marked "REVISE AND RESUBMIT". No work may begin on incorporating the material and equipment covered by this submittal into the work until the submittal is revised, resubmitted, and returned marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED".

4. If review and checking indicates the material and equipment submittal is unacceptable, copies will be returned marked "REJECTED". No work may begin on incorporating the material and equipment covered by this submittal into the work until a new submittal is made and returned marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED".

C. Approval of the submittal by the Engineer shall not relieve the Contractor from responsibility for any errors or omissions in such submittals nor from responsibility for complying with the requirements of this Contract.

B. If Shop Drawings show variations from Contract requirements, Contractor shall describe such variations in writing, separate from the drawings, at time of submission. All such variations must be approved by the Engineer.

PART 2 - PRODUCTS

2.01 MANUFACTURER'S DATA

A. Submittals for each manufactured item shall be comprised of manufacturer's descriptive literature, drawings, diagrams, performance and characteristic curves, and catalog cuts. Manufacturer's name, trade name, model or catalog number,

nameplate data, size, layout dimensions, capacity, project specification references, and any other additional information necessary to establish contract compliance shall be clearly indicated for each item submitted. Contractor shall identify items submitted for approval using an arrow or yellow highlighter. All submittals that fail to properly identify items will be returned to the Contractor.

2.02 SHOP DRAWINGS

A. Shop Drawings shall show types, sizes, accessories, elevations, floor plans, sectional views, installation details, elementary control diagrams, and wiring diagrams. Wiring diagrams shall identify circuit terminals and shall indicate the internal wiring for each item of equipment. Drawings shall also indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. If any equipment is disapproved, the drawings shall be revised to show acceptable equipment and be resubmitted. **Contractor shall provide a hard copy and electronic copy of all shop drawings. The electronic copies shall be in Adobe format (Portable Document Format) and shall be provided on a CD. Contractor shall use latest version of Adobe.**

2.03 OPERATION AND MAINTENANCE MANUAL

A. Submit an operation and maintenance manual covering the stipulated systems and equipment. Provide three (3) hard copies of the manual, bound in Avery D - Ring binder model number AVY79-799 or approved equal, shall be furnished to the City. **One (1) of the three copies of the operation and maintenance manual shall contain original documentation/manuals and not photocopies.** Each binder shall be no more than 75% full. Prior to system and equipment tests, one (1) complete, bound copy of the manual shall be submitted for approval. Three (3) approved copies of the manual each for this project, with all applicable test forms completed, shall be furnished to the City before completion of the Contract. The following identification shall be inscribed on the cover and spine of the binders:

Operation and Maintenance Manual — Electrical Switchgear
Project: City College Reservoir Electrical Improvements
Contractor:_____
Contract No.:_____
Date:_____

The contractor shall also provide the City with an electronic copy of each O&M manual. The electronic copies shall be in Adobe format (Portable Document Format) and shall be provided on a CD. Contractor shall use the latest version of Adobe.

B. Provide a table of contents and tab sheets to identify discrete subjects. Instruction sheets shall be legible and easily understood with large sheets and drawings folded in. Use manufacturer's original pre-printed instructions when

available, do not xerox these pre-printed instructions. Cross out all material which does not apply to the equipment furnished on this job.

C. The operating and maintenance instruction shall include, as a minimum, the following data for each item of mechanical and electrical equipment:

1. Name and location of the manufacturer, the manufacturer's local representative, the nearest supplier and spare parts warehouse.

2. Approved submittals applicable to operation and maintenance.

3. Recommended installation, adjustment, start-up, calibration, and troubleshooting procedures.

4. A control sequence describing start-up, operation, and shutdown

5. Detailed description of the function of each principal component of the systems.

6. Recommended lubrication and an estimate of yearly quantity needed.

7. Recommended step-by-step procedures for all modes of operation.

8. Complete internal and connection wiring diagrams.

9. Complete printed circuit board schematic and assembly drawings.

10. Recommended preventive maintenance procedures and schedule.

11. Complete parts lists, by generic title and identification number, with exploded views of each assembly.

12. Recommended spare parts.

13. Disassembly, overhaul, and reassembly instructions.

14. All completed test forms.

15. Provide ISA (International Society for Measurement and Control) S-20 forms for all instrumentation devices.

16. As built single line drawings of the entire electrical system including motor control drawings of each motor. Autocad files of both single line and motor control drawings on a CD.

D. Contractor is not required to provide manuals for equipment supplied by the City. However, any manuals provided to the Contractor by the City shall be returned in a condition acceptable to the Engineer or replaced at no cost to the City.

2.04 PROJECT RECORD DRAWINGS

A. The Contractor shall maintain a neatly and accurately marked set of record drawings showing the elementary control diagrams, wiring diagrams, and final locations and layout of all mechanical, electrical, and instrumentation equipment; piping and conduit; structures; and other facilities. Drawings shall be kept current weekly, with all work instructions and change orders; mechanical, electrical, and instrumentation equipment accommodations; and construction adjustment. Drawings shall be subject to the inspection of the Engineer at all times, and progress payments, or portions thereof, may be withheld if drawings are not accurate and current. Prior to acceptance of the work, the Contractor shall deliver to the Engineer two (2) sets of neatly marked record drawings, accurately showing all the information required above.

PART 3 - EXECUTION

3.01 SUBMITTAL PROCEDURE

A. At least thirty (30) days prior to the Contractors need for approval, Contractor shall forward to the Engineer all submittals required by the individual Sections of the Specifications. The Engineer may require that the Contractor submit a legible reproducible mylar for the City's use in lieu of multiple prints of a single drawing.

B. Identify all submittals by submittal number on letter of transmittal. Specification number shall be identified on the letter of transmittal. Submittals shall be numbered consecutively, and resubmittals shall have a letter suffix. For example:

1. 1st submittal: 2
2. 1st resubmittal: 2A
3. 2nd resubmittal: 2B, etc.

3.02 INFORMATION TO BE SUBMITTED FOR REVIEW

A. Information on items to be submitted for review are specified in the individual Sections of these Specifications. Submittals for each Section shall be bound together in one book. Book shall have numbered tab dividers for each item. Submittals that are related to, or affect, each other shall be forwarded simultaneously as a package to facilitate coordinated review. Uncoordinated submittals will be rejected. Do not combine unrelated materials in the same submittal. Submittals shall be arranged in same order as they appear in the Specification Section. Items shall be highlighted and clearly marked with the

same identification number as indicated on the drawings. The Contractor shall include submittal time appropriate within each item of work on the Construction Schedule. The City will receive submittals at the preconstruction meeting as specified in Section 01105, General Information and Requirements.

**** END OF SECTION ****

SECTION 01410

QUALITY CONTROL

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included:

1. Cooperate with the Engineer's selected testing agency and all others responsible for testing and inspecting the work as described herein.

2. Provide such other testing and inspecting as are specified to be furnished by the Contractor in this section and/or elsewhere in the contract documents

B. Related Work

1. Requirements for testing may be described in various sections of these specifications and applicable codes.

2. Where no testing requirements are described but the Engineer decides that testing is required, the Engineer may require such testing to be performed under current pertinent standards for testing. Payment for such testing will be made as described in this section.

C. Work Not Included:

1. Selection of testing laboratory: The City will select a pre-qualified independent testing laboratory.

2. Payment for specified initial testing: The City will only pay for **initial** material strength testing of items described in 1.02 TESTING DESCRIPTION, subparagraph A.1, herein. Contractor shall be responsible to pay for all other testing.

1.02 TESTING DESCRIPTION

A. Material Strength:

~~1. The City will only pay for initial testing services for concrete strength and slump, soil compaction, and grout strength.~~

2. When initial tests indicate non-compliance with the Contract Documents, the costs of any additional tests required for determining compliance will

be deducted by the City from the Contract Sum as reflected in the progress payments due the Contractor.

B. Operational Testing: All operational tests shall be paid for by the Contractor.

C. Code Compliance Testing

1. Inspections and tests not identified in 1.07 of this section, that are required by codes or ordinances, or by a plan approval authority, and which are made by a legally constituted authority, shall be the responsibility of and shall be paid for by the Contractor, unless otherwise provided in the Contract Documents.

D. Contractor's Convenience Testing:

1. Inspecting and testing performed exclusively for the Contractor's convenience, such as determining grain size or index properties of material proposed for use as import, shall be the sole responsibility of the Contractor.

2. Employment of testing laboratory shall in no way relieve Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

~~E. The City will provide initial testing for trench/structure backfill and embankment compaction.~~

1.03 REFERENCES

ANSI/ASTM D3740	Practice for Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
ANSI/ASTM E329	Standard Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction.

1.04 LABORATORY REPORTS

A. After each inspection and test, promptly submit three (3) copies of laboratory report to the Engineer. Include: Date issued, Project title and number, name of inspector, date and time of sampling or inspection, identification of product and Specifications section, location in the Project, type of inspection or test, date of test, results of tests, and conformance with Contract Documents. When requested by Engineer, provide interpretation of test results.

1.05 LIMITS ON TESTING LABORATORY AUTHORITY

A. Laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.

B. Laboratory may not approve or accept any portion of the Work.

C. Laboratory may not assume any duties of Contractor.

D. Laboratory has no authority to stop Work.

1.06 CONTRACTOR RESPONSIBILITIES

A. Deliver to laboratory at designated location adequate samples of materials proposed to be used which require testing, together with proposed mix designs.

B. Cooperate with laboratory personnel and provide access to Work and to manufacturer's facilities.

C. Provide incidental labor and facilities to provide access to work to be tested, to obtain and handle samples at the site or at source of products to be tested, to facilitate tests and inspections, and for storage and curing of test samples.

D. Notify laboratory twenty-four (24) hours prior to expected time for operations requiring inspection and testing services.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 COOPERATION WITH TESTING LABORATORY

A. Representatives of the testing laboratory shall have access to the work at all times and at all locations where the work is in progress. Provide facilities for such access to enable the laboratory to perform its functions properly.

3.02 TAKING SPECIMENS

A. All specimens and samples for testing, unless otherwise provided in the Contract Documents, shall be taken by the testing personnel. All sampling equipment and personnel will be provided by the testing laboratory. All deliveries of specimens and samples to the testing laboratory will be performed by the testing laboratory.

3.03 SCHEDULES FOR TESTING

A. Establishing Schedule:

1. By advance discussion with the testing laboratory selected by the City, determine the time required for the laboratory to perform its tests and to issue each of its findings.

2. Provide all required time within the construction schedule.

B. Revising Schedule: When changes of construction schedule are necessary during construction, coordinate all such changes with the testing laboratory as required.

C. Adherence to Schedule: When the testing laboratory is ready to test according to the established schedule, and is prevented from testing or taking specimens due to incompleteness of the work, all extra charges for testing attributable to the delay may be back-charged to the Contractor and shall not be borne by the City.

3.04 TESTING PROCEDURES

A. Notification: As an exception to requirements that may be stated elsewhere in the contract, the Engineer shall be given three (3) working days notice prior to each test. The Contractor shall provide all test equipment and personnel and submit written copies of all test results.

B. Failure to Meet Test: Any system material or workmanship which is found defective on the basis of acceptable tests shall be reported to the Engineer. Contractor shall replace the defective material or equipment and have test repeated until test proves satisfactory to the Engineer without additional cost to the City.

C. Operational Testing: After all pre-operational tests are satisfactorily complete, Contractor shall perform an operational test. All mechanical and electrical equipment shall be tested by the Contractor to the satisfaction of the Engineer before any facility is put into operation. Tests shall be made to determine whether the equipment has been properly assembled, aligned, adjusted and connected. Any changes, adjustments or replacements required to make the equipment operate as specified shall be carried out by the Contractor as part of the work.

**** END OF SECTION ****

SECTION 01600

MATERIAL AND EQUIPMENT

PART 1 - GENERAL

1.01 DESCRIPTION

A. Requirements Included:

1. Products.

2. Transportation and Handling.

3. Storage and Protection.

4. Substitutions and Product Options.

B. Related Requirements:

1. Section 01330: Submittals: Submittal of Manufacturers' Certificates.

1.02 QUALITY ASSURANCE

A. Include within the Contractor's quality assurance program such procedures as are required to assure full protection of work and materials.

1.03 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Manufacturer's Recommendations:

1. Except as otherwise approved by the Engineer, determine and comply with manufacturer's recommendations on product handling, storage and protection.

   a. Maintain packaged materials with seals unbroken and labels intact until time of use.

   b. Promptly remove damaged materials and unsuitable items from the job site, and promptly replace with material meeting the specified requirements, at no additional cost to the City.

2. The Engineer may reject as non-complying such material and products that do not bear identification satisfactory to the Engineer as to manufacturer, grade, quality, and other pertinent information.

3. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.

1.04 JOB CONDITIONS

A. Storage and Protection:

1. Store products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weather-tight enclosures; maintain within temperature and humidity ranges required by manufacturer's instructions.

2. Store loose granular materials on solid surfaces in a well-drained area; prevent mixing with foreign matter.

3. Arrange storage to provide access for inspection. Periodically inspect to assure products are undamaged and are maintained under required conditions.

4. After installation, provide coverings to protect products from damage from traffic and construction operations, remove when no longer needed.

5. Maintain finished surfaces clean, unmarred, and suitably protected until accepted by the Owner.

B. Repairs and Replacements:

1. In event of damage, promptly make replacements and repairs to the approval of the Engineer and at no additional cost to the City.

2. Additional time required to secure replacements and to make repairs will not be considered to justify an extension in the Contract Time of Completion.

1.05 ALTERNATIVES

A. Product Options:

1. Within ten (10) days after date of Contract, submit complete list of major products proposed, with name of manufacturer, trade name, and model.

2. Options:

a. Products Specified by Reference Standards or by Description Only: Any product meeting those standards.

b. Products Specified by Naming One (1) or More Manufacturers with

a Substitute Paragraph: Submit a request for substitution for any manufacturer not specifically named.

c. Products Specified by Naming Several Manufacturers: Products of named manufacturers meeting specifications; no options, no substitutions allowed.

d. Products Specified by Naming Only One (1) Manufacturer: No options, no substitutions allowed.

B. Substitutions:

1. Within ten (10) calendar days after date of Contract, Contractor shall submit requests to the Engineer for consideration of substitutions.

2. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.

3. Request constitutes a representation that Contractor:

a. Has investigated proposed product and determined that it meets or exceeds, in all respects, specified product.

b. Will provide the same warranty for substitution as for specified product.

c. Will coordinate installation and make other changes that may be required for Work to be complete in all respects.

d. Waives claims for additional costs that may subsequently become apparent.

4. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals without separate written request, or when acceptance will require substantial revision of Contract Documents.

5. Engineer will determine acceptability of proposed substitution and will notify Contractor of acceptance or rejection in writing within a reasonable time.

6. The Engineer can, at his option, require as a condition of acceptance of a substitution that the Contractor provide a credit to the City for the difference in cost of product(s) or components, or systems proposed as a substitution.

7. If, upon Engineer's review of a substitution, it is determined by the Engineer that the substitution is not acceptable, for whatever reason, the Contractor shall supply the specified product or products.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 SHIPPING AND PROTECTION OF EQUIPMENT

A. Definition: For the purpose of this article, "equipment" means all mechanical devices, all electrical devices, all electronic devices, and all items with one or more moving parts.

B. Packing and Marking: All equipment shall be adequately and effectively protected against damage from moisture, dust, handling or other cause during transport from manufacturer's or supplier's premises to site. Each item or package shall be clearly marked with a fitting or distinguishing mark that shall be shown on the packing lists. Stiffeners shall be used where necessary to maintain shapes and to give rigidity. Parts of equipment shall be delivered in assembled or sub-assembled units where possible.

C. Identification of Equipment: Each item of equipment shall have firmly affixed to it a nameplate, label or tag with its equipment number or other discrete identifying mark.

D. Protection of Equipment After Installation: After installation, all equipment shall be protected as required. During construction, including finishing, all equipment that may be affected must be completely covered.

E. Delivery of Equipment: City personnel will not accept materials or equipment deliveries for the Contractor.

F. Security: Security of equipment stored by the Contractor is his responsibility. All losses or damage shall be replaced or repaired at the Contractor's expense.

**** END OF SECTION ****

SECTION 01650

FACILITY STARTUP

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Procedures and actions required of the Contractor for Facility startup.

B. See Temporary Power in Section 01920 for related activities.

1.02 DEFINITIONS

A. Project Classified System (PCS): A defined part of the Project consisting of an arrangement of items, such as equipment, structures, components, piping, wiring, materials, or incidentals, related or connected to form an identifiable, unified, functional, operational, safe, and independent system.

B. Pre-Demonstration Period: The period of time after initial construction and installation activities during which the Contractor, with assistance from manufacturers' representatives, performs the following:

1. Finishing type construction work.
2. Equipment startup.

C. Demonstration Period: A one-week period of time, following the Pre-Demonstration Period, during which the Contractor initiates facility start-up and operates the Project Classified Systems, without exceeding specified downtime limitations. The purpose of the Demonstration Period is to prove the functional integrity of the mechanical and electrical equipment and components and the control interfaces of the respective equipment and components comprising the facility.

1.03 SUBMITTALS

A. Submit for review prior to completion of the Pre-Demonstration Period.

1. Master startup schedule:

a. Schedule to include:

1) Target date and time for the City to witness each system's initial startup.

2) Target date for initiation of Demonstration Period.

3) Test methods, procedures, and sample form for recording test data.

2. O&M Manuals:

   a. The required number of approved Operation and Maintenance Manuals. Manuals must be received by the Engineer a minimum of thirty (30) days prior to scheduling any required system training.

3. Equipment installation and pre-demonstration startup certifications.

   a. Letter verifying completion of all pre-demonstration startup activities, including receipt of all specified items from each manufacturer and/or supplier as the final item prior to initiation of Demonstration Period.

PART 2 PRODUCTS - (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Facility Startup is divided into two periods:

1. Pre Demonstration Period including:
   a. Startup of Equipment in presence of City personnel.
   b. Filing of all required submittals, including O&M manuals.
2. Demonstration Period including:
   a. Seven (7) day demonstration of functional integrity of facility or PCS.

3.02 PRE-DEMONSTRATION PERIOD

A. Equipment Startup:

1. Requirements for individual items of equipment are included in Divisions 2 through 17 of these Specifications. Factory acceptance tests for equipment shall be submitted in advance of the Demonstration Period per the respective Specification Sections.

2. Prepare the equipment so that it will operate properly and safely, and so that it will be ready to demonstrate functional integrity during the Demonstration Period.

3. Operate equipment in all operable modes, including manual and automatic modes. Falsify instrumentation signals inputs into the PLC or control panel as required to operate equipment in automatic mode, where it is

otherwise not possible for the equipment to run in automatic mode during the Pre-Demonstration Period.

4. Run all additional operable equipment.

5. Procedures include, but are not limited to, the following:

   a. Test or check and correct deficiencies of:

      1) Power, control, and monitoring circuits for continuity prior to connection to power source.
      2) Voltage of all circuits.
      3) Phase sequence.
      4) Cleanliness of connecting piping systems.
      5) Alignment of connected machinery.
      6) ~~Vacuum and/or~~ pressure of all closed systems.
      7) Lubrication.
      8) Valve orientation and position.
      9) Pumping equipment using clean water.
      10) Instrumentation and control signal generation, transmission, reception, and response.
      11) Tagging and identification systems
      12) All equipment: Proper connections, alignment, calibration and adjustment.

   b. Calibrate safety equipment.

   c. Manually rotate or activate moving parts to ensure that there is freedom of movement.

   d. "Bump"-start electric motors to verify proper rotation.

   e. Perform other tests, checks, and activities required to make the equipment ready for the Demonstration Period.

   f. Documentation:

      1) Prepare a log showing each equipment item subject to this paragraph and listing what is to be accomplished during Equipment Startup. Provide a place for Contractor and Engineer to record the date and the person accomplishing the required work. Submit completed document before requesting inspection for Substantial Completion certification.

6. Submit, without restrictions or qualifications, the following:
   a. Manufacturers' equipment installation check letters.
   b. Instrumentation Supplier's Instrumentation Installation Certificate.

B. Personnel Training:

1. See individual equipment specification sections.

2. Conduct all personnel training after completion of Equipment Startup for the equipment for which training is being conducted.
   a. Personnel training on individual equipment or systems will not be considered completed unless:
      1) All pretraining deliverables are received and approved before commencement of training on the individual equipment or system.
      2) No system malfunctions occur during training.
      3) All provisions of field and classroom training specifications are met.
   b. Training not in compliance with the above will be performed again in its entirety by the manufacturer at no additional cost to the City.

C. Complete the filing of all required submittals:

1. Shop drawings.

2. Approved Operation and Maintenance Manuals – submit thirty (30) calendar days prior to first training session.

3.03 DEMONSTRATION PERIOD

A. General:

1. Demonstrate the functional integrity of the altitude valve, mechanical, electrical, and control interfaces of the respective equipment and components comprising the facility under automatic control.

2. Demonstration Period: In the presence of City personnel, operate each pump for a period of thirty (30) consecutive minutes using line power. Flow, pressure, and level measurements shall be recorded during the entirety of the Demonstration Period.

3. If, during the Demonstration Period, the aggregate amount of time used for repair, alteration, or unscheduled adjustments to any equipment or systems that renders the affected equipment or system inoperative exceeds ten (10) percent of the Demonstration Period, the demonstration

of functional integrity will be deemed to have failed. In the event of failure, a new Demonstration Period will recommence after correction of the cause of failure. The new Demonstration Period shall have the same requirements and duration as the Demonstration Period previously conducted.

4. Conduct the demonstration of functional integrity under full operational conditions for a period of seven (7) consecutive 24-hour days.

5. City will provide operational personnel to provide process decisions affecting plant performance and will be available for process decisions and testing acceptance. Contractor shall perform all other functions including, but not limited to, equipment operation and maintenance until the successful completion of the Demonstration Period.

6. City reserves the right to simulate operational variables, equipment failures, routine maintenance scenarios, etc., to verify the functional integrity of automatic and manual backup systems and alternate operating modes.

7. The time of beginning and ending any Demonstration Period shall be agreed upon by Contractor and Engineer in advance of initiating Demonstration Period.

8. Throughout the Demonstration Period, provide knowledgeable personnel to provide final field instruction on select systems, and to respond to any system problems or failures which may occur.

9. Provide all labor, supervision, utilities, chemicals, maintenance, equipment, vehicles or any other item necessary to operate and demonstrate all systems being demonstrated.

****END OF SECTION****

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SECTION 01750

TESTING, TRAINING, AND FACILITY START-UP

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Equipment and system testing and start-up, services of manufacturer's representatives, training of City personnel, and final testing requirements for the completed facility.

1.02 CONTRACT REQUIREMENTS

A. Testing, training, and start-up are requisite to the satisfactory completion of the Contract. Complete testing, training, and start-up within the Contract Time. Allow realistic time frame for testing, training, and start-up activities. Furnish labor, power, chemicals, tools, equipment, instruments, and services required for and incidental to completing functional testing, performance testing, and operational testing. Provide competent, experienced technical representatives of equipment manufacturers for assembly, installation and testing guidance, and operator training.

1.03 START-UP PLAN

A. Submit start-up plan for each piece of equipment and each system not less than three (3) weeks prior to planned initial equipment or system start-up.

1. Provide detailed information and schedule for the following activities:
    a. Manufacturer's services
    b. Installation certifications
    c. Operator and technician training
    d. Completion of Operation and Maintenance Manual
    e. Functional testing
    f. Performance testing
    g. Operational testing

B. Provide testing plan with test logs for each item of equipment and each system when specified. Include testing of alarms, control circuits, capacities, speeds, flows, pressures, vibrations, sound levels, and other parameters.

C. Provide summary of shutdown requirements for existing systems which are necessary to complete start-up of new equipment and systems.

D. Revise and update start-up plan based upon review comments, actual progress,

or to accommodate changes in the sequence of activities.

E. Provide two training sessions for the operators and technicians for each piece of equipment listed below. Each training sessions shall be 4 hours in length. Contractor shall provide training materials. Contractor shall provide a submittal on the training classes outlining the course materials, instructor's resume, and course agenda. Training shall be provided for the following equipment:

1. Switchgear
2. MCC
3. MOVs
4. Altitude Valve
5. Leibert Cabinet
6. Pressure transducers

1.04 PERFORMANCE TESTING

A. Test equipment for proper performance at point of manufacturer of assembly when specified.

B. When Source Quality Control Testing is Specified:

1. Demonstrate equipment meets specified performance requirements.
2. Provide certified copies of test results.
3. Do not ship equipment until certified copies have received written acceptance from Engineer. Written acceptance does not constitute final acceptance.

1.05 GENERAL START-UP AND TESTING PROCEDURES

A. Mechanical Systems:

1. Remove rust preventives and oils applied to protect equipment during construction.
2. ~~Flush lubrication systems and dispose of flushing oils. Recharge lubrication system with lubricant recommended by manufacturer.~~
3. ~~Flush fuel system and provide fuel for testing and start-up.~~
4. ~~Install and adjust packing, mechanical seals, O-rings, and other seals. Replace defective seals.~~
5. Remove temporary supports, bracing, or other foreign objects installed to prevent damage during shipment, storage, and erection.
6. Check rotating machinery for correct direction of rotation and for freedom of moving parts before connecting driver.
7. ~~Perform cold alignment and hot alignment to manufacturer's tolerances.~~
8. ~~Adjust v-belt tension and variable pitch sheaves.~~
9. Inspect hand and motorized valves for proper adjustment. Tighten

packing glands to insure no leakage, but permit valve stems to rotate without galling. Verify valve seats are positioned for proper flow direction.

10. Tighten leaking flanges or replace flange gasket. Inspect screwed joints for leakage.
11. ~~Install gratings, safety chains, handrails, shaft guards, and sidewalks prior to operational testing.~~

B. Electrical Systems: As specified in Division 16.

C. Instrumentation Systems: As specified in Division 17.

1.06 FUNCTIONAL TESTING

A. Functionally test mechanical and electrical equipment for proper operation after general start-up and testing tasks have been completed.

B. Verify compatibility of new equipment with existing: Demonstrate proper rotation, alignment, speed, flow, pressure, vibration, sound level, adjustments, and calibration.

C. Perform initial checks in the presence of and with the assistance of manufacturer's representative.

D. Demonstrate proper operation of each instrument loop function as specified in Division 17.

E. Unless otherwise approved by the Engineer, conduct continuous eight (8) hour test under full load conditions. Replace parts which operate improperly.

1.07 CERTIFICATION OF PROPER INSTALLATION

A. At completion of functional testing, furnish written report prepared and signed by manufacturer's authorized representative, certifying equipment:

1. Has been properly installed, adjusted, aligned, and lubricated.
2. Is free of any stresses imposed by connections or anchor bolts.
3. Is suitable for satisfactory full-time operation under full load conditions.
4. Operates within the allowable limits for vibration.
5. Controls, protective devices, instrumentation, and control panels are properly installed, calibrated, and functioning, as designed.
6. Control logic for start-up, shutdown, sequencing, interlocks, and emergency shutdown have been tested and are functioning, as designed.

B. Co-sign the reports along with the manufacturer's representative and subcontractor.

1.08 TRAINING OF OWNER'S PERSONNEL

A. Provide at least four (4) hours of training, at agreed upon times, to designated Owners personnel in operation, adjustment, and maintenance of products, mechanical, electrical, instrumentation equipment, and installed items. Utilize manufacturer's representatives to conduct training sessions.

B. Provide Operation and Maintenance Manual for specific pieces of equipment or systems two (2) weeks prior to training session for that piece of equipment or system.

C. Satisfactorily complete functional testing before training Owner's personnel.

D. Schedule training sessions during the hours of Tuesday – Thursday: 7 a.m. – 12 p.m.; and/or 1 p.m.-3:30 p.m.

1.09 OPERATIONAL TESTING

A. Conduct operational test of the entire facility after completion of operator training. Demonstrate satisfactory operation of equipment and systems in actual operation. Conduct operational test for continuous seven (7) day period.

B. Immediately correct defects in material, workmanship, or equipment which became evident during operational test.

C. Repeat operational test when malfunctions or deficiencies cause shutdown or partial operation of the facility or results in performance that is less than specified.

1.10 RECORD KEEPING

A. Maintain and submit following records generated during start-up and testing phase of project:

1. Daily logs of equipment testing identifying all tests conducted and outcome.
2. Logs of time spent by manufacturer's representatives performing services on the job site.
3. Equipment lubrication records.
4. Electrical and instrumentation test results as required in Divisions 16 and 17.

**** END OF SECTION ****

SECTION 01770

CONTRACT CLOSEOUT

PART 1 - GENERAL

1.01 DESCRIPTION

A. Requirements Included:

1. Close Out Procedures.
2. Final Cleaning.
3. Project Record Documents.
4. Systems Demonstration.

1.02 CLOSEOUT PROCEDURES

A. Contractor shall notify the Engineer when the project is completed after which City representatives will perform a walk through and develop a list of deficient work items.

B. Contractor shall then correct all noted deficiencies to the satisfaction of the Engineer after which City Operation and Maintenance representatives will perform a final walk through and submit to the Contractor a final list of deficient work items.

C. Contractor shall then correct all additional deficiencies to the satisfaction of the Engineer after which a completion report will be prepared by the Engineer.

1.03 FINAL CLEANING

A. Execute prior to final inspection.

B. Clean all interior and exterior surfaces; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces. Clean equipment and fixtures to a sanitary condition, clean or replace filters on mechanical equipment. Clean roofs, gutters, downspouts, and drainage systems of any debris. Vacuum inside switchgear.

C. Clean site; sweep paved areas, rake clean other surfaces.

D. Remove waste and surplus materials, rubbish, and construction facilities from the

Project and from the site.

1.04 PROJECT RECORD DOCUMENTS

A. Store documents separate from those used for construction.

B. Keep documents current; do not permanently conceal any work until required information has been reviewed and recorded.

C. At Contract closeout, submit documents with transmittal letter containing date, Project title, Contractor's name and address, list of documents, and signature of Contractor.

1.05 SYSTEMS DEMONSTRATION

A. Prior to final inspection, demonstrate operation of each system and the entire system to Engineer and City's maintenance staff and instruct City's personnel in operation, adjustment and maintenance of equipment and systems, using the operation and maintenance data as the basis of instruction in accordance with Section 01750.

1.06 SPARE PARTS AND MAINTENANCE MATERIALS

A. Provide products, spare parts, and maintenance materials in quantities specified in each section, in addition to that required for completion of Work including a full set of replacement fuses for all electrical equipment.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

A. Contractor shall complete all punch list items prior to completing the work identified in this section.

**** END OF SECTION ****

SECTION 01920

CONSTRUCTION SEQUENCE

PART 1 GENERAL

1.01 DESCRIPTION

A. This specification covers the construction sequence for this project. In addition, the Contractor shall provide all equipment and materials to provide power to the emergency lighting panel, PLC, cubit, and etc. during construction.

The City anticipates awarding this project to the contractor in January or February of 2020 with a Notice to Proceed date in February or March of 2020. The anticipated Notice to Proceed date is the actual construction start date.

The Contractor shall provide the switchgear, MCC, and mechanical submittals prior to April of 2020. It is anticipated that the contractor can provide all the electrical and mechanical submittals and order this equipment between March and April of 2020. The Contractor shall not be permitted to perform any major work without City approved switchgear, MCC, and mechanical submittals and firm ship dates.

The City will take the reservoir out of service starting on July 6, 2020 and place the reservoir back in service on October 30, 2020. The Contractor shall install all the new electrical and mechanical equipment between July 6 to October 16 of 2020. The Contractor can perform any testing of the equipment the week of October 18, 2020. Any problems with the new equipment can then be fixed the week of October 25, 2020. Therefore, the major construction period for this project is from July 6 to October 16 of 2020. The City will allow some minor construction activities between April 6, 2020 and July 2, 2020 but all work shall be approved by the City in writing.

The above dates are approximate and may change at the discretion of the City of Sacramento.

The City will obtain a temporary SMUD service during the construction period. This temporary power will be used to power the existing emergency lighting panel, wall mounted lighting panel, PLC/radios, and cubit. The emergency lighting panel supplies power to the warning lights on top of the reservoir and a fire department radio. The cubit provides power to a City server. The wall mounted lighting panel provides power to the facility lights and outlets. The contractor shall minimize power disruptions to the emergency lighting panel, PLC/radios, and cubit when these items are placed on the new switchgear. The contractor shall notify the Engineer before placing these items on the new switchgear.

The contractor shall install a temporary SMUD meter, main breaker, lighting panel transformer, and feeder breakers to feed the existing emergency lighting panel, PLC/radio, and cubit. The contractor shall then run wires and conduits to the emergency lighting panel, PLC/radios, and the cubit. All equipment shall be installed per NEC requirements.

The Contractor shall perform the mechanical work within 20 working days. When the Contractor removes the existing reservoir altitude valve they shall cover the exposed piping with plastic after each work day. The Contractor shall be responsible for dewatering the 36" reservoir riser pipe. This riser pipe is 100 feet in length. The City will isolate the reservoir from the City water distribution system. The Contractor shall disinfect and test the new piping per the contract documents. The disinfection of the new piping is made easier if the existing piping is covered during non-working hours.

1.02 SUBMITTALS

A. Provide a drawing showing how the contractor will supply power to the existing emergency lighting panel and cubit.

B. Provide cut sheets on all components of the subpanel, main breaker, feeder breakers, conduit, transformer, and conductors.

C. Provide a construction sequence schedule.

D. Provide a test and disinfection plan.

PART 2 PRODUCTS

A. See Section 3.02 below.

PART 3 EXECUTION

3.01 CITY RESPONSIBILITIES

A. The city will obtain temporary electrical power from SMUD using the existing SMUD pad mounted transformer. The Contractor will remove the conductors feeding the existing MCC from the transformer per SMUD requirements after the temporary service is operational.

B. The City will isolate the reservoir from the City water distribution system.

3.02 CONTRACTOR RESPONSIBILITIES

A. The Contractor shall provide a temporary SMUD meter and subpanel as outlined below. There is an existing 25KVA 480/240/120V transformer on site that the contractor can use for a lighting panel transformer.

The existing SMUD transformer supplies 3 phase 480 V power.

B. The Contractor shall disconnect the emergency lighting panel from the two-pole breaker that feds this panel from the existing MCC.

C. The Contractor shall relocate the emergency lighting panel above the existing gutter. The Contractor shall reconnect the existing loads and connect back to the ATS. The contractor may need to extend the existing conductors. The new emergency lighting panel will need to go in the same location as the existing.

D. The Contractor shall install a temporary SMUD meter with a 100A main breaker. Connect the SMUD meter mounting panel to the SMUD transformer. The contractor shall connect the meter-mounting & main breaker panel to a temporary transformer. In addition, the Contractor shall install an eight-foot ground rod and ground conductor for bonding the meter-mounting panel. The contractor shall meet the SMUD installation requirements for temporary utility power. The contractor shall connect the lighting panel transformer to a subpanel. The subpanel shall contain one 20A two pole 120/240V breaker for the emergency lighting panel and one 30A two pole 120/240 breaker for the wall mounted lighting panel. Connect the subpanel to the emergency lighting panel and the wall mounted lighting panel. The wall mounted lighting panel provides power to the receptacles and facility lights.

Locate the SMUD meter and ground rod outside. Locate the subpanel and transformer inside the reservoir.

E. The contractor shall install a conduit from the subpanel to the control room. This conduit shall feed power to the existing PLC and cubit. The Contractor shall power the existing PLC cabinet and ensure that the PLC and both radios are operational during construction. In addition, the Contractor shall power the outlet in the existing cubit.

F. The generator, ATS, PLC/radios, and emergency lighting panel shall remain operational during construction of this project. Provide minimal power outages between cutovers consisting of transfer electrical circuits between existing power and temporary meter panel and the secondary cutover of temporary power and new electrical equipment.

G. The contractor shall coordinate the installation of the conduit into the SMUD pad mounted transformer with SMUD. SMUD will make all connections at the transformer.

H. All work shall adhere to the latest NEC and SMUD requirements.

I. The contractor can contact the City for the existing loads.

END OF SECTION

SECTION 02643

WATER PIPELINE TESTING AND DISINFECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. The Contractor shall perform flushing, disinfection, and testing of the section of pipeline within the reservoir control room. This includes conveyance of test water from City's designated source to point of use and all disposal thereof, all in accordance with the requirements of the Contract Documents. Disinfection and testing of the water pipeline shall be in accordance with Section 27 of the CSSS.

1.2 REFERENCED SECTIONS

A. Commercial Standards:

1. ANSI/AWWA B300 – Hypochlorites
2. ANSI/AWWA B301 – Liquid Chlorine.
3. ANSI/AWWA C651 – Disinfecting Water Mains

1.3 SUBMITTALS

A. A testing schedule, including proposed plans for water conveyance, control, disposal, and disinfection shall be submitted in writing for approval a minimum of 48 hours before testing is to start.

PART 2 - PRODUCTS

2.1 MATERIALS REQUIREMENTS

A. All test equipment, chemicals for chlorination, temporary valves, backflow assemblies, bulkheads, or other water control equipment and materials shall be determined and furnished by the Contractor subject to the Engineer's review. No materials shall be used which would be injurious to the construction or its future function.

B. Chlorine for disinfection shall be in the form of liquid chlorine, sodium hypochlorite solution, or calcium hypochlorite granules or tablets.

C. Liquid chlorine shall be in accordance with the requirements of ANSI/AWWA B301. Liquid chlorine shall be used only in combination with appropriate gas flow chlorinators and ejectors; under the direct supervision of an experienced technician; and when appropriate safety practices are observed.

D. Sodium hypochlorite and calcium hypochlorite shall be in accordance with the requirements of ANSI/AWWA B300.

PART 3 - EXECUTION

3.1 GENERALS

A. Unless otherwise provided herein, water for testing and disinfecting water pipelines will be furnished by the City; however, the Contractor shall make all necessary provisions for conveying the water from the City-designated source to the point of use.

B. Disinfection shall be accomplished by chlorination. All chlorinating and testing operations shall be performed in the presence of the Engineer.

C. Disinfection operations shall be scheduled by the Contractor as late as possible during the contract time period so as to assure the maximum degree of sterility of the facilities at the time the work is accepted by the City. Bacteriological testing shall be performed by a certified testing laboratory approved by the City and at the expense of the Contractor. Results of the bacteriological testing shall be satisfactory with the State Department of Health or appropriate regulatory agency.

3.2 HYDROSTATIC TESTING OF PIPELINES

A. Contractor shall furnish all hoses, pumps, pressure gauges, leakage measuring devices, connections, relief valves, temporary pressure heads, other necessary apparatus, and personnel required for hydrostatic pressure and leakage testing.

B. Prior to the hydrostatic testing, all pipelines shall be flushed or blown out as appropriate. The Contractor shall test all pipelines either in sections or as a unit. The test shall be made by closing valves when available, or by placing temporary bulkheads in the pipe and filling the line slowly with water. The Contractor shall be responsible for ascertaining that all test bulkheads are suitably restrained to resist the thrust of the test pressure without damage to, or movement of, the adjacent pipe. Any unharnessed sleeve-type couplings, expansion joints, or other sliding joints shall be restrained or suitably anchored prior to the test, to avoid movement and damage to piping and equipment.

C. The Contractor shall provide sufficient temporary air tappings in the pipelines to allow for evacuation of all entrapped air in each pipe segment to be tested. After completion of the tests, such taps shall be permanently plugged. Care shall be taken to see that all air vents are open during filling.

D. The pipeline shall be filled at a rate which will not cause any surges or exceed the rate at which the air can be released through the air valves at a reasonable velocity and all the air within the pipeline shall be properly purged. After the pipeline or section thereof has been filled, it shall be allowed to stand under a slight pressure for at least 24 hours to allow the concrete or mortar lining, as applicable, to absorb what water it will and to allow the escape of air from any air pockets. During this period, bulkheads, valves, and connections shall be examined for leaks. If leaks are found, corrective measures satisfactory to the Engineer shall be taken.

E. The hydrostatic test shall consist of holding the test pressure on the pipeline for a period of 2 hours at 150 psig measured at the lowest point of the pipeline section being tested. No pressure test will be required for a reservoir overflow line. All visible leaks shall be repaired in a manner acceptable to the Engineer.

1. Each test section shall not exceed the maximum allowable leakage as determined using the following formula. Leakage exceeding this amount shall be cause for rejection.

L = SDT/12,500

Where:
L = The minimum acceptable leakage in gallons S = The length of the test section in feet
D = The diameter of the pipe in inches T = The test time period in hours

F. In the case of pipelines that fail to pass the prescribed leakage test, the Contractor shall determine the cause of the leakage, shall take corrective measures necessary to repair the leaks, and shall again test the pipelines.

3.3 DISINFECTING PIPELINES

A. General: The water pipeline in the control room except those appurtenant to hydraulic structures shall be disinfected in accordance with the requirements of ANSI/AWWA C651 using the Continuous-Feed Method as modified herein.

B. Chlorination: A chlorine-water mixture shall be uniformly introduced into the pipeline by means of a solution-feed chlorinating device. The chlorine solution shall be introduced at one end of the pipeline through a tap in such a manner that as the pipeline is filled with water, the dosage applied to the water entering the pipe shall be approximately 50 mg/l. Care shall be taken to prevent the strong chlorine solution in the line being disinfected from flowing back into the line supplying the water.

C. Retention Period: Chlorinated water shall be retained in the pipeline long enough to destroy all non-spore-forming bacteria. This period shall be at least 24 hours. After the chlorine-treated water has been retained for the required time, the free chlorine residual at the pipeline extremities and at other representative points shall be at least 10 mg/l.

D. Chlorinating Valves: During the process of chlorinating the pipelines, all valves and other appurtenances shall be operated while the pipeline is filled with the heavily-chlorinated water.

E. Final Flushing: After the applicable retention period, the heavily chlorinated water shall be flushed from the pipeline until chlorine measurements show that the concentration in the water leaving the pipeline is no higher than that generally prevailing in the system or is acceptable for domestic use.

F. Bacteriological Testing: After final flushing and before the pipeline is placed in service, a sample, or samples shall be collected from the end of the line, and shall be tested for bacteriological quality in accordance with the requirements of the State Department of Health or other appropriate regulatory agency. For this purpose the pipe shall be re-filled with fresh potable water and left for a period of 24 hours before any sample is collected. Should the initial disinfection treatment fail to produce satisfactory bacteriological test results, the disinfection procedure shall be repeated until acceptable results are obtained.

G. After disinfection of the system and prior to coliform bacteria and turbidity testing, chlorinated water shall be disposed of such that water does not flood, inundate or damage property. Contractor shall dechlorinate the water by use of apparatus that injects or mixes EPA approved chemicals with the water to neutralize the chlorine before it is released to the ground, streams, or storm sewer systems. Residual chlorine levels shall be reduced and maintained to a maximum of one hundredth of a milligram per liter (0.01 mg/l). Contractor shall test the discharge at fifteen minute (15) intervals to insure that acceptable levels of neutralization are maintained. Discharge shall be stopped if chlorine levels exceed one hundredth of a milligram per liter (0.01 mg/l). All procedures shall be in accordance with manufacturer's recommendations and as approved by the Engineer.

3.4 CONNECTIONS TO EXISTING SYSTEM

A. Where connections are to be made to an existing potable water system, the interior surfaces of all pipe and fittings used in making the connections shall be swabbed or sprayed with a one percent hypochlorite solution before they are installed. Thorough flushing shall be started as soon as the connection is completed and shall be continued until discolored water is eliminated.

END OF SECTION

SECTION 13448

INTELLIGENT MOTORIZED ACTUATORS

PART 1 GENERAL

1.1 SUMMARY

A. The contractor shall remove and replace MOV 1, MOV 2, MOV 3, and MOV4 as shown on the plans. The main supply voltage to each MOV shall be 120 VAC as shown on the plans. Provide the MOV contacts as shown on the drawings. The valve sizes are shown on the plan sheets for reference.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

1.2 REFERENCES

A. American Water Works Association (AWWA):
   1. C504 - AWWA Standard for Rubber-Seated Butterfly Valves.
   2. C540 - AWWA Standard for Power-Actuating Devices for Valves and Slide Gates.

B. National Electrical Manufacturers Association (NEMA):
   1. NEMA 250 - Enclosures for Electrical Equipment (1,000 V Maximum).

1.3 DEFINITIONS:

A. NEMA:
   1. Type 4X enclosure in accordance with NEMA 250.

1.4 SUBMITTALS

A. Product data:
   1. Electrical ratings:
      a. Voltage and number of phases.
      b. Starting and running current.

c. Voltage levels and source for control and status.

2. Description of integral control interface.
3. Remote control station components.
4. Environmental ratings, including NEMA enclosure rating and submergence capabilities.
5. Gear ratios for both manual and motorized actuation.
6. Opening and closing directions.
7. Allowable starts per hour.
8. List of all included options and accessories.
9. Full travel times.
10. Gearbox data including gear ratio, and gearbox efficiency.
11. Affidavit in accordance with AWWA C540.

B. Shop drawings:
   1. Wiring diagrams:
      a. Include all options and expansion cards furnished with each actuator.
   2. Dimensioned drawings of each valve and actuator combination.
   3. Dimensioned drawings of each valve gearbox.
   4. Electric motor data.

C. Calculations: Submit the following for each valve/gate size and class:
   1. Operating torque calculations.
   2. Maximum torque calculations for seating and unseating.
   3. Maximum operating torque at starting and normal operation.

D. Test reports:
   1. Factory test report and certificate.

E. Manufacturer's instructions:
   1. Include manufacturer's instructions, description of system operation, start-up data and troubleshooting checklists.

F. Operations and maintenance data:
   1. Include manufacturer's literature; cleaning procedures, replacement part lists, wiring diagrams, and repair data.
   2. Include a list of all configurable parameters, and the final values for each.
   3. List of recommended spare parts.
   4. List of special tools necessary for proper operation and/or maintenance.
   5. Exploded view drawings that illustrate all assemblies, sub-assemblies, and components.
   6. Routine test procedures for all electronic and electrical

circuits.
7. Troubleshooting chart covering the complete valve and controls/electrical power systems, showing description of trouble, probable cause, and suggested remedy.
8. Certified factory and field-test results.

1.5 QUALITY ASSURANCE

A. Obtain required information from the valve/gate supplier, including but not limited to:
   1. Interface to gate or valve.
   2. Operating range:
      a. Quarter turn or multi-turn.
      b. Required turns for full travel on multi-turn applications.
   3. Direction of rotation for opening and closing.
   4. Maximum and normal torque requirements.
   ~~5. Additional sizing requirements indicated in the following Specifications:~~
      ~~a. Section 11294B - Heavy Duty Fabricated Stainless Steel Slide Gates.~~
      ~~b. Section 15111 - Ball Valves.~~
      ~~c. Section 15112 - Butterfly Valves.~~
      ~~d. Section 15115 - Gate, Globe, and Angle Valves.~~
      ~~e. Section 15116 - Plug Valves.~~

B. All motorized, intelligent actuators shall be the product of a single manufacturer for all valve and gate applications on this project, regardless of gate or valve type, manufacturer, or supplier.

1.6 SPARE PARTS

A. Provide the following spare parts:

   1. Stem nut.
   2. Worm shaft subassembly.
   3. Drive sleeve subassembly.
   4. Complete actuator seal kit.
   5. Actuator gearbox oil or grease (sufficient quantity to fill 4 gearboxes).
   6. Encoder.
   7. Electronics module.

B. Provide 1 spare motor for each size motor furnished.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Rotork Controls, Inc.:
Rotork Model IQT2000 Intelligent Electric Actuator
B. Auma Actuators SA with AC.2 Controls.
C. Approved equal.

2.2 CHARACTERISTICS

A. Provide actuators complete and operable with all components and accessories required for operation.

B. Power supply:
1. Voltage and phases as indicated on the plans.
2. Valve or gate motion independent of power supply phase rotation.
3. Provide an internal backup power source to maintain actuator LCD and remote contacts when main power is off. Backup power source shall not be required for the actuator to track position.

C. Size actuator to move the valves from full open to closed position:
1. As a minimum, size the actuator to move gates or valves at minimum 12 inches per minute under maximum load. Measure rate of closure for valves at maximum diameter of disc, plug, or ball.
2. **Each actuator shall open and close the valves as shown on the plans. The sizes of the valves are shown on the plan sheets. Each actuator shall also bolt up to each valve without modifications. The contractor shall contact the manufacturer to obtain the proper model number for submittal purposes.**

D. Control interface:
1. Configuration:
a. Provide a non-intrusive, non-contacting interface for configuring all input and output settings, control values, ranges, torque switch settings, valve position sensor settings, and options.
1) Configurable from a hand-held configuring tool or input devices on the actuator.
2. Local interface, integral to actuator:
a. Non-intrusive, non-contacting selector switches:
1) LOCAL-STOP-REMOTE:
a) Motor actuator operation is prevented with the switch in STOP.
2) OPEN-CLOSE:

a) Controls the valve when LOCAL-STOP-REMOTE is in LOCAL.
b) Spring return to center.
c) Configurable between maintained (actuator runs until end of travel, high torque, or a LOCAL-STOP-REMOTE is switched to STOP) and momentary (actuator stops when lever is released).

b. Local display:
1) Valve fully open and fully closed indicators.
2) Numerical display showing actual valve or gate position in percent of travel.

~~3. Remote control station - (VCP).~~
~~a. Provide remote control stations for actuators where indicated on the Drawings.~~
1) NEMA rating as listed below.
a) Use NEMA Type 4X enclosures for this applicaiton.
2) LOCAL-STOP-REMOTE selector switch.
3) LOCAL mode control devices:
a) Operate valve when LOCAL-STOP-REMOTE integral to actuator is in REMOTE and LOCAL-STOP-REMOTE on remote control station is in LOCAL.
b) OPEN-STOP-CLOSE maintained switch or OPEN, STOP and CLOSE pushbuttons where Maintained operation is indicated.
c) OPEN-CLOSE spring-return switch or OPEN and CLOSE pushbuttons where maintained operation is indicated.
4) Pilots lights to indicate valve position:
a) Fully open.
b) Fully closed.
5) LCD Display
a) Indicate all diagnostic and operational data along with numerical display showing actual valve or gate position in percent of travel.
b) Include interface for portable configurable device to download diagnostic and operational data and configuration settings.
c) LCD display shall be WT-IP68 rated.

4. Control inputs:
a. Capable of using 120 VAC or 24 VDC inputs.
b. Controls the valve when LOCAL-STOP-REMOTE is in REMOTE.
c. Isolated inputs capable of operating from external control voltage source or internal power supply:
1) Furnish 120 VAC and 24 VDC control power supplies

within the actuator.

d. Provide the following inputs:
   1) OPEN.
   2) CLOSE.
   3) STOP.

e. OPEN and CLOSE inputs configurable between maintained (actuator runs until end of travel, high torque, or a STOP input) and momentary (actuator stops when command is removed)

5. Status outputs:
   a. Monitor relay output: Dry contact, normally closed, opens when actuator is not in REMOTE or in the event of any internal fault or alarm condition.
   b. Dry contact outputs configured for the functions indicated on the Drawings. Provide the following outputs for all actuators:
      1) Fully closed.
      2) Fully open.
      3) LOCAL-STOP-REMOTE in REMOTE position.
   c. Capable of being configured for the following additional functions:
      1) Communications failure.
      2) High motor temperature.
      3) Valve opening or closing.
      4) Valve moving (continuous or pulsing).
      5) Motor tripped on torque in mid-travel.
      6) Motor stalled.
      7) Actuator being operated by hand wheel.
      8) Open or close interlock active.
      9) ESD active.
      10) Motor tripped on torque in mid-travel.
      11) Motor tripped on torque going open.
      12) Motor tripped on torque going closed.
      13) Pre-set torque exceeded.
      14) Valve jammed.
      15) Lost main power phase.
      16) Control supply lost.
      17) Battery low (if required to retain settings).
      18) Internal failure detected.
   d. All output contacts rated for 5 amps, 120 VAC and 24 VDC.
6. Analog input:
   a. Provide a 4-20 milliampere analog input for analog modulating valves when indicated on the Drawings.
   b. Modulate valve to maintain position based on analog input value.
   c. Maximum input impedance 250 ohms.
7. Analog output:

a. Provide an isolated 4-20 milliampere analog output when indicated on the Drawings.
   1) Loop power sourced from the actuator power supply.
   2) Capable of driving into a load up to 500 ohms.
   3) Output proportional to valve or gate position.
   4) Output for remote torque indication.

8. Network communications:
   a. Actuators shall include dual channel modules for redundant communication networks. Dual channels shall be isolated from one another.
   b. Communications and control between the actuator and plant's control system shall utilize the following protocol:
      1) Modbus RTU (RS-485).
   c. Provide control and feedback features as required per Control Strategies and Contract Drawings.

E. Declutching Handwheel:
   a. Provide a declutching handwheel override.

F. Relays
   a. Provide four programmable relays.
   b. Provide four extra indication contacts S5, S6, S7, and S8.

G. Torque Sensor
   a. Provide an adjustable torque sensor.

2.3 FEATURES

A. Time delay on reversal: Incorporate time delay between stopping actuator and starting in opposite direction to limit excessive current, torque, and heating from instantaneous reversal.

B. Data logging:
   1. Store diagnostic data and reference data.
      a. Time-stamped historical operating data, including number of operations and most recent operations.
      b. Torque profiles showing actual torque at each valve position through the operating range.
         1) Store reference data (recorded during commissioning) and data from last operation.
   2. Provide display of logged data on the actuator, or provisions to download to a personal computer.

2.4 MATERIALS

A. Construct motorized actuators of materials suitable for the environment in which the valve or gate is to be installed.

2.5 COMPONENTS

A. Motors:
   1. Specifically designed for valve actuator service with high starting torque, totally enclosed non-ventilated construction.
   2. Torque ratings equal to or greater than that required for valve seating and dynamic torques with a 25 percent factor of safety.
      a. Design requirements for rubber-seated AWWA butterfly valves:
         1) Design actuators for maximum gate or valve operating torque, in accordance with and using safety factors required in AWWA C504 and AWWA C540.
            a) Valve actuator torque requirement for open-close service: Not less than the required valve-seating and dynamic torques under design operating conditions in accordance with AWWA C504.
            b) Valve actuator torque requirement for modulating service: Not less than twice the required valve dynamic torque under design operating conditions in accordance with AWWA C504.
      b. Design requirements for slide gates, plug valves, gate valves, knife gate valves, globe valves, and diaphragm valves:
         1) Design valves and actuators for maximum operating torque, in accordance with and using safety factors required in AWWA C540.
         2) Design for the maximum torque and thrust running load over the full cycle.
         3) Maximum torque or thrust rating: The actuator stall torque or maximum thrust output shall not exceed the torque or thrust capability of the valve or gate, as determined by the valve or gate manufacturer.
   3. Capable of being removed and replaced without draining the actuator gear case.
   4. Motor bearings shall be amply proportioned of the anti-friction type and permanently lubricated.
   5. Rated for operating under the following conditions without exceeding temperature limits with ambient temperature of 40 degrees Celsius.
      a. Continuous operation for 15 minutes or twice the open-to-close operating time (whichever is greater) at normal operating torque or 33 percent of maximum torque (whichever is greater).
      b. 60 starts per hour for open/close service or 1,200 starts per hour for modulating service.

6. Provide the following motor protection features:
   a. Jammed valve (no valve motion detected through a time delay).
   b. High motor temperature (sensed by an embedded thermostats).
   c. High torque.
   d. Single phasing protection.

B. Enclosures:
   1. Stainless steel external fasteners.
   2. Provide 'O' ring seals for each of the following areas:
      a. Between the terminal compartment and the internal electrical elements
      b. Between the mechanical and electrical portions to protect from the ingress of oil, and to protect the mechanical components of oil from dust and moisture when the electrical terminal is open.
   3. Provide the following minimum enclosure ratings:
      a. NEMA Type 4X enclosure for general applications.

C. Position sensing:
   1. Electronic and adjustable using a solid-state encoder wheel.
      a. Mechanical limit switches and potentiometers are not acceptable.
   2. Capable of retaining position and monitoring valve or gate motion when valve is manually actuated and when main power is not present.
   3. Valve range and position switch outputs field adjustable.

D. Torque sensing:
   1. Torque shutdown setting: 40 percent to 100 percent rated torque.
      a. Adjustable in 1 percent increments.
   2. Torque display: 0 to 100 percent-rated torque.
   3. Capable of interrupting control circuit during both opening and closing and when valve torque overload occurs.
   4. Electrical or electronic torque sensing:
      a. Extrapolating torque from mechanically measured motor speed is not acceptable due to response time.
   5. Independent of variations in frequency, voltage, or temperature.
   6. The actuator shall store actual operational torque curves for retrieval by plant maintenance staff.
   7. Provide a temporary inhibit of the torque sensing system during unseating or during starting in mid-travel against high inertia loads.
   8. Provide visible verification of torque switch status without any housing disassembly.
   9. Terminals for remote torque indication.

E. Manual actuators:
   1. Hand wheel for manual operation.
      a. Maximum 80 pound pull on rim when operating gate or valve under maximum load.
      b. Provide pull chain when motorized actuator is located more than 6 feet above floor surface.
         1) Chain shall be of sufficient length to reach approximately 4 feet above the operating level.
         2) Where the chain obstructs an aisle or walkway, provide holdback or other means to ensure chain does not create a nuisance or hazard to operating personnel.
   2. Declutch lever: Padlockable, capable of mechanically disengaging motor and related gearing and freeing hand wheel for manual operation.

F. Gearing: Hardened alloy steel spur or helical gears and self-locking, alloy bronze worm gear set.
   1. Accurately cut to assure minimum backlash.
   2. Quarter Turn Valves 10 Inches and Larger shall have a separate worm gear drive with a splined adapter nut for ease of installation, orientation flexibility, and capable of locking the valve in place and manually operating the valve if the motor operator is ever removed for service.

G. Bearings:
   1. Anti-friction bearing with caged balls or rollers throughout.
   2. Sealed-for-life type thrust bearings housed in a separate thrust base.

H. Drive bushing:
   1. Easily detachable for machining to suit the valve stem or gearbox input shaft.
   2. Positioned in a detachable base of the actuator.

I. Lubrication:
   1. Provide totally enclosed actuator gearing with oil or grease filled gear case suitable for operation at any angle.
   2. Suitable for standard SAE80EP gear oil.
   3. Actuators requiring special or exotic lubricants are not acceptable.

2.6 ACCESSORIES

A. Software:
   1. Furnish PC-based diagnostic and configuration software to display diagnostic data and configure actuators.
   2. Provide software communications to the valve actuator and hand-held setting tool using Bluetooth wireless or IrDA infrared communications.
      a. Provide all accessories and drivers required for operation and communications with a standard personal computer running Microsoft Windows 7.
      b. Where infrared communications are used, furnish an IrDA to USB adapter with a mounting device to secure the infrared element to the valve actuator IrDA port:
         1) Provide with a minimum cable length of 3 feet, capable of being extended with a standard USB extension cable.

B. Setting tool:
   1. If required for setting or configuring the actuator, provide a hand-held IR remote setting tool. Provide a hand-held setting tool capable of non-intrusive calibration and interrogation of the actuator.
      a. Furnish 1 setting tool for every 10 actuators.
      b. Capable of communicating with PC-based configuration software, and transferring the following in either direction between the computer and programmer and setting tool, and between the setting tool and actuator:
      c. Actuator configurations.
         1) Capable of storing up to 10 different configurations.
      d. Diagnostic data.
         1) Capable of storing 4 complete sets of diagnostic data.

2.7 SOURCE QUALITY CONTROL

A. Factory test:
   1. Test each actuator in the factory and submit an individual test certificate for each actuator.
   2. Perform a high potential test and record the following information:
      a. Test voltage.
   3. Simulate a maximum and typical valve loads and record the following information:
      a. Current and power factor at maximum and set torque values.
      b. Torque as measured by the actuator.
      c. Actuator output speed or operating time.
   4. Performance testing: Conduct performance test for each actuator simulating valve operating torque from full-open to full-close and from full-close to full- open. The following information shall be

recorded during each performance test:

a. Torque at maximum torque setting.
b. Current at maximum torque setting.
c. Test voltage and frequency.
d. Actuator output speed and operating time for full-open to full-close.
e. Amperage draw on motors at breakaway and under normal operation.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install actuators in accordance with manufacturer's instructions.

3.2 FIELD ADJUSTMENTS

A. Field representatives of manufacturers of valves or gates with intelligent actuators shall adjust actuator controls and limits switches in the field for the required function.
B. Actuator manufacturer shall commission and configure the MOV to the settings on the drawings and program all relays.
C. Actuator manufacturer shall provide the Engineer with an electronic copy of the configuration files.

3.3 TRAINING

A. The actuator manufacturer shall provide two training sessions of 4 hours each as specified in Section 01750.

END OF SECTION

SECTION 15050

PIPING SYSTEMS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Work necessary to furnish, install, and test the piping system shown on the drawings and as specified herein.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section:

~~1.~~ Section 01330 – Submittals

~~2.~~ Section 02643 – Water Pipeline Testing and Disinfection

1.03 SUBMITTALS

A. Submittals shall demonstrate full compliance with all aspects of this specification, and shall include, but not be limited to, complete manufacturers' data on all pipe material, fittings, and coatings. Submittals shall be provided in accordance with Section 01330 and shall include the following information:

B. Shop Fabricated Piping

~~1.~~ Detailed pipe fabrication drawings showing special fittings and bends, dimensions, coatings, and other pertinent information.

~~2.~~ Layout drawing showing location of each pipe section and each special length; number or otherwise designate laying sequence on each piece.

~~3.~~ Pipe Wall Thickness: Identify wall thickness and rational method or standard applied to determine wall thickness for each size of each different service including exposed, submerged, buried, and concrete-encased installations for Contractor-designed piping.

4. Hydraulic Thrust Restraint for Restrained Joints: Details including materials, sizes, assembly ratings, and pipe attachment methods.

5. Thrust Blocks: Concrete quantity, bearing area on pipe, and fitting joint locations.

6. Dissimilar Buried Pipe Joints: Joint types and assembly drawings.

7. Anchor Bolt Calculations: Calculations and shop drawings shall be submitted with the pipe support submittal in accordance with Section 05501 for all anchorage details. All calculations shall be prepared and signed by a civil or structural engineer currently registered in the State of California.

C. Contractor's steel pipe submittal shall be completed and submitted to the Engineer within 30 working days from Notice to Proceed.

D. Equipment and Piping Coordination and Installation Drawings

1. The Drawings show only the general arrangements of the project equipment, piping and appurtenances. Contractor shall prepare and submit coordination and installation drawings that show the specific locations and dimensions of equipment, piping, valves, appurtenances, and related items, based upon dimensions for the actual concrete tank layout and equipment to be furnished from the accepted shop drawings.

2. Drawing Requirements

   a. Drawings shall be prepared with AutoCAD software on a PC compatible hardware platform using Microsoft Windows operating system. The drawing files shall be submitted with each piping system print. The drawing files shall be submitted on rewritable CDROM disks.

   b. The drawings shall be printed at a minimum scale of 3/8" = 1', on a minimum sheet size of 11" x 17". Piping shall be shown in plan and section views, or alternatively, as isometric piping spool drawings.

   c. Piping of nominal size less than 8" may be single line with scaled lay lengths and fittings. Piping of size 8" and greater shall be double line with scaled flanges, lay lengths, and fittings. Each pipe run shall be dimensioned.

   d. All pipe supports, ~~thrust restraints, and seismic bracing~~ shall be shown. All devices shown on the mechanical layout and schematic drawings and the P&ID drawings shall be shown.

3. During preparation of the drawings, Contractor shall provide interface and coordination between the pipe drawings and all equipment suppliers and subcontractors, and, including as a minimum, the structural, architectural, mechanical, electrical, and instrumentation and control elements of the work.

4. Submittals shall include load and sizing calculations for pipe supports, ~~thrust restraints, seismic bracing~~ and related items which have been prepared, stamped, and signed by a professional civil, mechanical, or structural engineer licensed by the State of California.

5. Submittal and review of the coordination and installation drawings shall be completed at least 30 days prior to commencement of piping fabrication for each system.

1.04 REFERENCE STANDARDS

A. The standards listed below are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800
ASTM A312	Seamless and Welded Austenitic Stainless Steel Pipes
ASTM D1784	Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

Reference	Title
ASTM D1785	Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120
ASTM D2241	Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)
ASTM D2564	Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings
AWWA C104	Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water
AWWA C105	Polyethylene Encasement for Ductile Iron Piping
AWWA C111	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
AWWA C115	Flanged Ductile-Iron and Gray-Iron Pipe with Threaded Flanges
AWWA C151	Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
AWWA C200	Steel Water Pipe 6-Inches and Larger
AWWA C205	Cement-Mortar Protective Lining and Coating for Steel Water Pipe
AWWA C208	Dimensions for Fabricated Steel Water Pipe Fittings

1.05 DESIGN REQUIREMENTS

A. Design piping systems in accordance with the following:

~~B. Buried Piping: H20-S16 traffic load with 1.5 impact factor, AASHTO Standard Specifications for Highway Bridges, as applicable.~~

~~C. Thrust Restraints:~~

D. Design for 150 psi test pressure.

E. Allowable Soil Pressure: 2,500 pounds per square foot.

F. Anchor bolts for pipe supports shall be designed in accordance with the CBC for Seismic Design Category D and Site Class D. This force shall be considered acting at the center of gravity of the piece under consideration.

PART 2 - MATERIALS

2.01 GENERAL

A. Pipe sizes are nominal inside diameter unless otherwise noted. All sizes of pipe shall be as called out on the Drawings and specified herein. All pipe and fittings delivered to the job site shall be clearly marked to identify the material, class, thickness, and manufacturer. All material shall be new and free of blemishes.

B. Where only one type of pipe is called out, no substitutions shall be allowed. Piping materials of like kind shall be the product of one manufacturer. All pipe shall be the regular product of a firm which has successfully manufactured comparable pipe for at least three (3) years. Pipe shall be accordance with Section 27 of the Standard Specifications. Appurtenances shall be accordance with Section 10 of the Standard Specifications

C. The Contractor is responsible for furnishing and installing all items necessary to make a complete and workable piping system. This includes, but is not limited to, valve boxes, insulating couplings and gaskets, piping specialties, and all other items required by the nature of the installation. Any item not specified herein but required by the installation shall be of first quality, equal in grade to similar

materials specified herein, and shall comply with all applicable reference standards listed herein.

D. **All new piping shall be epoxy coated on the interior and exterior per AWWA C210-15. Engineer shall pick the color. Epoxy coating shall be NSF 61 approved.**

~~2.02 PIPE IDENTIFICATION SCHEDULE~~

~~A. Piping materials are identified by a "Type" designation in these specifications. Specific piping materials, testing requirements and other pertinent information is summarized for each pipe type. Pipelines are designated on the Drawings by a two-element code, the first representing the nominal pipe diameter and the second an abbreviation indicating the piping system. The following schedules, except where indicated otherwise on the Drawings, identify pipe type to be used for each piping system. Where the pipe type is not specifically identified on the Drawings, materials shall be selected based on the pipe service as listed in the following schedule unless otherwise noted all materials are as specified in subsequent articles of this specification.~~

~~Abbr.~~	~~Service~~	~~Pipe Type~~
~~CL~~	~~Chlorine Solution~~	~~Rigid: Pipe Type C – Schedule 80 Polyvinyl Chloride Pressure Pipe~~ ~~Flexible: Reinforced clear PVC flexible tubing with polyester braid~~
~~DD~~	~~Door Drain~~	~~Pipe Type C – Schedule 80 Polyvinyl Chloride Pressure Pipe~~
~~D~~	~~Drain~~	~~Below floor slabs: Type D-3 – Cast Iron~~ ~~Under Tank: Pipe Type B – Steel Pipe.~~ ~~Outside Tank and Building: 4 to 10 inch: Pipe Type D-2 –Polyvinyl Chloride Pipe~~ ~~3 inch and smaller: Pipe Type C –Polyvinyl Chloride Pipe~~
~~IRR~~	~~Irrigation~~	~~Polyvinyl Chloride Pressure Pipe and Fittings per Irrigation Specifications~~
~~OF~~	~~Overflow~~	~~Pipe Type B – Steel Pipe~~
~~PD~~	~~Pump Discharge~~	~~Pipe Type B - Schedule 40 Polyvinyl Chloride Pressure Pipe~~
~~PFD~~	~~Perforated Drain~~	~~Schedule 80 Polyvinyl Chloride Pipe per Section 02215~~
~~PS~~	~~Pressure Sensing~~	~~Pipe Type H – Stainless Steel and Schedule 80 Polyvinyl Chloride Pressure Pipe~~
~~SD~~	~~Storm Drain~~	~~12 inch and larger: Pipe Type D-1 – Reinforced Concrete Pipe~~ ~~4 to 10 inch: Pipe Type D-2 – Polyvinyl Chloride Pipe~~
~~SL~~	~~Sample Line~~	~~Pipe Type H – Stainless Steel Exposed and Schedule 80 Polyvinyl Chloride Pressure Pipe Buried~~
~~SS~~	~~Sewer~~	~~10 inch and smaller: Pipe Type D-2 –Polyvinyl Chloride Pipe~~
~~W~~	~~Potable Water~~	~~3 inch and smaller (inside building): Pipe Type G – Copper Pipe~~ ~~3 inch and smaller (outside building): Pipe Type C – Schedule 80 Polyvinyl Chloride Pressure Pipe~~ ~~Larger than 3 inch: Pipe Type A–Ductile Iron Pipe between the Pump Station and the City Water Main as shown.~~ ~~All other pipe associated with the pump station and tank shall be Type B–Steel Pipe~~

2.03 PIPE TYPE A – CEMENT LINED DUCTILE IRON PIPE

A. Pipe

1. Ductile iron pipe shall be centrifugally cast from Grade 60-42-10 ductile iron and shall comply in all respects with AWWA C151 (ANSI A21.51).

2. Flanged pipe shall be Class 53 minimum. All other pipe shall be Pressure Class 350 minimum.

B. Fittings

1. Fittings shall be Class 350. Flange joint fittings shall be Class 250. All fittings shall be ductile iron shall be manufactured in accordance with AWWA C110 (ANSI A21.10). Where taps are shown on fittings, tapping bosses shall be used.

C. Joints

1. Pipe Type A-1, Exposed Pipe

a. All joints on ductile iron pipe installed above ground shall be flanged or plain end joints as shown. Flanges shall be in accordance with AWWA C115 (ANSI A21.15) and AWWA C110 (ANSI A21.10), and faced and drilled to 125 lb ANSI B16.1 standards.

2. Pipe Type A-2, Buried Pipe

a. All joints on ductile iron pipe installed below ground shall be restrained push-on joints. Restrained joints shall be provided and shall be rated for a water working pressure of not less than 350 psi with a minimum of 2:1 safety factor. Restrained joints shall be provided by a welded-on retainer ring.

b. Welded-On Retainer Ring: Type Single gasket push-on type joint meeting applicable requirements of ANSI/AWWA C111/A21.11, with restraint provided by a welded-on retainer ring. Joints shall be U.S. Pipe TR Flex, American Lok-Ring, Griffin Snap-Lock, or equal.

D. Lining and Coating

1. All ductile iron pipe shall have a standard cement mortar lining seal coated with asphaltic material in accordance with AWWA C104 (ANSI A21.4). Exterior of buried pipe shall be coated with standard bituminous coating. Exterior of exposed pipe shall be painted in accordance with Section 09900 Coating Systems.

E. Polyethylene Encasement

1. The surfaces of all buried ductile iron pipe and fittings shall be encased with two sheets of 8-mil minimum thickness polyethylene to form a continuous and all-encompassing layer of polyethylene between the piping and surrounding earth or backfill material. Polyethylene material shall conform to the requirements of ANSI/AWWA C105/A21.5. Material shall be 8 mil, linear low density polyethylene (LLDPE) and shall be marked at two foot intervals with manufacturer's name, year of manufacture, AWWA C105, film thickness and material, pipe size, and repair warning. All polyethylene shall be secured in place with 10-mil polyvinyl tape.

~~Installation shall conform to requirements of ANSI/AWWA C105/A21.5, Method A. Excess slack width in the polyethylene tube shall be taken up to make a snug, but not a tight fit, and secured with an adhesive tape wrapping around the pipe at the quarter points of each pipe length. Any rips, punctures or other damage to the polyethylene sleeve shall be repaired with adhesive tape or a short length of polyethylene tube cut open, wrapped around the pipe and secured in place.~~

~~F. Bolts, Nuts, Washers, and Gaskets~~

~~1. Bolts and nuts for flanges and fittings shall be high strength low alloy carbon steel hex bolts, as specified in AWWA C115 and C606.~~

~~2. Gaskets for flanged joints shall be 1/16 in. thick (1/8 in. thick for pipes 12 in. and larger), rubber conforming to applicable parts of ANSI B16.12 and AWWA C115 and C207. Gasket material shall be free from corrosive alkali or acid ingredients and suitable for use in potable water lines. Gaskets shall be one piece with holes to pass bolts.~~

~~3. Gaskets for push-on joints shall be SBR, conforming to AWWA C111. Lubricant for push-on joint piping shall be the pipe manufacturer's standard.~~

2.04 PIPE TYPE B – STEEL PIPE

A. Pipe

1. Steel pipe shall be spiral or straight seam manufactured and furnished in accordance with AWWA C200. All materials, fabrication and shop testing of steel pipe and steel pipe fabrications shall conform to the requirements of ANSI/AWWA C200. All dimensions shall conform to ANSI/AWWA C208. The minimum thickness of plate for pipe from which fabrications are made shall be ¼-inch. Steel for AWWA C200 pipe shall conform to the requirements of ASTM A36; ASTM A572, Grade 42; ASTM A570, Grades 33 and 36; or ASTM A283, Grade D. For pipe size 3-inches and smaller refer to Section 15050-2.06.C.

2. Minimum wall thickness of butt-welded and flanged steel pipe shall be as presented in the table below:

8 inch and smaller	Schedule 40 unless otherwise noted
10 inch to 24 inch	0.25 inch unless otherwise noted
30 inch	0.30 inch unless otherwise noted

B. Fittings

1. All fittings shall be rated for 150 psi, as a minimum working pressure.

2. Steel pipe fittings shall conform to AWWA C208, elbows to have a 22.5 degree maximum miter section angle, minimum two sections, wyes, tees, crosses, and outlets to be reinforced in accordance with AWWA Manual M-11. Provide weld-o-lets for taps.

C. Joints

1. Joints for steel pipe shall be flexible couplings, flanged, bell and spigot welded joints, or welded butt straps as shown. Pipe with field welded joints shall be installed in accordance with AWWA C206. Welding operators, procedures, and details shall be qualified in accordance with AWWA C206.

2. Flanges where shown shall be slip-on or weld neck per AWWA C207, Class D, 125 lb. Nuts and bolts shall be electrozinc plated and of the sizes and quantities recommended in AWWA C207. Gaskets for flanged joints shall be sheet rubber gaskets in one piece conforming to AWWA C207 and ANSI B16.21, 1/8-inch thick. The gasket shall be full-cut, with holes to pass bolts. Gasket material shall be free from corrosive alkali or acid ingredients. Segmented straight-joint or interlocking gaskets will not be accepted. Blind flanges shall be gasketed with the entire face with the gasket cemented to the blind flange. Gasket material shall be free from corrosive alkali or acid ingredients and suitable for use in potable water lines.

3. Flexible couplings (pipe sleeves) and flanged coupling adapters shall be furnished and installed by the Contractor. All couplings shall be suitable for a minimum working pressure of 150 psi. Flexible couplings for steel pipe shall be Smith-Blair Series 411, Romac Style 400, STRAUB Metal Grip, or equal. Flanged coupling adapters shall be Smith-Blair Series 913, Romac RC400, or equal. Sleeves shall be ten inches minimum length and have a fusion bonded coating suitable for potable water.

4. All welded pipe joints shall be field coated with cement mortar after installation as described herein.

D. Linings and Coatings

1. Exposed pipe and valves in the control room shall be liquid epoxy coated and lined in accordance with AWWA C210-15. Epoxy shall be 100% solid, two coats minimum 16 MDFT total. Epoxy shall be NSF 61 approved.

~~2. Encased steel pipe under the pump station and tank shall be shop primed outside, and cleaned and lined with cement-mortar in conformity with ANSI/AWWA C205.~~

~~3. Buried steel pipe and fabrications shall be reinforced cement mortar coated in accordance with AWWA C205. Internal surfaces of the buried steel pipe and fabrications shall be cleaned and lined with cement-mortar in conformity with ANSI/AWWA C205.~~

~~4. Exposed steel pipe and fabrications within the below grade vault shall be shop primed outside. Internal surfaces of the steel pipe and fabrications shall be cleaned and lined with cement-mortar in conformity with ANSI/AWWA C205.~~

~~5. Prime coat all exposed metal surfaces (not mortar or fusion bonded epoxy coated) in the shop prior to delivery to the site with a minimum 5 mils of high build, anticorrosive epoxy metal primer measured as a dry film thickness. Surface preparation and application shall be as recommended by coating material manufacturer.~~

E. Dielectric Isolation

1. All piping shall be dielectrically isolated from piping or other materials constructed from dissimilar metals.

2. Flange dielectric insulation sets shall contain full faced gaskets, full length sleeves, and double insulating washers or as specifically indicated on the Drawings. Insulation material for the flange insulation sets shall be phenolic resin and flange faced gaskets shall be neoprene faced phenolic resin. All insulating materials shall be of a type designated by the manufacturer as suitable for use at the operating and test pressures specified for the type of pipe on which the materials are to be installed.

3. Insulating flange gasket sets shall be installed at the specified locations. All insulating components shall be cleaned of all dirt, grease, oil and other foreign materials immediately prior to assembly. Bolt holes in mating flanges shall be properly aligned at the time bolts and insulating sleeves are inserted to prevent damage to the insulation. After flanged bolts have been tightened, each insulating washer shall be inspected for cracks or other damage. All damaged washers shall be replaced. After assembly, resistance between each bolt and flange shall be measured with an approved ohmmeter, and the minimum resistance shall be 50,000 ohms. All insulating flanged joints shall be coated.

F. Standard Joint Protection (Buried Pipe)

1. Exterior: After steel pipe section has been laid, clean the exposed metal at the exterior space at the joint. Wrap the joint with a strip of woven fabric (diaper) and band around the pipe at each side of the joint. The fabric shall be of such a weave as to allow the escape of air and excess water but prevent escape of mortar. Pour the joint full of grout (1 part cement to 1 part fine aggregate with sufficient water to form a consistency of thick cream) through a space in the woven fabric slightly to one side of the top. Rod the grout with a beaded wire or chain as it is poured into the joint. Immediately after completing the exterior joint, place damp earth over and around the joint to prevent rapid drying.

2. Interior: The inside joints of steel pipe 24 inches and larger shall be cleaned and thoroughly wetted before being filled with stiff cement mortar and finished off smooth by troweling or other equivalent method as approved. The inside joints of pipe less than 24 inches shall be mortared as specified in AWWA C205. Furnish sufficient swabs of the proper size and shape for use by the installation Contractor to remove excess mortar from the joints inside pipes with diameters less than 24 inches. These swabs shall be of rubber and capable of being inflated to the proper size for their intended use. The swabs shall be equipped with rings, straps, or similar devices which will permit a rope or cable to be attached to pull the swab through the pipe without deforming the swab to the point where the inside joint is not wiped clean.

G. Steel Wall Pipe

1. Fabricate of same material and thickness as connecting pipe, minimum thickness of 1/4-inch. Lining same as connecting pipe. Provide weep ring for all wall pipes to prevent water seepage with continuous fillet welded on each side all around. All penetrations through reinforced concrete walls

shall be constructed to prevent metal to metal contact between the pipe and reinforcing steel in the wall.

H. Pipe At Ground Level

1. Buried pipe material, coating, and lining shall extend to 6 inch above grade and shall terminate with a flange connection equipped with an insulating kit. Exposed piping shall be all pipes more than 6 inches above grade.

~~2.05 PIPE TYPE C – POLYVINYL CHLORIDE PRESSURE PIPE AND FITTINGS~~

~~A. Pipe PVC pipe shall be Schedule 40 or 80 as listed, Class 12454-B, rigid, unplasticized pipe made from polyvinyl chloride in accordance with ASTM D1784 and D1785. Joints shall be solvent weld, except that threaded or flanged joints are to be used where required at specific locations.~~

~~B. Fittings shall be Schedule 40 or 80 to match pipe, of the same material as the pipe, conforming to ASTM D2466.~~

~~C. Bolts, Nuts, Washers, and Gaskets~~

~~1. Bolts and nuts for flanges shall be Type 304 stainless steel, ASTM A193, Grade B8M hex head bolts and ASTM A194, Grade 8M, hex head nuts. Washers shall be of the same material as the bolts.~~

~~D. Solvent Cement~~

~~1. Solvent weld connections shall be made in strict accordance with the pipe manufacturer's recommendations using a solvent cement and primer (if recommended) meeting ASTM D2564. Solvent cement for Sodium Hypochlorite piping shall be IPS 724 CPVC solvent cement or equal. Primer shall be IPS P-70 primer or equal.~~

~~2.06 PIPE TYPE D – GRAVITY DRAINAGE~~

~~A. Pipe Type D-1~~

~~1. Pipe 12 inches and larger shall be reinforced concrete pipe and conform to the requirements of ASTM C76, Class III, unless otherwise shown. Joints shall be rubber gasketed and conform to ASTM C361.~~

~~B. Pipe Type D-2~~

~~1. Pipe 4 to 10 inches shall be polyvinyl chloride pipe and shall have a maximum dimension ratio of 26 unless otherwise specified and shall conform to ASTM D 3034. Pipe shall be furnished standard lengths of 20 feet. Joints shall be elastomeric gasket with bell and spigot ends. All material shall conform to the requirements of Sections 10.19 of the Standard Specifications.~~

~~C. Pipe Type D-3~~

~~1. Buried pipe below floor slabs three inch and larger shall be cast iron soil pipe, ASTM A74 with service hub and spigot compression type or hubless cast iron sanitary system per CISPI 301.~~

2.07 PIPE TYPE G – COPPER PIPE

1. For pipe 3 inches and smaller; exposed pipe shall be copper tubing type L, conforming to the requirements of ASTM B88. Joints shall be soldered or brazed with unions at valves and equipment. Solders shall be lead-free solder compatible with tubing and fittings materials. Fittings shall be wrought copper or bronze fittings meeting ANSI B16.22.

2. For pipe 3 inches and smaller; buried pipe shall be copper tubing type K, conforming to the requirements of ASTM B88. Joints shall be flared. Pipe shall be encased in 8-mil Polyethylene film prior to burial. Fittings shall conform to ANSI B16.22 or B16.26.

2.08 PIPE TYPE H – PRESSURE AND SAMPLE LINES

A. Pressure sensing lines and sample lines, above floor, ½ inch and smaller, shall be stainless steel tubing, ASTM A312 Type 316L, seamless, soft annealed, with flareless compression fittings. The minimum wall thickness shall be Schedule 40S. Stainless steel fittings shall be of the same material and pressure rating as the pipe.

B. Pressure sensing lines and sample lines buried, below floor, three inches and smaller, shall be PVC, ASTM D1785, Schedule 80. Provide magnetic tracer tape. Connections: plain end; solvent weld with threaded or flanged adapters for valves. Fittings, PVC, Schedule 80, socket weld.

2.09 PIPING CONNECTIONS – MISCELLANEOUS

A. Metallic Flexible Couplings and Flange Adapters

1. Where shown on the Drawings or required by installation, flexible couplings and flange adapters shall be furnished and installed by the Contractor. All couplings shall be restrained and suitable for a minimum working pressure of 150 psi.

2. Flexible couplings for steel pipe and steel pipe sizes shall be Rockwell (Smith-Blair) Type 411, Romac Style 400, Straub metal grip, or equal with the stop removed from the middle ring unless otherwise shown. Flexible couplings for cast or ductile iron pipe and equivalent sizes shall be Rockwell (Smith-Blair) Series 411, Dresser Style 38, Straub iron grip, or equal. Flexible reducing couplings shall be Rockwell Type 415, Romac Style RC400, or equal. Sleeves shall be galvanized steel or have a fusion bonded coating suitable for potable water. All coupling gaskets shall be synthetic rubber suitable for potable water.

B. Dielectric Isolation

1. General

a. All metallic piping shall be dielectrically isolated from all other metal piping, hangers, brackets, steel reinforcing and all other metal structures. All piping shall be dielectrically isolated from piping or other materials constructed from dissimilar metals.

2. Flange Insulators

a. Flange dielectric insulation sets shall contain full faced gaskets, full length sleeves, and double insulating washers or as

specifically indicated on the Drawings. Insulation material for the flange insulation sets shall be phenolic resin and flange faced gaskets shall be neoprene faced phenolic resin. All insulating materials shall be of a type designated by the manufacturer as suitable for use at the operating and test pressures specified for the type of pipe on which the materials are to be installed.

~~3. Wall Penetrations~~

~~a. All penetrations through reinforced concrete walls shall be constructed to prevent metal to metal contact between the pipe and reinforcing steel in the wall.~~

4. Insulating Unions

a. Insulating unions shall meet Federal Specifications WW-U-532, Class 1 requirements for dimensional, strength, and pressure requirements. Insulation barrier shall limit galvanic current to 1 percent of the short circuit current in a corresponding metallic joint. The insulating material shall be impervious to water. Each connector shall match the type of material to which it connects.

5. Pipe Supports

a. Any pipe hangers, supports, brackets and saddles installed on the buried side of dielectric insulators on the protected pipe shall be dielectrically isolated from the pipe by insertion of dielectric insulating material between the hanger and the pipe.

6. Testing

a. All dielectric isolation devices shall be field tested for continuity isolation prior to coating and backfill.

2.10 PIPING SUPPORTS AND HANGERS

A. General

~~1.~~ All piping shall be supported against sag, lateral and vertical movement in a manner which will prevent undue strain on any valve, fitting, pipe or piece of equipment. Unless otherwise indicated on the Drawings, exposed piping shall be supported at the base of all risers, at intervals not to exceed 5 ft on all horizontal runs of pipe 2 in. and smaller, at intervals not to exceed 8 ft on all horizontal runs of pipe 2½ in. through 4 in., and at intervals not to exceed 12 ft on all horizontal runs of pipe larger than 4 in.

~~2.~~ In addition, pipe supports shall be provided at changes in direction or elevation, adjacent to flexible couplings, at pipe connections to equipment and where otherwise shown.

~~3.~~ Piping shall be supported as described hereinafter and as shown by the pipe support details on the Drawings. Manufacturer's catalog figure numbers are typical of the types and quality of standard pipe supports and hangers to be employed.

~~4.~~ No attempt has been made to show all required pipe supports in all locations, either on the Drawings or in the details. The absence of pipe supports and details on any Drawings shall not relieve the Contractor of the responsibility of providing a satisfactory piping support system in

conformance with the functional and specific support spacing requirements of these specifications.

B. Hangers and Supports

1. Pedestal pipe supports shall be adjustable, with stanchion, saddle, and anchoring flange as shown, Grinnel, Fee, and Mason, or equal. Non-shrink grout shall be used under the floor flanges to give level bearing, and floor flanges shall be bolted to the floor with two stainless steel bolts cast in the concrete, if possible, or using stainless steel concrete anchors.

C. Anchors

1. All piping, raceways, accessories, and appurtenances shall be anchored to resist a lateral seismic force of 60 percent of its operating weight as required by the California Building Code. This force shall be considered acting at the center of gravity of the piece under consideration.

2. Piping with flexible connections and/or expansion joints shall be anchored such that the intended uses of these joints are maintained in the piping system.

2.11 TAPS AND FITTINGS FOR INSTRUMENTATION

A. The Contractor shall provide all taps, fittings, shutoff valves, etc., for instrumentation, flow control valves and other devices installed in pipelines.

2.12 PRESSURE TAPS

A. Gauge taps shall be provided where shown. Gauge taps shall consist of a 1/2 in gage cock attached by threaded nipple to the pipeline, duct or equipment. Gage cocks shall be Robertshaw 1303, Ashcroft 1095, or equal. The exposed threads of each gage cock shall be protected by a brass plug.

PART 3 - EXECUTION

3.01 GENERAL

A. Piping shall be installed in accordance with these specifications and as specified in Section 26 of the Sacramento Standard Specifications for Public Construction.

3.02 PREPARATION AND HANDLING OF PIPE

A. Each pipe and fitting shall be carefully inspected before the exposed pipe or fitting is installed or the buried pipe or fitting is lowered into the trench. The interior and exterior protective coatings shall be inspected, and all damaged areas, which are repairable in the opinion of the Engineer, shall be patched in the field with material similar to the original. Pipe unable to be repaired shall be removed from the project site and replaced with new, undamaged pipe. Clean ends of pipe thoroughly. Remove foreign matter and dirt from inside of pipe and keep clean during and after laying.

B. Use proper implements, tools, and facilities for the safe and proper protection of the pipe. Carefully handle pipe in such a manner as to avoid any physical damage. Do not drop or dump pipe into trenches.

3.03 INSTALLATION OF PIPING

A. General

1. All pipes shall be carefully placed and supported at the proper lines and grades and, where possible, shall be sloped to permit complete drainage. Piping runs shown on the Drawings shall be followed as closely as possible, except for minor adjustments to avoid architectural and structural features. If major relocations are required, they shall be approved by the Engineer.

2. Wherever a pipe three inches in diameter and larger passes from concrete to earth, a flexible pipe coupling, shall be installed within 1 foot of the concrete. Particular care shall be taken to ensure a full support of the pipe in the earth between and beyond the joints.

3. When installing buried PVC pipe, it shall be "snaked" in the trench. In addition, PVC pipe shall not be laid when temperature is 32°F, or below. Piping shall be installed without springing or forcing the pipe in a manner which would set up stresses in the pipe, valves, or connected equipment.

B. Exposed Pipe

1. Exposed pipe shall mean any pipe not buried or encased in concrete. In erecting exposed pipe a sufficient number of screw unions, flanged or grooved end type joints shall be used to allow any section or run of pipe to be disconnected without taking down adjacent runs. Flanges and grooved couplings shall be employed on pipes 2½ inches and larger. The provision of an adequate number of appropriate take-down fittings must be rigidly adhered to whether or not such fittings are indicated on the Drawings. Take-down fittings shall also be provided within two feet of threaded valves and other appurtenances. Where piping passes through concrete or masonry walls, take-down fittings shall be employed within 3 feet of the wall.

2. All exposed pipelines shall accommodate expansion and contraction forces by the use of expansion joints, anchors, and pipe guides. Where pipes cross structure expansion joints, rubber spherical molded type pipe expansion joints with restraining rods shall be installed whether specifically shown or not.

3. All unrestrained joints in pressure pipelines, including bell and spigot, flexible couplings, expansion joints and flange adapters shall have tension bars (tie rods) provided in accordance with AWWA M11 Design Manual, Figures 19.15 and 19.16, and Tables 19.7 and 19.8. Thrust protection shall be for 1½ times the specified test pressure for the pipe.

~~C. Buried Pipe~~

~~1. General~~

~~a. All buried pipe shall be prepared as herein before specified and shall be laid on the prepared granular base and bedded to ensure uniform bearing. No pipe shall be laid in water or when, in the opinion of the Engineer, trench conditions are unsuitable. Joints shall be made as herein specified for the respective types. Take~~

~~all precautions necessary to prevent uplift and floating of the pipe prior to backfilling.~~

~~b. Piping under slabs and structures shall be encased in concrete unless otherwise directed by the Engineer.~~

~~2. Gravity Lines~~

~~a. Laying of gravity pipelines shall proceed upgrade with the spigot ends pointing in the direction of flow. Each piece shall be laid true to line and grade and in such manner as to form a close concentric joint with the adjoining pipe and to prevent sudden offsets in the flow line. As the work progresses, the pipe interior shall be cleared of all dirt and debris of every description. Where clearing after laying is difficult because of small pipe size, a suitable swab or squeegee shall be kept in the pipe and pulled forward past each joint immediately after jointing has been completed. Pipe shall not be laid when the condition of the trench or the weather is unsuitable. At times when work is not in progress, open ends of pipe and fittings shall be closed.~~

~~3. Corrosion Protection~~

~~a. All buried metal parts such as valves and bolt-ups not cement mortar coated shall be coated with two coats of bitumastic in accordance with Section 09900 Coating Systems, and encased with two sheet of 8-mil minimum thickness polyethylene to form a continuous and all-encompassing layer of polyethylene between the protected metal and surrounding earth. All polyethylene shall be secured in place with 10-mil polyethylene tape.~~

4. Dielectric Connections

a. Where pipes of dissimilar metals are connected, a dielectric insulator shall be provided. Where copper pipe is supported from hangers, it shall be insulated from the hangers; or copper plated hangers shall be used.

b. Dielectric insulators shall be installed on the first exposed flanges or couplings of pipes which are connected to buried piping. For this purpose, an insulating joint or connection shall be provided on exposed existing and new piping which requires cathodic protection, within ten feet of each point of burial. Where connections are made between existing ferrous metal piping and new piping which is to receive cathodic protection, a dielectric insulator shall be installed.

c. Insulating flange gasket sets shall be installed at the specified locations. All insulating components shall be cleaned of all dirt, grease, oil and other foreign materials immediately prior to assembly. Bolt holes in mating flanges shall be properly aligned at the time bolts and insulating sleeves are inserted to prevent damage to the insulation. After flanged bolts have been tightened, each insulating washer shall be inspected for cracks or other damage. All damaged washers shall be replaced. After assembly, resistance between each bolt and flange shall be measured with an approved ohmmeter, and the minimum resistance shall be

50,000 ohms. All insulating flanged joints shall be coated as shown.

d. Insulating unions shall be installed at the specified locations. Joint compound or thread tape shall be applied to male threads only. Piping shall be worked into place without springing or forcing. Backing off to permit alignment of threaded joints will not be permitted. Threads shall be engaged so that no more than 3 threads remain exposed.

~~5. Locating Wire~~

~~a. All runs of water pipe, including services, shall have a No. 10 gauge solid soft drawn copper wire laid along the pipe to facilitate locating the pipe at a later date. The wire shall be stubbed up inside each valve box. Continuity test shall be conducted on each splice at all locations.~~

3.04 PIPELINE CLEANING AND TESTING

A. Water Pipelines

1. All water pipelines shall be subject to acceptance tests as specified in Section 02643. The Contractor shall provide all necessary utilities, labor, and facilities for testing, and shall dispose of all waste, including water. All tests shall be conducted in the presence of the Engineer.

B. Cleaning

1. The interior of all pipelines shall be thoroughly cleaned of all debris prior to testing and prior to connection of pipe to equipment, control and regulating devices or instrumentation. Cleaning shall be accomplished by flushing with water at a velocity of 2.5 ft/s or by pulling a tightly fitting cleaning ball or swab through the pipe. Accumulated debris shall be removed by dropping spools or valves. No test shall commence until the pipeline is completely cleaned to the satisfaction of the Engineer. Pump suction lines shall be cleaned prior to operation of pumps.

C. Disinfection

1. Disinfect all water piping as specified in Section 02643. Disinfect all new water pipe sections prior to making final connection to existing active operating piping.

~~D. Gravity Pipelines~~

~~1. Unless otherwise directed, Contractor shall perform Closed Circuit TV camera (CCTV) inspections of all new installations of sewer, and/or storm drain pipes. Comply with Section 26-12 requirements. In addition, all sewer and storm drain pipelines shall be subject to air or hydrostatic testing as specified in Section 26 of the Sacramento Standard Specifications.~~

END OF SECTION

SECTION 15100

VALVES AND APPURTENANCES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Miscellaneous valves and accessories for water service. Valves shall be installed in accordance with the manufacturer's recommendations. Valves shall be suitable for pressures up to 150 psi. Valves shall be complete with all necessary operating hand wheels, extension stems, valve boxes, floor stands, worm and gear operators, operating nuts, hardware and fasteners, and wrenches which are required for the proper completion of the work included under this section.

1.02 SECTION INCLUDES

A. The following Sections are referenced in this Section:

1. Section 01330 – Submittals

1.03 SUBMITTALS

A. Submittals shall demonstrate full compliance with all aspects of this specification and be submitted in accordance with Section 01330.

1.04 REFERENCE STANDARDS

A. The standards listed below are part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
AWWA C504	Rubber-Seated Butterfly Valves
AWWA C509	Resilient Seat Gate Valves for Water and Sewage Systems
AWWA C550	Protective Interior Coatings for Valves and Hydrants

PART 2 - PRODUCTS

2.01 GENERAL

A. Valves shall be furnished full line size unless specifically called out to be of reduced size. Unless otherwise specified, valves shall be rated for 150 psi working pressure minimum.

B. All valves shall be complete with all necessary operating hand wheels, chain wheels, extension stems, valve boxes, floor stands, worm and gear operators, operating nuts, chains, hardware and fasteners, and wrenches which are required for the proper completion of the work included under this

section. Operating torque to operate any valve shall not exceed 40 ft-lb. Unless otherwise indicated, the direction of rotation of the wheel, wrench nut or lever to open the valve shall be counterclockwise. Each valve body or operator shall have cast thereon the word "OPEN" and an arrow indicating the direction to open. Actual length of valves shall be within 1/16 inch (plus or minus) of the specified or catalog length except where installed adjacent to flexible or mechanical pipe couplings, where different lengths of a replacement can be accommodated. Flanges shall meet the requirements of ANSI B16.

C. Valve boxes and extended stems to within 24 inches of finished grade shall be provided for all buried valves.

2.02 ACTUATORS

A. All valves, except those which are equipped with power actuators or are designed for automatic operations, shall be provided with manual actuators. Unless otherwise specified or indicated on the Plans, each manual actuator shall be equipped with an operating hand wheel. Manual operators for butterfly valves shall be designed in accordance with AWWA C504 and shall have a disc position indicator designating the opened and closed position of the valve.

B. Operators for butterfly valves six-inches in diameter and smaller shall be level actuators and permit locking the valves in at least five intermediate positions between fully open and fully closed. Operators for butterfly valves eight-inches in diameter and larger shall be the traveling nut type. Manual operators for exposed service valves shall include a handwheel and be of the traveling nut, rack and pinion, or worm gear type and be gasketed for weatherproof service. Operators shall be equipped with adjustable mechanical stop-limiting devices to prevent over-travel of the disc in the open and closed positions and shall be self-locking and designed to hold the valve in any intermediate position between full open and full closed. Valve operator components shall withstand an input torque of 300 ft-lbs at the extreme operator positions without damage.

C. Operators for buried service shall be provided with a two-inch square operating nut unless otherwise specified or shown. Operating extension stems shall be provided to bring the operating nut to a point six inches below the surface of the ground and box cover. Extension stems shall be constructed of steel and shall be complete with two-inch square operating nut.

D. For power actuators see section 13448. ~~for valves shall be motorized actuators and shall be one of the following types:~~

~~1. For quarter-turn valves:~~

~~a. Open-close power actuators shall be Rotork IQT or approved equal. Power actuator shall be provided with four configurable indication contacts configured to indicate the following: remote selected (AUTO), internal failure (FAIL), fully closed~~

~~(CLOSE), and fully opened (OPEN). Four additional configurable contacts shall be provided. Power actuator shall operate on 120VAC power and all contacts shall be rated 5A, 120VAC.~~

~~b. Modulating power actuators shall be Rotork IQTM or approved equal. Power actuator shall set its position based on a 4-20mA set point signal and provide a 4-20mA valve position feedback signal (4mA = 0% open, 20mA = 100% open). Power actuator shall be provided with four configurable indication contacts configured to indicate the following: remote selected (AUTO), internal failure (FAIL), fully closed (CLOSE), and fully opened (OPEN). Four additional configurable contacts shall be provided. Power actuator shall operate on 120VAC power and all contacts shall be rated 5A. 120VAC.~~

~~2. For multi-turn gate valves:~~

~~a. Open-close power actuators shall be Rotork IQS or approved equal. Power actuator shall be provided with four configurable indication contacts configured to indicate the following: remote selected (AUTO), internal failure (FAIL), fully closed (CLOSE), and fully opened (OPEN). Four additional configurable contacts shall be provided. Power actuator shall operate on 120VAC power and all contacts shall be rated 5A, 120VAC.~~

2.03 BUTTERFLY VALVES

A. Butterfly valves shall be manufactured in accordance with the latest revision of AWWA C504, class 150B. Valves shall be iron body, flange ends, rubber seated, tight-closure. The manufacturer shall have produced AWWA butterfly valves for a minimum of five years. Valve interior and exterior shall be epoxy coated in accordance with AWWA C550 suitable for drinking water. The epoxy coating shall be NSF61 approved. Engineer shall pick color. Thru bolts connecting valves to main shall be carbon steel ASTM A193 grade B7 with ASTM A 194 grade 2H heavy hex nuts, or bolts and nuts of equivalent physical properties. Bolts that thread into the valve body larger than 1 inch shall have the same thread pitch as the valve body and conform to ASTM A193 grade B7 having UNC threads.

B. The actuator shall be equipped with a standard water works two inch (2") square wrench nut. The actuator shall open the valve left (counterclockwise) and shall be furnished with a position indicator if installed in a vault. Provide valve operating nut extensions in accordance with Standard Drawing W-308 in Section 38 of these Standard Specifications when installed valve operating nut is in excess of thirty inches (30") below finish grade.

C. Valve seats shall be field adjustable around the full three hundred and sixty degrees (360°) circumference and replaceable without dismantling

operator, disc or shaft and without removing the valve from the line. Seats attached to the valve disc are not allowed. All shafts shall be turned, ground and polished and constructed of 18-8 Type 304 stainless steel conforming to ASTM A 276. Valve shaft seals shall consist of self-adjusting "V" type packing capable of replacement without removal of the valve shaft.

D. All valves shall be fitted with non-metallic sleeve-type bearings. Bearings shall be corrosion resistant and self-lubricating. Bearing load shall not exceed one-fifth of the compressible strength of the bearing or shaft material. Non-adjustable thrust bearings designed to center the valve disc shall be furnished with the valve assembly and be preset at the factory.

E. Butterfly valves shall be manufactured by Dresser, Mueller, Kennedy, Pratt, or equal.

~~2.04 GATE VALVES~~

A. ~~All small gate valves of a size less than three inches for threaded joints shall be Crane Company No. 438, Mueller H10914, or equal, with wedge disc and rising stem and screwed ends.~~

B. ~~Resilient – Seated gate valves shall be cast iron, non-rising stem with a two inch (2") square operating nut. Valves shall conform to AWWA C 509. All interior and exterior ferrous surfaces shall be and coated with factory applied epoxy in accordance with AWWA C 550. Minimum thickness shall be eight (8) mils. Bolts shall be carbon steel ASTM A 193 grade B7 with ASTM A 194 grade 2H heavy hex nuts, or bolts and nuts of equivalent physical properties.~~

C. ~~Valves provided shall open left (counter clockwise), and shall have bonnet and valve body markings in accordance with the indicated AWWA standards. Unless otherwise directed, furnish valves with flange, mechanical, and/or push-on joints in accordance with the plans and special provisions. Provide valve operating nut extensions in accordance with Standard Drawing W-308 in Section 38 of the Standard Specifications when installed valve operating nut is in excess of thirty inches (30") below finish grade.~~

D. ~~All larger valves shall be iron body with bronze stem nuts, glands, and bushings; resilient-seated gate valve with resilient seat bonded or mechanically attached to the gate; non-rising stem (NRS); working water pressure of 200 psi; and conforming to the requirements of AWWA C509. Gate valves installed in vertical pipelines shall be of square bottom construction.~~

~~2.05 PLUG VALVES~~

A. ~~Cast iron or ductile iron body and plug, neoprene plug facing, stainless steel valve seat, Buna-N or PTFE stem packing, and Type 316 stainless steel plug bearing. Non-lubricated eccentric plug valve, suitable for drip-tight, bi-directional shutoff at 150 psi design pressure. Port area of at least 80 percent of the full pipe cross-sectional area. Bolts, Studs, Nuts and~~

~~Washers: Zinc plated in exposed installations, Type 316 stainless steel in buried installations. Valve as manufactured by DeZurik, Clow Valve Company, or equal.~~

2.06 BALL VALVES

A. Unless otherwise indicated or specified, all 3-inch and smaller shutoff valves shall be ball valves.

B. Two-inch and smaller ball valves for general air and water service shall be of bronze or brass construction with two piece end entry body, with threaded ends, Teflon seats, and hand lever operators. Valves shall be rated not less than 500 psi non-shock cold WOG and shall be drip tight in both directions. Valves shall be Apollo 70-100 series, Stockham S-216, or equal.

~~2.07 HOSE VALVES~~

A. ~~Hose valves shall be one and one/half inch in size unless otherwise indicated on the Plans. Valves shall be Class 125 angle valves with bronze body seat and disc equipped with hose nipple. Hose nipple shall be all brass with double male ends, NPT by straight hose tread. Valves shall be Stockham B-216, Walworth Fig 3059, or equal. Provide valve with vacuum breaker/backflow preventer in chlorine room.~~

~~2.08 SILENT CHECK VALVES~~

A. ~~Silent check valves shall be ductile iron body, bronze trim, center guided, stainless steel spring, and resilient seating. The minimum flow cross-sectional area shall be greater than the flow area of the pipe. The design shall provide a globe-style body, a center-guided, spring-loaded disc, guided at both ends with bronze bushings and bronze shafts. The valve shall be designed for a water working pressure of at least 125 psi. Silent check valves shall be Valmatic Series 1800, or APCO Series 600.~~

~~2.09 ELASTOMER TYPE CHECK VALVES~~

A. ~~Elastomer type check valves shall be slip-on or Class 125 flanged, as shown, round entry area to match pipe, contoured duckbill exit, rated for 50 psi minimum operating pressure, designed to open with 2 inches of line pressure and return to closed position under zero flow, as manufactured by Tideflex, Onyx or equal.~~

~~2.10 SERVICE SADDLES~~

A. ~~Double-strap design rated 150 psi minimum working pressure.~~

B. ~~Run diameter compatible with outside diameter of the pipe on which the saddle is installed. Taps with iron pipe threads.~~

C. ~~Malleable or ductile iron bodies and galvanized steel straps, steel hex nuts w/washers, and neoprene seals.~~

D. Manufacturers and Models: Smith-Blair, Inc., Series 313; Romac Industries, Inc., Series 202; or equal.

2.11 VALVE APPURTENANCES

A. Extension Stems for Buried Valve Operators

1. Where the depth of the valve is such that its centerline is more than three feet below grade, operating extension stems shall be provided to bring the operating nut to a point six inches below the surface of the ground and/or box cover. Extension stems shall be constructed of steel and shall be complete with two inch square operating nut.

B. Valve Boxes

1. Valve boxes shall be provided for all buried valves. They shall be concrete construction with a minimum throat diameter of nine inches and minimum wall thickness of one inch. Valve boxes shall have cast iron bases and covers with the appropriate service designation cast thereon. All parts shall be bituminous varnish coated. Valve boxes shall be Christy Concrete Products No. G-5 or equal. PVC pipe risers shall be C900 PVC, 8-inch diameter, extend to valve box and shall fit inside the valve box without slipping. Tracer wire shall be placed outside the riser pipe.

2.12 AIR RELEASE VALVES (ARV)

A. Air release valves located at each pump shall be of the simple lever type, 1/2-inch inlet and outlet unless otherwise shown, designed to have a small 3/32-inch venting orifice to vent the accumulation of air and other gases that may occur within a pipeline while the pump is operating. In closed position, valve to seat against resilient seat to prevent water leakage. Body and cover, cast or ductile iron; float and trim, stainless steel; seat, Viton or Buna-N. Provide return vent pipe turned 180 degrees downward and discharging to floor drain. Isolation valves shall be provided below each air valve.

B. Manufacturers and Products: APCO, Model 50; Val-Matic Valve, Model 22; or equal.

2.13 COMBINATION AIR VALVES (CAV)

A. Combination air valves for water service shall be single-body construction. Combination air valves shall have a small venting orifice to vent the accumulation of air and other gases with the line or system under pressure and shall have a large venting orifice to permit the release of air as the line is filling or relieve the vacuum as the line is draining or is under negative pressure. Valve shall have a two-inch inlet and outlet unless otherwise shown and designed to have a small 3/32-inch venting orifice. Body and cover, cast iron and ductile iron; float and trim, stainless steel; seat, Viton or Buna-N.

B. Provide return vent pipe turned 180 degrees downward. Isolation valves shall be provided below each air valve.

C. Manufacturers and Products: APCO Series 140/150; Val-Matic Valve, Model 202C; or equal.

2.14 FIRE HYDRANTS

A. Fire hydrants shall be dry barrel type in accordance with AWWA C502, and Sacramento Standard Specifications, Section 10.31. A six-inch gate valve shall be installed between the hydrant and the main line. The flange of the hydrant bury shall be two inches above finished grade. Break-off riser shall be installed on all hydrants.

B. Interior surfaces shall be factory applied epoxy coated. Hydrants shall be painted in the shop. Color shall be based on diameter of water main connected to hydrant.

2.15 DOUBLE DOOR CHECK VALVES

A. Each double door check valve shall be wafer type, with fusion bond epoxy coated cast iron or ductile iron body, cast bronze or stainless steel disc halves, suitable for installation between flange faces. The body shall be of one piece construction incorporating a vulcanized synthetic seal of Buna-N. Seal design shall include a raised sealing bead for positive seating at both high and low pressures. Disc stabilization in the full open position shall be provided by the use of a stop pin. The stop and pivot pins shall be of type 316 stainless steel. Closure shall be assisted with a 316 stainless steel torsion spring to provide a cracking pressure of 0.25 psig. Valve shall be designed for 250 psi minimum working pressure suitable for intended fluid service. Valve shall be APCO CDD 9000T Series, Val-Matic Series 8800W, or equal.

2.16 RUBBER FLAPPER CHECK VALVES

A. Each rubber flapper check valve shall consist of a cast iron or ductile iron body and cover with integrally cast end flanges, and a Buna-N swing flapper having an o-ring seating edge. Body and cover shall be factory fusion bond epoxy coated. Flapper to be captured between the body and the body cover in a manner to permit the flapper to flex from closed to full open position during flow through the valve. Flapper shall be easily removed without need to remove the valve from the line. Check valve shall have full pipe size flow area. Seating surface shall be on a 45° angle requiring the flapper to travel only 35° from closed to full open position, for minimum head loss and non-slam closure. Flapper shall be internally reinforced with steel, and have an elastic spring effect to assist the flapper in closing against a slight head to prevent slamming. Valve shall be designed for 175 psi minimum working pressure suitable for intended fluid service, and supplied with stainless cover bolts. Valve shall be APCO CRF-100, Crispin RF Series, Val-Matic 500A, or equal.

PART 3 - EXECUTION

3.01 PLACING

A. Valves installed in vertical runs of pipe shall have their operating stems oriented to facilitate the most practicable operation, as approved by the Engineer.

3.02 ANCHOR BOLTS

A. ~~Anchor bolts, nuts, and washers shall be Type 316 stainless steel and shall be cast in place during concrete placement. Threads shall be protected and shall be cleaned before the nuts are attached and tightened.~~

3.03 TESTING

A. Valves shall be tested at the same time the adjacent pipeline is tested. Joints shall show no visible leakage under test. Joints that show signs of leakage shall be repaired prior to final acceptance. If there are any special parts of control systems or operators that might be damaged by the pipeline test, they shall be properly protected. The Contractor shall be held responsible for any damage caused by the testing.

B. If requested by the City, the valve manufacturer shall furnish an affidavit stating the materials options furnished, and/or that these and other referenced specifications have been complied with.

3.04 CORROSION CONTROL

A. Exposed valves shall be painted in accordance with Section 15050. ~~All buried metal parts such as valves and bolt-ups not cement mortar coated shall be coated with two coats of bitumastic in accordance with Section 09900 and encased with one sheet of 8-mil minimum thickness polyethylene to form a continuous and all-encompassing layer of polyethylene between the protected metal and surrounding earth. All polyethylene shall be secured in place with 10-mil polyethylene tape.~~

END OF SECTION

SECTION 15220

RESERVOIR ALTITUDE VALVE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Provide a pressure sustaining 16" control valve for reservoir filling. Valve shall be a hydraulically operated altitude valve. Provide all accessories for a complete operating system. See plans for additional accessories to be added to this valve.

1.02 REFERENCED SECTIONS

A. The following Section is referenced in this Section:

Section 01330 – Submittals

1.03 REFERENCES STANDARDS

A. American National Standards Institute (ANSI) standards, most recent editions:

1. ANSI B16.42 -- Ductile Iron Pipe Flanges and Flanged Fittings.

2. ANSI/AWWA C116/A21.16 -- American National Standard for Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service.

3. NSF/ANSI 61 -- Drinking Water System Components-Health Effects.

B. American Society for Testing and Materials (ASTM) standards, most recent editions:

1. ASTM A536 -- Standard Specification for Ductile Iron Castings.

2. ASTM A240 -- Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.

C. National Electrical Manufacturers Association (NEMA).

1.04 SUBMITTALS

A. Submittals shall demonstrate full compliance with all aspects of this specification and be submitted in accordance with Section 01330.

B. Furnish Submittals Prior to Installation as specified.

1. Submit detailed technical information relating to each type of valve including descriptions of component parts, materials of construction, performance, and dimensions.

C. Process and Instrumentation Diagram

1. Provide full P&ID with associated tag numbers.

D. Installation, Operation, and Maintenance Instructions:

1. Furnish installation, operation, and maintenance instructions for each type of valve. Include information on valve operators in operation and maintenance instruction manual.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer of the valve(s) shall have had 10 years successful operational experience in comparable service.

B. Each valve shall be tested prior to shipment. The standard test shall include a functional stoke, pressure, and leak test of the valve body seat, fitted pilots and accessories. The contractor shall provide a copy of the test report to the Engineer.

C. The valve(s) shall be covered by a minimum three-year (3) warranty against defects in materials and workmanship.

D. All repairs and maintenance shall be possible without removing the valve from the line, when installed in accordance with manufacturers' recommendation.

1.06 DELIVERY STORAGE AND HANDLING

A. Protect valves from damage during handling and installation.

PART2 PRODUCTS

2.01 DUAL SOLENOID CONTROL VALVE

A. Supply a 16-inch Singer Model S106 – 2SC-PCO Dual Solenoid Control Valve.

1. The valve shall be equipped with a Model X156 Valve Position Transmitter

B. Function: The valve shall be a solenoid pilot operated control valve which will be positioned precisely, throughout the complete valve stroke, by intermittent operation of valve opening and valve closing solenoid pilot valves, electrically

energized or de-energized. The solenoid pilots shall be controlled using a programmable process controller. Manual solenoid bypass ball valves shall be provided for emergency override operation of the valve. The valve shall be controlled using a PLC based process control panel, programmed and supplied by the control valve manufacturer.

C. Operation: The valve shall provide modulating control using two 2-way solenoid pilot valves, one for valve opening control and the other for valve closing control. The selected solenoid is electrically energized to either apply or relieve main valve bonnet pressure to hydraulically close or open the main valve. Energizing the selected solenoid for a determined period of time, regulated by a solenoid and adjustable speed controls, the valve may be opened, closed or positioned to any point within the valve stroke, to maintain the desired process condition. The process controller, used to control the valve solenoids, shall be PLC controlled per the plans. The 2-way solenoid pilot valves shall be selected by the valve manufacturer and supplied as NO-Normally Open; energize solenoid to close, or NC-Normally Closed; energize solenoid to open. In the event of a power failure the main valve shall Fail Closed.

2.02 Main Valve

A. The main valve shall be a Singer specify main valve model number S106-PG single chamber, diaphragm actuated full port model.

B. The main valve, bonnet and removable stem cap shall be constructed of ASTM A536 (Grade 65/45/12) ductile iron.

C. Main valves of 2.5" (65mm) and larger shall have a removable stem cap for access to the main valve stem for alignment check, spring installation and ease of service and assembly.

D. All ductile iron parts on the valve shall be protected internally and externally by a coating of NSF-61 approved fusion bonded epoxy with a minimum thickness of 10 mils. The protective fusion bonded epoxy coating shall conform to the ANSI/AWWA C116/A21.16 specification. Engineer shall pick exterior color.

E. The main valve trim, consisting of seat ring and stem shall be constructed of AISI 316 stainless steel. The valve stem shall have wrench flats for ease of maintenance.

F. The main valve bonnet shall be located using two or more locating guide pins to maintain the inner valve assembly alignment and for ease of maintenance.

G. The main valve shall provide a drip-tight seal using a mechanically retained resilient disc, having a rectangular cross section, against the stationary AISI 316 stainless steel seat ring.

H. The stationary AISI 316 stainless steel seat ring of main valves 2.5" (65mm) and larger shall be held in place using Spiralock® self-locking screws and seat ring retainers.

I. The main valve elastomers: diaphragm, resilient disc and seals, shall be of EPDM or Buna-N.

J. All main valve fasteners (bolts, nuts, studs, cap screws) shall be supplied as AISI 18-8 or 304 stainless steel. All bonnet bolts shall be fitted with stainless steel washers to prevent damage to the bonnet coating.

K. Valve shall have flanged, threaded or grooved end connections. Flanged connections shall be ANSI/ASME B16.42 Class 150# flange drilled, faced and rated. Threaded connections shall be NPT.

2.03 Pilot Controls

A. The solenoid pilot valves shall be ASCO 2-way solenoid valves with satisfactory pressure rating and flow capacity (Cv) for the service conditions and operation requirements. Solenoid model to be specified by the manufacturer. Solenoid valve coil voltage shall be 110-120VAC 60Hz. Solenoid valve shall be supplied with a NEMA 4 enclosure. Solenoid valve body material shall be NSF 61 low lead brass or 303/304 stainless steel with NPT connections.

B. The pilot fittings shall be supplied as low lead brass or AISI 316 stainless steel.

C. The pilot tubing shall be supplied as ASTM B280 seamless copper or AISI 316 stainless steel.

D. Open and closing micrometer needle valve speed controls shall be supplied. Needle valves shall be constructed of low lead brass or 316 stainless steel with manual operator.

E. Pilot isolation and solenoid bypass ball valves shall be supplied. Ball valves shall be constructed of low lead brass or 316 stainless steel with stainless steel handle operator.

F. A pilot strainer shall be supplied as standard. Strainer material to be ASTM A351 CF8M stainless steel with a 40-mesh or 80-mesh 316 stainless steel screen. The external pilot strainer shall have a removable plug for easy maintenance access to the pilot screen and have provision for installation of a ball valve for pilot screen flushing.

G. Pressure gauges shall be 2 ½" oil filled and manufactured by Ashcroft 1032.

2.04 Control Valve Components

A. A Singer Model X156 Linear Inductive Valve Position Transmitter shall be provided. The X156, with supplied 24VDC external power, shall provide a precise 4-20mA calibrated output signal, with adjustable zero and span, proportional over 0-100% of valve stroke position. The valve position transmitter assembly shall be mounted directly to the valve and shall provide a non-contact transmitter detecting a stainless-steel target installed on the stainless steel valve stem. The valve position transducer, rescaling module, terminal blocks and wiring shall be housed within an IP67 / NEMA 4X/6 rated enclosure.

2.05 Operation

A. The Control valve shall be positioned by operation of the opening and closing solenoid valves by using the facility PLC. Provide manual bypass valves around each solenoid valve for emergency operation.

B. The valve shall control the high-water level in the water storage tank while sustaining inlet pressure Preliminary set point for pressure sustaining is 35 psi. The valve shall be suitable for continuous operation with a maximum flow rate of 8,000 gpm.

C. Provide hydraulically operated pilot to close valve based on reservoir water pressure independent of solenoid valve operation to close valve at high reservoir water level. Connect the valve reservoir sensing line directly to the existing sensing line at the reservoir as per the plans.

D. Provide lockable SST ball valve and plug to purge any air that may become trapped within the bonnet and stem cap.

2.06 MANUFACTURERS

A. Altitude valve shall be a Singer Valve model number 106PG single chamber, diagram actuated with position indicator to match existing equipment.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install valve(s) as shown on Plans and in accordance with manufacturers' and City's requirements.

B. When the valve is mounted in a horizontal line, the stem shall be installed vertically to reduce unnecessary wear on the guide, and to facilitate easy removal and replacement of the inner valve assembly.

C. The valve manufacturer shall provide start-up service to check installation and provide set-up operation of the valve. A total of 2 trips, 1 day per trip, shall be included for start-up services. Service shall be provided by the valve manufacturer or authorized representative and shall not be a third party sub-contractor.

The valve manufacturer shall commission the two pressure points and analog transmitter.

In addition, the valve manufacturer shall provide four hours of training to twelve City personnel on the operation and maintenance of the altitude valve. The valve manufacturer shall provide training materials and a training outline. The training outline shall be provided to the City prior to training for City approval.

D. The Contractor shall be capable of providing the required flow to the valve prior to start-up services.

E. The valve manufacturer shall provide two training sessions per section 01750.

END OF SECTION

SECTION 16050 - ELECTRICAL WORK, GENERAL

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Provide electrical work, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section apply to all sections in Division 16, except as indicated otherwise. The work of this Section is required for operation of electrically-driven equipment provided under specifications in other Divisions. Attention is directed to the requirement for proper coordination of the work of Division 17.

~~C. Provide electrical work for complete and operable bypass pumping including all pump controls and high level alarms per Section 01920.~~

D. Vendor supplied electrical equipment and control panels shall meet requirements of Division 16 and Division 17.

E. All concrete, excavation, backfill, and steel reinforcement work required for encasement, installation, or construction of the work of the various sections of Division 16 is included as a part of the work under the respective sections, including duct banks, handholes, manholes and housekeeping pads.

F. Provide all utility work shown on Contract Drawings, and per SMUD Drawings, Specifications and Standards. Coordinate with the Sacramento Municipal Utility District (SMUD). Work includes, but is not limited to, secondary conduits and conductors, service pole riser, Utility Meter, and required grounding and bonding. The City will pay all SMUD fees.

1.02 APPLICABLE CODES AND REQUIREMENTS

A. The work of this Section and all sections in Division 16 shall comply with the latest editions of the following:

1. NEC (NFPA 70) – National Electrical Code
2. UL- Underwriters Laboratories
3. NEMA- National Electrical Manufacturers Association
4. NETA – International Electrical Testing Association
5. NFPA 820 – National Fire Protection Association
6. Title 8, Subchapter 5, California Administrative Code – Electrical Safety Orders (Cal-OSHA)

B. All electrical equipment shall be listed by and shall bear the label of UL, or by an independent testing laboratory acceptable to the Engineer.

C. Installation of electrical equipment and materials shall comply with the NEC, Cal-OSHA, state building standards, and applicable local codes and regulations.

D. Where the requirements of the specifications conflict with the NEC, UL, NEMA, or other applicable standards; the more stringent requirements shall govern as approved by Engineer.

1.03 SIGNAGE

A. Provide danger, caution, and warning signs and equipment identification markings in accordance with Cal-OSHA and NEC requirements. Provide the following signage at a minimum, unless otherwise stated in individual equipment specifications sections.

1. ~~Arc Flash Labels – Provide Arc Flash labels as required per NEC Article 110.16 and Section 16341 and if this project requires an electrical study. Inscribe the label with the maximum available fault current at Panelboard main breaker with the date of calculation, per NEC Article 110.24.~~

2. Local Disconnect Switches and Equipment Nameplates– Each local disconnect switch and equipment, shall be legibly marked to indicate its purpose. Plastic tag shall have minimum ¼-inch lettering. Inscription shall include equipment name, equipment tag number, and the source of power.

3. Warning Signs- Provide signs near equipment that can start automatically, to read: "Caution Equipment to Start Automatically".

1.04 INSPECTION OF THE SITE AND EXISTING CONDITIONS

A. If pre-bid meeting is required and it includes a site visit; visit the sites and determine conditions at the sites and at all existing structures in order to become familiar with all existing conditions and electrical systems which will, in any way or manner, affect the work required under this Contract. No subsequent increase in Contract cost will be allowed for additional work required due to failure to fulfill this requirement.

B. Protect all existing aboveground and underground utilities during construction. Pay for all repairs should damage to underground utilities occur during construction.

1.05 RESPONSIBILITY

A. Complete systems functionally operational in accordance with the intent of these Contract Documents.

B. Coordinating the details of facility and process equipment layouts and construction for all Specification Divisions which affect the work covered under Division 16.

C. Furnishing and installing all incidental items not actually shown or specified, but which are required by good practice to provide complete functional systems.

D. Coordination with other Division for equipment electrical, wiring and cable requirements.

E. Coordinate, provide and install all SMUD utility requirements for electrical services.

F. Submit a complete copy of red lined as-builts every month after the Notice to Proceed date in accordance with the Record Drawing requirements of Section 01105. At end of project, prior to final acceptance and final payment, field confirm red lined as-builts with City Operation and Maintenance staff. Confirmation shall review in field the installed work versus the red lined as-builts. City Operation and Maintenance staff must approve the red lined as-builts for project acceptance and payment.

1.06 INTENT OF DRAWINGS

A. The Contract Drawings indicate the extent, general location, and arrangement of equipment. Duct bank and conduit runs are diagrammatic and may not show the exact locations for installation. Verify the locations of conduit stub-ups based upon conduit entry space of equipment furnished from the manufacturer's certified shop drawings and by inspection of the actual equipment to be installed. Coordinate with serving utilities and City for exact location of substructures.

B. In general, where the background on Contract Drawings has been screened, the area screened is work other than electrical, unless otherwise noted. Work under this Division 16 is shown heavier for contrast.

1.07 DUCTBANKS AND TRENCHES

A. "Duct banks" contain four or more conduits and shall be encased with non-reinforced concrete; refer to Detail DB. Electrical "trenches" contain three or

less conduits and shall have sand backfill and concrete cap; refer to Detail TD or the plans.

B. As-built the duct banks and trenches. Provide physical locations with width and depth call outs.

1.08 SUBMITTALS

A. General

1. Provide manufacturers' descriptive information and shop drawings for all equipment, material, and devices furnished under Divisions 16 and 17. Submit schematic (elementary) diagrams, equipment dimensional drawings, interconnection and connection diagrams, catalog cut sheet information, nameplate schedules, and calculations in accordance with Section 01105 and this Section. Device designations and symbols for schematic (elementary) connection or interconnection diagrams shall conform to the latest edition of NEMA ICS 1.
2. Submit complete electrical drawings for all equipment furnished in accordance with other Divisions that interface with electrical equipment. These drawings shall contain panel elevation, bill of materials, control schematic diagrams (complete with terminal numbers, device names, field equipment tag numbers) to provide complete identification of the circuits and provide coordination between the equipment. Both AutoCAD and PDF-type files are required.
3. Submit listing of equipment nameplates complete with inscriptions for review.
4. Check submittals for proper number of copies, adequate identification, correctness and compliance with Drawings and Specifications.
5. Submit submittals and Operation and Maintenance (O&M) Manuals per Section 01330.

B. Submit certified shop drawings and diagrams as follows, separate submittals for each facility:

1. Layouts indicating conformity with space requirements, including front and rear access requirements.
2. Detailed anchoring requirements, including stamped and signed seismic calculations confirming anchor type, size and depth.
3. Assembly drawings in sufficient detail to identify every part of the specified equipment, including bills of material.

4. General dimension, outline, and panel, section, and structure layout drawings showing the principal dimensions of the equipment, the location of all devices therein, and the size of electrical conduit windows and cable connections. Include front, rear, side elevations and top view. Include front and rear access requirements. Provide finish and materials, temperature limitations, and grounding requirements. Provide nameplate inscription schedule. Provide manufacturer anchoring requirements to confirm seismic results and equipment weights.

C. Seismic

1. Submit proof of compliance that the following electrical equipment items are seismically anchored: Panelboards, Motor Control Centers, Switchboards and Substation Transformers. Proof of compliance shall include complete anchorage details coordinated with equipment mounting provisions showing weights, calculations, anchoring points, welding, and any special considerations. Proof of compliance for each listed piece of equipment is to be prepared, stamped and signed by a licensed civil engineer in the state of California.

1.09 AREA DESIGNATIONS

A. General

1. Raceway system and enclosures shall comply with Section 16110 and the plans.
2. Table 1 lists the type of Electrical Equipment and Materials to be used based on applied area in Table 2.

Table 1- Electrical Equipment and Materials					
Applied Area Classification	Enclosure, Pull or J-Box NEMA Rating	Device Box or Small Enclosure	Strut and Mounting Hardware	Exposed Conduit System	Concrete Encased Conduit System
Interior General	NEMA 12	Cast Steel	Electro-galvanized Steel	Rigid Galvanized Steel	N/A
Corrosive & Class 1, Div.1	NEMA 7	304 Stainless Steel	304 Stainless Steel	316 Stainless Steel, Explosion Proof Flexible	N/A
Exterior Wet	NEMA 4	Cast Steel	304 Stainless Steel	Rigid Galvanized Steel	PVC SCH 40
Corrosive & Class 1, Div.2	NEMA 4X (non-sparking) NEMA 7 (sparking)	PVC Coated Cast Steel	304 Stainless Steel	PVC Coated Rigid Galvanized Steel	PVC SCH 40

3. Table 2 identifies Area Classifications.

Table 2- Areas Classifications		
Building/Facility	Area	Area Classification
Control Building	All Rooms	Interior General
Storm Drainage Sump (Storm)	Interior of Storm Wetwell	Corrosive & Class 1, Div. 1
	Outside of Storm Wetwell	Exterior Wet
Sewage Sump (Sewage)	Interior of Sewage Wetwell	Corrosive & Class 1, Div. 1
	Outside of Sewage Wetwell (60" high located 3' from hatch edge)	Corrosive & Class 1, Div. 2
Metering Vault	Interior	Corrosive & Class 1, Div. 2
General Site	All exterior Site Areas not otherwise designated	Exterior Wet

4. Installations in hazardous locations shall conform to the requirements of the National Electrical Code.

B. Material Requirements

1. NEMA 4 and 12 enclosures shall be steel coated with ANSI 61 light grey polyester paint.
2. NEMA 4X enclosure material shall be 304 stainless steel.

1.10 TESTS

A. Furnish all necessary testing equipment and pay all costs of tests, including all replacement parts and labor, due to damage resulting from damaged equipment or from testing and correction of faulty installation.

B. Factory Acceptance Testing shall take place within 100 miles of project site. If Factory Acceptance Testing is greater than 100 miles, reimburse City and Engineer for travel and lodging expenses at no extra cost to the City.

C. All test forms shall be submitted and approved prior to scheduling testing.

D. Provide a minimum of a two-week notification of Field Tests to the Engineer. Field Tests shall be witnessed and signed off by the Engineer in order to be considered valid.

E. NETA testing to be performed prior to energizing equipment.

1.11 TEMPORARY POWER AND LIGHTING

A. Provide temporary power and lighting for in accordance with NEC article 590. The average lighting level (foot-candle) shall meet OSHA 1926.56 and CAL-OSHA requirements.

1.12 DEFINITIONS (APPLICABLE TO SPECIFICATIONS AND DRAWINGS)

A. Above Grade – Not buried in ground and not embedded in concrete slab on ground.

B. Below Grade – Buried in ground and below floor-slab as applicable, and not embedded in concrete slab on ground.

C. Certified: – Confirmed to be accurate, or as represented, or as meeting standards.

D. Concealed – Inside building above grade and located within walls, furred spaces, crawl spaces, attics, above suspended ceiling, etc. In general, any item not visible or directly accessible.

E. Connect – Complete hookup of item with required services, including conduits, wires, and other accessories.

F. Engineer- Design Engineer, Inspector, or City of Sacramento designated construction coordinator

G. Exposed – Either visible or subject to mechanical or weather damage, indoor or outdoor, include areas such as mechanical and storage rooms. In general, any item that is directly accessible without removing walls, panels, ceilings or other parts of structure.

H. Underground – Buried in ground, including under building slabs.

I. Wiring – Electrical conduit, raceway, conductors and connections.

1.13 WARRANTY

A. The warranty for all provided equipment shall be not less than one year after approved and witnessed startup and receipt of approved as-built drawings and O&M Manuals, or City beneficial use, whichever is later.

PART 2 - PRODUCTS

2.01 GENERAL

A. All equipment and materials shall be new, shall be listed by UL, and shall bear the UL label where UL requirements apply. All equipment and materials shall be the products of experienced and reputable manufacturers in the industry. Similar items in the work shall be products of the same manufacturer. All equipment and materials shall be of industrial grade standard of construction.

B. Where a NEMA enclosure type is indicated in a non-hazardous location, utilize that type of enclosure, even though certain modifications such as cutouts for control devices may negate the NEMA rating.

2.02 MOUNTING HARDWARE

A. Miscellaneous Hardware

1. All nuts, bolts, and washers shall be 304 stainless steel.
2. Threaded rods for trapeze supports shall be continuous threaded, galvanized steel, and 3/8-inch diameter minimum.
3. Strut materials shall be per Table 1 in paragraph 1.10 Area Designations.
4. Where contact with concrete or dissimilar metals may cause galvanic corrosion, suitable non-metallic insulators shall be utilized to prevent such

corrosion. Where ends are exposed from cutting, coat ends of strut with zinc rich galvanizing compound.

5. Anchors for attaching equipment to concrete walls, floors and housekeeping pads shall be 304 stainless steel chemical anchors unless Contract Drawing details call for cast in place anchorage.

2.03 ELECTRICAL IDENTIFICATION

A. Submit list of electrical equipment with associated tag inscription and tag materials for approval.

B. All conduits, cables and individual wires shall be labeled. All terminal blocks shall be labeled.

C. All equipment, control devices, and panels shall include nameplate with description and tag number.

2.04 EQUIPMENT FINISH

A. Provide materials and equipment with manufacturers, standard finish application system with ANSI 61, light gray. Provide two spray cans of touchup paint, for each color. Some exterior equipment shall have other finish applied as specified in the individual equipment specifications.

~~2.05 OUTDOOR EQUIPMENT~~

~~A. Provide equipment and devices to be installed outdoors capable of continuous operation within an ambient temperature range of 0° C to 50° C. Equipment must be capable of proper operation at rated output continuously in this ambient temperature range in direct sun.~~

2.06 ELECTRICAL STUDY

The City will perform the electrical study. The contractor shall provide the following information to assist with the electrical study:

1. All cable sizes

2. All cable lengths

3. Type of each conduit, ie either PVC or metal

4. Name of manufacturer, model number, AIC rating, and amp rating of all protective devices. This shall include circuit breakers, MCPs, fuses, and etc.

5. Nameplate data on each pump

6. AIC rating of the MCC and switchboard.

PART 3 - EXECUTION

3.01 GENERAL

A. Incidentals: Provide all materials and incidentals required for a complete and operable system, even if not required explicitly by the Specifications or the Drawings. Typical incidentals are terminal lugs not furnished with vendor supplied equipment, compression connectors for cables, splices, junction and terminal boxes, and control wiring required by vendor furnished equipment to connect with other equipment indicated in the Contract Documents.

B. Field Control of Location and Arrangement: The Drawings diagrammatically indicate the desired location and arrangement of outlets, conduit runs, equipment, and other items. Exact locations shall be determined based on the physical size and arrangement of equipment, finished elevations, and other obstructions.

1. Where "home runs" are shown, route the conduits in accordance with the indicated installation requirements. Routings shall be exposed or encased as indicated.

2. 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 fixture locations and sensors shall be adjusted to avoid obstructions, hatches, openings and room reserved for equipment removal.

C. Workmanship: All materials and equipment shall be installed in strict accordance with the printed recommendations of the manufacturer. Installation shall be accomplished by workers skilled in the work. Installation shall be coordinated in the field with other trades to avoid interferences.

D. Protection of Equipment and Materials: Protect all materials and equipment against damage from any cause. 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, dust, dirt, plaster, or paint. All moving parts shall be kept clean and dry. Replace or refinish all damaged materials or equipment, including face plates of panels, at no additional expense to the contract.

E. Cap and label all spare conduits. Include pull tape in all spare conduits.

3.02 CONCRETE SLABS ON GRADE

A. Concrete slabs on grade shall be provided for all outdoor free-standing electrical equipment. Slabs on grade shall be four inches above the surrounding grade and a minimum of two inches larger in all dimensions than the equipment, or greater if required by anchoring calculations or shown on Contract Drawings.

3.03 EQUIPMENT ANCHORING

A. Floor-supported equipment and conduits shall be anchored in place by methods that will meet California seismic requirements.

~~B. Seismic sill leveling channels embedded in the concrete pad shall be installed for the Panelboard. Refer to Contract Drawing Detail EM.~~

C. Anchoring methods and leveling criteria specified in the printed recommendations of the equipment manufacturers are a part of the work of this Contract. Such recommendations shall be submitted as shop drawings.

3.04 EQUIPMENT IDENTIFICATION

A. General: Equipment and Devices shall be Identified as Follows:

1. Nameplates shall be provided for all equipment and instruments. Equipment description and equipment tag number, and electrical power source shall be utilized on all nameplates. If no tag number is given, assign and submit a number for approval.
2. All conduits and cables shall be labeled. Provide conduit tag, cable tag and wire tag label inscriptions. If no tag number is given, assign and submit a number for approval.
3. Furnish typewritten circuit directories for all panelboards; the circuit directory shall accurately reflect the load description connected to each circuit.

3.05 CUTTING AND PATCHING

A. Lay out work carefully in advance. Do not cut, drill, or notch any structural member or building surface without the specific approval of the Engineer. 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.

3.06 LOAD BALANCE

A. The Contract Drawings and Specifications indicate circuiting to electrical loads and distribution equipment. Balance electrical load between phases as nearly as possible on panelboards.

3.07 PHASE ARRANGEMENT, MOTOR AND GENERATOR ROTATION

A. The phase arrangement on three phase buses in electrical equipment shall be A, B, C (1, 2, 3) from front-to-back, top-to-bottom, left-to-right as viewed from the front of equipment or Panelboard.

B. Coordinate with SMUD to insure clockwise rotation A, B, C (1, 2, 3) as verified by the Panelboard phase rotation relay.

C. After final service connections are made, check and correct the rotation of all motors and any fixed generator. Coordinate rotation checks with equipment preoperational testing. Correct any discrepancies by shifting motor or generator conductors.

3.08 CLEANING AND TOUCHUP PAINTING

A. Keep the premises free from an accumulation of waste material or rubbish. Upon completion of the work, remove all materials, scraps, and debris from the premises and from the 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 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.

B. The interior of all electrical equipment and panels and enclosures, including windings of dry type transformers, shall be vacuumed and wiped free of dust just before final acceptance. Shutting off equipment to clean and wipe down shall be done at times as approved by the Engineer.

3.09 INSPECTION

A. Allow materials, equipment, and workmanship to be inspected at any time by the Engineer and City or their representatives. Any material not inspected and covered; such as in a trench or wall shall be exposed without any additional compensation.

B. Correct the 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.

3.10 OPERATION AND MAINTENANCE MANUALS

A. Provide Operation and Maintenance Manuals in hard cover, 3-ring binders, bound volumes per each facility, number as required to accommodate material 8½-inch x 11-inch for text and 11-inch x 17-inch half-sized drawings and also in accordance with provisions of Section 01770. Provide the number of copies specified. Electrical and Instrumentation O&Ms shall include the following as a minimum:

1. Operation, maintenance and renewal parts information for all equipment furnished under this Section.
2. Set of complete, final, as-reviewed and accepted manufacturer's or vendor's descriptive information.
3. As-built electric schematics, equipment, elevations, layouts, and installation drawings showing equipment as it was installed and connected. Provide PDF and AutoCAD formats on disk within O&Ms.
4. Index of all equipment suppliers with a list of current names, addresses, and telephone numbers of those who should be contacted for service, information, and assistance.
5. All factory and field test results.
6. Information listed under individual specification submittal requirements.
7. Complete facility Interconnection Diagrams for all equipment except lighting and receptacles. Show field wiring from equipment origin numbered terminal to destination numbered terminal in block diagram format. Include wire labels, cable labels, conduit numbers, handholes, junction boxes, etc.

3.11 RECORD DRAWINGS

A. Provide two sets of full-sized marked-up as-built Contract Drawings in accordance with specifications. Show all departures from original Drawings, underground cable, conduit, or duct runs dimensioned from established building lines, and all electrical work revisions. As-built drawings shall be initialed by the Engineer prior to submission for drafting. Obtain two new, clean sets of Contract Drawings for as-built production after each as-built submittal.

3.12 SERVICE CONTINUITY, START-UP AND SHUTDOWNS

A. Make no outages without the prior written authorization of the Engineer. Include all costs for temporary wiring and overtime work required in the Contract price. Remove all temporary wiring at the completion of the work. Shutdowns and startups shall be scheduled two weeks in advance, upon approval from the Engineer. Schedule of shutdowns and startups shall be limited between Tuesday and Thursday from 9:00 a.m. to 3:00 p.m., unless prior approval has been given from the Engineer.

3.13 TESTING

A. All testing shall be witnessed by the Engineer. All testing sheets shall be signed off by the Engineer to be considered valid. Refer to Sections 01650 and 16950 for further testing requirements.

B. Perform miscellaneous conductor testing and wiring device testing per Sections 16120 and 16140 during the Pre-Demonstration period.

C. Pre-Demonstration work under Division 16 and Division 17 includes; Factory Acceptance Testing, Manufacturer certification, Instrumentation Supplier certification, NETA Field Testing, equipment start-up, instrumentation simulation, PLC inputs/outputs and SCADA verification, approval of electrical and instrumentation O&M Manuals, and electrical and instrumentation training.

D. Demonstration period for electrical work shall include 7-day functional testing of the entire system. Perform Demonstration Testing per Section 01650.

3.14 SPARE PARTS

A. Provide spare parts for the switchgear and MCC per the manufacturer's recommendations

END OF SECTION

SECTION 16110 - ELECTRICAL RACEWAY SYSTEMS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Provide electrical raceway systems, complete and in place, in accordance with the Contract Documents.

B. All substructures utilized for Sacramento Municipal Utility District (SMUD) secondary service, including underground conduits, pole risers, and required substructures, shall be per SMUD standards.

1.02 SUBMITTALS

A. Submit for review in accordance with Sections 01330 and 16050.

B. Submit shop drawings and catalog data sheets of all raceways, fittings, boxes, supports, handholes, manholes, and mounting hardware; marked where applicable to show proposed materials and finishes.

C. Manhole shop drawings showing dimensions, construction details, racks, materials, coatings and cover inscriptions.

D. Fire stop shop drawings showing wall or floor fire rating, materials, depth and penetration dimensions; firestop dimensions, materials, installation instructions and fire rating of the assembly. Manufacturer's training certificates for all personnel installing fire stops.

E. Submit nameplate inscription schedules for approval.

F. Manufacturer's training certificates for all personnel installing PVCRGS.

1.03 QUALITY ASSURANCE

A. Seismic Design Requirements: All raceway systems to be furnished under this Section shall be designed and constructed to meet the seismic requirements of Section 16050 – Electrical Work, General.

PART 2 - PRODUCTS

2.01 GENERAL

A. Pull and junction boxes, fittings, and other indicated enclosures which are dedicated to the raceway system, shall comply with the requirements of this Section.

B. Electrical metallic tubing, intermediate metallic conduit, set-screw type couplings or fittings are not allowed.

C. No conduit shall be smaller than ¾-inch. All underground conduits shall be a minimum of one inch.

D. Conduits containing manufacturer cables shall be sized based on approved manufacturer cable at minimum 40-percent fill, unless approved by the Engineer.

2.02 RIGID GALVANIZED STEEL (RGS) CONDUIT

A. Rigid steel conduit shall be mild steel, hot-dip galvanized inside and out.

B. Rigid steel conduit and all appurtenances shall be manufactured in accordance with ANSI C80.1 and UL-6.

C. Acceptable products include: Allied Tube & Conduit, or equal.

2.03 RIGID NON-METALLIC (PVC40 & PVC80) CONDUIT

A. Rigid non-metallic conduit shall be Schedule 40 PVC, sunlight resistant, UL listed for concrete encasement. Conduit shall have factory-formed bell on one end.

B. Rigid PVC conduit shall be manufactured in accordance with NEMA TC-2 – Electrical Plastic Tubing and Conduit, and UL-651 – Standard for Rigid Non-metallic Conduit standards.

C. Conduit shall be marked for use with conductors having 90° C insulation.

D. Provide PVC Schedule 80 conduits for primary and secondary electrical service as required by the Sacramento Municipal Utility District.

E. Acceptable products include: Carlon Plus PVC, or equal.

2.04 RIGID PVC COATED GALVANIZED STEEL (PVCRGS) CONDUIT

A. The conduit, prior to PVC coating, shall meet the requirements for RGS conduit above.

B. PVC coating shall be manufactured in accordance with NEMA RN-1 and UL-6. The PVC coating shall be bonded to the outer surface of the galvanized conduit. The bond between the coating and the conduit surface shall be greater than the tensile strength of the coating.

C. PVC coating thickness shall be not less than 40 mils. Interior coating shall be minimum 2 mil urethane. All male threads on conduit, elbows and nipples shall be protected by urethane coating.

D. Acceptable products include: Robroy Plasti-Bond Red, T&B OCAL-Blue, or equal.

2.05 STAINLESS STEEL (SSC) CONDUIT

A. Stainless steel conduits, couplings, and fittings shall conform to UL-6A and manufactured with 316 grade stainless steel.

B. Acceptable products include: Calbrite Stainless Steel Conduit Systems, or equal

2.06 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Liquidtight flexible metal conduit shall be constructed of a flexible hot dipped galvanized steel core with a sunlight resistant thermoplastic outer jacket conforming to UL-360.

B. Acceptable products include: AFC Cable Systems Type LFMC or equal.

2.07 EXPLOSIONPROOF FLEXIBLE METAL CONDUIT

A. Explosionproof flexible conduit shall conform to requirements of Class I, Division 1 hazardous atmospheres per NEC Articles 500 series.

B. Flexible length shall consist of asphalt impregnated woven cloth duct, brass inner core, and bronze braid covering. End fittings shall be forged brass or cast bronze.

C. Provide special lengths and conduit size as noted on Contract Drawings. For example, gas analyzer cable shall be encased in ½" by 84" long explosionproof flexible metal conduit.

D. Acceptable products include: Crouse-Hinds #ECGJH series, or equal.

2.08 FITTINGS AND CONDUIT BODIES

A. General

1. All cast and malleable iron fittings for use with metallic conduit shall be the threaded type with five full threads.

2. All fittings and conduit bodies shall have neoprene gaskets and non-magnetic stainless steel screws. All covers shall be attached by means of holes tapped into the body of the fitting. Covers for fittings attached by means of clips or clamps will not be allowed.

3. Conduit, fittings, and conduit bodies in hazardous locations shall be suitable for the Class and Division indicated.

B. Fittings and Conduit Bodies for RGS Conduit

1. Use insulated throat grounding bushings for all rigid steel conduit ends. Bushings shall be threaded zinc-plated malleable iron grounding bushings with bonding screw and insulated throat rated for 150 degrees C. Acceptable products include: T&B Grounding

and Bonding Bushings, OZ Gedney Type BLG, Appleton Threaded Grounding Bushings, or equal.

2. Watertight hubs for rigid steel conduit shall be male thread type zinc-plated malleable iron with recessed "O" ring sea, insulated throat and ground bonding locknut. Acceptable products include: OZ Gedney Type CHM-T, Myers STG series, or equal.

3. For conduits bodies for rigid steel conduit sized as required by the NEC, use cast iron conduit bodies and covers with captive stainless steel screws and neoprene gaskets. Acceptable products include:t Crouse-Hinds Form 8 threaded condulets, OZ Gedney Form 8 threaded conduit bodies, or equal.

C. Fittings for Liquidtight Flexible Metal Conduit

1. Liquidtight flexible metal conduit fittings shall have cadmium-plated malleable iron body and gland nut with cast-in lug, brass grounding ferrule threaded to engage conduit spiral and o-ring seals around the conduit and box connection and insulated throat. Only straight or 45° fittings shall be used, 90° or elbow fittings are not acceptable.

2. For areas designed as corrosive, use galvanized steel-insulated throat connectors for liquid-tight flexible metal conduit, suitable for use in wet locations, with a minimum 40 mil PVC exterior coating and pressure sealing sleeves. Acceptable products include: Robroy Plasti-Bond Red Liquid-tight Connectors, Occidental Coating Company OCAL-Blue Double-Coat Sealtight Connectors, Perma-Cote Industries Supreme Liquid-tight Connectors, or equal.

D. Fittings and Conduit Bodies for PVC conduit

1. All fittings for use with rigid non-metallic conduit shall be PVC, solvent welded type schedule 40 or 80 compatible with the conduit.

2. Provide standard and special radius 22.5°, 45° & 90° elbows, standard, long line, repair & 5° couplings, male & female terminal adaptors, end bells, expansion joints, and tapered conduit plugs. Acceptable products include: Kraloy special radius elbows, CPxx, 5ECxx, LLCxx, RECxx, TAxx, FAxx, MEBxx, UTPxx series, or equal.

E. Fittings and Conduit Bodies for PVCRGS conduit

1. Hubs for PVCRGS conduit shall have a minimum 40-mil PVC exterior coating, a urethane interior coating, and pressure sealing sleeves. Acceptable products include: Robroy Plasti-Bond Red Type ST Hub, Perma-Cote Industries Supreme Type ST Hub, T&B OCAL-Blue Double-Coat Type ST Hub, or equal.

2. Conduit bodies for use with PVCRGS conduit shall be cast iron conduit bodies and covers with captive stainless steel screws, 40-mil PVC exterior coating with 2-mil internal urethane coating, and pressure sealing sleeves on all conduit openings. Acceptable

products include: Robroy Plasti-Bond Red Form 8 Conduit Bodies, T&B OCAL-Blue Double-Coat Form 8 Conduit Bodies, Perma-Cote Industries Supreme Form 8 Conduit Bodies, or equal.

2.09 JUNCTION AND PULL BOXES

A. Junction and pull boxes shall be provided as required to make the installation in accordance with NEC. Size junction and pull boxes in accordance with the NEC for the conduit sizes and number of conductors enclosed in the box. Enclosure NEMA rating shall be per Section 16050-1.09 Area Designations, Table 1 and Table 2.

B. Cast steel boxes shall be rated NEMA 3R, fabricated from cast ferrous alloy finished with zinc electroplate and aluminum polymer paint. Integrally cast threaded hubs or bosses shall be provided for conduit entrances and shall provide for full 5-thread contact on tightening. Drilling and threading shall be done before galvanizing. Cover plates shall be of similar hot-dip galvanized cast ferrous alloy material. A full body neoprene gasket shall be provided with the cover. Type 316 stainless steel screws shall be provided for covers. Exposed boxes requiring surface mounting shall have integrally cast mounting tables. Embedded boxes shall have a bonded PVC jacket. Acceptable products include: OZ Gedney FD Series, Crouse-Hinds FD Series, Appleton FD Series, Occidental Coating Company OCAL FD Series, or equal.

C. NEMA 4 rated enclosures shall be 14-gauge or 16-gauge with continuously welded seams, continuous door hinge, external operating clamp cover, external mounting feet, internal panel, ground stud on panel and door, oil-resistant gasket and a polyester powder coating inside and outside. Acceptable products include: Hoffman Bulletin A51NF Boxes, or equal.

D. NEMA 4X rated enclosures shall be 14-gauge or 16-gauge 304 stainless steel with continuously welded seams, continuous door hinge, external operating clamp cover, external mounting feet, internal panel, ground stud on panel and door, oil-resistant gasket. Acceptable products include: Hoffman Bulletin A51S Boxes, or equal.

E. NEMA 7 enclosures shall be rated for Class I, Division 1, Group D hazardous atmospheres, zinc electroplated cast ferrous alloy with external mounting tabs. Conduit hubs and covers shall provide 5-thread contact. Acceptable boxes include: Crouse-Hinds GUJ, EAB & GUB series, or equal. Acceptable larger enclosures include: Appleton AJBEWxxxxxx, or equal.

F. NEMA 12 rated enclosures shall be 14-gauge or 16-gauge steel with continuously welded seams, continuous door hinge, external operating

clamp cover, external mounting feet, internal panel, ground stud on panel and door, oil-resistant gasket and a polyester powder coating inside and outside. Acceptable products include: Hoffman Bulletin A51CH, or equal.

2.10 HANDHOLES

A. Handholes and special marking covers shall be designed for AASHTO H-20 traffic loading. Boxes shall include extensions for interior dimension shown on Contract Drawings. Handhole covers shall be checker plate, hot-dip galvanized after fabrication and provided with security "Penta" style bolts.

B. Handholes shall be escribed "ELECTRIC" or "SIGNAL" along with the equipment number permanently identified on the cover.

C. Acceptable products include: Christy Concrete B1017, B1324, or B1730 with extensions, check plate hot dipped galvanized cover, and security bolts, or equal.

2.11 MANHOLES

A. Manholes shall be reinforced precast concrete designed to withstand AASHTO H-20 loading at the depth shown on the drawings. Cover, neck and extensions shall be 36-inch clearance. Top slab shall be grooved to accept extension rings. Manhole joints and extension rings shall be sealed with Henry Ram-Nek primer and joint sealer, or equal. Manhole exterior shall be coated with 2#/yd^2 crystalline waterproofing Xypex Concentrate, or equal.

B. Duct entries shall be Schedule 40 PVC endbells cast into the manhole walls minimum 14" above floor and below ceiling. Pulling eyes shall be #304 stainless steel located on each wall and rated for 10,000# pulling force. Ground pig tails #4/0 copper shall be stubbed out of each duct entrance window and exothermically welded to ground plate on the interior walls. Floors shall slope to drain into a 12" sump. Each manhole shall be supplied with 304 stainless steel access ladder.

C. Manhole covers shall be cast with embossing: "DANGER-CONFINED SPACE". Manholes containing medium voltage conductors shall have the cover additionally embossed: "DANGER-HIGH VOLTAGE". Manhole equipment number shall be permanently identified with welded inscription on the cover.

2.12 MANHOLE AND HANDHOLE CABLE RACKS

A. Cable racks shall consist of 50% glass-reinforced polymer nonmetallic material with nominal 250# load rating. Manhole cable racks shall be a 36"

wall stanchion with slots accepting removable arms nominal size 4"W, 20"L. Handhole racks shall be one piece arms nominal size 3"W, with 5"H mounting surface. Acceptable products include: Underground Devices CR36B, RA20LP, HDL, MMxx series, or equal.

~~2.13 DUCTS AND SPACERS~~

~~A. Underground ducts shall be Schedule 40 PVC with non-reinforced concrete encasement for four or more ducts.~~

~~B. Underground ducts shall be Schedule 40 PVC with concrete cap for three or less ducts.~~

~~C. Concrete shall be per Section 03300 for duct banks, colored red.~~

~~D. Refer to Section 16110 – Electrical Raceway Systems for PVC conduit specification. Provide end bells on all conduit ends.~~

~~E. Acceptable products include: Carlon Snap-Loc Spacers, or equal, with minimum 2" duct separation.~~

2.14 WARNING TAPE

A. Provide heavy-gauge, red, non-adhesive polyethylene tape of six-inch minimum width, four-mil nominal thickness, with black lettering, for use in trenches containing electric circuits. Use tape with the following printed warning: "CAUTION-ELECTRIC LINE BURIED BELOW".

B. Acceptable products include: Harris Industries, Inc. Underground Tape Catalog No. UT-29, or equal.

2.15 CABLE TRAYS

A. Cable trays shall be plain finish 6063-T6 aluminum alloy welded construction, NEMA VE1 load class 12C. Tray shall have 5" side rail height of I-beam configuration, 1" wide bottom rungs on 9" centers, 24" width, unless shown otherwise on the drawings. Nominal one-rail mechanical properties shall be $I_x = 2.28\text{-in}^4$ and $S_x = 0.859\text{-in}^3$.

B. Cable tray system mating fittings shall be the same material as the straight sections with 3" tangent overlap, 12" minimum radius and 304 stainless steel hardware. Fittings shall include: horizontal elbows, tees & reducers, vertical inside & outside elbows, covers, splices, fire wall penetration sleeves and compatible accessories.

C. Acceptable products include: Legrand Itray PW 5A12C series, or equal.

2.16 SEALING FITTINGS AND UNIONS

A. Conduit seals and unions shall conform to UL 886 and the requirements of Class 1, Division 1 and 2, Group D, hazardous atmospheres per NEC Article 500 series.

B. The seal fittings shall be fabricated from cast ferrous alloy finished with zinc electroplate and aluminum acrylic paint. All vertical fittings shall be provided with stainless steel drain fittings. Sealing compound used for seal fittings shall be rated for hazardous area. Unions shall be electrogalvanized ferrous alloy type.

C. Acceptable products include: Crouse-Hinds Type EYS & EYD series with Chico A&X, Appleton UNF & UNY, Crouse-Hinds UNF & UNY, or equal.

2.17 EXPANSION/DEFLECTION COUPLINGS

A. Provide expansion/deflection couplings for use wherever conduit crosses an expansion joint. The couplings shall alleviate longitudinal, angular, and shear conduit stress caused by differential settlement. Acceptable products include: Crouse-Hinds Type XD, Appleton Deflection and Expansion Couplings, or equal.

2.18 CONDUIT TAGS

A. Provide permanent, stainless steel conduit tags with conduit numbers as designated on the conduit schedule drawings, pressure stamped onto the tag. Tags relying on adhesives or taped-on markers are not acceptable. Attach tags to conduits with 316 stainless steel tie wire at each end of the conduit.

B. Conduit tags in underground installations shall be engraved phenolic tags and applied with epoxy to the wall of the manhole or handhole above the conduit entrance, or attached to conduit end bell with black nylon cable tie.

2.19 SUPPORTS AND FITTINGS

A. Strut and mounting hardware shall be per Table 1 in Section 16050 – Electrical Work, General.

B. Strut and mounting hardware shall be sized to meet seismic requirements.

C. Strut and mounting hardware shall be stainless steel. All conduit supports and conduit fittings shall be of same material as conduit, including pipe straps, clamp back spacers, beam clamps, and other supports and fittings. For example, if conduits are PVC coated galvanized rigid steel, all conduit clamp back spacers shall be PVC coated galvanized rigid steel.

2.20 CONDUIT PENETRATION SEALS AND SLEEVES

A. Conduit penetration seals shall be a modular, mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the conduit and the opening. The elastomeric element shall be sized and selected per the manufacturer's recommendations and shall be suitable for use in standard service applications.

B. Sleeves shall be the thermoplastic type with water stops, suitable for poured wall construction.

C. Conduit penetration seals and sleeves shall be complete assemblies supplied by a single manufacturer.

D. Acceptable products include: Thunderline Corporation Link-Seal and Plastic Sleeves, Calpico Inc. Pipe Linx and Plastic Sleeves, or equal.

2.21 DUCT SEAL

A. Duct seal shall be a non-hardening compound designed as a waterstop and moisture barrier for sealing the annular space between conduit and electrical conductors and cables.

B. Acceptable products include: O-Z Gedney DUX, or equal.

2.22 PULL TAPE

A. Pull tape shall be minimum ½-inch in width, suitable for 1,250 pounds of pull strength.

B. Acceptable products include: Neptco Muletape WP1250P, or equal for non-detectable pull tape.

2.23 FIRESTOPS

A. Fire stop sealant/packing and pillow/putty systems shall have either intumescent, endothermic or ablative property with fire rating 1 through 4-hours in conformance with ASTM E814. Fire stop shall be equal to the wall or ceiling in which the penetration is located.

B. Fire stop sealant shall have intumescent expansion of up to 10 times original size when exposed to 300˚F heat source, rated up to 4-hours. Packing material shall be asbestos-free, inorganic woven material Acceptable products include: 3M Fire Barrier Sealant and Packing CP25WB+, PM4 or equal.

C. Fire stop pillows shall be self-locking, graphite-free, intumescent material rated up to 3-hours. Pillow shall have a release feature for reuse or reconfiguration. Putty shall be moldable, self- adhering, intumescent

material rated up to 4- hours. Acceptable products include: 3M Fire Barrier Self-Locking-Pillows and Moldable Putty+, or equal.

PART 3 - EXECUTION

3.01 GENERAL

A. Raceway systems shall be electrically and mechanically complete before conductors are installed. Bends and offsets shall be smooth and symmetrical, and shall be accomplished with tools designed for this purpose. Factory elbows shall be utilized wherever possible.

B. Raceway sizes shown on Drawings are minimum dimensions based on designed equipment.

C. Conduits located underground shall be backfilled with red colored concrete capped where three or less conduits in common trench, or encased in non-reinforced red colored concrete where duct banks contain four or more conduits. Duct bank conduits shall be supported with conduit spacers installed every five feet. Provide a minimum cover of two feet over the top of conduit for all underground raceways.

D. Underground raceways shall be inspected and approved prior backfill or concrete placement. Where raceways are indicated but routing is not shown, such as home runs or on conduit schedules; raceway routing shall be in accordance with the NEC.

E. Routings shall be adjusted to avoid obstructions. Coordinate with all other trades prior to installation of raceways. Lack of such coordination shall not be justification for extra compensation, and removal and re-installation to resolve conflicts shall be at no extra cost to the City.

F. All exposed raceways shall be installed at least ½-inch from walls or ceilings by the use of clamp backs or struts.

G. Wherever contact with concrete or dissimilar metals can produce galvanic corrosion of equipment, suitable insulating means shall be provided to prevent such corrosion.

3.02 SUPPORT

A. Support raceways at intervals not exceeding NEC requirements unless otherwise indicated. Support all raceways from structural members only. Do not support from pipe hangers or rods or other conduit.

B. Support flexible metal conduit with conduit clamps, except where the flexible metal conduit is fished and where sections less than four feet in length are used in concealed areas and as approved by Engineer.

3.03 BENDS

A. Make changes in the direction of runs with symmetrical bends or cast metal fittings. Make bends and offsets of the longest practical radius. Avoid field-made bends and offsets where possible; but, where necessary, make with an acceptable hickey or conduit bending machine.

B. Make bends in parallel or banked runs of raceways from the same center or centerline so that bends are parallel and of neat appearance. Factory elbows may be used in parallel or banked raceways if there is a change in the plane of the run and the raceways are of the same size. Otherwise, make field bends in parallel runs.

C. For PVC Schedule 40 and Schedule 80 conduits, use factory made elbows for all bends 30 degrees or larger.

D. Make no bends in flexible conduit that exceed allowable bending radius of the cable to be installed or that significantly restricts the conduits flexibility.

3.04 CONDUIT TO ENCLOSURE CONNECTIONS

A. Where conduit enters metal enclosure within Interior General areas, install an insulated throat grounding bushing on the end of each conduit. For all other areas install insulated throat grounding hub. Install a bonding jumper from the bushing to equipment ground bus or ground pad. Interconnection of bonding jumpers from each conduit grounding bushing to the equipment ground bus or ground pad is acceptable. If neither a ground bus or ground pad exists, connect the bonding jumper to the metallic enclosure with a bolted-lug connection.

B. All NEMA 4 and 4X enclosures without integral watertight hubs shall be connected with insulated throat grounding hubs. The conduit connections shall maintain the integrity of the enclosure NEMA rating. Liquid-tight PVC jacketed flexible metal conduit connections shall be corrosive resistant, watertight hub.

3.05 TRENCHING

A. Verify the location of all existing cables, conduits, piping, and other equipment in or near the areas to be trenched, prior to starting trenching. Repair any equipment damaged during trenching. Call an Underground Service firm before trenching. Trenches shall not be left unattended unless the area is fenced or barricaded to restrict entry to the area.

3.06 DUCT BANKS

A. 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.

B. Arrange multiple conduit runs substantially in accordance with any details shown on the drawings. Make minor changes in the location or cross-section as necessary to avoid obstructions or conflicts. Where raceway runs cannot be installed substantially as shown on submitted and approved layout drawings because of conditions not discoverable prior to digging of trenches, refer the condition to the Engineer for instructions before further work is done. Determine exact alignment and depth as required to avoid other utilities.

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. 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. Duct bank and trenching alignments shown on Drawings are diagrammatic. Actual alignments shall contain no sharp bends and shall be installed with minimum radius bends as required in the NEC or installed cable, whichever requires a larger radius bend.

E. Provide bell-ends on all PVC conduits entering handholes, stubbing up into transformer precast pad, and under open bottom floor mounted panelboards.

3.07 CONCRETE ENCASEMENT AND CONCRETE CAP

~~A. Encase or cap all underground conduits with red colored concrete per Section 03300.~~

~~B. Hold conduits for concrete-encased raceways securely in place by conduit spacer supports.~~

~~C. Envelopes may be poured directly against the sides of trenches if the cut is clean, even, and free of loose material. Remove loose material from trenches before and during the pouring of concrete to ensure sound envelopes. Carefully spade concrete during pouring to eliminate all voids under and between raceways and honeycombing of the exterior surface.~~

~~D. Do not use power-driven tampers or agitators unless they are specifically designed for the application.~~

~~E. Backfill material or above concrete envelope of concrete-encased conduit or concrete cap, may be selected from the excavated material if it contains no particles larger than three 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 AASHTO T180.~~

3.08 HANDHOLES AND MANHOLES

A. Provide excavation, backfilling, compaction and grading, etc., in accordance with requirements specified in Contract Documents.

B. Do not install handholes until final grading has been determined. Set frames just above final grade so that the site drains away from the handholes.

C. Make the installation so that raceways enter handholes at nearly right angles and as near as possible to one end of a wall, unless otherwise indicated.

D. Provide for over-excavation of the handhole foundation area and furnish minimum of one-foot depth of ¾-inch drain rock below the handhole.

E. Manhole and handhole racks shall be installed with 304 stainless steel chemical anchors with length sized for the cables. Secure cables in phase or control groups with tie wraps.

3.09 SMUD SUBSTRUCTURES

A. Install substructures including excavation, backfilling, compaction and grading, etc., in accordance with SMUD requirements. Install the grounding system for the Utility Meter in accordance with SMUD requirements. SMUD requires a pre-construction meeting with their field inspector prior starting work and for approvals during installations involving SMUD infrastructure.

3.10 PREPARATION FOR PULLING IN CONDUCTORS

A. Ream all raceways, remove burrs, and clean raceway interiors. Immediately after installation, plug or cap all raceway ends with watertight and dust-tight seals.

B. Pull a bristle brush and then a mandrel through each raceway to remove any debris and clean the raceway prior to pulling conductors. Mandrel diameter shall be approximately ¼-inch less than the raceway inside diameter, through each raceway. For conduits of one inch and less, pull a rag through to clean and remove debris prior to pulling the conductors.

C. For all raceways which contain less than 50 percent of the NEC-allowed fill, install a pull tape along with the conductors. Provide detectable pull tape in all fiber conduits.

D. Provide phenolic tags on cables, attached with nylon tie wires inside the handholes.

3.11 EMPTY RACEWAYS

A. Certain raceways will have no conductors pulled in as part of this Contract. Identify them with conduit tags at each end and at any intermediate pull point of each such empty raceway. Provide a removal cap over each end of empty raceways. Provide a pull tape in each empty raceway.

3.12 TRENCH SETTLING

A. If, at any time during a period of one-year dating from the date of final acceptance of the project, there shall be any settlement of conduit trenches, provide additional fill and to make such repairs or replacements in paving, planting, or structures, as deemed necessary by the Engineer at no additional costs to the contract.

3.13 PVC CONDUIT

A. Solvent weld PVC conduit joints with solvent recommended by the conduit manufacturer. Follow manufacturer's solvent welding instructions and provide watertight joints. Install PVC female adapters when joining PVC conduit to galvanized rigid metal conduit or PVC coated rigid steel conduit.

3.14 PVC COATED RIGID STEEL CONDUIT (PVCRGS)

A. Install in strict accordance with the manufacturer's instructions by personnel certified by the manufacturer for installation of PVCRGS. Utilize manufacturer's Spin-it and Z-wrench for tightening conduit. Install soft metallic jaws in pipe vises and half-shell clamps for chain vises. Utilize special shoes for conduit bending. Touch up any damage to the coating with conduit manufacturer acceptable patching compound. PVC boot shall cover all threads. Leave no metallic threads uncovered. Clean field threads with solvent and coat with urethane touch-up.

3.15 PENETRATIONS, FIRESTOPS AND CONDUIT SEALING

A. Conduits shall not be cast as part of cast-in-place structures. Cast-in-place structures shall include block-outs or sleeves to penetrate the structures. Coordinate sleeve installation with structural work.

B. Submit and obtain approval of fire stop prior to starting work. Install in accordance with the approved shop drawings and manufacturer's instructions. Fire stops shall be installed by personnel certified as being trained for installation by the manufacturer. Prepare substrate and supporting members and mask adjacent areas as necessary. Install so

that openings are completely filled, gaps sealed and material secured and adhered in place. Repair or replace defective installations in accordance with manufacturer's recommendations.

C. All conduits leaving the Panelboard or an enclosure to an underground handhole shall be sealed with duct seal compound to prevent the entrance into or exit from the structure with gases, liquids, or rodents. At structure penetrations, seal the interior of all raceways that enter above or below grade, with duct seal.

3.16 EXPOSED CONDUIT

A. All exposed conduit shall be as noted in Area Designations per Specification 16050.

B. PVC coated galvanized rigid steel factory elbows, couplings and risers shall be utilized for transition from underground concrete duct bank to exposed conduit. Conduit shall emerge from the duct bank perpendicular to the surface whenever possible.

C. Exposed conduits shall be 3/4-inch minimum trade size. Below grade conduits shall have a minimum trade size of one-inch, unless shown otherwise.

D. All threads shall be coated with a conductive lubricant before assembly. Acceptable products include: Appleton Type TLC, Thomas & Betts KOPR-Shield, or equal.

E. Joints shall be tight, thoroughly grounded, secure, and free of obstructions in the pipe. All conduits shall be adequately reamed to prevent damage to the wires and cables inside. Strap wrenches and vises shall be used to install conduits to prevent wrench marks on the conduits. Conduits with wrench marks shall be replaced at no additional cost.

3.17 FLEXIBLE CONDUIT

A. Make final connection to motors, instrumentation and other equipment where a flexible connection is required to facilitate removal or adjustment of equipment with liquid-tight flexible metal conduit. Liquidtight flexible metal conduit shall have a 12-inch minimum to 24-inch maximum length, unless otherwise shown on the drawings or approved by the Engineer.

3.18 PREPARATION FOR PULLING IN CONDUCTORS

A. Ream all raceways, remove burrs, and clean raceway interiors. Immediately after installation, plug or cap all raceway ends with watertight and dust-tight seals.

B. Pull a bristle brush and then mandrel through each raceway to remove any debris and clean raceway prior to pulling conductors. The diameter of the mandrel shall be approximately ¼ inch less than the raceway inside diameter, through each raceway. For conduits one inch and less, pull a rag through to clean and remove debris prior to pulling conductors.

C. For all raceways which contain less than 50 percent of the NEC allowed fill, install a pull tape along with the conductors. Provide detectable pull tape in all fiber conduits.

3.19 EMPTY RACEWAYS

A. Certain raceways will have no conductors pulled in as part of this Contract. Identify with conduit tags at each end and at any intermediate pull point of each such empty raceway. Provide a removal cap over each end of empty raceways. Provide a pull tape in each empty raceway.

3.20 JUNCTION AND PULL BOXES

A. Where indicated on the Contract Drawings, and where necessary, redirect multiple conduit and cable runs and provide and install appropriately-sized junction boxes. Furnish and install pull boxes where necessary in the raceway system to facilitate conductor installation.

B. Make all boxes accessible. Do not install boxes in finished areas unless accepted in writing by the Engineer. Mount all boxes plumb and level.

C. Conduit bodies maybe used for junction or pull boxes as long as sized for installation.

3.21 ELECTRICAL CONTINUITY

A. The entire electrical raceway system shall form a continuous metallic electrical conductor from the service point to every outlet and shall be grounded by connection to the main service ground.

B. Rigid steel conduits shall have threads coated with conductive sealant before screwing into fittings.

C. A ground wire shall be installed in all conduits. Conduits shall not be substituted for the grounding wire. Bond together the conduit system, enclosures, grounding system, and equipment bus bars.

3.22 CONDUIT IDENTIFICATION

A. All conduits shall be identified with minimum of two labels, one at either end. Labels shall be permanent, waterproof, legible, and attached with stainless steel wire.

B. All conduit labels shall be provided with submitted and approved inscription or as shown on the conduit schedule. Conduits shall be labeled prior to pulling cables and prior to beginning Pre-Demonstration period.

END OF SECTION

SECTION 16120 - CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Provide conductors, cables, terminations, splices and markers used for low voltage power, control, lighting, receptacle and signal circuits.

B. Provide conductors, cables, terminations, splices, fire wrapping and markers used for medium voltage power circuits.

1.02 SUBMITTALS

A. General: Submit for review in accordance with Section 01105 and Section 16050 – Electrical Work, General.

B. Catalog data sheets of all low voltage cables, wires, lugs, terminations, splices, connectors, compression tools, color-coded heat-shrink tubing, cold-shrink tubing, markers, tapes and pulling compounds.

C. Medium voltage cable, terminations, splices, pulling compound, markers, fireproofing and splicers training certificate and resume.

D. Medium voltage cable manufacturer's reel test results prior to shipment, pulling tension calculations and maximum dynamometer reading with tension conversion for each pull.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of Section 16050 – Electrical Work, General.

B. Accept cable and accessories in manufacturer's packaging, inspected for damage.

C. Store in accordance with manufacturer's instructions. Protect from weather, damage and off the ground. Provide adequate ventilation and heating above dew point to prevent condensation.

PART 2 - PRODUCTS

2.01 GENERAL

A. All conductors shall be stranded copper unless specified otherwise. Aluminum conductors are not permitted. Insulation shall bear the UL label and the manufacturer's trademark, and shall identify the type, voltage, and conductor size.

2.02 COLOR CODING

A. Power conductors shall have the following insulation (≥ #6 phase tape) colors. 208V & 240V three phase high-leg conductors shall be additionally phased taped orange per NEC requirements.

	120/208 or 240v	277/480V	5kV & 15kV
Phase A	Black	Brown	Black
Phase B	Red	Orange	Red
Phase C	Blue	Yellow	Blue
Neutral	White	White	
Ground	Green	Green	Green

B. Individual control conductor field wiring shall have the following insulation colors.

AC Control:	Purple (except neutrals are white)
AC Digital Inputs/Outputs:	Purple
AC Ground:	Green
DC Control:	Blue (except commons are gray)
DC Digital Inputs/Outputs:	Blue
24VDC+	Blue
24VDC-	Gray

2.03 LOW VOLTAGE POWER, CONTROL AND LIGHTING CONDUCTORS (LVC)

A. Power, control and lighting conductors shall be rated 600 volts, Class B stranded copper, UL-listed, with XHHW-2 insulation rated for 90°C in wet or dry locations. Acceptable products include: Okonite X-Olene XHHW-2, Southwire XHHW-2, or equal.

2.04 SIGNAL CABLES (SC)

A. Instrumentation cables shall be an assembly of individually insulated twisted pairs or triads with overall 100% shield coverage of aluminum polyester foil with tinned drain wire all inside a black PVC jacket. Cable shall be rated for 600 volts, 90°C wet or dry locations, suitable for installation in cable trays, ducts or direct burial. Cable shall be listed under UL1277 and UL1581. Insulation shall be color-coded and numbered (pairs-black/white & triads-black/white/red). Acceptable products include:

Okonite Okoseal-N Type P-OS Type TC Instrumentation Cable, Southwire Instrumentation Cable, or equal.

2.05 CONTROL CABLES (CC)

A. Control cables shall be an assembly of individual copper conductors with XHHW-2 insulation. Cable shall be rated for 600 volts, 90°C wet or dry locations and listed under UL83, UL1277 and UL1685. Cable shall be an assembly of conductors, fillers and tape, and ground wire with an overall black PVC jacket. Color coding for ≤ #10AWG shall follow ICEA Method 1, E-2 color sequence. Color coding for ≥ #8AWG shall be black with surface printing of numbers and color designation per ICEA Method 3, E-2 color sequence. Acceptable products include: Okonite Type TC/TC-ER (XHHW-2), or equal.

2.06 CATEGORY 5E CABLES (C5EI, C5EO)

A. CAT5e cable type C5EI (indoor) shall be TIA-568-C2 rated CAT5e, 100BaseTX and EtherNet/IP. Cable shall consist of four color coded, twisted pairs #24AWG solid copper, polyolefin insulated, aluminum foil polyester tape and tinned copper braid shields. Jacket shall be PVC 600V AWM and riser flame rated per UL1666. Jacket shall be color coded with sequential distance marking system. Acceptable products include: Belden 7957A, or equal.

B. CAT5e cable type C5EO (outdoor) shall be TIA-568-C2 rated CAT5e, 1000Base-T and power over Ethernet rated per IEEE802.3. Cable shall consist of four color coded, twisted pairs #23AWG solid copper, polyolefin insulation, gel filled water repellent inner core, polyethylene inner jacket with dry water block under corrugated coper-clad steel armor. Cable shall include sunlight and weather resistant polyethylene outer jacket. Acceptable products include: Superior Essex 04-001-55, or equal.

2.07 CATEGORY 6 (C6IO) AND CATEGORY 6A (C6AIO) CABLES

A. CAT6 cable type C6IO (indoor/outdoor) shall be TIA-568-C2 rated CAT6 1000Base-T and power over Ethernet rated per IEEE802.3. Cable shall consist of four color coded, twisted pairs #23AWG solid copper, polyolefin insulated. Inner core shall be gel filled with water repellent SAP yarn. Shield shall be overlapped corrugated copper-clad steel. Outer jacket shall be halogen-free polyethylene riser flame rated per UL1685. Acceptable products include: Superior Essex 04-001-63, or equal.

B. CAT6A cable type C6AIO (indoor/outdoor) shall be TIA-568-C2 rated CAT6 10GBase-T and power over Ethernet rated per IEEE802.3. Cable shall consist of four color coded, twisted pairs #23AWG solid copper,

polyolefin insulated. Inner core shall be gel filled with water repellent SAP yarn. Shield shall be overlapped corrugated copper-clad steel. Outer jacket shall be halogen-free polyethylene riser flame rated per UL1685. Acceptable products include: Superior Essex 04-001-A3.

2.08 GROUNDING CONDUCTORS (G)

A. Ground conductors in raceways shall be rated 600 volts, Class B stranded copper, UL-listed, with XHHW-2 insulation rated for 90°C in wet or dry locations. Acceptable products include: Southwire XHHW-2, or equal.

B. Ground mat conductors shall be bare concentric stranded copper conductors conforming to ASTM B8 for the direct buried ground grid system, transformers, panelboards, and where indicated on the drawings. Acceptable products include: Southwire Bare Copper Wire, or equal.

2.09 ANTENNA COAXIAL CABLE (COAX) CONNECTORS AND COLD-SHRINK

A. Antenna cables shall be 50-ohm, 1/2" coaxial copper-clad aluminum, corrugated copper outer conductor, low density foam dielectric with polyethylene jacket. Return loss shall be 24.3dB with 1.13 VSWR thru 2700MHz. Connectors

B. Connectors shall be compatible with the cable, captivated self-flare, gold inner contact plating with tri-metal outer contact plating, rated at -110dB shielding effectiveness. Cold-shrink shall be compatible with the cable and connectors, cold shrinkable EDPM tube with sealing foam strip.

C. Acceptable products include: CommScope Heliax LDF4-50A, F4PNF-C, F4PNM-C, #245174, or equal.

2.10 MEDIUM VOLTAGE CABLES 5KV (MV5) AND 15KV (MV15)

A. Conductor: Class B copper per ASTM B3 & B8.

B. Conductor Shield: Thermosetting extruded semi-conducting polymeric layer over the conductor.

C. Insulation: 133% rated Ethylene Propylene Rubber with nominal thickness of 115-mil for 5kV cable and 220-mil for 15kV cable.

D. Insulation Shield: Thermosetting extruded semi-conducting compound with 5-mil copper tape helically-wrapped providing 12.5% overlap.

E. Jacket: Nominal 70-mil Polyvinyl Chloride

F. Acceptable Products: Southwire CT1-09ET & CT1-13ET, Okonite Okoguard-Okoseal Type MV-105 5kV & 15kV, or equal.

2.11 FIRE ALARM CABLES (FAI & FAO)

A. Fire alarm cable type FAI (indoor applications) shall consist of 300V rated power limited cable. Conductor shall be one pair #18AWG solid copper, capacitance 16 pf/ft., polyolefin insulated, unshielded with PVC jacket riser flame rated per UL1666.

B. Fire alarm cable type FAO (outdoor applications) shall consist of 300V rated power limited cable. Conductors shall be one pair #16AWG stranded copper, capacitance 28 pf/ft., PVC/nylon insulated, water blocked, unshielded with PVC jacket vertical tray flame rated per UL1685.

C. Acceptable Products: FAI (indoor) West Penn D980, FAO (outdoor) West Penn AQ225, or equal.

2.12 PUBLIC ADDRESS CABLE (PA)

A. Public address cables shall consist of 300V rated power limited tray cable. Conductors shall be one twisted pair #16AWG stranded & tinned copper, capacitance 31pf/ft., inductance 0.17 µH/ft., PVC insulated, unshielded with PVC jacket vertical tray flame rated per UL1685.

B. Acceptable Products: Belden 9410, or equal.

2.13 600V CABLE TERMINATIONS AND INSULATION

A. Lugs and two-way connectors shall be tin-plated copper compression types conforming to UL486A. Both tool and connectors shall be from the same manufacturer with color-coded system for the cable size and compression tool die. Compression tool shall prevent reopening once started until the correct compression force is reached. Acceptable products include: Thomas & Betts TBM-series tools with matching lugs and connectors.

B. Crimp connectors for #10AWG and smaller conductors shall be plated electrolytic copper, color-coded nylon insulated locking forks and rings conforming to UL486A/B. Barrels shall be serrated brazed seam with wire range stamped on the tongue. Crimping tool shall be the same manufacturer as the connector. Acceptable products include: Thomas & Betts Sta-Kon series, or equal. Wire nuts for #8AWG and smaller lighting and receptacle conductors shall be color-coded winged nylon shell with steel spring conforming to UL 486D. Acceptable products include: 3M Scotchlok, Performance+, 312/512 series or equal. Waterproof wire nuts for #8AWG and smaller lighting and receptacle conductors shall be color-coded, silicone filled, winged nylon shell with steel spring conforming to UL486D. Acceptable products include: DryCon King 4, 5, 6 & 9 series, or equal.

C. Low voltage insulating tape shall be weather resistant, flame retardant, rated 80°C and 600V conforming to UL510. Electrical tape shall be 7mil vinyl plastic black or colored coded phase tape. Varnished cambric shall be 9mil varnish impregnated cotton adhesive backed. Acceptable products include: 3M Scotch 33, 35 & 2520, or equal.

D. Heat shrinkable insulation shall be rated 90°C and 600V conforming to UL486D. Heat shrinkable tubing, boots and end caps shall be heavy-wall, thermally stabilized cross-linked polyolefin with internal moisture sealant. Acceptable products include Thomas & Betts Shrink-Kon HS-series, or equal.

E. Insulated taps and splices shall be rated 90°C and 600V conforming to UL486A/B. Insulated taps shall be aluminum alloy lugs, prefilled with oxide inhibitor rated for copper conductors. Encapsulation shall be UV rated, chemically resistant plastisol compound. Insulated taps shall have removable caps and panel mounting ears. Acceptable products include Polaris IT series, or equal.

~~2.14 MEDIUM VOLTAGE TERMINATIONS, SPLICES, TAPES, CAPS AND RACKS~~

~~A. Medium voltage conductor lugs and splices shall be long barrel, tin-plated copper compression types conforming to UL486A. Lugs shall be rated 15kV with NEMA bolt holes. Splices shall be rated 35kV. Both tool and connectors shall be from the same manufacturer with color-coded system for the cable size and compression tool die. Compression tool shall have special rounding dies and prevent reopening once started until the correct compression force is reached. Acceptable products include: Thomas & Betts, TBM-series tools with matching lugs and splices #54475-54484, #54006-54018, or equal.~~

~~B. Medium voltage terminations shall be kit type suitable for tape shielded, 133% insulated 5kV & 15kV EPR cables. Kit shall consist of heat shrinkable stress control tubing, no-tracking outer insulation tube and skirts, high relative permittivity stress relief mastic and heat activated environmental sealant. 5kV terminations shall be rated 5-8kV, 95kV-BIL, 35kV-AC withstand per IEEE48. 15kV terminations shall be rated 15kV, 110kV-BIL, 50kV-AC withstand per IEEE48. Acceptable products include: Raychem HVT-8x-SG and HVT-15x-SG series, or equal.~~

~~C. Medium voltage splices shall be kit type suitable for tape shielded, 133% insulated 5kV & 15kV EPR cables. Kit shall be heat shrinkable polymeric construction utilizing an impedance layer stress control tube and high dielectric strength insulating layers. The outer insulating layer shall be bonded to a conducting layer for shielding. The splice shall be sealed with heat activated adhesive and an outer heat shrinkable tubing jacket. Kit~~

~~shall include grounding clamps and copper wire mesh for shield continuity. stress control tubing, no-tracking outer insulation tube and skirts, high relative permittivity stress relief mastic and heat activated environmental sealant. 5kV splices shall be rated 5-8kV, 95kV-BIL, 23kV-AC withstand per IEEE404. 15kV terminations shall be rated 15kV, 110kV-BIL, 35kV-AC withstand per IEEE404. Acceptable products include: Raychem HVS-8xxS and HVS-15xxS series, or equal.~~

~~D. Medium voltage insulating tape shall be weather resistant, high thermal conductivity, ethylene propylene liner-less rubber, short term rated 130°C up to 69kV. Fire-proofing tape shall be flexible, conformable, flame resistant, intumescent 30-mil elastomer rated self-extinguishing per UL94. Glass tape shall be 7-mil glass cloth with high temperature thermosetting silicone pressure sensitive adhesive rated 200°C and flame retardant per UL510. Acceptable products include: 3M Scotch 130C, 77 & 69, or equal.~~

~~E. Medium voltage temporary caps shall be 1kV heat shrink EPR with prefilled thermoplastic adhesive sealant to prevent moisture ingress. Acceptable products include: Raychem ESC, or equal.~~

2.15 CONDUCTOR AND CABLE MARKERS

A. Markers relying on adhesives or taped wrapped are not acceptable for conductor or cables. Markers shall be machine printed; hand printed markers are not acceptable.

B. Low voltage conductor markers shall be white 3-to-1 ratio heat-shrinkable, cross-linked polymer tubing flattened and mounted on a carrier for computer thermal transfer printing, and meet UL 224. Acceptable products include: TE Tyco RPS Marker System, or equal.

C. Low voltage cable markers shall be cross-linked flame retarded polymer cable tags mounted on a carrier for computer thermal transfer printing with holes for tie wrap installation. Acceptable products include: TE Tyco CM-SCE-TP Marker System, or equal.

D. Medium voltage cable markers shall consist of a polyethylene horizontal tie wrapped holder that accepts 1" high polyethylene black stamped numbers on yellow background. Acceptable products include: Almetek E-Z Tags TH-xP, H900, or equal.

2.16 COLORED HEATSHRINK TUBING

A. Heat shrinkable tubing shall be colored polyolefin, 1.5mm to 50mm unshrunk diameter, 3:1 shrink ratio. Tubing shall be rated 500V/mil dielectric strength, 1500psi and VW-1 flammability per UL-224. Acceptable products include: Techflex Shrinkflex H3Nxxx series, or equal.

2.17 PULLING COMPOUND

A. Pulling compounds shall be compatible with the conductor insulation. Acceptable products include: Ideal Clear-Guide, Aqua-Gel-II, or equal.

PART 3 - EXECUTION

3.01 GENERAL

A. No conductors shall be installed until conduits have been cleaned and labeled, and Interconnect Drawings have been submitted and approved.

B. Raceway system shall be complete and protected from weather before prior to cable pulling. Pulling low voltage conductors shall include rollers or sheaves to protect wires entering and leaving raceways.

C. Tighten terminal bolts using torque type wrenches and/or drivers to tighten to the inch-pound requirements of the NEC and UL.

D. Signal wiring shall not be run in the same raceway with power and control wiring except where specifically indicated.

3.02 600V CONDUCTOR AND CABLE INSTALLATION

A. Conductors and cables leaving raceways shall be trained in place and supported such that cable weight is not transferred to the termination point while maintaining the manufacturer's minimum bending radius.

B. Conductors in panels and electrical equipment #8AWG and smaller shall be bundled, tie-wrapped and fanned out onto terminals.

C. Conductors in junction and pull boxes shall be pulled with enough slack to be routed along the walls of the enclosure.

D. Install cable racks shall be installed at nominal 2-foot intervals in handholes and 3-foot intervals in manholes. Cables shall be routed along the outside walls and tie-wrapped to racks in three phase circuits or control groups.

E. Spare conductors and cables shall be labeled "spare", insulated with half lapped vinyl plastic tape, coiled and tie wrapped in groups at each end.

3.03 LOW VOLTAGE TERMINATIONS AND SPLICES

A. All conductors shall be terminated on an individual terminal or lug, except for control and signal cables where no more than two conductors shall be inserted into a single terminal.

B. Indoor lighting & receptacle conductors and solenoid pigtails shall be connected with standard wire nuts. Outdoor below grade lighting and

receptacle conductors shall be connected with waterproof wire nuts. Splices are not allowed in conduit bodies except for solenoid pigtails.

C. Terminations at panels and transformers shall be made up with compression connectors bolted to the terminals. Motor terminations and splices in manholes and handholes shall be made with Polaris IT style insulated taps with vinyl plastic tape overwrap.

D. Control and signal conductors shall not be spliced. Conductors shall be landed on numbered terminal blocks or lugs on vendor supplied equipment. For equipment without lugs, conductors shall be installed with crimp rings or locking forks.

E. Signal conductor shield and drain shall be grounded at only one end at the panel. Shields shall be neatly cut back with the end insulated under the wire marker when heat shrunk. Terminate the drain wire on a grounded terminal block directly adjacent to the signal conductors inside that cable.

F. Install antenna cable, connector cold-shrink weatherproofing and miscellaneous hardware for complete and operable radio system. Provide sealed fitting at top of antenna mast to prevent water entrance into the pole.

3.04 LOW VOLTAGE CONDUCTOR IDENTIFICATION

A. All cables and conductors shall be identified with markers at each terminal to which it is connected matching approved interconnection wiring diagrams. Installed and heat shrunk markers shall be positioned to be read without twisting the conductor or cable.

B. CAT5E/6 cables shall be additionally identified with color coded heat shrink below each marker indicating the system as follows; Administration-Blue, SCADA-Yellow and Video-Purple.

~~3.05 MEDIUM VOLTAGE CONDUCTOR INSTALLATION~~

~~A. Submit and obtain approval of pulling tension and sidewall pressure calculations prior to pulling conductors. Calculations shall include manufacturer's allowable pulling tension, sidewall pressure and jam ratio check.~~

~~B. Flexible feeding tubes or roller sheaves with radius not less than 12x cable diameter shall be used to feed the cable off reels over edges into ducts. Duct cleaning mandrels and cable pulling shall be done with double braided polypropylene composite rope. Nylon or stranded steel pulling lines are not allowed. Woven wire grips with swivels shall be used to pull conductors. The area of the cable covered by the grip plus one foot shall be cut off and discarded when the pull is complete. Cable ends shall be~~

resealed with medium voltage temporary cap immediately after pulling is complete.

C. Pulling equipment shall be variable speed hydraulic with pulling tension dynamometer. Medium voltage cable installation without a recording dynamometer is not allowed. Dynamometer shall have tension recorder that indicates the maximum value during the pull. Record the angle of the cables around the dynamometer sheave to translate dynamometer readings into pulling tension. Periodically record dynamometer readings during the pull and the maximum value after the pull is completed. Pull shall be at continuous speed between 15-45 feet per minute with continuously applied pulling lubricant. If excessive strain develops, the pull shall be halted and not restarted until the situation is resolved to the satisfaction of the Inspector. Cable shall be supported at all times avoiding short bends or excessive sags and shall not be permitted to lie on the manhole floor. Document and submit each cable pull with dynamometer sheave pulling angle, maximum reading and tension conversion.

D. Cables shall be installed in manholes along the walls providing the longest path between the entering and exiting duct. Install cables on medium voltage cable racks spaced approximately 36 inches on center secured in place with tie wraps. Train cables in place maintaining 12x cable diameter bending radius.

3.06 MEDIUM VOLTAGE TERMINATIONS AND SPLICES

A. Submit and obtain approval of medium voltage cable splicer qualifications prior to starting work. Use approved solvents and clean burning torches for heat shrinking. Conductor shield shall be continued across splices and tailed out for grounding in each manhole and final terminations. Install medium voltage connectors utilizing manufacturer's compression tools. Follow manufacturer's written instructions utilizing the material supplied in the kit to reinsulate the termination or splice.

B. Medium voltage cables shall be fireproofed in all manholes. Install fire-proofing tape held in place with overlap of glass tape in accordance with manufacturer's instructions. Medium voltage cables shall be wrapped together in three phase groups except for splices that shall be individually wrapped. Secure in place on cable racks with tie wraps.

C. Identify each circuit in every manhole with medium voltage cable markers over the fire proof wrap.

3.07 FIELD TESTING

A. Conductor and cable testing shall be done after cables are installed in the raceways and prior to energizing. Disconnect equipment that might be damaged by this test. Tests shall be documented on test sheets, witnessed and signed off by the Engineer. Cable field testing results shall be submitted to the Engineer for review and acceptance

B. Power and Control Conductor Test – After installation, provide megger testing at 1000V for conductor to conductor, and conductor to ground.

C. Signal Conductor Test – After installation measure continuity between conductors with ohmmeter and megger at 500V conductor to conductor, conductor to shield, and conductor to ground.

D. CAT5E & CAT6 Cable Test – After installation measure with a CAT5E/6 tester the following: return and insertion loss, attenuation NEXT, PSNEXT, FEXT, ELFEXT, PSELFEXT, ACR and PSCAR.

E. Antenna cable and antenna test: Test the radio transmission cables for return loss and voltage standing wave ratio. Make all connections from the radio to the antenna then test the transmission cables starting at the radio for return loss and voltage standing wave ratio (VSWR). Test equipment shall be Anritsu or approved equal. Submit a printout from the testing device showing the return loss and VSWR. Return loss shall be between 14dB to 48dB. The VSWR shall be between 1 and 1.4. If these values are not achieved, replace the cable connectors, lightning arrestor, and/or the transmission cables until these values are obtained. The testing shall be done at a frequency of 902 MHz to 928 MHz.

END OF SECTION

SECTION 16122

FIBER OPTIC CABLE

PART 1 - GENERAL

1.01 SCOPE

A. This Specification Section covers the furnishing, installing, connecting and testing of all fiber optic cables and termination equipment required to complete the project as specified herein and as shown.

B. The provisions of Sections 16050 and 16110 of these Specifications shall apply, unless otherwise specified in this Section.

1.02 SUBMITTALS

Descriptive literature for all materials furnished under this section shall be submitted in accordance with Section 01105 of these specifications.

A. Submittals shall include, but shall not be limited to, the following:

1. Submittals will include product data sheets for all fiber optic cables, and equipment of each type and characters, manufacturer's installation, operation and maintenance requirements on which work is to be performed under this contract.

2. Certified test reports prepared by manufacturer.

1.03 QUALITY ASSURANCE

A. Fiber optic cable and termination equipment of the type and characters specified shall be of a design which has been in satisfactory use for not less than three years in a minimum of 5 installations. For purposes similar to those intended herein.

B. Manufacturer shall provide certification that the manufacturer has been fabricating and assembling specified cables and equipment (as described in A above) in his current facility for a minimum of five (5) years.

C. All materials selected for the manufacture of the hardware shall be the best available for the purpose for which they are used, considering strength, ductility, durability and the best engineering practice.

D. All cable and equipment have been manufactured within one year of installation.

E. All optical fibers shall be proof tested by the fiber manufacturer at a minimum load of 50 kpsi.

F. All optical fibers shall be 100% attenuation tested. The attenuation of each fiber shall be provided with each cable reel.

~~G. The fiber installer shall have a current RCDD (Registered Communications Distribution Designer) on staff and available for the project.~~

1.04 DELIVERY, STORAGE, HANDLING AND PACKING

A. Fiber optic cable and termination equipment shall be delivered complete, in manufacturer's original, unopened protective packaging. Packing materials shall be such as to prevent damage to the materials during transportation and handling.

B. Maintain protective coverings until ready for installation.

C. The completed cable shall be packaged for shipment on non-returnable wooden reels.

D. Top and bottom ends of the cable shall be available for testing.

E. Each cable reel shall have a durable weatherproof label which shows the actual length of cable on the reel.

F. Both ends of the cable shall be sealed to prevent the ingress of moisture.

G. The cable manufacturer shall provide installation procedures and technical support concerning the items contained in this specification.

H. Each reel shall be stenciled and/or labeled clearly on the outside of one of the reel flanges to indicate the following information:

1. Manufacturer.

2. Date of manufacture.

3. Manufacturer's part number.

4. Cable length.

5. Cable configuration/fiber count.

6. Shipping date.

7. Factory reel number.

8. Reel weight.

9. Direction to un-reel.

I. The contractor shall be responsible for unloading and storage.

PART 2 - PRODUCTS

2.01 REFERENCE STANDARDS

Fiber optic cable and termination equipment supplied under this contract shall be designed, manufactured, and tested in accordance with the latest version of the following standards.

A. Telecommunications Industry Association (TIA) 455B "Standard Test Procedure for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and Other Fiber Optic Components":

FOTP-1	Cable Flexing for Fiber Optic Interconnecting Devices
FOTP-2	Impact Test Measurements for Fiber Optic Devices
FOTP-4	Fiber Optic Component Temperature life
FOTP-5	Humidity Test Procedure for Fiber Optic Components
FOTP-11	Vibration Test Procedure for Fiber Optic Components and Cables
FOTP-17	Maintenance Aging of Fiber Optic Connectors and Terminated Cable Assemblies

FOTP-18	Acceleration Testing for Components and Assemblies
FOTP-21	Mating Durability for Fiber Optic Interconnecting Devices
FOTP-25	Repeated Impact testing of Fiber Optic Cables and Cable Assemblies
FOTP-26	Crush Resistance of Fiber Optic Interconnecting Devices
FOTP-28	Measuring Dynamic and Fatigue Parameters of Optical Fibers by Tension
FOTP-31	Proof Testing Optical Fibers by Tension
FOTP-32	Fiber Optic Circuit Discontinuities
FOTP-33	Fiber Optic Cable Tensile Loading and Bending Test
FOTP-34	Interconnecting Device Insertion Loss Test
FOTP-35	Fiber Optic Component Dust (Fine Sand) Test
FOTP-36	Twist Test for Connecting Devices
FOTP-37	Low or High Temperature Bend Test for Fiber Optic Cable
FOTP-41	Compressive Loading Resistance of Fiber Optic Cables
FOTP-59	Measurement of Fiber Point Defects Using an OTDR
FOTP-61	Measurement of Fiber or Cable Attenuation Using an OTDR
FOTP-78	Measurement Methods and Test Procedures - Attenuation
FOTP-80	Measurement Methods and Test Procedures - Cutoff Wavelength
FOTP-81	Compound Flow (Drip) Test for Filled Fiber Optic Cable
FOTP-82	Fluid Penetration Test for Fluid-Blocked Fiber Optic Cable
FOTP-85	Fiber Optic Cable Twist Test

FOTP-86 Fiber Optic Cable Jacket Shrinkage

FOTP-88 Fiber Optic Cable Bend Test

FOTP-89 Fiber Optic Cable Jacket Elongation and Tensile Strength Test

FOTP-91 Fiber Optic Cable Twist-Bend Test

FOTP-98 Fiber Optic Cable External Freezing Test

FOTP-169 Chromatic Dispersion Measurement of Single-Mode Optical Fibers by the Phase-Shift Method

FOTP-170 Cable Cutoff Wavelength of Single-Mode Fiber by Transmitted Power

FOTP-178 Measurements Methods and Test Procedures - Coatings Strippability

B. Bellcore TR-NWT-000020, "Generic Requirements for Optical Fiber and Optical Fiber Cable".

C. U.S. Department of Agriculture, Rural Electrification Agency REA-PE-90, "Totally Filled Fiber Optic Cable".

2.02 FIBER OPTIC CABLE

A. General Fiber Characteristics

1. **Fiber Optic Cable shall be single mode cable, Corning Cable Systems ALTOS All-Dielectric Gel-Free cables or approved equal as shown below:**

Fiber Count	Corning Model Number
12 Strand Fiber	012EU4-T4101D20

~~2. Fiber Connector shall be AT&T Type LC.~~

3. Each fiber optic (F/O) cable, unless otherwise indicated, shall be all-dielectric loose-tube design with dry waterblocking. Cable shall be comprised of water-swellable tape yarns and/or tapes, dielectric

strength members (as required), ripcord(s) and MDPE jacket with available reverse oscillation lay (ROL) markings as required.

4. The optical fibers shall be contained within loose buffer tubes. The buffer tubes shall be made from polypropylene and be manufactured to a standard 3.0 mm in size, regardless of fiber count. The loose buffer tubes shall be surrounded by a water-swellabe tape and then surrounded by a dielectric strength member with aramid yarn as the primary strength member and a polyethylene sheath for overall protection.

5. All F/O cable on this project shall be from the same manufacturer, who is regularly engaged in the production of this material.

6. The cable shall be BellCore Certified TR-TSY-00020 for single-mode. Manufacturer shall be ISO 9001 and TL 9000 registered.

7. Each optical fiber shall be glass and consist of a doped silica core surrounded by concentric silica cladding. The fiber shall be a matched clad design step index optical fiber manufactured with the outside vapor deposition process (OVD). All fibers in the buffer tube shall be usable fibers and shall be sufficiently free of surface imperfections and inclusions to meet the optical, mechanical, and environmental requirements of these specifications.

8. The fiber shall be coated with a dual acrylate protective coating and the coating shall be in physical contact with the cladding surface. The coating shall be mechanically or chemically strippable without damaging the fiber.

9. The required fiber grade shall reflect the maximum individual fiber attenuation, to guarantee the required performance of each and every fiber in the cable.

10. Cable shall comply with the optical and mechanical requirements over an operating temperature range of -40 degrees C to +70 degrees C.

11. Cable shall be listed with Rural Utilities Service (RUS) 7 CFR 1755.900 and be fully compliant with ICEA S-87-640.

12. Single mode fibers within the finished cable shall meet the requirements in the following table:

Fiber Characteristics Table	
Parameters	**SM**
Fiber Type	Single Mode
Core Diameter	8.2 mm (nominal)
Max Tensile Strength, Short Term	2700 N
Max Tensile Strength, Long Term	890 N
Operation Temperature Range	-40° F to 158° F
Wavelengths	1310 nm / 1383 nm / 1550 nm
Max Attenuation @ 1,300 nm @ 1,383 nm @ 1,550 nm	 ≤ 0.4 dB/km ≤ 0.4 dB/km ≤ 0.3 dB/km
Serial 1 Gigabit Ethernet	5000 m
Outer Jacket Material	Polyethylene

13. For buffer tubes containing multiple fibers, each fiber shall be distinguishable from others in the same tube by means of color coding according to the following:

1. Blue	7. Red
2. Orange	8. Black
3. Green	9. Yellow
4. Brown	10. Violet
5. Slate	11. Rose
6. White	12. Aqua

14. The colors shall be targeted in accordance with the Munsell color shades and shall meet EIA/TIA-598 "Color Coding of Fiber Optic Cables."

15. The color formulation shall be compatible with the fiber coating and the buffer tube filling compound and be heat stable. It shall not fade or smear or be susceptible to migration and it shall not affect the transmission characteristics of the optical fibers and shall not cause fibers to stick together.

B. Cable Construction

1. Buffer Tubes

The loose buffer tubes shall provide clearance between the fibers and the inside of the tube to allow for thermal expansion without containing the fiber. The fibers shall be loose or suspended within the tubes. The fibers shall not adhere to the inside of the buffer tube. Each buffer tube shall contain a maximum of 12 fibers.

The loose buffer tubes shall be extruded from material having a coefficient of friction sufficiently low to allow the fiber free movement. Buffer tubes shall be made of tough abrasion resistant material to provide mechanical and environmental protection of the fibers yet designed to permit safe intentional "scoring" and breakout entry without jeopardizing the internal fibers.

Each buffer tube shall contain a water-swellable yarn for water-blocking protection. The water-swellable yarn shall be non-nutritive to fungus, electrically non-conductive, and homogeneous. It shall also be free from dirt or foreign matter. The buffer tube shall be gel free.

Buffer tubes shall be stranded around a water-swellable tape and a central member by a method that will prevent stress on the fibers when the cable jacket is placed under strain, such as the reverse oscillation stranding process.

Each buffer tube shall be distinguishable from other buffer tubes in the cable by means of color coding.

2. Central Member

The central member which functions as an anti-buckling element shall be a glass reinforced plastic rod with similar expansion and contraction characteristics as the optical fibers. A linear overcoat of Low Density Polyethylene shall be applied to the central member of the main trunk fiber cable to achieve the optimum diameter to provide the proper spacing between buffer tubes during stranding.

3. Filler Rods

Fillers may be included in the cable to lend symmetry to the cable cross-section where needed. Filler rods shall be solid medium or high density polyethylene. The diameter of filler rods shall be the same as the outer diameter of the buffer tubes.

4. Stranding

Completed buffer tubes shall be stranded around the overcoated central member using stranding methods, lay lengths and positioning such that the cable shall meet mechanical, environmental and performance specification. A polyester binding shall be applied over the stranded buffer tubes to hold them in place. Binders shall be applied with sufficient tension to secure the buffer tubes to the central member without crushing the buffer tubes The binders shall be non-hydroscope, non-wicking (or rendered so by the flooding compound), and dialectic with low shrinkage.

5. Tensile Strength Member

Tensile strength shall be provided by high tensile strength armored yarns and fiberglass which shall be helically stranded evenly around the cable core.

6. Outer Jacket

The jacket shall be free from holes, splits, and blisters and shall be high density polyethylene (PE) with a total minimum jacket thickness of 40 " 5 mils. Jacketing material shall be applied directly over the tensile strength members and flooding compound and shall not adhere to the armored strength material. The polyethylene shall contain carbon black to provide ultraviolet light protection and shall not promote the growth of fungus.

The outer jacket or sheath shall be marked with the manufacturer's name, the words "Fiber Optic Cable", date of manufacture, and sequential meter markers. The markings shall be repeated every meter. The actual length of the cable shall be within 1 percent of the length marking. The marking shall be in a contrasting color to the cable jacket. The height of the marking shall be approximately 2.5mm.

The cable shall contain at least one ripcord under the inner sheath for easy sheath removal.

The finished cable shall be capable of withstanding a pulling tension of 2700 N (600 lbs.), minimum.

C. Cable Performance

1. General

The F/O cable shall withstand water penetration when tested with one meter static head or equivalent continuous pressure applied at one end of a one meter length of filled cable for one hour. No water shall leak through the open cable end. Testing shall be done in accordance with EIA-455-82, "Fluid Penetration Test for Filled Fiber Optic Cable."

The cable shall exhibit no flow (drip or leak) at 70 degrees C. The weight of any compound that drips from the sample shall be less than 0.05 grams (0.002 ounce). A representative sample of cable shall be tested in accordance with EIA-455-81, "Compound Flow (Drip) Test for Filled Fiber Optic Cable". The test sample shall be prepared in accordance with Method A.

Crush resistance of the finished F/O cables shall be 220 N/cm applied uniformly over the length of the cable without showing evidence of cracking or splitting when tested in accordance with EIA-455-25A. The average increase in attenuation for the fibers shall be < 0.10 dB at 1550 nm (single-mode) for a cable subjected to this load. The cable shall not exhibit any measurable increase in attenuation after removal of load. Testing shall be in accordance with EIA-455-45, "Compressive Loading Resistance of Fiber Optic Cable" except that load shall be applied at the rate of 3 mm to 20 mm per minute and maintained for 10 minutes.

The cable shall withstand 25 cycles of mechanical flexing at a rate of 30 " 1 Cycles/minute. The average increase in attenuation for the fibers shall be <0.10 dB at 1550 nm (single-mode) at the completion of the test. Outer cable jacket cracking or splitting observed under 10X magnification shall constitute failure. The test shall be conducted in accordance with EIA-455-1-4, "Fiber Optic Cable Cyclic Flexing Test," except that the sheave diameter shall be a maximum diameter of 20X

the cable OD. The cable shall be tested in accordance with Test Conditions I and III of the ES-455.

The cable shall withstand 25 impact cycles. The average increase in attenuation for the fibers shall be <0.20 dB at 1550 nm (single-mode). The cable jacket shall not exhibit evidence of cracking or splitting. The test shall be conducted in accordance with EIA-455-25, "Impact Testing of Fiber Optic Cables and Cable Assemblies."

The cable shall withstand a tensile load of 2700 N (600 lbs) without exhibiting an average increase in attenuation of greater than 0.10 dB (single-mode). The test shall be conducted in accordance with EIA-455-33, "Fiber Optic Cable Tensile Loading and Bending Test," using a maximum mandrel and sheath diameter of 560 mm. The load shall be applied for one hour in Test Condition II of the EIA-455 procedure.

2. Quality Assurance

All optical fibers shall be proof tested by the F/O cable manufacturer at a minimum load of 100 kpsi. Documentation of factory results shall be provided to the Engineer prior to shipping.

All optical fibers shall be 100% attenuation tested by the manufacturer. The attenuation of each fiber shall be provided with each cable reel.

Attention is directed to "Testing" elsewhere in these special provisions.

3. Packaging and Shipping

The completed cable shall be packaged for shipment on lagged reels. The cable and reel shall be wrapped in water resistant covering.

Each end of the cable shall be securely fastened to the reel to prevent the cable from coming loose during transport. Six feet of cable length on each end of the cable shall be accessible for testing. Both ends of the cable shall be sealed to prevent the ingress of moisture.

Each cable reel shall have a durable weatherproof label or tag showing the manufacturer's name, the cable type, the actual length of cable on the reel, the Contractor's name, the contract number, and the

reel number. A shipping record shall be included in an attached weatherproof envelope showing the above information and shall include the date of manufacture, cable characteristics (size, attenuation, bandwidth, etc.), cable information number and any other pertinent information.

The diameter of the reel shall be at least thirty times the diameter of the cable. The F/O cable shall be in one continuous length per reel with no factory splices in the fiber. Each reel shall be marked to indicate the direction the reel should be rolled to prevent loosening of the cable.

~~**2.03 PATCH PANEL**~~

~~A. Contractor shall provide one Corning wall mountable closet housing model number WCH-02P or approved equal. Install the housing inside the control panel as directed by the Engineer. Include two Corning closet connector housing panels model number CCH-CP12-K1 or approved equal.~~

~~B. Contractor shall install one fiber patch cord from the patch panel to the Ntron switch. Connect patch cord to the fiber optic receiver mounted in the switch. Patch cord shall be Corning model number 020201R2Z31001M or approved equal.~~

PART 3 - EXECUTION

3.01 INSTALLATION

A. General

Installation procedures and technical support information shall be furnished at the time of delivery. Installation procedures shall be in conformance with the procedures specified by the cable manufacturer for the specific cable being installed. Contractor shall install all fiber optic cable per manufacturer's recommendations and the City's Plans and Special Provisions.

During cable installation, the bend radius shall be maintained at a minimum of twenty times the outside diameter of the cable. During installation the tensile force shall not exceed 600 lbs. The Contractor shall use a break -away swivel, or a slip-clutch capstan, set for less than 600 lbs. pulling tensile strength.

The fiber optic cable shall be installed without splices.

The City will terminate all fiber optic strands after all tests are completed by the Contractor.

Existing fiber optic cable must be protected from damage. The Contractor shall contact the City Inspector twenty four (24) hours prior to working near any existing city fiber optic cabling.

Fiber marking tags shall be installed on fiber optic cable in every pull box. The tags shall be non-adhesive, Hellermann-tyton 4" fiber optic marker, part number CMFO4 or approved equal.

Pull-tape shall be a made out of woven aramid yarns and contain a silicon lubricate. The pull-tape shall have sequential footage markings and have a minimum tensile strength of 2500 lbs. Pull-tape shall include a tracer wire. The Contractor shall install Arnco Bull Line Part #WP12LC (with trace wire) or approved equal with the fiber optic cable.

The Contractor shall maintain a record of all sheath footage markings for each cable span.

3.02 FIBER OPTIC TESTING

A. General

Prior to conducting any tests, the Contractor shall provide the Engineer with detailed descriptions of test procedures for review and approval.

Documentation of all test results shall be provided within 2 weeks to the Engineer for review and approval. System documentation shall incorporate test results, ongoing maintenance, and performance measurements.

All test procedures and equipment required under for this testing shall be furnished and maintained by the Contractor. Testing shall be performed in the presence of the Engineer.

A complete report of each test performed shall be submitted to the Engineer following completion of the test. The report shall include all actions, results, failures, and corrective or preventative measures taken.

The Contractor shall notify the City of his/her intention to conduct any test at least ten (10) calendar days in advance. The Engineer shall have the right to delay the start of the testing up to seven (7) calendar days to accommodate personnel schedules. The Contractor shall plan on this possible delay, and if exercised by the City, this delay shall not be considered a valid cause for time extension, missed milestones, or additional compensation. If any piece of equipment fails during the individual testing, the Contractor shall request that the tests be rescheduled with appropriate notification and approval by the Engineer. All equipment must be repaired and restored to full operation before being resubmitted for inspection or testing.

Full compensation for all testing and documentation shall be considered as included in the contract price paid and no additional compensation will be allowed therefore.

B. Factory Tests

Fiber Optic Cable--While on the shipping reel, after cabling but before shipment, 100 percent of all Fiber Optic line fibers shall be tested for attenuation. Copies of the results shall be (1) maintained on file, (2) attached to the cable reel in a waterproof pouch, and (3) submitted to the Contractor and to the Engineer prior to the delivery of the cable to the job site.

Attenuation tests shall be performed with a Optical Time Domain Reflectometer (OTDR) capable and calibrated to show anomalies of 0.2 dB as a minimum. Singlemode fibers (SM) shall be tested at 1,310 nm and 1,550 nm. The OTDR used shall have a printer capable of producing a verifying test trace with cable identification, numerical loss values, date and operator name. It shall be Windows based and have associated software to do comparisons and reproductions on 8-1/2-inch by 11-inch paper, via a personal computer (e.g. for example 383 PCW). OTDR for testing shall be provided by the Contractor at no cost to the City.

C. Pre-Installation Tests

Prior to installation, the Contractor shall conduct pre-installation tests on all equipment to be used for this project.

Fiber Optic Cables--Upon arrival at the site, the cable and reel shall be physically inspected for damage and 100 percent of the fibers shall be tested with a OTDR with a bare fiber adapter for attenuation. Test results shall be recorded and compared with the filed copy stored with the shipping reel. The

cable shall not be installed until completion of this test sequence. Copies of traces and test results shall be submitted to the Engineer. If the OTDR test results are unsatisfactory, the Fiber Optic cable segments shall be unacceptable and shall be replaced with a new segment of equal cable at the Contractor's expense. Unsatisfactory results are defined if the attenuation or dB loss is greater than manufacturer specifications for each cable tested. The new segment of cable shall then be tested to demonstrate acceptability. Copies of the test results shall be submitted to the Engineer.

E. **Post Installation Tests**

The Contractor shall test each fiber strand after installation to ensure that the fiber optic cable has been installed without damage and operates correctly.

Fiber Optic Cables: After the fiber optic cable has been pulled 100 percent of all the fibers shall be tested with the OTDR for attenuation using a bare fiber adapter. In addition, the Contactor shall use a power meter to test for continuity. The test results shall be recorded, compared, filed with the previous copies of these tests, and submitted to the Engineer. Copies of traces and test results shall be submitted to the Engineer. If the OTDR test results are unsatisfactory, the F/O cable segment shall be unacceptable. The unsatisfactory segments of cable shall be replaced with a new segment of cable at the Contractor's expense. Unsatisfactory results are defined if the attenuation or dB loss is greater than manufacturer specifications for each cable tested. The new segment of cable shall then be tested to demonstrate acceptability. Hard and soft copy of all records shall be provided to the City with test results along with the program to review the soft copy of the test results.

Electronic Copies of the fiber optic traces shall be saved in Bell-core Standard and a copy of all traces shall be submitted to the Engineer for analysis. Hard copies of the test results shall be submitted to the Engineer. End to End testing shall also be done from one direction using a transmission test set to measure attenuation at both 1310 and 1550 nm using a one jumper reference. Attenuation results shall be submitted to the Engineer for records in a hard copy format.

Test Results shall include the following:

- Total fiber length
- Individual fiber traces for complete fiber length
- Losses of all anomalies

- Wavelength tested and measurement directions
- Manufacturer, model number and serial number of test equipment
- Name, signature and company technician/engineer
- Test Equipment Calibration Certificate for all fiber test equipment
- Test Date

All testing shall be performed according to the Telecommunications Industry Association (TIA) Technical Service Bulletin TSB-140, "Additional Guidelines for Field – Testing Length, Loss and Polarity of Optical Fiber Cabling Systems."

The fiber cable shall meet or exceed ANSI/EIA/TIA – 568B.3 and the latest BICSI TDMM Standards.

Proof of Calibration of all fiber optic test equipment may be requested by the inspector at any time, and must be provided along with the test results.

3.03 DOCUMENTATION

A. The Contractor shall provide record and fiber configurations and test results. Documentation shall be submitted on 8 ½"x11" paper in a binder with a table of contents and tabbed.

B. Each submission shall be prominently identified including the date, name and address of the Contractor, and shall further indicate the specific individual (mailing address, telephone and fax number) to contact relative to matters in the submission. If more than one volume is used, each should be so identified.

END OF SECTION

SECTION 16140 - WIRING DEVICES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Provide wiring devices, complete and operable, in accordance with the Contract Documents.

1.02 SUBMITTALS

A. General: Contract submittals shall be in accordance with Section 01105 and Section 16050.

B. Catalog data sheets of switches, receptacles, generator receptacle, covers and appurtenances, marked to identify proposed materials.

PART 2 - PRODUCTS

2.01 GENERAL

A. Like products shall be from one manufacturer for standardization, operation, maintenance, and spare parts.

2.02 LIGHTING SWITCHES

A. Light switches shall conform to UL20, heavy duty, industrial, toggle type, 20A, 120/277V, rated, self-grounding, and back and side wired. Light switch handles shall be brown. Contact arm spring and terminal plate shall be copper alloy. Contact points shall be silver cadmium oxide. Ground terminal shall be nickel-plated steel with brass screw. Acceptable products include: Hubbell 122x series, Legrand P&S CSB20ACx series, or equal.

2.03 GENERAL PURPOSE RECEPTACLES

A. Duplex receptacles shall be heavy duty, industrial grade, 125V, 20A, polarized 2-pole, three-wire grounding type, NEMA 5-20R conforming to UL498. Receptacle shall have brown impact resistant nylon face, brass power contacts, and #10 brass or bronze terminal screws with pressure plate. Acceptable products include: Hubbell HBL5362, Legrand P&S 5362A, or equal.

B. Ground-fault circuit interrupting receptacles (GFCIs) shall be 125V, 20A, 2-pole, three-wire grounding type, self-test, industrial grade, NEMA 5-20R conforming to UL498 and UL943. Receptacle shall have brown polyester or

nylon face, LED indication of power and/or fault. Acceptable products include: Hubbell GFR5362SG, Legrand P&S 2097, or equal.

2.04 PORTABLE GENERATOR 400A CAMLOCK CONNECTION BOX

A. Generator receptacle shall be rated 240V or 480V, 400A, 3P, 4W camlock style compatible with City standard portable generators. Connection box enclosure shall conform to the plans with (4) four color coded male single pole camlock connectors semi-flush mounted out the bottom of the box. Acceptable product: Eaton Crouse-Hinds Cam-Lok J-Series E1016-170x male receptacles, 240V: Black, Red, Blue; 480V: Brown, Orange, Yellow; and Ground: Green, no equal.

2.05 OUTLET AND DEVICE BOXES

C. Outlet and Device boxes are specified in Section 16110.

2.06 DEVICE COVERS

D. Architecturally finished indoor areas: Switch and receptacle device plates shall be 302/304 stainless steel. Acceptable products include: Hubbell Sxx series, or equal

E. Switchgear Rooms or Metal Buildings: Switch and receptacle device plates shall be cast malleable iron with 304 stainless steel screws and neoprene gaskets. Acceptable products include: Appleton FSK-1TSG-C, FSK-1DR-C, FSK-GKR-1N, or equal.

F. Outdoor Areas: Switch covers shall be rated weatherproof, cast malleable iron with external pushrod, stainless steel screws, and neoprene gasket. Receptacle covers shall be rated weatherproof die-cast aluminum GFIC weatherproof lift covers, stainless steel screws, and neoprene gasket. Acceptable products include: Appleton FSK-WGF1 series, FSK-XVTS series, or equal.

~~2.07 MOTION SENSOR~~

~~G. Provide outdoor rated motion sensor, mounted to site lighting pole, with dry contact output. Motion sensor shall be 270 degree, dark bronze, LED indicator, dusk to dawn operation, manual override, sensitivity and time adjustment, UL listed for wet locations. When motion detected, sensor shall close a contact to energize relay, signaling intruder and sending alarm signal to PLC as well as energize the site light. Motion Sensor shall be 120 VAC with 120 VAC, rated contact.~~

~~H. Motion Sensor shall be Lithonia MS270W, or approved equal.~~

~~2.08 STROBE ALARM LIGHT~~

~~I. Provide outdoor rated strobe alarm light, wired to motion sensor controls. Strobe shall by UL listed. Strobe shall mount on site lighting pole, refer to Contract Drawings. Strobe shall be amber. Strobe shall be 120 VAC.~~

~~J. Strobe alarm light shall be Federal Signal LP3M 5WF89, or approved equal.~~

2.09 NAMEPLATES

K. Nameplates shall be engraved black plastic with white characters. Stainless steel plates shall be engraved with black enamel filled characters on the device plate.

2.10 NON-FUSED DISCONNECT SWITCHES, INDIVIDUAL, 0 TO 600 VOLTS

~~L. Provide disconnect switches in NEMA rated enclosures as specified in Section 16050 – Electrical Work, General. Provide switches that can be locked in the OFF position. Interlock enclosure and switches to prevent opening the cover with the switch in the ON position. Provide switches which are motor-rated, load-break, heavy-duty (HD) type, having external marking clearly indicating ON and OFF positions. Furnish switches meeting the requirements of NEMA KS 1. Provide switches suitable for use with 75°C wire at full NEC 75°C ampacity.~~

~~M. Provide disconnect switches with phenolic, engraved, nameplates (black lettering on white background) citing the name of the equipment, equipment tag, voltage, phase, service location.~~

~~N. Acceptable products include: Eaton Heavy Duty Safety Switches, or equal.~~

~~O. Booster pump disconnecting switch shall be motor rated, panel mounted rotary load switch, 16 amps, 240 VAC, three phase, 3 HP with padlockable handle. Allen Bradley 194E Series, or equal.~~

PART 3 - EXECUTION

3.01 INSTALLATION

A. In architecturally finished areas, receptacles and switches installed in pressed steel boxes shall be flush mounted. Support device boxes independently of conduit by attachment to the building structure or a structural member. Locate all light switches on the lock side of doors.

B. Multi-gang device boxes housing 277V lighting circuits shall have barriers or adequate spacing for 480V clearances per UL requirements.

C. Mount boxes at the following heights, unless otherwise shown on the drawings

1. Generator Receptacle 48 inches
2. Light Switches 48 inches
3. Convenience Receptacles:
    a. Outdoor: Minimum 24 inches above grade
    b. Indoor: 18 inches above grade to top of box

D. Where above heights do not suit the building construction or finish, locate boxes where directed by the Engineer.

3.02 NAMEPLATE ENGRAVING

A. Identify switch and receptacles with the panelboard and circuit number feeding that device. For example, a receptacle nameplate may be inscribed "LP1-12". Install plastic nameplates with epoxy glue on or near the device box. Stainless steel covers shall be engraved.

3.03 FIELD TESTING

A. Provide checkout, field, and functional testing of wiring devices in accordance with Section 16050. Wiring Devices testing shall be completed during Pre-Demonstration period.

B. Test each receptacle for polarity, ground integrity and GFIC trip with a standard receptacle tester.

C. Switches and photocells shall be function tested by energizing the fixtures.

D. Coordinate portable generator rotation testing with City during the Pre-Demonstration period. City will connect a portable generator to the reverse service receptacle. Verify correct rotation at the Panelboard phase rotation relay. Correct any discrepancies by shifting conductors at the reverse service receptacle.

END OF SECTION

SECTION 16430

LOW VOLTAGE MAIN SWITCHBOARD

PART 1 - GENERAL

1.01 SCOPE

A. This specification section covers Main Switchboard and includes coordinating the electrical hookup with SMUD. The main switchboard shall include two sections a meter section and a main/generator breakers section.

B. The provisions of Sections 16050 and 16120 of these specifications shall apply unless otherwise specified in this Section.

1.02 ELECTRIC SERVICE COORDINATION

A. The existing SMUD electric service is 3-phase, 4-wire, 480 V and is feed from an existing SMUD pad mounted transformer.

B. The Contractor shall coordinate the electric service hookup with SMUD such that the service is available to match their schedule (Sacramento Utility District Contact: Heather Macias, 916-732-5507).

C. The 480 V electric service for this project will be fed from the existing SMUD pad mounted transformer. The Contractor shall furnish and install the conductors and pull tape per the Plans and in accordance with SMUD requirements. SMUD will make all connections at the transformers.

D. The Contractor shall make sure that the electrical service phase rotation is clockwise.

1.03 SUBMITTALS

A. Submittals for the Main Switchboard shall include, but shall not be limited to, the following:

1. Catalog cuts showing and identifying manufacturer, catalog numbers, dimensions, weights and material.

2. Assembly drawings of the equipment.

3. Operating and Maintenance Manuals as specified in Section 01105.

4. Dimensioned "as-built" drawings.

5. Single line drawing.

6. Certified test reports prepared by manufacturer.

1.04 QUALITY ASSURANCE

A. The manufacturer has been fabricating and assembling similar equipment for a minimum of five (5) years.

B. The switchboard shall be built to the latest UL 891standards.

PART 2 - PRODUCTS

2.01 MAIN SWITCHBOARD

A. CONSTRUCTION

The enclosures shall be designed for top and bottom entry of incoming and outgoing conduits. The main switchboard section shall meet NEMA 1A standards with a gasket. The Main Switchboard shall be factory assembled, tested, and subsequently shipped to the job site as a complete operational assembly.

Fabrication shall be of welded steel with all welds ground smooth. The enclosure shall be constructed of leveled hot rolled pickled steel, No. 12 gage except that 14 gauge can be used for interior parts. The exterior doors shall have a heavy duty hasp for padlocking. All doors and dead fronts shall have continuous stainless steel piano type hinges. All hardware shall be stainless steel.

1. Meter sockets, current transformer mounting brackets, test switches and wiring shall be furnished and installed as required by SMUD.

2. Identification: The switchboard shall have a permanent metal identification plate providing the following information: manufacturer, serial number, type and electrical ratings.

3. Bus arrangement shall be phase A-phase B-phase C, left-to-right, top-to-bottom, front-to-rear as viewed from the front.

4. An interior copper bar ground bus at 1/4 inch by 1 inch minimum shall be provided along the entire length of the assembly, located near the bottom, and bolted to the frame. The ground bus shall include lugs for equipment grounding conductors.

B. CIRCUIT BREAKERS - MOLDED CASE TYPE

The circuit breakers shall be operated by a toggle type handle and shall have a quick-make, quick-break, over-center switching mechanism that is mechanically trip-free from the handle so that the contacts cannot be held closed against short circuits and abnormal currents. Tripping due to overload or short-circuit shall be clearly indicated by the handle automatically assuming a position midway between the manual ON and OFF positions.

Contacts shall be of non-welding silver alloy.

Each pole shall provide inverse time delay and instantaneous circuit protection, and the minimum interrupting rating shall be as shown on the Plans.

The main breaker and generator breaker shall have adjustable instantaneous, short time pickup, short time delay, long time pickup, and long time delay settings.

Each breaker shall have contacts that close when the breaker is in the closed position.

The main circuit breaker shall be padlockable as specified in the current edition of the EUSERC standards.

The circuit breakers shall be General Electric, Square D, Cutler-Hammer or equal and shall be NEMA rated.

C. BUS BARS

Bus bars shall be silver-plated copper. All bus bars shall be sized to limit the heat rise to 65 degrees Centigrade above ambient temperature of 40 degrees Centigrade maximum.

Bus joints shall be welded, brazed, or bolted. Bolted joints shall be silver surfaces. Bolts and associated hardware shall be corrosion-resistant and shall be rear accessible.

Insulating barriers shall be provided where primary busses pass from one compartment to another. The main and riser bus shall be fully isolated from the circuit breaker and instrument and auxiliary compartments. The bus bar shall be bolted where horizontal and vertical busses are joined. All bolted connections shall be silver-plated. Solid vertical insulating barriers shall be provided in the section between the cable and bus compartments. A barrier system shall be provided that isolated the bus from the cable compartment.

D. IDENTIFICATION

Main breaker nameplate shall be Red background with white lettering. Minimum letter size 3/8".

E. FUSES

Fuses shall be Bussman, General Electric, or equal. Equality shall be based on Bussman time current characteristic curves.

F. SPACE HEATERS AND THERMOSTAT

Space heaters and an adjustable thermostat shall be provided for the switchboard. Heater shall be large enough to prevent condensation from forming. Voltage shall be 120 V, single phase. Thermostats shall have a range of 40 to 80 degrees F and shall have contacts rated 120 volts, 10 amperes continuous, 60 Hz. Provide expanded metal shield for each heater.

G. SPARE PARTS

Provide spare parts per Section 16050.

H. AVAILABLE SHORT CIRCUIT CURRENT IDENTIFICATION

The main breaker section shall be labeled with a phenolic plastic nameplate that indicates the amount of available short circuit current per NEC. The engineer shall indicate that available short circuit either on the plans or specifications.

I. GENERATOR RECEPTACLES

The switchboard manufacturer shall provide and install the generator receptacles as shown on the plans.

PART 3 - EXECUTION

3.01 FACTORY ACCEPTANCE TESTS

A. Switchboards and MCCs and their components shall be given Manufacturer's standard electrical and mechanical production tests and inspections. The tests shall include electrical continuity check, dielectric tests for each circuit, and inspection for proper functioning of all components including controls, protective devices, metering, and alarm devices. Test the current and ground functions of circuit breakers for proper operation. Factory Acceptance Testing procedures shall be submitted to the Engineer for approval. Factory Acceptance Testing shall be

witnessed by the **Engineer** and **City**. The City will pay for the expenses to send a City representative to the Factory Acceptance Testing (FAT). The electrical manufacturer shall give the City three weeks' notice prior to the FAT. Do not ship equipment until test reports have received written acceptance from the Engineer.

3.02 INSTALLATION AND TESTS

A. Facilities for SMUD service shall be inspected and approved prior to acceptance of the Contractor's work.

B. Contractor shall furnish all material and labor including, but not limited to, transportation, loading, lifting, jacking, wiring to completely install Main Switchboard as shown on the drawings and shall conform with the National Electric Code (NEC).

C. Refer to Section 16950 for all the testing requirements.

D. Secure switchboard to foundation per plans.

3.03 SPARE PARTS

A. Provide spare parts per the manufacturer's recommendations.

END OF SECTION

SECTION 16450 - GROUNDING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Provide the electrical grounding system, complete and operable, in accordance with the Contract Documents.

B. The grounding system is intended to provide a low resistance path to earth ground. Acceptable ground system resistance is 2 ohms or less.

C. Coordinate, provide and install grounding system at the Utility Meter per SMUD requirements.

1.02 SUBMITTALS

A. General: Submittals shall be in accordance with the requirements of Section 01150 and Section 16050 – Electrical Work, General.

B. Catalog data sheets of exothermic connectors, molds/shots & instructions, compression connectors, ground rod/clamp, ground well/cover, fence ground connectors, marked to identify proposed materials.

PART 2 - PRODUCTS

2.01 GROUND GRID

A. Ground grid shall be bare annealed copper conductors suitable for direct burial per Section 16120. Conductors shall be #2/0 unless indicated otherwise.

2.02 GROUND RODS AND CLAMPS

A. Ground rods shall be copper-clad steel, 3/4-inch diameter and 10 feet long conforming to UL 467. Electrolyte copper 10 mils thick shall be mechanically bonded to the rigid steel core. Ground rod clamps shall be cast high strength copper alloy with hex-head screw. Furnish T&B Blackburn 7510 rod and, JAB34H clamp, or equal.

2.03 EXOTHERMIC CONNECTORS

A. Exothermic connections shall consist of a molecular weld utilizing the reaction of copper oxide and aluminum powder in a semi-permanent graphite mold. Connections include cable/cable, cable/rebar and

cable/steel types. Acceptable products include: Cadweld-series, Thermoweld-series, BurndyWeld-series, or equal.

2.04 COMPRESSION CONNECTORS

A. Lugs and splices shall be tin-plated copper compression types conforming to UL486A. Both tool and connectors shall be from the same manufacturer with color-coded system for the cable size and compression tool die. Compression tool shall prevent reopening once started until the correct compression force is reached. Acceptable products include: Thomas & Betts TBM-series, Burndy Hydent-series compression tool with matching lugs and splices, or equal.

2.05 GROUND ROD BOXES

A. Boxes shall be precast, high density, reinforced concrete with cast iron ring and lid rated H/20 traffic, nominal 10-inch interior diameter and 12 inches deep. Covers shall be cast iron. All covers shall include special markings: "GROUND ROD". Acceptable products include: Oldcastle Christy G03/G03C, or equal.

2.06 FENCE GROUND CONNECTORS

A. Fence fabric ground connectors shall be electroplated tinned brass body with stainless steel hardware conforming to UL467 and UL96. Cable/post and cable/braid connectors shall be high copper cast body with Durium U-bolts and hardware conforming to UL467. Flexible braid shall be flat-woven tinned copper with seamless copper ferrules on each end rated #2AWG. Acceptable products include: Burndy FFG, GAR, GG and Braid Type B series, or equal.

PART 3 - EXECUTION

3.01 GENERAL

A. Grounding electrode system shall consist of bonding together the ground mat, ground rods, duct bank ground conductors and connecting them to panelboard ground bus, utility meter, structural metal frame, flow meter, poles, fences, gates and other metal structures likely to become energized.

B. Ground continuity throughout the facility shall be maintained by means of a ground conductor run in all non-metallic conduits and in any conduit containing circuits operating over 50 volts. Grounding conductors which

are run in conduit shall be insulated copper conductors per Section 16120.

C. All grounding shall be installed prior to start of Pre-Demonstration period.

3.02 GROUND MAT

A. Ground mat conductors shall be buried a minimum of 30-inches deep.

B. Grounding conductors that extend beyond concrete surfaces for connection to equipment shall be of sufficient length to reach final connection without splicing. Locate close as possible to the final connection point and protected from damage during construction.

C. Ground conductors embedded in duct banks shall be exothermically welded to manhole ground tails and compression spliced together inside handholes.

D. Within slab on grade the grounding cable shall be embedded in the bottom or installed beneath the slab. Provide exothermic weld between concrete encased grounding conductor and the slab on grade reinforcement bars.

E. If the resistance to ground exceeds 2-ohms, extra work will be directed by the Engineer. Extend the ground mat, install additional ground rods at least 10-feet apart and retest.

3.03 GROUND RODS

A. Ground rods shall be installed with bolted connections to allow removal from the ground mat for individual testing. Drive ground below grade and with one end exposed six inches above a sand backfill with bolted connection accessible. Install a ground well at each location flush with finished grade.

B. The location of ground rods shall be as indicated. The lengths of rods forming an individual ground array shall be equal and shall be of the quantity required to obtain a ground resistance of no less than 2-ohms.

3.04 EXOTHERMIC CONNECTIONS

A. All embedded or buried ground connections shall be made by exothermic weld type connectors. Conductors and mold shall be prepared in accordance with manufacturer's instructions. Reusable molds shall be replaced at intervals in accordance with manufacturer's instructions.

3.05 COMPRESSION CONNECTIONS

A. All exposed ground connections shall be made by compression connection lugs bolted to the surface or equipment. Building structural steel shall be connected to the ground mat where shown on the drawings. Completely remove all paint, dirt, or other surface coverings at connection points so that good metal-to-metal contact is made.

B. All motors 100HP and larger shall have supplemental grounding conductor from the ground mat tapped to the motor frame or equipment housing.

~~3.06 FENCE AND GATE GROUNDING~~

~~A. Fences enclosures shall be connected to the ground mat at fence posts forming corners and gate hinge posts with #2/0 copper and cable/post connectors buried below grade. Fence fabric shall be grounded with #4 copper cables and fabric connectors adjacent to each corner post. Gates shall be grounded with cable/post connectors and flexible braid.~~

3.07 INSPECTION

A. 24-hour notification for inspection is required prior to backfilling or encasing in concrete any portion of the ground system.

3.08 FIELD TESTS

A. Ground mat shall be NETA tested per Section 16950. Grounding tests shall be completed, submitted and approved prior to energizing electrical equipment.

END OF SECTION

SECTION 16480

LOW VOLTAGE MOTOR CONTROL CENTER

PART 1 -- GENERAL

1.01 SCOPE

A. This Specification Section covers the furnishing, installing and testing of the Motor Control Center as specified herein, as shown on the Drawings, and as required for a complete electrical installation.

B. The provisions of Sections 16050 and 16120 of these specifications shall apply unless otherwise specified in this Section.

1.02 SUBMITTALS

A. Submittals for the Motor Control Center shall include, but shall not be limited to, the following:

1. Catalog cuts showing and identifying manufacturer, catalog numbers, dimensions, weights, nameplate data, and material of all components.

2. Assembly drawings with front, side, section views and uprights. Drawings to show location of all accessories.

3. Catalog cuts of specified components.

4. Operating and Maintenance Manuals as specified in Section 01105.

5. Dimensioned as-built drawings.

6. Certified test reports prepared by the manufacturer.

7. Control diagrams

1.03 QUALITY ASSURANCE

A. The manufacturer has been fabricating and assembling similar equipment for a minimum of five (5) years.

B. The MCC shall be built and labeled by a manufacturer with a UL file listing. The MCC shall meet UL 845.

PART 2 -- PRODUCTS

2.01 MATERIAL AND EQUIPMENT

A. The Motor Control Center shall be a 3 phase, 3 wire, 480 volt, free standing, dead front enclosure with either NEMA Class I or II designation and NEMA Type B or Type C-S wiring. For those enclosures containing across the line motor starters the enclosure shall be NEMA 12 construction and labeled as NEMA 12 with no vents. The center shall contain the proper clearances and space for safe operation of the equipment therein. Control voltage shall be 120 VAC.

Motor control centers shall be Allen-Bradley, Eaton "Freedom", General Electric 8000 Line, Square D Model 6I, or approved equal.

A. Motor Circuit Protector (MCP) shall be molded case quick make quick break with adjustable instantaneous trip from 700 percent to 1300 percent of the motor full load amperes. The instantaneous trip setting shall also meet the requirements of the latest version of the NEC. The motor circuit protector shall be rated 600 volts with adjustable trip settings. MCP shall be General Electric "map break", Eaton "MCP", or approved equal. The operating handle shall close the MCP when placed in the upward position and open the MCP in the downward position. The handle shall accept multiple padlocks to lock the MCP in the open position. MCP shall be NEMA rated. Each MCP shall have an AIC rating greater than that shown on the single line diagram.

C. Circuit Breakers: **Circuit Breaker shall be molded case and NEMA rated.** The circuit breakers shall conform to the requirements of NEMA ABI and UL 489 and shall be trip-free, thermal magnetic bolt-on type; connect breakers in uniform phase sequence starting at the top left phase bus; provide full busing and all necessary mounting hardware; use common trip devices not handle ties. Two or three pole breakers shall be common trip units. Each breaker pole shall provide inverse time delay and instantaneous circuit protection for breakers rated under 100 A. Breakers shall have toggle, quick make, and quick break operating mechanisms. Trip position of the breakers shall be clearly indicated by movement of the operating handles to the center position. Circuit breakers rated to IEC standards shall not be acceptable.

D. Panelboard: Panelboard shall conform to the requirements of NEMA PB-12 and UL-67. Bus shall be copper. Provide quantity and size of branch breakers and spare spaces as shown on the Drawings.

E. Magnetic starters shall have auxiliary contacts as required by the Plans including N-O and N-C contacts as indicated on the Plans, plus one each spare N-O and N-C contact. The combination motor starters shall be drawout-type for size 5 and below. The fixed-type unit assembly shall be constructed so that it can be easily removed

from its panel using pull apart terminal strips to the terminal block and withdrawing from the primary bus. Removal of a unit assembly shall be possible without rear access and without disturbing any other unit in the motor control center.

F. Each starter unit shall have its own 480 V - 120 V AC control power transformer. It shall have a 120 volt grounded secondary. One secondary fuse and 2 primary fuses shall be provided. Control power transformers shall be sized to accommodate the control devices indicated or as shown on the Plans.

G. Full voltage motor starters shall be sized as indicated on the Plans. The starters shall have the same interrupting capacity as the circuit breakers and power busses.

H. Motor starters shall be designed to NEMA ratings only. Starters designed to IEC ratings shall not be acceptable.

I. Elapsed Time Meter: Elapsed time meter shall be large panel mounted, non-reset type, capable of reading 99,999.9 hours to the nearest 1/10 hour, rated 120 volts, 60 Hz. Elapsed time meter shall be mounted on the exterior of the section door between 40" and 60" from the bottom of the panel. Elapsed Time Meters shall be Eagle Signal Controls Model # HK410A6 or Engineer approved equal. Meters using push on retaining clips shall not be acceptable.

J. Indicating Lights and Lenses: Indicating lights shall be industrial, waterproof NEMA 4/4X, transformer type, with LED type lamps, and push to test. Lights shall be manufactured by Allen Bradley, Eaton, or approved equal. Mount all indicating lights on front panel of motor control center.

Unless otherwise specified, indicating lights shall be equipped with colored lenses in accordance with the following schedule:

COLOR	FUNCTION	EXAMPLE
White or Clear	Normal Condition	Control power on, status OK
Red	Run, valve closed	Motor running, end of cycle
Green	Ready, valve open	Equipment ready, operating
Amber or Yellow	Abnormal condition	Failure of equipment or status abnormal, fault condition

K. Control and Protective Equipment: Control relays, timers, switches (including contactor auxiliary switches), indicating lights, push buttons, overload relays, fuses, control transformers, terminal blocks and wiring shall be furnished and installed as shown on the drawings. Overload relays shall be sized to trip according to NEC as per data on the motor nameplate and shall be NEMA style. **Each overload relay shall be electronic and have ground fault protection. Overload relay shall be**

an Eaton C440 or equal. Push buttons shall be NEMA style. Contractor shall test each back spin relay and set per Engineer=s requirements.

L. Station Service Transformer: Transformer shall be dry type and sized per Plans. All windings of the transformer shall be copper. The transformer shall have NEMA energy efficiency rating.

M. Phase Failure and Reverse Phase (PFR) Relay: Relay shall have single pole-double throw (SPDT) contact which shall operate on power failure, phase loss, or reversal, providing a signal to the telemetry system. Reset shall be automatic. Nominal AC voltage shall be 480V, 3 phase. The phase failure and reverse phase relay for plant voltage monitoring shall be Time Mark Model No. A258B (258B for 240V service) or Diversified Electronics SLA Series, Catalog No. SLA 440 ASA (SLA 230 ASA for 240V service) or approved equal. Contractor shall adjust relay to lowest setting before installation.

N. Provide 150 W electric resistance type strip heater in each vertical section. Voltage shall be 120 V, single phase. Furnish thermostats to control heaters with one thermostat per heater located in its respective section. Thermostats shall have a range of 40 to 80 degrees F and shall have contacts rated 120 volts, 10 amperes continuous, 60 Hz. Provide expanded metal shield for each heater.

O. Busses:

1. The grounding bus shall be 1/4" by 1" copper, hard connected, running the full width of the MCC and located near bottom. Grounding bus shall be bolted to the frame of the MCC and include lugs for equipment grounding conductors.

2. The main horizontal bus shall be silver or tin plated copper located within an isolated compartment. The bus shall be rated as shown on the Plans.

3. The vertical bus in each section shall consist of a single silver or tin plated copper conductor per phase with a current capacity of not less than 600 amperes. The vertical bus shall be completely isolated and insulated with a labyrinth bus barrier, and shall extend the full height of the section wherever possible. The bus shall be rated as shown on the Plans.

P. Wireways: A separate vertical wireway shall be provided adjacent to each vertical unit, and shall be covered by a hinged door. Each individual unit compartment shall be provided with a side barrier to permit pulling wire in the vertical wireway without disturbing adjacent unit components.

Q. Buckets: Buckets shall be removable from the MCC as a unit and have pull apart terminal blocks to allow removal of individual buckets without disconnecting control and instrumentation wiring.

R. Provide and install high voltage switchgear rubber matting in from of the entire length of the switchgear, ATS, MCC, and control panel plus 6" on both ends. Also, provide rubber matting in front of the triple switch and load bank control panel. Matting shall conform to ASTM D178-93 Type 1 Class 2, proof tested at 20,000 volts AC. The matting shall be black, ¼" thick and 48" wide. Rubber matting shall be manufactured by Mats, Inc. Model No. 0213 Corrugated Rubber Switchboard Matting, or equal.

S. DIGITAL POWER METER, ACCESSORIES, AND CURRENT TRANSFORMERS

Digital power meter shall be Electro Industries 3 Phase Digital Multi-Function Power Monitor model number Shark200-60-10-V3-D2-INP100S-X, no equal.

A 3-pole fuse block with neon blown fuse indicator rated 600V, 30A, 200kAIC RMS symmetrical with Class CC fuses shall be provided for the Digital Power Meter as shown on the Plans. The fuse holder shall be Allen-Bradley Catalog #1492-FB3C30-L or equal. A safety cover for each meter shall also be provided.

The digital power meter shall utilize utility grade current transformers (CTs) for measuring current. The CTs shall have an accuracy of 0.3% and shall meet ANSI/IEEE specification C57.13. CTs shall be mounted in such a way as to provide easy access for inspection and maintenance. The CTs shall be landed on terminal blocks. The terminal blocks shall be Marathon Heavy Duty Terminal Blocks 1600 SC series or equal.

The digital power meter, shorting block, and fuse block shall be mounted in the motor control center. The digital power meter shall be connected to the load side of the main breaker. The CT's shall be connected so the digital power meter reads the correct current and power factor measurements.

T. MCC BUCKET WIRING

The MCC bucket wiring shall be a minimum of 14-gauge TEW flexible wiring. Use the following color code:

MCC bucket wiring colors shall be as follows:

Neutral	White
120V	Red
External voltage	Yellow
Ground	Ground
Power Circuits before CPT	Black

U. SURGE PROTECTIVE DEVICE

The surge protective device shall conform to UL1449 and UL1283 rated 200kA (SCCR) with 20kA nominal discharge current. Surge suppressor shall be specifically selected for the nominal voltage and electrical system configuration of the utility service. Protection modes shall include L-N, L-L (normal) and L-G, N-G (common) with nanosecond response time. Surge suppressors shall have a built-in diagnostic package with LED display for the status of each phase. Suppressor shall have 20-year free replacement warranty. Acceptable products include: Eaton PTX160 series or approved equal.

PART 3 -- EXECUTION

3.01 FACTORY ACCEPTANCE TESTS

A. Switchboards and MCCs and their components shall be given Manufacturer's standard electrical and mechanical production tests and inspections. The tests shall include electrical continuity check, dielectric tests for each circuit, and inspection for proper functioning of all components including controls, protective devices, metering, and alarm devices. Test the current and ground functions of circuit breakers for proper operation. Factory Acceptance Testing procedures shall be submitted to the Engineer for approval. Factory Acceptance Testing shall be witnessed by the **Engineer**. The City will pay for the expenses to send a City representative to the Factory Acceptance Testing (FAT). The electrical manufacturer shall give the City three weeks' notice prior to the FAT. Do not ship equipment until test reports have received written acceptance from the Engineer.

3.02 INSTALLATION

A. Contractor shall furnish all material and labor including, but not limited to, transportation, loading, lifting, jacking, wiring to completely install Motor Control Center as shown on the drawings and shall conform with the National Electrical Code (NEC).

B. Secure MCC to foundation per the plans.

3.03 SPARE PARTS

A. Provide spare parts per the manufacturer's recommendations.

END OF SECTION

SECTION 16500

LIGHTING FIXTURES AND POLES

PART 1 - GENERAL

1.01 SCOPE

A. This specification section covers the furnishing, and installing of lighting fixtures, wiring devices, ~~poles~~, conduit, wiring and other material for the complete indoor and outdoor lighting as shown on the drawings. Lighting fixtures and hardware shall be installed as shown on the Plans.

B. **The contractor shall remove all existing conductors between any existing device and the existing lighting panels. Existing devices include but is not limited to lighting fixtures, light switches, fire department radio, tower lights, and receptacles. The contractor shall install new conductors to every device per the conduit schedule.**

1.02 SUBMITTALS

A. Catalog cuts showing manufacturer, catalog numbers, dimensions, weights and material for fixtures and poles shall be submitted to the Engineer for review in accordance with Section 01330.

B. Catalog data sheets for each fixture listing UL conformance, hardware, mounting requirements, weather rating, finish, photometric data, options, lamps and LEL data.

C. Catalog data sheets for each pole listing ASTM conformance, construction details, height, attachment arms, handhole orientation, gauge, finish, and anchor bolts.

D. Submit seismic calculations that size the supports for the lighting fixtures greater than 50 pounds.

1.03 REFERENCE STANDARDS

A. Materials and equipment supplied under this contact shall be designed, manufactured, and tested in accordance with the latest version of the following standard:

1. National Electrical Manufactures Association (NEMA).
2. Underwriters Laboratories Inc.
3. National Electrical Code.

PART 2 - PRODUCTS

2.01 FIXTURES – GENERAL

A. Provide luminaires with proper hangers, mounting stems, and hardware necessary for complete installation. Install appropriate fittings provided by the manufacturer to make the assembly complete.

B. Lighting Fixtures shall be complete with mounting brackets and hardware, lamps, lenses, fixtures wire, and all required accessories as specified and as required by NEC. The lighting fixtures and fixture accessories shall be as shown on the drawings or approved equal. Mounting brackets shall be consistent with field conditions.

2.02 LED VAPORTIGHT WRAPAROUND

A. Fixture housing shall be 4-foot, 1-piece UL746C reinforced fiberglass, IP67 moisture & dust proof, UL94-5VA flammability and UL listed for wet locations. Lens shall be ribbed frosted high impact acrylic secured over seamless urethane gasket with cam latches. Gear tray shall be steel with white polyester finish. LEDs shall be 46W, 3600 lumens, 4100K color with 85,000-hour L70 lifetime. Power supply shall be 120-277V rated. Acceptable products include; Simkar EN2LED 4 RFA F 90L 50 U1 with EN2MB option or approved equal.

2.03 LED WALL PACK

A. Fixture housing shall be dark bronze powder coat finished die-cast aluminum with sealed tempered glass lens rated IP65 moisture & dust proof, UL listed for wet locations. Mounting shall be with wall mount bracket for recessed junction boxes or with included junction box with ½"-NPS 5-thread conduit hub. LEDs shall be 20W, 2,663 lumens, 5000K color with 100,000-hour, L73 lifetime. Power supply shall be 120V rated. Options include button photocontrol and visor. Acceptable products include; Lithonia OLWX1 LED 20W 50K 120 PE or approved equal.

2.04 LIGHTING DEVICES

A. Light Switches: Switches shall be single pole, specification grade, 277 volt, 3 wire, 20 ampere A.C., ivory in color with stainless steel cover plates. Furnish Hubbell 1221, Leviton 1201-2, or approved equal. **Light switches shall be labeled with nameplates per section 16010. Light switches mounted outside shall be weather proof and enclosed in a weatherproof cover. The weatherproof cover shall be rated NEMA 3R, die cast metal and pad lockable.**

B. GFCI Receptacles shall be ivory, 20 A, NEMA 5-20R furnished with stainless steel plates. Receptacles shall be Leviton #6899, G.E. #TGTR115, Square D

#GFDR120, or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All lighting poles and fixtures shall be directly grounded to the site grounding system by means of a conductor of a size not less than that required by NEC. If insulated, the ground conductor insulation shall be colored green.

B. The Contractor shall install all lighting fixtures in accordance with the manufacturer's instructions and recommendations.

C. All exterior fixtures shall be aligned and directed as shown on the Plans and as directed by the Engineer to illuminate the desired area properly. Fixtures shall be directly and rigidly mounted on Contractor provided supporting structures.

D. Unless otherwise noted on the plans: general use receptacles shall be mounted 18" above the finish floor to device centerline, light switches shall be mounted 48" above finish floor to device centerline.

E. Prior to acceptance by the City the Contractor shall thoroughly clean the fixtures and lamps.

3.02 DELIVERY AND HANDLING

A. Lighting fixtures shall be delivered and stored in their original cartons from the manufacturers until the time of installation.

B. All stored equipment shall be protected in accordance with the manufacturer's recommendations and Section 01105.

3.03 INSTALLATION

A. Install each luminaire plumb and level in a manner recommended by the luminaire manufacturer and accepted by the Engineer.

B. Install fixtures in such a manner as to avoid obstructions and to give proper illumination result. Coordinate location of light fixtures and mounting heights as not to interfere with other equipment, piping, etc. Obtain Engineer's approval of final lighting fixture positions and mounting heights.

C. Provide and install all fixtures complete, including lamps, and ready for service.

3.04 CLEANUP

A. Fixture lenses, diffusers, and reflectors shall be cleaned just prior to the system demonstration test.

B. Fixture trim, including poles and support brackets, where finish has been damaged, shall be touched-up with paint supplied by manufacturer.

3.05 FIELD TESTS

A. Test all lighting systems for proper operation and conformity to these specifications and as shown on the Contract Drawings. Perform field testing to verify operation of light fixtures, controls, photocell, etc. Verify lighting circuits match panelboard schedule.

B. Lighting system testing shall be witnessed by the Engineer and City for functional operation. Field testing of lighting systems shall be performed during Pre-Demonstration period.

C. Refer to Section 01650 – Facility Startup for further testing requirements.

END OF SECTION

SECTION 16922

MISCELLANEOUS EQUIPMENT

PART 1 - GENERAL

1.01 SCOPE

A. This Section covers the furnishing and installation of the following equipment: magnetic door switch and uninterruptible power supply (UPS).

1.02 REFERENCE PUBLICATIONS

A. The equipment covered under this contract shall be designed, manufactured, and tested in accordance with the latest version of the applicable industrial standards.

1.03 SUBMITTALS

A. Manufacturers Data:

1. Magnetic Door Switch
2. UPS

B. Shop Drawings.

C. Operations and Maintenance Manuals as specified in Section 01105.

1.04 QUALITY ASSURANCE

A. The manufacturer shall verify that they have been fabricating and assembling similar equipment for a minimum of five (5) years. Manufacturer shall be located in the United States.

PART 2 – PRODUCTS

2.01 MAGNETIC DOOR SWITCH (DS)

A. Magnetic door switch shall be Sentrol model number 1044TW or approved equal. Color shall be natural (off-white).

2.02 UNINTERRUPTIBLE POWER SUPPLY

A. The UPS shall provide full power to its connected load as shown on the Plans for a minimum of 30 minutes following loss of primary power and shall be an on-line system which provides continuous, no break power during complete blackouts or

momentary interruptions. Transient power surges and dips shall not affect the operation of the devices connected to the UPS.

B. The UPS shall be rated to provide a minimum of 1500 VA, 1350 W at output at 120 VAC at an efficiency of 95%. The UPS shall be a Eaton model number PW 9PX1500RTN, no equal.

C. Install UPS as shown on the drawing and provide all necessary wiring. Plug cords and receptacles shall be provided so that the UPS can be readily bypassed with power being obtained directly from the panelboard.

D. Battery: Maintenance free lead acid.

E. Provide optional Eaton Network Card-MS for the UPS and connect to the Ethernet switch as shown on the Plans.

F. Total harmonic distortion: Less than 5% on fundamental sine wave.

G. Provide optional extended battery module for the UPS model number 9PXEBM48RT.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The Contractor shall be responsible for the installation of the equipment specified and shall pull all the cables and wires and make all the connections as shown on the Plans. The City will conduct tests to determine its acceptability.

3.02 FIELD TESTING

A. After finishing all the connections, the Contractor shall cooperate with City during the testing.

END OF SECTION

1610SECTION 16950

OPERATIONAL TESTING

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. The Contractor shall test the motor control centers, switchgear, switchboard, metal-enclosed busways, all circuit breakers, grounding system, ground fault protection system, and the automatic transfer switch per the latest edition of the ANSI/NETA Testing Acceptance Specification.

B. These tests shall assure that all equipment is operational within industry and manufacturer's tolerances and is installed in accordance with design plans and specifications. The tests and inspections shall determine the suitability for energization and the suitability for Owner acceptance of the Contractor's work.

C. The Contractor is responsible for the safe operation of the switchgear during construction and testing.

D. The electrical testing shall not take place until the following has been completed:

1. The electrical studies, ~~per section 16013,~~ shall be completed and approved by the Engineer. The City will perform the electrical studies.

2. All protective devices shall be set per the electrical studies recommendations.

E. **Testing company shall be NETA certified. Provide written NETA certification prior to performing any testing. The lead technician performing the testing shall be NETA level 3 certified. Provide NETA certificates of all employees who will be performing the testing prior to performing any testing.**

F. **For the following tests reference the latest edition of the ANSI/NETA Testing Acceptance Specification for additional information including references to Tables and/or Sections:**

1. **Switchgear and Switchboard Assemblies**
2. **Metal-Enclosed Busways**
3. **Circuit Breakers, Insulated-Case/Molded-Case**
4. **Circuit Breakers, Low Voltage Power**
5. **Grounding Systems**
6. **Grounding-Fault Protection Systems, Low-Voltage (if applicable)**
7. **Motor Control, Motor Control Centers, Low-Voltage**

8. **Emergency Systems, Automatic Transfer Switch**

1.02 SUBMITTALS

A. The Contractor shall submit the following tests to the Engineer:

1. System Operational Testing
2. Phase Rotation Preoperational Test
3. 600 Volt Conductor Test.
4. Wiring Test.
5. Generator and ATS Test.
6. Switchgear and Switchboard Assemblies
7. Metal-Enclosed Busways
8. Circuit Breakers, Insulated-Case/Molded-Case
9. Circuit Breakers, Low-Voltage Power
10. Grounding Systems
11. Grounding-Fault Protection Systems, Low-Voltage (if applicable)
12. Motor Control, Motor Starters, Low-Voltage
13. Emergency Systems, Automatic Transfer Switch

B. Three copies of each test mentioned above shall include the following data and be submitted with the Operation and Maintenance Manual:

1. Summary of project, construction contract numbers
2. Description of equipment tested
3. Description of test
4. Test personnel
5. List of test equipment used and calibration date
6. Test results, date and weather conditions
7. Conclusions and recommendations
8. Appendix, including all test forms

PART 2 - TESTING

2.01 TESTING

A. Furnish test reports which are to include the following:

1. Summary of project
2. Description of equipment tested.
3. Description of tests performed.
4. Test results
5. Conclusions and recommendations.
6. Completed test forms.
7. List of test equipment used and calibration dates.

B. Electrical Testing instrument calibration:

a. Utilize a NETA Testing Agency with a calibration program which maintains all applicable test instrumentation within rated accuracy.

b. The accuracy shall be traceable to the National Institute of Standards and Technology (NIST) in an unbroken chain.

c. Calibrate instruments in accordance with the following frequency schedule:

1) Digital field instruments: 12 months maximum.

2) Analog field instruments: 6 months maximum.

3) Laboratory instruments: 12 months maximum.

4) Leased specialty equipment where the accuracy is guaranteed by the lessor (such as Doble): 12 months maximum.

d. Dated calibration labels shall be visible on all test equipment.

e. Maintain an up-to-date instrument calibration record for each test instrument:

1) The records shall show the date and results of each calibration or test.

f. Maintain an up-to-date instrument calibration instruction and procedure for each test instrument.

PART 3 - EXECUTION

3.01 SYSTEM OPERATIONAL TESTING

A. The City will coordinate testing of the facility after all work has been completed by the Contractor per the plans and specifications. The Contractor will conduct the tests as outlined below.

B. If any of these tests fail due to the work performed per the contract the Contractor shall immediately fix the problem to the satisfaction of the engineer and reschedule the test. City personnel will assist the Contractor during these tests.

3.02 PHASE ROTATION PREOPERATIONAL TEST

A. Check connections to all equipment for proper phase relationship from the

generator prior to any operational testing. During this test, disconnect all devices which could be damaged by the application of voltage or reversed phase sequence. Three phase equipment shall be tested for the phase sequence "ABC" front to back, left to right and top to bottom.

B. Verify that the phase rotation of the motors and generator matches the utility.

3.03 600 VOLT CONDUCTOR TEST

A. Megger and record insulation resistances of all 600 volt t insulated conductors using a 500 volt megger for thirty seconds. Make tests with circuits installed in conduit and isolated from source and load. Each conductor shall be meggered conductor to conductor and conductor to ground. These tests shall be made on cable after installation with all splices made up and terminators installed but not connected to the equipment.

3.04 WIRING TEST

A. Verify all wire connections/terminations are per contact drawings or approved changes. Check for proper termination of all wires.

3.05 GENERATOR AND ATS TEST

A. Contractor shall trip the breaker that feds power to the emergency lighting panel to initiate starting of the generator. Generator shall start and run for 10 minutes. Contractor shall then close the breaker. ATS shall stop the generator after a cool down period. The contractor shall notify the City if this test fails and rectify the situation to the satisfaction of the City. The generator and ATS are existing and will be reused.

3.06 SWITCHGEAR AND SWITCHBOARD ASSEMBLIES

Visual and Mechanical Inspection

1. Compare equipment nameplate data with drawings and specifications.

2. Inspect physical and mechanical condition.

3. Inspect anchorage, alignment, grounding, and required area clearances.

4. Verify the unit is clean and all shipping bracing, loose parts, and documentation shipped inside cubicles have been removed.

5. Verify that fuse and circuit breaker sizes and types correspond to drawings and coordination study as well as to the circuit breaker's address for microprocessor-communication packages.

6. Verify that current and voltage transformer ratios correspond to drawings.

7. Verify that wiring connections are tight and that wiring is secure to prevent damage during routine operation of moving parts.

8. Inspect bolted electrical connections for high resistance using one or more of the following methods:

   a. Use of a low-resistance ohmmeter in accordance with Section 7.1.2.

   b. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or Table 100.12.

   c. ~~Perform thermographic survey in accordance with Section 9.~~

9. Verify operation and sequencing of interlocking systems.

10. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

11. Inspect insulators for evidence of physical damage or contaminated surfaces.

12. Verify correct barrier and shutter installation and operation.

13. Exercise all active components.

14. Inspect mechanical indicating devices for correct operation.

15. Verify that filters are in place and vents are clear.

16. Perform visual and mechanical inspection of instrument transformers in accordance with Section 7.10.

17. Perform visual and mechanical inspection of surge arresters in accordance with Section 7.19.

18. Inspect control power transformers.

   a. Inspect for physical damage, cracked insulation, broken leads,

tightness of connections, defective wiring, and overall general condition.

b. Verify that primary and secondary fuse or circuit breaker ratings match drawings.

c. Verify correct functioning of drawout disconnecting contacts, grounding contacts, and interlocks.

Electrical Tests

1. Perform resistance measurements through bolted electrical connections with a low-resistance ohmmeter, if applicable, in accordance with Section 7.1.1.

2. Perform insulation-resistance tests on each bus section, phase-to-phase and phase-to-ground, for one minute in accordance with Table 100.1.

3. Perform a dielectric withstand voltage test on each bus section, each phase-to-ground with phases not under test grounded, in accordance with manufacturer's published data. If manufacturer has no recommendation for this test, it shall be in accordance with Table 100.2. The test voltage shall be applied for one minute.

4. Perform insulation-resistance tests on control wiring with respect to ground. Applied potential shall be 500 volts dc for 300-volt rated cable and 1000 volts dc for 600-volt rated cable. Test duration shall be one minute. For units with solid-state components or control devices that can not tolerate the applied voltage, follow the manufacturer's recommendation. This test is optional.

5. Perform electrical tests on instrument transformers in accordance with Section 7.10.

6. Perform ground-resistance tests in accordance with Section 7.13.

7. Determine accuracy of all meters and calibrate watthour meters in accordance with Section 7.11. Verify multipliers.

8. Control Power Transformers

   a. Perform insulation-resistance tests. Perform measurements from winding-to-winding and each winding-to-ground. Test voltages shall be in accordance with Table 100.1 unless otherwise specified by the manufacturer.

b. Perform a turns-ratio test on all tap positions.

c. Perform secondary wiring integrity test. Disconnect transformer at secondary terminals and connect secondary wiring to a rated secondary voltage source. Verify correct potential at all devices.

d. Verify correct secondary voltage by energizing the primary winding with system voltage. Measure secondary voltage with the secondary wiring disconnected.

e. Verify correct function of control transfer relays located in the switchgear with multiple control power sources.

9. Voltage Transformers

a. Perform secondary wiring integrity test. Verify correct potential at all devices.

b. Verify secondary voltages by energizing the primary winding with system voltage.

10. ~~Perform current-injection tests on the entire current circuit in each section of switchgear.~~

~~a. Perform current tests by secondary injection with magnitudes such that a minimum current of 1.0 ampere flows in the secondary circuit. Verify correct magnitude of current at each device in the circuit.~~

~~b. Perform current tests by primary injection with magnitudes such that a minimum of 1.0 ampere flows in the secondary circuit. Verify correct magnitude of current at each device in the circuit. This test is optional.~~

11. Perform system function tests in accordance with Section 8.

12. Verify operation of cubicle switchgear/switchboard space heaters.

13. Perform phasing checks on double-ended or dual-source switchgear to insure correct bus phasing from each source.

14. Perform electrical tests of surge arresters in accordance with Section 7.19.

Test Values – Visual and Mechanical

1. Compare bolted connection resistance values to values of similar

connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value. (7.1.1.8.1)

2. Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.12. (7.1.1.8.2)

3. ~~Results of the thermographic survey shall be in accordance with Section 9. (7.1.1.8.3)~~

Test Values – Electrical

1. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2. Insulation-resistance values of bus insulation shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1. Values of insulation resistance less than this table or manufacturer's recommendations should be investigated. Dielectric withstand voltage tests shall not proceed until insulation-resistance levels are raised above minimum values.

3. If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the dielectric withstand test, the test specimen is considered to have passed the test.

4. Minimum insulation-resistance values of control wiring shall not be less than two megohms.

5. Results of electrical tests on instrument transformers shall be in accordance with Section 7.10.

6. Results of ground-resistance tests shall be in accordance with Section 7.13.

7. Accuracy of meters shall be in accordance with Section 7.11.

8. Control Power Transformers

   a. Insulation-resistance values of control power transformers shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1. Values of insulation resistance less than this table or manufacturer's recommendations should be investigated.

b. Turns-ratio test results shall not deviate by more than one-half percent from either the adjacent coils or the calculated ratio.

c. Secondary wiring shall be in accordance with design drawings and specifications.

d. Secondary voltage shall be in accordance with design specifications.

e. Control transfer relays shall perform as designed.

9. Voltage transformers

a. Secondary wiring shall be in accordance with design drawings and specifications.

b. Secondary voltage shall be in accordance with design specifications

10. Current-injection tests shall prove current wiring is in accordance with design specifications.

11. Results of system function tests shall be in accordance with Section 8.

12. Heaters shall be operational.

13. Phasing checks shall prove the switchgear or switchboard phasing is correct and in accordance with the system design.

14. Results of electrical tests on surge arresters shall be in accordance with Section 7.19.

3.07 METAL-ENCLOSED BUSWAYS

Visual and Mechanical Inspection

1. Compare equipment nameplate data with drawings and specifications.

2. Inspect physical and mechanical condition.

3. Inspect anchorage, alignment, and grounding.

4. Verify correct connection in accordance with single-line diagram.

5. Inspect bolted electrical connections for high resistance using one or more of the following methods:

a. Use of a low-resistance ohmmeter in accordance with Section 7.4.2.

b. Verify tightness of accessible bolted electrical connections and bus joints by calibrated torque-wrench method in accordance with manufacturer's published data or Table 100.12.

c. ~~Perform thermographic survey in accordance with Section 9.~~

6. Confirm physical orientation in accordance with manufacturer's labels to insure adequate cooling.

7. Examine outdoor busway for removal of "weep-hole" plugs, if applicable, and the correct installation of joint shield.

Electrical Tests

1. Perform resistance measurements through bolted connections and bus joints with a low- resistance ohmmeter, if applicable, in accordance with Section 7.4.1.

2. Measure insulation resistance of each busway, phase-to-phase and phase-to-ground for one minute, in accordance with Table 100.1.

3. Perform a dielectric withstand voltage test on each busway, phase-to-ground with phases not under test grounded, in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.17. Where no dc test value is shown in Table 100.17, an ac value shall be used. The test voltage shall be applied for one minute.

4. Measure resistance of assembled busway sections on insulated busway and compare values with adjacent phases.

5. Perform phasing test on each busway tie section energized by separate sources. Tests must be performed from their permanent sources.

6. Verify operation of busway space heaters.

Test Values – Visual and Mechanical

1. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value. (7.4.1.5.1)

2. Bolt-torque levels should be in accordance with manufacturer's published

data. In the absence of manufacturer's published data, use Table 100.12. (7.4.1.5.2)

3. ~~Results of the thermographic survey shall be in accordance with Section 9. (7.4.1.5.3)~~

Test Values – Electrical

1. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2. Insulation-resistance test voltages and resistance values shall be in accordance with manufacturer's published. In the absence of manufacturer's published data, use Table 100.1. Minimum resistance values are for a nominal 1000-foot busway run. Use the following formula to convert the measured resistance value to the 1000-foot nominal value:

$$R1000\ ft = Measured\ Resistance \times \frac{Length\ of\ Run}{1000}$$

   Converted values of insulation resistance less than those in Table 100.1 or manufacturer's minimum should be investigated. Dielectric withstand voltage tests shall not proceed until insulation-resistance levels are raised above minimum values.

3. If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the dielectric withstand test, the test specimen is considered to have passed the test.

4. Microhm or dc millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's published data is not available, investigate values which deviate from those of similar bus connections and sections by more than 50 percent of the lowest value.

5. Phasing test results shall indicate the phase relationships are in accordance with system design.

6. Heaters shall be operational.

3.08 CIRCUIT BREAKERS, INSULATED-CASE/MOLDED-CASE

Visual and Mechanical Inspection

1. Compare equipment nameplate data with drawings and specifications.

2. Inspect physical and mechanical condition.

3. Inspect anchorage and alignment.

4. Verify the unit is clean.

5. Operate the circuit breaker to insure smooth operation.

6. Inspect bolted electrical connections for high resistance using one or more of the following methods:

   a. Use of a low-resistance ohmmeter in accordance with Section 7.6.1.1.2.

   b. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or Table 100.12.

   c. ~~Perform thermographic survey in accordance with Section 9.~~

7. Inspect operating mechanism, contacts, and arc chutes in unsealed units.

8. Perform adjustments for final protective device settings in accordance with the coordination study.

Electrical Tests

1. Perform resistance measurements through bolted connections with a low-resistance ohmmeter, if applicable, in accordance with Section 7.6.1.1.1.

2. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to- ground with the circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1.

3. Perform a contact/pole-resistance test.

4. Perform insulation-resistance tests on all control wiring with respect to ground. Applied potential shall be 500 volts dc for 300-volt rated cable

and 1000 volts dc for 600-volt rated cable. Test duration shall be one minute. For units with solid-state components, follow manufacturer's recommendation. This test is optional.

5. Determine long-time pickup and delay by primary current injection.

6. Determine short-time pickup and delay by primary current injection.

7. Determine ground-fault pickup and time delay by primary current injection.

8. Determine instantaneous pickup by primary current injection.

9. Test functions of the trip unit by means of secondary injection. This test is optional.

10. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data.

11. Verify correct operation of auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, anti-pump function, and trip unit battery condition. Reset all trip logs and indicators.

12. Verify operation of charging mechanism.

Test Values – Visual and Mechanical

1. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value. (7.6.1.1.1.6.1)

2. Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.12. (7.6.1.1.1.6.2)

~~3. Results of the thermographic survey shall be in accordance with Section 9. (7.6.1.1.1.6.3)~~

4. Settings shall comply with coordination study recommendations. (7.6.1.1.1.8)

Test Values – Electrical

1. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2. Insulation-resistance values shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1. Values of insulation resistance less than this table or manufacturer's recommendations should be investigated.

3. Microhm or dc millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's published data is not available, investigate values that deviate from adjacent poles or similar breakers by more than 50 percent of the lowest value.

4. Insulation-resistance values of control wiring shall not be less than two megohms.

5. Long-time pickup values shall be as specified, and the trip characteristic shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors. If manufacturer's curves are not available, trip times shall not exceed the value shown in Table 100.7.

6. Short-time pickup values shall be as specified, and the trip characteristic shall not exceed manufacturer's published time-current tolerance band.

7. Ground fault pickup values shall be as specified, and the trip characteristic shall not exceed manufacturer's published time-current tolerance band.

8. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances. In the absence of manufacturer's published data, refer to Table 100.8.

9. Pickup values and trip characteristics shall be within manufacturer's published tolerances.

10. Minimum pickup voltage of the shunt trip and close coils shall conform to the manufacturer's published data. In the absence of the manufacturer's published data, refer to Table 100.20.

11. Breaker open, close, trip, trip-free, anti-pump, and auxiliary features shall function as designed.

12. The charging mechanism shall operate in accordance with manufacturer's published data.

3.09 CIRCUIT BREAKERS, LOW-VOLTAGE POWER

Visual and Mechanical Inspection

1. Compare equipment nameplate data with drawings and specifications.

2. Inspect physical and mechanical condition.

3. Inspect anchorage, alignment, and grounding.

4. Verify that all maintenance devices are available for servicing and operating the breaker.

5. Verify the unit is clean.

6. Verify the arc chutes are intact.

7. Inspect moving and stationary contacts for condition and alignment.

8. Verify that primary and secondary contact wipe and other dimensions vital to satisfactory operation of the breaker are correct.

9. Perform all mechanical operator and contact alignment tests on both the breaker and its operating mechanism in accordance with manufacturer's published data.

10. Inspect bolted electrical connections for high resistance using one or more of the following methods:

    a. Use of a low-resistance ohmmeter in accordance with Section 7.6.1.2.2.

    b. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or Table 100.12.

    c. ~~Perform a thermographic survey in accordance with Section 9.~~

11. Verify cell fit and element alignment.

12. Verify racking mechanism operation.

13. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

14. Perform adjustments for final protective device settings in accordance with

coordination study provided by end user.

15. Record as-found and as-left operation counter readings.

Electrical Tests

1. Perform resistance measurements through bolted connections with a low-resistance ohmmeter, if applicable, in accordance with Section 7.6.1.2.1.

2. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to- ground with the circuit breaker closed, and across each open pole. Test voltage shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1.

3. Perform a contact/pole-resistance test.

4. Perform insulation-resistance tests on all control wiring with respect to ground. Applied potential shall be 500 volts dc for 300-volt rated cable and 1000 volts dc for 600-volt rated cable. Test duration shall be one minute. For units with solid-state components, follow manufacturer's recommendation. This test is optional.

5. Determine long-time pickup and delay by primary current injection.

6. Determine short-time pickup and delay by primary current injection.

7. Determine ground-fault pickup and delay by primary current injection.

8. Determine instantaneous pickup value by primary current injection.

9. Test functions of the trip unit by means of secondary injection. This test is optional.

10. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data.

11. Verify correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, antipump function, and trip unit battery condition. Reset all trip logs and indicators.

12. Verify operation of charging mechanism.

Test Values – Visual and Mechanical

1. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value. (7.6.1.2.1.10.1).

2. Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.12. (7.6.1.2.1.10.2)

3. ~~Results of the thermographic survey shall be in accordance with Section 9. (7.6.1.2.1.10.3)~~

4. Settings shall comply with coordination study recommendations. (7.6.1.2.1.14)

5. Operations counter shall advance one digit per close-open cycle. (7.6.1.2.1.15)

Test Values – Electrical

1. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2. Insulation-resistance values of circuit breakers shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA Table 100.1. Values of insulation resistance less than this table or manufacturer's recommendations should be investigated.

3. Microhm or dc millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data. In the absence of manufacturer's published data, investigate values that deviate from adjacent poles or similar breakers by more than 50 percent of the lowest value

4. Insulation-resistance values of control wiring shall not be less than two megohms.

5. Long-time pickup values shall be as specified, and the trip characteristic shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors. If manufacturer's curves are not available, trip times shall not exceed the value shown in Table 100.7.

6. Short-time pickup values shall be as specified, and the trip characteristic shall not exceed manufacturer's published time-current tolerance band.

7. Ground fault pickup values shall be as specified, and the trip characteristic shall not exceed manufacturer's published time-current tolerance band.

8. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances. In the absence of manufacturer's published data, refer to Table 100.8.

9. Pickup values and trip characteristic shall be as specified and within manufacturer's published tolerances.

10. Minimum pickup voltage of the shunt trip and close coils shall conform to the manufacturer's published data. In the absence of the manufacturer's published data, refer to Table 100.20.

11. Auxiliary features shall operate in accordance with manufacturer's published data.

12. The charging mechanism shall operate in accordance with manufacturer's published data.

3.10 GROUNDING SYSTEMS

Visual and Mechanical Inspection

1. Verify ground system is in compliance with drawings, specifications, and NFPA 70 *National Electrical Code Article 250.*

2. Inspect physical and mechanical condition.

3. Inspect bolted electrical connections for high resistance using one or more of the following methods:

   a. Use of low-resistance ohmmeter in accordance with Section 7.13.2.

   b. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or Table 100.12.

4. Inspect anchorage.

Electrical Tests

1. Perform resistance measurements through bolted connections with a low-resistance ohmmeter, if applicable, in accordance with section 7.13.1.

2. Perform fall-of-potential or alternative test in accordance with ANSI/IEEE 81 on the main grounding electrode or system.

3. Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral, and derived neutral points.

Test Values – Visual and Mechanical

1. Grounding system electrical and mechanical connections shall be free of corrosion. (7.13.1.2)

2. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value. (7.13.1.3.1)

3. Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.12. (7.13.1.3.2)

Test Values – Electrical

1. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2. The resistance between the main grounding electrode and ground shall be no greater than five ohms for large commercial or industrial systems and one ohm or less for generating or transmission station grounds unless otherwise specified by the owner. (Reference ANSI/IEEE Standard 142)

3. Investigate point-to-point resistance values that exceed 0.5 ohm.

3.11 GROUND-FAULT PROTECTION SYSTEMS, LOW-VOLTAGE

Visual and Mechanical Inspection

1. Compare equipment nameplate data with drawings and specifications.

2. Inspect the components for damage and errors in polarity or conductor routing.

   a. Verify that ground connection is made on the source side of the neutral disconnect link and on the source side of any ground fault sensor.

   b. Verify that the neutral sensors are connected with correct polarity on both primary and secondary.

   c. Verify that all phase conductors and the neutral pass through the sensor in the same direction for zero sequence systems.

   d. Verify that grounding conductors do not pass through the zero sequence sensors.

   e. Verify that the grounded conductor is solidly grounded.

3. Verify the unit is clean.

4. Inspect bolted electrical connections for high resistance using one or more of the following methods:

   a. Use of low-resistance ohmmeter in accordance with Section 7.14.2.

   b. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or Table 100.12.

5. Verify correct operation of all functions of the self-test panel, if applicable.

6. Verify that the control power transformer has adequate capacity for the system.

7. Set pickup and time-delay settings in accordance with the settings provided in the owner's specifications. Record appropriate operation and test sequences as required by NFPA 70, *National Electrical Code*, Article 230.95.

Electrical Tests

1. Perform resistance measurements through bolted connections with a low-resistance ohmmeter, if applicable, in accordance with Section 7.14.1.

2. Measure the system neutral-to-ground insulation resistance with the neutral disconnect link temporarily removed. Replace the neutral disconnect link after testing.

3. Perform insulation resistance test on all control wiring with respect to ground. Applied potential shall be 500 volts dc for 300-volt rated cable and 1000 volts dc for 600-volt rated cable. Test duration shall be one minute. For units with solid-state components or control devices that cannot tolerate the applied voltage, follow manufacturer's recommendation. This test is optional.

4. Perform ground fault protective device pickup tests using primary injection.

5. For summation type systems utilizing phase and neutral current transformers, verify correct polarities by applying current to each phase-neutral current transformer pair. This test also applies to molded-case breakers utilizing an external neutral current transformer.

6. Measure time delay of the ground fault protective device at a value equal to or greater than 150 percent of the pickup value.

7. Verify reduced control voltage tripping capability is 55 percent for ac systems and 80 percent for dc systems.

8. Verify blocking capability of zone interlock systems.

Test Values – Visual and Mechanical

1. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value. (7.14.1.4.1)

2. Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.12. (7.14.1.4.2)

Test Values – Electrical

1. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar

bolted connections by more than 50 percent of the lowest value.

2. System neutral-to-ground insulation resistance shall be a minimum of one megohm.

3. Insulation-resistance values of control wiring shall not be less than two megohms.

4. Results of pickup test shall be greater than 90 percent of the ground fault protection device pickup setting and less than 1200 amperes or 125 percent of the pickup setting, whichever is smaller.

5. The ground fault protective device shall operate when current direction is the same relative to polarity marks in the two current transformers. The ground fault protective device shall not operate when current direction is opposite relative to polarity marks in the two current transformers.

6. Relay timing shall be in accordance with manufacturer's published data but must be no longer than one second at 3000 amperes in accordance with ANSI/NFPA 70, *National Electrical Code*, Article 230.95.

7. The circuit interrupting device shall operate when control voltage is 55 percent of nominal voltage for ac circuits and 80 percent of nominal voltage for dc circuits.

8. Results of zone-blocking tests shall be in accordance with manufacturer's published data and design specifications.

3.12 MOTOR CONTROL, MOTOR STARTERS, LOW-VOLTAGE

Visual and Mechanical Inspection

1. Compare equipment nameplate data with drawings and specifications.

2. Inspect physical and mechanical condition.

3. Inspect anchorage, alignment, and grounding.

4. Verify the unit is clean.

5. Inspect contactors.

   a. Verify mechanical operation.

   b. Verify contact gap, wipe, alignment, and pressure are in accordance with manufacturer's published data.

6. Motor-Running Protection

   a. Verify overload element rating is correct for its application.

   b. If motor-running protection is provided by fuses, verify correct fuse rating.

7. Inspect bolted electrical connections for high resistance using one or more of the following methods:

   a. Use of low-resistance ohmmeter in accordance with Section 7.16.1.1.2.

   b. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or Table 100.12.

   c. ~~Perform thermographic survey in accordance with Section 9.~~

8. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

Electrical Tests

1. Perform resistance measurements through bolted connections with a low-resistance ohmmeter, if applicable, in accordance with Section 7.16.1.1.1.

2. Perform insulation-resistance tests on each pole, phase-to-phase and phase-to-ground with starter closed, and across each open pole for one minute. Test voltage shall be in accordance with manufacturer's published data or Table 100.5.

3. Perform insulation-resistance tests on all control wiring with respect to ground. Applied potential shall be 500 volts dc for 300-volt rated cable and 1000 volts dc for 600-volt rated cable. Test duration shall be one minute. For units with solid-state components, follow manufacturer's recommendation. This test is optional.

4. Test motor protection devices in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Section 7.9.

5. Test circuit breakers in accordance with Section 3.08.

6. Perform operational tests by initiating control devices.

Test Values – Visual and Mechanical

1. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value. (7.16.1.1.1.7.1)

2. Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.12. (7.16.1.1.1.7.2)

3. ~~Results of the thermographic survey shall be in accordance with Section 9. (7.16.1.1.1.7.3)~~

Test Values – Electrical

1. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2. Insulation-resistance values shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.5. Values of insulation resistance less than this table or manufacturer's recommendations should be investigated.

3. Insulation-resistance values of control wiring shall not be less than two megohms.

4. Motor protection parameters shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Section 7.9.

5. Circuit breaker test results shall be in accordance with Section 7.6.1.1.

6. Control devices shall perform in accordance with system design requirements.

3.13 EMERGENCY SYSTEMS, AUTOMATIC TRANSFER SWITCHES

Visual and Mechanical Inspection

1. Compare equipment nameplate data with drawings and specifications.

2. Inspect physical and mechanical condition.

3. Inspect anchorage, alignment, grounding, and required clearances.

4. Verify the unit is clean.

5. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

6. Verify that manual transfer warnings are attached and visible.

7. Verify tightness of all control connections.

8. Inspect bolted electrical connections for high resistance using one or more of the following methods:

   a. Use of low-resistance ohmmeter in accordance with Section 7.22.3.2.

   b. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or Table 100.12.

   c. ~~Perform thermographic survey in accordance with Section 9.~~

9. Perform manual transfer operation.

10. Verify positive mechanical interlocking between normal and alternate sources.

Electrical Tests

1. Perform resistance measurements through bolted connections with a low-resistance ohmmeter, if applicable, in accordance with Section 7.22.3.1.

2. Perform insulation-resistance tests on all control wiring with respect to ground. Applied potential shall be 500 volts dc for 300-volt rated cable and 1000 volts dc for 600-volt rated cable. Test duration shall be one minute. For units with solid-state components or for control devices that cannot tolerate the applied voltage, follow manufacturer's recommendation. This test is optional.

3. Perform a contact/pole-resistance test.

4. Verify settings and operation of control devices.

5. Calibrate and set all relays and timers in accordance with Section 7.9.

6. Verify phase rotation, phasing, and synchronized operation as required by the application.

7. Perform automatic transfer tests:

a. Simulate loss of normal power.

b. Return to normal power.

c. Simulate loss of emergency power.

d. Simulate all forms of single-phase conditions.

8. Verify correct operation and timing of the following functions:

a. Normal source voltage-sensing and frequency-sensing relays.

b. Engine start sequence.

c. Time delay upon transfer.

d. Alternate source voltage-sensing and frequency-sensing relays.

e. Automatic transfer operation.

f. Interlocks and limit switch function.

g. Time delay and retransfer upon normal power restoration.

h. Engine cool down and shutdown feature.

Test Values – Visual and Mechanical

1. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value. (7.22.3.1.8.1)

2. Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.12. (7.22.3.1.8.2)

~~3. Results of the thermographic survey shall be in accordance with Section 9. (7.22.3.1.8.3)~~

Test Values – Electrical

1. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2. Insulation-resistance values of control wiring shall not be less than two megohms.

3. Microhm or dc millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's published data is not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

4. Control devices shall operate in accordance with manufacturer's published data.

5. Relay test results shall be in accordance with Section 7.9.

6. Phase rotation, phasing, and synchonization shall be in accordance with system design specifications.

7. Automatic transfers shall operate in accordance with manufacturer's design.

8. Operation and timing shall be in accordance with manufacturer's and system design requirements.

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SECTION 17100

PROCESS CONTROL AND INSTRUMENTATION SYSTEMS

PART 1 - GENERAL

1.01 SCOPE

A. The **CONTRACTOR** shall provide the following Instrumentation and Control components in accordance with the Contract Documents. The components shall include, but not be limited to, the following:

1. Instruments specified in Division 17104.
2. Equipment specified in section 17520.
3. Network equipment as specified in section 17720.

B. The requirements of this Section apply to all components of the CONTROL SYSTEM unless indicated otherwise.

C. Responsibilities:

1. The **CONTRACTOR**, using a qualified Instrumentation Supplier and qualified Electrical and Mechanical installers, shall be responsible to the City for the supplying, installation, labeling and termination of all instruments to the City furnished control cabinets and consoles.
2. ~~The **CONTRACTOR** shall install all City furnished control cabinets and install City furnished consoles and connect external wires i.e. power and Ethernet.~~
3. Due to the complexities associated with the interfacing of numerous instruments, panels, local controls, PLC I/O devices, it is the intent of these specifications that the Instrumentation Supplier be responsible to the **CONTRACTOR** for the installation and termination of the components to both new and existing devices provided under other sections of this contract.
4. The Instrumentation Supplier shall perform the following work:
   a. Prepare submittals.
   b. Design, develop, and electronically draft loop drawings and control panel designs.

c. Prepare the test plan and the spare parts submittals.

d. Perform setup, bench calibration and loop checks after installation.

e. Oversee and certify installation of all devices provided under Division 17.

f. Oversee, document, and certify loop testing.

g. Provide hardware support during the performance test.

h. Prepare record drawings.

i. Provide training on the pressure transducers.

1.02 REFERENCE PUBLICATIONS

A. The equipment covered under this contract shall be designed, manufactured, and tested in accordance with the latest version of the applicable industrial standards.

1.03 SUBMITTALS

A. Provide submittals in accordance with the Special Provisions. Submittals shall be approved by the Engineer prior to manufacture and shipment.

B. Provide Operations and Maintenance Manuals as specified in the Special Provisions.

1.04 QUALITY ASSURANCE

A. The manufacturer shall verify that they have been fabricating and assembling similar equipment for a minimum of five (5) years.

PART 2 -- PRODUCTS

2.01 GENERAL

A. **Code and Regulatory Compliance:** All work shall conform to or exceed the applicable requirements of the National Electrical Code.

B. **Current Technology:** All meters, instruments, and other components shall be the most recent field-proven models marketed by their manufacturers at the time of submittal of the shop drawings unless otherwise required to match existing equipment.

C. **Hardware Commonality:** All instruments which utilize a common measurement principle (for example, d/p cells, pressure transmitters, level transmitters which monitor hydrostatic head) shall be furnished by a single Manufacturer. All panel mounted instruments shall have matching style and general appearance. Instruments performing similar functions shall be of the same type, model, or class, and shall be from a single Manufacturer.

D. **Loop Accuracy:** The accuracy of each instrumentation system or loop shall be determined as a probable maximum error; this shall be the square-root of the sum of the squares of certified "accuracies" of the designated components in each system, expressed as a percentage of the actual span or value of the measured variable. Each individual instrument shall have a minimum accuracy of plus and minus 0.5 percent of full scale and a minimum repeatability of plus and minus 0.25 percent of full scale unless otherwise indicated. Instruments which do not conform to or improve upon these criteria are not acceptable.

E. **Instrument and Loop Power:** Power requirements and input/output connections for all components shall be verified. Power for transmitted signals shall, in general, originate in and be supplied by the control panel devices. All power supplies shall be mounted within control panels or in the field at the point of application.

2.02 SPARE PARTS AND SPECIAL TOOLS

A. The CONTRACTOR shall furnish a list of all spare parts and special tools required to calibrate and maintain all of the instrumentation provided under the Contract Documents as recommended by the manufacturer.

B. Provide spare per Section 16050.

2.03 FACTORY TESTING

A. The CONTRACTOR shall provide copies of all factory tests for each piece of instrumentation.

PART 3 -- EXECUTION

3.01 PRODUCT HANDLING

A. **Tagging:** Each component shall be tagged to identify its location, instrument tag number, and function in the system. A permanent stainless steel or other non-corrosive material tag firmly attached and permanently and indelibly marked with the instrument tag number, as given in the plans, shall be provided on each piece of the instrumentation. Identification shall be prominently displayed on the outside of the package.

3.02 MANUFACTURER'S SERVICES

A. The CONTRACTOR shall furnish the following Manufacturer's services for the instrumentation listed below:

1. Perform factory calibration
2. Oversee installation
3. Verify installation of installed instrument
4. Certify installation and reconfirm Manufacturer's accuracy statement
5. Oversee loop testing, prepare loop validation sheets, and certify loop testing
6. Oversee pre-commissioning, prepare pre-commissioning validation sheets, and certify pre-commissioning
7. Train the OWNER's personnel

3.03 INSTALLATION

A. **General:**

All instrumentation, including instrumentation furnished under other Divisions, shall be installed under Division 17 and the manufacturers' instructions.

The monitoring and control system configurations indicated are diagrammatic. The locations of equipment are approximate. The exact locations and routing of wiring and cables shall be governed by structural conditions and physical interferences and by the location of electrical terminations on equipment. All equipment shall be located and installed so that it will be readily accessible for operation and maintenance. Where job conditions require reasonable changes in approximated locations and arrangements, or when the City exercises the right to require changes in location of equipment which do not impact material quantities or cause material rework, the CONTRACTOR shall make such changes without additional cost to the City.

All power and signal wires shall be terminated with crimped type lugs.

All connectors shall be water tight.

All wires shall be mounted clearly with an identification tag that is of a permanent and reusable nature.

All wire and cable shall be arranged in a neat manner and securely supported in cable groups and connected from terminal to terminal without splices unless specifically approved by the ENGINEER. All wiring shall be protected from sharp edges and corners.

All mounting stands and bracket materials and workmanship shall comply with requirements of the Contract Documents.

3.04 CALIBRATION

A. **General:** All devices provided under Division 17 shall be calibrated according to the manufacturer's recommended procedures to verify operational readiness and ability to meet the indicated functional and tolerance requirements. **The contractor shall provide calibration certification certificate for each instrument provided.**

B. **Calibration Points:** Each instrument shall be calibrated at 20, 40, 60, 80 and 100% of span using test instruments to simulate inputs. The test instruments shall have accuracy's traceable to National Institute of Testing Standards and has a current calibration date.

C. **Factory Calibration:** Instruments which have been factory calibrated shall be examined in the field to determine whether any of the calibrations are in need of adjustment. Such adjustments, if required, shall be made only after consultation with the ENGINEER.

D. **Field Calibration:** Instruments which were not bench-calibrated shall be calibrated in the field to insure proper operation in accordance with the instrument loop diagrams or specification data sheets.

E. **Calibration Sheets:** Each instrument calibration sheet shall provide the following information and a space for sign-off on individual items and on the completed unit:

1. Project name
2. Loop number
3. Tag number
4. Manufacturer
5. Model number
6. Serial number
7. Calibration range

8. Calibration data: Input, output, and error at 10 percent, 50 percent and 90 percent of span

9. Switch setting, contact action, and deadband for discrete elements

10. Space for comments

11. Space for sign-off by Instrumentation Supplier and date

12. Test equipment used and associated serial numbers

F. **Calibration Tags:** A calibration and testing tag shall be attached to each piece of equipment or system at a location determined by the ENGINEER. The CONTRACTOR shall have the Instrumentation Supplier sign the tag when calibration is complete. The ENGINEER will sign the tag when the calibration and testing has been accepted.

3.05 LOOP TESTING

A. **General:** Individual instrument loop diagrams per ISA Standard S5.4 - Instrument Loop Diagrams, expanded format, shall be submitted to the ENGINEER for review prior to the loop tests. The CONTRACTOR shall notify the ENGINEER of scheduled tests a minimum of 30 days prior to the estimated completion date of installation and wiring of the instrument. After the ENGINEER'S review of the submitted loop diagrams for correctness and compliance with the specifications, loop testing shall proceed. The loop check shall be witnessed by the ENGINEER.

B. **Control Valve Tests:** All control valves, cylinders, drives and connecting linkages shall be stroked from the operator interface units as well as local control devices and adjusted to verify proper control action, hand switch action, limit switch settings, torque settings, remote control actions, and remote feedback of valve status and position. Control valve actions and positioner settings shall be checked with the valves in place to insure that no changes have occurred since the bench calibration.

C. ~~**Interlocks:** All hardware and software interlocks between the instrumentation and the motor control circuits, control circuits of variable speed controllers and packaged equipment controls shall be checked to the maximum extent possible.~~

D. **Instrument and Instrument Component Validation:** Each instrument shall be field tested, inspected, and adjusted to its indicated performance requirement in accordance with its Manufacturer's specifications and instructions. Any instrument which fails to meet any Contract requirement, or, in the absence of a Contract requirement, any published manufacturer performance specification for functional and

operational parameters, shall be repaired or replaced, at the discretion of the ENGINEER at no additional cost to the OWNER.

All digital input and output signals shall be tested to ensure that the signal from the device is seen at the PLC. The City will assist with testing the digital input and output signals.

The City will test to determine if all the Ethernet connections are operating correctly and set all IP addresses for each device.

All analog input signals shall be tested to ensure that the signal for each analog device is seen at the PLC. Each analog device shall be tested over its complete range. The City will assist with testing each analog device.

E. **Loop Validation Sheets:** The CONTRACTOR shall prepare loop confirmation sheets for each loop covering each active instrumentation and control device except simple hand switches and lights. Loop confirmation sheets shall form the basis for operational tests and documentation. Each loop confirmation sheet shall cite the following information and shall provide spaces for sign-off on individual items and on the complete loop by the Instrumentation Supplier:

1. Project name
2. Loop number
3. Tag number, description, manufacturer and model number for each element
4. Installation bulletin number
5. Specification sheet number
6. Loop description number
7. Adjustment check
8. Space for comments
9. Space for loop sign-off by Instrumentation Supplier and date
10. Space for ENGINEER witness signature and date

F. **Loop Certifications:** When installation tests have been successfully completed for all individual instruments and all separate analog control networks, a certified copy of all test forms signed by the ENGINEER or the ENGINEER's representative as a witness, with test data entered, shall be submitted to the ENGINEER together with a

clear and unequivocal statement that all instrumentation has been successfully calibrated, inspected, and tested.

3.06 PRECOMMISSIONING

A. **General:** Pre-commissioning shall commence after acceptance of all wire tests, calibration tests and loop tests, and all inspections have demonstrated that the instrumentation and control system complies with all Contract requirements. Pre-commissioning shall demonstrate proper operation of all systems with process equipment operating over full operating ranges under conditions as closely resembling actual operating conditions as possible.

B. **Pre-commissioning Procedures and Documentation:** All pre-commissioning and test activities shall follow detailed test procedures and check lists accepted by the ENGINEER. All test data shall be acquired using equipment as required and shall be recorded on test forms accepted by the ENGINEER, which include calculated tolerance limits for each step. Completion of all system pre-commissioning and test activities shall be documented by a certified report, including all test forms with test data entered, delivered to the ENGINEER with a clear and unequivocal statement that all system pre-commissioning and test requirements have been satisfied.

C. **Loop Tuning:** All electronic control stations incorporating proportional, integral or differential control circuits shall be optimally tuned, experimentally, by applying control signal disturbances and adjusting the gain, reset, or rate settings as required to achieve a proper response. Measured final control element variable position/speed setpoint settings shall be compared to measured final control element position/speed values at 20, 40, 60, 80 and 100% of span and the results checked against indicated accuracy tolerances.

D. **Pre-commissioning Validation Sheets:** Pre-commissioning shall be documented on one of two types of test forms as follows:

1. For functions which can be demonstrated on a loop-by-loop basis, the form shall include:

    a. Project name

    b. Loop number

    c. Loop description

    d. Tag number, description, manufacturer and data sheet number for each component.

2. For functions which cannot be demonstrated on a loop-by-loop basis, the test form shall be a listing of the specific tests to be conducted. With each test description the following information shall be included:

   a. Specification page and paragraph of function demonstrated

   b. Description of function

   c. Space for sign-off and date by both the Instrumentation Supplier and ENGINEER

D. **Pre-commissioning Certification:** The CONTRACTOR shall submit a instrumentation and control system pre-commissioning completion report which shall state that all Contract requirements have been met and shall include a listing of all instrumentation and control system maintenance and repair activities conducted during the pre-commissioning testing. Acceptance of the instrumentation and control system pre-commissioning testing must be provided in writing by the ENGINEER before the performance testing may begin. Final acceptance of the control system shall be based upon plant completion as stated in the General Conditions.

3.09 TRAINING

A. **General:** The CONTRACTOR shall train the OWNER'S personnel on the maintenance, calibration and repair of all instruments provided under this Contract. The contractor shall provide training as specified in section 01750.

B. **Instructions:** The training shall be performed by qualified representatives of the equipment manufacturers and shall be specific to each piece of equipment.

C. **Duration:** Each training class shall be a minimum of 4 hours in duration and shall cover, as a minimum, operational theory, maintenance, trouble shooting/repair, and calibration of the instrument.

D. **Schedule:** Training shall be performed during the pre-commissioning phase of the project. The training sessions shall be scheduled a minimum of 3 weeks in advance of when the courses are to be initiated. The ENGINEER will review the course outline for suitability and provide comments that shall be incorporated.

E. **Agenda:** The training shall include operation and maintenance procedures, trouble shooting with necessary test equipment, and changing set points, and calibration for that specific piece of equipment.

F. **Documentation:** The Contractor shall provide a copy of the training materials utilized during the lesson with all notes, diagrams, and comments.

3.10 ACCEPTANCE

A. The following conditions shall be fulfilled before the WORK is considered substantially complete:

1. All submittals have been completed and approved.

2. The instrumentation has been calibrated, loop tested and pre-commissioned.

3. The OWNER training has been performed.

4. All required spare parts and expendable supplies and test equipment have been delivered to the ENGINEER.

5. The performance test has been successfully completed.

6. All punch-list items have been corrected.

7. All record drawings in both hard copy and electronic format have been submitted.

8. Revisions to the OWNER'S Manuals that may have resulted from the field tests have been made and reviewed.

9. All debris associated with installation of instrumentation has been removed.

10. All probes, elements, sample lines, transmitters, tubing, and enclosures have been cleaned and are in like-new condition.

END OF SECTION

SECTION 17101

CONTROL STRATEGIES

PART 1 - GENERAL

1.01 SCOPE

A. This Section covers the control strategies for programming the PLC, HMI, and City SCADA systems as outlined in the plans and specifications. The City SCADA system resides at 1391 35th Avenue and uses VTS Trihedral software to operate. **All programming will be provided by the City.**

B. **THE CITY WILL PROVIDE ALL PLC, HMI, AND SCADA PROGRAMMING.**

C. See attached I/O List for a complete list of digital input points, digital output points, analog signals, and Ethernet points.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 GENERAL DESCRIPTION

A. The PLC shall perform reservoir level control, level monitoring, facility monitoring, alarm monitoring, and initiate the starting and stopping of three pumps for the reservoir.

B. **PUMP/MOV CONTROL LOGIC**

The pumps will have 3 modes of operation, HAND, OFF and AUTO. These modes will be selectable from either the local HMI or the City SCADA system. When in HAND the pump will run and be controlled locally. When in OFF the pump will not be permitted to run. When in AUTO, the pumps will start and stop based upon water level or manual input from the plant operator. The PLC and/or plant operator shall be able to run one, two, or all three pumps at the same time. The plant operator shall be able choose which pump they want to turn on.

C. **ALARM LOGIC**

Digital alarms shall have debounce time delays. Digital alarms shall have the ability to be disabled from either the local HMI or the City SCADA. Digital alarms shall have the option of being latched or self-resetting.

Analog alarms shall have up to 4 alarm levels, LOLO, LOW, HIGH and HIHI. All analog alarms shall have debounce delay timers. All analog alarms shall have the ability to be inhibited. Analog alarms shall have the option of being latched or self-resetting.

All alarm setpoints shall be adjustable from either the local HMI or the City SCADA system. Analog alarm setpoints shall be checked for appropriate range. If the operator attempts to adjust the setpoint either too high or too low, the setpoint shall be prevented from being set out of range by limiting the value to the low and high range limits.

Alarm inhibit functions shall be configurable from either the local HMI or the City SCADA system.

D. **RUN TIME**

Run time accumulators shall totalize equipment running time in the following groups; current 24 hours, previous 24 hours, current week, previous week, current month and previous month.

E. START COUNTERS

Equipment starts shall be totalized in the following groups; current 24 hours, previous 24 hours, current week, previous week, current month and previous month.

F. All alarms, status points, and analog signals shall be displayed on the HMI and City SCADA system. The analog signals shall be displayed in the units shown on the drawings and specifications.

G. The following information from the **digital power meter** shall be displayed on the HMI and City SCADA system:

1. Phase A line to line voltage
2. Phase B line to line voltage
3. Phase C line to line voltage
4. Phase A current in RMS
5. Phase B current in RMS

6. Phase C current in RMS
7. Kilowatts in KW
8. Power factor in percent

H. The PLC will be used to calculate the water flow rate into and out of the reservoir based upon changes in the reservoir level. The PLC will use a series of math equations to calculate water flow rate.

I. The following **status information** shall be displayed on the HMI and City SCADA system:

1. Main breaker closed
2. Generator breaker closed
3. ATS connected to SMUD
4. ATS connected to generator
5. Generator on
6. Pump 1 ready input
7. Pump 1 running
8. MOV 1 close status
9. MOV 1 open status
10. MOV 1 not in remote
11. Pump 2 ready input
12. Pump 2 running
13. MOV 2 close status
14. MOV 2 open status
15. MOV 2 not in remote
16. Pump 3 ready input
17. Pump 3 running
18. MOV 3 close status
19. MOV 3 open status
20. MOV 3 not in remote
21. Rain fall total

The PLC program shall be able to count the number of pulses from the rain gauge and use a mathematical formula to calculate rain fall total in inches.

J. The following **analog information** shall be displayed on the HMI and City SCADA system:

1. Reservoir level in feet
2. System pressure in PSIG
3. Inlet valve position in percent

The analog information shall be displayed graphically and in number format.

K. The following **alarms** shall be displayed on the HMI and City SCADA system:

1. Reservoir intrusion
2. Control room intrusion
3. PLC cabinet intrusion
4. Surge protective device alarm
5. PLC UPS on bypass
6. Network UPS on bypass
7. PFR alarm
8. Reservoir low level
9. Reservoir high level
10. Pump 1 overload alarm
11. MOV 1 Failure
12. Pump 2 overload alarm
13. MOV 2 failure alarm
14. Pump 3 overload alarm
15. MOV 3 failure alarm
16. Power supply PS-1 failure
17. Power supply PS-2 failure

L. The starting and stopping of the generator will be controlled from a contact inside the ATS. When the ATS senses a loss of utility power then a contact will close initiating starting of the generator. Once power is restored from the utility the contact closure will open turning off the generator.

M. The programmer shall develop a single line drawing of the facility based upon the single line drawing from the plan set and shall be created in VTS Trihedral. The drawing shall indicate the following:

1. Position of the main breaker that is open (red) or closed (green)
2. Position of the generator breaker that is open (red) or closed (green)
3. Position of the ATS that on utility (green) or on generator power (red)
4. Status of each pump that is on (green) or off (blue)
5. Status of each MOV that is on (red) or off (green)

The symbols on the single line drawing shall change colors as indicated above.

N. The altitude valve shall be opened or closed from the PLC in increments using a pulsed signal from the PLC. This valve shall be controlled from the HMI and/or SCADA system. The altitude valve will automatically close if the valve sensing the water level is too high.

O. The PLC shall be able to poll information from other facilities using the omni

antenna located on top of the reservoir. This information shall be passed on to the City Scada system and displayed on the VTS Trihedral.

P. The PLC shall be able to display the rain fall total on the HMI and City Scada system. The rain totals shall be shown in inches and displayed as per day, per month, and year to date.

PLC INPUT/OUTPUT LIST

Description	I/O Type	Function
Reservoir Intrusion	Digital Input-1	Alarm
Control Room Intrusion	Digital Input-2	Alarm
PLC Cabinet Intrusion	Digital Input-3	Alarm
SPD Trouble	Digital Input-4	Alarm
PLC UPS on Bypass	Digital Input-5	Alarm
Network UPS on Bypass	Digital Input-6	Alarm
PFR Alarm	Digital Input-7	Alarm
Rain Gauge	Digital Input-8	Counter
Reservoir Low Level Alarm	Digital Input-9	Status
Reservoir High Level Alarm	Digital Input 10	Status
Main Breaker Closed	Digital Input-11	Alarm
Generator Breaker Closed	Digital Input 12	Alarm
ATS Connected to SMUD	Digital Input-13	Alarm
ATS Connected to Generator	Digital Input-14	Alarm
Generator On	Digital Input-15	Alarm
Spare	Digital Input-16	Alarm

Description	I/O Type	Function
Pump 1 Ready Input	Digital Input-17	Status
Pump 1 Running	Digital Input-18	Status
Pump 1 Overload Alarm	Digital Input-19	Alarm
MOV 1 Failure	Digital Input-20	Alarm
MOV 1 Close Status	Digital Input-21	Status
MOV 1 Open Status	Digital Input-22	Status
MOV 1 Not in Remote	Digital Input-23	Status
Spare	Digital Input-24	Alarm
Pump 2 Ready Input	Digital Input-25	Alarm
Pump 2 Running	Digital Input 26	Status
Pump 2 Overload Alarm	Digital Input-27	Status
MOV 2 Failure	Digital Input-28	Status
MOV 2 Close Status	Digital Input-29	Alarm
MOV 2 Open Status	Digital Input-30	Alarm
MOV 2 Not in Remote	Digital Input-31	Status
Spare	Digital Input-32	

Description	I/O Type	Function
Pump 3 Ready Input	Digital Input-33	
Pump 3 Running	Digital Input-34	
Pump 3 Overload Alarm	Digital Input-35	
MOV 3 Failure	Digital Input-36	
MOV 3 Close Status	Digital Input-37	
MOV 3 Open Status	Digital Input-38	
MOV 3 Not in Remote	Digital Input-39	
Spare	Digital Input-40	
Spare	Digital Input-41	
Spare	Digital Input 42	
Spare	Digital Input-43	
Spare	Digital Input-44	
Spare	Digital Input-45	
Spare	Digital Input-46	
Power Supply PS-1 Failure	Digital Input-47	Alarm
Power Supply PS-2 Failure	Digital Input-48	Alarm

Description	I/O Type	Function
Pump 1 Auto Start	Digital Output-1	Command
Pump 2 Auto Start	Digital Output-2	Command
Pump 3 Auto Start	Digital Output-3	Command
Fill Valve Open	Digital Output-4	Command
Fill Valve Close	Digital Output-5	Command
Spare	Digital Output-6	
Spare	Digital Output-7	
Spare	Digital Output-8	
Spare	Digital Output-9	
Spare	Digital Output 10	
Spare	Digital Output-11	
Spare	Digital Output-12	
Spare	Digital Output-13	
Spare	Digital Output-14	
Spare	Digital Output-15	
Spare	Digital Output-16	

Description	I/O Type	Function	Range	Units
Reservoir Level A	Analog Input-1	Level	0 – 360	Inches
System Water Pressure	Analog Input-2	Pressure	0 – 85	PSIG
Inlet Valve Position	Analog Input-3	Position	0 – 100	%
Spare	Analog Input-4			
Spare	Analog Input-5			
Spare	Analog Input-6			
Spare	Analog Input-7			
Spare	Analog Input-8			

Ethernet Data

Digital Power Meter Ethernet Data

1. Phase A, B, and C line to line voltages
2. Phase A current in RMS
3. Phase B current in RMS
4. Phase C current in RMS
5. Kilowatts in KW
6. Power factor in percent

END OF SECTION

SECTION 17104

PRESSURE MEASURING SYSTEMS

PART 1 - GENERAL

1.01 SCOPE

A. This Section covers the furnishing, installation, and testing of instrumentation as specified herein, as shown on the Drawings, and as required for a complete installation. Furnish and install pressure measuring systems, complete and operable, with the requirements of the Contract Documents.

1.02 REFERENCE PUBLICATIONS

A. The equipment covered under this contract shall be designed, manufactured, and tested in accordance with the latest version of the applicable industrial standards.

1.03 SUBMITTALS

A. Provide submittals in accordance with Sections 01330 and 17100. Submittals shall be approved by the Engineer prior to manufacture and shipment.

B. Provide Operations and Maintenance Manuals as specified in the Special Provisions.

C. Catalog data sheets, configuration selection data, ISA-TR20-Instrument Specification Forms and factory calibration test sheets

D. Manufacturer's warranties as published in its literature in the O&M Manual.

1.04 QUALITY ASSURANCE

A. The manufacturer shall verify that they have been fabricating and assembling similar equipment for a minimum of five (5) years.

PART 2 - PRODUCTS

2.01 GENERAL

A. All devices specified herein shall conform to the requirements of Section 17100 – Process Control and Instrumentation Systems.

B. All instruments shall have stainless steel nameplates with tag number and description.

2.02 WATER LEVEL PRESSURE TRANSMITTER

A. The contractor shall replace the water level pressure transmitter. The transmitter shall be able to read water pressure inside an elevated reservoir. The reservoir is located 100 feet above grade and is 25 feet in height. The new transmitter shall have an accuracy of ±0.25% of span with a power supply voltage varying between 12.5 to 36 volts DC. The static pressure ratings shall be 150 psi and the diaphragm material shall be stainless steel. Pressure transducer shall be equipped with built-in LCD indicator, Rosemount Option M6. The pressure transmitter shall be Rosemount "Smart" transmitter model No 3051T-G-2-A-2B-2-1-J-S5-M6 or approved equal. This unit shall be calibrated for 0-130 feet of water column at the factory and recorded on a calibration sheet. This transmitter shall have an offset of 95 feet based upon field conditions. The offset shall be programmed in the field. The calibration sheet shall be provided to the Engineer and filed in the O&M manual.

2.03 WATER SYSTEM PRESSURE TRANSMITTER

A. The contractor shall replace the water system pressure transmitter. The transmitter shall be able to read water pressure over a range of 0 to 125 PSI. The new transmitter shall have an accuracy of ±0.25% of span with a power supply voltage varying between 12.5 to 36 volts DC. The static pressure ratings shall be 150 psi and the diaphragm material shall be stainless steel. Pressure transducer shall be equipped with built-in LCD indicator, Rosemount Option M6. The pressure transmitter shall be Rosemount "Smart" transmitter model No 3051T-G-2-A-2B-2-1-J-S5-M6 or approved equal. Each unit shall be calibrated for 0-85 PSI at the factory and recorded on a calibration sheet. The calibration sheet shall be provided to the Engineer and filed in the O&M manual.

2.04 PRESSURE SWITCH

A. Pressure switches shall be the adjustable type with setpoint repeatability of ±1% of full range. Switches shall be pressure or differential pressure as shown on the control drawings. Pressure connection shall be ¼"-NPT and conduit entry shall be ¾"-NPT. Switch element shall SPDT rated 15A@125Vac and 6A@30Vdc. Actuator seal shall be Buna-N. Pressure range shall be selected for the setpoint to be within 25-75% of full range. Enclosure shall be epoxy coated aluminum rated either NEMA4X of NEMA7 in hazardous locations. Pressure switches shall be Ashcroft B-Series switches or approved. The pressure switches shall be an Ashcroft model number B4-24-B-XFS-60 PSI.

2.05 PRESSURE GAUGE

A. Pressure gage shall be bourdon tube style, 316LSS tube & socket, 400SS Teflon coated pinion gear, glycerin filled polycarbonate case, acrylic window, 4-½" dial, 270-degree movement, ½% of span accuracy rating with ¼" NPT lower connection. Pressure range shall be selected to be 125% of system full pressure. Acceptable products include Ashcroft Type 1279 Duraguage or equal. ~~For sewage and drainage applications include the optional 316L 2" isolating diaphragm and Tri-clover clamp.~~ Acceptable products include Ashcroft Type 1032, Alfa Laval Tri-Clamp, or equal.

2.06 INSTRUMENT TUBING AND FITTINGS

A. Instrument tubing shall be seamless 316SS tube from the same manufacturer as the fittings. Fittings shall be the ferrule swage and back ferrule design. Furnish Parker 316SS CPI/A-Lok fittings and TUBE-316-xx or equal.

PART 3 – EXECUTION

3.01 GENERAL

A. Submit and obtain approval of catalog data, ISA data sheets and control panel layouts prior to installing any instrument.

3.02 INSTALLATION

A. Pressure instruments and tubing shall be installed per manufacturer's recommendations and as shown on the drawings. Install instruments close as practical to the process tap and positioned to permit observation and maintenance.

3.03 PRESSURE TRANSMITTERS

A. Pressure transmitters shall be independently supported from the process connection and tubing with standard brackets or to wall or control panel back plane with 304SS fasteners.

B. ~~Pressure transmitters for sewage and drainage systems shall be installed with a root and isolation valve per Division 15 and sanitary isolating diaphragm with Tri-Clover clamp as specified herein.~~

C. Pressure transmitters for potable water and air systems shall be installed with a pressure manifold for isolation and calibration in place.

3.04 PRESSURE GAGES AND SWITCHES

A. Gages and switches shall be permitted to be supported from the process tap if observable and accessible from ground level.

B. Gauges and switches for potable water and air systems shall be installed with pressure manifold for isolation and calibration in place.

C. ~~Gauges and switches for sewage and drainage systems shall be installed with a root and isolation valve per Division 15. Pressure gauges for sewage and drainage shall include a sanitary isolating diaphragm and Tri-Clover clamp as specified herein.~~

3.05 PRE-DEMONSTRATION TESTING

A. Calibrate instruments per manufacturer's instruction and Section 17100 requirements.

B. Loop test instruments end-to-end from field to control panel and SCADA system per Section 17100.

C. Refer to Section 01650 – Facility Startup for further testing requirements.

3.06 DEMONSTRATION TESTING

A. Perform seven (7) day demonstration of functional integrity per Section 01650.

3.07 TRAINING

A. Provide manufacturer's technical representative pressure measuring system training to City as specified in Sections 01750 and 17100. Provide two identical training sessions; each session lasting up to two hours. All training shall be completed during Pre-Demonstration period.

3.08 SHIPPING, HANDLING, AND DELIVERY

A. The instrumentation equipment shall be protected for shipment by the manufacturer.

3.09 INSTRUMENTATION EQUIPMENT INSTALLATION

A. The instrumentation equipment shall be installed per the manufacturer's recommendation and as shown on the plans.

The Contractor shall provide an ISA calibration sheet for each instrument supplied. Each instrument shall then be calibrated to ISA standards and recorded.

B. Pressure measuring systems shall be handled, installed, calibrated, loop-tested, pre-commissioned, and performance tested according to Section 17100, "Process Control and Instrumentation Systems."

C. All instrumentation shall be tested and calibrated as outlined in Section 17100.

D. **All sensors shall be loop calibrated at the factory as a complete assembly, see Section 17100.**

PART 4 - WARRANTY

4.01 MANUFACTURER'S WARRANTY

A. The manufacturer shall provide a one-year warranty that covers parts, labor and travel. The warranty period shall start of the day the City accepts the project.

END OF SECTION

SECTION 17520

PROGRAMMABLE LOGIC CONTROLLER SYSTEM

PART 1 - GENERAL

1.01 SCOPE

A. This Section covers the furnishing and installation of a Programmable Logic Controller (PLC) system, antenna cable, and other appurtenances necessary for a complete and operating system. The PLC system shall contain a Modicon PLC, I/O modules, power supply, radio transceiver, circuit breakers, fuses, panduit, terminal blocks and all devices necessary for a complete system. **This system shall be mounted on a Modicon rack(s) inside the control panel as shown on the Plans. The City will provide all the programming for the PLC and operator interface panel.** The City will be responsible for providing all necessary work so that the PLC communicates with its regional site. This includes development of SCADA display graphic screens on the master SCADA network.

1.02 REFERENCE STANDARDS

A. The equipment covered under this contract shall be designed, manufactured, and tested in accordance with the latest version of the following industrial standards:

1. American National Standards Institute (ANSI)/Institute of Electrical and Electronic Engineers (IEEE):

   a. C37.90.2, Trial-Use Standard Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers.

   b. C62.41, IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

2. Electronic Industries Association (EIA):

   a. TIA-232-E, Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.

   b. 422-A, Electrical Characteristics of Balanced Voltage Digital Interface Circuits.

3. National Electrical Manufacturers Association (NEMA):

a. ICS 1, General Standards for Industrial Control and Systems.

b. ICS 1.1, Safety Guidelines for the Application, Installation and Maintenance of Solid State Control.

c. ICS 4, Terminal Blocks for Industrial Use.

d. ICS 6, Enclosures for Industrial Controls and Systems.

4. National Fire Protection Association (NFPA):

a. National Electric Code (NEC).

1.03 SUBMITTALS

A. Provide four copies of submittals, in accordance with the Special Provisions, for all major components within the PLC system including the following:

1. Back-pan plans, sections and details. Showing all major components mounted on the back-pan.

2. Internal wiring and terminal blocks.

3. Tabular I/O listing including the following data:

a. Each I/O point.
b. Name of each I/O device.
c. Instrumentation tag number of the I/O device in the Plans.
d. PLC system internal address of each I/O.

4. Antenna and transmission cables.

5. Radio.

6. PLC parts and Switch.

7. Power Supply.

~~8. Antenna.~~

PART 2 - PRODUCTS

2.01 PLC SYSTEM

A. PLC and associated equipment shall be mounted on raised DIN rail as shown on the Plans. The PLC system/enclosure shall be built according to the requirements of NEMA ICS 6-1993 R2006.

B. PLC system grounding and electrical spacing shall be in accordance with NEMA ICS 6.

C. PLC shall be wired as defined below:

1. Install all wiring without splicing in panduit raceways as shown on the plans. Size the panduit per the plans. Panduit shall have removable covers.

2. Wire bending space shall be in accordance with Tables 7-9, 7-10, and 7-11 in NEMA ICS 6-1993 R2006.

3. Keep AC power lines separate from low-level DC lines, I/O power supply cables, and all I/O rack interconnect cables.

4. Keep AC signal wires separate from DC signal wires.

5. When I/O wiring must cross AC power wiring, it shall only do so at right angles.

6. Allow 2 inches between the I/O modules and any raceway, between the terminal strip and raceway, and between the terminal strip and I/O modules.

7. Bundle and tie down wires in a neat and orderly manner.

D. The PLC system shall be grounded as follows:

1. Separate ground wires from power wiring at the point of entry.

2. Minimize ground wire length by locating the ground reference point as close as possible to the point of entry of the plant power supply.

3. Ground all electrical racks or chassis and machine elements to a central ground bus.

E. PLC termination requirements:

1. Terminal block markings, mechanical characteristics and electrical characteristics shall be in accordance with NEMA ICS 4.

2. Make connections to I/O modules by terminating all field wiring to terminals and then installing wiring to each I/O modules as shown on the Plans.

3. Terminals shall facilitate wire sizes 12 AWG and 14 AWG rated for 120 VAC applications.

4. Provide terminal blocks as shown on the Plans and with continuous marking strip.

5. Label each wire within the PLC system with wire numbers as shown on the Plans.

6. Provide terminals for individual termination of each signal shield.

7. Provide all wiring between the terminal blocks and the PLC components.

8. Field wiring shall not be disturbed when removing or replacing an I/O module.

2.02 PLC AND INTERFACE MODULES

A. The programmable logic controller, modules, and operator interface panel will be provided by the Contractor.

B. The Contractor will provide the following Modicon PLC parts:

1. Two Racks – model number BME XBP 0800
2. One Processor – model number BME P580 4040
3. Two Power Supplies – model number BMX CPS 3020
4. Four Discrete Digital Input Modules – model number BMX DDI 1602
5. One Discrete Digital Output Module – model number BMX DDO 1602
6. One Analog Input Module – model number BMX AMI 0810
7. Two NOC Modules – model number BMX NOC 0301
8. One NOM Module – model number BMX NOM 0200
9. Two Rack Extender Modules – model number BMX XBE 1000
10. Two Line Terminators model number TSX TLYEX A & B
11. One TSX CBY 005K cable
12. Four Passive Connection Sub-Base for Digital Input Modules – model number ABE7H16S21.
13. One Sub-Base with Relay for Digital Output Module – model number

ABE7R16T330.

14. **Five Pre-Formed Cables – model number TWDFCW30K.**
15. **Five Modicon 340 Removable Screw Clamp Terminal Block – model number BMX FTB 2010.**
16. **One Sub-Base for Analog Input Module – model number ABE7CPA31E.**
17. **One Pre-Formed Cables – model number BMX FTA 150.**

C. **The Contractor will provide one Magelis Operator Interface panel model number XBTGT4230, no equal.**

2.03 PERFORMANCE AND DESIGN REQUIREMENTS

A. The PLC system shall accomplish the control requirements of the I/O list, Drawings, and Specifications.

B. The design application and installation of the PLC system shall conform to NEMA ICS 1.1.

C. The PLC system shall operate in ambient conditions of 32 to 140 Degree F temperature and 0 to 95 percent relative humidity without the need for purging or air conditioning.

D. Input/Output Connection Requirements:

1. Discrete inputs/outputs and analog outputs shall be fused as recommended by the manufacturer:

   a. Provide blown fuse indication for all fuses.

   b. Fuses shall be in accordance with module manufacturer's specifications and installed at terminal block.

E. All PLC control system components shall be capable of meeting or exceeding electromagnetic interference tests per ANSI/IEEE C37.90.2.

F. Incorporate the following minimum safety measures:

1. A main circuit breaker shall be placed in the power circuit as a means of removing power from the entire PLC system. Each power supply shall be protected by its own circuit breaker. Size the breaker as shown on plans.

2. Safe wiring:

   a. The loss of power or control signal to the equipment shall result in the equipment either shutting down or operating safely.

b. Activation of alarms and stopping of equipment shall result from the de-energization of control circuits, rather than the energization of control circuits.

c. Shield twisted cables shall be used for low voltage signal wires and shall be placed in conduits segregated for that purpose only. In addition, the cables shall not be placed in the same conduit or bundled with the power cables.

G. Construct PLC system with high noise immunity to prevent occurrence of false logic signals resulting from switching transients, relay and circuit breaker noise or conducted and radiated radio frequency interference.

H. Operator intervention:

1. Logic system failure shall not preclude proper operator intervention.

I. Power Supply Units:

1. **Provide two regulated 24 VDC power supplies rated for 120 W output as shown on the plans. Power supply shall be ABB model number 1SVR 427 034 R0000 or equal.** Power supply shall be connected to provide power to the devices as shown on the Plans.

2. Each power supply shall be sized such that it will carry no more than 75 percent of its load as shown on the Plans.

3. Provide power supplies to successfully withstand surges in AC power circuits per the wave form, voltage amplitude, current amplitude, and frequency provided in IEEE C62.41.

4. **Provide one redundancy module rated for 24 VDC and 40 A as shown on the plans. Redundancy module shall be Sola HD model number SDN 30/40RED or equal. Connect redundancy module as shown on the plans.**

J. Fuses:

Provide all fuse holders and fuses as shown on the plans.

K. ~~Relays:~~

~~Provide eight Idec Relays model number RH1B-ULD-DC24 or equal.~~

2.04 MAINTENANCE MATERIALS

A. Furnish the City with operation and maintenance manuals in accordance with the Special Provisions. Operation and maintenance manuals shall contain information on all components within this specification. The operations and maintenance manuals shall also be provided on a CD in accordance with the Special Provisions.

2.05 RADIO TRANSCEIVERS

A. Provide one GE MDS iNet radio model number iNETII DG D N, no equal. Install radio as shown on the plans. The radio shall be capable of transmitting data either serial or Ethernet. The operating frequency shall be 902 MHz to 928 MHz. The radio shall be powered by 24 VDC.

B. The contractor shall remove and salvage the existing radios from the existing PLC cabinet after the new station is operational and at the direction of the Engineer.

2.06 TRANSMISSION CABLE(S)

A. ~~Supply the transmission cables to connect the radio antenna port (via 50 ohm "Superflex" cable/lightning arrester) with the existing antenna. The cable shall be low-loss foam-dielectric type, 1/2 inch in diameter, and sufficient length to route each cable from the existing antenna to each lightning arrester (field verify). The transmission cable shall be weatherproof suitable for direct environmental exposure. Use "O" ring seals on all connectors.~~ **~~The transmission cable shall be Andrew Corp. LDF4-50A.~~** ~~The cable shall be installed without splices and be installed between the existing radio and the PLC as shown on the plans.~~ The contractor shall reuse the existing antenna cable to the OMNI antenna and connect this cable to the new radio. The contractor shall terminate this cable with a new N type connector if needed.

B. **Provide a section of "Superflex" cable between the radio and the lightning arrester. The cable shall be Andrew Corp. FSJ1-50A or equal with factory installed type N connectors.**

C. Connectors for the transmission cable shall be type N.

D. The Contractor shall field verify the length of antenna cable required for the project. The cables shall be installed without splices.

2.07 ETHERNET SWITCH

A. Provide one Allen Bradley Stratix 8300 Industrial Managed Switch model number 1783-RMS10T, no equal. Connect the switch as shown on the plans.

2.08 OMNI ANTENNA

A. The contractor shall reuse the existing omni antenna.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The Contractor shall be responsible for the installation of the PLC system and shall pull all the cables and wires and make all the connections as shown on the Plans or as directed by the Engineer. The PLC system shall be installed in accordance with manufacturer's written instructions.

B. The City will perform the following work:

1. Verify correct installation of the PLC system.

2. Verify the correct installation, type, and size of wiring terminated from field devices, and to the PLC system.

3. Verify the correct connection of all power sources supplied to and from the PLC system.

4. Verification of I/O terminations and proper device calibrations.

5. Perform a point to point test of all the PLC functions that are transmitted back to the City. Verify that all data points are transmitted back to the City.

C. If deficiencies are found in section B items 1 through 5 above, the Contractor shall immediately correct the problem at no cost to the City.

D. The Contractor shall terminate the antenna and signal transmission cables with type N connectors.

E. The Contractor shall install the lightning protector, copper strap, and instrument grounding. The Contractor shall install a number 10 copper wire to connect the lightening arresters to the ground bus.

F. ~~The City will provide the Contractor with coordinates on where to point the antenna. Contractor shall mount antenna after receiving the City coordinates~~

~~and point antenna per City's direction.~~

3.02 PLC FIELD TESTING

A. After finishing all the connections, the Contractor shall cooperate with the City during the field testing.

B. The City will perform the following:

1. Configure radio communication parameters.
2. Configure radio output power.

C. The City and Contractor shall perform a point to point test of all wiring between the PLC and field devices.

D. All devices connected to the digital input card shall be operated to ensure that the PLC recognizes the changed state of each device.

E. During the testing the PLC program shall be exercised to call for all output devices connected to the digital output card to activate. Any device that fails to operate shall be replaced at the contractor's expense.

F. All analog devices connected to the PLC shall be calibrated per Section 17100. Each analog device shall be operated to determine if the PLC recognizes the analog signal.

G. Test the transmission cables for return loss and voltage standing wave ratio. Make all connections from the radio to the antenna then test the transmission cables starting at the radio for return loss and voltage standing wave ratio (VSWR). Test equipment shall be Anritsu or approved equal. Submit a printout from the testing device showing the return loss and VSWR. Return loss shall be between 14dB to 48dB. The VSWR shall be between 1 and 1.4. If these values are not achieved the contractor shall replace the cable connectors, lightning arrestor, and/or the transmission cables until these values are obtained. The testing shall be done at a frequency of 902 MHz to 928 MHz.

3.03 DEMONSTRATION

A. The Contractor shall demonstrate that the PLC system operates according to Plans and specifications. If defects are found in the hardware or installation Contractor shall fix problems at no cost to the City.

3.04 SPARE PARTS

A. Provide spare parts per Section 16050.

END OF SECTION

RESOLUTION NO. 2019-

Adopted by the Sacramento City Council

January 14, 2020

CITY COLLEGE RESERVOIR ELECTRICAL IMPROVEMENTS

BACKGROUND

A. The City College Reservoir Electrical Improvements project will install new electrical switchgear at the City College Reservoir facility, which will enhance the reliability of the facility.

B. The Project was advertised, and three bids were received on November 13, 2019. Koch and Koch, Inc. was determined to be the lowest, responsive and responsible bidder

C. A budget transfer of $210,000 is necessary to provide sufficient funding for the City College Reservoir Electrical Improvements project.

BASED ON THE FACTS SET FORTH IN THE BACKGROUND, THE CITY COUNCIL RESOLVES AS FOLLOWS:

Section 1. The contract plans and specifications for the City College Reservoir Electrical Improvements are approved.

Section 2. The City Manager or the City Manager's designee is authorized to execute a contract with Koch and Koch, Inc. to install electrical improvements at City College Reservoir for an amount not–to-exceed $546,000.

Section 3. A budget transfer of $210,000 from the Base Water CIP Contingency Program (Z14000700) Water Fund (Fund 6005) to the Reservoir Rehabilitation Program (Z14130500) Water Fund (Fund 6005) is approved.

Adopted by the City of Sacramento City Council on January 14, 2020, by the following vote:

Ayes:

Noes:

Abstain:

Absent:

Attest:

The presence of an electronic signature certifies that the foregoing is a true and correct copy as approved by the Sacramento City Council.