THE CITY OF

PLEASANTON©

PUBLIC WORKS DEPARTMENT, ENGINEERING DIVISION

GENERAL PROVISIONS, NOTICE TO BIDDERS, SPECIAL PROVISIONS, PROPOSAL AND CONTRACT FOR

Sewer Station S-14 Electrical Improvements
Project No. 24265

Bid Opening Date – February 19, 2025

2:00 p.m.

To be used in conjunction with the City Standard Specifications and Details dated November 2016, the State Standard Specifications and Plans dated 2023 and all updates at the time of bid, and the Labor Surcharge and Equipment Rental Rates in effect on the date the work is accomplished.

APPROVED

1/10/25

Adam M. Nelkie, City Engineer
No. 78830
Expires: 9/30/2025

NOTICE TO BIDDERS

Proposals Sought; Time for Receipt

Sealed Bid Proposals will be received by the City Clerk's Office of the City of Pleasanton, Civic Center, in-person at 123 Main Street (or by mail to P.O. Box 520), Pleasanton, CA 94566, until 2:00 p.m., **February 19, 2025,** for work as described in the Plans and Specifications entitled:

Sewer Station S-14 Electrical Improvements
Project No. 24265

At the above-mentioned time, date and address, the Bid Proposals will be publicly opened and read.

Please review the City website and/or bidnetdirect.com for addendum(s) prior to submission.

Scope of Work and Project Location

The existing electrical and control panel for Sewer Station S-14 was in a below-grade vault and was damaged by flooding during the January 2023 storms. The station is currently operational with the use of temporary power and controls. This project will install a permanent outdoor electrical and control panel above ground to reduce the risk of damage from future storms.

This work will consist of, but is not limited to, demolition and disposal of existing equipment vault, connecting to existing meter/main disconnect, installation of above ground Machine Control Center (MCC) and SCADA integration, installation of Automatic Transfer Switch (ATS) and generator connection panel, installation of conduit and wiring, flowmeter, sump pumps, concrete pad, bypass power connection and operational maintenance of existing pump station motor controls and control system until the station is fully transferred to the new system, operational testing, start-up and commissioning.

The Engineer’s cost estimate for the project is $500,000.

Location: 6520 Alisal St, Pleasanton, CA 94566 (near the corner of Alisal Street and Alisal Court), GPS: 37.635246, -121.870615

The project is anticipated to be reimbursed by the Federal Emergency Management Agency (FEMA) as part of Disaster Recovery from 4683DR-CA. Projects financed in whole or in part by Federal funds are subject to Title 49 of the Code of Federal Regulations, Part 26, “Participation by Disadvantaged Business Enterprises in Department of Transportation Financial Assistance Programs.” Certified Disadvantaged Business Enterprises, Minority Owned Business Enterprises, and Women Owned Business Enterprises are strongly encouraged to apply. The contractor shall make good

faith efforts when procuring services. Disadvantaged Business Enterprise Participation Level (DBE Goal) for this project is 12.0 percent. This percentage may change in the future; the contractor must adhere to any new Federal requirements. The contractor shall take the FEMA-recommended socioeconomic affirmative steps to ensure that small and minority businesses, women's business enterprises, and labor surplus area firms are used when possible if subcontracts are used.

The Contractor is required to submit proof of Good Faith Effort (GFE), which includes, but is not limited to, DBE solicitation documents and/or forms, phone logs, and email. The Contractor shall comply with Exhibit A - "Special Provisions – FEMA Federal Provisions," Section XVIII "MBE/WBE Requirements" and submit "Exhibit B, DBE Subcontractor Utilization Form" with the bid. If the Contractor does not meet the MBE/WBE goal, they must submit a GFE with the bid. If the GFE documentation is not submitted with the bid, it must be submitted by 4 p.m. next business day after the bid opening. The submittal must include the name of the contractor, the project name and other relevant information.

There will be no pre-bid meeting held for this project.

Copies of Plans and Specifications

In order to be an eligible bidder, plans, specifications and all bid proposal and contract documents must adhere to the latest version of all bid documents as amended through any addendums. Plans may be purchased from the Public Works Department, Engineering Division of the City of Pleasanton, Civic Center, 200 Old Bernal Avenue, at a cost of **$35 per set** (with 11x17 plans) or **$100 per set** (with full-sized plans) plus shipping. Plans will be electronically available on the City's website and bidnetdirect.com at no charge. The City requires all parties interested in this bid opportunity to email the City to be added to the plan holder list. Any addenda will be sent electronically to those on the plan holder list prior to the bid opening date. To request plans or to be added to the plan holder list, please email: ssaklaen@cityofpleasantonca.gov and kroberts@cityofpleasantonca.gov.

Bid Security and Contract Bonds

Each Bid Proposal shall be accompanied by either cash, a cashier's check or a certified check, amounting to not less than ten percent of the bid, payable to the order of the City of Pleasanton or by a bond for that amount and payable in the form contained in this bid package. The successful Bidder will be required to furnish performance and payment bonds, each in an amount not less than one hundred percent (100%) of the contract price, and a maintenance bond not less than ten percent (10%) of the contract price.

Bid Forms

The Contractor is responsible for reviewing the City of Pleasanton's City Bids website (and/or bidnetdirect.com) to ensure they have the latest addendums and utilize all updated documents issued through addendum. Bidders must complete bid proposal and submit it in its entirety. Failure to do so will cause the bid to be deemed nonresponsive.

City of Pleasanton's City Bids Website:
http://www.cityofpleasantonca.gov/business/bids.asp

Bids Received After Deadline

Bids received after the time established for receiving bids will not be considered. Except as provided in Section "Instruction to Bidders," no Bidder may withdraw a bid after the time established for receiving bids or before the award and execution of the contract, unless the award is delayed for a period of ninety (90) calendar days after the date of the City's opening of bids.

Rejection of Bids

The City reserves the right to reject any or all bids and to determine which bid is, in the City's judgment, the lowest responsive and responsible bid of a Bidder or group of Bidders. The City also reserves the right to waive any inconsequential omissions or discrepancies in any bid and to delete certain items listed in the bid as set forth therein. Costs for developing, submitting, and presenting bids are the sole responsibility of the Bidder and claims for reimbursement will not be accepted by the City.

Contractor's License Classification

As provided in California Business & Professions Code Section 7028.15, the City has determined that at the time of bid, the Contractor shall possess a valid **Class A General Engineering Contractor and/or C-10 Electrical Contractor** license. The Contractor's failure to possess the specified license shall render the Bid as non-responsive and shall act to bar award of the contract to any Bidder not possessing said license at the time of bid, unless exempted by federal or state law.

Contractor's Department of Industrial Relations Registration

Bidder and its Subcontractors must be registered and qualified to perform public work pursuant to section 1725.5 of the Labor Code, subject to limited legal exceptions under Labor Code section 1771.1.

This Contract will be subject to compliance monitoring and enforcement by the California Department of Industrial Relations, pursuant to Labor Code section 1771.4.

Substitution of Securities in Lieu of Retention

At the successful Contractor's option, securities may be substituted for the required retention, in accordance with provisions of Section 22300 of California Public Contract Code.

Prevailing Wage

In accordance with California Labor Code Sections 1770 et seq., the Contractor shall pay general prevailing rate of per diem wages to all workers employed under this contract.

Labor Nondiscrimination

The awarded Contractor shall comply with the requirements of the State of California's Standard Specification Code Section 7-1.01A(4) "Labor Nondiscrimination" under this contract.

Questions

Questions should be directed to the project engineer either in person at 200 Old Bernal Avenue, Pleasanton, California, by mail at P.O. Box 520, Pleasanton, California 94566-0802, by phone at (925) 931-5658, or by email at **ssaklaen@cityofpleasantonca.gov**. Questions will only be answered by reference to particular sections of these bid documents. If interpretation is deemed necessary, then the question shall be addressed in writing and a clarification shall be given to all prospective Bidders through addenda. To allow time for issuance of addenda, questions shall only be accepted prior to seven (7) calendar days before the bid opening date.

CITY OF PLEASANTON

Date: 1/14/25

By: _____
Jocelyn Kwong, City Clerk

THIS PAGE LEFT INTENTIONALLY BLANK

BID PROPOSAL

Sewer Station S-14 Electrical Improvements
Project No. 24265

DATE: _____

Proposal of _____ (hereinafter called "Bidder") a _____ organized and existing under the laws of the State _____, doing business as _____, to the City of Pleasanton, City Clerk, 123 Main Street, Pleasanton, California (hereinafter called "City").

Ladies and Gentlemen:

The Bidder, in compliance with the invitation for bids for the **SEWER STATION S-14 ELECTRICAL IMPROVEMENTS, PROJECT NO. 24265,** City of Pleasanton, having examined the Plans and Specifications and related documents and the premises of the proposed work, and being familiar with all of the conditions surrounding the construction of the proposed project including the availability of materials and supplies, declares that this proposal is made without collusion with any other person, firm or corporation and agrees to construct the project in accordance with the contract documents, within the time set forth therein, and at the prices stated below. These prices are to cover all expenses incurred in performing the work required under the Contract Documents, of which this Bid Proposal is a part.

Bidder shall agree to commence work under this Contract within fifteen (15) calendar days after the date of written "Notice to Proceed" and fully complete the project within sixty **(60)** working days after start of work. Bidder shall pay as liquidated damages in the sum of $**1,200.00** per calendar day should the successful Bidder fail to complete the work within this time limit unless the successful Bidder is granted a time extension.

Bidder acknowledges receipt of the following addendum:

No.	Date	No.	Date
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Bidder to perform all of the work described in the Contract Documents for the total bid amount entered.

Item No.	Quantity (Approximate)	Unit of Measure	Item Description	Unit Price	Total
1	1	LS	Installation of All Items required as per Contract Drawings and Specifications		
			TOTAL	$	

Note: The Bidder acknowledges that the total amount set forth above is for the entire project as represented by the Contract Documents regardless of itemization.

Attached is a bid guaranty bond duly completed by a guaranty company authorized to carry on business in the State of California in the amount of at least ten percent (10%) of the total amount of the bid, or alternately, there is attached a certified or cashier's check payable to the City in the amount of at least ten percent (10%) of the total amount of the bid.

If this Bid Proposal is accepted, bidder agrees to sign the contract and to furnish the performance bond, labor and materials bond, maintenance bond, and the required evidences of insurance within ten (10) working days after receiving written notice of the award of the contract. If bidder fails to contract as provided herein or fails to provide the bonds and/or evidence of insurance, the City may at its option, determine the acceptance thereof shall be null and void, and the forfeiture of such security accompanying this Bid Proposal shall operate and the same shall be the property of the City of Pleasanton.

This Bid Proposal shall be good and may not be modified, withdrawn or canceled for a period of ninety (90) calendar days after the date of the City's opening of bids.

Bidder hereby certifies that the licensing information hereinafter stated is true and correct. Bidder further agrees, if the bid is accepted and a contract for performance of the work is entered into with the City, to so plan work and to prosecute it with such diligence that the work shall be completed within the time stipulated in the agreement. Under the penalty of perjury bidder affirms that, to the best of bidder's knowledge, the representations made in this bid are true.

Bidders are required by law to be licensed and regulated by the contractors' State License Board. Any questions concerning a contractor may be referred to the Registrar, Contractors' State License Board.

It is a misdemeanor for any person to submit a bid to a public agency in order to engage in the business or act in the capacity of a contractor within this state without having a license therefor, except for specific cases outlined in Business and Professions Code, Section 7028.15.

_____	_____
Name of Bidder	Contractor's License Number
_____	_____
Signature of Bidder	Expiration Date
_____	_____
Print Name	Address of Bidder
_____	_____
Title of Signatory	
_____	(____)_____
State of Incorporation	Telephone Number
_____	_____
DIR Registration Number	Contractor’s Email Address

BID BOND FORM

Note: Bidders must use this form if a bid bond is to be used as bidder's security. This form is not necessary if cash, cashier's check made payable to the City, or certified check made payable to the City, accompanies the bid.

We, the undersigned, _____ ("Principal"), and _____ a corporation organized and existing under and by virtue of the laws of the State of _____ and authorized to do business in the State of California as a surety, ("Surety"), acknowledge ourselves jointly and severally bound to the CITY OF PLEASANTON for ten percent (10%) of the total bid amount.

Contractor's Bid $_____
10% Bid Bond $_____

The above amount to be paid to the CITY OF PLEASANTON as follows: If Principal's bid for the work required for the project, described below,

SEWER STATION S-14 ELECTRICAL IMPROVEMENTS
PROJECT NO. 24265

shall be accepted and the proposed contract awarded to Principal, and if Principal shall fail to execute the contract within the time specified in the Award and Execution of Contract section of this Contract Document, and to furnish the required faithful performance and labor and material bonds; otherwise, the obligation shall be void. Bid errors shall not constitute a defense to forfeiture.

If the City of Pleasanton brings suit upon this bond and judgment is recovered, Surety shall pay all costs incurred by the CITY OF PLEASANTON in bringing such suit, including reasonable attorney's fees.

IN WITNESS WHEREOF, we hereunto set our hands and seals this __day of _____, 20__.

_____
Principal

_____
By:

_____
Surety:

_____
By:

(Notarization of Surety's signature required)

(corporate seal)

THIS PAGE LEFT INTENTIONALLY BLANK

CERTIFICATION OF BIDDER'S

EXPERIENCE AND QUALIFICATIONS

The undersigned Bidder certifies that the Bidder is, at the time of the bidding, and shall be, throughout the period of the contract, licensed by the State of California to do the type of work required under the terms of the contract documents. Bidder further certifies that the Bidder is skilled and regularly engaged in the general class and type of work called for in the contract documents.

The Bidder represents that the Bidder is competent, knowledgeable and has special skills in the nature, extent and inherent conditions of the work to be performed. Bidder further acknowledges that there are certain peculiar and inherent conditions existent in the construction of the particular facilities which may create, during the construction program, unusual or peculiar unsafe conditions hazardous to persons and property. Bidder expressly acknowledges that the Bidder is aware of such peculiar risks and has the skill and experience to foresee and to adopt protective measures to adequately and safely perform the construction work with respect to such hazards.

Bidder has been engaged in the contracting business, under the present business name, for _____ years. Experience in work of a similar nature to that called for in the contract documents extends over a period of _____ years.

BIDDER'S CONTRACT EXPERIENCE

The Bidder shall list below three projects completed in the last seven (7) years of similar size and complexity that indicate the Bidder's experience as a Contractor.

1.

Project	Amount
Owner	Contact
Telephone	Completion Date

2.

Project	Amount
Owner	Contact
Telephone	Completion Date

3.

Project	Amount
Owner	Contact
Telephone	Completion Date

Name of Bidder _____

Signed this _____ day of _____, 20_____.

BIDDER'S LABOR CLASSIFICATIONS

The Bidder shall list below the anticipated labor classifications completed by Bidder. List Subcontractor's classifications under List of Subcontractors.

☐ ASBESTOS	☐ BOILERMAKER	☐ BRICKLAYERS	☐ CARPENTERS
☐ CARPET/LINOLEUM	☐ CEMENT MASONS	☐ DRYWALL FINISHER	☐ DRYWALL/LATHERS
☐ ELECTRICIANS	☐ ELEVATOR MECHANIC	☐ GLAZIERS	☐ IRON WORKERS
☐ LABORERS	☐ MILLWRIGHTS	☐ OPERATING ENG	☐ PAINTERS
☐ PILE DRIVERS	☐ PIPE TRADES	☐ PLASTERERS	☐ ROOFERS
☐ SHEET METAL	☐ SOUND/COMM	☐ SURVEYORS	☐ TEAMSTER
☐ TILE WORKERS	☐ _____	☐ _____	☐ _____

B. BIDDER'S FINANCIAL RESPONSIBILITY

Reference is hereby made to the following banks and surety companies as to the financial responsibility and general reliability of the Bidder:

1. Name of Bank _____

   Address _____

2. Name of Bank _____

   Address _____

3. Surety Company _____

   Address _____

4. Surety Company _____

   Address _____

C. LIST OF SUBCONTRACTORS

In conformance with Section 2.1 – 1.10 of the Caltrans Standard Specifications and § 4100 of California Public Contract Code, the Bidder shall provide the following information for each Subcontractor to whom the Bidder proposes to subcontract portions of the work in an amount in excess of one-half of one percent of the total Bid Proposal OR $10,000, whichever is greater.

1. Name of Subcontractor _____

Contractor License Number _____

Address _____ Phone No. _____

Individual, Partnership or Corporation _____

Dollar Value of work to be Performed _____

Work to be Performed _____

Labor Classification/s _____

DIR Registration # _____

CSLB# _____ Email _____

2. Name of Subcontractor _____

Contractor License Number _____

Address _____ Phone No. _____

Individual, Partnership or Corporation _____

Dollar Value of work to be Performed _____

Work to be Performed _____

Labor Classification/s _____

DIR Registration # _____

CSLB# _____ Email _____

3. Name of Subcontractor _____

Contractor License Number _____

Address _____ Phone No. _____

Individual, Partnership or Corporation _____

Dollar Value of work to be Performed _____

Work to be Performed _____

Labor Classification/s _____

DIR Registration # _____

CSLB# _____ Email _____

4. Name of Subcontractor _____

Contractor License Number _____

Address _____ Phone No. _____

Individual, Partnership or Corporation _____

Dollar Value of work to be Performed _____

Work to be Performed _____

Labor Classification/s _____

DIR Registration # _____

CSLB# _____ Email _____

5. Name of Subcontractor _____

Contractor License Number _____

Address _____ Phone No. _____

Individual, Partnership or Corporation _____

Dollar Value of work to be Performed _____

Work to be Performed _____

Labor Classification/s _____

DIR Registration # _____

CSLB# _____ Email _____

6. Name of Subcontractor _____

Contractor License Number _____

Address _____ Phone No. _____

Individual, Partnership or Corporation _____

Dollar Value of work to be Performed _____

Work to be Performed _____

Labor Classification/s _____

DIR Registration # _____

CSLB# _____ Email _____

Signature of Bidder: _____

INSTRUCTIONS TO BIDDERS

General

The City of Pleasanton, hereinafter referred to as "City," will receive at the City Clerk's Office of the City of Pleasanton, Civic Center, 123 Main Street, Pleasanton, California, until the hour and day specified in the "Notice to Bidders," sealed Bid Proposals for furnishing materials, equipment and/or labor for performing the work described in these Contract Documents. All Bid Proposals shall be submitted in accordance with the provisions of the "Proposal Requirements and Conditions" set forth under Section 2 of the Standard Specifications of the State of California, except as modified herein.

Bid Proposal Form

All Bid Proposals shall be submitted on the Bid Proposal forms which are bound herein. All Bid Proposal forms shall be filled in completely in ink with all signature blocks signed by the Bidder. The completed Bid Proposal forms shall remain bound with the Contract Documents provided and shall be sealed in an envelope addressed to the City of Pleasanton, California and clearly labeled with identifying project name and number, and bid opening date.

Delivery of Bid Proposal

The Bid Proposal shall be delivered by the time and to the place set forth in the "Notice to Bidders." It is the Bidder's sole responsibility to see that his or her Bid Proposal is received in proper time. Any proposal received after the time fixed for opening of bids shall be returned to the Bidder unopened.

Opening of Bid Proposals

The Bid Proposals shall be publicly opened and read at the time and place fixed in the "Notice to Bidders."

Modifications and Alternative Proposals

Each Bidder represents that his or her Bid Proposal is based upon the materials and equipment described in the Contract Documents. Unauthorized conditions, limitations or provisions attached to a Bid Proposal will render it non-responsive and may cause its rejection. The completed Bid Proposal forms shall be without interlineations, alterations or erasures. Alternative Bid Proposals will not be considered unless written request has been submitted to the Engineer for approval at least **fourteen (14)** calendar days prior to the date for receipt of Bids. The request shall include the name of substitute material or equipment drawings, cut sheets, performance and test dates and any other data or information necessary for complete evaluation. If the Engineer approves any proposed substitution, such approval shall be set forth in an Addendum. Oral, telegraphic, or telephonic Bid Proposals or modifications will not be considered.

Contractor's Department of Industrial Relations Registration

A bid will not be accepted nor any contract entered into without proof that the bidder and its subcontractors are registered with the California Department of Industrial Relations to perform public work pursuant to Labor Code Section 1725.5, subject to limited legal exceptions.

Discrepancies in Bid Proposals

In the event there is more than one bid item on a Bid Proposal form, the Bidder shall furnish a price for all items and failure to do so will render the Bid Proposal non-responsive and may cause its rejection. In the event there are unit price bid items on a Bid Proposal form and the "amount" indicated for a unit price bid item does not equal the product of the unit price and quantity, the unit price shall govern and the amount will be corrected accordingly. In the event there is more than one bid item on the Bid Proposal form and the total indicated on the Bid Proposal form does not agree with the sum of the amounts bid on the individual items, the price bid on the individual items shall govern and the total on the proposal will be corrected accordingly.

Bid Security

Each Bid Proposal shall be accompanied by cash, a cashier's check or a certified check, amounting to ten percent (10%) of the Bid, payable to the order of the City of Pleasanton or by a bond for that amount and so payable in the form contained in this bid package. The amount so posted shall be forfeited to the City if the successful bidder does not, within ten (10) working days not including Saturday, Sunday and legal holidays after date of postage of mailed written notice that the contract has been awarded, enter into a contract with the City for the work.

After the contract is duly entered into by the successful bidder, the amount of the deposit will be returned to the Bidder. All certified checks, cashier's checks, and cash deposits of the unsuccessful bidders will be returned to the bidders within two (2) weeks after the contract is entered into by the successful bidder.

Miscellaneous

For requirements on Bidder's examination of site, withdrawal of proposals, and disqualification of bidders, refer to Section 2 of the Standard Specifications of the State of California.

AWARD AND EXECUTION OF CONTRACT

General

Award and execution of Contract shall be in accordance with "Award and Execution of Contract" set forth under Section 3 of the Standard Specifications of the State of California except as modified herein.

Award of Contract

The City reserves the right to reject for any reason any or all Bid Proposals.

No Bidder shall modify, withdraw or cancel a Bid Proposal or any part thereof for ninety (90) calendar days after the time designated for the opening of Bids in the "Notice to Bidders." Within this time period of ninety (90) days and if the City so chooses, the Contract shall be awarded to the lowest responsible Bidder.

In accordance with the provisions of California Business & Professions Code Section 7028.5, the City has determined that at the time that a bid is submitted, the bidder shall possess a valid **Class A General Engineering Contractor and/or C-10 Electrical Contractor** license. Failure to possess the specified license shall render the bid as non-responsive and shall act to bar award of the Contract to any Bidder not possessing said license at the time of bid.

Execution of Contract

Within ten (10) working days, not including Saturday, Sundays and legal holidays, after date of postage of mailed notice of award to the lowest responsible Bidder, the following documents shall be submitted to the City.

- Executed contract
- Contract bonds as required by the forms contained herein including:

  ◊ Faithful Performance Bond for 100% of contract price
  ◊ Labor and Material Bond for 100% of contract price
  ◊ Maintenance Bond for 10% of contract price

- Certificates of insurance
- Evidence of a current business license to conduct business in the City of Pleasanton

Failure to submit the above shall be just cause for forfeiture of the Bid Proposal security.

THIS PAGE LEFT INTENTIONALLY BLANK

CONTRACT

SEWER STATION S-14 ELECTRICAL IMPROVEMENTS
PROJECT NO. 24265

THIS CONTRACT is made and entered into this ___day of ___ 20XX by and between _____, ("Contractor"), whose address is_____, and telephone number is and the CITY OF PLEASANTON, a municipal corporation ("City").

W I T N E S S E T H:

WHEREAS, the City has awarded to the Contractor a contract for **SEWER STATION S-14 ELECTRICAL IMPROVEMENTS, PROJECT NO. 24265,**

NOW, THEREFORE, in consideration of the mutual promises set forth herein, the parties agree as follows:

1. Work to be Performed

The existing electrical and control panel for Sewer Station S-14 was in a below-grade vault and was damaged by flooding during the January 2023 storms. The station is currently operational with the use of temporary power and controls. This project will install a permanent outdoor electrical and control panel above ground to reduce the risk of damage from future storms.

This work will consist of, but is not limited to, demolition and disposal of existing equipment vault, connecting to existing meter/main disconnect, installation of above ground Machine Control Center (MCC) and SCADA integration, installation of Automatic Transfer Switch (ATS) and generator connection panel, installation of conduit and wiring, flowmeter, sump pumps, concrete pad, bypass power connection and operational maintenance of existing pump station motor controls and control system until the station is fully transferred to the new system, operational testing, start-up and commissioning.

Said work is more particularly shown in the following documents which are on file with the Public Works Department, Engineering Division of the City and are incorporated herein by this reference:

A. Approved Plans and Specifications entitled the **SEWER STATION S-14 ELECTRICAL IMPROVEMENTS, PROJECT NO. 24265,** and addenda thereto, if any.

B. Contract Change Orders approved by the City Engineer, done in accordance with the Standard Specifications.

C. The elements of the proposal submitted to the City by the Contractor, which the City has accepted.

2. Compensation. The City shall pay the Contractor for work actually performed at the unit prices set out in the Contractor's proposal to the City as set forth in Exhibit A of this agreement and incorporated herein. The quantities of work stated therein are estimates only; actual quantities will be measured for payment in accordance with the specifications.

3. Method of Payment.

   A. Progress Payments. As of the twentieth day of each month, the Contractor may submit for review a request for progress payment, listing the amount and value of work actually performed during the preceding month, or part thereof. Upon the City Engineer's review and approval, including adjustments if any, City shall make a progress payment to the Contractor.

   B. 5% Retention. Five percent (5%) of the amount due shall be retained by the City as retention. The City shall retain five percent (5%) of the contract amount for thirty-five (35) days after the Notice of Completion for the work is recorded. The Contractor may elect to receive 100 percent of payments due under the contract documents from time to time, without retention from any portion of the payment by the City, by depositing securities of equivalent value with the City in accordance with the provisions of Section 22300 of the California Public Contract Code. Such securities, if deposited by the Contractor, shall be valued by the City, whose decision on valuation of the securities shall be final. Securities eligible for investment under this provision shall be limited to those listed in Section 16430 of the California Government Code.

   C. Time of Payment. Requests submitted promptly as of the 20th day of each month will be paid by the 10th day of the following month.

4. Incorporation of Contract Documents. This Contract expressly incorporates all terms and conditions contained in the Contract Documents. In the event there is any conflict between this Contract and the Contract Documents, this Contract shall control.

5. Indemnification. Contractor shall indemnify, save and hold harmless from and defend the City, members of the City Council and their agents, servants and employees, against any and all claims, costs, demands, causes of action, suits, losses, expense or other detriment or liability arising from or out of acts or omissions of Contractor, its agents, sub-contractors, officials or employees, in connection with the execution of the work covered by this Contract or any amendments thereto.

6. Certification re: Workers' Compensation. In accordance with Section 1861 of the California Labor Code, each contractor to whom a public works contract is awarded shall sign and file with the awarding body the following certification prior to performing the work of the contract: "I am aware of the provisions of Section 3700 of the Labor Code which require every employer to be insured against liability for workers' compensation or to undertake self-insurance in accordance with the provisions of that code, and I will comply with such provisions before commencing the performance of the work of this contract."

7. Department of Industrial Relations: Pursuant to Labor Code section 1771.1, the Bidder and its Subcontractors must be registered and qualified to perform public work pursuant to section 1725.5 of the Labor Code, subject to limited legal exceptions.

8. Independent Contractor. The Contractor is an independent contractor retained by the City to perform the work described herein. All personnel employed by the Contractor, including subcontractors, and personnel of said subcontractors, are not and shall not be employees of the City.

9. Warranty Against Defects. The Contractor hereby warrants all work done under this contract against all defects in materials and workmanship for a period of 12 months following City's acceptance of said work. If any defects occur within said 12 months, the Contractor shall be solely responsible for the correction of those defects.

10. Federal Provision FEMA. The Contractor shall comply with all applicable FEMA requirements as outlined in the specifications, which is attached and incorporated to the extent consistent with this agreement.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement the date and year first above written.

CONTRACTOR:

By: _____
Its Authorized Agent

By: _____
Its Authorized Agent
(Second signature required if a corporation)

CITY OF PLEASANTON:

By: _____
Gerry Beaudin, City Manager

ATTEST:

_____
Jocelyn Kwong, City Clerk

APPROVED AS TO FORM:

_____
Daniel G. Sodergren, City Attorney

Bond No. _____

CONTRACTOR'S BOND FOR FAITHFUL PERFORMANCE

KNOW ALL PERSONS BY THESE PRESENTS:

Whereas, The City Council of the City of Pleasanton, State of California, and _____ ("Principal") have entered into an agreement whereby Principal agrees to install and complete certain designated public improvements, which said agreement, dated _____, 20__, and identified as **SEWER STATION S-14 ELECTRICAL IMPROVEMENTS, PROJECT NO. 24265,** is hereby referred to and made a part hereof; and

Whereas, Said Principal is required under the terms of said agreement to furnish a bond for the faithful performance of said agreement.

Now, therefore, we, Principal and _____ ("Surety"), are held and firmly bound unto the City of Pleasanton, in the penal sum of _____ dollars ($_____) lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, successors, executors and administrators, jointly and severally, firmly by these presents.

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

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

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

In witness whereof, this instrument has been duly executed by the Principal(s) and Surety above named, on _____, 20____..

Contractor	Surety
By: _____	By:_____
By: _____	By:_____
Date Signed: _____	_____ Surety Address _____ _____ _____ Surety's Phone No.

(attach acknowledgments)

LABOR AND MATERIAL BOND

Whereas, the City Council of the City of Pleasanton, State of California, and _____ ("Principal") have entered into an agreement whereby Principal agrees to install and complete certain designated public improvements, which agreement, dated _____, 20__, and identified as **SEWER STATION S-14 ELECTRICAL IMPROVEMENTS, PROJECT NO. 24265,** is hereby referred to and made a part hereof; and

Whereas, Under the terms of the agreement, Principal is required before entering upon the performance of the work, to file a good and sufficient payment bond with the City of Pleasanton to secure the claims to which reference is made in Title 3 (commencing with Section 9000) of Part 6 of Division 4 of the Civil Code.

Now, therefore, Principal and the undersigned as corporate surety, are held firmly bound unto the City of Pleasanton and all contractors, subcontractors, laborers, material suppliers, and other persons employed in the performance of the agreement and referred to in Title 3 (commencing with Section9000) of Part 6 of Division 4 of the Civil Code in the sum of _____ dollars ($_____), for materials furnished or labor thereon of any kind, or for amounts due under the Unemployment Insurance Act with respect to this work or labor, that the surety will pay the same in an amount not exceeding the amount hereinabove set forth, and also in case suit is brought upon this bond, will pay, in addition to the face amount thereof, costs and reasonable expenses and fees, including reasonable attorney's fees, incurred by City of Pleasanton in successfully enforcing this obligation, to be awarded and fixed by the court, and to be taxed as costs and to be included in the judgment therein rendered.

It is hereby expressly stipulated and agreed that this bond shall inure to the benefit of any and all persons, companies, and corporations entitled to file claims under Title3 (commencing with Section 9000) of Part 6 of Division 4 of the Civil Code, so as to give a right of action to them or their assigns in any suit brought upon this bond.

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

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

In witness whereof, this instrument has been duly executed by Principal and surety above named, on _____, 20____.

Principal Surety

By: _____ By: _____

(Signature of Principal and Surety must be notarized)

THIS PAGE LEFT INTENTIONALLY BLANK

Bond No. _____

CONTRACTOR'S BOND FOR ONE YEAR MAINTENANCE

SEWER STATION S-14 ELECTRICAL IMPROVEMENTS
PROJECT NO. 24265

KNOW ALL PERSONS BY THESE PRESENTS:

WHEREAS, the City of Pleasanton has awarded and _____ ("Contractor") is about to execute a Contract for the above-referenced Project ("Contract") and the terms thereof, which are incorporated herein by reference, require the furnishing of a bond with said Contract providing for maintenance for a period of one (1) year from the date of acceptance by the City Council of said contract by the Contractor.

NOW, THEREFORE, WE, Contractor and _____ ("Surety"), are held firmly bound unto the City of Pleasanton, as Agency in the penal sum of:
_____ DOLLARS, ($_____), lawful money of the United States of America, said sum being ten percent (10%) of the estimated amount payable by Agency under the terms of the contract, for payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that if the above bounden _____, Principal(s), within a period of one (1) year after the completion and acceptance of the project fulfills the provisions of the Contract and complies with any necessary repairs or replacement of faulty materials to the **SEWER STATION S-14 ELECTRICAL IMPROVEMENTS, PROJECT NO. 24265,** and related facilities, then the above obligation shall be void; otherwise to remain in full force and effect.

No cancellation or termination of this bond by Surety shall be effective unless thirty (30) days prior written notice thereof has been delivered to the City Engineer, provided that no cancellation or termination shall affect any liability incurred or accrued hereunder prior to the expiration of said thirty (30) day period or any work performed under any Contract issued by the City.

This bond is executed in accordance with the rules, regulations, standards, specifications and policies of the City of Pleasanton.

Bond No. _____

IN WITNESS WHEREOF, the Principal(s) and Surety have caused these presents to be executed, and corporate names and seals to be hereunto attached by proper officers hereunto duly authorized, the day and year first herein-above written.

Contractor

By:

By:

_____
Date Signed

Surety

By: _____

By: _____

Surety Address:

_____

_____

Surety Phone No. (___) _____

(attach acknowledgments)

GENERAL PROVISIONS

Unless otherwise stated in these Contract Documents or deemed inapplicable by the Engineer, the General Provisions of the State of California Standard Specifications are hereby incorporated with the following General Provisions.

SECTION 1. DEFINITIONS AND TERMS

As used in these Contract Documents unless the context otherwise requires, the following terms have the meanings indicated:

Addenda: Are written or graphic instruments, clarifications or corrections, issued prior to the execution of the contract, which modify or interpret the Contract Documents.

Bidder: Any individual, partnership or corporation submitting a Bid Proposal for the work described in the Contract Documents.

Bidding Documents: Includes the Notice to Bidders, the Bid Proposal, Bid Bond, Contractor's Information Forms including the Contractor's past experience, financial responsibility and Subcontractors, and Instructions to Bidders.

City: The City of Pleasanton.

City Standard Specifications and Standard Details: Means the November 2016 edition of the City's Standard Specifications and Standard Details.

Contractor: Any individual, partnership or corporation that has entered into a Contract with the City to perform the work described in the Contract Documents.

Contract Documents: Includes the Bidding Documents, the Award and Execution of Contract Requirements, the Contract, the Labor and Material Bond, the Performance Bond, the Maintenance Bond, the City General Provisions, the Special Provisions, Project Plans, the City of Pleasanton Standard Specifications, and Standard Details, the State Standard Specifications and Plans, all Addenda issued by the City and all Change Orders executed by the City.

Engineer: The City Engineer of the City of Pleasanton, acting either directly or through properly authorized agents, such agents acting within the scope of the particular duties entrusted to them.

General Provisions: Those Specifications that apply to all projects unless specifically modified by Special Provisions.

Project Plans: Drawings specifically prepared for a particular project.

Special Provisions: Specifications specifically prepared for a particular project.

State Standard Specifications and Standard Plans: Means the May 2018 edition of the Standard Specifications and Standard Plans of the State of California, Department of Transportation. Any reference therein to the State of California or a State agency, office or officer shall be interpreted to refer to the City or its corresponding agency, office or officer acting under this contract.

Subcontractor: Any individual, partnership or corporation that has contracted with the Contractor to provide labor, equipment and/or materials described in the Contract Documents which is an amount in excess of one-half of one (1) percent of the Contractor's total Bid.

Work: Material, equipment and labor to be provided to City by the Contractor as defined by the Contract Documents.

SECTION 2. SCOPE OF WORK

The Work presented in these Contract Documents shall be done in accordance with: 1) the Special Provisions and Project Plans, 2) the City Standard Specifications and Standard Details and 3) the State Standard Specifications and Standard Plans. In case of conflicting portions, the above order of precedence shall prevail. In case of conflict between the specifications and drawings, the specifications shall prevail.

SECTION 3. CONTROL OF WORK AND MATERIALS

3-01. Protection of Workers in Trench Excavations: As required by Section 6705 of the California Labor Code and in addition thereto, whenever work under the Contract involves the excavation of any trench or trenches 5 feet or more in depth, the Contractor shall submit for acceptance by the City or by a registered civil or structural engineer, employed by the City, to whom authority to accept has been delegated, in advance of excavation, a detailed plan showing the design of shoring, bracing, sloping, or other provisions to be made for worker protection from the hazard of caving ground during the excavation, of such trench or trenches. If such plan varies from the shoring system standards established by the Construction Safety Orders of the Division of Industrial Safety, the plan shall be prepared by a registered civil or structural engineer employed by the Contractor, and all costs therefore shall be included in the price named in the Contract for completion of the Work as set forth in the Contract Documents. Nothing in this Section shall be construed to impose tort liability on the City, the Engineer, nor any of their officers, agents, representatives, or employees.

3-02. Substitution of Materials; Assignment of Certain Rights: In accordance with the provisions of Section 3400 of the California Public Contract Code, a Contractor shall be provided a period of not less than 35 days after award of the contract for submission of data substantiating a request for a substitution of "an equal" item.

In accordance with Section 4552 of the Government Code, the Bidder shall conform to the following requirements: In submitting a bid to a public purchasing body, the Bidder offers and agrees that if the bid is accepted, it will assign to the purchasing body all rights, title and interest in and to all causes of action it may have under Section 4 of the Clayton Act (15 U.S.C. Sec. 15) or under the Cartwright Act [Chapter 2 (commencing with Section 16700) of Part 2 of Division 7 of the Business and Professions Code], arising from purchase of goods, materials, or services by the bidder for sale to the purchasing body pursuant to the bid. Such assignment shall be made and become effective at the time the purchasing body tenders final payment to the Bidder.

SECTION 4. LEGAL RELATIONS AND RESPONSIBILITY

4-01. Travel and Subsistence Payments:

(a) As required by Section 1773.1 of the California Labor Code the Contractor shall pay travel and subsistence payments to each worker needed to execute the Work, as such travel and subsistence payments are defined in the applicable collective bargaining agreements filed in accordance with this Section.

(b) To establish such travel and subsistence payments, the representative of any craft, classification, or type of worker needed to execute the contracts shall file with the Department of Industrial Relations fully executed copies of collective bargaining agreements for the particular craft, classification or type of work involved. Such agreements shall be filed within 10 days after their execution and thereafter shall establish such travel and subsistence payments whenever filed 30 days prior to the call for bids.

4-02. State Wage Determination:

(a) As required by Sections 1770 et seq., of the California Labor Code, the Contractor shall pay not less than the prevailing rate of per diem wages as determined by the Director of the California Department of Industrial Relations. Copies of such prevailing rate of per diem wages are on file at the City's Engineering Counter, which copies shall be made available to any interested party on request. The Contractor shall post a copy of such determination at each job site.

(b) As provided in Section 1775 of the California Labor Code, the Contractor shall, as a penalty to the City, forfeit $50.00 for each calendar day, or portion thereof, for each worker paid less than the prevailing rates as determined by the City Engineer for such work or craft in which such worker is employed for any public work done under the contract by it or by any subcontractor under it.

4-03. Payroll Records; Retention; Inspection; Compliance Penalties; Rules and Regulations

(a) As required under the provisions of Section 1776 of the California Labor Code, each Contractor and subcontractor shall keep an accurate payroll record, showing the name, address, social security number, work classification, straight time and overtime hours worked each day and week, and the actual per diem wages paid to each journeyman, apprentice, worker, or other employee employed by him or her in connection with the public work.

(b) The payroll records enumerated in Paragraph 4-03(a), herein, shall be certified and shall be available for inspection at all reasonable hours at the principal office of the Contractor on the following basis:

1. A certified copy of an employee's payroll record shall be made available for inspection or furnished to the employee or his or her authorized representative on request.

2. A certified copy of all payroll records enumerated in Paragraph 4-03(a), herein, shall be made available for inspection or furnished upon request to a representative of the body awarding the contract, the Division of Labor Standards Enforcement, and the Division of Apprenticeship Standards of the Department of Industrial Relations.

3. A certified copy of all payroll records enumerated in Paragraph 4-03(a), herein, shall be made available upon request by the public for inspection or copies thereof made; provided, however, that a request by the public shall be made through either the body awarding the contract, the Division of Apprenticeship Standards, or the Division of labor Standards Enforcement. If the requested payroll records have not been provided pursuant to subparagraph 4-03(b2), herein, the requesting party shall pay the costs of preparation by the Contractor, subcontractors, and the entity through which the request was made. The public shall not be given access to the records at the principal offices of the Contractor.

(c) Each Contractor shall file a certified copy of the records, enumerated in Paragraph 4-03(a) with the entity that requested the records within 10 days after receipt of a written request.

(d) Any copy of records made available for inspection and copies furnished upon request to the public or any public agency by the awarding body, the Division of Apprenticeship Standards, or the Division of Labor Standards Enforcement, shall be marked or obliterated in such a manner as to prevent disclosure of an individual's name, address, and social security number. The name and address of the Contractor awarded the contract or performing the contract shall not be marked or obliterated.

(e) The Contractor shall inform the body awarding the contract of the location of the records enumerated under Paragraph 4-03(a) including the street address, city and county, and shall, within five (5) working days, provide a notice of change of location and address.

(f) In the event of noncompliance with the requirements of this Article, the Contractor shall have ten (10) days in which to comply subsequent to receipt of written notice specifying in what respects the Contractor must comply with this Article. Should noncompliance still be evident after the 10-day period, the Contractor shall, as a penalty to the state or political subdivision on whose behalf the Contract is made or awarded, forfeit $25.00 dollars for each calendar day, or portion thereof, for each worker, until strict compliance is effectuated. Upon the request of the Division of Apprenticeship Standards or the Division of Labor Standards Enforcement, these penalties shall be withheld from progress payments then due. Responsibility for compliance with these Paragraphs 4-03(a) through 4-03(f) lies with the Contractor.

(g) In conformance with State Bill 854 all contractors and subcontractors must furnish electronic certified payroll records directly to the Labor Commissioner (aka Division of Labor Standards Enforcement) as of projects awarded on or after April 1, 2015 unless exempted by federal or state law.

4-04. Apprentices: Attention is directed to Sections 1777.5 and 1777.6 and 1777.7 of the California Labor Code and Title 8, California Administrative Code Section 200 et seq. To insure compliance and complete understanding of the law regarding apprentices, and specifically the required ratio thereunder, the Contractor (and subcontractors) should, where some question exists, contact the Division of Apprenticeship Standards prior to commencement of the work. Responsibility for compliance with this Section 4.04 lies with the Contractor. The City policy is to encourage the employment and training of apprentices on its construction contracts as may be permitted under local apprenticeship standards.

4-05. Working Hours. The Contractor shall comply with all applicable provisions of Section 1810 to 1815, inclusive, of the California Labor Code relating to working hours. The Contractor shall, as a penalty of the City, forfeit $25.00 for each worker employed in the execution of the contract by the Contractor or by any Subcontractor for each calendar day during which such worker is required or permitted to work more than eight (8) hours in any one calendar day and 40 hours in any one calendar week, unless such worker receives compensation for all hours worked in excess of eight (8) hours at not less than 1-1/2 times the basic rate of pay.

4-06. Workers' Compensation:

(a) In accordance with the provisions of Section 1860 of the California Labor Code, the Contractor's attention is directed to the requirement that in accordance with the provisions of Section 3700 of the California Labor Code, every contractor will be required to secure the payment of compensation of his or her employees.

(b) In accordance with the provisions of Section 1861 of the California Labor Code, each Contractor to whom a public works contract is awarded shall sign and file with the awarding body the following certification prior to performing the work of the contract: "I am aware of the provisions of Section 3700 of the Labor Code which require every employer to be insured against liability for worker's compensation or to undertake self-insurance in accordance with the provisions of that code, and I will comply with such provisions before commencing the performance of the work of this contract."

4-07. Prime Contractor Job Site Postings. Pursuant to Labor Code Section 1771.4, Contractor is required to post all job site notices prescribed by law or regulation. The contractor shall comply with all applicable provisions of section 16451 (d) of California Labor Code relating to the posting of job site notices prescribed by regulation.

4-08. Insurance Requirements for Contractors: BIDDER'S ATTENTION IS DIRECTED TO THE INSURANCE REQUIREMENTS BELOW. IT IS HIGHLY RECOMMENDED THAT BIDDERS CONFER WITH THEIR RESPECTIVE INSURANCE CARRIERS OR BROKERS TO DETERMINE IN ADVANCE OF BID SUBMISSION THE AVAILABILITY OF INSURANCE CERTIFICATES AND ENDORSEMENTS AS PRESCRIBED AND PROVIDED HEREIN. IF AN APPARENT LOW BIDDER FAILS TO COMPLY STRICTLY WITH THE INSURANCE REQUIREMENTS, THAT BIDDER MAY BE DISQUALIFIED FROM AWARD OF THE CONTRACT.

Contractor shall procure and maintain for the duration of this contract, including one year maintenance period, contract insurance against claims for injuries to persons or damages to property which may arise from or in connection with the performance of the work hereunder by the Contractor, the Contractor's agents, representatives, employees or subcontractors. The cost of such insurance shall be included in the Contractor's bid.

(a) Minimum Scope of Insurance

Coverage shall be at least as broad as:

1. Insurance Services Office form number CG 00 01 (ED. 1/96) covering Commercial General Liability and name the City as additional insured.

2. Insurance Services Office form number CA 00 01 (Ed. 12/93) covering Automobile Liability, Code 1 "any auto."

3. Workers' Compensation insurance as required by the Labor Code of the State of California and Employers Liability insurance, and an endorsement for waiver of subrogation.

(b) Minimum Limits of Insurance

Contractor shall maintain limits no less than:

1. General Liability: $2,000,000 per occurrence for bodily injury, personal injury and property damage. If Commercial General Liability Insurance or other form with a general aggregate limit is used, either the general aggregate limit shall apply separately to this project/location or the general aggregate limit shall be twice the required occurrence limit.

2. Automobile Liability: $2,000,000 per accident for bodily injury and property damage.

3. Workers' Compensation and Employers Liability: Workers' compensation limits as required by the Labor Code of the State of California and Employers Liability limits of $2,000,000 per accident.

(c) Deductibles and Self-Insured Retentions

Any deductibles or self-insured retentions must be declared to and approved by the City. At the option of the City, either: the insurer shall reduce or eliminate such deductibles or self-insured retentions as respects the City, its officers, officials, employees and volunteers; or the Contractor shall procure a bond guaranteeing payment of losses and related investigations, claim administration and defense expenses.

(d) Other Insurance Provisions

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

1. General Liability and Automobile Liability Coverages

   a. The City, its officers, officials, employees and volunteers are to be covered as additional insureds as respects: liability arising out of activities performed by or on behalf of the Contractor; products and completed operations of the Contractor; premises owned, occupied or used by the Contractor; or automobiles owned, leased, hired or borrowed by the Contractor. The coverage shall contain no special limitations on the scope of protection afforded to the City, its officers, officials, employees or volunteers.

   b. The Contractor's insurance coverage shall be primary insurance as respects the City, its officers, officials, employees and volunteers. Any insurance or self-insurance maintained by the City, its

officers, officials, employees or volunteers shall be excess of the Contractor's insurance and shall not contribute with it.

c. The specific coverage obligations set forth in this Section 4-07 are minimums only, and the Contractor shall have the obligation to provide the minimum coverages stated in these Specifications or such greater or broader coverage, if available in the Contractor's policies.

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

e. The 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.

2. Workers' Compensation and Employers Liability Coverage

The insurer shall agree to waive all rights of subrogation against the City, its officers, officials, employees and volunteers for losses arising from work performed by the Contractor for the Agency.

3. All Coverages

Each insurance policy required by this clause shall be endorsed to state that coverage shall not be suspended, voided, canceled by either party, reduced in coverage or in limits except after thirty (30) days' prior written notice by certified mail, return receipt requested, has been given to the City.

(e) Acceptability of Insurers

Insurance is to be placed with insurers with a Best's rating of no less than A:VII.

(f) Verification of Coverage

The Contractor shall furnish the City with certificates of insurance and with original endorsements effecting coverage required by this clause. The certificates and endorsements for each insurance policy are to be signed by a person authorized by that insurer to bind coverage on its behalf. The certificates and endorsements may be on forms provided by the City. Where by statute, the City's workers' compensation-related forms cannot be used, equivalent forms approved by the Insurance Commissioner are to be substituted. All certificates and endorsements are to be received and approved by the City before work commences. The City reserves the right to require insurance policies, at any time.

(g) Subcontractors

The Contractor shall include all subcontractors as insureds under its policies or shall furnish separate certificates and endorsements for **each subcontractor. All coverages for subcontractors shall be subject** to all of the requirements stated herein.

4-09. Department of Industrial Relations: **This Contract** will be subject to compliance monitoring and enforcement by the California Department of Industrial Relations, pursuant to Labor Code section 1771.4 Attention is directed to Section 1725.5 of the California Labor Code. To insure compliance and complete understanding of the law regarding contractor registration the Contractor (and subcontractors) should, where some question exists, contact the Department of Industrial Relations prior to submission of bid. Responsibility for compliance with this Section lies with the Contractor and Sub contractors.

SECTION 5. PROSECUTION AND PROGRESS

5-01. Removal, Relocation, or Protection of Existing Utilities: In accordance with the provisions of Section 4215 of the California Government Code, the Contractor shall not be assessed liquidated damages for delay in completion of the project, when such delay was caused by the failure of the City or owner of the utility to provide for the removal or relocation of such utility facilities.

5-02. Preconstruction Conference: Following award of contract, submittal of executed contract, and approval of certificates of insurance and bonds, but before start of work, a preconstruction conference shall be held at a mutually agreed time and place. The conference shall be arranged by the City and attended by City representatives including the inspector, and the Contractor, Contractor's superintendent and major subcontractors. Contractor shall present at the conference the progress and submittal schedules, and progress payment format, and provide emergency phone numbers.

The purpose of the conference is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established.

5-03. Beginning of Work: The Contractor shall be prepared to begin work within fifteen (15) calendar days after "Notice to Proceed".

SECTION 6. MEASUREMENT AND PAYMENT

6-01. Payments: Attention is directed to Section 9-1.16, "Partial Payments," and 9-1.17, "Payment After Acceptance," of the State Standard Specifications and these City General Provisions.

As of the 20th day of each month, requests for progress payment listing amount and value of work performed during that month may be submitted for review. Upon review and approval or adjustment by the Engineer, progress payment will be made, retaining five percent (5%) of the amount due. Requests submitted promptly as of the twentieth of the month will be paid normally by the tenth of the following month.

The Bidder's attention is directed to the provisions of Section 9 of the Standard Specifications and the following modification, all of which are applicable to this Contract:

Upon receipt of written notice that the work is ready for final inspection and acceptance, the Engineer shall, within five (5) days, make such inspection, and when the Engineer finds the work acceptable under the Contract and the Contract fully performed, the Engineer will recommend to the City Council (at the next following Council meeting) that the Contract be accepted and a "Notice of Completion" be prepared and recorded. The entire balance found to be due the Contractor, including the retained percentage, shall be paid to the Contractor by the City within fifteen (15) days after the expiration of thirty (30) days following the date of recordation of the Notice of Completion.

The Contractor shall supply with each progress payment request (with the exception of the first progress payment submittal) an email, fax or letter from each subcontractor stating: (a) the date that he/she has received his/her portion of the preceding payment; and (b) if the payment received was the total amount then due. Should the payment not include the total amount invoiced due to a dispute, the subcontractor shall include the details of such dispute in his/her letter with enough information for the City to verify that the provisions of Section 7108.5 of the CA Business and Professions Code have been met.

Before the final payment is due, the Contractor shall submit evidence satisfactory to the Engineer that all payrolls, material bills, and other indebtedness connected with the work have been paid, except that in case of disputed indebtedness or liens, the Contractor may submit in lieu of evidence of payment, a surety bond satisfactory to the City guaranteeing payment of all such disputed amounts when adjudicated in cases where such payment has not already been guaranteed by surety bond.

6-02. Substitution of Securities in Lieu of Retention: Pursuant to Section 22300 of the Public Contract Code, the Contractor may substitute securities for any money held by the City to insure performance of the contract. At the request and expense of the Contractor, securities equivalent to the amount withheld shall be deposited with the City or federally-chartered banks as an escrow agent, who shall return such securities to the Contractor upon satisfactory completion of the contract. Deposit of securities with an escrow agent shall be subject to written agreement in accordance with the provisions of Section 22300. The City shall not certify that the contract has been completed until at least 35 days after filing by the City of a Notice of Completion. Securities shall be limited to those listed in Section 16430 of the California Government Code, bank or savings and loan certificates of deposit, interest bearing demand deposit accounts, standby letters of credit, or any other security mutually agreed upon by the Contractor and the City.

SECTION 7. DISPUTE RESOLUTION

7-01. Claims. This Section applies to and provides the exclusive procedures for any Claim arising from or related to the Contract or performance of the Work.

(A) *Definition.* "Claim" means a separate demand by Contractor, submitted in writing by registered or certified mail with return receipt requested, for change in the Contract Time, including a time extension or relief from liquidated damages, or a change in the Contract Price, that has previously been submitted to City as a Change Order in accordance with the requirements of the Contract Documents, and which has been rejected or disputed by City, in whole or in part.

(B) *Limitations.* A Claim may only include the portion of a previously rejected demand that remains in dispute between Contractor and City. With the exception of any dispute regarding the amount of money actually paid to Contractor as Final Payment, Contractor is not entitled to submit a Claim demanding a change in the Contract Time or the Contract Price, which has not previously been submitted to City in full compliance with this Section, and subsequently rejected in whole or in part by City.

(C) *Scope of Section.* This Section is intended to provide the exclusive procedures for submission and resolution of Claims of any amount, and applies in addition to the provisions of Public Contract Code Section 9204 and Sections 20104 et seq., which are incorporated by reference herein.

(D) *No Work Delay.* Notwithstanding the submission of a Claim or any other dispute between the parties related to the Project or the Contract Documents, Contractor must perform the Work and may not delay or cease Work pending resolution of the Claim or other dispute, but must continue to diligently prosecute the performance and timely completion of the Work, including the Work pertaining to the Claim or other dispute.

7-02. Claims Submission. The following requirements apply to any Claim subject to this Section:

(A) *Substantiation.* The Claim must be submitted to City in writing, clearly identified as a "Claim" submitted pursuant to this Section 7, and must include all of the documents necessary to substantiate the Claim including the Change Order request that was rejected in whole or in part, and a copy of City's written rejection that is in dispute. The Claim must clearly identify and describe the dispute, including relevant references to applicable portions of the Contract Documents, and a chronology of relevant events. Any Claim for additional payment must include a complete, itemized breakdown of all labor, materials, taxes, insurance, and subcontract, or other costs. Substantiating documentation such as payroll records, receipts, invoices, or the like, must be submitted in support of each claimed cost. Any Claim for an extension of time or delay costs must be substantiated with schedule analysis and narrative depicting and explaining claimed time impacts.

(B) *Claim Format.* A Claim must be submitted in the following format:

(1) General introduction, specifically identifying the submission as a "Claim" submitted under this Section 7.

(2) Relevant background information, including identification of the specific demand at issue, and the date of City's rejection of that demand.

(3) Detailed explanation of the issue(s) in dispute. For multiple issues, separately number and identify each issue and include the following for each separate issue:

(a) The background of the issue, including references to relevant provisions of the Contract Documents;

(b) A succinct statement of the matter in dispute, including Contractor's position and the basis for that position;

(c) A chronology of relevant events;

(d) The identification and attachment of all supporting documents (see subsection (A), above, on Substantiation); and

(e) Use of a separate page for each issue.

(4) Summary of issues and damages.

(5) The following certification, executed by the Contractor's authorized representative:

"The undersigned Contractor certifies under penalty of perjury that its statements and representations in this Claim are true and correct. Contractor warrants that this Claim is comprehensive and complete as to the matters in dispute, and agrees that any costs, expenses, or delay claim not included herein are deemed waived. Contractor understands that submission of a Claim which has no basis in fact or which Contractor knows to be false may violate the False Claims Act (Government Code Section 12650 et seq.)."

(C) *Submission Deadlines.*

(1) A Claim must be submitted within 15 days of the date that City notified the Contractor in writing that a request for a change in the Contract Time or Contract Price has been rejected in whole or in part.

(2) With the exception of any dispute regarding the amount of Final Payment, any Claim must be filed on or before the date of Final Payment, or will be deemed waived.

(3) A Claim disputing the amount of Final Payment must be submitted within 15 days of the effective date of Final Payment.

(4) Strict compliance with these Claim submission deadlines is necessary to ensure that any dispute may be mitigated as soon as possible, and to facilitate cost-efficient administration of the Project. *Any Claim that is not submitted within the specified deadlines will be deemed waived by the Contractor.*

7-03. City's Response. City will respond within 45 days of receipt of the Claim with a written statement identifying which portion(s) of the Claim are disputed, unless the 45-day period is extended by mutual agreement of City and the Contractor or as otherwise allowed under Public Contract Code section 9204. However, if City determines that the Claim is not adequately documented, City may first request in writing, within 30 days of receipt of the Claim, any additional documentation supporting the Claim or relating to defenses to the Claim that City may have against the Claim. If the Contractor fails to submit the additional documentation to City within 15 days of receipt of City's request, the Claim will be deemed waived.

(A) *Additional Information.* If additional information is thereafter required, it may be requested and provided upon mutual agreement of City and Contractor.

(B) *Non-Waiver.* Any failure by City to respond within the times specified above may not be construed as acceptance of the Claim in whole or in part, or as a waiver of any provision of these Contract Documents.

7-04. Meet and Confer. If the Contractor disputes City's written response, or City fails to respond within 45 days of receipt of the Claim with, the Contractor may notify City of the dispute in writing of the sent by registered or certified mail, return receipt requested, and demand an informal conference to meet and confer for settlement of the issues in dispute. If the Contractor fails to dispute City's response in writing within the specified time, the Contractor's Claim will be deemed waived.

(A) *Schedule Meet and Confer.* Upon receipt of the demand to meet and confer, City will schedule the meet and confer conference to be held within 30 days, or later if needed to ensure the mutual availability of each of the individuals that each party requires to represent its interests at the meet and confer conference.

(B) *Location for Meet and Confer.* The meet and confer conference will be scheduled at a location at or near City's principal office.

(C) *Written Statement After Meet and Confer.* Within ten working days after the meet and confer has concluded, City will issue a written statement identifying which portion(s) of the Claim remain in dispute, if any.

(D) *Submission to Mediation.* If the Claim or any portion remains in dispute following the meet and confer conference, within ten working days after the City issues the written statement identifying any portion(s) of the Claim remaining in

dispute, the disputed portion(s) will be submitted for mediation, as set forth below.

7-05. Mediation and Government Code Claims.

(A) *Mediation.* Within ten working days after the City issues the written statement identifying any portion(s) of the Claim remaining in dispute following the meet and confer, City and Contractor will mutually agree to a mediator, as provided under Public Contract Code section 9204. Mediation will be scheduled to ensure the mutual availability of the selected mediator and all of the individuals that each party requires to represent its interests. The parties will share the costs of mediation equally, except costs incurred by each party for its representation by legal counsel or any other consultants.

(B) *Government Code Claims*.

(1) Timely presentment of a Government Code Claim is a condition precedent to filing any legal action based on or arising from the Contract.

(2) The time for filing a Government Code Claim will be tolled from the time the Contractor submits its written Claim until the time that Claim is denied in whole or in part at the conclusion of the meet and confer process, including any period of time used by the meet and confer process. However, if the Claim is submitted to mediation, the time for filing a Government Code Claim will be tolled until conclusion of the mediation, including any continuations, if the Claim is not fully resolved by mutual agreement of the parties during the mediation or any continuation of the mediation.

7-06. Tort Claims. This Section does not apply to tort claims and nothing in this Section is intended nor will be construed to change the time periods for filing tort-based Government Code Claims.

7-07. Arbitration. It is expressly agreed, under California Code of Civil Procedure Section 1296, that in any arbitration to resolve a dispute relating to this Contract, the arbitrator's award must be supported by law and substantial evidence.

7-08. Damages. The Contractor bears the burden of proving entitlement to and the amount of any claimed damages. The Contractor is not entitled to damages calculated on a total cost basis, but must prove actual damages. The Contractor is not entitled to recovery of any alleged home office overhead. The Eichleay Formula or similar formula may not be used for any recovery under the Contract. The Contractor is not entitled to consequential damages, including home office overhead or any form of overhead not directly incurred at the Worksite; lost profits; loss of productivity; lost opportunity to work on other projects; diminished bonding capacity; increased cost of financing for the Project; extended capital costs; non-availability of labor, material or equipment due to delays; or any other indirect loss arising from the Contract.

7-09. Multiple Claims. In the interest of efficiency, City, acting in its sole discretion, may elect to process multiple Claims concurrently, in which case the applicable procedures above will be based on the total amount of such Claims rather than the amount of each individual Claim. Any such election will not operate to change or waive any other requirements of this Section.

7-10. Other Disputes. The procedures in this Section 7 will apply to any and all disputes or legal actions, in addition to Claims, arising from or related to this Contract, unless and only to the extent that compliance with a procedural requirement is expressly and specifically waived by City.

THIS PAGE LEFT INTENTIONALLY BLANK

ATTENTION BIDDERS:

Your bid shall represent the cost of performing all Work described in the Contract Documents including:

Special Provisions and Project Plans,
City Standard Specifications and Details,
State Standard Specifications and Plans, and
all Addenda and Change Orders.

CITY STANDARD SPECIFICATIONS AND DETAILS **(Approved November 2016)** is a separate document that is available at the City of Pleasanton Engineering Division, Civic Center 200 Old Bernal Avenue (physical location) or P.O. Box 520 (mailing address) for a non-refundable cost of $20.

Call (925) 931-5650 to request a copy of the *City Standard Specifications and Details.*

The City Standard Specifications and Details can be viewed online at the City's Web Page, http://www.cityofpleasantonca.gov/ (Select: Government, Departments, Engineering, Standard Specifications & Details)

SPECIAL PROVISIONS

(These Special Provisions are to be used in conjunction with
the City Standard Specifications and Standard Details, and
the State Standard Specifications and Standard Plans)

All work shall be constructed in accordance with the City of Pleasanton Standard Specifications and Details dated November 2016, and as augmented by these Special Provisions. The Sections noted are those in the Standard Specifications except for the new Section(s) added. Where conflict exists between these documents and existing conditions, request clarification from the Project Engineer.

Good Neighbor Letter and/or Door Knocker

Attached and made part of these special provisions is a sample of a "Good Neighbor Letter," informing the public of upcoming construction activity. The letters are required, a minimum of 48 hours before work and within a 250-foot radius of the upcoming work locations. The contractor is required to submit the draft letters to the City for review and approval prior to the start of any work. The Contractor shall also confirm in writing and with detail that letters have been sent by indicating on a map the location of distribution with addresses of mail destinations, accompanied by a copy of the typical letters sent.

Similarly, a door knocker can also be used in addition to a good neighbor letter at the discretion of the Engineer. A door knocker shall be distributed a minimum of 48 hours in advance of an upcoming work and shall be distributed within 250 feet on either side of a work location. The contractor is required to submit a draft of the door knocker to the City for review and approval prior to their distribution and start of any work.

The letters and door knockers are to be distributed to all entities, businesses and residents that are directly impacted when access to their property may be impeded, and may also include other areas affected which is not restricted to the project's limit of work.

(SAMPLE LETTER ON FOLLOWING PAGE)

REQUIRED GOOD NEIGHBOR LETTER (48 HRS Notice)

On Contractor's Letterhead

Date:____/____/____

RE: City Project Name and CIP No._____

Dear Resident:

Please be advised that construction activity will be taking place for the Sewer Station S-14 Electrical Improvements, CIP No. 24265.

Work will begin at [(Time of Day: _____) on (Day of week: _____), (Date,___/___/___)]. It is anticipated that this work will be completed by (Time of Day: _____) on (Day of week: _____), (Date,___/__/___), weather permitting. The work will take place Monday thru Friday from XX to XX.

During this time period you may have limited access to your driveway while work occurs in front of your business.

If you have questions, please feel free to contact Mr./Ms. _____ who is our construction superintendent on this project at ____ - _____. Also, you may contact the City's Inspector (Inspector assigned to project: Mr./Ms. _____ directly at 925-___-____).

Sincerely,

_____
Contractor Name

Attachment(s): None/List of affected streets
Sincerely,

_____
Contractor Name

1-20 Permits and Licenses

Replace the section entirely as follows:

Contractor shall be responsible for obtaining and paying for all necessary permits, including all required City permits. The Contractor and all subcontractors shall also be required to obtain City of Pleasanton Business Licenses. Prior to the start of any work for this project, the contractor shall apply for and obtain a "no fee" encroachment permit from the City of Pleasanton's Public Works Engineering Division, at 200 Old Bernal, Pleasanton, CA.

Contractor shall be responsible for proper disposal of waste generated from the construction site, including permit/disposal fees.

The Contractor shall submit copies of all permits to the Engineer prior to the start of work.

Full compensation for conforming to the provisions herein, including but not limited to the City Business License fee, permit, etc., shall be considered as included in the contract prices paid for the various contract items of work and no separate payment shall be allowed therefor.

1-33 Measurement and Payment

Replace the section entirely as follows:

Measurement and payment for bid items are described in this section. Full compensation for Work not appearing as a specific bid item but required by the Contract Documents shall be considered as included in the contract unit price paid for the various items of work and no additional compensation will, therefore, be allowed. Measurement and payment descriptions within the various sections of the City Standard Specifications for the various items of work shall not apply. Caltrans Standard Specifications 2023 shall be the reference document for further clarification on measure and pay and additional work, including specified markups associated with work completed under Time and Material Basis.

1-33A Bid Item Measurement and Payment Descriptions

Furnishing all labor, supervision, materials, tools, equipment, and incidentals for the following work shall be considered as included in the various bid items, and no additional compensation will be made therefore:

Bid Item No. 1, Installation of All Items as per Contract Drawings and Specifications

The contract lump sum (LS) price paid for bid item #1, shall include full compensation for furnishing all labor, supervision, mobilization, materials, tools, equipment, and incidentals and for doing all work involved in developing and

implementing the Traffic Control Plan, Water Pollution Control Plan/BMP, demolition and disposal of an existing equipment vault, connecting to existing meter/main disconnect, installation of above ground Machine Control Center (MCC) and SCADA integration, installation of Automatic Transfer Switch (ATS) and generator connection panel, installation of conduit and wiring, flowmeter, sump pumps, temporary bypass flow as required during schedule outage, site grading, concrete pad, bypass power connection and operational maintenance of existing pump station motor controls and control system until station is fully transferred to new system, operational testing, start-up and commissioning as shown on the plans, as specified in the Technical and Standard Specifications and these Special Provisions, and as directed by the Engineer.

Add new section as follows:

1-35.1 General Requirements and Constraints on Work and Scheduling of Work

A. Upon Contract award by the City Council and after the fully executed contract, within 21 calendar days contractor shall be required to submit shop drawings of long lead items, including the MCC and necessary appurtenances. Notice to Release of Design and Procure Material and Equipment will be issued by the city within 3 days of shop drawings approval. The Notice to Procced will start the working days and will be set upon an agreed date when delivery of the long lead items is confirmed by the written statement of vendor/supplier.

B. Site access (key for vault and wet well, electrical panel) for Contractor's use will be provided by the City at the beginning of the construction.

C. General requirements and constraints on Work:
   1. The S-14 sewer facility is critical to the City for public service.
   2. Implement necessary work zone safety measures.

1-35.2 Shutdown and Construction Constraints

The following constraints shall be observed while working in and around the S-14 Sewer Lift Station.

a. The working hours during construction are from 8:00 a.m. to 5:00 p.m., Monday through Friday, unless stated otherwise.
b. The S-14 sewer lift station is an active sewer conveyance facility and is critical for the City.
c. Conduct work such that the City's ability to pump sewage is not impaired throughout construction.
d. Conduct commissioning activities as specified in plans and specification. Commission in a manner that will not impair capabilities of essential elements of S-14 Sewer Lift Station throughout the Contract time.

e. Working within the lift station's wet well and dry wells requires a confined space entry. Contractor shall comply with all pertinent regulatory requirements as such for confined space entry, including OSHA. Contractor shall provide all required safety plans for entry and emergency extractions and meet the requirements identified herein.

f. The lift station may be taken out of service for the duration of wet well refilling period which is approximately 1 - 2 hours per outage. Brief outages are allowed only between 10:00 a.m. and 2:00 p.m. Longer outages (more than 4 hours) may be accommodated by Contractor request and City approval. Contractor will be responsible for bypassing wetwell flow. When the contractor is bypassing wet well flow for an extended period, they will provide automatic float controls.

g. Longer outages (more than 4 hours) will require the Contractor to submit a request for outage, obtain City approval, and furnish and operate a generator to power the pump controls and instrumentation to assure that wet well level and alarms remain intact and within operable range during the outage.

1-35.3 Safety Plans Requirements

Within 15 calendar days of Notice to Proceed, the Contractor shall submit a site safety plan with the fundamental purpose to protect all personnel (City, public and Contractor).

1-36 Schedule of Values

Contractor shall prepare schedule of values identifying costs of major items of works and subcontracted items. Schedule of values shall include all quantities and prices of items which when added together equal the contract price and subdivides the work into component parts in sufficient detail to serve as the basis for progress payments during performance of the work. Such prices will include an appropriate amount of overhead and profit applicable to each item of the work. The schedule of values shall be submitted to City for review and approval prior to contractor's first billing. Contractor shall submit corrected schedule of values within 10 days upon receipt of reviewed Schedule of Values, but no later than 10 days prior to anticipated submittal of first application for payment. When the schedule is changed or revised to include added or deleted work, the schedule of values shall also be revised such that the sum total of all cost loaded activities continuously equal the current contract value.

1-37 Record Drawings Information

The existing record drawings information for S-14 is available for digital download only. Record drawings information can be accessed via City website and/or bidnetdirect.

https://www.cityofpleasantonca.gov/business/bids.asp

1-38 Recycled Water

The City of Pleasanton requires the use of recycled water for all applicable construction activities.

Recycled water is available within the City of Pleasanton and accessed through a recycled water fire hydrant. The Contractor shall complete and submit the City of Pleasanton Water Meter Activity Form, which includes the Terms and Conditions for Commercial Recycled Water Use and copy of recycled water use train certificate if Contractor has not already obtained one.

SECTION 2. TRAFFIC CONTROL

2-01A Public Convenience and Safety

Add:

Upon completion of each day's work, the contractor shall be responsible for leaving the work area free of hazards and shall provide all necessary temporary signs, warning devices, plating of trenches and barricades at no additional cost to the city. Access is to be provided for all adjacent businesses/residents at all times including non-construction hours. Maintain access for pedestrian and disabled persons at all times including non-construction hours.

2-01C Haul Routes

Replace with:

The construction haul route shall be I-680 to Bernal Avenue to Site or I-680 to Sunol Boulevard to to Site.

SECTION 3. CLEARING AND GRUBBING

Add new section as follows:

3-03J Temporary Fencing

Temporary 6-foot fences shall be furnished, constructed, and maintained around the perimeter of the on and/or off-site storage area(s) and laydown yard(s). Screened fencing shall be used around the storage areas. Fencing shall be located on hardscape services where possible. If vegetation is damaged it shall be replaced by sod by the Contractor, or as directed by the Engineer, at no additional cost to the City.

SECTION 19. IRRIGATION

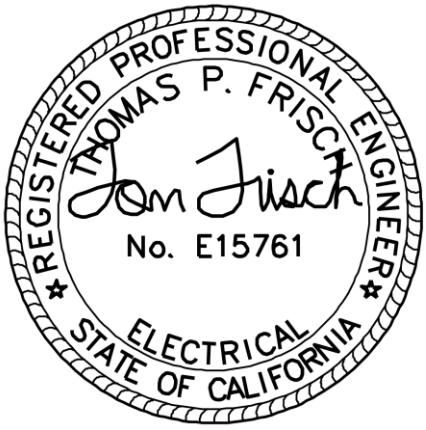
19-01D Damage to Property

Add:

Damage to the adjacent fence and the other facility caused by the construction activities shall be the responsibility of the Contractor. The Contractor shall repair or replace to match or better that are damaged during construction or by Contractor activities. The City shall inspect all restoration work prior to covering it with soil and prior to planting and laying sod, which shall not be initiated until the irrigation system, fencing restoration work is approved.

PAGE INTENTIONALLY BLANK

The special provisions contained herein have been prepared by or under the direction of the following Registered Persons.



SECTION 16010 – ELECTRICAL GENERAL

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The following list of components and areas of work is a summary of the work required in the electrical and controls portion of the Drawings and Specifications. The list is not comprehensive of the total work required nor is it in any specific order. It is merely being provided as an aid to the bidder. Work not listed herein, but described in the plans or Specifications, is also part of the overall scope of work.

1. Demolition of existing equipment vault. Includes:
   a. Vault lid, vault walls to 2 ft below grade.
   b. Electrical equipment conduit and wire.
   c. Sump pump and piping.
   d. Ventilation equipment, conduit and wire.
2. Existing Utility metering panel:
   a. Consists of Utility Metering with Main Disconnect.
   b. Plug unused conduit holes from previous installations.
   c. Provide temporary cable connection to existing temporary motor control panel.
3. Motor Controls:
   a. Pump control panels with solid state starters.
   b. Systems Integrator to design, furnish, assemble, wire, test, and complete all test forms pertaining to motor controls as part of their scope of work.
4. Control panel(s):
   a. Systems Integrator to detail design, furnish, assemble, wire, test, and complete all test forms pertaining to control panels as part of their scope of work.
   b. System Integrator shall remove and transmit PLC and Operator Interface to Application Programmer upon conclusion of factory testing. Purpose is for Application Programmer to complete PLC and OI programming and bench testing.
   c. Application programmer will return the PLC and OI to the System Integrator for insertion into the control panel at the beginning of Field Testing. Contractor shall re-install the PLC and OI into the Control Panel.
   d. System Integrator to perform factory and field testing as required for this project. Instrumentation calibrations and I/O checkout must be complete prior to Operational Testing.

e. System Integrator to coordinate, configure, and place communications system(s) into operation during pre-operational testing of system hardware.

5. PLC, OI, and SCADA Applications Programming:
   a. Configuration and Programming of the Programmable Logic Controller (PLC), and Operator Interface (OI), and SCADA System is by Application Programmer. Application programmer is defined in this specification section [Qualifications].
   b. Application Programmer work is limited to programming and testing (labor only) of the PLC, OI, and SCADA. All other material, assembly, and installation is by Contractor.
   c. Pre-energization and pre-operational testing must be complete prior to Application Programmer arrival for start-up services. Instrumentation calibrations and I/O checkout must be complete.
   d. Application Programmer will be available to startup systems as they become available. The Contractor shall notify the Application programmer of start-up and testing dates 2 weeks minimum in advance of requirement.
6. Instrumentation
   a. Systems Integrator to design, furnish, assemble, wire, test, and complete test forms pertaining to instrumentation as part of their scope of work.
   b. Furnish NSF/ANSI 61 certified products that have undergone testing for any device, valve, instrument, or assembly that will come into contact with drinking water.
   c. Furnish mounting supports or other accessories as detailed and as recommended by the instrument manufacturer for the application.
7. Conduit, junction boxes, pull boxes, wire, and grounding system, for equipment interconnection, and operation.
   a. Contractor to perform termination of all field wiring and internal wiring for equipment that required dis-assembly for shipping.
   b. Contractor to label conduits, wire, and equipment per specifications.
8. Furnish and install process piping, shut off, sample and calibration valves, drains, pressure reducers and calibration equipment for connection of instrumentation as defined in manufacturer installation instructions or as indicated.
9. Trenching, backfilling, compaction and resurfacing for all new underground conduit routes, concrete pads, and pull boxes.
10. Coordination and equipment for connection of power utility and telephone services per utility Drawings and standards.
11. Site electrical devices, lights and receptacles.
12. Seismic Anchorage Design Calculations and conforming installation.

13. System startup, calibration, testing and documentation.

B. Electro-mechanical equipment to be installed in this project may be specified in other divisions but will interface to equipment provided under Electrical Specifications. Obtain submittals for those devices, review, coordinate and provide all interfacing equipment, software, communications, I/O, and testing to integrate the equipment to the extent possible and as intended.

C. Install electrical and control portion of electro-mechanical equipment specified in other sections. Reference those Specifications, pertinent details, and follow all manufacturer instructions to erect, install and commission equipment. Furnish all electrical equipment, interconnecting wire, and make connections to place equipment in operation.

D. All electrical equipment and materials, and methods - including installation, calibration, and testing - shall conform to the applicable codes and standards listed in this and other Sections. All electrical materials and work shall conform to published standards of the National Electric Code (NEC) current issue, Institute of Electrical and Electronic Engineers (IEEE), and Underwriters Laboratories Inc (UL).

1.02 RELATED SPECIFICATIONS

A. The following specification sections are part of the [Electrical Specifications].

Section	Description
16110	Conduit and Boxes
16120	Low Voltage Wire and Data Cable
16250	Automatic Transfer Switch
16450	Grounding
16600	Factory and Field Testing
16905	Control Panels
16910	PLC & OI Hardware
16915	PLC & OI Applications Programming
16940	Instrumentation

B. Owner, Engineer, Construction Manager, and City are used within Electrical Specifications and are interchangeable. They are all representatives of the Owner, in this case, the City of Pleasanton.

1.03 QUALIFICATIONS AND REQUIRED WORK SCOPE

A. Electrical Contractor / Certified Electrician

1. Management and installation of the entire electrical and control system required for this project shall be by an Electrical Contractor or Certified Electrician (EC/CE) meeting qualifications as defined herein.
2. EC/CE shall select, furnish, and install all commodity electrical materials (conduit, wire, supports, fittings, ductbanks, etc) that are generally not "custom" or uniquely manufactured for this project. Custom electrical panels, controls, and instrumentation shall be furnished by Systems Integrator but installed by EC/CE.
3. The EC/CE shall meet the following minimum qualifications:
    a. Has a current C10 Electrical Contractor's License and/or project Foreman who is a Californina Certified Electrician issued by the State of California Department of Industrial Relations.
    b. EC/CE shall comply with State law which requires that all personnel installing electrical components are certified by the State of California as "Electrician" or "Electrician Trainee." Trainees may install electrical components only under direct supervision of a certified Electrician.
    c. EC/CE shall have sufficient qualified personnel to staff the project and meet the construction schedule as defined by the Contract requirements or as approved during the submittal process.
    d. EC/CE shall be regularly engaged in similar industrial power and controls electrical work.
    e. EC/CE shall have successfully performed work of similar or greater complexity (as measured in contract value on industrial power and controls projects) on at least three (3) previous projects.
    f. EC/CE must be competent in performance, supervision and coordination of work required and performed by equipment suppliers or other specialty subcontractors.
    g. EC/CE shall be capable of looking at electrical equipment submittals, prior to installation, comparing hookup requirements to the Drawings, and notifying Engineer of any deficiencies.
    h. EC/CE shall be competent in methods and materials execution and selection associated in the type of electrical and instrumentation work indicated in Drawings and specified in this Division.
    i. EC/CE shall be familiar with and understand codes and requirements from NFPA70, NFPA110, and all other governing national or local codes.
    j. EC/CE shall know and understand common terms and abbreviations used in this Industry. Not all terms and abbreviations will be defined in the Drawings and Specifications.
4. If the EC/CE does not meet the qualifications, the EC/CE may be stopped from doing further work, rejected, removed, and/or required to meet qualifications prior to the resumption of work.

B. System Integrator

1. Systems Integrator shall be a supplier to the Electrical Contractor or Certified Electrician and must be competent in performance, supervision and coordination of work required in this contract.
2. This includes, but is not limited to, all work necessary to select, furnish, construct, supervise installation, configure, calibrate, test, and place into operation all transmitters, instruments, programmable controllers, control panels, motor controls, alarm equipment, communications, monitoring equipment, and accessories.
3. The System Integrator shall have on staff a Project Engineer with three years prior experience on similar sized projects. This Project Engineer shall coordinate the technical aspects of this project and prepare the submittals and drawings. The Project Engineer shall attend coordination meetings when specifically requested by the Engineer.
4. The System Integrator (SI) shall meet the following minimum qualifications:
    a. SI shall be regularly engaged providing electrical and control systems for industrial projects.
    b. SI shall have an Electrical Engineer on staff registered in the State of California as a Professional Engineer.
    c. SI shall be capable of labeling all electrical panels as manufactured or customized by the System Integrator with appropriate Underwriters Laboratories (UL) label prior to factory testing or shipment to project site.
    d. SI shall have successfully completed work of similar or greater complexity and on similar facilities on at least ten previous projects under the present company name.
    e. SI shall be actively engaged in the following disciplines for the last 5 consecutive years.
        1) Design and manufacturing of custom Control Panels, Motor Controls, and associated devices and equipment as specified in this division.
        2) Programming and commissioning of SCADA, PLC and Operator Interface hardware.
        3) Instrumentation - selection, purchase, calibration, start-up and commissioning.
        4) Testing, calibration, start-up, and commissioning of control systems.
    f. SI shall have a permanent, fully staffed and equipped service facility within 200 miles of the project site for a minimum of 1 year prior to bid date with personnel and equipment required to maintain, repair and calibrate the instrumentation system.
5. The Companies listed below have been determined to meet minimum qualifications specified in this section for providing services as System

Integrators on the project. Other System Integrators that wish to be added to the list shall submit a statement of qualifications to Owner/Engineer, no later than two weeks prior to bid opening. The statement of qualifications shall list relevant experience and address each item of the experience qualifications as listed above. The Owner/Engineer may list any additional System Integrators qualified during the bid period in an addendum prior to bid opening.

a.	Tesco Controls, Inc.	(916) 395-8800
b.	Primex Control Systems	(707) 449-0341
c.	Telstar, Inc.	(925) 671-2888
d.	Aqua Sierra Controls	(530) 823-3241
e.	Technical Systems, Inc (TSI)	(707) 678-4444
f.	WM Lyles Company SI division	(530) 499 4305

C. Application Programmer

1. The Applications Programmer will be a part of the Construction Management team and their work is not in contract.
2. The Application Programmer work is limited to programming and configuration, and associated startup and testing services of the PLC, Operator Interface, and SCADA. All other work is by Contractor.

1.04 CONTRACT DOCUMENTS

A. The resolution of conflicting information within the contract electrical documents shall put precedence on electrical Drawings over that of electrical Specifications.

B. The Drawings and Specifications are intended to be descriptive of the type of electrical system to be provided with sufficient detail to construct. Minor omission of detail shall not relieve a qualified contractor from the obligation to provide a complete operational system if it can be determined that the particular detail is usual and customary for similar systems.

C. The following Specifications may incorporate specific equipment or materials that do not have equal equipment listed. These items are standards because of their familiarity, serviceability, and/or spare parts inventory. However, equal alternate equipment or materials (noted in the submittal cover letter) will be considered for use on this project if submitted. The Engineer may reject said equipment for the purpose of adherence to standards.

D. Contract Drawings are diagrammatic and indicate general arrangement of systems and equipment.

1. Exact locations and layouts of electrical products shall be defined during submittal, assembly, or field fit during construction. Field measurements take precedence over dimensioned drawings. Drawing intent is to show

initial size, capacity, approximate location, orientation, and general relationship of equipment in area shown but may not show exact detail or arrangement.

2. However, when materials, locations, sizes, or methods are specifically dimensioned, detailed or noted, the Drawings shall take precedence over electrical Specifications in the event of conflict. In no case, is NEC, UL, or other applicable governing standards to be overridden.

E. The Contractor shall examine the architectural, mechanical, structural, and electrical and instrumentation submittals and equipment furnished under other Specifications divisions in order to determine conduit routing, stub-up locations, and final terminations for all conduits and cables. Conduits shall be stubbed up as near as possible to equipment electrical terminals. The exact locations and routing of cables and conduits shall be governed by structural conditions, physical interferences, and the physical location of wire terminations on equipment.

F. All equipment shall be installed and located so that it can be readily accessed for operation and maintenance. If accessibility appears to be compromised, the location of equipment or stub ups shall be modified to the extent possible.

G. Where conduits are shown on the Drawings, or stated to be furnished but not explicitly shown, as part of the scope of work; the Contractor shall provide all fittings, boxes, wiring, etc. as required for completion of the raceway system in compliance with the NEC and the applicable Specifications in this Section.

H. No changes from the Drawings or Specifications shall be made without written approval of the Engineer. Should there be a need to deviate from the Contract documents, submit written details and reasons for all changes to the Engineer for review.

I. The Contractor shall maintain a neatly and accurately marked full size set of Contract Drawings recording the as built locations and layout of all electrical and instrumentation equipment, routing of raceways, junction and pull boxes, and other diagram or drawing changes. Drawings shall be kept current weekly, with all "change orders", submittal modifications, and construction changes shown. Drawings shall be subject to the inspection by the Engineer at all times, progress payments or portions thereof may be withheld if Drawings are not accurate or current.

J. When documents are changed, they shall be marked with erasable colored pencils or PDF markup tools using the following coloring scheme:

1. Additions - Blue
2. Deletions - red

K. Prior to acceptance of the work, the Contractor shall deliver to the Engineer one set of record full size drawings neatly marked accurately showing the information required above.

1.05 UTILITY COORDINATION AND FEES

A. Not required this project. Existing main circuit breaker to be point of connection.

1.06 PROJECT COORDINATION

A. Prior to submittal, the Electrical Contractor shall coordinate with equipment suppliers to verify sizes, mounting, connections, storage, and delivery of equipment. If there are any issues whereby the solution will be in conflict with plans and Specifications, or that are undefined and need direction, they shall be brought to the attention of the Engineer or Construction Manager via the RFI process.

1.07 SUPERVISION

A. The Contractor shall schedule all activities, manage all technical aspects of the project, coordinate submittals and drawings, and attend all project meetings associated with this Section. The Contractor shall coordinate and confirm that the project schedule is being adhered to and all work is being completed within the scheduled time frames.

B. The Contractor shall supervise all work in this Section, including the electrical system general construction work, from the beginning to completion and final acceptance.

C. The Contractor shall coordinate, obtain, prepare, and/or complete the documentation required within this division. All documentation shall be complete and delivered prior to final acceptance.

1.08 INSPECTIONS

A. General

1. Contract work or materials shall be subject to inspection at any time by the Engineer. If equipment, material, or installation method does not conform to the Contract documents, or does not have a favorably reviewed submittal status and has been determined to be unsatisfactory by the Engineer, then the Contractor shall remove said material from the premises; and if said material has been installed, the entire expense of removing and replacing same, including any cutting and patching that may be necessary, shall be borne by the Contractor.

2. The Engineer may inspect and test the fabricated equipment at the factory before shipment to job site. See Electrical Specifications [Factory and Field Testing] for requirements.
3. Work shall not be closed in or covered over before inspection and approval by the Engineer. All costs associated with uncovering and making repairs where non-inspected work has been performed shall be borne by the Contractor.
4. The Contractor shall cooperate with the Engineer and provide assistance at all times for the inspection of the electrical system under this Contract. The Contractor shall remove covers, provide access, operate equipment, and perform other reasonable work which, in the opinion of the Engineer, will be necessary to determine the quality of the work.

B. Milestones requiring inspection and signoff.
1. Underground conduit and grounding system complete. Do not cover any portion of conduit prior to inspection. Conduits must be labeled with temporary tags per Electrical Specifications [Conduit and Boxes] and [Grounding].
2. Factory testing. Coordinate test date with Engineer 2 weeks prior to test scheduled date.
3. Installation of electrical equipment. Equipment is anchored in place, conduit connections are complete, no wire is yet pulled into conduit. Permanent conduit tags must be in place per Electrical Specifications [Conduit and Boxes] and [Grounding].
4. Wire termination complete. Do not energize equipment. All wire tags must be installed and wires terminated per Electrical Specifications [Low Voltage Wire and Data Cable]. Pre-energization testing to commence after inspection.
5. Testing per Electrical Specifications [Factory and Field Testing]. All testing per Electrical Specifications [Factory and Field Testing] shall be witnessed unless specifically declined by the Engineer. Schedule tests with Engineer 2 weeks prior to test date.
6. Start-up per Electrical Specifications [Factory and Field Testing]. Schedule tests with Engineer 2 weeks prior to test date.
7. Punch list – final inspection. Schedule final walkthrough with Engineer one week prior to intended project completion date. All items on punchlist must be complete prior to scheduling walk-through.

1.09 JOB CONDITIONS

A. Construction Power and Telephone Service
1. The Contractor shall coordinate, furnish and install, temporary utility services required during construction of the project, such as temporary electrical power and telephone service. Temporary services shall be

installed in accordance with the applicable codes and regulations of the serving utilities.

2. Upon completion of the project, remove temporary services. All equipment and material shall be the property of the Contractor.

B. Equipment Storage

1. The Contractor shall provide adequate protection for all equipment and materials during shipment, storage and construction.
2. Equipment and materials shall be completely and sufficiently sealed and covered and set on a pallet above grade so that they are protected from weather, wind, dust, water, or construction operations.
3. Equipment shall not be stored outdoors. Where equipment is stored or installed in an area with susceptibility to moisture, such as unheated buildings, untested piping, etc., provide an acceptable means to prevent moisture damage, such as plastic cover and a uniformly distributed heat source to prevent condensation.

C. The project site is located where outside temperatures vary between 10 deg F. to 110 deg F. Humidity in this area will range from 10% to 100%.

1.10 AREA CLASSIFICATIONS

A. Area classifications are shown on the site electrical plans. The area enclosed by walls or the entire drawing area shall be classified as shown unless otherwise described in notes.

B. All electrical equipment, enclosures, conduit, and supports shall be formally rated for or, at minimum, meet the intent of the rating as interpreted by Engineer.

C. If no area classification rating is shown on the Drawings, classification shall default to a NEMA 12 rating for indoors, and NEMA 4 rating for outdoors (non corrosive) and NEMA 4X for corrosive areas both indoors and outdoors.

1.11 SUBMITTAL REQUIREMENTS

A. General

1. Requirements described herein are specific to electrical submittals and are secondary to those described in other general Specifications sections. Any additional requirements described here that are beyond those described in those sections shall be provided as described. Conflicts shall be resolved by giving priority to general Specifications.
2. The Contractor shall ensure that the System Integrator and/or equipment suppliers provide the submittal documentation required in this section.

Submittals shall be neat, orderly, complete (without un-needed parsing), and indexed.

3. The Contractor shall coordinate submittals with the work so that project will not be delayed. This coordination shall include scheduling the different categories of submittals, so that one will not be delayed for lack of coordination with another. Time extensions will not be allowed due to failure to properly schedule submittals.
4. No material or equipment shall be delivered to the job site until the submittal for such items has been reviewed by the Engineer and marked "no exceptions noted" or "make corrections noted".
5. The equipment Specifications have been prepared on the basis of the equipment first named in the Specifications. The Contractor shall note that the second named equipment, if given, is considered acceptable and equal equipment, but in some cases additional design, options, or modifications may be required to meet Specifications or functional installation.
6. Exceptions to the Specifications or Drawings or equipment or procedures submitted as “equal” to specified equipment shall be clearly identified in a letter at the front of the submittal. Submittal data for “equal” equipment or procedures shall contain sufficient details so a proper evaluation may be made by the Engineer. The Contractor is responsible for verifying proper application/operation of substituted equipment.
7. The opinion of the Engineer will be the final determination whether a substitution request meets the design intent.
8. Deviations from the Contract documents shall not be incorporated into the work without prior written approval of the Engineer. A "Change Order" directive from the Engineer is required prior to incorporating any deviation from the Contract documents that has costs associated. The cost differential associated with this change order must be negotiated with the Owner to amend the Contract to reflect the costs or savings.

B. Submittal Procedures

1. Identify all submittals by submittal number on letter of transmittal. Submittals shall be numbered consecutively and resubmittals shall have a letter suffix. For example:
   a. 1st submittal: 1
   b. 1st resubmittal: 1A
   c. 2nd resubmittal: 1B, etc.
2. Within 30 calendar days after contract award maximum and as the construction schedule dictates, the Contractor shall furnish to the Engineer all submittals (electronic) required for this Division. Interconnection drawings, training documents test procedures, and O&M Manuals as applicable shall be submitted timely as to not delay the project.

a. Submittals shall be delivered entirely electronically via email (no hard copy required). However, General Contractor supervision must not be circumvented by sending submittals direct to Engineer.
b. Electronic Submittals shall be viewable using a PDF reader.
c. Electronic (PDF) submittals must follow all applicable requirements for indexing, bookmarks, highlighting, selection indicators (box, highlight) etc. Use of native PDF files (not scans) are required if one exists on the World Wide Web (WWW).

3. Submittal Preparation
   a. Electronic submittals shall be assembled in accordance with the Specifications with table of contents, bookmarks, tabs, subtabs, etc. utilizing the electronic bookmarks feature available in the PDF assembler. Only one PDF file is allowed for each submittal. Multiple (.PDF) files will not be acceptable.
   b. Use of native PDF files (not scans) are required if one exists on the www. Ignoring this requirement is cause for submittal rejection.
   c. Submittal shall be appropriately labeled with the project name, contract number, equipment supplier's name, specification section(s), and major material contained therein.
   d. An index shall be provided. This index shall itemize the contents of each tab and subtab section.
   e. Field equipment shop documents, panel equipment shop documents, drawings, and bill of materials shall be grouped under separate tabs. Shop documents shall be ordered in the same sequence as their corresponding Contract specification subsection.
   f. All spare parts shall be listed separately at the end of the Bill of Materials list.
   g. Data summary sheets shall be provided for each individual piece of instrumentation. The data summary sheets shall have the following information preceding their corresponding catalog data:
      1) Instrumentation type and tag name.
      2) Location/description.
      3) The manufacturer's model and part number with all options.
      4) Range, span, units, input and output signals.
      5) Description of component.
      6) Contract specification subsection number reference.

4. The reviewed submittals will be annotated "Make Corrections Noted", "No Exceptions Noted", "Revise and Resubmit Noted Items", or "Rejected without Review." The following actions shall then be taken by the Contractor:

a. "No Exceptions Noted" - The Contractor may proceed with the work covered in this submittal. No resubmission is necessary.
b. “Make Corrections Noted” - The Contractor may proceed with the work covered in this submittal incorporating the changes noted. However, the Contractor shall revise the submittal in accord with the changes noted and resubmit six (6) copies of drawings, bill of materials, and catalog data denoting changes within 14 calendar days when requested by the Engineer for record keeping purposes.
c. "Revise and Resubmit Noted Items" - The Contractor shall not proceed with the work covered in this submittal. The Contractor shall revise and correct the submittal in accordance with the comments and resubmit six (6) copies within 14 calendar days for approval.
d. "Rejected without Review" submittal - The Contractor shall not proceed with the work covered in this submittal. The submittal did not address the work scope as defined by the submittal’s title or the previous submittal comments have not been addressed in full. The Contractor shall revise and correct the submittal in accordance with the Specifications, and resubmit six (6) copies within calendar 14 days for approval.

5. Resubmittals shall address all comments by the Engineer. A submittal response letter shall be submitted that addresses each comment by the Engineer with a standardized response of “revised” or with a written explanation. Partial re-submittals (that do not address all comments) may be returned without review at the discretion of the Engineer.
6. The Contractor shall be responsible for the Engineer's review cost for each resubmittal in excess of the second resubmittal. These costs will be back-charged to the Contractor and will be deducted from his progress payments.

C. Certified Electrician qualifications—Provide resume submittal for Electrical project foreman who will be managing the daily work on site. Electrician must meet qualifications as noted in Electrical Specifications, [Qualifications and Required Work Scope].

D. Electrical Equipment -- Submittal data shall be grouped by equipment type. Each submittal shall be as complete as possible covering the entire project and scope of supply. Drawings or equipment submitted individually that are not on the critical path will not be accepted for individual review. The electrical submittals shall include (as a minimum):
1. Table of Contents
2. Comment Letter: The Project Engineer of the System Integrator shall note all deviations from Contract Documents and the reason(s) for the

deviation. They may use this forum to inform the Engineer or installing Contractor of important information related to the project. RFIs must be submitted separately. Re-submittals shall include written responses to every comment provided by the Engineer during the previous review.

3. Bill of Materials: The Contractor and System Integrator each shall provide Bill of Material for electrical components formatted as shown below. Generic names or part numbers as defined by a distributor or Integrator are not acceptable. Only the originating manufacturer's name and part number shall be listed. Provide separate bill of materials for each panel, MCC, instrument list, etc.

Bill of Material

Item #	Qty	Tag#	Description	Manufacturer	Part #

4. Catalog Data shall include the following: (features and options shall be highlighted, circled, or "arrowed.")
   a. Instrumentation data summary sheets (by Contractor)
   b. Manufacturer's technical information brochure
   c. Physical size and mounting details and illustrations
   d. Calibration Range
   e. Input/output signals
   f. Electric power, air, and/or water supply requirements.
   g. Options selected and available (Cross out items not included)
   h. Materials of construction of components

E. Shop Drawings Shop drawings shall be furnished for each electrical panel even if one was not shown explicitly on the Drawings. Shop drawings shall be numbered in sequence. Blank drawings or drawings that contain no specific project data will not be accepted for review.

1. Shop Drawings shall be generated with a computer utilizing AutoCAD or similar drafting program. Drawings shall be no smaller than 11" x 17". The lettering shall be legible and no smaller than 0.75 inch in height.
2. Shop Drawings shall be custom prepared for this project and shall have borders and a title block identifying the project, manufacturer, system or location, drawing number, drawing title, AutoCAD file name, project engineer, date, revisions, and type of drawing. Diagrams shall carry a uniform and coordinated set of wire colors, wire numbers, and terminal block numbers. The shop drawings shall include the following as a minimum:
3. Electrical one-line diagrams detailing all devices associated with the power distribution system. The following applicable information or data shall be shown on the one- or three- line diagram: location, size and

amperage rating of bus; size and amperage rating of wire or cable; breaker ratings, number of poles, and frame sizes; power fail and other protective devices; fuse size and type.

4. Detailed analog and digital I/O diagrams showing the wiring requirements for each instrument or device connection. Reference the Drawings for an example of each I/O card drawing requirements. If one is not included in the Drawings, then one may be obtained from the Engineer upon request.
5. Elementary (wiring) diagrams shall be provided for all relay logic, programmable logic controls, motor controls, power supplies, and other wiring. All elementary (wiring) diagrams shall be drawn in JIC EMP/EGP format and standards showing ladder rung numbers and coil and contact cross referencing numbers.
6. Equipment exterior and interior scaled drawings of front, side, elevation, deadfront, front panel devices, and backpan components. Show fabrication methods and details; including material of construction, paint color, door latch and lock, and ventilation system. Show shipping split locations and offloading information. Submit base plan showing allowed conduit entrance areas and bolt hole locations.
7. Drawings shall show UL required information as needed to UL label the equipment in accordance with UL procedures for label applied.
8. Submit full size drawing of all nameplates and tags, as specified herein, to be used on project. Submittal to include the following:
    a. Dimensions of nameplate.
    b. Exact lettering and font for each nameplate.
    c. Color of nameplate.
    d. Color of lettering.
    e. Materials of construction.
    f. Method and materials for attachment.
    g. Drawing showing location of nameplates on each, panel and enclosure.

F. Seismic Anchor Design Calculations

1. All switchgear, motor controls centers, transformers, cabinets, raceways, supports, and electrical materials shall be so installed as to remain in a secure and captive position when subjected to a horizontal force in accordance with the current, applicable, and more stringent of current California Building Code (CBC) or International Building Code (IBC) requirements. Method of securing shall constrain equipment against both vertical and horizontal forces and overturning forces.
2. Calculations as prepared by a civil engineer registered in the State of California shall be submitted in accordance with current code requirements for earthquakes forces on all specified equipment. Calculations shall include wind loading forces for equipment installed

outdoors. Use seismic and wind factors based on the project location and exposure. The risk Category is IV.

3. Provide a submittal, minimum 3 weeks prior to equipment installation, of calculations, materials needed, and supporting drawings and details for installation by Contractor.

1.12 OPERATING AND MAINTENANCE INFORMATION

A. Operational Training

1. At time of completion, the Contractor shall provide a period of not less than 6 hours training for instruction of operation and maintenance personnel in the use of systems. Instruct all personnel at one time in one session. Make necessary arrangements with manufacturer's representative. Provide product literature and application guides for user's reference during instruction.

B. Operations and Maintenance Manuals

1. Provide Operation and Maintenance manuals per Specifications as described in “Submittal Requirements” in this section with the following additional requirements:
   a. A comprehensive index.
   b. A complete "Record" set of favorably reviewed electrical submittals as provided under subsection “Submittal Requirements” illustrating all components, piping, and electrical connections.
   c. A complete list of the equipment supplied, including serial numbers, ranges, catalog cuts, and pertinent data.
   d. Full Specifications on each item.
   e. Detailed service, maintenance and operation instructions for each item supplied. Schematic diagrams of all electronic devices shall be included. A complete parts list with stock numbers shall be provided for the components that make up the assembly. All of these shall be originals, no copies.
   f. Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.
   g. Shop drawings in native file format and updated to reflect as-built conditions.
   h. Application programs, configurations, calculations, documents or other computer electronic files prepared for this project. Provide all files in native file format such as .dwg, .rss, .xls, .doc, etc.
2. Submit electronic readable PDF file format (email with attachments or download links) of the proposed O&M manuals for review by the

Engineer. Submittals shall be delivered timely to the Engineer to allow for review period, corrections, and re-submissions as necessary.

a. General Contractor supervision must not be circumvented by sending submittals direct to Engineer.

C. At the end of the project hard copy and soft copy electronic PDF files, shall be updated to "as-built" conditions.

PART 2 PRODUCTS

2.01 QUALITY

A. All equipment and materials shall be new, in current production, and the products of reputable suppliers having adequate experience in the manufacture of these particular items. For uniformity, only one manufacturer will be accepted for each type of product.

B. Products specified that have become obsolete (out of current manufacturing, or have been superseded by another product) shall be cross-referenced to a replacement product(s) and provided in lieu of the specified product(s) for no additional cost. Under no conditions, shall products be submitted or furnished that are known (on manufacturer's list of obsolescence) and expected to be removed from current production within 12 months after project submittal. Products found to have been furnished this way will be removed and replaced at Contractor's expense.

C. All equipment shall be designed for the service intended and shall be of rugged construction, of ample strength for all stresses which may occur during fabrication, transportation, erection, and continuous or intermittent operation. All equipment shall be adequately braced and anchored and shall be installed in a neat and workmanlike manner. Appearance and safety, as well as utility, shall be given consideration in the design of details. All components and devices installed shall be standard items of industrial grade, unless otherwise noted, and shall be of sturdy and durable construction suitable for long, trouble free service. Light duty, fragile and competitive grade devices of questionable durability shall not be used.

D. The Contractor should expect that there will be occasional freezing conditions at the project site in outdoor locations. Instrument valves, tubing, instrumentation, and other components which are outdoors and susceptible to damage if frozen, must be provided with internal or external protection. Freeze protection can consist of internal or external active heaters with thermostats and/or passive insulation systems. Active systems can be powered from a nearby receptacle or via the conduit intended for the device.

E. Products that are specified and include a manufacturer, trade name or catalog number are intended to establish a standard of quality, performance, warranty and service. Products that are specified “or equal,” do not prohibit the use of equal products of other manufacturers provided they are submitted, identified and promoted as equal, and favorably reviewed by the Engineer prior to procurement and installation.

F. Products submitted as “equal” to the named products will be reviewed for conformance with the Specifications and in comparison with the first named product. If the equal product meets Specifications, but does not have a feature or performance characteristic that is available with the first named product, and that feature or performance is required for this project, then the submitted equal product may be rejected on those grounds.

G. In the event that some claims of the manufacturer of submitted “equal” product are called into question by the Engineer, the Contractor, may be required to prove those claims either prior to installation or during startup of product. If the product does not meet the claims made or Specifications, the product may be rejected by the Engineer and a replacement product must be submitted by the Contractor in its place. All cost for the rejected product, installation, testing, and removal will be the responsibility of the Contractor.

H. Underwriters Laboratories (UL) listing is required for all substituted equipment when such a listing is available for the first named equipment. Extra parts, labor, panel space, power supplies, circuit breakers, and/or GFIC devices shall be provided as necessary for incorporation of specified non-UL components.

I. When required herein or requested by the Engineer, the Contractor shall submit equipment or material samples for test or evaluation. The samples shall be furnished with information as to their source and prepared in such quantities and sizes as may be required for proper examination and tests, with all freight and charges prepaid. All samples shall be submitted before shipment of the equipment or material to the job site and in ample time to permit the making of proper tests, analyses, examinations, rejections, and resubmissions before incorporated into the work.

2.02 NAMEPLATES & TAGS

A. Equipment exterior nameplates Nameplate material shall be rigid laminated black plastic with beveled edges and white lettering; except for caution, warning, and danger nameplates the color shall be red with white lettering. The size of the nameplate shall be as shown on the Drawings. No letters are allowed smaller than 3/16". All nameplates located outdoors shall be UV resistant. Securely fasten nameplates in place using two stainless steel screws, type 316L, if the nameplate is not an integral part of the device. Epoxy cement or glued on

nameplates will not be acceptable. Engrave the nameplates with the inscriptions as approved by the Engineer in the submittal.

1. For each major piece of electrical equipment provide a manufacturer's nameplate showing the Contract specified name and number designation, and pertinent ratings such as voltage, # of phases, ratings, etc.
2. For each device with a specific identity (pushbutton, indicator, instrument, etc.) mounted on the exterior or deadfront of a piece of equipment provide a nameplate with the inscription as shown on the Drawings and described herein.
3. Where required by code, provide nameplates denoting information required. For example:
    a. Transformers not in sight of disconnect, furnish nameplate denoting location of feeding circuit breaker or disconnect.
    b. Motor controls without door interlock or disconnecting circuit breaker; furnish nameplate denoting location or feeding circuit breaker or disconnect.
4. Where no inscription is indicated on the Drawings or described herein, furnish nameplates with an appropriate inscription providing the name and number of device.
5. Install Safety Signs in accordance with the latest OSHA requirements.
    a. Entrances to electrical rooms and stations: Danger Sign requirements, ELECTRICAL ROOM, HIGH VOLTAGE (define voltage, example 480 VAC) KEEP OUT, AUTHORIZED PERSONNEL ONLY.
    b. Equipment enclosures, cable tray and wireway where 120 VAC or higher and 50 V DC and higher exist: Danger Sign requirements, HIGH VOLTAGE (define voltage, example 480 VAC) AUTHORIZED PERSONNEL ONLY.
    c. Equipment such as motor control centers, control panels, etc., where more than one source may be present in an enclosure or cubicle: Danger Sign requirements, VOLTAGE (define voltage, example 120 VAC control voltage or 480 VAC power) FROM MULTIPLE SOURCES IN THIS ENCLOSURE.
    d. Equipment such as switchboards, switchgear, panelboards and motor control centers: Warning Sign requirements, WARNING, SERVICE ENTRANCE DISCONNECT FOR 1 OF ___ (define quantity) SERVICES TO THIS BUILDING. OTHER SERVICE ENTRANCE DISCONNECTS ARE LOCATED AT (define locations).
6. Caution, warning and danger nameplates shall be red with white lettering

B. Equipment Interior Nameplates Nameplate material shall be clear plastic with black machine printed lettering as produced by a KROY or similar machine; except caution, warning, and danger nameplates shall have red lettering. The size of the nameplate tape shall be no smaller than 1/2” in height with 3/8"

lettering unless otherwise approved by the Engineer. Securely fasten nameplates in place on a clean surface using the adhesion of the tape. For each device with a specific identity (relay, module, power supply, fuse, terminal block, etc.) mounted in the interior of a piece of equipment provide a nameplate with the inscription as shown on the Drawings and described herein. Where no inscription is indicated on the Drawings or described herein, furnish nameplates with an appropriate inscription providing the name and number of device used on the submittal drawings. Stamp the nameplates with the inscriptions as approved by the Engineer in the submittal.

C. Equipment Tags When there is no space or it is impractical to attach an engraved plastic nameplate with screws, as is the case with most field devices and instruments, the Contractor shall attach a tag to the equipment with the same inscriptions as specified above in paragraph A. The tag shall be made from stainless steel material and the size of the nameplate shall be no smaller than 3/8"h x 2"w with 3/16" machine printed or engraved lettering unless otherwise approved by the Engineer. The tag shall be attached to the equipment with stainless steel wire of the type normally used for this purpose.

D. Voltage Monitor Relay (VMR)

1. The voltage monitor relay (VMR) shall continuously monitor the three phases for power loss, low voltage, phase loss, and phase reversal. The VMR shall interface to the control circuit with DPDT contacts rated for 4 Amps at 120 VAC. The VMR shall have a drop out voltage adjustment, time delay adjustment, and status indicating LEDs. Voltage monitor relay shall be Time Mark 2652, or equal.

2.03 MOLDED CASE CIRCUIT BREAKERS

A. General

1. Circuit breakers and motor circuit protectors shall be manufactured by Eaton Cutler-Hammer, Square D, G.E., Siemens, or equal.
2. Circuit breakers shall be the bolt-on type.
3. Multiple pole circuit breakers shall be designed so that an overload on one pole automatically causes all poles to open. The use of tandem or dual circuit breakers in a normal single pole space to provide the number of poles or spaces specified are not acceptable.
4. Molded case circuit breakers shall be operated by a single toggle-type handle and shall have a quick-make, quick-break switching mechanism. An automatic trip of the breaker shall be clearly indicated by the handle position. Contacts shall be non-welding silver alloy and have flash reduction arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.

5. Minimum interrupting capacity:
    a. 480 volt circuit breaker shall have a minimum interrupting capacity of 22,000 amperes or as shown on Drawings.
    b. 120 or 208 or 240 volt breaker shall have a minimum interrupting capacity of 10,000 amperes or as shown on Drawings.
6. Circuit Breakers protecting full voltage or solid state reduced voltage motor starters shall be motor circuit protector (MCP) breakers with adjustable magnetic trip unless otherwise noted on the Drawings.
7. Circuit breakers shall be UL listed for series application.
8. Where indicated circuit breakers shall be current limiting.
9. Where indicated on Drawings, provide UL listed circuit breakers for continuous duty at 100% of their ampere rating in the intended enclosure.
10. Furnish add-on features such as auxiliary position status contacts, trip indication contacts, zone interlocking, shunt trip coils, etc, as shown in the Drawings.

B. Trip Unit – Molded Case Circuit Breakers
1. Circuit Breakers over 400 volt and over 90A trip units as defined herein. All other circuit breakers shall have shall have non-electronic thermal-magnetic (TM) trip units with inverse time-current characteristics.
2. The trip unit shall be Eaton type Power Expert Release (PXR) or equal.
    a. Each circuit breaker trip unit shall have three (3) current sensors, voltage sensors, microprocessor, and flux transfer trip solenoid at minimum.
    b. Trip units shall be continuously self-checking and provide a visual indication that the internal circuitry is being monitored and is fully operational.
    c. Trip units shall be powered from the primary voltage connected to the circuit breaker. Current flow shall not be required for settings functions. Circuit breaker trip units shall be operable and adjustable with zero current flowing through the circuit breaker.
    d. True RMS sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current and voltage sensors, and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time-delay settings are reached.
    e. Trip units shall be provided with a display panel. Trip units shall have an information system that provides LEDs to indicate mode of trip following an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip. A reset button shall be provided to turn off the LED indication after an automatic trip

f. Programming may be done via a keypad at the faceplate of the unit. Programming via the communication network if or as shown in Drawings.
g. The trip unit shall offer a three-event trip log that will store the trip data, and shall time and date stamp the event.
h. The trip unit shall have the following advanced protective features integral to the trip unit:
    1) Adjustable undervoltage release (defeatable)
    2) Adjustable overvoltage release (defeatable)
    3) Reverse power and fault current
    4) Reverse sequence voltage
    5) Under-frequency
    6) Over-frequency
    7) Voltage phase unbalance and phase loss during current detection.
i. Although not preferred but if needed, furnish 24VDC redundant power supply with terminal blocks and 0.5A miniature circuit breakers to distribute control power to each circuit breaker trip unit that requires it for settings. The power supply shall be connected below the main breaker and transfer switch but above any feeder circuit breakers. Provide option for external power supply input.

3. System coordination shall be provided by the following microprocessor-based time-current curve shaping adjustments:
    a. Adjustable long-time setting (set by adjusting the trip setting dial to an amount not to exceed rating plug)
    b. Adjustable short-time setting and delay with selective flat or I2t curve shaping,
    c. Adjustable instantaneous setting
    d. Adjustable ground fault setting and delay with selective flat or I2t curve shaping.
4. The microprocessor-based trip unit shall have both powered and unpowered thermal memory to provide protection against cumulative overheating should a number of overload conditions occur in quick succession.
5. Furnish internal ground fault protection with adjustable settings. Provide neutral ground fault sensor for four-wire loads. Bypass neutral sensor for 3 wire loads.
6. Include ARMS technology for all circuit breakers 400A and above or where shown on Drawings.
    a. Activation and deactivation of the ARMS technology and local indication shall be accessible from the face of the trip unit without opening the circuit breaker door or cover and exposing operators to energized parts.

b. Recalibration or adjustment of trip unit parameters shall not be required when enabling / disabling the ARMS technology.

7. Breakers shall have built-in test points for testing the long-time delay, instantaneous, and ground fault functions of the breaker by means of a test set.

C. Manual operators

1. Furnish door interlocked manual operators for mains and selected feeder circuit breakers as shown in the Drawings.
2. Manually operated mechanisms designed to open, close and reset circuit breakers.
3. Operators shall be available in three basic configurations— flange mounted, through-the door rotating and direct handle through door to provide a variety of options for different applications and enclosure ratings.

2.04 MOTOR CONTROL ACCESSORIES

A. Control Power Transformer:

1. Control power transformer shall be epoxy encapsulated for dust and moisture protection. The internal wiring shall be copper and have 105 deg. C insulation rating. The unit shall feature barriered screw terminals for connection to electrical circuits. Provide with time-delay, slow-blow secondary fuse rated to protect the transformer and interrupt 10,000 amperes at 120VAC. Two primary fuses rated for 480 VAC and AIC as shown in the Drawings shall be provided. Transformer minimum size and voltage ratings shall be as shown on Contract Drawings. Control power transformer shall be Micron Impervitran, Cutler Hammer MTE or equal.

B. Solid State Soft Starter:

1. Each solid state soft starter (SSS) shall be provided as a standalone unit to be incorporated into a control panel. The SSS shall be used for starting motors (voltage and horsepower shown in the Drawings) by limiting the voltage and/or current provided to the motor during starting and stopping operations. The SSS shall use gated power Silicon Controlled Rectifiers (SCRs) during motor starting/stopping and include an integral bypass contactor to bypass the SCRs on all three phases during steady state motor operation. Configuration of the SSS shall be completed by setting rotating dials and dip switches on the face of the unit. Selections for ramp time seconds, current limit percentage, overload amperage, and motor overload curve (Class 10 or Class 20) shall be available. The SSS shall be suitable for operation in temperatures 32°F to 122°F (0°C to 50°C). Provide MOV input protection modules and auxiliary run and

alarm contacts. Control voltage for the starter shall be 120 Vac unless otherwise shown in the Drawings.

2. The SSS shall be an Allen-Bradley SMC-3, Sprecher and Schuh PCS, Schneider Altistart ATS01 (up 32A), or equal.

C. Moisture Over-temp Relay:

1. Provide new MiniCAS-120 relay, no equal. Provide Omron P3GA-11 reverse relay socket no equal.

D. Field Control Station:

1. Enclosures shall be NEMA 4X stainless steel with pre-punched holes as a standard product of the pushbutton/switch manufacturer.
2. Control stations in hazardous locations shall be rated for such duty utilizing enclosures rated for the classification or hermetically sealed switch blocks as appropriate.
3. Boxes shall be mounted with regard for architectural and structural requirements. Field control station shall be mounted at 48" height unless otherwise noted.
4. Box dimensions shall be in accordance with size, quantity of conductors, and conduit clearances per NEC Article 370 Requirements.
5. Control station enclosures shall be Allen-Bradley 800H, or equal.

E. Sump Termination Panel.

1. Two section enclosure with cord seals between the ventilated section and the termination section. Panel shall prevent gasses from transmitting from one side of the enclosure to the other. Termination section shall include terminal blocks rated 150% of pump FLA minimum with quantity as required for the pumps and instrumentation. Panel shall be fabricated from 316 stainless steel with padlockable door and aluminum backpan in termination section. Furnish Tesco 24-STP Sump Termination Panel, or equal.

2.05 DEVICES

A. Switches

1. General purpose commercial grade switches shall be manufactured in accordance with UL 20. Switches shall be one pole, brown, 20 amps at 277 VAC, 1HP at 120 VAC, 2 HP at 240 VAC. Switches shall have copper alloy contact arm with silver cadmium oxide contacts. Switches shall have slotted terminal screws and a separate green grounding screw. Provide Leviton, Hubbel, or equal.

B. Receptacles

1. General purpose receptacles shall be commercial grade, duplex and rated 20 amps, 120 VAC, 2 pole, 3 wire grounding, NEMA 5-20R configuration,

specification grade, and side wired to screw terminals. Face color shall be brown when paired with stainless steel covers. General purpose receptacles shall be specification grade Leviton, Hubbel, or equal.

2. GFI receptacles shall be commercial grade, duplex, brown, 20A, 120V, back and side wired, with "test" and "reset" buttons. “Daisy Chain” connecting multiple receptacles from one GFI unit is not acceptable. GFI receptacles shall be Leviton, Hubbel, or equal.
3. Boxes shown in NEMA 3R environments and outdoor locations shall be weatherproof while in-use. Furnish in-use weatherproof covers and weatherproof boxes for these areas. Receptacles, plugs, and housings shall be fabricated of impact resistant plastic with o-rings and gaskets to prevent the entrance or water, vapors, and chemicals when unplugged or plugged.
4. Definite purpose receptacles and plugs in NEMA 4 or 4X environments where a receptacle is shown and a device is to be connected continuously, shall be listed as UL type 4, 4X, (Plug).
5. Circular plugs shall be retrofitted onto equipment so as to be compatible with the receptacles to maintain in-use ratings. Furnish Hubbel Watertight Wiring Devices and Accessories, or equal.

2.06 POWER MONITORING

A. Power Monitor

1. General:
    a. Microprocessor based multifunction power and energy meter
    b. Designed for multifunction electrical power, voltage, and current measurement on 3 phase power systems.
    c. Measured parameters: voltage, current, frequency, unbalance, kW, KVAR, KVA, power factor, kWh.
    d. Support for 3-Element Wye, 2.5 Element Wye, 2 Element Delta, 4 wire Delta systems.
    e. 200 ms update for power measurement, 100ms update for voltage, current, Hz.
    f. Din rail mounting
    g. 85 to 264 VAC control power, 5W.
2. Voltage Inputs
    a. Configurable to potential transformer ratio.
    b. Input impedance of 1 Mega Ohm, 0.014W at 120 Volts.
    c. Direct voltage input range
        1) 347 Volts Line to Neutral
        2) 600 Volts Line to Line.
    d. 2500V withstand.
3. Current Inputs:
    a. Configurable to current transformer (CT) ratio 1A or 5A input.

b. Burden 0.05VA, Impedance 0.002 ohms
c. Meter shall have a maximum burden of 0.005VA per phase, at the maximum of 15 Amperes continuous input.
d. Fault current withstand shall be 200 Amps for 1/2 second.

4. Digital I/O:
   a. Two status inputs 24VDC dry contact.
   b. Two assignable digital relay outputs
5. Accuracy
   a. Revenue meter accuracy
   b. +/- 1% or better for volts and amps
   c. +/- 1% for power and energy functions.
   d. True RMS measurements
6. Communications
   a. Ethernet - 100BaseT Ethernet IP Allen Bradley protocol
   b. Modbus TCP
7. Acceptable Products
   a. Allen Bradley PM1000 1408-EM3A-ENT with Ethernet
   b. Or Equal

2.07 RADIO SYSTEM

A. RADIO MODEM

1. Each radio system shall be furnished and installed complete and functional for the intended use. A radio system shall include but not be limited to, radio, antenna, mounting hardware, Ethernet cables with connectors, and an ESD protector mounted within 2 feet of radio.
2. Licensed frequency radio for City of Pleasanton. Model GE SD4, no equal.

B. ANTENNA

1. Re-use existing antenna.

C. TRANSMISSION CABLE

1. Provide 50 Ohm, ½" weatherproof coaxial cable from lighting arrestor to antenna. The coax cable shall have a corrugated outer conductor of copper, copper-clad aluminum inner conductor with foam dielectric. The coax cable shall be jacketed for corrosive environment and ultra-violet exposure. The coax cable shall be capable of a minimum bending radius of 5 inches. The cable shall be installed as one continuous length from the antenna to the lighting arrestor. Antenna cable shall be Andrew Superflex FSJ4-50B, 1/2" coax cable or equal.
2. Cable end "N" connectors shall be furnished for field installation after the cable is run in conduit. Provide straight or right angle connectors as required for the installation as required.

3. Pigtail connector. Provide low loss connection cable for connecting the Radio antenna connection to the lightning arrestor. Pigtail shall have compatible connectors for the radio and lightning arrestor.
4. Furnish an antenna lighting arrestor with “N” connector on the antenna coaxial transmission line. The lighting arrestor shall be grounded to the control panel ground buss by a #8 AWG or larger bonding wire. The lighting arrestor shall be insulated from the backpan. The lightning arrestor shall be a PolyPhaser IS-50NX-C2 or equal.
5. The cable shall be carefully installed to prevent damage to the jacket and routed with a minimum bending radius of 8 inches except where required at the conduit to free-air transition.
6. Provide connector weatherproofing kits for outdoor exposed connectors. All mating connectors that are exposed to weather shall be wrapped with a sealing material designed to protect against water and dirt entry into the connectors.

PART 3 EXECUTION

3.01 CONSTRUCTION METHODS

A. Equipment shall be assembled and wired by the manufacturer prior to shipment. Field modifications or changes are not allowed without a written "change order" to the Contract. Field changes, however large or small, shall be executed using the components, materials, wiring, labeling, and assembly methods identical to that of the original supplied equipment.

B. Factory as-built Drawings for each custom manufactured control panel or MCC shall be shipped with the equipment and placed inside in waterproof envelopes.

3.02 EQUIPMENT FABRICATION

A. All electrical equipment, including custom manufactured equipment, shall meet the requirements of Underwriters Laboratories (UL) and bear the appropriate label. Panels shall be affixed with UL label prior to shipment and be built in accordance with the UL guidelines and procedure that corresponds to the UL label. Custom control panels shall bear a UL-508A label for general use, minimum, with additional UL labels as required per intended service.
   1. Design and furnish a Low Voltage Limited Energy Circuit for any device(s) not bearing a UL listing or registration that are required to be installed into a UL labeled panel.
   2. Revise voltages for any electrical parts and equipment that are specified that do not bear the UL listing or registration.

B. Panel cutouts for devices (i.e. indicating lights, switches) shall be cut, punched, or drilled and smoothly finished with rounded edges. Exposed metal from cutouts that are made after the final paint finish has been applied shall be touched up with a matching paint prior to installing device.

C. Equipment doors shall swing freely and close and latch with proper alignment.

D. Component within the electrical equipment shall be securely mounted on an interior subpanel or backpan and arranged for easy servicing. Mounting bolts and screws shall be front mounted for device removal without special tools or removal of entire mounting panel.

E. A ground bus shall be provided in each enclosure or cabinet. It shall have provisions for connecting a minimum of ten grounding conductors. Screw type lugs shall be provided for connection of grounding conductors. All grounding conductors shall be sized as shown on plans or in accordance with NEC Table 250 95, whichever is larger.

F. Bolts and screws for mounting devices on doors shall have a flush head which blends into the device or door surface. No fastening devices shall project through the outer surfaces of equipment.

3.03 WORKMANSHIP

A. All work in this division shall conform to the codes and standards outlined herein.

B. Installation shall be performed by qualified personnel providing first class workmanship per Electrical Specifications [Electrical General, Qualifications].

C. Maintain equipment installed (or to be installed) in new condition. Protect equipment from damage while in Contractor care from dust, water, or mishaps that are typical to construction sites

D. Confirm that equipment and materials are correct for their intended duty and will be installed per manufacturer guidelines. Equipment and components found to be installed inconsistent with manufacturer guidelines and/or these Specifications will not be acceptable and subject to removal and replacement.

E. Upon completion of daily work, remove excess materials, scraps, and debris from the work area and from the inside of equipment.

F. Upon notification, stop work on any portion of the installation that is determined to be non-compliant with contract or being installed by unqualified personnel.

G. Perform all work to correct improper installations at no additional cost to the owner.

H. Equipment furnished under this contract or provided to Contractor for installation shall be installed in accordance with manufacturer's instructions, installation calculations, and contract documents.

3.04 EQUIPMENT SHIPMENT AND STORAGE

A. Shipment -- Any equipment whose destination (jobsite) is more than 25 miles from the factory shall be carefully protected for shipping. All openings shall be protected by plywood securely fastened to the framework of the equipment. Equipment shall be adequately covered during local delivery.

B. Storage -- From the time of receipt until the equipment is installed and energized, the equipment shall be considered in storage. While in storage, a 120V, 1 phase source of power shall be made available and connected to space heaters in all items of equipment so equipped. Equipment not provided with space heaters shall be provided with a light bulb or electric heater while in storage to prevent moisture condensation. Unless stored indoors, it shall be a least 1 foot above grade covered with at least 2 layers of heavy polyethylene plastic sheets and anchored to prevent damage by high winds. All equipment shall be protected from dust and moisture prior to and during construction.

3.05 DAMAGED PRODUCTS

A. Damaged products that cannot be repaired to new condition shall be replaced with new products. All equipment and materials shall be in like-new condition at start-up and commissioning.

B. Any equipment furnished outside of contract to the Contractor shall be repaired or replaced if damaged while in the Contractor’s care. The Contractor shall pay for the parts and/or services of the original equipment manufacturer (OEM) to troubleshoot, asses, and repair damaged equipment.

C. Minor cosmetic damage shall be repaired by spray painting, after properly preparing the surface, all scratches or defects in the finish of the equipment. Only identical paint furnished by the equipment manufacturer shall be used for such purposes.

3.06 INSTALLATION

A. General
   1. Install all products per manufacturer's recommendations and the Drawings.

2. Provide all necessary hardware, conduit, wiring, fittings, and devices to connect the electrical equipment provided under other Sections.
3. Furnish and install wiring between adjacent equipment sections that are not completed at factory. Install 1-1/2" minimum diameter insulated chase nipples with lock rings and insulated bushings for thru wiring.
4. Protect wiring insulation from wear by installing rubber cushions, bushings, or strip insulation, or by fastening the wiring to a rigid surface with zip ties and anchors.
5. Provide additional devices, wiring, conduits, relays, signal converters, isolators to complete interfaces of the electrical and instrumentation system.
6. Changing normally open contacts to normally closed contacts or vice versa
7. Adding additional relays to provide more contacts as necessary.
8. All programmable devices (not specifically excluded herein) shall be programmed, set-up and tested by the Contractor prior to startup. Programming and set-up parameters shall be adjusted or changed as directed by the Engineer during start-up and throughout the warranty period.
9. Coordinate with the Engineer and setup all alarm, process, and operation setpoints.
10. Keep a copy of the manufacturer's installation instructions on the jobsite available for review at all times prior to and during the installation of the associated equipment.

B. Panels and enclosures:
1. Install panels and enclosures at the location shown on the Plans or approved by the Engineer.
2. Install level and plumb.
3. Seal all enclosure openings to prevent entrance of insects and rodents.
4. Clearance about electrical equipment shall meet the minimum requirements of NEC 110.26

C. Electrical receptacles, plugs, and switches
1. Electrical plugs, receptacles, cords, and connectors required to power or interface the equipment and panels shall be furnished and installed by the Contractor.
2. Ground fault circuit interrupter receptacles shall be used where noted as GFI on plan or where in outdoor NEMA 3R locations, or in areas that are indoor and in same room as water pipe.
3. Boxes shown in NEMA 3R environments and outdoor locations shall be weatherproof while in-use. Furnish in-use weatherproof covers and weatherproof boxes for these areas.

4. Definite purpose receptacles and plugs in NEMA 4 or 4X environments where a receptacle is shown and a device is to be connected continuously, shall be listed as UL type 4, 4X, (Plug) and NEMA 3R (flip cover).

D. Conduits and Ducts:
   1. Install all conduits and ducts per Electrical Specifications [Conduit and Boxes] and [Grounding].
   2. Minimum wire bending space at terminals and minimum width of wiring gutters shall comply with NEC tables 312-6 (a) & (b).

E. Wiring, Grounding, and Shielding:
   1. Observe proper grounding and shielding practices as this application environment is generally noisy. The shield of shielded cables shall be terminated to ground at one end only, the origination end. The shield at the other end shall be encased in an insulated material to isolate it from ground.

F. Cutting and Patching:
   1. The Contractor shall do all cutting and patching required for installing his work. Any cutting which may impair the structure shall require prior approval by the Engineer. Cutting and patching shall be done only by skilled labor of the respective trades. All surfaces shall be restored to their original condition after cutting and patching.

G. Cleaning and Touch up:
   1. At the completion of the work, all parts of the installation, including all equipment, exposed conduit, and fittings, shall be thoroughly cleaned of grease and metal cuttings. Any discoloration or other damage to parts of the building, the finish, or the furnishings, due to the Contractor's failure to properly clean the system, shall be repaired by the Contractor.
   2. The Contractor shall thoroughly clean any of his exposed work requiring same.
   3. Vacuum and clean the inside of all electrical and instrumentation enclosures prior to applying power.
   4. The Contractor shall paint scratched or blemished surfaces with the necessary coats of quick drying paint to match existing color, texture and thickness. This shall include all prime painted electrical equipment including but not limited to enclosures, poles, boxes, devices etc.

3.07 APPLICATION OF POWER

A. The Engineer will direct the energization and de-energization of all existing and new equipment. The Contractor is not authorized to energize or de-energize any

equipment unless they have been given written permission to do so or while in the presence of the Engineer.

1. Any equipment that is under repair, demolition or installation shall be locked off and tagged out of service with Contractor supplied padlocks and tags.
2. The Contractor is required to comply with NFPA 70E and specifically in regards to safety when working on live equipment. Obtain work permits when needed to do live work.

B. The Contractor is responsible for grounding of high and medium voltage cabling and/or bus during installation and removal of equipment. The contractor is responsible for complying with all California Electrical Safety Orders (ESO) and Occupational Safety and Health Act (OSHA) safety requirements and procedures while working in or near medium voltage equipment.

3.08 WARRANTY

A. The Contractor shall warrant all electrical and instrumentation equipment & software for a period of 1 year from date of final acceptance. Standard published warranties of equipment which exceed the preceding specified length of time shall be honored by the manufacturer or supplier.

B. The Contractor shall have a staff of experienced personnel available to provide on-site warranty service on 2 working days notice during the warranty period. Such personnel shall be capable of fully testing and diagnosing hardware & software and implementing corrective measures.

3.09 FINAL ACCEPTANCE

A. Final acceptance will be given by the Engineer after the equipment testing is complete, each deficiency has been corrected, final documentation has been provided, and all the requirements of Contract documents have been fulfilled.

B. At the end of the project, following the completion of the field tests, and prior to final acceptance, the Contractor shall provide the following:

1. Each "operation and maintenance" manual shall be modified or supplemented to reflect all field changes and as built conditions.
2. Two (2) disk copies of all final documentation to reflect as-built conditions.

C. Keys: Submit two sets of all keys for locks supplied on this project. Wire all keys for each lock securely together. Tag and plainly mark with lock number or equipment identification, and indicate physical location, such as panel or switch number.

END OF SECTION

SECTION 16110 – CONDUIT AND BOXES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Labor, materials, equipment, tools, safety gear, test equipment, incidentals, services, and transportation for a complete electro-mechanical installation as shown on the Drawings, included in these Specifications, or as can be reasonably implied from project descriptions.

B. The scope of work includes:
   1. Furnish and install conduits, wireways, raceways, cable trays, junction boxes, pull boxes, and associated hardware. Provide conduit, fittings, hardware, hangars, mounting channel, and other parts for a complete raceway installation.
   2. Replacement of liquid tight flex conduit that is sun exposed for any conduit that is getting new conductors.
   3. Demolishing conduit and conductors for demolished equipment.
   4. Furnish and install grounding system required by drawings, or if not shown or defined, as required by Article 250 of the NEC.
   5. Installations shall be designed and installed with components meeting the NEMA area designation.

C. Work includes that specified in Electrical Specifications [Electrical General].

1.02 REFERENCES

A. Electrical Specifications [Electrical General]

B. Electrical Specifications [Low Voltage Wire & Data Cable]

C. Electrical Specifications [Grounding]

D. Project Drawings

1.03 QUALIFICATIONS

A. Material furnished under this specification shall be installed by qualified installers meeting requirements specified in Electrical Specifications [Electrical General, Qualifications].

1.04 SUBMITTAL REQUIREMENTS

A. Provide submittals and drawings as specified in Electrical Specifications [Electrical General, Submittal Requirements].

PART 2 PRODUCTS

2.01 CONDUIT, RACEWAYS AND WIREWAYS

A. GENERAL - Conduit, raceways, and wireways, wiring methods, materials, installation shall meet all requirements of the NEC, be UL labeled for the application, and meet the minimum following specifications.

1. All wiring shall be installed in conduits, raceways, or wireways when interconnecting equipment and devices.
    a. The minimum size conduit shall be 3/4-inch unless indicated otherwise on the Drawings or for special connections to equipment.
    b. Provide cords and cord seals for devices or instrumentation requiring waterproof seal to maintain NEMA 4 or 4X ratings. Example devices include lighting and pipe mounted instruments that are located below grade.
2. Conduits may connect into junction boxes or wireways as shown in the drawings or as requested by Contractor and approved by Engineer. Junction boxes (circle with J in drawings) can be as simple as a condulet or JIC box, or larger box as determined by contractor and needed for the installation. Drawing may or may not depict junction box requirements that may be required by code. Wireways or junction boxes shall be rated for area (as noted in the Drawings), or furnish minimum NEMA 4 if not noted.
3. The Contractor shall use conduit material types (SPEC per conduit schedule) as defined below or as otherwise shown in the contract drawings or as specifically called out in the conduit schedule.
    a. Non-exposed underground portions of conduit run shall be PVC-40 for all signals and voltages unless otherwise shown in the conduit schedule.

b. Exposed conduit material (not underground and beyond transition) shall be per the following table unless specifically noted otherwise in the plan drawings. The conduit schedule denotes the conduit type for non-exposed (under-ground, in-concrete, etc.) and does not apply or coordinate with this table. Exposed condulets, elbows, fittings, device boxes, and hardware shall be of the same material and finish as the adjacent conduit.

Location	Material
NEMA 1 or 12	Galvanized rigid steel (GRS)
NEMA 3R	Galvanized rigid steel (GRS)
NEMA 4	PVC-Coated Steel (GRS-PVC)
NEMA4X	PVC-Coated Steel (GRS-PVC)
Class 1 Div 1 or 2 hazardous	PVC-Coated Steel (GRS-PVC)

4. Conduit stubs and transitions:
   a. Conduit transitions shall be GRS-PVC for 6" on either side of the mtransition point (minimum) or as shown in drawing details. Conduit transition is defined as conduit sections emerging from or through concrete or earth or from below to above grade or through walls or vaults, non-exposed to exposed.
   b. Beneath pad mounted electrical equipment, where not exposed, shall be installed or trimmed to 2" or less above slab and have bushing or end bell installed. Overall height of conduit entering into the base of equipment shall be enough for bushings/bells to be installed but be high enough for conduit tags to be installed.
   c. Uniform in height for each panel or section. Conduits end bushings/bells shall not vary in height above slab more than ½" from lowest to highest.
   d. Conduits shall be spaced apart such that bushings and end bells may be installed without interfering with the adjacent conduits.
   e. Transitions to PVC shall include PVC coated locknuts to shield exposed steel pipe threads.
   f. Through walls – shall protrude approximately 2" and include end bell or bushing. Pack space around conduit with non-shrink grout if the thru-hole was core drilled.
   g. From hazardous locations – shall include seal off and/or conduit cable seals as required per NEC.
   h. Conduits for future use shall be capped with coupling and plug. Identify each end with conduit labels.
   i. Existing conduits that are no longer able to be used due to removal of equipment or shown demolished, shall have flexible

conduit removed, wires removed or pulled back to the nearest pullbox, coiled and labeled at each end. Disconnect wires at each end.

5. Conduit Tags
   a. All conduits listed in the "Conduit and Wire Routing Schedule" shall have conduit tags at both ends of each conduit run with tag number from schedule identified. This shall include ends within underground pull boxes.
   b. All conduits shall have temporary tags during construction. Temporary tags may be made from duct tape with hand written ink marking or suitable equivalent. Temporary tags shall be removed by Contractor at time of installation of permanent tags.
   c. Tag material shall be rigid laminated red plastic with white lettering. The size of the tag shall be ¼" thick by 1" round or ¾" x 1" rectangle minimum.
   d. Letter height shall be 3/8" minimum. Engrave the tags with the conduit number or acronym. Labeling shall be neatly installed for visibility and shall be clearly legible. Securely fasten tags in place using 20ga stainless steel tie wire through a pilot hole on the tag.
   e. Conduit tags shall be Custom manufactured per specification.
6. Supports
   a. Cross section of a single channel shall be 1-5/8" x 1-5/8" and cross-section of a double channel shall be 1-5/8" x 3-1/4". The channel wall thickness shall be 12 gauge as applicable.
   b. One-Hole clamps shall be intended for pipe mounting on support channels and equipped with clamp-backs. The clamps shall be Efcor, Thomas and Betts, Appleton or equal
   c. Spacers, provided to support underground conduits in concrete encasements, shall be plastic. The spacers shall be Carlon, Johns-Manville, Underground Products or equal
   d. Anchors shall be expansion type for securing equipment to concrete foundations, floors and walls. Anchors shall have length identification mark on the exposed end of the bolt. Provide Hilti Kwik Bolt 3, or equal.
   e. Stanchions shall be provided as needed to mount equipment and electrical components. Stanchions shall be shop fabricated from welded 4" c-channel, 12" x 12" x ¼" steel base plate, coated with a rust inhibiting primer and top coat of gray polyurethane gloss paint. Attach equipment to the stanchion direct or on a ¼" aluminum sheet sized for the equipment supported.
   f. Conduit Hangers shall be trapeze construction, with double channel, 3/8-inch rods and nuts. Suspend from suitable structural support.

g. Support material and finish shall be per the following table unless otherwise noted in the drawings. Brackets, fittings and hardware shall be of the same material and finish.

Location	Material
Indoors NEMA 12	Galvanized steel
Outdoors NEMA 3R	Galvanized steel
Outdoors NEMA 4	Stainless Steel type 316
Corrosive areas NEMA4X	PVC bonded, 40 mil, factory applied

h. Equipment mounting racks shall be designed by installer for rigid equipment and conduit mounting. Racks shall be bolted or welded construction and sized for equipment or as shown on the drawings.

i. Strut channels shall be used for mounting equipment to walls and for supporting conduit runs. Double strut channel type shall be used for fabricating equipment mounting racks as required and/or as detailed on the drawings. Add additional supports to rigid mounting locations as needed to prevent wobbling and to meet seismic requirements. All field cut surfaces of the strut channels shall be deburred and coated to prevent rust.

B. Galvanized Rigid Steel Conduit - (GRS)

1. Manufactured from high-strength steel and hot dipped zinc galvanized inside and out. Conduit and fittings shall meet UL 514B, UL 6, and conform to NEMA RN 2. Conduit shall be capable of being used as an equipment grounding conductor per NEC 250.
2. Provide galvanized rigid steel factory sweeps and elbows for 90 degree transitions.
3. Cast fittings and device boxes shall be malleable iron or aluminum. Appleton type FS/FD or equal.
4. In hazardous locations, fittings shall meet and be listed UL 886.
5. All fittings, hubs, couplings, pulling elbows and connectors shall be threaded-type. Set-screw type and compression-type are not acceptable. All thread conduit is not allowed over 1/2” exposed length. Cover plates shall be cast iron with sealing gasket in NEMA 3R locations.
6. Conduits entering enclosures shall be fitted with insulated grounding bushing; O-Z "HBLG", Appleton "GIB", or approved equal. All grounding bushings shall be tied to the grounding system with properly sized bonding conductors per the NEC code.
7. Combination expansion-deflection fittings installed exposed shall be Type XD as manufactured by Crouse-Hinds Co.; Type DX as manufactured by

O.Z. Gedney Co.; Type DF as manufactured by Appleton Electric Co., or equal

C. Galvanized Rigid and Coated Steel Conduit (GRS-PVC)

1. Galvanized Rigid Steel conduit with a 40-mil thick polyvinylchloride exterior coating and a 2-mil urethane interior coating meeting NEMA RN-1, UL-6 and ETL PVC-001. The bond of the PVC to the zinc coated pipe must be stronger than the tensile strength of the PVC.
2. Provide PVC coated galvanized rigid steel factory sweeps and elbows for 90 degree transitions.
3. Cast fittings and device boxes shall be malleable iron or aluminum with a 40-mil thick PVC coating meeting the same
4. In hazardous locations, fittings shall meet and be listed UL 886.
5. Provide PVC coated threaded-type fittings, hubs, pulling elbows, couplings, and connectors; set-screw type and compression-type are not acceptable. Form 8 conduit fittings, ½" through 4", must have a tongue-in-groove gasket to effectively seal out the corrosive elements. Covers shall be supplied with plastic encapsulated stainless steel cover screws. Form 8 fittings shall be UL and type 4X and IP69 listed.
6. A PVC Coated Sealing Locknut shall be used on all exposed male threads transitioning into female NPT threads which do not have sealing sleeves, including transitions from PVC couplings/female adapters to PVC Coated GRC elbows in direct burial applications. "PVC Coated Sealing Locknuts" are not to be used in place of a Myers hub
7. A PVC sleeve extending one pipe diameter or two inches, whichever is less, shall be formed at every female fitting opening except unions. The inside sleeve diameter shall be matched to the outside diameter of the conduit.
8. All junction and metal pull boxes shall be galvanized with exterior surfaces PVC coated to 40 mils thickness.
9. Unistrut, strut clamps, pipe straps, and clamp back spacers, shall have 40 mil thick PVC coating. All mounting anchors shall be stainless steel.
10. Conduits entering enclosures shall be fitted with insulated grounding bushing. All grounding bushings shall be tied to the grounding system with properly sized bonding conductors per the NEC code.
11. GRS-PVC conduit to be Robroy Plasti-bond, Perma-Cote, KorKap, T&B OCAL or equal.

D. PVC Conduit, Schedule 40 or 80 (PVC-40, PVC-80)

1. Shall be high impact schedule 40 or 80 polyvinylchloride suitable for use underground, direct burial and for use with 90 C wires, and shall conform to UL 651. Shall be UL listed and labeled for "direct" burial.
2. Elbows, and risers shall be per exposed conduit transition detail. PVC conduit is not allowed above ground except where specifically indicated.

3. PVC fittings shall have solvent-weld-type conduit connections. Fittings and device boxes shall be PVC with factory fabricated conduit connections. Provide Carlon or equal.
4. Conduits entering enclosures shall be fitted with a glued male adapter, lock ring and bushing to prevent wire chafing. Conduits entering panels through concrete to an open bottom or entering a pull box shall have a glued end bell fitting.
5. PVC conduit shall be stored on a flat surface and shielded from the sun.

E. Liquid Tight Flexible Metal Conduit (above 2-1/2") - (FLEX)
1. Liquid Tight Flexible Metal conduit shall be moisture and oil-proof with PVC jacket extruded over a galvanized flexible steel conduit.
2. Liquid Tight Flexible Metallic Conduit shall be sunlight, oil, and flame resistant and approved for the installation of electrical conductors in indoor and outdoor applications.
3. Liquid Tight Flexible Nonmetallic Conduit shall be listed to UL standard UL 360.
4. Liquid Tight flexible metallic conduit shall be installed in accordance with Article 351, Part B of the National Electrical Code (NEC) and other applicable sections of the NEC and/or local electrical codes.
5. Liquid Tight Fittings shall be listed for the use with Liquid tight Flexible Metallic Conduit and conform to UL514B.
    a. Outdoors when extension of GRS-PVC: PVC coated galvanized steel with insulated bushings.
    b. Outdoors when extension of GRS: Galvanized steel with insulated bushings.
    c. Indoors or outdoors when extension of stainless steel: 316 stainless steel with sealing ring and insulated bushing.
    d. Indoors: Galvanized steel with insulated bushings.
6. Flexible Metallic Conduit shall be Amer-Tite type GP or equal.

F. EMT Conduit, Electrical Metallic Tubing
1. Thinwall electroplated galvanized steel suitable for indoor and outdoor use with 90 C wires, and conform to UL 797.
2. All fittings, hubs, couplings, pulling elbows and connectors shall be compression-type, set screw type are not acceptable.

G. Flexible Metal Clad Conduit (MC)
1. Flexible Metal Conduit (type MC) shall include stranded or solid copper THHN/THWN conductors with aluminum interlocking steel strip armor cover.
2. UL 1, UL 1479, File Reference E11831, CSA File Number 15035, CSA C22.2 No. 56 (trade size 3/8 only)
3. NEC 250.118(5), 300.22(C), 348, 430.223, 501.10(B)(2), 645.5

4. Cable Tray installations per NEC
5. UL Classified 1, 2 and 3-hour Through-Penetration Fire Systems UL File R14141
6. Fittings shall be listed for the use with Flexible Metallic Conduit and conform to UL514B.
    a. Steel Box Connectors are design coordinated with type MC Cable.
    b. No locknut required
    c. Positive grip clamp assures grounding continuity and holding power
    d. Tilt-in and tighten installation technique
    e. Wire protection provided by built-in insulated throat bushing
    f. UL Standard 514B, UL Listed File # E–164166
    g. CSA Certified File # LR–84516 for AFC–50, 75, and 5075 only

2.02 CONDUIT SEALING BUSHINGS

A. Conduit Sealing Bushings shall provide a positive fluid seal for all styles of conduits, including aluminum, galvanized rigid steel, and PVC.

B. Seals

C. Sizes available range from 3/4” thru 6” in both solid and split styles and available as blank, single, two and three conductors.

D. Seal conduits from wetwells within underground pullboxes with conduit cable seals. Furnish Roxtec RS UG, Crouse Hinds, OZ Gedney, or equal.

2.03 DEVICE BOXES

A. Boxes
1. Device boxes shall be of zinc-galvanized malleable iron or cast aluminum with shape and size best suited for the particular application, rated for the location installed, and shall be supported directly to structure by means of screws, anchors, or bolts.
2. Box dimensions shall be in accordance with size, quantity of conductors, and conduit clearances per NEC articles 314 requirements.
3. Boxes exposed to the weather or in moist locations shall be weatherproof (WP) by means of gasketing under a weatherproof cover.
4. Boxes connected to GRS-PVC conduit runs shall be PVC coated with 40 mil coating.

B. Device Plates and Covers
1. Indoor general purpose device plates and covers shall be stainless steel. Plates or covers shall be attached with stainless steel screws. An

engraved plastic label denoting circuit breaker number and panelboard name shall be affixed to each cover with #4 stainless steel screws.

2. Weatherproof switch, outlet, and receptacle boxes shall be fitted with gasketed covers rated for wet locations. Each access cover shall have a padlockable cover to maintain security and weatherproof integrity even when a plug is connected to the receptacle. Screws and hinge springs shall be stainless steel. Weatherproof access covers shall be Leviton 5977-CL, Cooper 4966, or equal.

2.04 PULL BOXES

A. Junction Boxes

1. Where required for best installation or where specifically called out in the Drawings, junction boxes shall have JIC type construction with hinged door, NEMA 4X rating, manufactured of type 304 stainless steel or as otherwise shown. Door shall be fastened with clamps and stainless steel screws. No devices, screws, rivets, or bolts shall protrude through the exterior surface unless specifically shown on the Drawings. Boxes shall be Hoffman, Circle AW, or equal.

B. Underground Boxes

1. Underground pull boxes shall be prefabricated “Christy Box” size and type as noted in the Drawings or equal. Size shall be as shown or dimensioned on the Drawings. Provide larger boxes as needed to meet code or as determined in field to allow for adequate pull area at Contractor discretion. Extension sections shall be provided as necessary to reach the depth of underground conduits with maximum depth of 48”. All boxes shall have galvanized steel hold down bolts and hardware. Boxes shall be H/20 loading rated and have traffic rated covers. Steel covers or lids shall be galvanized and grounded with bonding jumper to the local grounding circuit per NEC. Pull box covers shall be labeled electrical, signal, utility, and telephone, whichever applies. Pull boxes shall be Christy Concrete Products, Brooks or equal.

C. Pull Box and Vault Identification

1. Engrave or bead weld box covers with minimum thickness of ¼” x 1” lettering with pullbox name (i.e. PBX-XXX) and purpose (electrical, signal, fiber, telephone, etc.). Provide an additional identifier “high voltage” for boxes with 600 volts or higher.
2. Utility pull boxes shall be labeled per Utility Company standards.

PART 3 EXECUTION

3.01 WORKMANSHIP

A. All work in this Section shall conform to the codes and standards specified in Electrical Specifications [Electrical General, Workmanship].

3.02 INSTALLATION

A. System:
   1. Install all products per Electrical Specifications [Electrical General, Installation].

B. Rigid Conduits and Ducts:
   1. Exposed conduits shall be neatly arranged with runs perpendicular or level and parallel to walls. Bends shall be concentric.
   2. Except as expressly indicated or approved, all conduits shall be surface mount on block walls, concealed behind gypsum walls, and buried to required depth below floor slabs.
   3. Pipe threads shall be treated with conductive thread compound.
   4. Installation of the GRS-PVC conduits must be in accordance with the manufacturer's installation procedures using recommended tools.
      a. Apply touch up compound at each fitting sealing sleeve edge to improve watertight seal.
      b. To ensure compliance, the installer(s) must be "manufacturer certified" before installation can proceed.
      c. Certification available by contacting manufacturer's representative and attending a brief instructional course. Valid and unexpired certification card shall be available for review per installer.
   5. Repair GRS-PVC coating utilizing a touch-up compound as provided by the manufacturer of the conduit of the same material as the coating. Overlap beyond the damaged area to cover the PVC coating. Contact from touchup compound to PVC is required to maintain integrity. The entire conduit shall be replaced if the repair exceeds 1" combined length.
   6. A maximum of three equivalent 90 degree elbows are allowed in any continuous run. Install pull boxes where required to limit bends in conduit runs to not more than 270 degrees or where pulling tension would exceed the maximum allowable for the cable.
   7. Route all above grade conduits parallel or perpendicular to structure lines and/or piping. Conduits installed above grade shall be braced in place with stanchions. Expansion joints shall be installed every 100 feet. Bends shall be concentric.
      a. Combination expansion-deflection fittings installed exposed shall be Type XD as manufactured by Crouse-Hinds Co.; Type DX as

manufactured by O.Z. Gedney Co.; Type DF as manufactured by Appleton Electric Co., or equal

8. Care shall be exercised to avoid interference with the work of other trades. This work shall be planned and coordinated with the other trades to prevent such interference. Process Pipe, mechanical and HVAC shall have precedence over conduits for routing and space requirements.
9. Seal each bottom entrance conduit into the MCC and other electrical enclosures with plugging compound sealant to prevent the entrance of gasses, insects and rodents. Plugging compound sealant shall be Gardner Bender Duct Seal or equal.
10. Seal conduits from wetwells within underground pullboxes with conduit cable seals. Furnish Roxtec RS UG, Crouse Hinds, or equal.
11. Exposed conduit stubs for future use shall be capped with coupling and plugged. Drill hole in plug for pull rope as necessary.
12. Explosion proof seal-off fittings shall be provided on all conduits that enter or leave hazardous areas per requirements of the National Electrical Code, Chapter 5 and UL 886. The seal-off fitting shall prevent hazardous gases and/or flames from passing from one type area to another through the conduit system. Ceramic or other non-asbestos fiber material and sealing compound shall be placed in the fitting to complete the seal.
13. Hazardous location conduit outlet boxes shall be used in hazardous locations for change in direction, access to conductors and as pull and splice boxes.
14. All spare conduits shall have 1/8" nylon pull ropes installed.

C. Flexible Conduit and Cords

1. Final connections to vibrating equipment such as motors, heaters and fans shall be made with liquid tight flexible conduit.
2. Flexible conduit lengths shall not be greater than 36 inches for sizes up to 2 ½” and 48 inches for 3” and larger conduit.
3. Flexible conduit shall include a ground conductor for equipment bonding in circuits over 30 VDC or as shown in the conduit schedule.
4. Flexible conduit shall only be installed in exposed or accessible locations.
5. Where equipment is cord connected, submersible rated, and conduit connections are not possible without modification, devices and equipment may be free-air cord connected in lieu of flexible conduit. Connection to adjacent rigid conduit shall be through liquid-tight cord connector fitting specifically designed for the purpose and sized appropriately for the cord. Cord connectors shall be rated similar to the adjacent conduit they are connected to: Stainless steel, galvanized or plastic.

D. Excavation and Layout:

1. Trenches for conduit below floor slabs and other underground electrical conduit shall be excavated to the required depths per utility requirements or specific detail. Conduits under floor slabs shall have minimum trench depth to contain bends without any portion of the radius visible at finished grade.
2. Provide minimum 1" space between conduits and lay conduits parallel to each other to the extent possible unless otherwise indicated in drawings and details.
3. Install spacers to support underground conduits. Horizontal and vertical separation shall be maintained by plastic spacers set every four feet. Spacers shall be Carlon Snap-Loc or equal.
4. Underground conduits outside of structures, excluding utility conduits, shall have a minimum cover of 24 inches except under roadways where minimum cover shall be 30 inches or as otherwise shown in the Contract Drawings. Back filling shall be done only after conduits have been inspected.
5. Excavation and back fill of conduits shall conform to the requirements herein and as indicated in drawing details unless otherwise noted. Conduits for other entities (Utilities, etc.) shall be as required and inspected by the governing entity.
6. At all times during the installation of the electrical system, the Contractor shall provide barricades, fences, guard rails, etc., to safeguard all personnel, including small children, from excavated trenches.

E. Backfill Material:
1. Backfill material shall be free of rocks greater than 1" in diameter and as noted in the drawing details or notes as indicated. If no backfill requirements are noted, then backfill shall be CLSM (Controlled low strength material) or sand slurry cement mix with 1000 to 1200 psi compressive strength.

F. Underground pullboxes:
1. Pullboxes shall be located in areas that will experience the least traffic loading and in the general vicinity as shown in the Drawings. Boxes in pavement shall be set at final grade and boxes in planter areas shall be set 1" above final grade. Boxes shall not be buried by landscape material.
2. Steel pull box lids shall be grounded per NEC 250.4(A)(5) and 314.4.
3. Boxes shall be set on compacted base and base rock to minimize settling of the box over time. If the box is located in a paved traffic area, a 6" x 6" concrete ring shall be poured around the box below the pavement.

G. Device Mounting Heights:

1. Mounting heights of fixtures and devices shall be as follows unless otherwise indicated or when height has to be adjusted to be over or under counter tops.
    a. Wall switches => 48 inches
    b. Convenience outlets => 18 inches
    c. Telephone outlets => 18 inches
    d. Bracket fixtures => 7 feet 6 inches

H. Cutting, Coring, Patching and Repairing:
1. The Contractor shall do all cutting and patching required to install his work. Any cutting which may impair the structure will require prior approval. Cutting and patching shall be done only by skilled labor of the respective trades. Where it is becomes necessary to cut into existing work for the purpose of making electrical installations, locate existing post tension cables, rebar and electrical services prior to core drilling using ground penetrating radar or similar technologies. All surfaces shall be restored to their original condition after cutting and patching.

3.03 FIELD ASSISTANCE

A. General: Provide all equipment and supplies necessary to perform all testing. The Owner shall have the option to witness and participate in the on-site tests performed by the installer.

B. Per Electrical Specifications [Factory and Field Testing].

3.04 WARRANTY

A. Provide warranty as specified in Electrical Specifications [Electrical General, Warranty].

END OF SECTION

SECTION 16120 – LOW VOLTAGE WIRE & DATA CABLE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Labor, materials, equipment, tools, safety gear, test equipment, incidentals, services, and transportation for a complete electro-mechanical installation as shown on the Drawings, included in these Specifications, or as can be reasonably implied from project descriptions.

B. The scope of work includes:
   1. Furnish and install wire, splices, lugs, or other miscellaneous devices as defined in this specification.
   2. End to end wiring and terminations for each system, device, instrument, and piece of equipment shown in the Drawings as new, or rehabilitated, or reconnected.
   3. Testing of conductors and completed wired systems.
   4. Installations shall be designed and installed with components meeting the NEMA area designation.

C. Work includes that specified in Electrical Specifications [Electrical General].

1.02 REFERENCES

A. Electrical Specifications [Electrical General]

B. Electrical Specifications [Conduit and Boxes]

C. Electrical Specifications [Grounding]

D. Project Drawings

1.03 QUALIFICATIONS

A. Material furnished under this specification shall be installed by qualified installers meeting requirements specified in Electrical Specifications [Electrical General, Qualifications].

1.04 SUBMITTALS AND DRAWINGS

A. Provide submittals and drawings as specified in Electrical Specifications [Electrical General, Submittal Requirements].

PART 2 PRODUCTS

2.01 WIRING AND ELECTRICAL DEVICES

A. General
   1. General
      a. Provide wiring and electrical devices specified herein and install field and internal panel wiring as shown on the Contract Drawings.
      b. This section applies to all wires or conductors used internal (non-field) to electrical equipment or external for field wiring.
      c. Field wire quantity and size shall be per “Conduit and Wire Routing Schedule.”
   2. Analog Signals
      a. Analog signal transmission between electric or electronic instruments shall be 4-20 milliamperes and shall operate at 24 volts DC unless otherwise specified. Milliampere signals shall be current regulated and shall not be affected by changes in load resistance within the unit's rating.
      b. Provide powered current isolators wherever the loops’ load resistance exceeds the originating current signal transmitter's rating. Associated shunt resistors shall be located on rail-mounted terminal blocks. Exposed resistor leads shall be insulated with heat-shrink tubing.

B. Low Voltage Wire and Cable (through 600V except instrument signals)
   1. General: Low voltage conductors shall be used for power, control, lighting and miscellaneous circuits. This Section applies to all wires or conductors used internal for all electrical equipment or external for field wiring. Wire shall be new, plainly marked with UL label, gauge, voltage, type of insulation, and manufacturer's name.
      a. Conductors shall be copper with a minimum of 98% conductivity.
      b. Control and instrument wiring shall have tinned copper conductors.
      c. Class C stranding. Solid conductors may be used for lighting and receptacle circuits.
      d. Wire shall be rated 600 volt (min).
      e. Size all conductors per NEC minimum or as shown on the drawings.
         1) Minimum #12 AWG for wires used in power transmission circuits or as defined on the drawings.
         2) Minimum #14 AWG for wires used in signal transmission circuits or as defined on the drawings.
   2. Wire colors and sizes shall not change within the circuit.

3. Wire shall be properly fused or breaker protected at or below the maximum amperage rating allowed by the NEC.
4. Control and Power Wiring:
    a. Field wire in conduit:
        1) Type XHHW-2, XLPE insulation, rated 90 °C in wet or dry locations, oil resistant.
            a) Use for power circuits carrying voltages higher than 200 volts phase to ground.
        2) Type THHN / THWN, PVC with nylon jacket insulation, rated 90 °C in dry locations and 75 °C in wet locations, oil resistant, UL83.
            a) Use for power circuits with voltages below 200 volts phase to ground, or control circuits.
        3) Minimum #12 AWG for wires used in power transmission circuits or as defined on the drawings.
        4) Minimum #14 AWG for wires used in signal transmission circuits or as defined on the drawings.
    b. Field wire in tray (Tray Cable type TC):
        1) Individual cables - Insulation type THHN/THWN, rated 90 °C in dry locations and 75 °C in wet locations, oil resistant, UL83.
        2) 3 or more conductor plus ground wire in a single cable.
        3) UL Listed as sunlight resistant, direct burial, and open wiring.
        4) Conductor sizing per ICEA Publication P-54-440 for cable tray and ICEA P-46-426 for conduit
        5) Minimum #12 AWG for wires used in power transmission circuits or as defined on the drawings.
        6) Minimum #14 AWG for wires used in signal or control transmission circuits or as defined on the drawings.
    c. Power cord
        1) Flexible wire cord shall be type SOW, SOOW, or G and be provided in 2, 3, or 4 conductor plus ground as required for connected load.
        2) EPR insulation, 90 deg C rating, oil and abrasion resistant., overall jacket plus individual conductor jackets. 600V rated
        3) Conductors shall be stranded copper.
        4) Cord shall be installed with cord grips on each end where it enters termination enclosures.
    d. Nonfield control panel or factory installed equipment internal wiring:
        1) Insulation - Type MTW, NFPA standard 79, UL 1063 with tinned copper.

2) Minimum #14 AWG for wires used for individual conductor circuits 100 volts and above.
3) Minimum #18 AWG for wires used for individual conductor circuits below 100 volts.

5. Instrument wiring:
   a. Field: Instrument cables shall have 600V tray cable rated insulation and 100% individual shielded twisted pair #18 (or #16 conductors) with drain wire. Single twisted shielded pair (TSPR) cables shall be Belden 9341 (or 9342), or approved equal. Three wire twisted shielded cables (#18 TS3W) shall be Belden 1119A or equal. See drawings for cable size required.
   b. Non-Field: Instrument cables shall have 300V rated insulation and 100% individual shielded twisted pair #18 conductors with drain wire. Single twisted shielded pair (TSPR.) cables shall be Belden 8760, or approved equal. Three wire shielded cable shall be Belden 8770 or equal.
   c. Field multi-pair instrument cable as required per conduit schedule shall have 300V rated insulation and 100% individual shielded twisted pair #18 conductors with drain wire. Multiple twisted shielded pair (T.S.PR.) cables shall be Belden 9773 thru 9777, or equal.
   d. Multi-pair cable is not allowed (unless specifically called out in conduit schedule or on plans) for use in field or non-field applications. One T.S.PR cable is required for each signal.
6. Manufacturer Supplied Cables
   a. Cables and wiring for special systems provided by the manufacturer with the equipment shall be installed per the manufacturer's recommendations.
7. Data Cable
   a. Data network category 6 cable (indoor) shall consist of 4 pair unshielded twisted pair #23 awg solid copper conductors. The cable shall be rated by IEEE for service intended – plenum and dry.
      1) Cable: IEEE Category 6, various manufacturers.
      2) Connectors: Standard RJ-45 with boot.
   b. Data network cable (outdoor) shall consist of 4 pair foil and braid shielded twisted pair #24 awg solid copper conductors with anti-crosstalk divider, and drain wire. Rated Level 2 Category 6+ Outdoor Carrier by IEEE for use in plenum, conduit, wet or dry.
      1) Cable: IEEE Category 6, Belden 2149a, or equal
      2) Connectors: Grounded RJ-45 with drain wire crimp.
8. Temporary motor or panel hook-up
   a. Temporary cable may be cord without conduit or PVC conduit with wiring. In either case, the cabling must be protected from

damage during construction. Sections may be located out of harms way, buried, or sleeved in steel conduit as needed.

b. Power Circuits: Provide 2, 3, or 4 conductor plus ground power supply cable(s) for temporary pump connections or electrical power circuits. Cables shall be sized for breaker rating amperage, (minimum).

c. Provide multi-conductor (TC) cables for digital control circuits. Provide quantity of conductors as needed.

d. Provide instrument wiring for 4-20 ma instrumentation.

e. Voltage drop in power circuits shall not exceed 15% during motor start and 5% during operation.

C. Color Code

1. All wires #8 and below shall have wire insulation the color specified. Wires #6 and larger may be black with color electrical tape at termination points.
2. No other colors shall be used without prior approval.
3. Color code color code of all wire shall conform with the following table:

WIRE COLOR CODE TABLE

Description	Phase/Code Letter	Field wire or tape color	Non-Field Wire Color
480V, 3 Ph	A	Brown	Brown
	B	Orange	Orange
	C	Yellow	Yellow
240V or 208V, 3 Ph	A	Black	-
	B	Red (Orange if high leg)	-
	C	Blue	-
	Neutral	White	White
240 / 120 V, 1 Ph	L1	Black	Black
	L2	Red	-
24V Positive	24+	Blue	Pink
24V Negative	24-	Gray	Gray
12V Positive	12+	Blue	Red
12V Negative	12-	Black	Black
AC Control		Red	Red (Yellow for foreign circuits)

DC Control		Blue	Blue
Ground	G	Green	Green
Shielded Pair	+ -	Red, Clear, or White Black	Clear or White Black

2.02 WIRE MARKING

A. All panel, enclosure and field wiring shall have wire labels on both ends of each wire. Labeling shall be neatly installed for visibility and shall be clearly legible. Each conductor of instrument shielded signal wiring shall be labeled. Wire labels shall be machine printed with on white heat shrinkable tubing. Each label shall fit a minimum 23 characters, 3/16" in height before shrink. Tubing shall be oversized for the wire and shrunk into place using an electric heat gun. The "shrunk" label shall have just enough give to allow the label to be rotated. Hand lettered wire labels are not acceptable and shall be replaced at the Contractor's expense. Provide Brady "PermaSleeve" or equal.

1. Node Style Wire Identification All wires that are electrically the same (connected to common termination points) and do not pass through a contact or other switching device shall have the same wire identification. The wire labeling code for each end of the same wire shall be identical.
   a. The wire identification code for internal panel wiring shall be the number/letter as designated on the Drawing elementary and/or approved shop drawings.
   b. Wire labeling for field wiring shall contain the field equipment name/tag as a prefix and the pupose. (I.E. FIT071-+ and FIT071-- or P10-124) where + or 124 are the field device terminal block name or purpose. The hierarchy of prefix label names is 1) Instrument Tag, 2) Electrical panel or equipment name, and 3) Equipment name. Therefore, wires from MCC50 P10 cubicle to PLC10 will be labeled MCC50-P10-xx where xx is the terminal number or the purpose. Wires from field pressure switch PSH10 to MCC50 P10 will be labeled PSH-10-xx where xx is the PSH terminal block name. See example PLC I/O wiring diagram.
   c. Wire labels shall be per control panel submittal and/or interconnection submittal drawings using rules described above – Wire labels must be documented prior to printing and before they are applied. Abbreviations may be used in the wire label as long as they are consistent and understandable.
   d. Wire labels for lighting and receptacle circuits shall consist of the panel board and circuit number and a unique node number. (I.E. LP#3-A, LP#3-B, LP#3-N)

e. Wire labels may be omitted on “neutral jumpers” less than 8” in length.
f. Wire labelling shall be documented and revised on drawings to as-built conditions.

2.03 ELECTRICAL TAPE / SHRINKABLE INSULATORS

A. Vinyl tape shall be 7 mil, 600 volt rated, flame retardant, hot and cold weather resistant conforming to UL510. Provide 3M Scotch Super 33+ vinyl tape or equal
1. Vinyl tape for color coding shall be 7 mil, ¾” width, vinyl tape conforming to UL 510. Provide 3M Scotch 35 vinyl tape or equal.

B. Rubber Tape: EPR rubber, 90 deg C continuous rated. Provide 3M 130C rubber tape or equal.

C. Varnished Cambric Tape: Adhesive backed, 7 mil, bias cut cotton tape, coated with yellow insulating varnish. Provide 3M Scotch 2510 or equal.

D. Shrinkable insulators shall be heat shrinkable, polyolefin thick wall sleeves, end caps and cable repair sleeves are designed for use in splicing, sealing and re-jacketing of direct bury secondary cables. The insulators shall comply with UL 486D and be rated up to 1000 Volts. They shall provide long-term reliable performance overhead, underground or submerged with mechanical and environmental protection. Shrinkable insulators shall be 3M ITCSN or 3M IMCSN per manufacturer instructions for the application or equal.

PART 3 EXECUTION

3.01 WORKMANSHIP

A. All work in this Section shall conform to the codes and standards specified in Electrical Specifications [Electrical General, Workmanship].

B. Perform work to remedy non-compliant installations after inspection.

C. Upon notification, stop work on any portion of the installation that is determined to be substandard or being installed by unqualified personnel.

3.02 FABRICATION AND INSTALLATION

A. System:
1. Install all products specified in Electrical Specifications [Electrical General, Installation].
2. Panels shall be completely factory wired and tested before shipment.
3. All spare PLC input / output points shall be wired to terminal blocks.

4. A minimum of 20% spare unwired terminals shall be provided in each panel.

B. Wiring Methods:

1. Wiring Separation: Wires carrying 100 volts and above shall be physically separated from lower voltage wiring by using separate bundles or wire ways with sufficient distance to minimize the introduction of noise, crossing only at 90 degree angles.
2. Harness: All wiring shall be neatly bundled and laced with plastic tie wraps, anchored in place by screw attached retainer. Where space is available, wiring shall be run in slotted plastic wireways with dust covers. Wireways shall be sized such that the wire fill does not exceed 60%. Tie wraps shall be T&B TY RAP or equal.
3. Retainers: Wireways, retainers, and other devices shall be screw mounted with round head 316 stainless steel screws or mechanically mounted by push in or snap in attachments. Glue or sticky back attachment of any type or style shall not be used. Retainers shall be T&B TC series or equal.
4. Hinge Loops: Where wiring crosses hinged surfaces, provide a "U" shaped hinge loop protected by clear nylon spiral wrap. The hinge loop shall be of sufficient length to permit opening and closing the door without stressing any of the terminations or connections. Spiral wrap shall be Graybar T25N or equal.
5. Routing: Wires and cable shall be routed such as to maintain separation between 100 Volt or higher from 100 volt or lower wiring being run in the same duct or bundle. Wires and cables shall have sufficient length to allow slack and to avoid any strain or tension in the wire or cable.
    a. Wires shall be routed in slotted plastic wireways with snap covers. Wires carrying 120 VAC shall be separated as much as possible from other wires and signal cables, and shall be routed only in ducts for 120 VAC. If the power wiring has to cross the signal wiring, the crossing shall be as close to a right angle as possible. Wireways for 24 VDC wiring shall be used for all other wires and cables. Routing of 120 VAC in combined wireways shall be minimized. Wires and cables shall be placed in the wireways in a straight, neat and organized fashion and shall not be kinked, tangled or twisted together. Additional wire ducting shall be provided for use by the electrical subcontractor for routing field wires to their landing points in the each electrical and instrumentation panel.
    b. Provide 2” minimum separation between wireway and terminal blocks.
    c. Wiring not routed in wireways shall be neatly bundled, treed, and laced with plastic ties.

C. Wire Terminations

1. Single wire and cable conductors shall be terminated according to the requirements of the terminal device as follows:
    a. Crimp-on terminals: shall be UL listed, self-insulating sleeve type, with ring or rectangular type tongue, suitable for the size and material of the wire to be terminated, and for use with either solid or stranded conductors.
    b. Terminal Blocks: Remove the last +/- 0.25 inches insulation from of the conductor and insert it under the pressure plate to full length of the bare portion of the conductor. Tighten the screw to close the pressure plate onto the conductor. No more than two conductors shall be installed in a single terminal. All strands of the conductor shall be captured under the pressure plate.
    c. Screw-less terminals: wire shall be stripped back and inserted per the terminal manufacturer's instructions.
2. When stripping insulation from conductors, do not score or damage conductor.
3. The drain wire and stripped end of outer jacket of shielded cables shall be covered with heat shrink insulating tubing. The drain wire shall be covered along its full bare length between the cable jacket cover and the terminal lug and placed on end outer jacket to cover foil.
4. Condulets with wire nut connections shall be supplied for wire termination to devices with leads instead of terminals (i.e. solenoid valves, level probe, etc.).

D. Wire Splicing

1. No wires shall be spliced without prior approval.
2. Where splices are allowed or approved they shall conform to the following:
    a. Wire splicing devices shall be sized according to manufacturer's recommendations.
    b. Splices of #10 and smaller, including fixture taps, shall be made with nylon self insulated twist on wire nuts; T & B "Piggys", Ideal "Wing Nut" or equal.
    c. Splices of #8 and larger shall be hex key screw, two way connectors, insulated with molded high-dielectric strength plastic; NSI Polaris IPL or IPLD Series terminal blocks or equal.
    d. Non-Motor Splices #10 and smaller in underground pullboxes shall have wire-nut connections inside and insulator tube which are sealed with non-hardening silicone based sealant that protects the connection from moisture and corrosion. The wire nut shall be pushed to the bottom of the tube and a locking cap closed to prevent moisture and dirt from entering the tube. The

tube is factory filled with sealant and UL listed for waterproof connections. Provide 3M DBY-6 or DBR-6 or equal.

E. Wire Installation

1. Exercise care in pulling wires and cables into conduit or wireways so as to avoid kinking, stressing the cables, or damaging the insulation. Use a UL listed pulling compound for lubrication within conduits as necessary. The raceway construction shall be complete and protected from weather before cable is pulled in. Swab conduits before installing cables and exercise care in pulling, to avoid damage to the insulation or conductors.
2. All wire and cables (with the exception of coaxial antenna cable) shall be installed within UL listed raceways or enclosures. Install all wires and cables in one continuous length unless splices are per Contract Drawings, required to connect equipment or submitted and favorably reviewed.
3. Bundle incoming wire and cables in panels. Zip-tie at intervals of 2” and neatly spread into trees and connect to their respective terminals. Allow sufficient slack in cables for alterations in terminal connections. Do not bundle, tape or tie wires within conduits.

3.03 WARRANTY

A. Provide warranty as specified in Electrical Specifications [Electrical General, Warranty].

END OF SECTION

SECTION 16250 - AUTOMATIC TRANSFER SWITCH

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall supply the automatic transfer switch (ATS) as specified herein.

B. The ATS scope of work includes:
1. Providing and installing one automatic transfer switch of rating shown on Contract Drawings.
2. Submittal data and drawings.
3. Startup assistance.
4. Factory and field testing.
5. Operation and maintenance manuals.
6. Warranty of all components.

C. Startup and configuration of ATS with installed voltages and loads.

D. As required under Electrical Specifications [Factory and Field Testing], furnish all required labor, materials, safety equipment, transportation, test equipment, incidentals and services to perform factory and/or field testing.

1.02 REFERENCES

A. Electrical Specifications [Electrical General]

B. Electrical Specifications [Factory and Field Testing]

C. Project Drawings

1.03 SUBMITTALS REQUIREMENTS

A. Provide Submittals as specified in Electrical Specifications [Electrical General, Submittal Requirements].

B. Include a record of each parameter available to be changed by the user. The list shall include factory defaults and space for entered values.

1.04 OPERATION AND MAINTENANCE INFORMATION

A. Provide operation and maintenance information as specified in Electrical Specifications [Electrical General, Operating and Maintenance Information].

B. Include a record of each ATS parameter setup during startup and testing and place a copy of setting in each O & M manual.

PART 2 PRODUCTS

2.01 AUTOMATIC TRANSFER SWITCH

A. General:

1. The ATS shall be UL listed in accordance with UL 1008 and be labeled in accordance with that standard's 1½ and 3 cycle, long-time ratings. ATSs which are not tested and labeled with 1½ and 3 cycle (any breaker) ratings and have series, or specific breaker ratings only, are not acceptable.
2. The ATS shall be rated to close on and withstand 42,000 RMS symmetrical short circuit amperes at the ATS terminals or otherwise shown. Provide overcurrent protection as shown on the Contract drawings.
3. The ATS manufacturer shall be certified to ISO 9001 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation and servicing in accordance with ISO 9001.
4. ATS types utilizing components of molded case circuit breakers, contactors, or parts thereof, are not acceptable.
5. The switch assembly shall be installed in a NEMA enclosure located as shown on Contract drawings.
6. The automatic transfer switch shall be an ASCO Model 7000, Zenith ZTSD, each with options to meet specified requirements, or equal.

B. Switch Unit:

1. The transfer switch unit shall be electrically operated and mechanically held. The electrical operator shall be solenoid operated and only momentarily energized to minimize power consumption and heat generation.
2. The transfer switch shall be a conventional 2 position transfer configuration. The switch may only remain in transition for a fraction of a second.
3. The switch shall be 3 pole double throw with inherently interlocked construction. A solid neutral shall be provided for all systems.
4. Wide contact gaps shall be provided to insure positive isolation of the normal and emergency power sources.
5. The switch shall be fully rated for amperage shown on Contract Drawings, for switching all types of loads including induction motors. The ratings shall apply to the voltage and mounting arrangement as shown in the drawings.

6. The main power contacts shall have silver alloy contact construction featuring a wiping action each time the switch is operated. Arc chutes shall be utilized to contain the inherent spark created when switching under load.
7. The main contact design shall allow repeated making and breaking of rated full load current, with a combination of motor and other loads and without damage or undue wear to the contacts.
8. All main power contacts and auxiliary contacts shall be mechanically driven from a common actuator shaft.
9. The bus shall be constructed of silver plated copper.
10. Inspection of all contacts, linkages and moving parts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors.
11. All switch and relay contacts, coils, mechanical linkages, and control elements shall be serviceable or removable from the front of the mounted switch or accessory assembly without removal of the switch or assembly from the compartment and without disconnection of the power cables or control wiring.
12. The switch shall have a manual operating handle for maintenance purposes.
13. Compression screw type solder-less terminals or lugs shall be provided for connecting all external line & load power cables and control wiring. All connections shall be accessible from the front without removal of internal components.
14. A terminal strip shall be provided for terminating all control wiring. All terminals shall be numbered with machine printed lettering matching the wire number of the terminated wire.
15. All control wiring shall have permanent identification at each point of connection. Wire identification shall be by machine printed numbered wiring sleeves. Electrically common wires shall have the same wire number. Electrically different wiring shall have unique wire numbers.
16. Control wiring shall be neatly bundled and secured in place by plastic cable ties. Wiring shall be protected with plastic spiral wrap where it crosses over a hinge to the door.

C. ATS CONTROL PANEL
1. A control panel shall be provided to direct the operation of the transfer switch. The modules sensing and logic shall be a controlled by a built in microprocessor. Control panels that do not utilize microprocessor electronics to control the operation of the switch are not acceptable.
2. A four line, 20 character LCD display and keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available

for viewing and limited control through the serial communications input port.

3. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance.
   a. Sensing and control logic shall be provided on multi-layer printed circuit boards.
   b. The panel shall be enclosed with a protective cover and be outer door or deadfront mounted such that it may be operated with the door closed for safety and ease of maintenance.
4. A single controller shall provide twelve selectable nominal voltages for maximum application flexibility and minimal spare part requirements. Voltage sensing shall be true RMS type and shall be accurate to ± 1% of nominal voltage. Frequency sensing shall be accurate to ± 0.2%.
   a. The under-voltage of each phase of the normal source shall be monitored, with pickup adjustable from 85% to 100% of nominal and the dropout adjustable from 75% to 98% of pickup setting, both in increments of 1%. These adjustments shall be factory set at 85% dropout, and 90% pickup.
   b. The voltage of each phase of the emergency source shall be monitored, with pickup adjustable from 85% to 100% of nominal. This adjustment shall be factory set at 95% pickup.
   c. Frequency sensing of the emergency source shall be provided, with pickup adjustable from 90% to 100% of nominal. This adjustment shall be factory set at 97% pickup.
   d. The control panel shall meet or exceed the voltage surge withstand capability in accordance with IEEE Standard 472 1974 (ANSI C37.90a 1974) and the withstand voltage test in accordance with the proposed NEMA Standard ICS1 109.21.
5. The transfer switch control panel shall be capable of operating over a temperature range of -20 to +60 degrees C.
6. The transfer switch shall be provided with advanced inphase algorithm which measures the frequency difference between the two sources and initiates transfer at appropriate phase angels to minimize disturbances from transferring motor loads.
7. The control panel shall include the following field adjustable time delays:
   a. Time delay to override momentary normal source outages, adjustable from 0 to 5 minutes. This adjustment shall be field set to place emergency generator on-line in 1 minute.
   b. Transfer to emergency time delay for controlled timing of load transfer to emergency, adjustable from 0 to 5 minutes. This adjustment shall be field set switch position in 5 seconds after power has stabilized.

c. Emergency source failure time delay to ignore momentary transients during initial generator set loading, adjustable from 0 to 6 seconds. Set at 2 seconds.

d. Retransfer to normal time delay, adjustable 0 to 60 minutes. This adjustment shall be factory set at 5 minutes. The time delay is automatically bypassed if the emergency source fails and normal source is acceptable.

e. Unloaded running time delay for emergency engine generator cooldown, adjustable from 0 to 60 minutes. This adjustment shall be factory set at 5 minutes.

f. Generator Exercise Timer: Timer provided for operator adjustment of day of week, time of day and run duration for exercising the generator under operating loads by activating the automatic transfer switch. . Timer shall be mounted on the ATS outer deadfront door.

g. The controller shall provide an integral engine exerciser. The timer shall be field set by the Contractor with date and time during training. The engine exerciser shall allow the user to program up to seven different exercise routines. For each routine, the user shall be able to:

1) Enable or disable the routine.
2) Enable or disable transfer of the load during routine.
3) Set the start time of day, day of week, week of month, alternate or every time start, duration of run.
4) At the end of the specified duration the switch shall transfer the load back to normal and run the generator for the specified cool down period. A 10-year life battery that supplies power to the real time clock in the event of a power loss will maintain all time and date information.

8. The controller shall commit to start engine which requires the engine to reach proper output and run at least the duration of the cooldown setting, regardless of whether the load is transferred.

9. Provide interface relays or main switch follower contacts to comply with I/O interface requirements as defined in the P&ID diagram. Interfacing relays shall be industrial grade plug-in type with dust covers. Interface connections shall be wired to backpan terminal blocks. At minimum, the switch shall have the following unused I/O contacts available:

a. Switch in Normal – SPDT rated 10 amps, 120 VAC
b. Switch in Emergency – SPDT rated 10 amps, 120 VAC
c. Engine starting contact -- DPDT gold-flashed contacts rated 10 amps, 32 VDC
d. Emergency Power available – SPDT rated 10 amps, 120 VAC
e. Normal Power available – SPDT rated 10 amps, 120 VAC

10. Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to emergency and for remote contacts which open to inhibit transfer to emergency and/or retransfer to normal.
11. Provide separate LED signal lights with nameplates indicating the following:
    a. Utility power is available (green)
    b. Generator power is available (red)
    c. ATS is connected to Utility source (green)
    d. ATS is connected to the Generator source (red)
    e. ATS in neutral position (wht)
12. A three position momentary-type test switch shall be provided for the test / automatic / reset modes:
    a. Test: simulate normal source failure
    b. Automatic: normal operation
    c. Reset: bypass the time delays on either transfer to emergency or retransfer to normal.
13. All adjustments shall be field adjustable without the use of tools, meters, power supplies, or special test equipment and can be made safely without personal exposure to live parts
14. Each adjustment resolution shall be settable within minimum increments of 1%.
15. Repetitive accuracy of timer, voltage and frequency settings over a temperature range of –20° C to 70° C shall be within +/ 2%.
16. The control panel programming shall be lockable via password protection.
17. The wire harness for connection of the control panel to the transfer switch shall have sufficient length to reach between the mounting locations shown on the Contract drawings.
18. Provide the following displays on the controller:
    a. Event log to display 99 logged events with the time and date of the event, event type and event reason.
    b. Total number of ATS transfers.
    c. Number of ATS transfers caused by power source failures.
    d. Total number of days ATS has been in operation.
    e. Total number of hours that the normal and emergency sources have been available.

PART 3 EXECUTION

3.01 WORKMANSHIP

A. All work in this Section shall conform to the codes and standards specified in Electrical Specifications [Electrical General, Workmanship].

3.02 FIELD ASSISTANCE

A. Testing, checkout and start-up of the ATS equipment shall be performed under the technical direction of a factory trained authorized manufacturer representative.
   1. The setup and programming of the ATS shall be provided by a factory-trained representative who is authorized by the ATS manufacturer to perform the startup. This setup and programming shall be done prior to and during the first application of power.
   2. Provide testing as specified in Electrical Specifications [Factory and Field Testing].

B. Provide 1 hour of “ATS Setup” Training on operating and maintenance procedures.

3.03 WARRANTY

A. Provide warranty as specified in Electrical Specifications [Electrical General, Warranty].

END OF SECTION

SECTION 16450 - GROUNDING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Labor, materials, equipment, tools, safety gear, test equipment, incidentals, services, and transportation for a complete electro-mechanical installation as shown on the Drawings, included in these Specifications, or as can be reasonably implied from project descriptions.

B. The scope of work includes:
   1. Furnish and install grounding system required by Drawings, or if not shown or defined, as required by Article 250 of the NEC. Ground conductors shall be sized for the protective device, minimum.
   2. Furnish and install conduits, junction boxes, underground boxes, and associated hardware. Provide hardware, conduit, fittings, and other parts for a complete grounding installation.
   3. Installations shall be designed and installed with components meeting the NEMA area designation.

C. Work includes that specified in Electrical Specifications [Electrical General].

1.02 REFERENCES

A. Electrical Specifications [Electrical General]

B. Electrical Specifications [Low Voltage Wire & Data Cable]

C. Project Drawings

1.03 QUALIFICATIONS

A. Material furnished under this specification shall be installed by qualified installers meeting requirements specified in Electrical Specifications [Electrical General, Qualifications].

1.04 SUBMITTAL REQUIREMENTS

A. Provide submittals and Drawings as specified in Electrical Specifications [Electrical General, Submittal Requirements].

B. Submit manufacturer's product information for connections, clamps, rods, terminals, and grounding system components.

PART 2 PRODUCTS

2.01 GROUNDING SYSTEM

A. General
1. Grounding conductors shall be sized as shown on the Drawings or in accordance with NEC article 250, whichever is larger.
2. Components of the grounding electrode system shall be manufactured in accordance with UL 467 - Standard for Safety Grounding and Bonding Equipment.

B. Grounding System
1. Utility services 200A and below: Provide 1 ground rod connected to the service panel with #2 bare copper ground wire and as shown on the drawings.
2. The ground bonding wire(s) from the ground rod(s) shall extend through and appropriately sized conduit into the electrical panel. Connect the ground wire(s) to the ground bus with readily visible UL approved "ground clamp" attached to the ground bus.
3. Install bare copper ground bond wires from the UFER ground to the various locations shown on the Drawings.

C. Raceway Grounds
1. Metallic conduits shall be assembled to provide a continuous ground path. Metallic conduits shall be bonded using insulated grounding bushings.
2. Provide separate code size wire ground conductor for all conduit types.

D. Equipment and Enclosure Grounds
1. Electrical and distribution equipment shall be connected to the grounding system. Cables shall be sized as specified.

E. Components
1. Ground rod shall be ¾” x 10 ft solid steel with 10-mil copper-cladding.
2. Provide ground well enclosures for all outdoor ground rods. Furnish Christy type F8, Christy N9, or Christy B1017 (traffic areas), marked “GROUND” or equal unless otherwise shown on the Drawings.
3. Ground rod clamps shall be bolt-on type as manufactured by O-Z Gedney type GRC, or equal.
4. Exothermic weld connections shall form a permanent, low resistance, molecular bond between two copper conductors and be rated for the same or higher current capacity as the conductor. Furnish Nvent Erico Cadweld or equal.
5. Every piece of equipment shall be grounded per NEC.

6. Each electrical enclosure shall have a copper ground bus. Screw type fasteners shall be provided on all ground busses for connection of grounding conductors. Ground bus shall be a Challenger GB series, ILSCO CAN series or equal.

PART 3 EXECUTION

3.01 WORKMANSHIP

A. All work in this Section shall conform to the codes and standards specified in specified in Electrical Specifications [Electrical General, Workmanship].

3.02 INSTALLATION

A. Grounding System:
1. Install all products per Electrical Specifications [Electrical General, Installation].
2. Install ground rods to full depth with 3” maximum exposed above pads and 9” maximum exposed in underground boxes.
3. Each nonmetallic conduit shall contain a code sized grounding conductor.
4. The system neutral conductor and all equipment and devices required to be grounded by the National Electrical Code shall be grounded in a manner that satisfies the requirements of the National Code.
5. The system neutral (grounded conductor) shall be connected to the system's grounding conductor at only a single point in the system. This connection shall be made by a removable bonding jumper sized in accordance with the applicable provisions of the National Electrical Code if the size is not shown on the Drawings. The grounding of the system neutral shall be in the enclosure that houses the service entrance main overcurrent protection.
6. Utilize mechanical connections in accessible locations and exothermic connections in non-accessible or buried locations.
7. The secondary on all transformers shall be grounded.
8. All raceway systems, supports, enclosures, panels, motor frames, and equipment housings shall be permanently and effectively grounded.
9. Install insulated grounding conductor with feeders and branch circuit conductors in conduits. Size grounding conductors in accordance with NEC. Install from grounding bus of serving panel to ground bus of served panel, grounding screw of receptacles, lighting fixture housing, light switch outlet boxes or metal enclosures of service equipment. Ground conduits by means of grounding bushings on terminations at panelboards and distribution panels with 12ga. conductor to grounding bus
10. All receptacles shall have their grounding contact connected to a grounding conductor.

11. Branch circuit grounding conductors for receptacles or other electrical loads shall be arranged such that the removal of a lighting fixture, receptacle, or other load does not interrupt the ground continuity to any other part of the circuit.
12. Attachment of the grounding conductor to equipment or enclosures shall be by connectors specifically provided for grounding. Mounting, support, or bracing bolts shall not be used as an attachment point for ground conductors.
13. Install grounding electrode conductor and connect to reinforcing steel in foundation footing. Electrically bond building steel to ground system. Bond metal siding not attached to grounded structure.
14. Furnish exothermic grounding connections for all underground connections to wire, rebar, or other steel components required to be grounded.

3.03 FIELD QUALITY CONTROL

A. Inspections:
   1. Ground system shall be inspected prior to cover.

B. Testing:
   1. Complete applicable test forms if provided in testing specifications [Factory and Field Testing]. If form is not provided, furnish results on a vendor standard form.
   2. Test each grounding connection to determine the ground resistance. The grounding test shall be IEEE 81.2 and NETA 7.13. The current reference rod shall be driven at least 100 feet from the ground rod or grid under test. The measurements shall be made at 10-foot intervals beginning 20 feet from the test electrode and ending 80 feet from it, in direct line between the ground rod or center of grid and the current reference electrode. Investigate ground resistance in excess of 1 ohm and revise or install new or additional ground electrodes as needed to reduce point to point resistance to less than 1 ohm.

END OF SECTION

SECTION 16600 - FACTORY AND FIELD TESTING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section defines factory and field testing requirements of electrical and instrumentation equipment and as specified in this section and in Electrical Specifications. All equipment provided under Electrical Specifications and electrical equipment provided under other sections shall be tested as specified herein.

B. The System Integrator and/or Electrical Contractor shall provide all labor, tools, material, power, and technical supervision to perform the specified tests and inspections.

C. The Electrical Contractor shall be present during field testing and assist the System Integrator in testing all equipment. The Electrical Contractor shall be ready to correct any wiring problems found during testing.

D. The Application Programmer (defined in Electrical Specifications [Electrical General].) and/or Construction Manager will be actively engaged in Operational Testing and Commissioning. These efforts shall be combined efforts of the Application-Programmer/Construction-Manager/Engineer and Contractor. The Contractor shall facilitate test as outlined herein such that hardware, software and application programming are tested completely and all applicable test documentation is completed.

1. Expect that field operational testing (SCADA and PLC automated controls checkout) is going to require 2 weeks after pre-operational tests are done. Contractor and System Integrator shall assist in this start-up. Coordinate with Owner Representative to schedule this start-up period.

E. It is the intent of these tests to ensure that all equipment is operational within industry and manufacturer's tolerances and is assembled in accordance with design plans and Specifications.

F. The Owner and/or Construction Manager may witness testing in effort to insure quality and verify results. The Contractor is required to provide notification 2 weeks prior to any test that are intended to be documented and submitted for approval or are final tests. The Owner and Construction Manager must specifically decline witness of each test to be performed, and the test must be successful, and it must be documented on the day of test, in order for it to not have to be repeated in the presence of an authorized witness. Only the Owner or Construction Manager may assign an authorized witness.

G. All tests shall be documented in writing by the person performing the test on the test forms submitted (and similar to those shown at the end of this section) and signed by the Engineer as satisfactorily completed. The Electrical Contractor or System Integrator performing tests shall keep a detailed log of all tests that failed or did not meet Specifications, including date of occurrence and correction.

H. The Contractor shall perform all applicable testing of Owner supplied or existing equipment as a unit and as part of a system. Testing shall include documentation and witness sign-off.

I. The radio and communications equipment shall be completely configured by the Contractor for permanent operation. Radio diagnostics, addresses, and configuration shall be recorded and provided with testing submittals. Provide data in tabular format on Excel spreadsheet. Contractor is required to test every path, link, repeater until optimum results are obtained. Test form example is not provided for this purpose and must be generated by the Contractor.

1.02 REFERENCES

A. Electrical Specifications [Electrical General]

B. Project Drawings

C. Additional testing may be specified in other Electrical Specifications.

1.03 FACTORY AND FIELD GENERAL REQUIREMENTS

A. Testing General
   1. Prior to any field testing Operation & Maintenance Manuals shall have been submitted and approved.
   2. The test forms shall be completed by the contractor during testing and calibration of all equipment. All tests shall be witnessed by the Owner's Representative. Completed test forms shall be given to the Owner's Representative the day of the test. Complete two sets of test forms if Contractor wants to keep a copy.
   3. The Contractor shall give the Engineer 10 working days notice of the dates and time for inspections and testing.
   4. Include test results in the Maintenance and Operational Manual.
   5. As a minimum, all the tests indicated/specified on the test forms shall be performed and test forms filled out by the Contractor.
   6. Prepare and submit formal test procedures and forms at least two weeks prior to the start of testing. Testing shall not commence until the test procedures have been reviewed and approved. Submit a combined test procedure submittal with separate sections for factory and field tests.

7. If the results of any of tests are unacceptable, the Contractor shall make corrections and perform the tests again until they are acceptable; these tests shall be done at no additional cost.

B. Failure to Meet Test

1. Any system, material or workmanship which is found defective on the basis of these tests shall be reported immediately following the test. The Contractor shall replace the defective material or equipment and have tests repeated.

C. Safety

1. Testing shall conform to the respective manufacturer's recommendations. All manufacturers' safety precautions shall be followed.
2. Safety, as shown herein and in other divisions, shall be a combination of all methods and practices described. Safety practices may not be determined based on the least restrictive requirement, but instead, on the most restrictive requirement. Obtain clarification if there is any question prior to performing tests.
3. The procedures stated herein are guidelines for the intended tests, the Contractor shall be responsible to modify these tests to fit the particular application and ensure personnel safety. Absolutely no tests shall be performed in such a fashion that personnel safety is jeopardized.
4. The Contractor shall have two or more personnel present at all tests.
5. Two non-licensed portable radios shall be provided by the Contractor for use during testing.
6. Contractor shall comply with California Electrical Safety Orders (ESO) and Occupational Safety and Health Act (OSHA): All test and procedures shall comply with ESO and OSHA as to safety, protective clothing, clearances, padlocks and barriers around electrical equipment energized during testing.
7. The first set of tests to be performed (pre-energization) shall determine the suitability for energization and shall be completed with all power turned off.

1.04 QUALIFICATIONS

A. System Integrator Representative

1. The system integrator representative shall have 1 year experience in field testing of equipment working for the System Integrator or equivalent. If the representative does not demonstrate necessary experience or competence during testing or start-up, the System Integrator shall provide a representative meeting the required competence and experience.

B. Electrical Contractor Representative
   1. The Electrician shall have 5 years minimum experience working with industrial control systems and have a Journeyman level experience rating.

1.05 SUBMITTAL REQUIREMENTS

A. The Contractor shall ensure that the System Integrator, and all equipment suppliers provide the submittal documentation required in this section. Submittals shall be complete, neat, orderly, and indexed. The Contractor shall check all submittals required under this Division for the correct number of copies, adequate identification, correctness, and compliance with the Contract Specifications and Drawings, and initial all copies certifying compliance.

B. The System Integrator shall assemble and submit for approval complete testing procedures and forms at least two weeks prior to the start of testing. Contractor is responsible for compiling testing procedures and forms from multiple sub-contractors as required.

C. Test submittal shall include: (as applicable)
   1. Proposed procedure for operational testing whether it is performed in the factory or field. Procedure shall include method, simulated I/O requirements, bypass piping, telemetry, and necessary materials and equipment to conduct test.
   2. Test forms (for all tests, factory and field, and regardless of who performs tests). Test forms shall be electronically completed prior to submittal with entry spaces filled to the extent possible. The only remaining data that shall require completion during the test is the test data itself. Test forms shall be provided as illustrated at the end of this section or equal.
   3. Approved shop one-line, elementary diagrams and PLC I/O drawings.
   4. Control strategies photocopied at 75% reduction with room at the side of page for comments on each paragraph or control strategy.

PART 2 PRODUCTS

2.01 TEST EQUIPMENT

A. Test equipment required to perform testing and document results shall be provided by Contractor or System Integrator.

B. Test instruments shall be calibrated to references traceable to the National Institute of Standards and Technology. Instrument calibration shall be current to one year from date of start-up. Test equipment accuracy shall be at least twice

the accuracy of instrument being calibrated. Test instrument certificates of calibration shall be on-hand and provided prior to testing.

All test equipment to be used as part of the testing shall be listed in the submitted testing sheets. Contractor supplying the component or system to be tested shall provide all necessary test equipment.

C. The overall accuracy of each input and output loop shall be checked to ensure that it is within manufacturer's Specification tolerances. In no case shall the error exceed 0.25% or 0.04 mA.

PART 3 EXECUTION

3.01 FACTORY TESTING

A. General Requirements

1. The System Integrator shall conduct a thorough and complete factory test witnessed by Engineer per the criteria specified herein. Factory test shall be held within 150 miles of project location.
2. Temporary wiring and equipment shall be provided and connected during these tests to simulate the complete assembled system.
3. The testing shall not be started until the manufacturer has completed fabrication, wiring, setup, programming; quality control testing; and can demonstrate the system is complete and operational.
4. The equipment required for factory testing shall consist of, but is not limited to, control panels, MCCs, and/or miscellaneous electrical panels as provided under this contract.
5. Two digital multimeters/signal generators (minimum +/ 0.1% accuracy) with clip on leads shall be supplied and utilized during testing for measurement of digital and analog outputs.
6. All factory tests shall be conducted at the System Integrator’s facility. All factory tests shall be completed prior to shipment to the jobsite. The equipment shall be fully assembled, and connected (and programmed) similar to as it will be installed.
7. The length of the factory testing shall be a minimum of one (1) working day(s) (8 hours per day).
8. Faulty and/or incorrect hardware or software operation of major portions of the system may, at the discretion of the Engineer, be cause for suspension, cancellation, or restarting of the factory test, at no additional cost to the Owner or extension in Contract time.
9. The Systems Integrator shall develop, furnish, and install a test program to be loaded into PLCs to verify all Logic Controller I/O Point to Point Tests prior to start of applications program testing. Systems Integrator

shall use a computer running PLC programming software to confirm I/O calibration and status, force outputs and communications configuration.

10. The factory test will be considered complete only when the integrated system has successfully passed all tests. No electrical equipment shall be shipped to jobsite without completed test documentation.
11. During the testing period, under the supervision of the System Integrator, the Owner's Representative shall have unlimited and unrestricted access to the usage and testing of system hardware, configuration, software, meters and tools.
12. The System Integrator shall pay all expenses incurred by his personnel including labor, material, transportation, lodging, daily subsistence, and other associated incidental costs during the factory testing.
13. Acceptance and witnessing of the factory tests does not relieve or exclude the Contractor from conforming to the requirements of the Contract Documents.
14. Upon conclusion of factory testing, and at the request of the Application Programmer, the System integrator shall remove the PLC, OI, and communication equipment for Application Programmer's use and programming. The System Integrator shall provide equipment to Application Programmer immediately or ship unit within 2 working days. The System Integrator shall not be responsible for equipment while in Application Programmer's care.
15. All modifications to documentation as a result of the factory tests shall be corrected and completed before the submittal and delivery of "Operation and Maintenance" Manuals.
16. Copies of the completed and witnessed factory testing forms shall be included in the Operation and Maintenance Manual.

B. Factory Tests

1. Structured Factory Tests: The associated factory tests are to be performed by the System Integrator and witnessed by the Owner's Representative. The associated test forms shall be completed during each stage of the test.
    a. Visual and Mechanical Inspection Tests
    b. Wiring Tests
        1) Contractor shall confirm correct panel wiring per System Integrator panel shop drawings. Panel shop drawings shall be compared with Contract P&IDs and other Drawings to verify all hardwire logic are accounted for. Panel drawings used in factory tests shall be redlined and inserted into Factory Testing Results submittal.
    c. MCC and Control Panel Pre-Operational Tests
    d. Logic Controller I/O Point to Point Tests

2. Unstructured Factory Tests: The various unstructured tests shall include, but are not limited to, the following.
    a. Simulate the equipment failure and power fail/restart of PLC. Check the effects of each failure on maintaining operations with the remaining equipment.
    b. The factory tests, as a minimum, shall simulate all normal and abnormal operating conditions including steady state, change of state, variable changes, fluctuations, transients, upsets, start up, shutdown, power failure, and equipment failure conditions.
    c. Measure and test all power supplies for correct voltage. Operate rechargeable devices under battery power to test run duration, alarms and automatic recovery.

3.02 FIELD TESTING

A. General Requirements
1. Field testing is broken down into 4 components
    a. Pre-Energization testing
    b. Pre-Operational Testing
    c. Operational Testing
    d. Trial Period/Commissioning
2. Project wide, all Pre-Energization testing must be completed prior to Pre-Operational testing, all Pre-Operational testing must be completed prior to Operational Testing, and all Operational Testing must be completed prior to Commissioning.
    a. Any deviation of this order, whether on a component level or larger scale, must be approved.
    b. Out of order testing, if allowed, will be evaluated on a case-by-case basis when brought to the attention of the Owner's Representative. The Owner's Representative may require that the entire system, or portions thereof, be retested once the missing component(s) are installed and functional.
3. All equipment supplied by the Contractor or others shall be tested by Contractor per these specifications.
4. Two digital multimeters/signal generators (minimum +/ 0.1% accuracy) , AC current meters, torque wrench, and other specialized test equipment shall be provided by the Contractor for use during testing.
5. If the equipment is determined not to be ready for testing, the test will be cancelled and rescheduled for a later date.
6. Faulty and/or incorrect hardware or software operation of major portions of the system may be cause for suspension, cancellation, or restarting of the area of testing, at no additional cost or extension in Contract time.
7. During the Operational testing period, under the supervision of the System Integrator, the Owner's Representative shall have unlimited and

unrestricted access to the usage and testing of all hardware and software in the system.

8. The System Integrator shall pay all expenses incurred by his personnel including labor, material, transportation, lodging, daily subsistence, and other associated incidental costs during field testing.
9. Acceptance and witnessing of the tests does not relieve or exclude the Contractor from conforming to the requirements of the Contract Documents.
10. All modifications to documentation as a result of the tests shall be corrected and completed before the delivery of "as-built" documentation.
11. Copies of the completed and witnessed field testing forms shall be included in the Operation and Maintenance Manual.
12. The various contractors on this project (General Contractor, Electrical Contractor and System Integrator) shall assume the lead role in testing activities as listed below. The Contractor shall obtain assistance of suppliers and/or manufacturers representatives for any major equipment testing.
    a. Electrical Contractor:
        1) Pre Energization Tests
            a) Visual Mechanical Tests
            b) Wire Insulation and Continuity Tests.
            c) Panelboard Tests
            d) Breaker Tests
        2) Trial Period
        3) Commissioning.
    b. System Integrator:
        1) Pre-Operational Tests
            a) Visual Mechanical Tests
            b) Control panel pre-operational test
            c) MCC pre-operational test
            d) Motor Tests.
            e) PLC I/O point to point tests.
            f) Instrumentation switch tests
            g) Instrumentation transmitter tests.
        2) Operational Tests.
        3) Trial Period
        4) Commissioning
    c. General Contractor
        1) Test Scheduling
        2) Operational Tests.
        3) Trial Period
        4) Commissioning.
    d. Application Programmer (software systems)

1) Operational Tests.
2) Trial Period
3) Commissioning.

B. Electrical Field Tests – The following test shall be performed within each test category. Complete test forms for each electrical panel, instrument, and/or device. Provide separate form for each component to be tested.

1. Pre-Energization Inspections and Tests:
   a. Visual and Mechanical Inspection Tests
   b. Wire Insulation and Continuity Tests
   c. Grounding System Tests
   d. Panelboard Tests
   e. Breaker Tests
2. Pre-Operational Tests:
   a. MCC Pre-operational Tests:
   b. Control Panel Pre-operational Tests:
   c. Motor Testing:
   d. Instrumentation Switch Calibration Tests
   e. Instrument Transmitter Calibration Tests
   f. PLC I/O point tests.
   g. Communication Tests
      1) The Contractor shall verify that all communications via radio, telephone, wireline, fiber optic, or other are functional and ready for operational testing. Revise all configurable parameters without additional cost to the Owner as required for an optimally functional system.
      2) Verify that all components of the communication system operate together under all operating and power restart conditions. If faults occur, investigate source of problem and correct. Revise all configurable parameters without additional cost to the Owner.
      3) Change setpoints from SCADA and confirm that corresponding field setpoint changes correctly. Check every I/O point on every screen, trend, and database.
3. Operational Tests:
   a. After all the previous tests in this subsection are complete, the test forms are completed and signed-off, the Contractor shall conduct operational testing.
   b. Representatives from the General Contractor, Electrical Contractor, System Integrator, and Owner's Representative shall be present during testing. Operational testing shall be performed by Contractor in the presence of the Owner's Representative.
   c. During operational testing the Contractor shall follow the instructions of the Owner. The Owner may place restrictions on

operation that must be followed by the Contractor during testing. Any accidents or fines caused by actions of the Contractor where warnings or restrictions were placed, shall be remedied or paid by the Contractor.

d. Alarm Tests
   1) Generate the digital and/or analog signals at the primary device to verify that each PLC I/O point is functional and properly programmed. Verify that all parameters (i.e., setpoints, enable/disable toggle bits, timers, etc.) for the alarms operate according to the Specifications. Multiple alarm states (i.e., LO, LO LO, HI, HI HI, etc.) shall be checked.

e. Operational Control Tests
   1) Generate the digital and/or analog signals at the primary device by raising or lowering the actual measured process. Inject signal into the terminals or utilize a "force" function within the device only as necessary. Verify that each control system is functional and properly configured and programmed.
   2) Each line of control logic in the Control Strategies section shall be checked. When the complete control strategy has been checked, it shall be signed and dated by testing person and person witnessing test.
   3) Verify that all parameters (i.e., setpoints, runtimers, totalization, etc.) operate according to the Specifications.

f. Other Tests
   1) Force a power failure and power fail/restart of PLC and all other systems. Check the effects of each failure on each piece of equipment and automatic recovery.
   2) Force a PLC communication error. Demonstrate error detection, alarming, and recovery.
   3) Perform additional operational testing that has not already been witnessed.
   4) Perform any additional operational testing as necessary to confirm robust and error free operation under all operational conditions.

4. Trial Period
   a. Station/Equipment shall be activated to automatically run for 5 days, 24 hours per day Monday through Friday.
   b. During the trial period the Owner's Representative will test all modes of operation and will look for errors and malfunctions. A punchlist will be generated to be completed by Contractor and re-tested prior to Commissioning.

c. If equipment failure occurs during the trial period, the Contractor shall repair or replace the defective equipment and shall begin another trial period, Monday through Friday.
d. This test shall be repeated until all new equipment functions acceptably and without failure for consecutive days.

C. Commissioning:
1. Commissioning shall not commence until Operational testing and System Training are complete with documentation submitted and with prior approval.
2. Commissioning period
a. The new equipment shall be activated by the Contractor to operate in full automatic for 10 consecutive days, 24 hours per day. Commissioning shall only start on Mondays or Tuesdays.
b. During Commissioning, the Owner will monitor and run the station in normal automatic mode. If equipment failure occurs during Commissioning, the Contractor shall repair or replace the defective equipment and shall begin another commissioning period after repairs are complete.
c. Parallel, existing and/or back-up systems shall remain in place and functional during commissioning period. Demolition of parallel, existing or back-up systems shall not begin until commissioning is completed.
d. This test shall be repeated until the new equipment functions acceptably for a consecutive commissioning period.
e. Warranty will begin at the start of a successful commissioning period. However, if major hardware failure occurs during commissioning, the warranty and commissioning will restart once the problem has been identified and repaired.

3.03 WARRANTY:

A. Provide warranty per Electrical Specifications [Electrical General, Warranty].
1. The completion of the above tests does not relieve the Contractor from any warranties specified in the Electrical Specifications or other sections.
2. Warranty shall begin on the start date of a successful Commissioning period.

3.04 FINAL ACCEPTANCE:

A. Final Acceptance per Electrical Specifications [Electrical General].

SECTION 16600

TEST FORMS

Index of Forms:

PC	Power Conductor Test Form
CC	Control Conductor Test Form
IC	Instrumentation Conductor Test Form
VM	Electrical Equipment Visual and Mechanical Inspection Form
PB	Panelboard Test Form
MCO	MCC Operational Test Form
CPO	Control Panel Operational Test Form
BD	Breaker Device Test Form
GCL	Generator Field Check List
GPT	Generator Performance Test Form
GSLD	Generator Sound Level Data Form
MOTOR	Motor Test Form
HM	Harmonic Measurement Test Form
IOP	Programmable Logic Controller I/O Point-to-Point Test Form
ISC	Instrumentation Switch Calibration Test Form
ITC	Instrumentation Transmitter Calibration Test Form

END OF SECTION

POWER CONDUCTOR TEST FORM

PROJECT NAME: _____ DATE OF TEST: _____

TESTING COMPANY: _____ TEST LOCATION: _____

EQUIPMENT #: _____

INSULATION TESTS						
CONDUIT	PHASE TO GROUND			PHASE TO PHASE		
#	A	B	C	AB	BC	CA

NOTES:

1) Use single form for up to 25 power conduits. Use additional forms as necessary.

2) Disconnect both ends of wiring prior to megger tests.

3) Megger insulation resistances of all 600 volt insulated conductors using a 500 volt megger for 10 seconds minimum (30 seconds minimum for motor leads). 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 terminations installed but not connected to the equipment.

4) Each megger reading shall not be less than 22 Meg-ohms resistive. Corrective action shall be taken if values are recorded less than 10 Meg-ohms. Conductors with low ohm values, that do not match similar lengths of conductors the same size, shall be replaced at no additional cost to the Owner.

5) Values of different phases of conductors in the same conduit run showing substantially different Meg-ohm values, even if showing above 22 Meg-ohms shall be replaced.

CERTIFIED BY: _____ _____ _____

SIGNATURE COMPANY DATE

WITNESSED BY: _____ _____ _____

SIGNATURE COMPANY DATE

CONTROL CONDUCTOR TEST FORM

PROJECT NAME: _____ DATE OF TEST: _____

TESTING COMPANY: _____ TEST LOCATION: _____

INSULATION TESTS											
COND. # OF #	COND. TO GROUND	CONDUCTOR TO CONDUCTOR									
1		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X									
2		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X	X								
3		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X	X	X							
4		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X	X	X	X						
5		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X	X	X	X	X					
6		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X	X	X	X	X	X				
7		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X	X	X	X	X	X	X			
8		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X	X	X	X	X	X	X	X		
9		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X	X	X	X	X	X	X	X	X	
10		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X	X	X	X	X	X	X	X	X	X

NOTES:

1) Use single form for each conduit.

2) Disconnect both ends of wiring prior to megger tests.

3) Megger insulation resistances of all 600 volt insulated conductors using a 500 volt megger for 10 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 terminations installed but not connected to the equipment.

4) Each megger reading shall not be less than 22 Meg-ohms resistive. Corrective action shall be taken if values are recorded less than 10 Meg-ohms. Conductors with low ohm values, that do not match similar lengths of conductors the same size, shall be replaced at no additional cost to the Owner.

5) Values of different phases of conductors in the same conduit run showing substantially different Meg-ohm values, even if showing above 22 Meg-ohms shall be replaced.

CERTIFIED BY: _____ _____ _____

SIGNATURE COMPANY DATE

WITNESSED BY: _____ _____ _____

SIGNATURE COMPANY DATE

INSTRUMENTATION CONDUCTOR TEST FORM

PROJECT NAME: _____ DATE OF TEST: _____

TESTING COMPANY: _____ TEST LOCATION: _____

CONDUIT NUMBER: _____ EQUIPMENT #: _____

CONTINUITY TESTS			INSULATION TESTS	
CONDUCTOR PAIR # OF #	CONDUCTOR TO CONDUCTOR	CONDUCTOR TO SHIELD	CONDUCTOR TO CONDUCTOR	SHIELD TO GROUND

NOTES:

1) Disconnect both ends of wiring prior to megger tests.

2) Megger insulation resistances of all 600 volt insulated conductors using a 500 volt megger for ten 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) Each megger reading shall not be less than 10 Meg-ohms resistive. Corrective action shall be taken if values are recorded less than 10 Meg-ohms. Conductors with low ohm values, that do not match similar lengths of conductors the same size, shall be replaced at no additional cost to the Owner.

4) Continuity Tests: Each instrumentation conductor twisted shielded pair shall have the conductor and shield continuity measured with an ohmmeter. Conductors with high ohm values, that do not match similar lengths of conductors the same size, shall be replaced at no additional cost to the Owner.

CERTIFIED BY: _____ _____ _____

SIGNATURE COMPANY DATE

WITNESSED BY: _____ _____ _____

SIGNATURE COMPANY DATE

GROUNDING SYSTEM TEST FORM

PROJECT NAME: _____ DATE OF TEST: _____

TESTING COMPANY: _____ TEST LOCATION: _____

TECHNICIAN: _____ TEST LOCATION: _____

EQUIPMENT NAME: _____

SOIL CONDITION: circle one WET DRY MOIST DAYS SINCE LAST RAIN # _____ OVER 7 _____

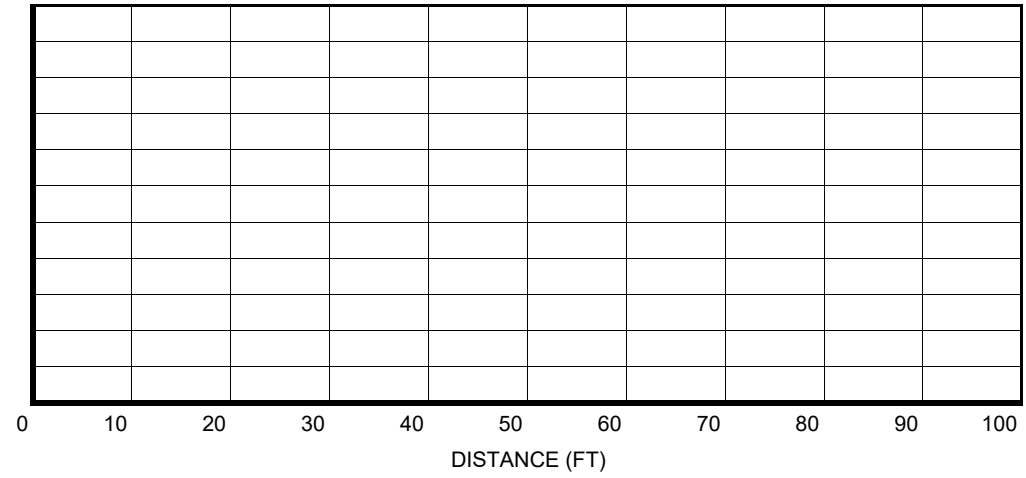
TEST ROD LOCATION RELATIVE TO SYSTEM GROUND UNDER TEST (DISTANCE AND DIRECTION) _____

COMMENTS:

FALL OF POTENTIAL TEST

MEASURED VOLTAGE PROBE	
DIST.	RESIST.
20	
30	
40	
50	
60	
70	
80	
90	

GRAPH OF MEASURED RESISTANCE VS. DISTANCE FROM TEST PROBE



NOTES:

1) Use ground resistance test meter and perform separate ground test for each building or independently derived grounding system.

2) Verify ground system is in compliance with drawings and specifications.

3) Perform the test not less than two days after the most recent rainfall and in the afternoon after any ground condensation (dew) has evaporated.

4) Investigate point-to-point resistance values which exceed 1.0 ohm. Correct (by adding additional grounding systems as necessary) and re-test. Consult design engineer if for direction on additional grounding materials and methods.

5) Connect all ground electrodes and/or UFER ground together and perform fall of potential test.

6) Perform fall-of-potential test in accordance with IEEE Standard 81 and NETA 7.13 on the main grounding electrode or system. Install reference electrode(s) a minimum of 100 feet from system under test. Connect power supply. Install/test/record/remove the potential test electrode every 10 feet during test.

7) Test measurements shall be made at 10 feet intervals in a straight line beginning at 90 feet and ending 10 feet from the system being tested. Plot resistance readings on graphical chart above.

8) Perform point-to-point resistance tests to verify low resistance between the main grounding system and all electrical equipment connected to the grounding system. Document results graphically from rod to rod and rod to equipment. Purpose is to check Cad-Weld connections and continuity point to point.

CERTIFIED BY: _____ _____ _____

SIGNATURE COMPANY DATE

WITNESSED BY: _____ _____ _____

SIGNATURE COMPANY DATE

ELECTRICAL EQUIPMENT
VISUAL AND MECHANICAL INSPECTION FORM

PROJECT NAME: _____ DATE OF TEST: _____

TESTING COMPANY: _____ TEST LOCATION: _____

EQUIPMENT NAME: _____ EQUIPMENT #: _____

NAMEPLATE DATA (complete as applicable)

MANUFACTURER: _____ ENCLOSURE: _____

MODEL #: _____ U.L. #: _____

VOLTAGE: _____ PHASE: _____

BUS AMPERAGE: _____ SERVICE: _____

BUS TYPE: _____ BUS BRACING: _____

VERTICAL BUS: _____ HORIZONTAL BUS: _____

GROUND BUS: _____ NEUTRAL BUS: _____

SERIES #:

PHYSICAL INSPECTION CHECKLIST

ENTER A-ACCEPTABLE R-NEEDS REPAIR OR REPLACEMENT NA-NOT APPLICABLE

ITEM	CHECK	NOTES
CHECK NON-ELECTRICAL FASTENERS FOR TIGHTNESS		
TORQUE TEST ALL WIRING AND BUS CONNECTIONS		
VERIFY ANCHORAGE IS PER SPECS AND/OR CALCS		
CHECK BUS BRACING AND CLEARANCE		
CHECK MAIN GROUNDING CONNECTION AND SIZE		
VERIFY GROUND BUS BONDING		
VERIFY EQUIPMENT GROUNDS		
VERIFY CONDUIT GROUNDS AND BUSHINGS		
CHECK NEUTRAL BUS AND CONNECTIONS		
VERIFY ALL BREAKERS AND FUSES ARE RATED PROPERLY		
INSPECT FOR BROKEN OR DAMAGED EQUIPMENT		
INSPECT ALIGNMENT OF PANEL AND DOOR		
VERIFY REMOVAL OF ALL DEBRIS AND DUST		
VERIFY WIRE LABELS ARE INSTALLED		
VERIFY ALL WIRE TERMINATIONS		
CHECK FOR PROPER WIRE SIZES		
CHECK FOR PROPER WIRE COLOR CODES		
VERIFY ALL NAMEPLATES		
CHECK FOR PROPER CLEARANCES AND WORKING SPACE		
INSPECT ALL PAINT SURFACES		
CHECK HEATERS AND THERMOSTATS		
CHECK VENTILATION AND FILTERS		
CHECK IF DRAWINGS MATCH EQUIPMENT		
CHECK ACCURACY OF OPERATION & MAINTENANCE		

NOTES:

1) Complete checklist above. Note any items that were found out of compliance.

2) Torque all electrical connections to values defined by equipment manufacturer or per NEC 110-14.

CERTIFIED BY: _____ _____ _____

SIGNATURE COMPANY DATE

WITNESSED BY: _____ _____ _____

SIGNATURE COMPANY DATE

PANEL BOARD TEST FORM

PROJECT NAME: _____ DATE OF TEST: _____

TESTING COMPANY: _____ TEST LOCATION: _____

PANEL NAME: _____ PANEL TAG #: _____

PANELBOARD NAMEPLATE DATA

UL #: _____ MANUFACTURE: _____

MAIN BREAKER RATING: _____ MODEL #: _____

PHASE: _____ VOLTAGE: _____

VERTICAL BUS RATING: _____ BUS AMPERAGE: _____

NEUTRAL BUS RATING: _____ BUS TYPE: _____

GROUND BUS RATING: _____ ENCLOSURE: _____

ENTRY LOCATION: _____ SERIES: _____

PHYSICAL INSPECTION CHECKLIST

ITEM	CHECK	NOTES
TIGHTEN ALL BOLTS AND SCREWS		
TIGHTEN ALL WIRING AND BUS CONNECTIONS		
VERIFY ALL BREAKERS AND FUSES ARE RATED PROPERLY		
CHECK BUS BRACING AND CLEARANCE		
CHECK MAIN GROUNDING CONNECTION AND SIZE		
VERIFY GROUND BUS BONDING		
VERIFY EQUIPMENT GROUNDS		
VERIFY CONDUIT GROUNDS AND BUSHINGS		
CHECK NEUTRAL BUS AND CONNECTIONS		
INSPECT FOR BROKEN OR DAMAGED EQUIPMENT		
INSPECT ALIGNMENT OF PANEL AND DOOR		
VERIFY ANCHORAGE		
VERIFY REMOVAL OF ALL DEBRIS AND DUST		
VERIFY CIRCUIT BREAKER LEGEND PER CONTRACT		
INSPECT ALL PAINT SURFACES		
VERIFY WIRE LABELS ARE INSTALLED		
VERIFY ALL WIRE TERMINATIONS		
VERIFY PANEL SCHEDULE WITH TERMINATIONS		
VERIFY PROPER WIRE SIZE		

NOTES:

1) Complete checklist above by entering a checkmark for acceptable, R for needs repair or attention

CERTIFIED BY: _____ _____ _____

SIGNATURE COMPANY DATE

WITNESSED BY: _____ _____ _____

SIGNATURE COMPANY DATE

MOTOR CONTROL PRE-OPERATIONAL TEST FORM

PROJECT NAME: _____ DATE OF TEST: _____

TESTING COMPANY: _____ TEST LOCATION: _____

MCC NAME: _____ MCC MANUFACTURE _____

MCC TYPE: _____ MCC LOCATION: _____

EQUIPMENT NAME	EQUIPMENT TAG #	CUBICLE #	LOCAL DEVICE CHECKS AND TESTS						REMOTE DEVICE CHECKS AND TESTS		
			CONTROL SWITCH	TIME RELAY SETTINGS	METERING & INDICATIONS	OVERLOAD RESET	INTERLOCKS & CONTROL	ALARM & STATUS	CONTROL SWITCH	PUSHBUTTON LOCKOUT & STOP	METERING INDICATIONS

NOTES:

1) Verify equipment powers up and operates correctly in hand.

2) Perform trip functions and verify equipment returns to normal operation with only necessary operator intervention.

3) Enter data for each piece of equipment being served from MCC or Control Panel.

4) Enter NA - for non applicable entries.

CERTIFIED BY: _____ _____ _____

SIGNATURE COMPANY DATE

WITNESSED BY: _____ _____ _____

SIGNATURE COMPANY DATE

CONTROL PANEL PRE-OPERATIONAL TEST FORM

PROJECT NAME: _____ DATE OF TEST: _____

TESTING COMPANY: _____ TEST LOCATION: _____

CONTROL PANEL NAME: _____ CONTROL PANEL TAG #: _____

CONTROL PANEL MANUFACTURER: _____ CONTROL PANEL TYPE: _____

CATEGORY	EQUIPMENT TAG #	DEVICE CHECKS AND TEST								
		CONTROL SWITCHES	OPERATOR INTERFACE	PANEL METERS	PANEL LIGHTS	PANEL NAMEPLATES	PLC POWER SUPPLY	I/O CARDS		
Height										
Voltage										
Function										
CATEGORY	EQUIPMENT TAG #	POWER SUPPLY 1 (V)	POWER SUPPLY 2 (V)	POWER SUPPLY 3 (V)	UPS	PANEL LIGHTS				
Function										
Voltage										

NOTES:

1) Set configurable parameters and verify voltage input prior to applying power.

2) Verify equipment powers up and operates correctly.

3) Perform trip functions and verify equipment returns to normal operation with only necessary operator intervention.

4) Complete checklist above by entering a checkmark (CM) for acceptable, or R for needs repair or attention, or NA for not applicable

Attention Requied:

CERTIFIED BY: _____ _____ _____

SIGNATURE COMPANY DATE

WITNESSED BY: _____ _____ _____

SIGNATURE COMPANY DATE

BREAKER DEVICE TEST FORM

PROJECT NAME: _____ DATE OF TEST: _____

TESTING COMPANY: _____ TEST LOCATION: _____

PANEL NAME: _____ PANEL TAG #: _____

PANEL TYPE: _____

EQUIPMENT INFORMATION

EQUIPMENT NAME: _____ EQUIPMENT H.P.: _____

EQUIPMENT TAG#: _____ EQUIPMENT KVA: _____

BREAKER INFORMATION

MANUFACTURE: _____ VOLTAGE: _____ CHARACTER: _____

PART #: _____ INTERRUPT: _____ CURVE: _____

FRAME #: _____ RATING: _____ LOCATION: _____

BREAKER TESTS

MFGR TRIP TIME @300% MIN: _____ BREAKER RATING/ RANGE: _____

MFGR TRIP TIME @300% MAX: _____ FINAL BREAKER SETTING: _____

MFGR INST. PICKUP AMPS: _____

CONTACT RESISTANCE TESTS - OHMS / INSULATION RESISTANCE TESTS - MEGOHMS

PHASE A	PHASE B	PHASE C	A-GND	B-GND	C-GND

CURRENT TESTS
TRIP TIME IN SECONDS @ 300% AMPS / INSTANTANEOUS CURRENT TRIP TESTS
AMPS

PHASE A	PHASE B	PHASE C	PHASE A	PHASE B	PHASE C

ADDITIONAL TESTS AND SETTING AS APPLICABLE

	PICK UP		DELAY-TIME		
FUNCTION	RANGE	SETTING	RANGE	SETTING	
LONG TIME					
SHORT TIME					
GROUND FLT.					

NOTES:

1) All breakers shall be checked for proper mounting, conductor size, and feeder designation. Operate circuit breaker to ensure smooth operation. Inspect case for cracks or other defects. Check tightness of connection with torque wrench in accordance with manufacturer's recommendations.

2) Thermal magnetic breakers, 100 amps and above, shall be test pet NETA specification 7.6.1.1. Time current characteristic tests shall be performed bypassing 300% rated current through each pole separately. Trip time shall be noted. Instantaneous pickup current shall be determined by run up or pulse method. Clearing times should be within 4 cycles or less. At end of test, the thermal breakers shall be set by Contractor. Test Ground-Fault Protection per NEC 230.95.

3) Magnetic breakers (MCP), regardless of amperage rating, shall be tested. Instantaneous pickup current shall be determined by run up or pulse method. Clearing time should be within 4 cycles or less. At end of test the breaker trip setting shall be set by Contractor based on the motor locked rotor current.

4) Contact resistance shall be measured and be compared to adjacent poles and similar breaker. Deviations of more than 50% shall be reported to Engineer. Insulation resistance shall be measured and shall not be less than 50 megaohms. All trip times shall fall within NETA Table values. Instantaneous pickup current levels should be within 20% of manufacturer's published values.

CERTIFIED BY: _____ _____ _____

SIGNATURE COMPANY DATE

WITNESSED BY: _____ _____ _____

SIGNATURE COMPANY DATE

MOTOR TEST FORM

PROJECT NAME: _____ DATE OF TEST: _____

TESTING COMPANY: _____ TEST LOCATION: _____

MOTOR NAME: _____ MOTOR TAG: _____

SERIAL #: _____

MOTOR NAMEPLATE DATA

MFG:		PHASE:		TYPE:		P.F:		S.F:		NEMA:	
VOLTS:		HP:		DUTY:		RPM:		CODE:		DESIGN:	
FREQ:		FLA:		MODEL:		FRAME #:		ROTATION (CW/CCW):			

INSULATION RESISTANCE TEST PHASE-TO-GROUND/PHASE-TO-PHASE

A: _____ / _____ B: _____ / _____ C: _____ / _____

CONTROL SETTINGS AND TESTS

MOTOR HEATER MEASURED AMPS:	_____ (AMPS)	MOTOR OVERLOAD SETTING:	_____ (AMPS)			
MOTOR THERMAL TRIP TEST:	_____	OVERLOAD RESET TEST:	_____ (YES/NO)			
MINIMUM SPEED (IF VFD):	_____ (HERTZ)	COIL RESISTANCE:	AB	BC	CA	

PHYSICAL MOTOR TESTS - ACTUAL MEASURED VALUES

VOLTAGE (VOLTS)		AMPERAGE (AMPS)		POWER	
AB:	_____ V	A:	_____ A	POWER FACTOR:	_____
BC:	_____ V	B:	_____ A	POWER DRAW:	_____ KW
CA:	_____ V	C:	_____ A	HORSEPOWER:	_____ HP
IMBALANCE:	_____ %	IMBALANCE:	_____ %		

NOTES:

1) Perform coil resistance measurements on motor leads with a low-resistance ohmmeter. Note measurements.

2) Perform insulation-resistance test utilizing 500 volt megger and/or accordance with manufacturer's published testing procedures. Motors 200 HP and more test duration 10 minutes, 200 HP and less test duration 1 minute.

3) Perform DC overpotential tests on motors rated 1000 HP and 4000 volts or greater in accordance with ANSI/IEEE Standard 95.

4) Verify that pump/shaft seals are lubricated and that automated lubrication systems are functional.

5) Verify that motor protection/monitoring circuits are installed and connected per contract drawings and manufacturer requirements.

6) Verify that the motor space heater is functional.

7) Perform a rotation test to insure correct shaft direction by "bumping" motor. Reverse as necessary in appropriate place. Phase taping must remain in order on terminals left-to-right once completed.

8) Measure running current and evaluate relative to load conditions and nameplate full-load amperes.

9) Record the voltage and current on all phases while operating under full-load. If voltage or current imbalance is above 2 percent, or if current is above nameplate FLA or expected level, investigate cause and report on findings. Calculate imbalance by dividing (high minus low measurement) by the average measurement of all 3 phases.

10) Vibration tests shall be conducted in cases of discernable abnormal vibration or when ordered by the Engineer (due to perceived excessive vibration). Vibration shall not exceed 0.1 in./sec as measured opposite driven end of motor. Make necessary corrections to reduce vibration below limit at all operational speeds and loads.

COMMENTS:

CERTIFIED BY: _____ _____ _____

SIGNATURE COMPANY DATE

WITNESSED BY: _____ _____ _____

SIGNATURE COMPANY DATE

PROGRAMMABLE LOGIC CONTROLLER I/O POINT-TO-POINT TEST FORM

PROJECT NAME: _____ DATE OF TEST: _____

TESTING CO: _____ TEST LOCATION: _____

PANEL NAME: _____ PANEL TAG #: _____

PLC NAME: _____ RACK # _____ SLOT # _____ I/O TYPE _____

I/O POINT				Scale					Digital	Operator	SCADA	Pass/Fail
I/O #	TYPE	TAG #	Description	@4mA	@8mA	@12mA	@16mA	@20mA	On/Off	Interface	Screen	CM or R
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												

NOTES:

1) Connect signal generator to each I/O point for factory testing.
2) Utilize actual instrument to generate signals for field pre-operational tests where possible.
3) Verify function and accuracy of loop by by switching the digital signal or modulating the analog signal from the connected device or instrument
4) Field verify all instruments and indicators within loop of signal.
4) Confirm polarity of signals and calibration ranges are equivalent for all components in loop.
5) Include significant digits past decimal in scale columns
6) Complete checklist above by entering a checkmark (CM) for acceptable, or R for needs repair or attention
7) Note items that need attention below

Attention Requied:

CERTIFIED BY: _____ _____ _____

SIGNATURE COMPANY DATE

WITNESSED BY: _____ _____ _____

SIGNATURE COMPANY DATE

INSTRUMENTATION SWITCH CALIBRATION TESTS FORM

PROJECT NAME: _____ DATE OF TEST: _____

TESTING COMPANY: _____ TEST LOCATION: _____

INSTRUMENT NAME: _____ INSTRUMENT TAG#: _____

INSTRUMENT UNITS: _____ NAME: _____

TYPE: _____ MODEL: _____

SERIAL #: _____

MANUFACTURER	INSTRUMENT
NAME: _____	UNITS: _____
TYPE: _____	
MODEL: _____	
SERIAL #: _____	

PROCESS SETPOINT	INCREASING TRIP POINT	DECREASING TRIP POINT	DEADBAND	SETPOINT TIME DELAY	ACTUAL TIME DELAY

NOTES:

1) Field test instrumentation and associated control systems in accordance with the specifications and the manufacturer's instructions. Instrumenatation shall function as intended under actual process conditions or shall be repaired or replaced at Contractors expnse.

2) Complete a separate calibration form for each instrument provided.

3) Simulate process variable in field by applying known pressure, temperature, opening/closing measured device, raising/lowering actual level, etc. as required to confirm calibration. This step must be witnessed by inspector.

CERTIFIED BY: _____ _____ _____

SIGNATURE COMPANY DATE

WITNESSED BY: _____ _____ _____

SIGNATURE COMPANY DATE

INSTRUMENTATION TRANSMITTER CALIBRATION TEST FORM

PROJECT NAME: _____ DATE OF TEST: _____

TESTING COMPANY: _____ TEST LOCATION: _____

INSTRUMENT NAME: _____ INSTRUMENT TAG#: _____

MANUFACTURER		INSTRUMENT	
NAME:		RANGE:	
TYPE:		SCALE:	
MODEL:		UNITS:	
SERIAL #:		TRANSMITTER OUTPUT:	
REMOTE SENSOR TYPE:		FACTORY SPECIFIED ACCURACY:	
(If Applicable)		REMOTE SENSOR OUTPUT:	
		(If Applicable)	

DESIGNED VALUE				ACTUAL VALUE			
INPUT SIGNAL	OUTPUT	ENG VALUE	CALCULATED TOLERANCES	INSTRUMENT DISPLAY	INSTRUMENT OUTPUT SIGNAL	PROCESS INDICATOR	LOGIC VALUE

NOTES:

1) With this form, attach and submit factory calibration forms for flowmeters and transmitters that are available from factory.

2) Field test and calibrate instrumentation and associated control systems in accordance with the specifications and the manufacturer's instructions. Instrumenatation shall meet specified accuracy or shall be repaired or replace at Contractor's expense.

3) Complete a separate calibration form for each instrument provided.

4) Simulate process variable in field by applying known pressure, temperature, pH, etc. as required to confirm calibration. This step must be witnessed by inspector.

5) Provide parameter value for each parameter changed from factory default.

CERTIFIED BY: _____ _____ _____

SIGNATURE COMPANY DATE

WITNESSED BY: _____ _____ _____

SIGNATURE COMPANY DATE

SECTION 16905 - CONTROL PANELS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Provide complete wired and tested control panels and terminal panels with devices installed per the Drawings and as stated herein.

B. Provide all necessary hardware, conduit, wiring, fittings, and devices to connect the control panel to equipment provided under other Sections.

1.02 REFERENCES

A. Electrical Specifications [Electrical General].

B. Electrical Specifications [Low Voltage Wire & Data Cable]

C. Electrical Specifications [PLC & OI Hardware]

D. Electrical Specifications [PLC & OI Application Programming]

E. Electrical Specifications [Instrumentation]

1.03 SUBMITTAL REQUIREMENTS

A. Provide submittals and Drawings as specified in Electrical Specifications [Electrical General, Submittal Requirements].

B. Submit shop construction Drawings for the Control Panel. The following Drawings shall be provided as a minimum:
   1. Scaled drawings of the Control panel elevation, baseplan. The dimensions and locations of the cutouts shall be dimensioned from the bottom left corner of the door(s).
   2. Scaled drawings of the backpan including all mounted components and wireways.
   3. Wiring diagrams for AC and DC power distribution, I/O for each card in the PLC and communications block diagrams.

C. Calculations for environmental controls. Environmental controls (including air conditioners, exhaust fans, heaters and circulation fans) shall maintain interior panels temperatures within ratings of all internal equipment given the intended installation location.
   1. Design and install environmental control systems to meet requirements herein and prevent premature failure of panel internal components.

2. Environmental controls may be shown in the Drawings and shall be considered the minimum level required. Additional components or systems shall be provided to meet internal temperature requirements.
3. Environmental control systems shall prevent and control intrusion of dust and bugs through the use of filtration systems.
4. Environmental control systems shall maintain humidity below that of the external ambient air and without condensation within panel.

1.04 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Provide operating instructions as specified in Electrical Specifications [Electrical General].

PART 2 PRODUCTS

2.01 ENCLOSURE

A. The enclosure for the control panel shall be (at minimum) sized as shown in the Contract Drawings.
   1. Arrangement: Where so indicated, the instruments mounted in the panels shall have the nominal size and general arrangement shown. Panel layouts and nameplates shall conform to the approved submittal.
   2. Assembly: Mount all equipment on 12 ga. painted white backpan(s) that is bolted to rear (and sides) of the enclosure. Use drill and tap method for machine thread screws for all internal components on mounting panels. Provide extra mounting bolts through the rear of the structure if equipment weight exceeds backpanel mounting stud capacity.
   3. Hardware: Provide door latch and accessories as detailed in the Contract Drawings or as required to meet NEMA area ratings.
      a. Provide one or two single point latches for panels up to 36” height.
      b. Provide 3 point latching mechanisms for panels over 36” height consisting of rotating handle with latch, extension bars with plastic wheels at ends and guide slots at top and bottom of door, or as otherwise shown on drawings.
      c. Hinges, pins, bolts and screws shall be of 316 stainless steel only.
   4. When physical size requirements for individual components are different than that detailed on the Control Panel backpan drawing, the wiring diagrams and specifications herein shall supersede the elevation drawing and the Contractor shall furnish additional panel width as needed to fit the electrical equipment. Deviations with sufficient evidence for the change shall be submitted for approval. The Contractor is required to provide for all equipment including spares and spaces as shown in the wiring diagrams.

2.02 CONTROL PANEL CIRCUIT BREAKERS

A. Furnish circuit breakers and accessories as required per Drawings and application.
   1. Copper busbar systems, up to 480VAC, 115A, 1, 2 or 3 phase as needed for application
   2. Trip rating per Drawings or as needed for protected device. Trip curves as selected by System Integrator.
      a. B curve magnetic trip point: 3 to 5 times the rated current, typically used for computers and electronic equipment with very low inrush loads (PLC wiring).
      b. C curve magnetic trip point: 5 to 10 times the rated current, typically used for small transformers, pilot devices, etc.
      c. D curve magnetic trip point: 10 to 20 times the rated current, typically used for transformers or loads with very high inductive loads.
   3. Quantity of pins and feed in lugs as required.
   4. Auxiliary contact, shunt trip as required in Drawings.
   5. DIN rail mounted, 18mm width per pole, finger safe pressure plate terminals.

B. Motor applications:
   1. UL489 for branch circuit protection up to 40A, 1 to 3 pole.
   2. 5 kAIC interrupting capacity @ 480 VAC
   3. Alltech, Eaton FAZ, or equal.

C. Control circuit transformers and other Non-motor applications:
   1. UL1077 supplementary protection up to 63 amps, 1 to 2 pole, AC or DC.
   2. Used where a UL489 protective device is upstream powering the circuit (from a panelboard or other source).
   3. Used within control circuits for power supplies, control power transformers, relays and PLC I/O points.
   4. Used in place of fuses that are applied as supplementary protection.
   5. Eaton FAZ, or equal.

2.03 FUSES AND FUSE HOLDER

A. Fuses shall not be used in branch or control circuits unless specifically shown in the Drawings. Circuit breakers shall be furnished and utilized where possible.

B. Fuses used in circuits 200 VAC and above shall be time delay, 13/32" x 1 1/2", and have an interrupting rating of 10,000 AIC at 500 VAC. Fuses shall be Bussman type FNQ or approved equal. Fuse holders shall feature open fuse indication lights and shall be rated 30A at 600 VAC. Fuse holders shall be Bussman Optima Series OPM or equal.

C. Fuses used in 120 VAC shall be time delay, 1/4" x 1 1/4", and have a rating of 250 VAC. Fuses shall be Bussman type MDA or approved equal. Fuse holders shall be of the same manufacturer, series and color as the adjacent terminal blocks and have blown fuse neon indicators. Fuse holders shall be Entrelec ML 10/13.SFL, Allen Bradley 1492-H4 or equal.

D. Fuses used in signal and 24 VDC circuits shall be fast acting, 5mm x 20mm and have a rating of 250 VAC. Fuses shall be Bussman type GMA or approved equal Fuse holders shall be of the same manufacturer, series and color as the adjacent terminal blocks and have blown fuse LED indicators. Fuse holders shall be Entrelec M 4/8.SFDT, Allen Bradley- 1492-H5 or equal

E. Fuses shall be sized in conformance with the NEC.

2.04 TERMINAL BLOCKS AND ACCESSORIES

A. General

1. Terminal blocks to be clamp type, 0.2 inch spacing, 300 volt, 20 amp, and mounted on 35mm DIN rail. DIN rail shall be same type as used for the relays. Install extra DIN rail on each type of terminal strip with 10% spare terminals for future additions.
    a. Provide larger terminal as necessary based on gauge of connected wiring. Those terminals with 10-gauge larger gauge wiring or more than one 12-gauge wire should be evaluated and changed.
2. Provide terminal blocks with "follower" plates that compress the wires and have wire guide tangs for ease of maintenance. Terminal blocks that compress the wires with direct screw compression are unacceptable. All power, control and instrument wires entering and leaving a compartment shall terminate on terminal blocks with wire numbers on terminals and on both ends of the wires.
3. Provide end clamps, separators, din rails, and jumpers to complete terminal block system. See example PLC I/O drawing for additional information. Engineer can provide on request if not available in plans.
4. Terminal Tags and Markers: Each terminal strip shall have a unique identifying alphanumeric code at one end (i.e.: TB1, TB2, etc.) or as shown in Drawings.
5. Plastic marking tabs shall be provided to label each terminal block. These marking tabs shall have a unique number/letter for each terminal which is identical to the "elementary" and "loop" diagram wire designation. Numbers on these marking strip shall be machine printed and 1/8” high letters minimum.
6. Terminal blocks shall be physically separated into groups by the level of signal and voltage served and as shown in the drawings. Power and control wiring above 100 volts shall have a separate group of terminal

blocks from terminal blocks for wiring below 100 volts, intermixing of these two types of wiring on the same group of terminal blocks is not allowed.

B. CP – Control Panel Terminal Blocks

1. All terminal blocks and relays shall be Gray in color unless otherwise shown on the Drawings. Do not color code terminal blocks or terminal labels without instruction.
2. Analog inputs, analog outputs, and digital inputs shall utilize one general purpose terminal block per input or power terminal. All blocks associated with a particular PLC input shall be in close proximity to each other.
3. Digital outputs shall utilize the relay terminals directly as the field connection terminal block.
4. Accessories are not listed such as end caps, anchors, jumpers, bridges, marking strips, or other items necessary to make up a complete terminal block layout. Furnish all parts necessary per manufacturer's intended solution. Minimize the use of wire jumpers for adjacent terminals.
5. Provide a ground terminal or connection point for each grounding conductor. Grounds will be associated with each incoming conduit and with shielded cables.
6. Provide a separate power, signal, common, and/or neutral/negative terminal for every wire and PLC or remote device connection at minimum.

Description	Model number, Allen Bradley or equal
General Purpose Terminal Block, 20A	1492-J3
Disconnect Terminal Block, 20A	1492-JPKD3
Double Stack Terminal Block, 20A (if needed to fit components into panel only)	1492-JD3
Grounding Terminal Block	1492-JG3
PLC Digital Output Relays, 120VAC, 6A, SPDT	700-HLT1U1
PLC Digital Output Relays, 24VDC, 6A, SPDT	700-HLT1Z24
Terminal Block Relays, 6A, DPDT	700-HLT2U1

C. MCC – Motor Starter Cubicle Terminal Blocks

1. MCC cubicle terminal blocks shall be pull apart as supplied standard by MCC manufacturer.

D. Power – Power terminal Blocks

1. Backpan mounted termination blocks shall be rated for 600V (min). The power termination blocks shall be rated to accept Copper or Aluminum cable and rated as shown on Contract one-line diagrams. Termination

blocks shall be insulated with molded plastic covering and finger safe cover. Each termination block shall be provided with quantity and size of primary and secondary cable connections as required per installation. The power termination blocks shall be Erico UD, UDJ, BD, TD, or SB series or equal.

2. Unmounted termination blocks shall be constructed of aluminum and suitable for use with Aluminum and copper wire. Size and quantity of cable connections shall be as required for installation. Termination blocks shall be insulated with molded high-dielectric strength plastic covering and eliminate the need for tape insulation of electric connection. The termination block shall have removable access plugs over the wire entry and hex screw ports. Provide NSI Polaris IPL or IPLD Series terminal blocks or equal.

E. Panel Receptacles

1. Ground fault circuit interrupter receptacles shall be used where shown for convenience use. Dedicated receptacles for equipment may be standard duplex outlets. GFI and standard receptacles shall be commercial grade, duplex, ivory, 20A, 120V, back and side wired. Furnish Leviton, Hubbel, or equal.

F. Panel Ground

1. Each electrical enclosure shall have a copper ground bus. Screw type fasteners shall be provided on all ground busses for connection of grounding conductors. Ground bus shall be a Challenger GB series, ILSCO CAN series or equal.
2. A 12ga. copper ground wire shall be attached between the ground bar and the panel enclosure, and between the ground bar and the mounting panels. The ground connection to the enclosure and panel shall be made by sanding the paint finish off a small area, drilling a hole for a 0.25 inch bolt and mounting a 0.25-20 bolt to the panel to serve as grounding stud. The grounding stud shall be attached with a nut and flat washers on both sides of the enclosure/panel, and with an inside tooth star lock washer next to the panel surface. The star lock washer shall be on the inside surface of the enclosure, and the front surface of the mounting panel. The grounding wire shall be secured to the stud with a nut and inside tooth star lock washer. These grounding points shall be located within 12 inches of the bottom to the grounding bar. Each terminal strip rail shall be individually grounded by means of a #12 AWG wire to the ground bus.
3. Components within the panel shall be grounded according to the manufacturer's recommendations.

2.05 COMPONENTS

A. Switches and Pushbuttons

1. Switches (HS) and pushbuttons (HC) for general purpose applications shall be water and oil tight as defined by NEMA 4X, corrosion resistant as defined by NEMA ICS 6 110.58, U.L. listed, standard 30 mm diameter, with plastic holding nut.
2. Switches and pushbuttons shall have contacts rated NEMA A600 or 10 amperes continuous and 600 VAC. Provide NO and NC contacts to facilitate functional requirements indicated.
3. Engraved black legend plates shall be provided to define each switch and pushbutton function.
4. Selector switch handles and pushbutton caps shall be black unless otherwise noted on drawing. Lock-out stop caps shall be red.
5. Selector switches for hand off auto (HOA) applications shall have the hand position to the left, off in center, and auto in the right position.
6. Pushbuttons and selector switches in hazardous locations shall have hermetically sealed contacts or explosion proof enclosures.
7. Lockout stop pushbuttons shall include padlocking attachment. Pushbutton type shall be coordinated with padlock attachment type.
8. Switches and pushbuttons shall be Allen-Bradley 800H, or equal.

B. Indicating Lights

1. Indicating Lights for general purpose applications shall be NEMA 4X, corrosion resistant as defined by NEMA ICS 6 110.58, U.L. listed, 30 mm diameter, with plastic lens, plastic holding nut, and miniature bayonet lamp base.
2. Lamp shall be full voltage 120 VAC with 28 chip (min) High Intensity LED.
3. Indicating lights shall have contacts rated NEMA A600 or 10 amperes continuous and 600 VAC. Provide NO and NC contacts to facilitate functional requirements indicated.
4. Engraved black legend plates shall be provided to define each lights function.
5. Indicating light type and color of lens shall as follows or as otherwise shown on the Drawings:
   a. Open/On — Green
   b. Closed/Off — Red
   c. Alarm — Amber or Blue
   d. Power On — White
6. Indicating lights designated "PTT" on wiring diagram or shown with push-to-test wiring shall be provided with a push to test switch and wiring.
7. Indication lights shall be Allen-Bradley 800H, or equal.

C. Relays and Timers

1. General: Relays and timers shall be provided with N.O. or N.C. contacts as shown on the Drawings. All spare contacts shown shall be provided. Contacts shall be rated 10 amps minimum at 120 VAC, 60 Hz unless otherwise shown on the Drawings. Coil voltage shall be 120 VAC unless otherwise described or shown on the Drawings. Relays and timers shall be designed for continuous duty. All relays shall be U.L. listed. All relays and sockets shall be the product of a single manufacturer. The following is a summary of abbreviations associated with relays and timers:
    a. CR – Control relay
    b. CRM – Control relay (miniature)
    c. TR – Timing relay
    d. TDOE – Time delay on energization
    e. TDOD – Time delay on de-energization
    f. PR – Power Relay
2. Sockets for plug in relays and timers shall be standard industrial type DIN rail mount with barrier type pressure plate screw terminals. Sockets shall be rated 300 VAC, 10 amps minimum.
    a. Blade 8 or 11 pin for coil voltage above 90 volts AC or DC.
    b. Octal 8 or 11 pin for coil voltage below 90 volts AC or DC.
3. Control relays (CR) shall be plug in type with neon indicating lights and clear see through sealed housing to exclude dust. Provide IDEC Type RR, or equal. Two form C contacts (minimum) shall be provided on each relay.
4. Control relays (CRM) shall be plug in type with LED indicating lights and clear see through sealed housing to exclude dust. Provide Omron MY4ZN series, or equal. Four form C contacts (minimum) shall be provided on each relay.
5. Time delay relays on energization (TR-TDOE) shall be solid-state plug-in relays with adjustable timer ranges from 1 second to 10 hours selectable unless other ranges are shown. Provide LED timer energized indicator lamp. Time delay relays shall be IDEC RTE, or equal.
6. Time Delay Relays (TR-TDOD)
    a. Time delay relays on de-energization (TR-TDOD) (continuous power control input) shall be solid-state plug-in relays with a timer adjustable range from 1 second to 10 hours selectable unless other ranges are shown. Provide LED timer energized indicator lamp. Time delay relays shall be IDEC RTE, or equal.
    b. Time delay relays on de-energization (TR-TDOD) (true off) shall be solid-state plug-in relays with a timer adjustable range from 1 second to 10 minutes unless other ranges are shown. True off time delay relays shall be IDEC GT3F-2, or equal.
7. Power relays (PR) shall be plug in ice cube type with clear sealed housing to exclude dust.

a. Applications requiring 3PDT contacts rated 20A or 0.5 HP at 120 VAC (minimum), furnish Magnecraft Type 389FXCXC-120A, or equal.
b. Applications requiring SPDT contacts rated 25A or 1.5 HP at 240 VAC, furnish Magnecraft Type 389FXBXC-120A, or equal.
c. Furnish compatible blade type relay socket model 70-788EL11-1 or equal.

2.06 POWER SUPPLIES

A. Uninterruptible Power Supply (UPS)
1. The UPS shall be installed within the control panel and power all process related 120 VAC devices and DC power supplies.
2. The UPS capacity/size shall be as shown in the contract Drawings. The battery capacity shall be such that it may provide nameplate power for 10 minutes (min) from a fully charged battery(s).
3. The UPS shall provide surge protection and filtering: 0.3% IEEE surge let-through, zero clamping response time to meet UL 1449. The inverter shall provide true sine wave output.
4. When the Utility power voltage is outside of a preset range (approx. <100 < V < 130 VAC) then the UPS shall power the load from storage batteries and a solid state inverter.
5. The power supply shall be wired into the control panel power circuit per the contract Drawings.
6. The UPS operating ambient temperature range shall be 32 deg F to 122 deg F minimum.
7. The inverter shall be self resetting and continuously on-line regardless of the Utility power existence. Configure the UPS to restart automatically upon restart of utility power without operator intervention. The rectifier/charger shall recharge and maintain float charge on the batteries automatically.
8. The UPS shall be of a readily available commercial manufacturer. Provide American Power Conversion Smart UPS, or equal.

B. DC Power Supply (PS)
1. The DC power supply shall utilize a switching power stage, rectifier and voltage regulator. The power supply case shall be DIN rail mountable.
2. The power supply shall operate on 120V AC and provide DC output voltage and current as shown in the Contract Drawings.
3. The power supply shall be wired and fused per manufacturer instructions and Contract Drawings. Power supply output shall include self resetting overcurrent protection.
4. Power supplies below 101 Watts output power shall be Class 2 rated.

5. The power supply shall provide 2% voltage regulation for a change of 10% load to 100% full load.
6. The DC power supply shall be IDEC PS5R Series (non-redundant applications), Sola SDN-C, Phoenix Contact Quint Power, or equal.

C. DC Power Redundancy Module
1. The external redundancy module shall allow two power supplies to exist in a parallel redundant configurations. The external modules purpose is to increase the reliability by isolating the power supplies and providing a single output. If either of the power supplies was to fail, the output would not be impacted. The redundancy module shall include monitoring contacts for each input power supply and for the output. Provide the redundancy module with capacity rating equivalent or larger than the power supply rating.
2. The DC power redundancy module shall be Sola SDN xx RED, Phoenix Contact Trio Diode, Weidmuller Pro RM, or equal.

D. DC Battery Control Module (DC UPS)
1. The DC UPS shall charge 24 volt lead acid battery and switches over to battery power upon DC power failure with zero crossover time.
2. The power supply shall operate on 24V DC and provide DC voltage and current as shown in the Contract Drawings.
3. The power supply shall be wired and fused per manufacturer instructions and Contract Drawings.
4. During power failure the battery voltage shall pass through to power the load with voltage limits to prevent discharge of battery below 85% of nominal voltage.
5. Equipped with over temperature, over current protection, and adjustable current limit.
6. The DC Battery Control Module shall be Sola SDU, Phoenix Contact Trio UPS, Weidmuller CP DC UPS, or equal.

2.07 MISCELLANEOUS COMPONENTS

A. Wireway: Manufactured from light gray rigid PVC suitable for continuous use at temperatures up to 50 deg C. Wireway shall be 2” height, width as required with 0.5” slot spacing with removable covers. Provide Panduit type “F” or equal.

B. Hardware: 316 stainless steel machine thread screws and bolts, hinge pins, washers, nuts, and lock-washers.

C. Intrusion Switch: The intrusion switch shall have a pin plunger that is depressed when the door is closed. The form C contacts shall be rated 2A at 120 VAC. Provide Hoffman A-LFSWD, Microswitch 1AC2 or equal.

D. LED Strip Light: The LED light shall be an “under cabinet” style with multiple LED lamps and acrylic diffuser. Lamp shall be switched on/off from integral switch or PIR motion sensor. Light housing shall be capable of magnet mount to top or side of enclosure or will include mounting tabs for mounting to brackets. Lamp shall be powered from 120VAC or from 24~48 VDC or shown in the contract Drawings. LED Strip Light shall be Stego 02540, or equal.

E. Circulation Fans: The control panel temperature shall be maintained 10 deg. F below lowest internal device’s temperature rating. The fans shall be 4” or 6” unless otherwise noted on Contract Drawings. The Contractor shall calculate the heat generation of all internal components and determine if the fans submitted will meet the cooling requirements of the internal components. Circulation fans shall include louver with filter and bug screen for outdoor installations.

F. Forced Air Heater: The control panel temperature shall be kept above 50 deg. F through the use of a resistive forced air heater when the panel is located outdoors. The heater shall contain a fan, heating elements, and thermostat within a single self contained unit. The wattage of the heater shall be as calculated by the supplier using the manufacturers sizing method to meet the temperature requirements. The heater shall be Hoffman D-AH series, or equal.

G. Thermostats: The air circulation fans shall be controlled by adjustable thermostat. The thermostat shall be mounted near the top of the panel and easily accessible by a technician. The thermostat shall be capable of control of a heater or cooling fan(s) by selecting the proper contact logic. The thermostat range shall be adjustable from 30 to 140 deg F. Thermostat shall be Hoffman A-TEMxx, or equal.

H. Temperature Transmitter: The temperature transmitter shall provide a 4-20 mA output directly proportional to the temperature range o the transmitter. The transmitter shall have a factory calibrated temperature range of -4 to 158 deg F. Transmitter shall be din rail mounted. Furnish XEGsys Model SSGTT-2070, or equal.

PART 3 EXECUTION

3.01 WORKMANSHIP

A. All work in this Section shall conform to the codes and standards specified in Electrical Specifications [Electrical General, Workmanship].

3.02 FABRICATION

A. Equipment Mounting:

1. Mount all equipment using manufacturers mounting tabs/holes or brackets where possible. Where not possible, construct custom brackets to panel mount or backpan mount components as shown in the Contract Drawings.
2. Equipment or laptop shelves shall be provided where shown on the Contract Drawings. Equipment shown on shelves shall not be placed on the bottom of the panel after field installation.
3. All nuts, bolts, screws, washers and hinges used in the panel shall be stainless steel. All components shall be mounted using bolts or screw fasteners only which are drilled and tapped into the backpan. Pop rivets shall not be allowed within panel except for enclosure support arms.

B. Environmental:
1. Control panel environmental accessories including fans, louvers, filters, bugscreens, air conditioners, etc. shall be provided as noted in the Drawings and as necessary for a complete environmental solution.
2. Panels environmental controls shall be designed during shop drawing submittal and fabricated to maintain temperatures 10 degrees F below lowest internal equipment maximum temperature rating.
3. Contractor shall provide (additional) fans, louvers, screens, sunshades, air conditioners, etc. as necessary to prevent equipment malfunction or premature failure. Provide associated wiring and thermostats as needed.
4. Environments:
   a. NEMA 4X rated panels shall be cooled/heated with closed loop type conditioning systems to include air conditioners, internal panel circulation fans and resistive heaters.
   b. NEMA 3R rated outdoor panels shall be cooled/heated with open loop type conditioning systems to include air conditioners, exhaust fans and louvers, internal panel circulation fans and resistive heaters. All exhaust fans and louvers shall include filters and bugscreens.
   c. NEMA 12 or 1 rated indoor panels shall be cooled/heated with open loop type conditioning systems to include air conditioners, exhaust fans and louvers, internal panel circulation fans and resistive heaters. All exhaust fans and louvers shall include filters and bugscreens.

3.03 INSTALLATION

A. Wiring:
1. Install all equipment per Electrical Specifications [Electrical General].
2. All internal and field wiring shall be per Electrical Specifications [Low Voltage Wire].

3. Panel Wiring: All wiring shall be installed in wireways between terminal blocks and devices. Reference Contract Drawings for Control panel power distribution diagram and control panel elementary diagrams.
4. Field Wiring: Wireways shall be provided for field wiring. Reference Contract Drawings for control panel power distribution diagram and control panel elementary diagrams.

B. Cleaning:
1. The Contractor shall clean the inside of the control panel of any dust or debris remaining at the completion of installation and testing.
2. The Contractor shall exercise care when using a vacuum cleaner or compressed air such as not to damage any component within the panel.
3. Many electrical and computer components are open for ventilation. Falling debris can penetrate the openings and cause equipment failure. Equipment with debris inside shall be removed, cleaned and/or replaced.

3.04 FIELD ASSISTANCE

A. Provide testing as specified in Electrical Specifications [Factory and Field Testing].

3.05 WARRANTY

A. Provide warranty as specified in Electrical Specifications [Electrical General, Warranty].

3.06 FINAL ACCEPTANCE

A. Final Acceptance per Electrical Specifications [Electrical General].

END OF SECTION

SECTION 16910 - PLC & OI HARDWARE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Providing and installing Programmable Logic Controller (PLC) and Operator Interface Hardware and all supporting hardware, wiring and devices as specified in Electrical Specifications.

1.02 REFERENCES

A. Electrical Specifications [Electrical General]

B. Electrical Specifications [Low Voltage Wire and Data Cable]

C. Electrical Specifications [PLC and OI Application Programming]

1.03 SUBMITTAL REQUIREMENTS

A. Provide submittals per Electrical Specifications [Electrical General, Submittal Requirements].

B. Submit documentation showing the number and type of I/O modules required to meet the I/O requirements specified herein. Include complete manufacturer's part and model numbers.

1. PLC I/O points are determined by the P&ID Drawings. The Contractor shall count and total the PLC I/O points per PLC controller and per type of I/O required based on the P&ID diagrams. Provide 25% spare I/O points per I/O type per PLC.

C. Submit calculations showing that the power supply meets the specified requirements and the requirements of the devices powered. Confirm PLC power supply is sufficient for all possible operable conditions.

D. Submit shop drawings showing physical backpan layout of equipment in Control Panel.

E. Submit communications block diagram including PLC, OI, motor controls, power supplies, switches, routers, radios, and any other connected components.

F. Submit hardware Operations and Maintenance Manual per Electrical Specifications [Electrical General].

PART 2 PRODUCTS

2.01 GENERAL

A. Provide PLC modules from a single family of products, using the same software and interchangeable I/O cards, that can be configured for a range of applications from small, uncomplicated sites to large, complex sites with a variety of equipment.

B. Provide a PLC that will meet the following requirements:
   1. Size and provide a CPU and power supply to accommodate the CPU, I/O cards, communication devices, etc. as specified herein.

C. Provide a PLC that can be expanded in the field by the addition of the following types of plug-in modules or cards and interface cables without rendering the originally furnished PLC components obsolete.
   1. Digital Inputs
   2. Digital Output
   3. Analog Input
   4. Analog Output with PID control

D. Size the PLC enclosure such that local I/O modules and supporting hardware required to meet the ultimate point count, as specified herein, will fit into the space of a single enclosure.

2.02 MECHANICAL

A. Provide modular PLC consisting CPU, power supply, communications, and I/O modules.

B. Provide I/O modules with removable terminal strips so that I/O modules can be removed without disconnecting field wiring.

2.03 PLC COMPONENTS

A. The following components (Allen Bradley, or equal compatibility with existing City's system) shall be provided to complete the PLC(s). Only major components are listed. Multiples of some components are required- see Drawings.

B. Compact Logix 5380

1.	Processor – (0.6MB, 8 I/O, 16 IP nodes)	5069-L306ER
2.	Power Supply	5069-FPD
3.	Digital Input Module (AC)	5069-IA16
4.	Digital Input Module (DC) low voltage field or internal contacts)	5069-IB16 (As needed for
5.	Digital Output Module (Relay)	5069-OW16

6.	Analog Input Module	5069-IF8
7.	Analog Output Module	5069-OF4
8.	Serial Comm Card 2 port	5069-SERIAL
9.	Address Reserve Module	5069-ARM
10.	Terminal Block 6 point	5069-RTB6
11.	Terminal Block 18 point	5069-RTB18
12.	Terminal Block 6-4 point	5069-RTB64

2.04 ISOLATION/INTERFACE RELAYS

A. Provide output isolation relays on all digital outputs that operate devices external to the control panel and on spare outputs or as otherwise shown in the Drawings. The relay coil connection shall be on one side of the relay base and form-C output contacts on the other.

B. Relays shall be 6A SPDT, coil voltage as required, indicating, plug in style as manufactured by Allen Bradley 700-HLT1U1 or equal. Provide jumper bars for common buss connections, Allen Bradley 700-TBJ20G, or equal.

2.05 ETHERNET SWITCH

A. The unmanaged Ethernet switch shall have minimum 8 ports. Ports shall be 10/100 Base-Tx with RJ-45, 8 pin female connectors. Switch shall be suitable for power from 10 - 30 VDC. Switch shall be N-Tron 108TX, Allen Bradley Stratix 2000, or equal.

2.06 BROADBAND WIRELESS CELLULAR ROUTER

A. Acceptable products: Sierra Wireless RV55 4G LTE intelligent gateway, or equal. Compatible with Verizon and AT&T

B. General Specifications
1. Internet Connections Supported: 1 Embedded 3G/4G connection
2. Networks Supported for Embedded Modem: Verizon 2G, 3G, and 4G
3. Ethernet ports: 1 LAN, 10/100.
4. SIM card slot for with broadband plan (by Owner)
5. AC wall pack power supply or 12 to 28 VDC from panel power supply.
6. AWS, LTE, HSDPA, HSDPA+
7. Onboard IPSec SSL VPN client, SSH, HTTPS
8. Operating Temperature: -30˚C to +70˚C (-22 to 158˚F)

C. Host Interfaces:
1. 10/100 Base-T RJ45 Ethernet
2. RS-232 Serial Port

D. LED Indicators:

1. Signal strength, Activity, Power

E. Antenna:
   1. 800-1900 MHz Magnet Mount Antenna
   2. SMA Male Connector and 10-Foot RG174 Coax Cable
   3. Wilson Electronics, or equal

2.07 IP SERVICE ROUTER

A. Acceptable products: Netgate SG-2100 or equal.

B. Provide shelf for panel mounting of router.

C. General Specifications
   1. 2x 1 Gigabit WAN/LAN ports plus a 4 port switch provide high-speed wired connectivity
   2. PF-Sense firewall to support stateful packet filtering, firewall, and pure router capability.
   3. Supports IPsec, OpenVPN, PPTP, IPv6, NAT, BGP, RADIUS
   4. ARM v7 Cortex-A9, 2 GB DDR4L memory, M.2 expansion for SSD, or LTE.

2.08 OPERATOR INTERFACE (OI)
   1. Allen Bradley Panelview Plus 7 Standard, 2711P or approved equal.
   2. Touch Screen
      a. 12 inch screen size with 1024 x 768 resolution, 65536 colors.
      b. TFT color touchscreen with LED backlight and 300nits brightness.
      c. Alarm history screen with present status and acknowledge functions.
   3. Communications
      a. Ethernet Allen Bradley IP protocol
      b. Type B USB port for programming.
      c. Type A USB port for data logging and alarm history.
   4. Data storage
      a. 82MB backed up RAM for program, Two SD RAM slots for data.
      b. Furnish one 32GB SDHC card for data storage.
      c. Trending for up to 16 pens (colors) with historical data access from USB RAM drive.
   5. Environmental conditions:
      a. Operating Temperature: 32 to 122 degrees F
      b. Storage Temperature: -4 to 140 degrees F
      c. Humidity Rating: 10 to 90%, non-condensing at 32° F to 86° F
      d. Rating: NEMA 12, 13, 4X (indoor only)
      e. Voltage: 24VDC.

2.09 ETHERNET IP TO SERIAL CONVERTER

A. The IP to serial converter allows a connection from Logix controllers to serial devices. Multiple protocols supported such as Modbus and DF1. Unit shall operate on 24 VDC power. Provide routing module, Prosoft PLX51-DF1-ENI, no equal.

PART 3 EXECUTION

3.01 WORKMANSHIP

A. All work in this Section shall conform to the codes and standards specified in Electrical Specifications [Electrical General, Workmanship].

3.02 INSTALLATION

A. Fabrication
   1. Mount, wire and Ground PLC and OI per manufacturer's recommendations.
   2. Organize equipment on control panel backpan per Backpan Layout detail in Contract Drawings.
   3. Locate and install PLC(s) and OI(s) per Contract Drawings.

B. Wiring
   1. Terminate status, control and analog wiring on terminal blocks.
   2. Label and wire PLC to terminal blocks per Electrical Specifications [Wire, Fuses & Terminal Block] and Example I/O Wiring Diagram in the Drawings.
   3. All spare I/O points shall be wired to terminal blocks.
   4. Install communication cables to connect the PLC to external devices.
   5. Bundle and tie down wires in a neat and orderly manner.
   6. Terminate drain wire of shielded cables at backpan terminal block only.

3.03 FIELD ASSISTANCE

A. Provide testing as specified in Electrical Specifications [Factory and Field Testing].

3.04 WARRANTY

A. Provide warranty per Electrical Specifications [Electrical General, Warranty].

B. Perform the following services during the warranty period:
   1. Repair or replace damaged modules returned for service within 24 hours.
   2. Determine and report the cause of failure of modules returned for service.

3. Resolve design or implementation problems discovered.

3.05 FINAL ACCEPTANCE

A. Final Acceptance per Electrical Specifications [Electrical General].

END OF SECTION

SECTION 16915 - PLC & OI APPLICATIONS PROGRAMMING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Programming of the PLCs, OIs and SCADA to control the station automatic functions and communications.

1.02 REFERENCES

A. Electrical Specifications [Electrical General]

B. Electrical Specifications [PLC and OI Hardware]

C. Project Drawings

1.03 QUALIFICATIONS

A. Services furnished under this specification shall be performed by Application Programmer meeting requirements specified in Electrical Specifications [Electrical General, Qualifications].

1.04 SECTION INCLUDES

A. Program definition and control descriptions for Programmable Logic Controller(s) (PLCs) used to control new equipment (and existing equipment as noted) as it relates to this project.

B. Operator Interface(s) (OIs) configuration and programming to compliment PLC program code.
   1. Touch screen graphics, database, and configuration to support local control of the station/project. Graphic screens shall generally be based on P&ID drawings.
   2. Display of station status and values and allow for changes to settable parameters within the PLC program.
      a. Display of analog values and associated alarms.
      b. Display of digital values and alarms
      c. Alarm notification of un-acknowleged and acknowleged alarms.
      d. Manual control of equipment.
      e. Display values for setpoints and ability to modify setpoint values.
   3. Configuration of alarm notifications system for all alarms.

C. SCADA system is existing and has present license capacity for addition of this project. SCADA software is Wonderware.
   1. Current SCADA system includes 2 SCADA I/O server computers and one historical database server with SCADAlarm alarm notification.
   2. Add or enable driver for communications to Allen Bradley IP over ethernet and VPN to remote site.
   3. Coordinate with Pleasanton IT department to set up central VPN host.
   4. SCADA screen graphics, database, and configuration to support remote control of the station/project. Graphic screens shall generally be based on P&ID drawings.
   5. Configuration of historian database to log specific datapoints to record station activities and situations.
      a. Analog values and associated alarms.
      b. Digital alarms
      c. Equipment start/stop or open/close.
   6. Configuration of (voice and/or text) alarm notifications system for all alarms.

D. Related work as specified in Electrical Specifications [Electrical General].

1.05 SUBMITTAL REQUIREMENTS

A. Provide submittals per Electrical Specifications [Electrical General, Submittal Requirements].

B. Submit software operations manual including the following as a minimum.
   1. Program Code
      a. Program code demonstrating function in compliance with descriptions herein.
   2. Setpoint listing with description
   3. Program description
      a. Provide written description of program operation. Description shall cover all aspects of normal operation and alarm shutdowns. Describe all alarms and their effect on operation. Describe alarms that require manual reset.
   4. Register cross reference listing
      a. The listing shall be in table format and include all program constants and variable registers with their functions.
      b. The listing shall show (block and rung number) where the register is used within the program code.
   5. Configuration and Set-up
      a. The configuration of the processor and hardware selections shall be summarized.
      b. The configuration of the communication ports shall be shown.

6. Data Tables
    a. Print data tables with initial register values shown.
7. Special files
    a. Include any special files that are particular to the manufacturer. All files pertinent to programming or configuration shall be submitted.

C. Submit software documentation demonstrating understanding of control software requirements and compliance with Portability and Maintainability requirements specified in this Section.
1. Submit OI graphic layout and PLC program listing with cross-references for approval 4 weeks prior to factory test.
2. A PDF color copy of SCADA and OI graphic screens and PLC applications programs (with comments) shall be provided with the submittals and for as-programmed final documentation for O&M manuals. Layout shall be sized so that the complete program logic with comments fits on one page (portrait or landscape) and rotated upward.
3. Submit electronic version of SCADA and OI graphic screens and PLC applications programs native file format with each software submittal and at the end of the project for as-programmed final documentation for O & M manuals. Provide thumb drive with files or via internet with project name and purpose identified file and folder names.

1.06 PROGRAMMING METHODS

A. Design and code programs per the following:
1. Utilize ladder logic programming language as available in the PLC manufacturer's configuration software. Other software languages such as function block, flow charts, and structured text shall not be used unless approved through RFI/submittal process.
2. Clearly comment each line of program logic code. Include module headers detailing the purpose of the module, programmer name, date of last revision, revision history, and description of sequence of events.
3. Comment for each block of code explaining purpose of program block.
4. Code shall use the P&ID device names as the prefix to the names or tagnames throughout the program logic. Reference tag formation below. If PLC does not use tagnames as data reference, then provide tagname in symbol name or in comment areas at minimum.
5. Data arrays may be used in tagname aliases for communication data transfers.
    a. Provide program file for each type of program logic. The following are types that should be used, as applicable and at minimum.
    b. Analog input scaling
    c. Analog output scaling

d. Analog alarms
e. Digital alarms
f. PLC clock, midnight and today/yesterday control
g. Flow totalizations
h. Equipment runtimes
i. Equipment starts
j. Communications
k. Each individual piece of controlled equipment (digital control)
l. Each individual piece of controlled equipment (analog control)
m. Each individual process system (digital control)
n. Each individual process system (analog control)

B. All custom software, including diagnostic, configuration and applications programming software shall become the sole property of the Owner for their use on this and future Owner projects.

C. No software or documentation shall be labeled proprietary.

D. Provide two (2) digital copies of all as-installed programs at the end of the project.

E. Furnish and maintain 256MB (min) USB RAM thumb drive on site and within control panel so that latest program files are always available and up-to-date. Upon conclusion of each downloaded program change, the USB RAM thumb drive shall be updated.

PART 2 PRODUCTS

2.01 APPLICATIONS PROGRAMMING SOFTWARE

A. The Application Programmer is responsible for obtaining PLC & OI configuration software to program and configure the PLC & OI for testing purposes.

2.02 APPLICATIONS PROGRAM CODE

A. The Application Programmer will provide, install and test (with Contractor assistance) application programming. The descriptions provided herein are not final and may have modifications made to them during construction that may change the nature of operation.

B. The SCADA screens shall be modeled after similar processes or equipment within the SCADA System. Motors, valves, values, colors, menus, etc. Modify layouts as needed and adjust programming as needed to meet requirements herein.

C. The program code shall be written without any “hard-coded” constants that would effectively require a program change to modify the value. Program code shall contain variable registers only.

2.03 CONTROL STRATEGIES

A. General Requirements:

1. The following requirements (General and Specific) are intended to be used as a guideline for application programming of the PLC. They are the major functions and are not intended to be completely comprehensive of all requirements of the station operation and do not attempt to cover all necessary program routines for an operational system. Additional features, functions and registers will be required for an operational system.
2. The following general program functions shall be provided:
    a. Enable/disable toggle bits and variable time delays for all alarms.
    b. Analog input noise filtering -- software or firmware.
    c. SCADA Auto-Off-Manual controls for all equipment controlled by the PLC. These control buttons shall also be accessible via the OI(s).
    d. All equipment to have a Remote Reset feature available from SCADA and OI(s). Remote Reset signal to be held on until cleared by Reset Feedback signal.
    e. Normal operations shall continue with loss of SCADA connection. The PLC code shall act on I/O connections, PLC to PLC communications, and non-SCADA communications only to control the system. Only in the event of SCADA override, shall the system not act on PLC I/O connections and non-SCADA communications. None of the program code to control the system shall reside in the SCADA system.
    f. Time of day clock synchronization with SCADA system. PLC shall have registers defined for SCADA system clock write. The PLC shall have code written to recognize that the register(s) have been written to, stop the real time clock, set the clock, and restart it, with the value in the register(s). Date and time of day shall be set.
    g. Resettable and non-resettable operation hour meters for all equipment and resettable starts counters for all equipment.
    h. Scaling to engineering values of all variables. Minimum of 3 significant digits required.
        1) Level in 1/10th Feet or Inches
        2) Pressure in 1/10th PSI.
        3) Flow in GPM.
        4) Flow totalization

a) Total non-resettable flow displayed in MGD with 9999999.999 presentation layout.
b) Total resettable flow displayed in MGD with 9999999.999 presentation layout.
c) Total yesterday flow displayed in KGAL with 99999.9 presentation layout.
d) All registers shall roll over to zero automatically.

5) Speed in percent %.
6) Motor current in 1/10 amps.
a) Convert current input to power (in KW) where shown on drawings. Assume voltage to be 480 and power factor to be 0.85.

i. Data register types:
1) Any register that requires precision past the decimal shall be floating point type.
2) Integer registers may be used where decimal precision is not required.
3) Boolean registers shall be used for all statuses and on/off controls.

j. All set point registers, enable/disable toggle bits and settable variable time delays shall be adjustable from the OI direct to program data table.

k. Provide communications messaging as required to share data information and interlocks between PLCs. Message structure shall be fail safe as to keep overflows or other improper operation from occurring.

l. A power fail shall reset all routines.

m. Pumps and equipment shall have backspin delays and power fail sequential re-start delay routines.

n. All powered equipment and devices shall have an assigned essential / non-essential status for purposes of generator load shedding.

o. Programming code shall have automatic error checking and proper initialization to prevent illegal operations such as negative values being placed in timer presets or mathematical out of range functions which could cause a processor fault.

p. PLC shall be programmed so that, in the event of a power interruption, the equipment controlled shall resume normal operation upon power restoration without requiring a manual reset unless otherwise shown.

q. Set points
1) Minimum required set points for Lead / Lag pumping scenario.
a) Lead Pump start level

b) Lag Pump start level
c) Lead Pump stop level
d) Lag Pump stop level
e) Pump Start delay time
f) Pump Stop delay time
g) Backspin delay time
h) Sequential Start delay time
i) Pump rotation selection (0=auto rotate, 1=P1 Lead, 2=P2 Lead)

2) Additional minimum required set points for Lead / Lag pumping scenario when variable speed control is used.

a) Minimum Lead Pump speed to start Lag Pump
b) Minimum Lag Pump speed to stop Lag Pump
c) Maximum Pump Speed
d) Minimum Pump Speed

3. Analog Scaling:
   a. All analog values shall be adjusted (if necessary) prior to scaling for required offsets due to hardware / firmware conditions.
   b. All analog input values shall be scaled into real world engineering units and presented in REAL (floating point) format for use by SCADA and the OI(s).
   c. All analog output values shall be scaled from real world engineering units into INT (decimal) format to control current or voltage output from an analog output device.
4. Alarms General:
   a. Common alarms: Provide all applicable alarms per device based on available P&ID inputs and outputs.
      1) Motor power or amperage alarms shall be disabled when the motor is not running.
      2) If a device is called to start or move and the associated run status does not confirm start or move after a time delay then post a device “Run fail” alarm.
      3) All equipment (as marked on P&ID drawings) shall have a non-running alarm.
      4) Not in Auto alarm: All devices (valves, gates, pumps) with auto switch monitoring shall have associated “Not in auto” alarms.
      5) Moisture / Temperature alarms: All submersible pumps shall have “Moisture” and “Over temperature” alarms.
      6) Seal Water Fail alarm: All sludge type pumps shall have “Seal water fail” alarms.
      7) Pressure alarm: All sludge type pumps shall have “Inlet and Outlet pressure” alarms.

8) Temperature alarm: All sludge type pumps shall have a pump body "Over Temp" alarm.
9) Differential pressure alarm: All filters shall have "Differential pressure" alarms.
10) Low oil alarm: All lubricated mechanical devices (gearboxes etc.) shall have a "Low oil" alarm.
11) Vibration alarm: All moving mechanical devices (gearboxes, aerators, pumps etc.) shall have a "Vibration" alarm.
12) Over torque alarm: All geared mechanical devices (clarifiers etc.) shall have an "Over torque" alarm.
13) VFD Fault: All VFDs shall have a common fault alarm as a minimum. Further breakdown of alarms shall be provided based on data available from the VFD. All VFDs shall have a manual reset available from the OI(s) and SCADA.
14) Flow, level, pressure, analytical and other analog alarms shall follow alarm structure as defined herein.
15) All digital alarm values will have at a minimum an associated alarm structure as defined herein.

b. Analog Alarms:
1) If an analog value is above/below the associated set point, and the associated time delay has exceeded the time delay set point, then the alarm shall be generated / annunciated.
2) Transducer out of range alarms. If the scaled value of the analog input exceeds 21 mA or falls below 3.5 mA, an out of range alarm shall be triggered for that input.
3) The alarm shall automatically reset unless a latch is required to keep the process from resuming and re-creating the alarm. A latching alarm requires either a reset set point for hysteresis or a manual reset.
4) The low flow alarms (and pressure alarms if applicable) shall only be enabled when the associated pump or system is running.
    a) Provide low flow alarm for pump operation where flow is expected above setpoint continuously when running. Alarm shall shutdown system and fail pump. If other pumps are available, they shall be called in its place.
5) Example analog alarm display structure (Units per alarm type). ENABLE / DISABLE shall be a toggle switch. DELAY to be editable timer base value for associated alarm delay timer. SET POINT column to contain current analog value in Transducer Fail Alarm row. Other alarm rows to contain editable alarm set point value with REAL (floating point)

data type. LATCH to be either reset set point value for reset of alarm or manual reset toggle (blank if alarm is not latching).

Description	Status	En / Dis	Delay	Set Point	Latch
Transducer Fail Alarm	ALARM	Enable	10 sec.	28.4 GPM	Reset
High Alarm	OK	Enable	5 Sec.	xxx.x GPM	OK
High Warning	ALARM	Enable	5 Sec.	xxx.x GPM	
Low Warning	OK	Enable	5 Sec.	xxx.x GPM	xxx.x GPM
Low Alarm	OK	Disable	5 Sec.	xxx.x GPM	xxx.x GPM

c. Digital Alarms:

1) If the digital alarm state is TRUE and the associated time delay timer has exceeded the time delay set point, then the alarm shall be generated / annunciated.

2) The alarm shall automatically reset unless it is designated as “latch”. A latching alarm requires a manual reset.

3) Example digital alarm Structure. ENABLE / DISABLE to be a toggle switch. DELAY to be editable timer base value for associated alarm delay timer. LATCH to be a manual reset toggle (blank if alarm is not latching).

Description	Status	En / Dis	Delay	Latch
Generic Digital Alarm 1	OK	Disable	10 sec.	
Generic Digital Alarm 2	ALARM	Enable	10 sec.	Reset

d. Communications Alarm:

1) The SCADA and connected PLC(s) shall monitor for communications between controllers and they shall post an alarm if any PLC fails to respond to message queries.

5. Totalization:

a. Flow totalization (Example):

1) If an analog flow input value is positive, then increment the flow totalizers (resettable and not resettable) for each 1000 gallons of accumulated flow.

2) If internal flow reset status is set, then set resettable flow totalizer to zero and reset the resettable totalizer.

3) Similar for all flowmeters / totalizers.

b. Hour Meters (Example):

1) If Generic Pump #1 running is set, then start hour timers.
2) If internal run time hours reset status is set, then set resettable run time hours to zero.
3) Similar for all device run time hours.

c. Starts Counters (Example):
1) If Generic Pump #1 running input is set or Generic Pump #1 start command is set (if running input is not available), then increment starts counter.
2) If internal starts reset status is set, then set resettable starts counter to zero and reset.
3) Similar for all device starts.

d. Intrusion Alarms (Example):
1) Provide intrusion alarms for panels and buildings with intrusion switches.
2) Alarm shall be generated after an adjustable time delay to SCADA.
3) If an OI or SCADA is present, then provide a way for an operator to reset and disable the intrusion alarm for a setpoint period of time.
4) After that time elapses, then the alarm shall be re-activated automatically.
5) If no SCADA or OI, then the alarm shall reset automatically once the condition is returned to normal state.

B. SPECIFIC REQUIREMENTS – Wastewater Lift Station

1. To be further defined by System Integrator and submitted for review. Include all operations to provide a fully functioning system.
a. Must comply with general requirements.
b. Provide time delays and time delay setpoints for all functions.

2. Pump Interlocks:
a. Power failure via power monitor.
b. High discharge pressure per pump
c. Low flow alarm per pump (when pump is operating)
d. Backup control system active on high or high-high alarm.

3. Consists of programming function for the following:
a. Wastewater Lift Station (Wetwell Level Control)
1) Wastewater lift pump station shall maintain wetwell level between start and stop level setpoints.
2) Pump Start Control
a) Start lead pump on lead pump start level setpoint.
b) Start lag pump on lag pump start level setpoint.
c) Stop lag pump on lag pump stop level setpoint.
d) Stop lead pump on lead pump stop level setpoint.

b. Level Transmitter Selection

1) Manual selection of controlling transmitter from SCADA.
2) Alarm if transmitters are out of sync beyond maximum difference setpoint.

2.04 OPERATOR INTERFACE (OI) and SCADA

A. Operator Interface
1. Full manual and automatic control interface to be provided on each touchscreen OI. Group controls logically to provide intuitive navigation through display screens for operators. Utilize colors and flashing symbols to designate abnormal conditions.
a. Station overview with current status and alarms.
b. Pump or equipment status, setpoints, and alarms for each pump. Use green for run, red for stop, yellow for alarm.
c. Station setpoints operation screens. Gray, white, black colors.
d. Alarm summary screens – flashing in alarm, yellow if active and acknowledged, gray if acknowledged and corrected.
2. Include all setpoints, controls selections, alarms, enable/disables, delay setpoints, status of equipment, and scaled analog values.
3. Each OI to allow full station operation and adjustment independent of SCADA.

B. SCADA
1. Provide SCADA display screens similar to existing screens for other associated facilities. Submit all new displays for review.
2. Include sufficient displays to incorporate all controls, statuses, alarms, setpoints and trends required for station operation.
3. Provide status and alarm indication of communications from SCADA to all PLC(s).

PART 3 EXECUTION

3.01 SOFTWARE DEVELOPMENT

A. The programming, setup and configuration of the PLC & OI shall be done by the Application Programmer as defined in [Electrical, General].

B. The PLC & OI shall be ready to be placed in operation at the time of Operational Testing.

C. Do not enable or set any passwords on the PLC software or hardware for this project.

D. Additional Programmer Labor Hours

1. The Application Programmer shall include in his bid price an additional 16 hours of PLC/OI/SCADA program configuration changes to be designated by the Engineer or Owner during testing and start-up.

3.02 FIELD ASSISTANCE

A. Provide testing as specified in Electrical Specifications [Factory and Field Testing].

3.03 WARRANTY

A. Troubleshoot and correct all program abnormalities, glitches and bugs uncovered during the warranty period. Provide phone and/or on-site support as required to correct problem(s).

B. Software support which shall be provided by the Application Programmer as it relates to this project:
   1. Free technical software and hardware troubleshooting phone support for a period of one year. Phone support shall be provided directly from the Application Programmer. Phone support shall be available between 8 a.m. and 4 p.m. Pacific Standard Time Monday through Friday.
   2. The Application Programmer shall correct any software configuration error that is discovered within the warranty period, at no additional cost to Owner. Updated documentation for each "operation and maintenance" manual and new USB flash drives of updated software shall be provided for each correction.

END OF SECTION

SECTION 16940 – INSTRUMENTATION

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish, configure, test, commission, and warrant instrumentation as shown in the P&IDs, plans, and/or listed in specification section.

B. Include necessary piping, valves, pressure reducers, mounting brackets or flanges, supports, and anchors to complete installation.

C. Provide sunshades for instrumentation for all instruments that are exposed to direct sunlight.

D. System Integrator selection of instrumentation shall be per manufacturer's recommendation for the application and per specifications. If a manufacturer's recommendation or installation instructions are inconsistent with the Contract installation details or specifications, then the Contractor shall submit an RFI describing the inconsistency. If the inconsistency is due to substitution from the first named equipment, then the responsibility of coordination and any additional cost shall be borne by the Contractor.

E. The Contractor shall coordinate with each supplier of instrumentation to confirm that primary elements are provided in a timely manner, meeting critical path scheduling.

F. The Contractor shall coordinate process connection size, equipment size, and material type, and oversee the installation, calibration, and acceptance testing.

G. Projects that come into contact with drinking water: (NSF-61 certification)
   1. Furnish NSF/ANSI 61 certified products that have undergone testing for any device, valve, instrument, or assembly that will come into contact with drinking water.
   2. The certification determines what contaminants may migrate or leach from the product into drinking water and confirms if they are below the maximum levels allowed to be considered safe.
   3. Flowmeters, pressure transmitters, and chemical analyzers are a few of the products that may fall into this category requirement.

H. Provide all devices, valves, tubing, fittings, wiring, terminal blocks, calibration consumables, initial calibration equipment, accessories, sunshades and enclosures as specified herein and as shown on Contract Drawings.

I. The Contractor shall furnish all tools, calibration equipment, calibration materials, specialized parts and incidentals necessary to integrate the instrument to the application.

J. Contractor shall furnish labor for installation, verification, start-up, calibration, testing and commissioning. Contractor shall prove proper function of instrument prior project completion.

1.02 REFERENCES

A. Electrical Specifications [Electrical General]

B. Electrical Specifications [Factory and Field Testing]

1.03 SUBMITTALS AND DRAWINGS

A. Submit shop documents and drawings for approval in accordance with this subsection and as specified in Electrical Specifications [Electrical General, Submittal Requirements].

B. Submit Operating Instructions (O&M Manuals) for each instrumentation device prior to equipment installation.

1.04 OPERATING AND MAINTENANCE INFORMATION

A. Provide operating instructions as specified in Electrical Specifications [Electrical General, Operating and Maintenance Instructions].

PART 2 PRODUCTS

2.01 QUALITY

A. Electrical Specifications [Electrical General, Quality].

B. All equipment shall be designed and constructed so that in the event of a power interruption, the equipment specified hereunder shall resume normal operation without requiring a manual reset.

C. Signal transmission from remote or field electric and electronic devices shall be 4 20 mA, sourced by a 24 VDC supply internal to the instrument or from a 24 VDC power supply located within the panel that is to receive the signal. Nonstandard transmission methods such as impulse duration, pulse rate, and voltage regulated will not be permitted except where specifically noted.

D. Transmitters or devices located in Class 1, Division 1 hazardous areas shall be rated for hazardous location installations per NEC and UL. Explosion proof

enclosures and raceways or current/spark limiting devices located inside or outside of the classified area shall be furnished to comply with code requirements.

E. Outputs of equipment that are not of the standard signals as outlined, shall have the output immediately converted to 4-20 mA signals for remote transmission.

2.02 INSTRUMENT IDENTIFICATION

A. All major instrumentation and equipment items or systems specified in this Division and/or on the P&IDs are identified by tag numbers. Tag field equipment with assigned instrumentation tag number and functional description.
   1. Tags shall be 1/2" stainless steel DYMO impressed tape with 3/16"(minimum) height characters.
   2. Metal tape embosser shall feature a built in hole punching device and scissor cutoff tool.

B. Attach tags to equipment with a 4" long, 20-gage stainless steel wire leash for small devices, or two stainless steel screws for larger instruments; however, such permanent attachment shall not be on an ordinarily replaceable part or in an area that will be subject to unintended overuse fatigue. Make the tag plainly visible.

2.03 LEVEL COMPONENTS

A. Float Switch
   1. LSH-52, LSHH-52, LSL-52
   2. Tilting float level switches shall be a mercury free float switch, whose specified weight is less than that of the process liquid displaced, to actuate switches as the level changes. The non-mercury snap action switch is actuated by a steel ball rolling back and forth within a switching tube in plastic float housing. The SPDT switch shall be rated 7A at 120 VAC shall be integrally mounted in the float and connected to a control box by a nitrile PVC jacketed waterproof electric cable with three finely stranded No.18 conductors. The weight shall be integrally mounted so that no metals shall contact the process liquid. Tilting type level switch shall be Anchor Scientific Eco-Float Model GSI, or equal.

B. Radar Level Transmitter:
   1. LIT-51B, Scale based on wetwell depth.
   2. The radar level transmitter shall utilize non-contacting radar signal reflection technology to provide level monitoring for up to 15 meter range.
   3. The level transmitter (LT) shall have the following features:
      a. 1.5" MNPT connection

b. NEMA 4X / IP65 enclosure.
c. 2 wire 24 vdc loop powered, ground isolated, 4-20 mA output, max load of 750 ohm.
d. Bluetooth connectivity to cell phone for configuring parameters.
e. Operating temperature range from -40 to 140 deg. F in full sunlight.

4. The radar level transmitter shall be Endress and Hauser Micropilot FMR20, or equal.

C. Ultrasonic Level Transmitter:

1. LIT-51A, 0-30 FT Range, Scale based on wetwell depth.
2. The ultrasonic level transmitter shall utilize non-contacting ultrasonic signal reflection technology to provide level monitoring for up to 50 ft range.
3. The transmitter shall feature advanced echo processing algorithms that can be configured to ignore selected echos.
4. The transmitter shall be capable of controlling two pumps in a lead/lag configuration or using outputs for high and low level alarm outputs.
5. The transducer level element (LE) shall have the following features:
   a. Corrosion resistant plastic body, completely submergence rated.
   b. Rated for Class 1, Div. 1 hazardous atmospheres.
   c. Operating temperature of -40 to 200 deg F.
   d. Beam angle (degrees) as required for the application and to avoid obstructions.
   e. Beam range as required for the application.
6. The level indicating transmitter shall have the following features:
   a. NEMA 4X / IP65 enclosure.
   b. Ground isolated 4-20 mA output, max load of 750 ohm.
   c. Two 5 amp at 120V AC, SPDT relays.
   d. Integral 4 button keypad for configuring parameters.
   e. Integral 1.5” x 4” (min) backlit LCD display.
   f. Operating temperature range from -40 to 140 deg. F.
7. Provide one hand held or integral programming interface with each transmitter provided.
8. The ultrasonic level transmitter shall be Pulsar Ultra 3, or equal. The sensor range shall be 0-33 feet meeting all required applications. Provide 10m cable length. Provide dB10 sensor, standard transducer face, with 65mm angle bracket mount.
9. The ultrasonic level transmitter shall be Endress and Hauser Prosonic S FMU90, Siemens Hydroranger 200, or equal.

2.04 PRESSURE COMPONENTS

A. Submergence Rated Gauge Pressure Transmitter

1. PIT-61, PIT-62, 0-100 PSI
2. The submersible pressure transmitter shall be 4-20 mA loop powered with integral manufacturer's cable containing electrical conductors and breather tube. The transmitter electronics shall be electrically isolated from the fluid and include lightning protection and a sealed breathing system on the end of the breather tube.
3. The cable shall be Oil resistant PVC insulated with #20 ga shielded wire cable with integral non-pinch breather tube.
4. The body of the transmitter shall be corrosion resistant, all stainless steel construction. The transmitter shall have 1/4" FNPT connection with internal stainless steel sensing diaphragm. The submergence rated level transmitter shall be Blue-Ribbon model BR311GM, or equal.

B. Isolation Seal:
1. Diaphragm Seal (316SS) -- shall be factory assembled and filled prior to shipment. The fill fluid shall be silicone oil and suitable for the application. The diaphragm seal shall be designed for continuous duty, and shall prevent loss of process fluid if pressure instrument is removed or fails. The diaphragm seal shall feature a flushing connection and flushing ball valve. The diaphragm materials shall be suitable for contact with the measurement liquid without corrosion. The body of the diaphragm seal shall all welded made of 316 stainless steel with removable diaphragm. Instrument connection shall be 1/2-inch NPT and pipe connection 1" NPT. Furnish Blue Ribbon Series 1000, Ashcroft diaphragm seal Type 203 or equal.

2.05 FLOW COMPONENTS

A. Magnetic Flow Meter:
1. FIT-71, 4", 0-1000 GPM
2. The magnetic flow meter shall consist of a flow tube FE and a converter FIT, complete with interconnecting cables.
3. The magnetic flow meter shall be of the low frequency electromagnetic induction type and shall produce a DC pulse signal directly proportional and linear to the flow rate, with the duration not less than 100 milliseconds. Complete zero stability shall be an inherent characteristic of the metering system. Meters requiring field zero adjustment will not be acceptable. The meter accuracy shall not be affected by changes in fluid pressure, temperature, viscosity, or conductivity.
4. Accuracy
   a. The maximum error of the complete metering system including flow element and flow indicating transmitter shall be 0.50% of actual flowrate (in specified units) and readout over the range of full scale velocity settings from 1 to 30 feet per second. Variations

in temperature, voltage, and frequency within the ranges listed herein shall not affect the overall measuring accuracy.

b. Measured variables: volume flow, mass flow, and conductivity indications and signal transmission outputs as required and shown in the P&IDs. Accuracy on conductivity shall be 5% of range.

c. Suitable for 0xDN applications where inlet and outlet straight pipe length pipe requirements are 1 pipe diameter or less. Flowmeter inaccuracy shall not exceed 0.75% of actual flowrate over the range 0.5 to 1 M/S and 0.5% for 1 to 30 feet per second.

5. Flow Element (FE)

a. The flow element shall be based on a carbon steel pipe spool with ANSI class 150 flange connections or be flangeless construction as required by mechanical drawings. Class 300 flanges shall be provided where shown or when the pressure and temperature of the process fluid exceeds the rating of a 150 lb flange. The flow element size shall be as shown in the mechanical drawings and listed in the Instrumentation Schedule. Flange type and bolt pattern shall be coordinated with the mechanical Contractor prior to submittal.

b. The flow element shall have Hastalloy C4 coil and grounding electrodes.

c. Stainless steel grounding rings shall be provided at both ends of the flow element for all flowmeter applications. Grounding rings shall be manufactured from stainless steel, 2 mm thickness with grounding tab for electrical wire connection, and fit within the flange bolt circle. Grounding ring shall be self centering within pipe.

d. The flow element internal liner material shall be Teflon, polyurethane or hard rubber, unless recommended otherwise by the manufacturer for the application and approved.

e. Nema rating as defined in the Instrumentation Schedule.

6. Flow Indicating Transmitter (FIT)

a. The electronic flow indicating transmitter shall be mounted remotely from flow tube as shown on Contract drawings.

b. The electronic transmitter shall be provided in a NEMA rated enclosure per the Instrumentation Schedule.

c. The transmitter shall be interchangeable with all sizes of flow elements and shall be field replaceable (without replacing flow element) in the event of transmitter failure.

d. The transmitter shall be microprocessor controlled, utilizing digital signal processing with automatic zero correction to provide a linear 4 20 mA signal proportional to flow rate.

e. The transmitter shall incorporate a high impedance amplifier of 100,000 Megohms or greater, eliminating the need for electrode cleaning systems.

f. The transmitter shall contain a self test mode to allow the operator to manually simulate the output 4 20 mA signal to any value between 0% and 100% to check out any driven devices in the loop.

g. Rate indicator and totalizer: An alphanumeric LCD backlit display shall be provided to continuously display the flowrate and totalizer with units and all programming functions.

h. All programming configuration of the Flowmeter shall be completed through the transmitter's pushbutton interface. A communication device shall not be necessary to configure the flow transmitter.

i. PC based software shall be available and included for configuration and troubleshooting. Connection to flowmeter shall be via computer USB port and include interface cables as required.

j. The transmitter shall be designed for operation from a power source of 120 volts AC, with a power consumption of less than 20 watts. The flow element shall be powered from the transmitter.

k. The transmitter shall operate continuously without fault in an ambient temperature range from 14 to 140 °F. The flowmeter shall be suitable for operation in direct sunlight without the use of a sunshade. If a sunshade becomes required after installation for any operational reason, one shall be furnished and installed free of charge.

l. The following configurable parameters shall be provided at a minimum:

1) Field adjustable flow signal dampening.

2) Low flow cutoff (forces zero flow signal) between 0.0-5.0% of full scale rate.

3) Empty pipe detection (forces zero flow signal) if the pipe is not full.

4) Selection for forward/reverse/both flow directions.

7. Flow Indicating Transmitter (FIT) I/O Interface

a. Flow Signal: 4-20 mA signal proportional to the flow. The signal shall be field configurable for the flow calibration specified and others within the flow tube accuracy range. The flow signal shall be capable of measurement for forward and reverse flows combined by offsetting zero to mid scale (12 mA).

8. If the flow indicating transmitter (FIT) is shown in the Contract drawings to be mounted remotely from the flow element (FE), the manufacturer

shall provide all cabling between flow element and flow indicating transmitter.

9. All mounting hardware and/or devices necessary to complete the installation shall be provided by the manufacturer at no additional cost to the Owner.
10. The meter shall be hydraulically calibrated at a facility located in the United States and the calibration shall be traceable to the National Bureau of Standards. A certified copy of the calibration test results shall be submitted to the Owner prior to shipment of the meter.
11. The magnetic flowmeter shall be Endress and Hauser Promag, or equal.

PART 3 EXECUTION

3.01 WORKMANSHIP

A. Instrumentation work shall conform to workmanship standards specified in Electrical Specifications [Electrical General, Workmanship].

B. The Contractor shall employ personnel who are skilled and experienced in the installation and connection of equipment defined in this section. Contractor qualifications are specified in Electrical Specifications [Electrical General].

C. Verify that all equipment and materials fit properly.

D. All instrumentation configuration, programming and calibration shall be completed prior to the start of field tests.

E. Equipment without approved submittals shall not be installed.

F. All equipment shall be properly stored indoors while awaiting installation. Protect installed equipment from construction debris or mishaps. The Contractor will replace any equipment that is not in new condition at the time of installation and/or start-up.

G. Perform work to remedy non-compliant installations after inspection.

3.02 INSTALLATION

A. Install and supply all products necessary to provide an operational instrumentation system. This shall include the following:

1. Contract Drawings are intended to show the basic functional requirements of the instrumentation system. Insufficient detail does not relieve the Contractor from the responsibility to provide a complete and functioning system. If additional detail or clarification is required, the Contractor shall request such information prior to installation.

2. Provide relays, signal converters, isolators, boosters, power conditioners, circuit cards, and other miscellaneous devices as required for the compatible and functional interface.
3. Provide analog loop isolators where required to eliminate "ground loops."
4. The instrumentation and accessory equipment shall be installed in accordance with the manufacturer's instructions and located as shown on the Drawings or as approved. When manufacturer's installation literature specifies a particular location or orientation in a process line due to measurement accuracy considerations, the installation shall be in conformance with the manufacturer's instructions.

B. Instrument installation methods.
1. Install instruments at the location shown on the Plans or approved. Instruments enclosures shall be NEMA rated for the installed location.
2. Install level and plumb.
3. All instruments shall be provided with floor stands or wall brackets as shown in installation details or as required for functional installation.
4. Mounting stands shall be custom manufactured of aluminum channel with base plate unless otherwise noted in installation detail.
5. Mounting channels (unistrut), and spacers shall be galvanized steel above ground outdoors and stainless steel below ground (wetwell), unless otherwise noted in installation details.
6. All screws, bolts and anchors shall be stainless steel.

C. Wiring and raceway installation methods:
1. Terminal blocks shall be provided at all instrument cable junctions and all wires shall be identified at such junctions.
2. Instrumentation wiring shall be run without splices between instruments, terminal boxes, or panels.

D. Wiring, grounding, and shielding: The following practices shall be observed unless modified by manufacturer's standards.
1. Each electronic equipment chassis shall be grounded to power ground.
2. Shielded twisted pair, shielded triad, or manufacturer supplied cables only shall be used for analog signals and communications signals.
3. Drain wire of shielded cables used for analog inputs to the PLC shall be connected at the PLC unit only. Shield shall be isolated from ground at all other termination points including transmitters.
4. Drain wire of shielded cables used for analog outputs from the PLC shall be connected at signal receiving device only. Shield shall be isolated from ground at all other termination points.

5. If electrical interference noise is imposed on DC status and alarm signals, then they shall be re-routed or wire changed to shielded twisted pair cables.
6. Each shield drain wire which is not connected to ground shall be cut off covered with a heat shrink insulating boot at cable jacket end. Shields shall be connected together at each transition from one cable to another for an effectively continuous shield circuit.

3.03 SUPPLIER SERVICES

A. The Contractor shall be responsible for each supplier of equipment to provide the following minimum services for each type of instrument supplied. Each supplier shall provide a qualified instrumentation field technician to perform services listed herein. Contractor shall supply all calibration materials necessary to commission unit and shall not use any consumable materials that are intended to be furnished for the first period of use.
   1. Advise and instruct Contractor on proper installation requirements.
   2. Inspect, calibrate, test, and place equipment in operation. Calibrate instruments to values as shown in the instrument index or as noted herein. If instrument spans are required to change (within instrument range) during startup for process reasons, the Contractor shall change them as directed by the Engineer.
   3. Programmable devices shall be programmed and tested prior to startup. Programming shall be adjusted or changed as directed by the Engineer at any time prior to final acceptance.
   4. Perform testing in the presence of Engineer.
   5. Visit the project site as often as required and spend as much time as necessary to ensure accurate and operational instrumentation.
   6. Provide training as specified in FIELD ASSISTANCE.

3.04 FIELD ASSISTANCE

A. The instrument supplier shall provide a minimum of one (1) hour of field training to instruct Owner’s personnel in the use, operation, calibration, programming, and maintenance on each type of "field" instrument.

3.05 SPARE PARTS

A. Provide spare parts as described in each products section herein and specified in Electrical Specifications [Electrical General, Spare Parts].

B. Contractor shall supply all calibration materials necessary to commission unit and shall not use any consumable materials that are intended to be handed over to the Owner as defined in the instrument specifications.

3.06 WARRANTY

A. Provide warranty as specified in Electrical Specifications [Electrical General, Warranty].

3.07 FINAL ACCEPTANCE

A. Final Acceptance per Electrical Specifications [Electrical General].

END OF SECTION

EXHIBIT A

FEDERAL PROVISIONS – FEMA

I. DEFINITIONS

A. **Government** means the United States of America and any executive department or agency thereof.

B. **FEMA** means the Federal Emergency Management Agency.

C. **Third Party Subcontract** means a subcontract at any tier entered into by Contractor or subcontractor, financed in whole or in part with Federal assistance originally derived from the Federal Emergency Management Agency.

II. FEDERAL CHANGES

A. Contractor shall at all times comply with all applicable regulations, policies, procedures, and FEMA Directives as they may be amended or promulgated from time to time during the term of this Agreement, including but not limited to those requirements of 2 CFR 200.317 through 200.326 and more fully set forth in Appendix II to Part 200—Contract Provisions for non– Federal Entity Contracts Under Federal Awards, which is included herein by reference. Contractor's failure to so comply shall constitute a material breach of this contract.

B. The Contractor agrees to include the above clause in each third party subcontract financed in whole or in part with Federal assistance provided by FEMA. It is further agreed that the clause shall not be modified, except to identify the subcontractor who will be subject to its provisions.

III. ACCESS TO RECORDS

A. The Contractor agrees to provide the City, FEMA, the Comptroller General of the United States or any their authorized representatives access to any books, documents, papers, and records of the Contractor which are directly pertinent to this Agreement for the purposes of making audits, examinations, excerpts, and transcriptions.

B. The Contractor agrees to permit any of the foregoing parties to reproduce by any means whatsoever or to copy excerpts and transcriptions as reasonablyneeded.

C. The Contractor agrees to maintain all books, records, accounts, and reports required under this Agreement for a period of not less than three years after the later of: (a) the date of termination or expiration of this Agreement or (b) the date City makes final payment under this Agreement, except in the event of litigation or settlement of claims arising from the performance of this Agreement, in which case, Contractor agrees to maintain same until the City, FEMA, the Comptroller General, or any of their duly authorized representatives, have disposed of all such litigation, appeals, claims, or exceptions relatedthereto.

D. The requirements set for in paragraphs A, B, and C above are all in addition to, and should not be considered to be in lieu of, those requirements set forth in the City's Agreement.

IV. DEBARMENT AND SUSPENSION

A. This contract is a covered transaction for purposes of 2 C.F.R. pt. 180 and 2 C.F.R. pt. 3000. As such the contractor is required to verify that none of the contractor, its principals (defined at 2
C.F.R. § 180.995), or its affiliates (defined at 2 C.F.R. § 180.905) are excluded (defined at 2
C.F.R. § 180.940) or disqualified (defined at 2 C.F.R. § 180.935).

B. Contractor represents and warrants that it is not debarred, suspended, or otherwise excluded from or ineligible for participation in Federal assistance programs under Executive Order 12549, "Debarment and Suspension" or on the USEPA's List of Violating Facilities. Contractor agrees that neither Contractor nor any of its third party subcontractors shall enter into any third party subcontracts for any of the work under this Agreement with a third party subcontractor who is debarred, suspended, or otherwise excluded from or ineligible for participation in Federal assistance programs under executive Order 12549 or on the USEPA's List of Violating Facilities. Gov. Code § 4477.

C. The contractor must comply with 2 C.F.R. pt. 180, subpart C and 2 C.F.R. pt. 3000, subpart C and must include a requirement to comply with these regulations in any lower tier covered transaction it enters into. Contractor agrees to the provisions of the Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion—Lower Tier Covered Transactions, attached hereto and incorporated herein. For purposes of this Agreement, Contractor is the "prospective lower tier participant."

D. The Contractor agrees to include paragraphs A and B above in each third party subcontract financed in whole or in part with Federal assistance provided by FEMA. It is further agreed that the paragraphs shall not be modified, except to identify the subcontractor who will be subject to its provisions.

E. This certification is a material representation of fact relied upon by City. If it is later determined that the contractor did not comply with 2 C.F.R. pt. 180, subpart C and 2 C.F.R. pt. 3000, subpart C, in addition to remedies available to the State of California, the City, and the Federal Government may pursue available remedies, including but not limited to suspension and/or debarment.

F. The bidder or proposer agrees to comply with the requirements of 2 C.F.R. pt. 180, subpart C and 2 C.F.R. pt. 3000, subpart C while this offer is valid and throughout the period of any contract that may arise from this offer. The bidder or proposer further agrees to include a provision requiring such compliance in its lower tier covered transactions."

V. NO FEDERAL GOVERNMENT OBLIGATIONS TO CONTRACTOR

A. The City and Contractor acknowledge and agree that, notwithstanding any concurrence by the Federal Government in or approval of the solicitation or award of the underlying contract, absent the express written consent by the Government, the Government is not a party to this contract and shall not be subject to any obligations or liabilities to the City, Contractor, or any other party (whether or not a party to that contract) pertaining to any matter resulting from the underlying contract.

B. The Contractor agrees to include the above clause in each third party subcontract financed in whole or in part with Federal assistance provided by FEMA. It is further agreed that the clause shall not be modified, except to identify the subcontractor who will be subject to its provisions.

VI. EQUAL EMPLOYMENT OPPORTUNITY COMPLIANCE (applicable to all construction contracts awarded meeting the definition of "federally assisted construction contract" under 41 CFR 61-1.3)

Contractor agrees to comply with Executive Order 11246 of September 24, 1965, entitled "Equal Employment Opportunity," as amended by Executive Order 11375 of October 13, 1967, and as supplemented in Department of Labor regulations (41 CFR Part 60). 41 CFR 60.14 is hereby incorporated by reference.

A. Contractors and subcontractors shall not unlawfully discriminate, harass, or allow harassment against any employee or applicant for employment because of sex, race, color, ancestry, religious creed, national origin, sexual orientation, physical disability (including HIV and AIDS), mental disability, medical condition (cancer), age (over 40), marital status, and denial of family care leave.

B. Contractors, and subcontractors shall ensure that the evaluation and treatment of their employees and applicants for employment are free from such discrimination and harassment.

C. Contractors and subcontractors shall comply with the provisions of the Fair Employment and Housing Act (Gov. Code, § 12990 (a-f) et seq.) and the applicable regulations promulgated thereunder (California Code of Regulations, Title 2, Section 7285 et seq.). The applicable regulations of the Fair Employment and Housing Commission implementing Government Code Section 12990 (a-f), set forth in Chapter 5 of Division 4 of Title 2 of the California Code of Regulations, are incorporated into this Agreement by reference and made a part hereof as if set forth in full.

D. Contractors, and subcontractors shall give written notice of their obligations under this clause to labor organizations with which they have a collective bargaining or other Agreement.

VII. ANTI-KICKBACK ACT COMPLIANCE (applicable to all contracts and subgrants for construction or repair; 44 CFR §13.36(i)(4))

Contractor agrees to comply with the Copeland "Anti-Kickback" Act (18 U.S.C. 874) as supplemented in Department of Labor regulations (29 CFR Part 3).

VIII. DAVIS-BACON ACT COMPLIANCE (applicable to construction contracts in excess of $2,000 awarded by grantees and subgrantees when required by Federal grant program legislation;)

To the extent required by any Federal grant programs applicable to expected funding or reimbursement of City's expenses incurred in connection with the services provided under this Agreement, Contractor agrees to comply with the Davis-Bacon Act (40 U.S.C. 276a to 276a–7) as supplemented by Department of Labor regulations (29 CFR Part 5) as set forth below. These requirements are in addition to any requirements set forth in the Agreement.

A. The Contractor shall be bound to the provisions of the Davis-Bacon Act, and agrees to be bound by all the provisions of Labor Code section 1771 regarding prevailing wages. All labor on this project shall be paid neither less than the greater of the minimum wage rates established by the U.S. Secretary of Labor (Federal Wage Rates), or by the State of California Director of Department of Industrial Relations (State Wage Rates). Current DIR requirements may be found at http://www.dir.ca.gov/lcp.asp.

B. The general prevailing wage rates may be accessed at the Department of Labor Home Page at www.wdol.gov. Under the Davis Bacon heading, click on "Selecting DBA WDs." In the drop down menu for State, select, "California." In the drop down menu for City, select "City of Pleasanton" In the drop down menu for Construction Type, make the appropriate selection. Then, click Search.

IX. CONTRACT WORK HOURS AND SAFETY STANDARDS (applicable to all contracts in excess of $100,000 that involve the employment of mechanics or laborers, but not to purchases of supplies or materials or articles ordinarily available on the open market, or contracts for transportation or transmission of intelligence)

A. Compliance: Contractor agrees that it shall comply with Sections 103 and 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 327–330) as supplemented by Department of Labor regulations (29 CFR Part 5), which are incorporated herein.

B. Overtime: No contractor or subcontractor contracting for any part of the work under this Agreement which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

C. Violation; liability for unpaid wages; liquidated damages: In the event of any violation of the provisions of Paragraph B, the Contractor and any subcontractor responsible therefore shall be liable to any affected employee for his unpaid wages. In additions, such Contractor and subcontractor shall be liable to the United States for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic employed in violation of the provisions of paragraph B in the sum of $10 for each calendar day on which such employee was required or permitted to be employed on such work in excess of eight hours or in excess of his standard workweek of forty hours without payment of the overtime wages required by paragraph B.

D. Withholding for unpaid wages and liquidated damages: The City shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set for in paragraph C of this section.

E. Subcontracts: The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraphs

A through D of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs A through D of this section.

X. NOTICE OF REPORTING REQUIREMENTS

A. Contractor acknowledges that it has read and understands the reporting requirements of FEMA in Part III of Chapter 11 of the United States Department of Justice's Office of Justice Programs Financial Guide, and agrees to comply with any such applicable requirements.

B. The Contractor agrees to include the above clause in each third party subcontract financed in whole or in part with Federal assistance provided by FEMA. It is further agreed that the clause shall not be modified, except to identify the subcontractor who will be subject to its provisions.

XI. NOTICE OF REQUIREMENTS PERTAINING TO COPYRIGHTS

A. Contractor agrees that FEMA shall have a royalty-free, nonexclusive, and irrevocable license to reproduce, publish or otherwise use, and to authorize others to use, for government purposes:

1) The copyright in any work developed with the assistance of funds provided under this Agreement;
2) Any rights of copyright to which Contractor purchases ownership with the assistance of funds provided under this Agreement.

B. The Contractor agrees to include paragraph A above in each third party subcontract financed in whole or in part with Federal assistance provided by FEMA. It is further agreed that the clause shall not be modified, except to identify the subcontractor who will be subject to its provisions.

XII. PATENT RIGHTS (applicable to contracts for experimental, research, or development projects financed by FEMA; 44 CFR §13.36(i)(8))

A. General. If any invention, improvement, or discovery is conceived or first actually reduced to practice in the course of or under this Agreement, and that invention, improvement, or discovery is patentable under the laws of the United States of America or any foreign country, the City and Contractor agree to take actions necessary to provide immediate notice and a detailed report to FEMA.

B. Unless the Government later makes a contrary determination in writing, irrespective of Contractor's status (a large business, small business, state government or state instrumentality, local government, nonprofit organization, institution of higher education, individual), the City and Contractor agree to take the necessary actions to provide, through FEMA, those rights in that invention due the Federal Government as described in U.S. Department of Commerce regulations, "Rights to Inventions Made by Nonprofit Organizations and Small Business Firms Under Government Grants, Contracts and Cooperative Agreements," 37 CFR, Part 401.

C. The Contractor agrees to include paragraphs A and B above in each third party subcontract for experimental, developmental, or research work financed in whole or in part with Federal assistance provided by FEMA.

XIII. ENERGY CONSERVATION REQUIREMENTS

A. The Contractor agrees to comply with mandatory standards and policies relating to energy efficiency which are contained in the state energy conservation plan issued in compliance with the Energy Policy and Conservation Act (42 USC 6201).

B. The Contractor agrees to include paragraph A above in each third party subcontract financed in whole or in part with Federal assistance provided by FEMA. It is further agreed that the clause shall not be modified, except to identify the subcontractor who will be subject to its provisions.

XIV. CLEAN AIR AND WATER REQUIREMENTS (applicable to all contracts and subcontracts in excess $100,000, including indefinite quantities where the amount is expected to exceed $100,000 in any year)

A. Contractor agrees to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air

Act (42 U.S.C. 7401-7671q) and the Federal Water Pollution Control Act as amended (33 U.S.C. 1251-1387), and will report violations to FEMA and the Regional Office of the Environmental Protection Agency (EPA).

B. Contractor agrees to report each violation of these requirements to the City and understands and agrees that the City will, in turn, report each violation as required to assure notification to FEMA and the appropriate EPA regional office.

C. The Contractor agrees to include paragraph A and B above in each third party subcontract exceeding $100,000 financed in whole or in part with Federal assistance provided by FEMA.

XV. TERMINATION FOR CONVENIENCE OF CITY (applicable to all contracts in excess of $10,000). See Agreement.

XVI. TERMINATION FOR DEFAULT (applicable to all contracts in excess of $10,000) Contractor's failure to perform or observe any term, covenant or condition of this Agreement shall constitute an event of default under this Agreement. See Agreement.

XVII. LOBBYING (Byrd Anti-Lobbying Amendment, 31 U.S.C. § 1352 (as amended).)

A. Contractor shall not use or pay any funds received under this Agreement to influence or attempt to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

B. Contractor agrees to the provisions of Certification Regarding Lobbying, attached hereto and incorporated herein (applicable for contracts or subcontracts in excess of $100,000).

C. Contractor agrees to include paragraphs A and B above in each third party subcontract financed in whole or in part with Federal assistance provided by FEMA. It is further agreed that the clause shall not be modified, except to identify the subcontractor who will be subject to its provisions.

XVIII. MBE / WBE REQUIREMENTS

The City intends to seek reimbursement of its costs incurred in connection with this project from FEMA. Accordingly, the CONTRACTOR shall make every effort to procure Minority and Women's Business Enterprises ("DBEs") through the "Good Faith Effort" process as required in 2 CFR 200.321. Failure to perform the "Good Faith Effort" process and submit the forms listed below with the bid/proposal shall be cause for a bid/proposal to be rejected as non-responsive and/or be considered as a material breach of the contract.

PRIME CONTRACTOR RESPONSIBILITIES

All recipients of this grant funding, as well as their prime contractors and subcontractors, must take all affirmative steps to assure that minority firms, women's business enterprises, and labor surplus area firms are used when possible make every effort to solicit bids from eligible DBEs. This information must be documented and reported.

"GOOD FAITH" EFFORT PROCESS

Any public or private entity receiving federal funds must demonstrate that efforts were made to attract MBE/WBEs. The process to attract MBE/WBEs is referred to as the "Good Faith" effort. This effort requires the recipient, prime contractor and any subcontractors to take the steps listed below to assure that MBE/WBEs are used whenever possible as sources of supplies, construction, equipment, or services. If a CONTRACTOR fails to take the steps outlined below shall cause the bid/proposal to be rejected as non-responsive and/or be deemed a material breach of the contract.

A. Place qualified small and minority businesses and women's business enterprises on solicitation lists;
B. Assure that small and minority businesses, and women's business enterprises are solicited whenever they are potential sources;
C. Divide total requirements, when economically feasible, into smaller tasks or quantities to permit maximum participation by small and minority business, and women's business enterprises;
D. Establish delivery schedules, where the requirement permits, which encourage participation by small and minority business, and women's business enterprises; and
E. Use the services and assistance of the Small Business Administration, and the Minority Business Development Agency of the Department of Commerce.
F. If subcontracts are to be let, Contractor shall take the affirmative steps listed in 2 CFR 200.321.

XIX. PROCUREMENT OF RECOVERED MATERIALS (2 CFR 200.322)

Contractor shall comply with Section 6002 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act. The requirements of Section 6002 include procuring only items designated in guidelines of the Environmental Protection Agency (EPA) at 40 CFR part 247 that contain the highest percentage of recovered materials practicable, consistent with maintaining a satisfactory level of competition, where the purchase price of the item exceeds $10,000 or the value of the quantity acquired during the preceding fiscal year exceeded $10,000; procuring solid waste management services in a manner that maximizes energy and resource recovery; and establishing an affirmative procurement program for procurement of recovered materials identified in the EPA guidelines.

XX. INCORPORATION OF UNIFORM ADMINISTRATIVE REQUIREMENTS

The preceding provisions include, in part, certain standard terms and conditions required by FEMA, whether or not expressly set forth in the preceding contract provisions. All contractual provisions required by FEMA are hereby incorporated by reference. Anything to the contrary herein notwithstanding, all FEMA mandated terms shall be deemed to control in the event of a conflict with other provisions contained in this Agreement. Contractor shall not perform any act, fail to perform any act, or refuse to comply with any City requests that would cause City to be in violation of the FEMA terms and conditions.

I declare under penalty of perjury that I have read, understood, and agree to comply with all of the provisions set forth in Exhibit A.

_____ _____

Contractor Signature Date

ATTACHMENT A 1
CERTIFICATION REGARDING DEBARMENT, SUSPENSION, INELIGIBILITY AND VOLUNTARY EXCLUSION – LOWER TIER COVERED TRANSACTIONS

(Lower Tier refers to the agency or contractor receiving Federal funds, as well as any subcontractors that the agency or contractor enters into contract with using those funds)

As required by Executive Order 12549, Debarment and Suspension, as defined at 44 CFR Part 17, City may not enter into contract with any entity that is debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded by the Federal Government from participating in transactions involving Federal funds. Contractor is required to sign the certification below which specifies that neither Contractor nor its principals are presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded by the Federal agency. It also certifies that Contractor will not use, directly or indirectly, any of these funds to employ, award contracts to, engage the services of, or fund any contractor that is debarred, suspended, or ineligible under 44 CFR Part 17.

Instruction for Certification

1. By signing and submitting this proposal, the prospective lower tier participant is providing the certification set out below.
2. The certification in this clause is a material representation of fact upon which reliance was placed when this transaction was entered into. If it is later determined that the prospective lower tier participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government the department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.
3. The prospective lower tier participant shall provide immediate written notice to the person to whom this proposal is submitted if at any time the prospective lower tier participant learns that its certification was erroneous when submitted or had become erroneous by reason of changed circumstances.
4. The terms covered transaction, debarred, suspended, ineligible, lower tier covered transaction, participant, person, primary covered transaction, principal, proposal, and voluntarily excluded, as used in this clause, have the meaning set out in the Definition and Coverage sections of rules implementing Executive Order 12549. You may contact the person to which this proposal is submitted for assistance in obtaining a copy of those regulations.
5. The prospective lower tier participant agrees by submitting this agreement that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is proposed for debarment under 48 CFR Part 9, subpart 9.4, debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency with which this transaction originated.
6. The prospective lower tier participant further agrees by submitting this proposal that it will include this clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transaction," without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions.
7. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that it is not proposed for debarment under 48 CFR part 9, subpart 9.4, debarred, suspended, ineligible, or voluntarily excluded from covered transactions, unless it knows that the certification is erroneous. A participant may decide the method and frequency by which it determines the eligibility of its principals. Each participant may, but is not required to,

check the List of Parties Excluded from Federal Procurement and Nonprocurement Programs.

8. Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of a participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.
9. Except for transactions authorized under paragraph 5 of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is proposed for debarment under 48 CFR part 9, subpart 9.4, suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction originated may pursue available remedies, including suspension and/or debarment.

Certification Regarding Debarment, Suspension, Ineligibility an Voluntary Exclusion – Lower Tier Covered Transactions

1. The prospective lower tier participant certifies, by submission of its proposal, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any Federal department or agency.
2. Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

I declare under penalty of perjury that I have read, understood, and agree to comply with all of the provisions set forth in Attachment A 1.

_____ _____

Contractor Signature Date

Attachment A 2
CERTIFICATION REGARDING LOBBYING

Certification for Contracts, Grants, Loans, and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:

1. No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.
2. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.
3. The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loan, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

I declare under penalty of perjury that I have read, understood, and agree to comply with all of the provisions set forth in Attachment A 2.

_____ _____

Contractor Signature Date

EXHIBIT B
DBE Subcontractor Utilization Form

This form is intended to capture the prime contractor's actual and/or anticipated use of identified certified DBE[1] subcontractors[2] and the estimated dollar amount of each subcontract.

Prime Contractor Name		Project Name
Bid/Proposal No.	Assistance Agreement ID No. (If known)	Point of Contact
Address		
Telephone No.	Email Address	
Issuing/Funding Entity:		

I have identified potential DBE certified subcontractors	O YES	O NO

Subcontractor Name/ Company Name	**Company Address/Phone/Email**	**Est. Dollar Amt**	**Currently DBE Certified?**

[1] A DBE is a Disadvantaged, Minority, Small or Woman Business Enterprise that has been certified as described in 40 CFR 33.204-33.205.

[2] Subcontractor is defined as a company, firm, joint venture or individual who enters into an agreement with a contractor to provide services.

EXHIBIT B
DBE Subcontractor Performance

I certify under penalty of perjury that the foregoing statements are true and correct. Signing this form does not signify a commitment to utilize the subcontractors above. In the event of a replacement of a subcontractor, I will adhere to the replacement requirements set forth in 40 CRF Part 33 Section 33.302(c).

Prime Contractor Signature	Print Name
Title	**Date**

EXHIBIT B
DBE Subcontractor Performance

This form is intended to capture the DBE[3] subcontractors'[4] description of work to be performed and the price of the work submitted to the prime contractor. Prime contractor is required to have its DBE subcontractors complete this form and include all completed forms in the prime contractors bid or proposal package unless subcontractors will not be used.

Subcontractor Name		Project Name
Bid/Proposal No.	Assistance Agreement ID No. (If known)	Point of Contact
Address		
Telephone No.	Email Address	
Prime Contractor Name	Issuing/Funding Entity:	

Contract Item Number	**Description of Work Submitted to the Prime Contractor Involving construction, Services, Equipment or Supplies**	**Price of Work Submitted to the Prime Contractor**
BDE Certified by ○ **DOT** ○ **SBA** ○ Other: _____	Meets/ exceeds FEMA certification standards: ○ YES ○ NO ○ Unknown	

[3] A DBE is a Disadvantaged, Minority, Small or Woman Business Enterprise that has been certified as described in 40 CFR 33.204-33.205

[4] Subcontractor is defined as a company, firm, joint venture or individual who enters into an agreement with a contractor to provide services pursuant to an EPA award of financial assistance.

EXHIBIT B
DBE Subcontractor Performance

I certify under penalty of perjury that the foregoing statements are true and correct. Signing this form does not signify a commitment to utilize the subcontractors above. I am aware of that in the event of a replacement of a subcontractor, I will adhere to the replacement requirements set forth in 40 CRF Part 33 Section 33.302(c).

Prime Contractor Signature	Print Name
Title	**Date**

Subcontractor Signature	Print Name
Title	**Date**

Exhibit C

SUBSTITUTION REQUEST FORM

TO: _____

PROJECT: _____

CONTRACTOR: _____

SUBCONTRACTOR/SUPPLIER: _____

DRAWING SHEET REFERENCE/
DETAIL NO: _____

Contractor submits for consideration the following equipment instead of the specified item for the above project:

SECTION	PARAGRAPH	SPECIFIED ITEM

Proposed Substitution:

_____

_____

_____

For products specified by reference standard: Select any product meeting that standard.

For products specified by naming one or more products or manufacturer:

1. Select products of any named manufacturer meeting specifications.
2. For any product or manufacturer that is not specifically named, submit information required herein.

Attach manufacturer's literature, including complete technical data and laboratory test results, if applicable. Explain why proposed substitution is a true equivalent to specified item.

Include complete information on changes to Drawings and Specification that the proposed substitution will require for its proper installation. Fill in the blanks below:

A. Does the substitution affect dimensions shown on Drawings?_____

B. Will the Contractor pay for changes to the building design, including engineering and detailing costs, caused by the requested substitution?_____

C. What effect does the substitution have on other contractors, trades, suppliers, contiguous materials or equipment, or time of performance?

_____

_____

_____

D. What are the differences between the proposed substitution and the specified item? If proposed substitution has a color or pattern, provide a color board showing proposed substitution in relation to the other adjacent colors and patterns.

_____

_____

_____

_____

E. Manufacturers' guarantees and warranties of the proposed and specified items are:

_____Same _____Different (explain on attachment)

(Contractor Certification on the Following Page)

Contractor certifies, under the penalty of perjury pursuant to the laws of the State of California, that the function, appearance, and quality of the proposed substitution are equivalent or superior to those of the specified item.

Submitted by:

Firm

_____

Signature _____ Printed Name

_____

Address:

Telephone

Date Signed

For Use by City of Pleasanton

☐ Accepted ☐ Accepted as Noted

☐ Not Accepted ☐ Rec'd Too Late

By: _____

Date: _____

Remarks:

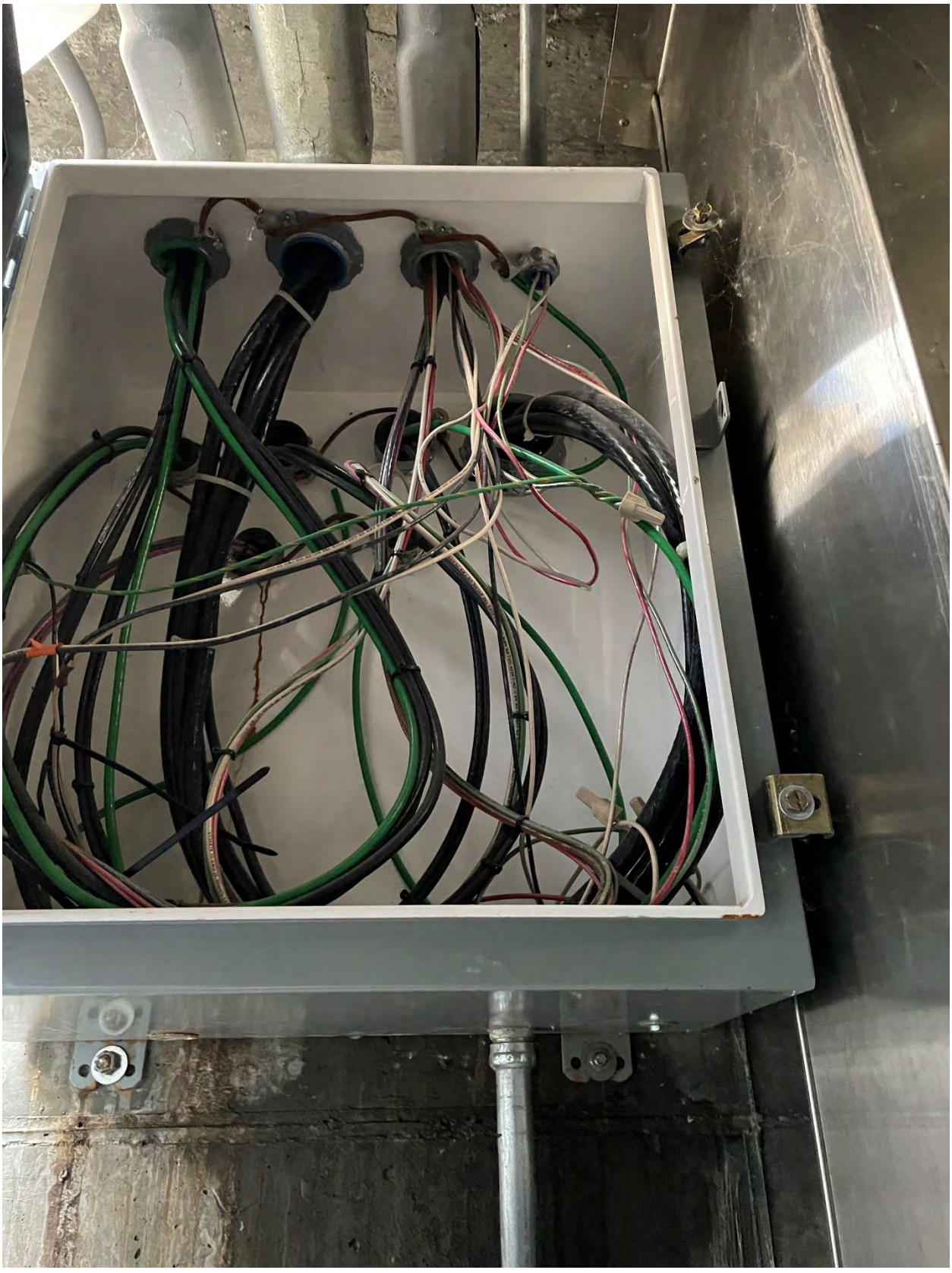
_____

_____

_____

_____

Exhibit D

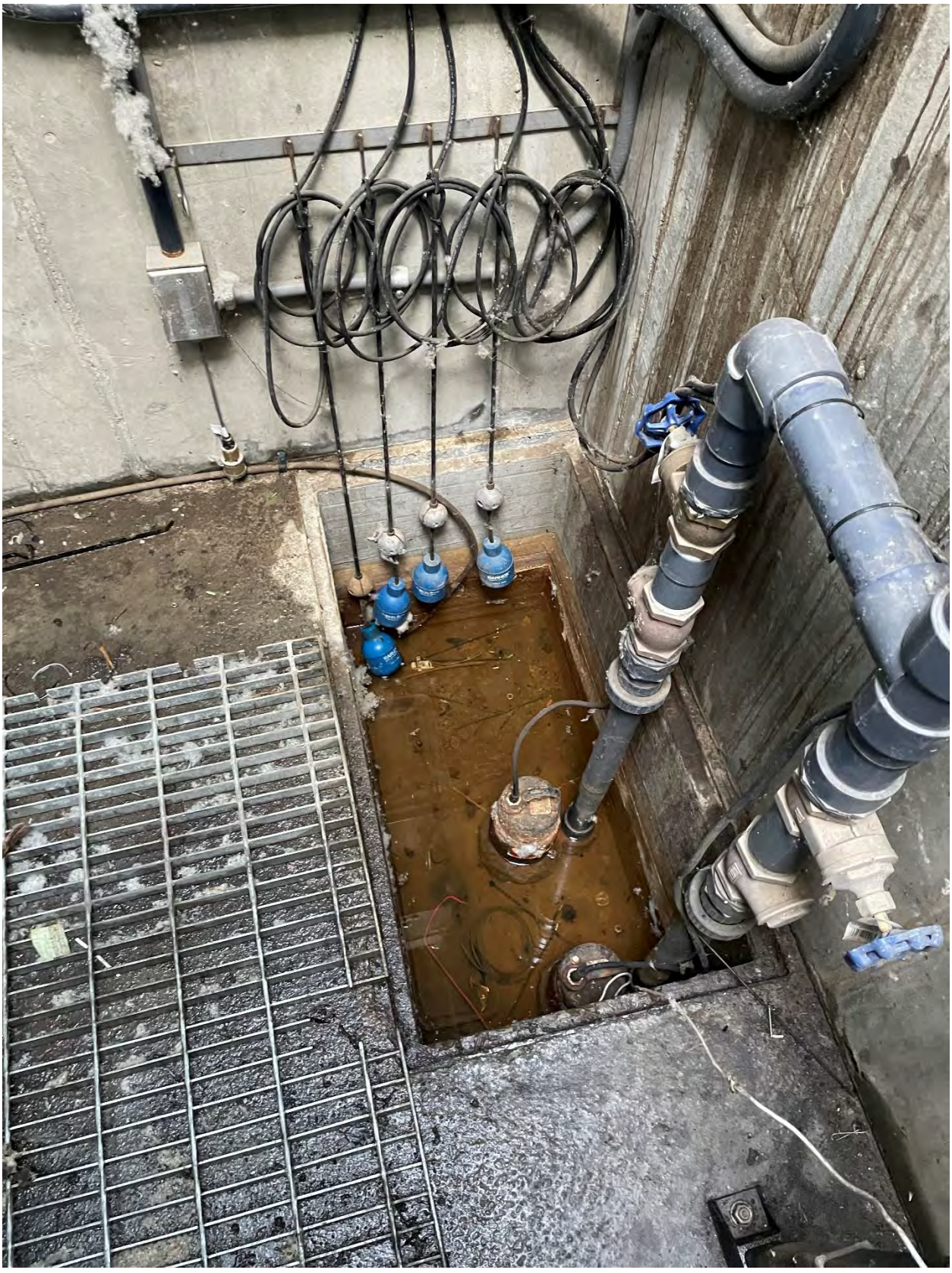



GENERAL INSTRUCTIONS
BEHIND THIS DOOR


ASCO
7000 SERIES
Automatic Delayed Transition
Transfer Switch
GENERAL INSTRUCTIONS
BEHIND THIS DOOR


GENERATOR ATS FEED DISCONNECT
GENERATOR TRANSFORMER DISCONNECT
PUMP 1
AUTOMATIC TRANSFER SWITCH
ASCO
7000 SERIES
Automatic Delayed Transition Transfer Switch
GENERAL INSTRUCTIONS BEHIND THIS DOOR


PANEL E.P. DISCONNECT
NOTICE
GENERATOR ATS FEED DISCONNECT
GENERATOR TRANSFORMER DISCONNECT
PUMP 1
AUTOMATIC TRANSFER SWITCH
ASCO
7000 SERIES
GENERAL INSTRUCTIONS BEHIND THIS DOOR

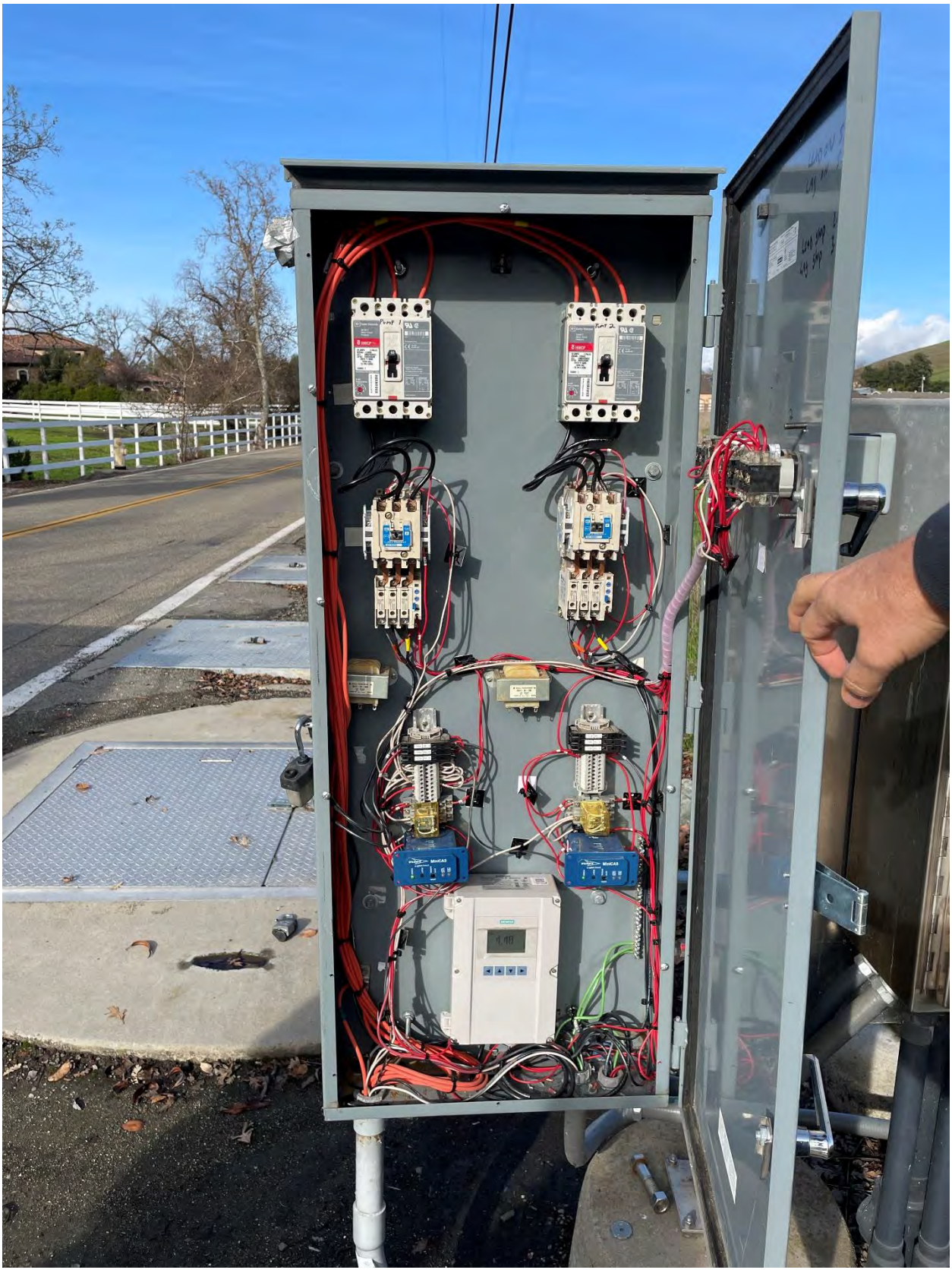



ALBISA STREET
SEWER LIFT STATION
(S14)
DISCONNECT
PUMP RUNNING
LEVEL ALARM

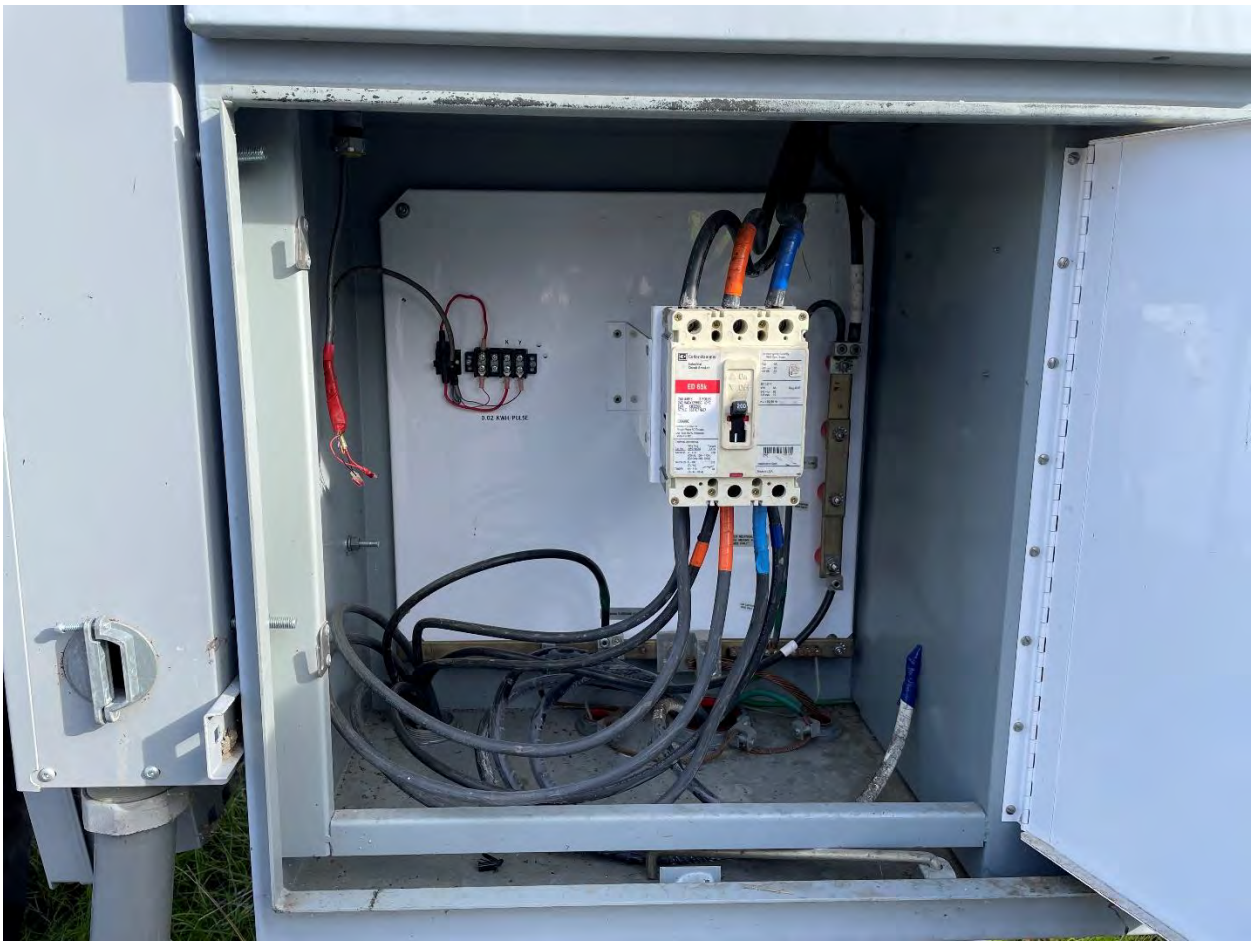

PUMP RUNNING
LEVEL ALARM


PUMP RUNNING
LEVEL ALARM

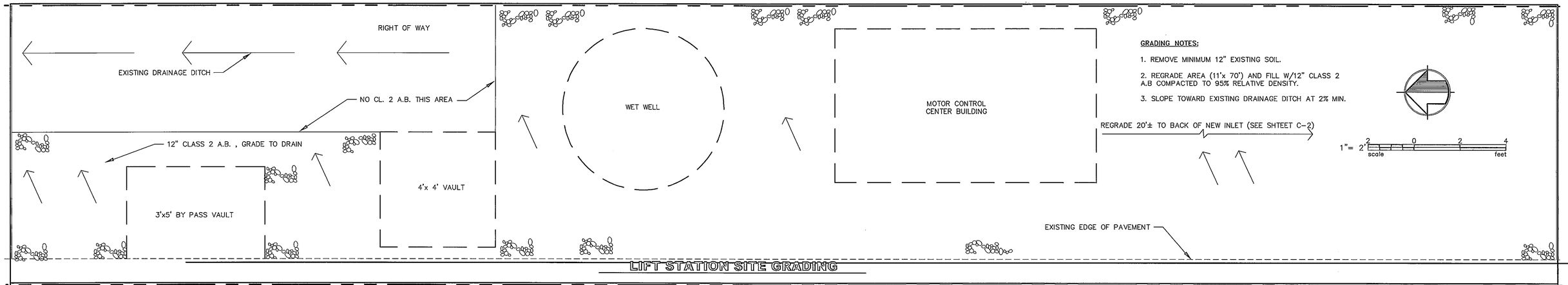
SEWER STATION S-14 ELECTRICAL IMPROVEMENTS, CIP NO. 24265



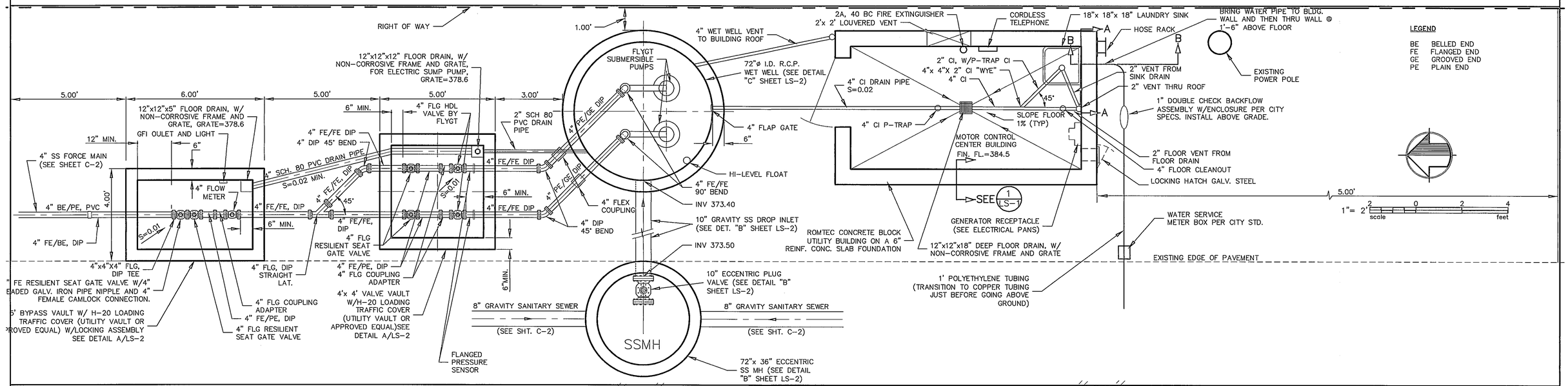

Enhanced Power Supply Watthour Meter
PG&E
SmartMeter
Mult by 1
CL 200 120-480V 4W M16S Kt 21.6
50/60Hz CA 0.2 TA 30 Kh 21.6 TV 120

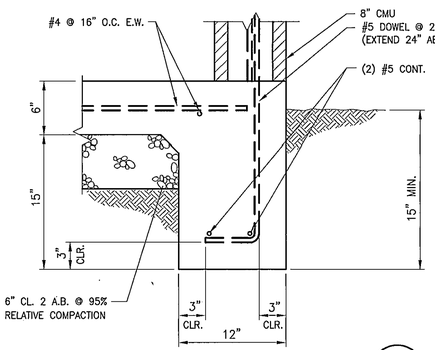



6614

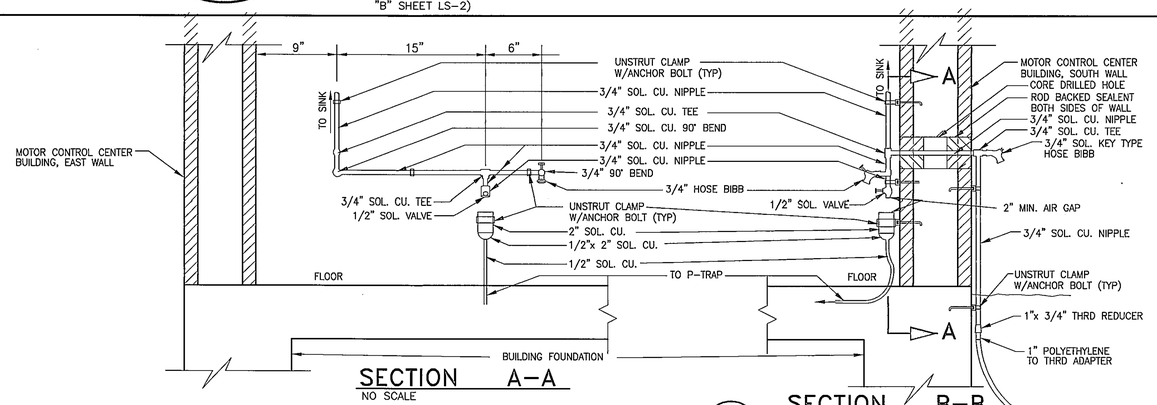


LIFT STATION SITE GRADING





TYPICAL FOUNDATION SECTION (1 LS-1)
SCALE: 1 1/2" = 1'-0" (MOTOR CONTROL CENTER BUILDING)



SECTION A-A
NO SCALE

WATER PIPING SECTION (2 LS-1)
(MOTOR CONTROL CENTER BUILDING) NO SCALE

SECTION B-B
NO SCALE

BID SET

FEBRUARY 25, 2002 1:08:08 p.m.
XREFS: TB24736H (DRAWING: S:\JOBFILES\497022\DWG\LS-1.DWG)

Consulting Civil and Structural Engineers
CREEGAN+D'ANGELO
6800 KOLL CENTER PARKWAY, SUITE 150
PLEASANTON, CALIFORNIA 94566-7022
PHONE: 925 417-5260 FAX: 925 249-1264
SAN JOSE, FAIRFIELD, MONTEREY, PLEASANTON, SAN FRANCISCO

REGISTERED PROFESSIONAL ENGINEER — PHILIP A. GRUBSTICK — No. C22489 — EXP. 12-31-03 — CIVIL — STATE OF CALIFORNIA

Rev. No.	Date	Sheet No.	Approved by City	Date

THE CITY OF PLEASANTON

CITY OF PLEASANTON
Department of Public Works

GOLF COURSE PROJECT
PROJECT 968036

SEWER LIFT STATION SITE PLAN

DRAWN:	CADD STAFF
CHECKED:	GEH
TRAFFIC MANAGER:	
DEPUTY DIRECTOR:	

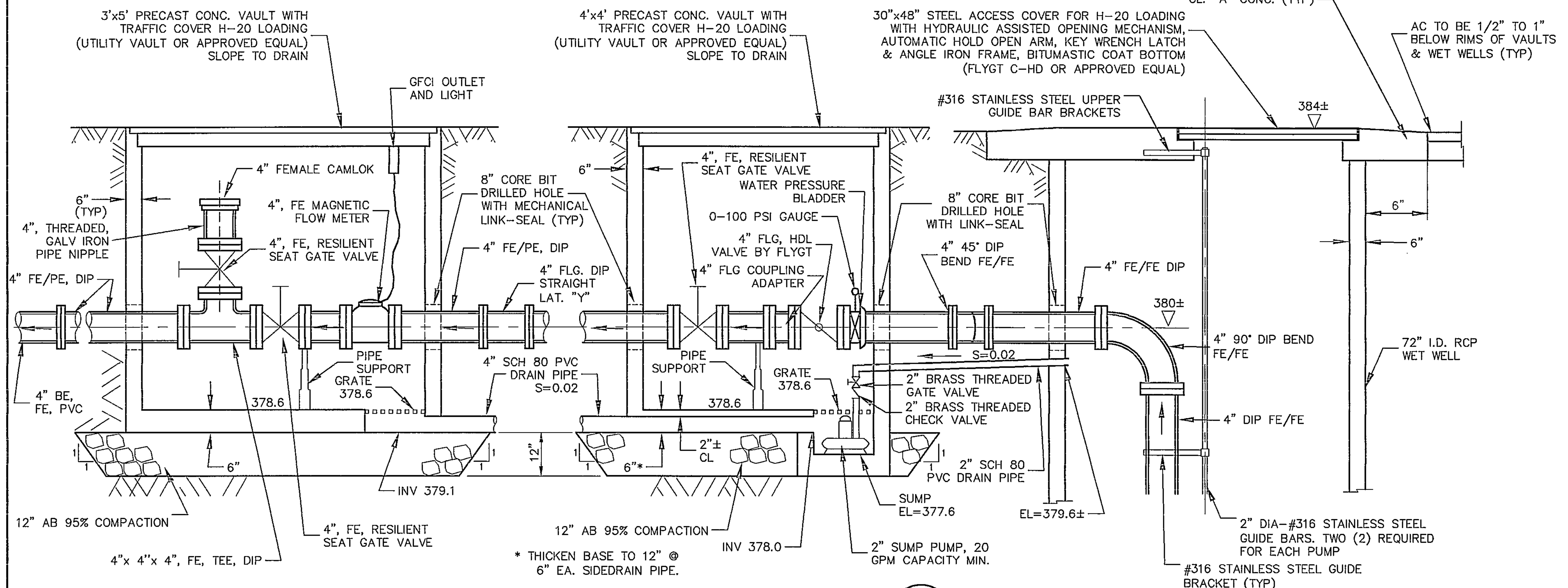
PHILIP A. GRUBSTICK
CITY ENGINEER
C22489, EXP: 9/30/05

APPROVED:

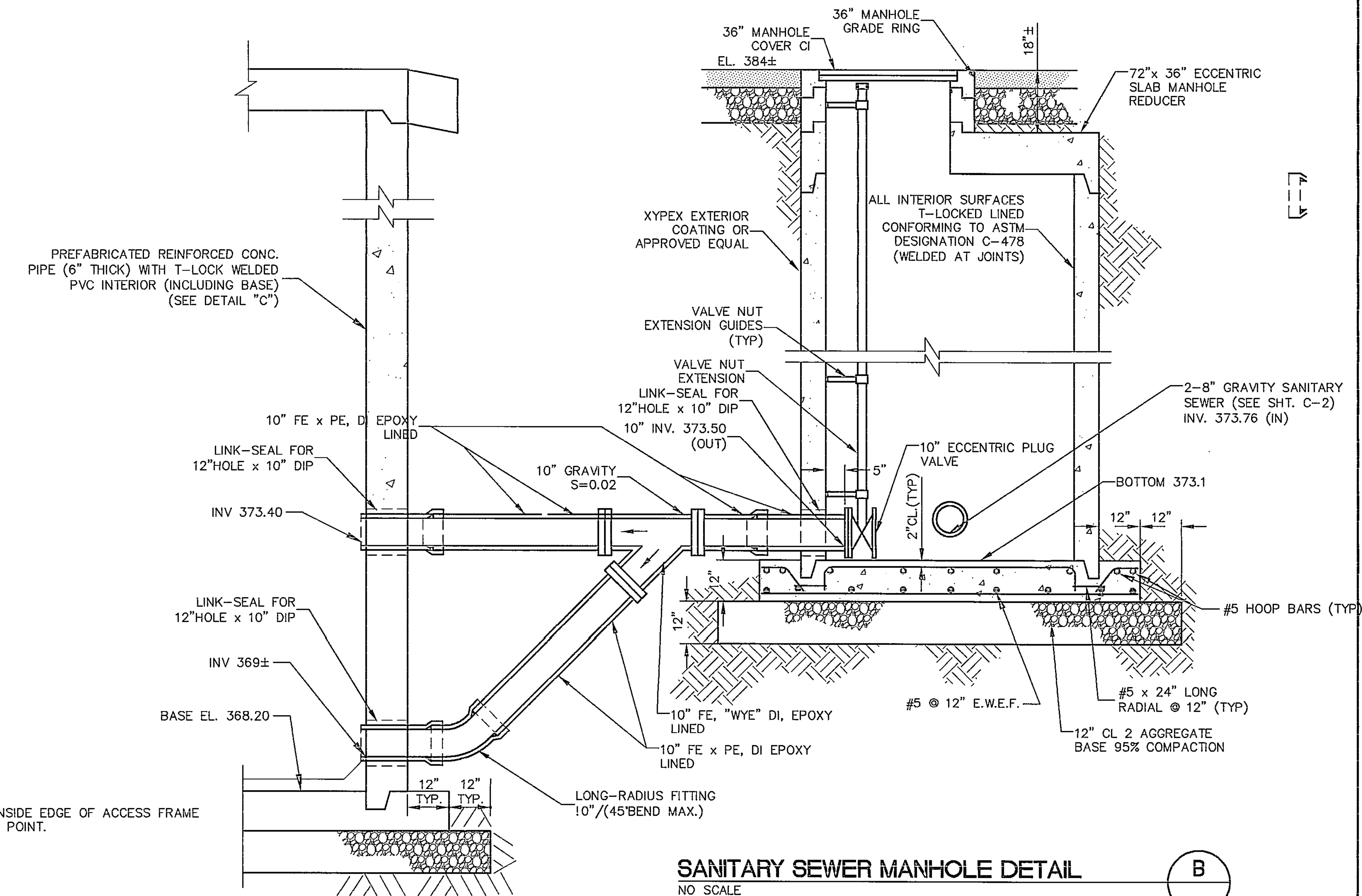
RANDALL A. LUM
DIRECTOR OF PUBLIC WORKS
RCE #28060

DATE: FEB. 2002
SCALE: AS SHOWN
JOB NO.: 497022

LS-1
SHEET 8 OF 42

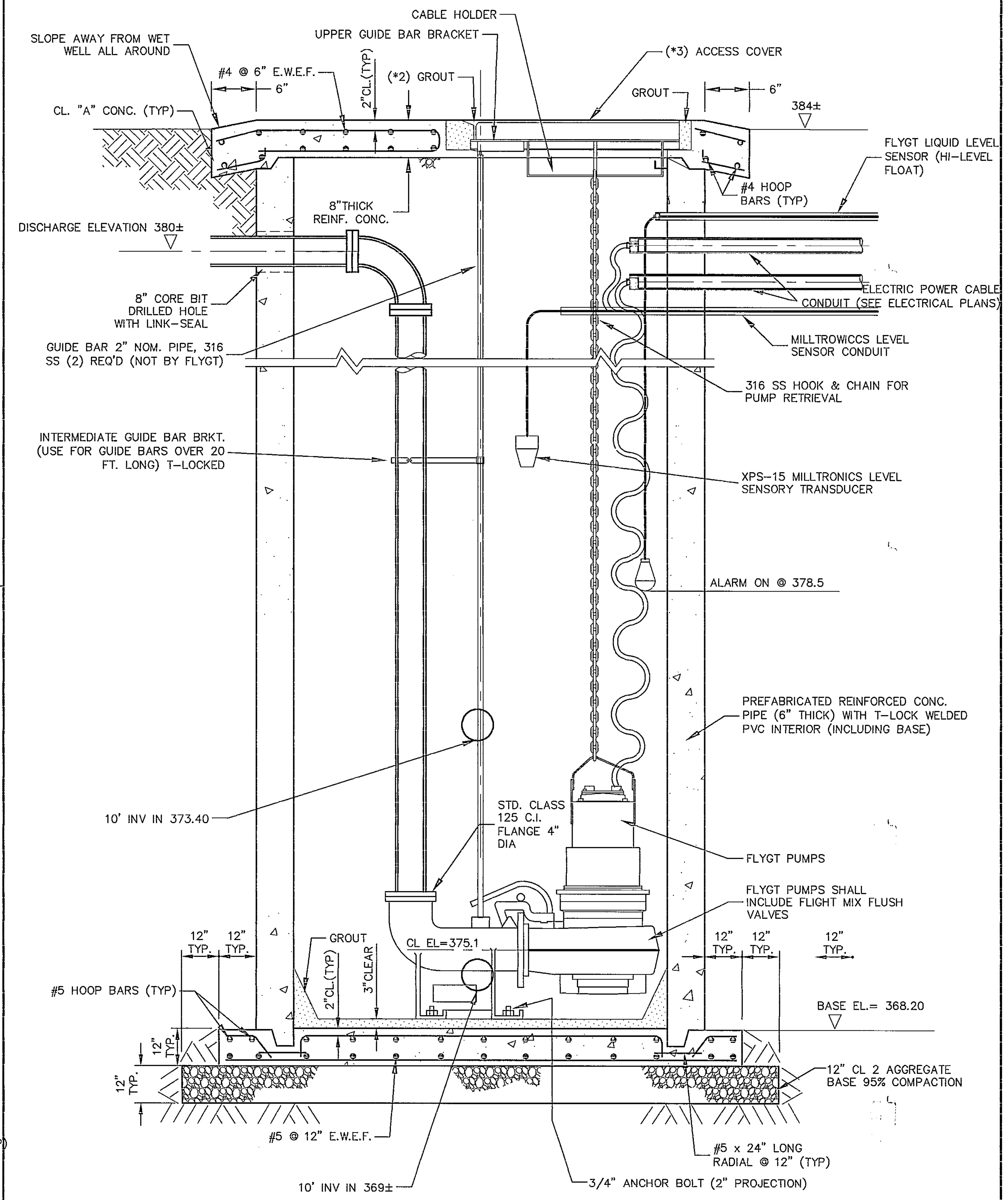


VALVE VAULTS DETAIL
NO SCALE
A



* NOTES:
1. LOCATE ANCHOR BOLTS USING CLEAR INSIDE EDGE OF ACCESS FRAME AND CENTER LINE OF PUMP AS REFERENCE POINT.
2. GROUT OPENING FOR ACCESS FRAME.
3. HEAVY DUTY ACCESS COVER.
4. AT WALL OPENIGS FILL ANNULAR SPACE WITH LINK-SEAL.

SANITARY SEWER MANHOLE DETAIL
NO SCALE
B



NOTE:
1. PROVIDE HUBBEL CORROSION-RESISTANT STRAIGHT NYLON CONNECTORS (i.e. MODEL SHC 1042CR) FOR ALL ELECTRICAL CONDUIT.

WET WELL DETAIL
NO SCALE
C

BID SET

C+D Consulting Civil and Structural Engineers
CREEGAN+D'ANGELO
6800 KOLL CENTER PARKWAY, SUITE 150
PLEASANTON, CALIFORNIA 94566-7022
PHONE: 925 417-5260 FAX: 925 249-1264
SAN JOSE, FAIRFIELD, MONTEREY, PLEASANTON, SAN FRANCISCO

Rev. No.	Date	Sheet No.	Approved by City	Date

THE CITY OF PLEASANTON

CITY OF PLEASANTON
Department of Public Works

GOLF COURSE PROJECT
PROJECT 988036
SEWER LIFT STATION DETAILS

DRAWN:	CADD STAFF
CHECKED:	GEH
TRAFFIC MANAGER:	
DEPUTY DIRECTOR:	

PHILIP A. GRUBSTICK, CITY ENGINEER, C22489, EXP: 9/30/05

APPROVED: RANDALL A. LUM, DIRECTOR OF PUBLIC WORKS, RCE #28080

DATE: FEB. 2002
SCALE: AS SHOWN
JOB NO.: 497022
LS-2
SHEET 9 OF 42

WIRING – CONNECTIONS

SYMBOL	DESCRIPTION
	PANEL OR EQUIPMENT WIRING
	FIELD WIRING
	EXISTING WIRING
	CONDUCTORS – NOT CONNECTED
	CONDUCTORS – CONNECTED
	GROUND
	CHASSIS OR FRAME GROUND
	PLUG AND RECEPTACLE
	INCOMING LINE
	TERMINAL BLOCKS
	TERMINALS
	PULL APART TERMINAL BLOCKS
SHIELD / CONDUCTOR	SHIELDED CABLE

SWITCHES – PROCESS

SYMBOL	DESCRIPTION
FS	FLOW SWITCH – CLOSES UPON INCREASING FLOW
FS	FLOW SWITCH – OPENS UPON INCREASING FLOW
LS	LEVEL SWITCH – CLOSES UPON INCREASING LEVEL
LS	LEVEL SWITCH – OPENS UPON INCREASING LEVEL
PS	PRESSURE SWITCH – CLOSES UPON INCREASING PRESSURE (INCREASING VACUUM)
PS	PRESSURE SWITCH – OPENS UPON INCREASING PRESSURE (INCREASING VACUUM)
TS	TEMPERATURE SWITCH – CLOSES UPON INCREASING TEMPERATURE
TS	TEMPERATURE SWITCH – OPENS UPON INCREASING TEMPERATURE
ZS	LIMIT SWITCH – CLOSES AT SET LIMIT
ZS	LIMIT SWITCH – OPENS AT SET LIMIT
ZS	PROXIMITY SWITCH – CLOSES UPON DECREASING DISTANCE
ZS	PROXIMITY SWITCH – OPENS UPON DECREASING DISTANCE
WS	TORQUE SWITCH – CLOSES UPON INCREASING TORQUE
WS	TORQUE SWITCH – OPENS UPON INCREASING TORQUE

DEVICES – RELAY

SYMBOL	DESCRIPTION
CR 1 / 28, 111	CONTROL RELAY CR1 WITH NORMALLY OPEN CONTACT ON LINE 28 & NORMALLY CLOSED CONTACT ON LINE 111
TR 2	TIME DELAY RELAY TR2 – ADJUSTABLE TIME DELAY RANGE & SETTING AS SHOWN
TDOE / TDOD	TIME DELAY ON ENERGIZATION / TIME DELAY ON DE-ENERGIZATION
M 1	CONTACTOR OR STARTER M1
SV	SOLENOID
CR1 / (105)	NORMALLY OPEN, RELAY CONTACT – ACTUATED BY RELAY CR1 COIL LOCATED ON LINE 105
CR1	NORMALLY CLOSED, RELAY CONTACT – ACTUATED BY RELAY CR1
TR2	NORMALLY OPEN, TIME DELAY RELAY CONTACT – CONTACT CLOSES AFTER TR2 IS ENERGIZED
TR2	NORMALLY CLOSED, TIME DELAY RELAY CONTACT – CONTACT OPENS AFTER TR2 IS ENERGIZED
TR2	NORMALLY OPEN, TIME DELAY RELAY CONTACT – CONTACT OPENS AFTER TR2 IS DE-ENERGIZED
TR2	NORMALLY CLOSED, TIME DELAY RELAY CONTACT – CONTACT CLOSES AFTER TR2 IS DE-ENERGIZED

COMPONENTS

SYMBOL	DESCRIPTION
RES	RESISTOR
	POTENTIOMETER
	CAPACITOR, FIXED
	CAPACITOR, ADJUSTABLE
	DIODE
	DIODE, ZENER
	VARISTOR TRANSIENT VOLTAGE SUPPRESSOR
	VOLTAGE SURGE SUPPRESSOR, AC
	LIGHT EMITTING DIODE
	TRANSISTOR
RTD	RESISTANCE TEMPERATURE DETECTOR (RTD)
	THERMOCOUPLE (T/C)
	THERMISTOR

DEVICES – MISCELLANEOUS

SYMBOL	DESCRIPTION
	AUDIBLE ALARM
TG	TACHOMETER GENERATOR
+	BATTERY
HTR	HEATER
	3 PHASE HEATER
# HP	3 PHASE MOTOR # = MOTOR HP
# HP	SINGLE PHASE MOTOR
	TRANSFORMER

PLAN – SYMBOLS

SYMBOL	DESCRIPTION
	CONDUIT, EXPOSED
	CONDUIT, IN SLAB OR BELOW GRADE
	CONDUIT, EXISTING
	CONDUIT, CONCEALED IN WALL OR CEILING
	CONDUIT STUBBED OUT & CAPPED
	CONDUIT BENDS TOWARD OBSERVER
	CONDUIT BENDS AWAY FROM OBSERVER
	CONDUIT ENDS
	CONDUIT CHANGE IN ELEVATION
G	BARE COPPER GROUND WIRE
	GROUND CONNECTION BOLTED TYPE
	GROUND CONNECTION EXOTHERMIC WELD TYPE
	DISCONNECT SWITCH
	FIELD MOUNTED DEVICE
	SPECIAL RECEPTACLE
J	JUNCTION BOX
	CONTROL STATION
# A o	LIGHTING FIXTURE # – CIRCUIT BREAKER NUMBER A – FIXTURE SCHEDULE REF. o – CONTROL SWITCH REFERENCE OR PE FOR PHOTO CELL
#	DUPLEX RECEPTACLE # – CIRCUIT BREAKER NUMBER
#	FOURPLEX RECEPTACLE # – CIRCUIT BREAKER NUMBER
$ 2 o	TOGGLE SWITCH SUBSCRIPT – CIRCUIT CONTROLLED SUPERSCRIPT – BLANK = 1 POLE 2 = 2 POLE 3 = 3 WAY OL = MOTOR OVERLOAD LETTER – H = HEAT SENSOR S = SMOKE DETECTOR
L	
#	CONDUIT
	3 PHASE POWER RECEPTACLE
	TELEPHONE OUTLET
	REMOVE I/O DATA OUTLET
	FIBER OPTIC OUTLET

P & I DIAGRAM SYMBOLS

SYMBOL	DESCRIPTION
XXX	FIELD MOUNTED INSTRUMENT
XXX / XXX	FACE MOUNTED INSTUMENT ON LOCAL PANEL, OPERATOR ACCESSIBLE
XXX / XXX	FACE MOUNTED INSTRUMENT ON FIELD PANEL, OPERATOR ACCESSIBLE
XXX / XXX	INSTRUMENT MOUNTED IN LOCAL PANEL, OPERATOR INACCESSIBLE
XXX / XXX	INSTRUMENT MOUNTED IN FIELD PANEL, OPERATOR INACCESSIBLE
I / CS # / DWG #	OPERATION PERFORMED WITH LOGIC OR HARDWIRED DEVICES – REFERENCE CONTROL STATEGY # – REFERENCE ELEMENTARY DWG. #
XXX / XXX	PLC OR COMPUTER FUNCTION PERFORMING OPERATION WITH VISUAL INDICATION
XXX / XXX	PLC OR COMPUTER FUNCTION PERFORMING OPERATION WITH VISUAL ALARM INDICATION
XXX / XXX	PLC OR COMPUTER PERFORMING INTERNAL OPERATION
XXX / XXX	PLC OR COMPUTER PERFORMING INTERNAL ALARM OPERATION
∝ ∫ ∂/∂t	PROPORTIONAL, INTEGRAL, AND DIFFERENTIAL PARAMETERS
% +/–	RATIO AND BIAS PARAMETERS
	AUDIBLE ALARM (BUZZER OR HORN)
X	LAMP OR ANNUNCIATOR INDICATION (STATUS OR ALARM)
XXXXX	EQUIPMENT NUMBER OR TAG
XXXXX o	JUMP TAG FROM ONE AREA TO ANOTHER AREA OF DRAWING "o" TAG CONNECT POINT ON EACH DRAWING
o XXXXX	
XXXXX	REGISTER IN INSTRUMENTS, PLC(S) AND COMPUTERS
XXXXX	REGISTER OR STATUS FOR REMOTE COMPUTER OR TELEMETRY SYSTEM
	ELECTRIC SIGNAL
	EXISTING ELECTRIC SIGNAL
	LOGIC OR DATA SIGNAL
	PNEUMATIC SIGNAL
	CAPILLARY TUBING (FILLED SYSTEM)
	HYDRAULIC SIGNAL
ES / AS	SONIC OR ELECTROMAGNETIC SIGNAL
E	ELECTRIC SUPPLY FROM PANELBOARD CKT
A	AIR SUPPLY
	DISCRETE INPUT
	DISCRETE OUTPUT
	ANALOG INPUT
	ANALOG OUTPUT

SWITCHES – OPERATOR

SYMBOL	DESCRIPTION
SW	TOGGLE OR DISCONNECT SWITCH
PB	PUSHBUTTON – NORMALLY OPEN, MOMENTARY ACTION
PB	PUSHBUTTON – NORMALLY CLOSED, MOMENTARY ACTION
PB	PUSHBUTTON, MECHANICALLY INTERLOCKED, DOUBLE CIRCUIT – NORMALLY CLOSED AND NORMALLY OPEN, MAINTAINED ACTION
H O A	SELECTOR SWITCH, 3 POSITION – CONTACT STATUS SHOWN EXISTS AT POSITION OF H–HAND, O–OFF, OR A–AUTO
2–1 1–2	SELECTOR SWITCH, 2 POSITION – CONTACT STATUS SHOWN EXISTS AT POSITION AS SHOWN

DEVICES – FRONT PANEL

SYMBOL	DESCRIPTION
X	INDICATING LIGHT, LETTER "X" INDICATES COLOR: R=RED G=GREEN, A=AMBER, W=WHITE Y=YELLOW, B=BLUE
PTT X	INDICATING LIGHT, PUSH TO TEST
∂A/∂t	AMP METER
∂V/∂t	VOLT METER
ETM	ELAPSED TIME METER
RTM	RUN TIME METER
XS	MULTI–POSITION SWITCH WHERE LETTER "X" IS FUNCTION: A=AMP, V=VOLT

DEVICES – PROTECTIVE

SYMBOL	DESCRIPTION
	DISCONNECT, 3 POLE
	CIRCUIT BREAKER, 3 POLE THERMAL MAGNETIC (TM) OR MOTOR CIRCUIT PROTECT (MCP)
OL	THERMAL OVERLOAD CONTACT
	THERMAL OVERLOAD ELEMENT
	FUSE WITH BLOWN FUSE INDICATING LIGHT
	FUSE

T.E.E.M.
(916) 457–8144

REGISTERED PROFESSIONAL ENGINEER
RICHARD L. VOGT
NO. 11840
Exp.9–30–2004
ELECTRICAL
STATE OF CALIFORNIA

FILE: 0110BE01

BID SET

Consulting Civil and Structural Engineers
CREEGAN+D'ANGELO
6800 KOLL CENTER PARKWAY, SUITE 150
PLEASANTON, CALIFORNIA 94566–7022
PHONE: 925 417–5260 FAX: 925 249–1284
SAN JOSE, FAIRFIELD, MONTEREY, PLEASANTON, SAN FRANCISCO

Rev. No.	Date	Sheet No.	Approved by City	Date

THE CITY OF PLEASANTON

CITY OF PLEASANTON
Department of Public Works

GOLF COURSE PROJECT
PROJECT 968036
ALISAL STREET SEWER LIFT STATION
ELECTRICAL & INSTRUMENTATION SYMBOLS

DRAWN: ZK
CHECKED: RLV
TRAFFIC MANAGER:
DEPUTY DIRECTOR:

PHILIP A. GRUBSTICK
CITY ENGINEER
C22489, EXP: 9/30/01

APPROVED:

RANDALL A. LUM
DIRECTOR OF PUBLIC WORKS
RCE #28060

DATE: FEB. 2002
SCALE: NONE
JOB NO.: 497022

E–1
SHEET 20 OF 42

MISCELLANEOUS ABBREVIATIONS

&	AND	MUX	MULTIPLEXER
@	AT	MV	MERCURY VAPOR
A	AMBER, AMPERES	N	NEUTRAL
AC	ALTERNATING CURRENT	NC	NORMALLY CLOSED
AFF	ABOVE FINISHED FLOOR	NIC	NOT IN CONTRACT
AI	ANALOG INPUT	NL	NIGHT LIGHT
AIC	AMP INTERRUPTING CAPACITY SYMMETRICAL	NO	NORMALLY OPEN
ALT	ALTERNATOR	NOT	NOT TO SCALE
AM	AMMETER	NP	NAMEPLATE
AO	ANALOG OUTPUT	NTS	NOT TO SCALE
AWG	AMERICAN WIRE GUAGE	(N)	NEW
B	BLUE	OC	ON CENTER
BC	BARE COPPER	OL	OVERLOAD
BFC	BELOW FINISHED CEILING	ORP	OXIDATION REDUCTION POTENTIAL
BOD	BIOCHEMICAL OXYGEN DEMAND	P	PHASE, POLE
C	CONDUIT	PB	PUSHBUTTON
CAP	CAPACITOR	PBX	PULL BOX
CB	CIRCUIT BREAKER	PF	POWER FACTOR
CKT	CIRCUIT	PFR	POWER (PHASE) FAIL RELAY
COAX	COAXIAL CABLE	PH	HYDROGEN ION CONCENTRATION
COMM	COMMUNICATION PORT	PI	PULSE INPUT
CPT	CONTROL POWER TRANSFORMER	PLC	PROGRAMMABLE LOGIC CONTROLLER
CR	CONTROL RELAY	PMP	PUMP
CT	CURRENT TRANSFORMER	PNL	PANEL
CU	COPPER	POT	POTENTIOMETER
DC	DIRECT CURRENT	PR	PAIR, TWISTED & SHIELDED CABLE
DET	DETAIL	PRESS	PRESSURE
DI	DIGITAL INPUT	PRI	PRIMARY
DIAG	DIAGRAM	PROVIDE	FURNISH, INSTALL & CONNECT
DISC	DISCONNECT	PRR	POWER RELAY
DO	DIGITAL OUTPUT	PS	PRESSURE SWITCH
DPDT	DOUBLE POLE DOUBLE THROW	PT	POTENTIAL TRANSFORMER
DWG	DRAWING	PTT	PUSH TO TEST
ELEV	ELEVATION	PV	PROCESS VARIABLE
EMT	ELECTRICAL METALLIC TUBING	PVC	POLYVINYLCHLORIDE
ETM	ELAPSED TIME METER	PWR	POWER
(E)	EXISTING	R	RED
F	FRAME	RCT	REPEAT CYCLE TIMER
FC	FAIL CLOSED	REF	REFERENCE
FLA	FULL LOAD AMPS	RMS	ROOT MEAN SQUARED
FLP	FAIL LAST POSITION	RT	RESET TIMER
FO	FAIL OPEN	RTD	RESISTANCE TEMPERATURE DETECTOR
FLR	FLASHER RELAY	RTM	RUN TIME METER
FLUOR	FLUORESCENT	RVNR	REDUCED VOLTAGE NON-REVERSING
FLEX	FLEXIBLE, METAL LIQUID TIGHT CONDUIT	(R)	REWIRE, RELOCATE, REVISE, REUSE
FS	FLOW SWITCH	S	SWITCH
FVNR	FULL VOLTAGE NON-REVERSING	SCH	SCHEDULE
FVR	FULL VOLTAGE REVERSING	SEC	SECONDARY
FWD	FORWARD	SECS	SECONDS
(F)	FUTURE	SEL	SELECTOR
G	GREEN	SFA	SERVICE FACTOR AMPS
GALV	GALVANIZED	SP	SET POINT
GFI	GROUND FAULT CIRCUIT INTERRUPTER	SPEC	SPECIFICATION
GND	GROUND	SR	SENSING RELAY
GRS	GALVANIZED RIGID STEEL CONDUIT	SS	STAINLESS STEEL
GRS-PVC	PVC COATED GRS CONDUIT	STT	START
HI	HIGH	STP	STOP
HID	HIGH INTENSITY DISCHARGE	SV	SOLENOID VALVE
HOA	HAND-OFF-AUTO	SW	SWITCH
HP	HORSEPOWER	SWBD	SWITCHBOARD
HPS	HIGH PRESSURE SODIUM	SYMM	SYMMETRICAL
HTR	HEATER	T	TRIP
HZ	HERTZ (CYCLES PER SECOND)	TB	TERMINAL BLOCK
HZD	HAZARDOUS AREA, EXPLOSION PROOF	TC	TIME CLOCK
I	INTERLOCK	TDOD	TIME DELAY ON DE-ENERGIZATION
I/O	INPUT/OUTPUT	TDOE	TIME DELAY ON ENERGIZATION
ICR	INSTRUMENTATION CONTROL RELAY	TEL	TELEMETRY
INCAN	INCANDESCENT	TELCO	TELEPHONE COMPANY
INST	INSTANTANEOUS	TM	THERMAL MAGNETIC
ISC	SHORT CKT INTERRUPTING CURRENT (SYMM)	TEMP	TEMPERATURE
ISR	INTRINSICALLY SAFE RELAY	TOC	TOTAL ORGANIC CARBON
J	JUNCTION BOX	TR	TIME DELAY RELAY
K	KILO, PREFIX	TRIAD	TWISTED & SHIELDED 3 CONDUCTOR
LA	LIGHTNING ARRESTOR	TS	TEMPERATURE SWITCH
LC	LIGHTING CONTACTOR	TSPR	TWISTED & SHIELDED PAIR
LEL	LOWER EXPLOSIVE LIMIT	TYP	TYPICAL
LO	LOW	UG	UNDERGROUND
LOS	LOCK-OUT STOP SWITCH	UON	UNLESS OTHERWISE NOTED
LPU	LINE PROTECTION UNIT	V	VOLTAGE
LR	LATCHING RELAY	VA	VOLT AMPS
LS	LEVEL SWITCH	VAR	VOLT AMP REACTIVE
M	MOTOR CONTACTOR	VFD	VARIABLE FREQUENCY DRIVE
MAX	MAXIMUM	VLV	VALVE
MCC	MOTOR CONTROL CENTER	VM	VOLTMETER
MCM	THOUSAND CIRCULAR MILLS	W	WHITE, WATTS
MCP	MOTOR CIRCUIT PROTECTOR	WHM	WATT HOURMETER
MD	MOISTURE DETECTION	WM	WATTMETER
MH	MANHOLE	WP	WATERPROOF, WEATHER PROOF
MHD	METAL HALIDE	WS	TORQUE SWITCH
MIN	MINIMUM	XFMR	TRANSFORMER
MINS	MINUTES	XS	MISCELLANEOUS SWITCH
MODEM	MODULATOR/DEMODULATOR	Y	YELLOW
MOV	MOTOR OPERATED VALVE	Z	IMPEDANCE
MTR	MOTOR	ZS	LIMIT SWITCH

INSTRUMENT IDENTIFICATION LETTERS

	FIRST – LETTER	SUCCEEDING – LETTER			
	MEASURED OF INITIATING VARIABLE	MODIFIER	READOUT PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS		ALARM		
B	BURNER, COMBUSTION		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
C	CONDUCTIVITY			CONTROLLER	
D	DENSITY	DIFFERENTIAL			
E	VOLTAGE		SENSOR, PRIMARY ELEMENT		
F	FLOW RATE	RATIO (FRACTION)			
G	GENERAL		GLASS VIEWING DEVICE		
H	HAND				HIGH, OPENED
I	CURRENT (ELEC.)		INDICATING, INDICATOR		
J	POWER	SCAN			
K	TIME, TIME SCHEDULE	TIME RATE OF CHANGE		CONTROL STATION	
L	LEVEL		LIGHT		LOW, CLOSED
M	MOISTURE	MOMENTARY			MIDDLE
N	STATUS		STATUS	USER'S CHOICE	USER'S CHOICE
O	OPERATOR		ORIFICE, RESTRICTION		
P	PRESSURE, VACUUM		POINT (TEST) CONNECTION		
Q	QUANTITY	INTEGRATE, TOTALIZE			
R	RESET		RECORD		
S	SPEED, FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMITTER	TEST
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	MULTIFUNCTION
V	VIBRATION, MECH. ANALYSIS			VALVE, DAMPER LOUVER	
W	WEIGHT, FORCE		WELL		
X	SWITCH	X AXIS	UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED
Y	EVENT, STATE OR PRESENCE	Y AXIS		RELAY, COMPUTER, CONVERTOR	
Z	POSITION DIMENSION	Z AXIS		DRIVER, ACTUATOR, UNCLASSEIFIED FINAL CONTROL ELEMENT	

T.E.E.m.
(916) 457-8144

REGISTERED PROFESSIONAL ENGINEER
RICHARD L. YOUNGER
NO. 11840
Exp. 9-30-2004
ELECTRICAL
STATE OF CALIFORNIA

FILE: 0110BE02

BID SET

CREEGAN+D'ANGELO
Consulting Civil and Structural Engineers
6800 KOLL CENTER PARKWAY, SUITE 150
PLEASANTON, CALIFORNIA 94566-7022
PHONE: 925 417-5260 FAX: 925 249-1264
SAN JOSE, FAIRFIELD, MONTEREY, PLEASANTON, SAN FRANCISCO

Rev. No.	Date	Sheet No.	Approved by City	Date

THE CITY OF PLEASANTON

CITY OF PLEASANTON
Department of Public Works

GOLF COURSE PROJECT
PROJECT 968036
ALISAL STREET SEWER LIFT STATION
ELECTRICAL & INSTRUMENTATION ABBREVIATIONS

DRAWN: ZK
CHECKED: RLV
TRAFFIC MANAGER:
DEPUTY DIRECTOR:

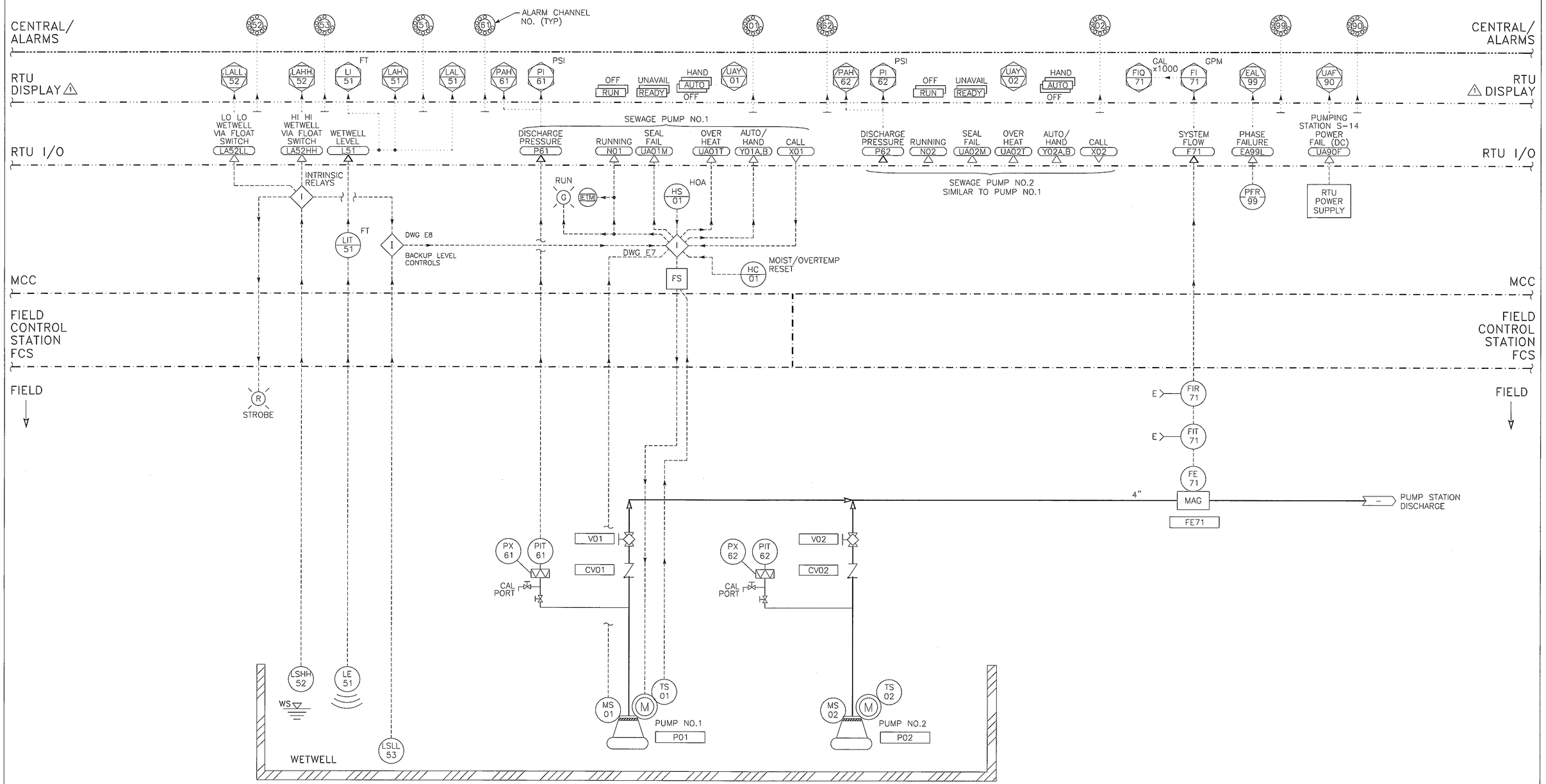
PHILIP A. GRUBSTICK
CITY ENGINEER
C22489, EXP: 9/30/01

APPROVED:

RANDALL A. LUM
DIRECTOR OF PUBLIC WORKS
RCE #28060

DATE: FEB. 2002
SCALE: NONE
JOB NO.: 497022

E-2
SHEET 21 OF 42



SEWAGE LIFT STATION

NOTES: ⚠1 ALL DISPLAY VALUES SHOWN FOR RTU SHALL ALSO BE DISPLAYED AT CENTRAL.

BID SET

T.E.E.M.
(916) 457-8144

REGISTERED PROFESSIONAL ENGINEER RICHARD L. VOGLER NO. 11840 Exp.9-30-2004 ELECTRICAL STATE OF CALIFORNIA

FILE: 0110BE03

Consulting Civil and Structural Engineers
CREEGAN+D'ANGELO
6800 KOLL CENTER PARKWAY, SUITE 150
PLEASANTON, CALIFORNIA 94566-7022
PHONE: 925 417-5260 FAX: 925 249-1264
SAN JOSE, FAIRFIELD, MONTEREY, PLEASANTON, SAN FRANCISCO

Rev. No.	Date	Sheet No.	Approved by City	Date

THE CITY OF PLEASANTON

CITY OF PLEASANTON
Department of Public Works

GOLF COURSE PROJECT
PROJECT 968036

ALISAL STREET SEWER LIFT STATION
PUMP #1 & 2 P&ID

DRAWN:	ZK
CHECKED:	RLV
TRAFFIC MANAGER:	
DEPUTY DIRECTOR:	

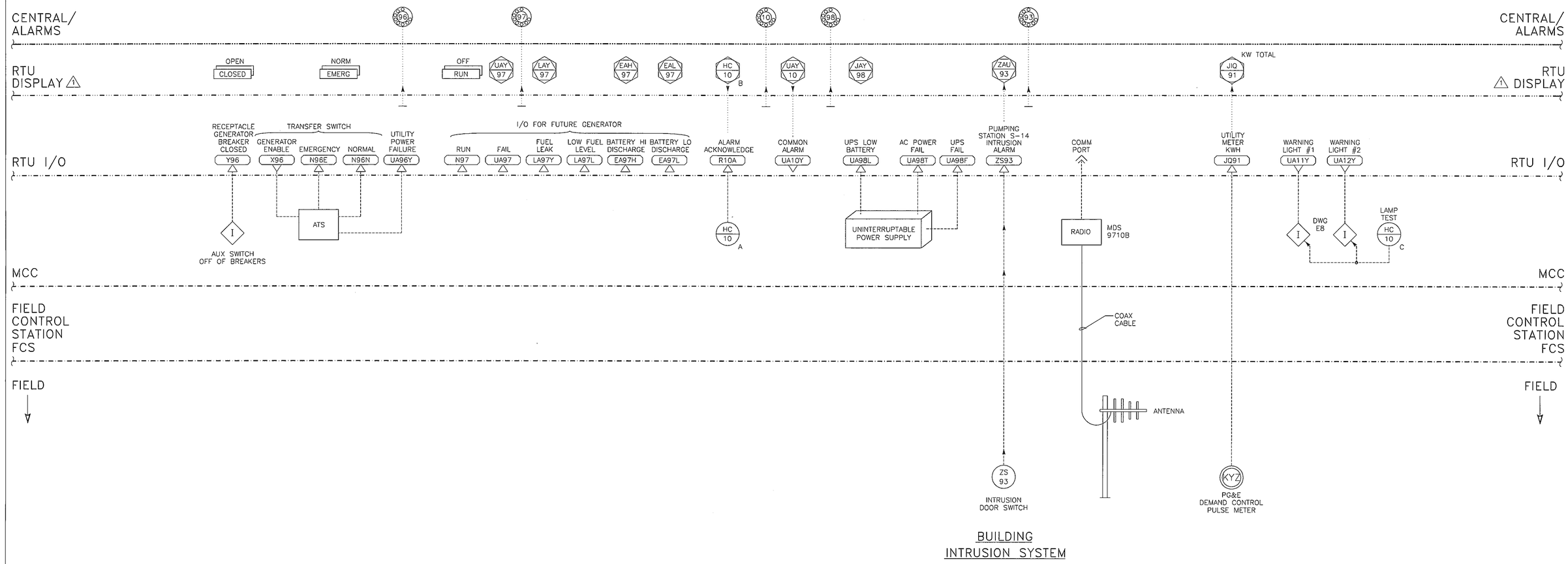
PHILIP A. GRUBSTICK
CITY ENGINEER
C22489, EXP: 9/30/01

APPROVED:

RANDALL A. LUM
DIRECTOR OF PUBLIC WORKS
RCE #28080

DATE: FEB. 2002
SCALE: NONE
JOB NO.: 497022

E-3
SHEET 22 OF 42



NOTES: 1 ALL DISPLAY VALUES SHOWN FOR RTU SHALL ALSO BE DISPLAYED AT CENTRAL.

BID SET

T.E.E.M.
(916) 457-8144

REGISTERED PROFESSIONAL ENGINEER RICHARD L. VICKER No. 11840 Exp. 9-30-2004 ELECTRICAL STATE OF CALIFORNIA

FILE: 0110BE04

CREEGAN+D'ANGELO
Consulting Civil and Structural Engineers
6800 KOLL CENTER PARKWAY, SUITE 150
PLEASANTON, CALIFORNIA 94566-7022
PHONE: 925 417-5260 FAX: 925 249-1264
SAN JOSE, FAIRFIELD, MONTEREY, PLEASANTON, SAN FRANCISCO

Rev. No.	Date	Sheet No.	Approved by City	Date

THE CITY OF PLEASANTON

CITY OF PLEASANTON
Department of Public Works

GOLF COURSE PROJECT
PROJECT 968036

ALISAL STREET SEWER LIFT STATION
AUXILIARY SYSTEM P&ID

DRAWN: ZK		APPROVED:	DATE: FEB. 2002
CHECKED: RLV			SCALE: NONE
TRAFFIC MANAGER:			
DEPUTY DIRECTOR:	PHILIP A. GRUBSTICK CITY ENGINEER C22489, EXP: 9/30/01	RANDALL A. LUM DIRECTOR OF PUBLIC WORKS RCE #28060	JOB NO.: 497022

E-4 SHEET 23 OF 42

UTILITY SERVICE
LOAD CALCULATIONS

DESCRIPTION	LOAD AMPS	QTY	LOAD VA
10 HP PUMP	28	2	23,279
PANELBOARD "LP"			4,580
SUBTOTAL			27,859
LARGEST MOTOR @ 25% ADDITIONAL: 25 HP => 0.25 x 11,639 VA=			2,910
TOTAL			30,769

/ 240 V, 3 PHASE, 4 WIRE

SERVICE AMPS = 74 AMPS
80% RATED
1.25 MULTIPLIER
SERVICE SIZE = 93 AMPS

VOLTS 120 240
PHASE 1
WIRE 3

PANEL "LP"
BUS AMPS 100
MAIN BKR NONE

LOCATION: MCC
ENCLOSURE: FLUSH
AIC RATING: 10,000

BKR NO.		LOAD VA	LINE AMPS		AMPS/ POLE	BKR NO.
1	INSIDE BUILDING LIGHTS	58	0		20/1	1
3	RECEPTACLES	540		5	20/1	3
5	SUMP PUMP	500	4		20/1	5
7	MCC GFI RECEPTACLE	180		2	20/1	7
9	OUTSIDE GFI RECEPTACLE	180	2		20/1	9
11	BACKUP LEVEL CONTROLS	200		2	20/1	11
13	VAULT LIGHT	28	0		20/1	13
15	VAULT RECEPTACLE	180		2	20/1	15
17	SPARE	0	0		20/1	17
19	SPARE	0		0	20/1	19
21	SPARE	0	0		20/1	21
23	SPARE	0		0	20/1	23

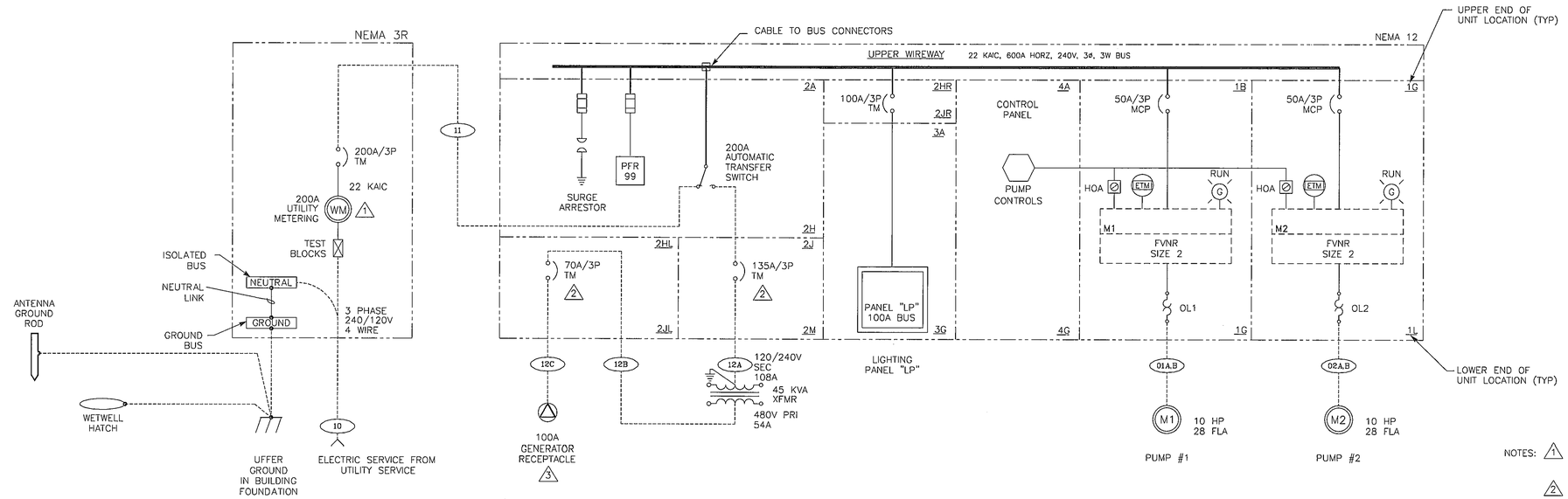
BKR NO.	AMPS/ POLE	LINE AMPS		LOAD VA		BKR NO.
2	20/1	1		118	EXTERIOR LIGHTS	2
4	20/1		6	700	PROGRAMMABLE CONTROLLER & RADIO	4
6	20/1	5		650	MCC, HEATER, FAN & LIGHTS	6
8	20/1		10	1,200	BUILDING EXHAUST FAN	8
10	20/1	0		0	ENGINE BLOCK HEATER	10
12	20/1		0	0	BATTERY CHARGER	12
14	20/1	2		200	RECORDER & FLOWMETER	14
16	20/1		3	360	TELCO RECEPTACLE	16
18	20/1	0		0	SPARE	18
20	20/1		0	0	SPARE	20
22	20/1	0		0	SPARE	22
24	20/1		0	0	SPARE	24

PHASE	A	B
LEFT SIDE AMPS	6	9
LEFT SIDE KVA	0.77	1.10
TOTAL KVA		5
TOTAL AMPS @ 240V, 1P		21
DIVERSITY FACTOR		0.90
LOAD KVA		4.58

NEUTRAL

GROUND

A	B	PHASE
8	19	RIGHT SIDE AMPS
0.97	2.26	RIGHT SIDE KVA
0.77	1.10	LEFT SIDE KVA
1.7	3.4	TOTAL PHASE KVA
14	28	TOTAL PHASE AMPS
68	132	% OF AVERAGE



NOTES:
1. POWER UTILITY SHALL INSTALL DEMAND CONTROL PULSE METER.
2. PROVIDE AUXILIARY SWITCH ON BREAKERS FOR CONNECTION TO RTU INPUT Y96.
3. CROUSE HINDS #AREA SERIES WITH S22 REVERSE POLARITY IN AJC RECEPTACLE WITH SCREW CAP.

METERING SECTION

MOTOR CONTROL CENTER

SINGLE LINE DIAGRAM

T.E.E.m.
(916) 457-8144

REGISTERED PROFESSIONAL ENGINEER
RICHARD L. VORKER
NO. 11940
Exp. 9-30-2004
ELECTRICAL
STATE OF CALIFORNIA

FILE: 0110BE05

BID SET

CREEGAN+D'ANGELO
Consulting Civil and Structural Engineers
6800 KOLL CENTER PARKWAY, SUITE 150
PLEASANTON, CALIFORNIA 94566-7022
PHONE: 925 417-5260 FAX: 925 249-1284
SAN JOSE, FAIRFIELD, MONTEREY, PLEASANTON, SAN FRANCISCO

Rev. No.	Date	Sheet No.	Approved by City	Date

THE CITY OF PLEASANTON

CITY OF PLEASANTON
Department of Public Works

GOLF COURSE PROJECT
PROJECT 968036

ALISAL STREET SEWER LIFT STATION
MCC SINGLE LINE DIAGRAM

DRAWN: ZK
CHECKED: RLV
TRAFFIC MANAGER:
DEPUTY DIRECTOR:

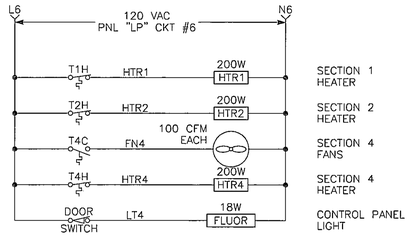
PHILIP A. GRUBSTICK
CITY ENGINEER
C22489, EXP: 9/30/01

APPROVED:

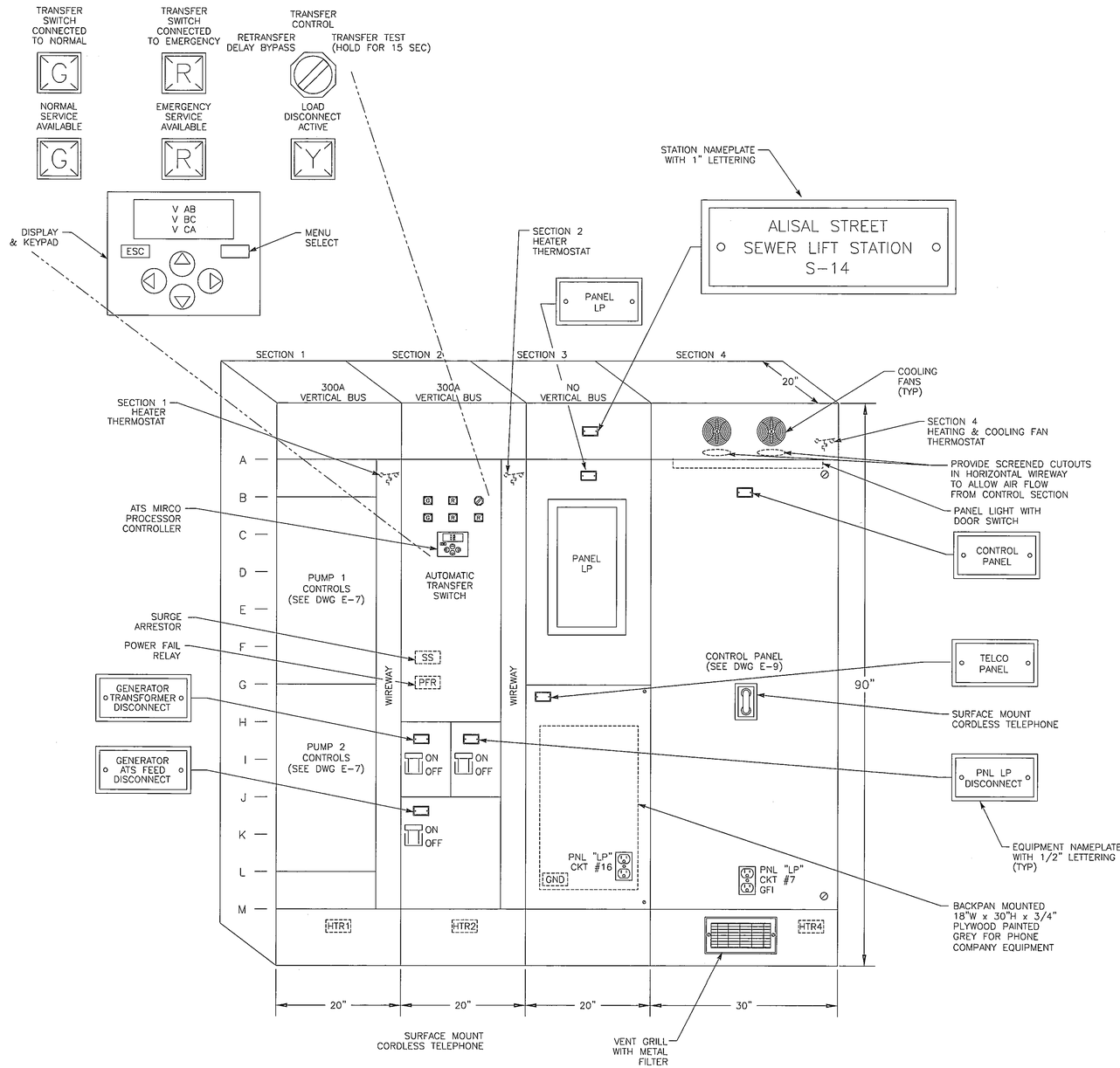
RANDALL A. LUM
DIRECTOR OF PUBLIC WORKS
RCE #28060

DATE: FEB. 2002
SCALE: NONE
JOB NO.: 497022

E-5
SHEET 24 OF 42



MCC HEATER & FAN ELEMENTARY DIAGRAM



MCC ELEVATION

T.E.E.M.
(916) 457-8144

REGISTERED PROFESSIONAL ENGINEER
RICHARD L. VICKERY
NO. 11840
Exp.9-30-2004
ELECTRICAL
STATE OF CALIFORNIA

FILE: 0110BE06

BID SET

Consulting Civil and Structural Engineers
CREEGAN+D'ANGELO
6800 KOLL CENTER PARKWAY, SUITE 150
PLEASANTON, CALIFORNIA 94566-7022
PHONE: 925 417-5260 FAX: 925 249-1284
SAN JOSE, FAIRFIELD, MONTEREY, PLEASANTON, SAN FRANCISCO

Rev. No.	Date	Sheet No.	Approved by City	Date

THE CITY OF PLEASANTON

CITY OF PLEASANTON
Department of Public Works

GOLF COURSE PROJECT
PROJECT 968036

ALISAL STREET SEWER LIFT STATION
MCC ELEVATION

DRAWN: ZK
CHECKED: RLV
TRAFFIC MANAGER:
DEPUTY DIRECTOR:

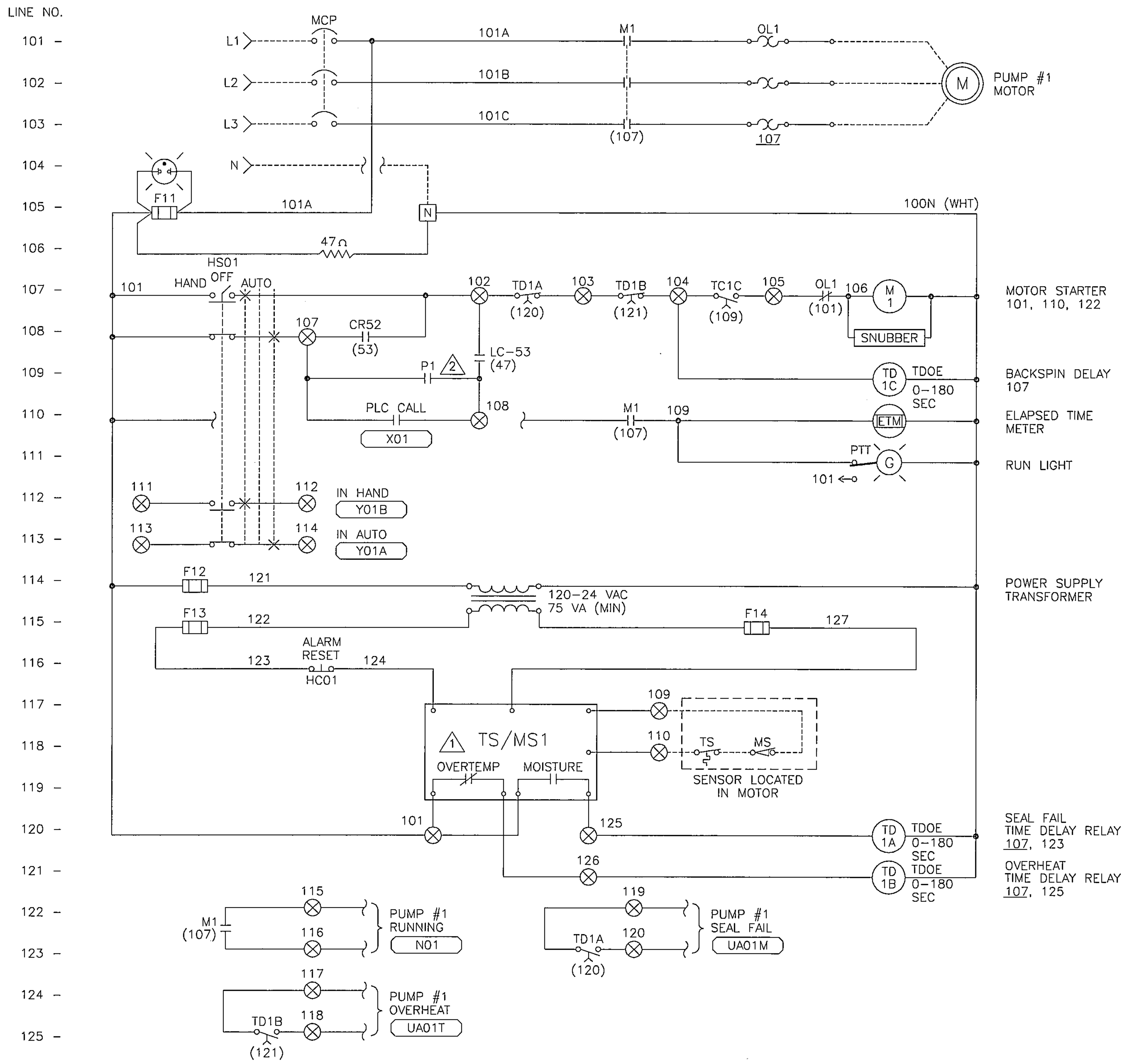
PHILIP A. GRUBSTICK
CITY ENGINEER
C22489, EXP: 9/30/01

APPROVED:

RANDALL A. LUM
DIRECTOR OF PUBLIC WORKS
RCE #28060

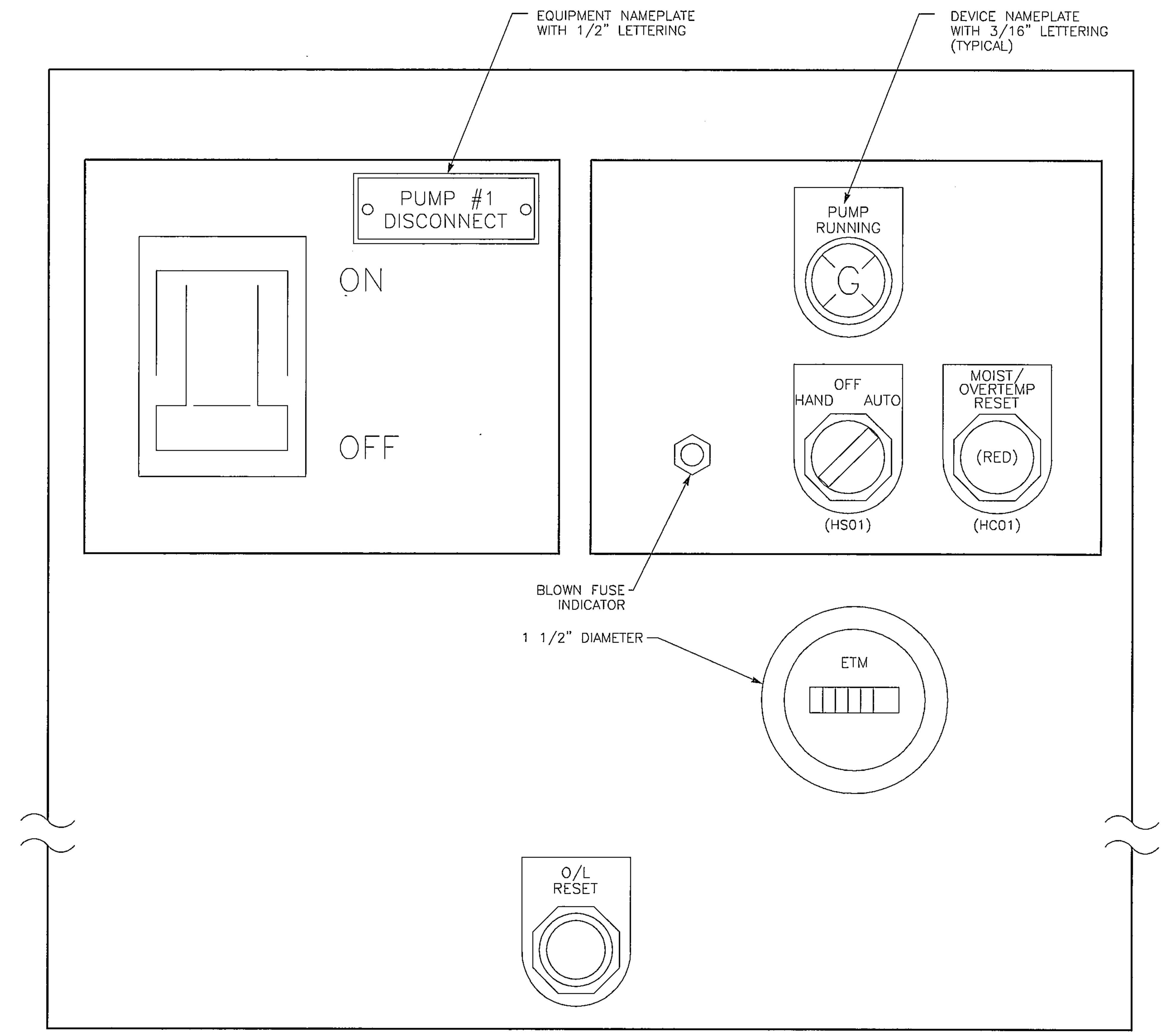
DATE: FEB. 2002
SCALE: NONE
JOB NO.: 497022

E-6
SHEET 25 OF 42



PUMP #1 ELEMENTARY DIAGRAM

SIMILAR DIAGRAM FOR PUMP NO.2
USE 2, 20 SERIES NUMBERING FOR DEVICES
AND 200 SERIES WIRE #s



CUBICLE LAYOUT

(SIMILAR FOR PUMP #2)

NOTES: 1. SUBMERSIBLE MOTOR MOISTURE/OVERTEMP RELAY(S) TO BE SUPPLIED BY PUMP MANUFACTURER AND INSTALLED & WIRED BY MCC MANUFACTURER.

2. DIGITAL OUTPUT FROM MILLTRONICS. ONE PER PUMP. CONFIGURE CALL TO BE STAGED START AFTER PLC START AND BEFORE FLOAT BACK-UP. SEE DWG E-8.

T.E.Em.
(916) 457-8144

REGISTERED PROFESSIONAL ENGINEER
RICHARD L. VOGLER
NO. 11840
Exp.9-30-2004
ELECTRICAL
STATE OF CALIFORNIA

BID SET

FILE: 0110BE07

Consulting Civil and Structural Engineers
CREEGAN+D'ANGELO
6800 KOLL CENTER PARKWAY, SUITE 150
PLEASANTON, CALIFORNIA 94566-7022
PHONE: 925 417-5260 FAX: 925 249-1264
SAN JOSE, FAIRFIELD, MONTEREY, PLEASANTON, SAN FRANCISCO

Rev. No.	Date	Sheet No.	Approved by City	Date

THE CITY OF PLEASANTON

CITY OF PLEASANTON
Department of
Public Works

GOLF COURSE PROJECT
PROJECT 968036

ALISAL STREET SEWER LIFT STATION
PUMP 1 & 2 ELEMENTARY DIAGRAMS

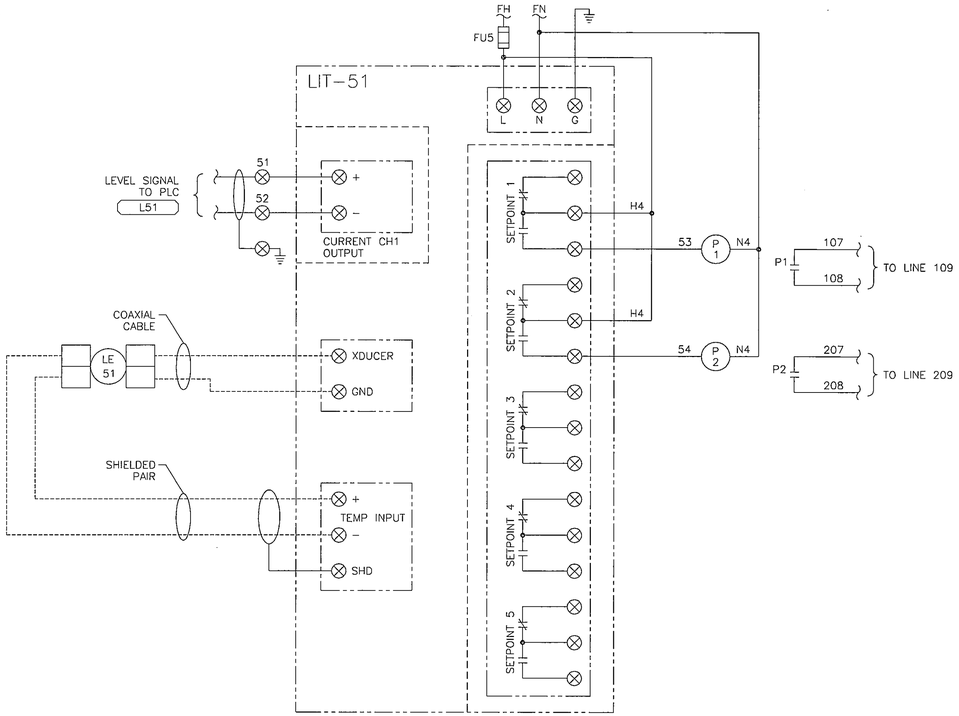
DRAWN: ZK
CHECKED: RLV
TRAFFIC MANAGER:
DEPUTY DIRECTOR:

PHILIP A. GRUBSTICK
CITY ENGINEER
C22489, EXP: 9/30/01

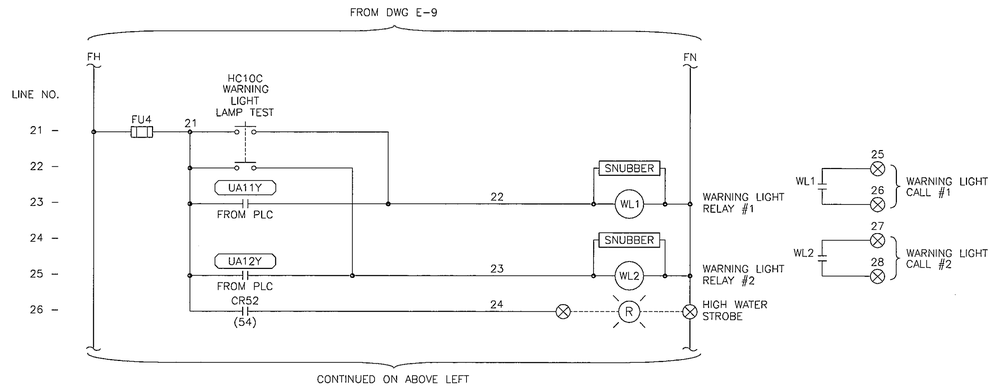
APPROVED:
RANDALL A. LUM
DIRECTOR OF PUBLIC WORKS
RCE #28060

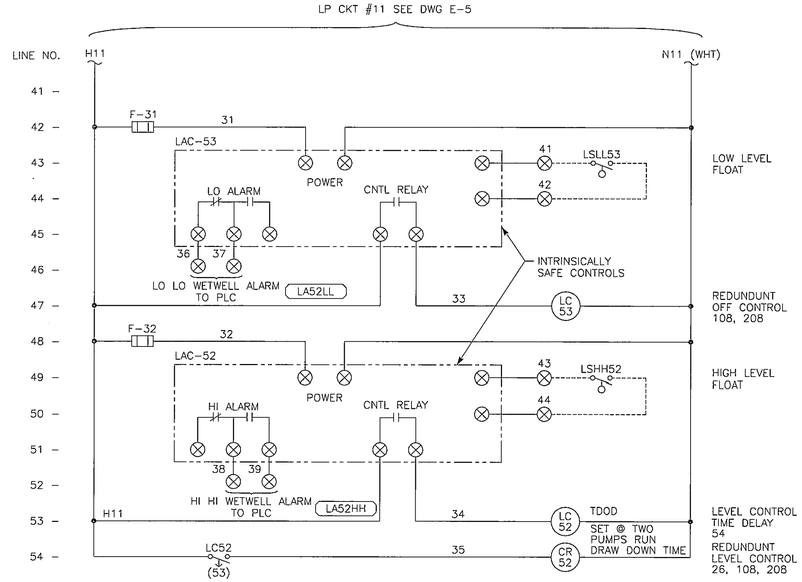
DATE: FEB. 2002
SCALE: NONE
JOB NO.: 497022

E-7
SHEET 26 OF 42



LEVEL TRANSMITTER WIRING DIAGRAM





BACKUP CONTROLS WIRING DIAGRAM

BID SET

T.E.Em.
(916) 457-8144

REGISTERED PROFESSIONAL ENGINEER RICHARD L. VOLKERT NO. 11840 Exp 9-30-2004 ELECTRICAL STATE OF CALIFORNIA

FILE: 0110BE08

Consulting Civil and Structural Engineers
CREEGAN+D'ANGELO
6800 KOLL CENTER PARKWAY, SUITE 150
PLEASANTON, CALIFORNIA 94566-7022
PHONE: 925 417-5260 FAX: 925 249-1264
SAN JOSE, FAIRFIELD, MONTEREY, PLEASANTON, SAN FRANCISCO

Rev. No.	Date	Sheet No.	Approved by City	Date

THE CITY OF PLEASANTON

CITY OF PLEASANTON
Department of Public Works

GOLF COURSE PROJECT
PROJECT 968036
ALISAL STREET SEWER LIFT STATION
LEVEL CONTROLS & LEVEL TRANS
ASSEMBLY DETAIL

DRAWN: ZK
CHECKED: RLV
TRAFFIC MANAGER:
DEPUTY DIRECTOR:

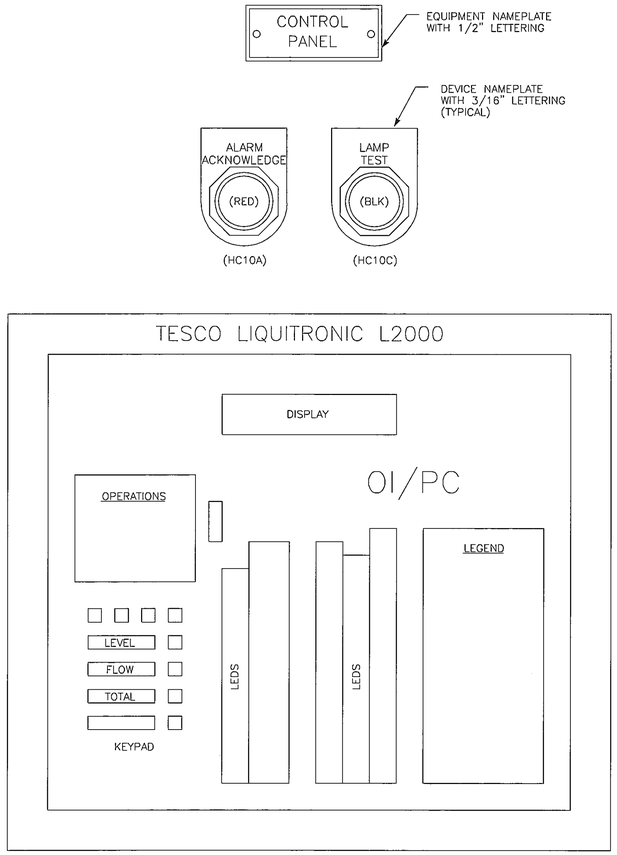
PHILIP A. GRUBSTICK
CITY ENGINEER
C22489, EXP: 9/30/01

APPROVED:

RANDALL A. LUM
DIRECTOR OF PUBLIC WORKS
RCE #28060

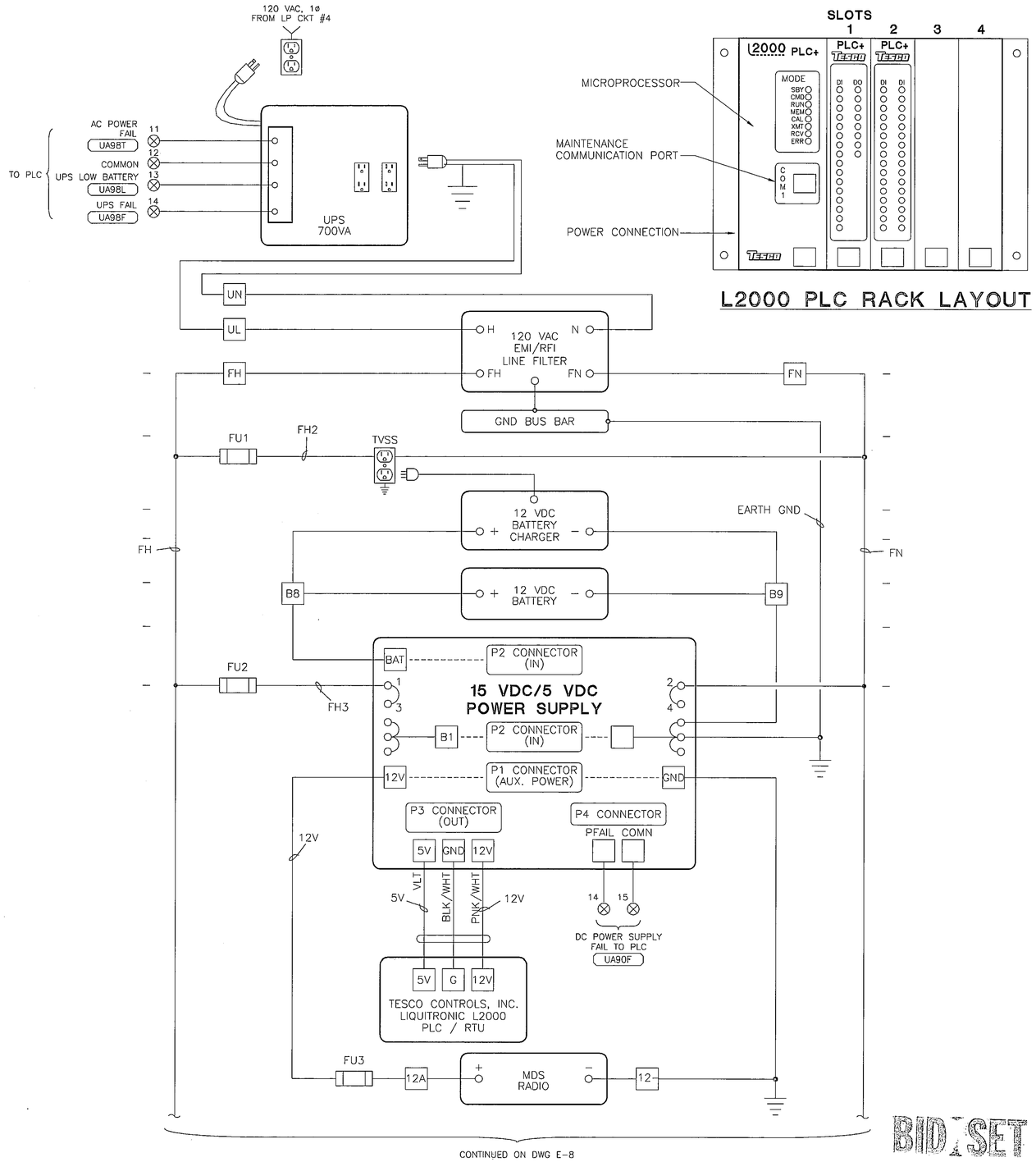
DATE: FEB. 2002
SCALE: NONE
JOB NO.: 497022

E-8
SHEET 27 OF 42



CONTROL PANEL LAYOUT

NOTES: 1 MOUNT INSTRUMENT ON STANDOFFS TO BRING DISPLAYS FLUSH BEHIND DOORS.



PLC POWER DISTRIBUTION WIRING DIAGRAM

L2000 PLC RACK LAYOUT

BID SET

T.E.E.M.
(916) 457-8144

REGISTERED PROFESSIONAL ENGINEER RICHARD L. KOELER NO. 19940 Exp.9-30-2004 ELECTRICAL STATE OF CALIFORNIA

FILE: 0110BE09

CREEGAN+D'ANGELO
Consulting Civil and Structural Engineers
6800 KOLL CENTER PARKWAY, SUITE 150
PLEASANTON, CALIFORNIA 94566-7022
PHONE: 925 417-5260 FAX: 925 249-1284
SAN JOSE, FAIRFIELD, MONTEREY, PLEASANTON, SAN FRANCISCO

Rev. No.	Date	Sheet No.	Approved by City	Date

THE CITY OF PLEASANTON

CITY OF PLEASANTON
Department of Public Works

GOLF COURSE PROJECT
PROJECT 968036
ALISAL STREET SEWER LIFT STATION
CONTROL STATION LAYOUT & POWER DISTRIBUTION

DRAWN: ZK
CHECKED: RLV
TRAFFIC MANAGER:
DEPUTY DIRECTOR:

PHILIP A. GRUBSTICK
CITY ENGINEER
C22489, EXP: 9/30/01

APPROVED:

RANDALL A. LUM
DIRECTOR OF PUBLIC WORKS
RCE #28060

DATE: FEB. 2002
SCALE: NONE
JOB NO.: 497022

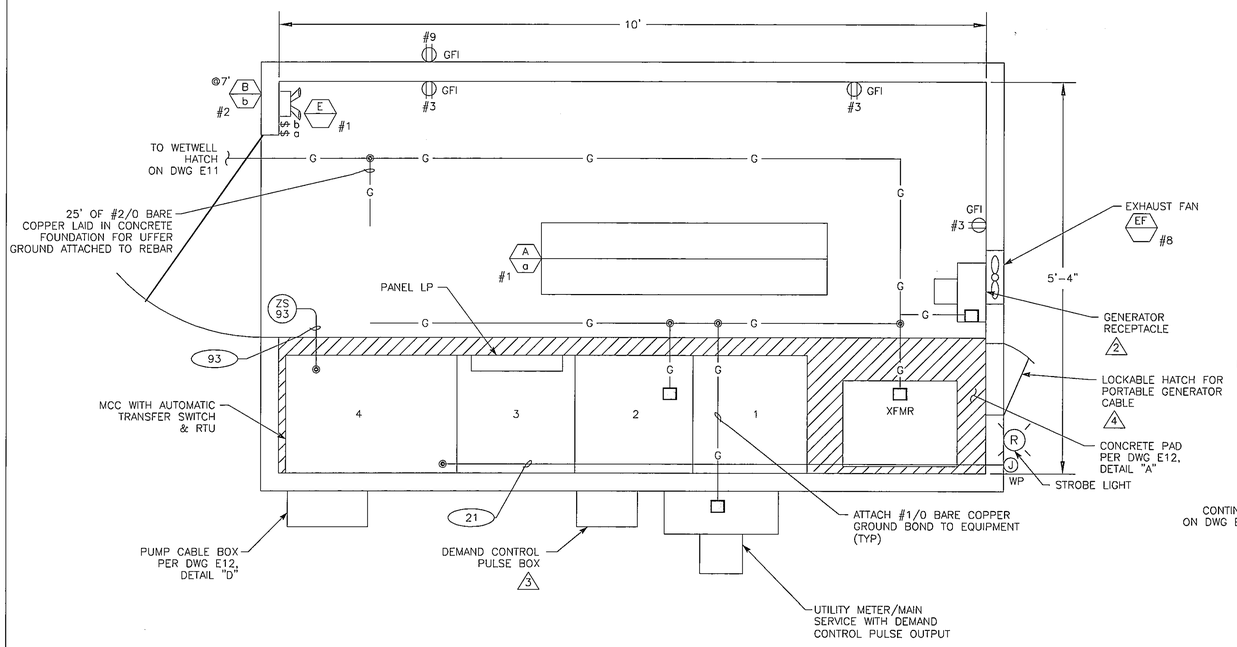
E-9
SHEET 28 OF 42

LIGHT FIXTURE SCHEDULE

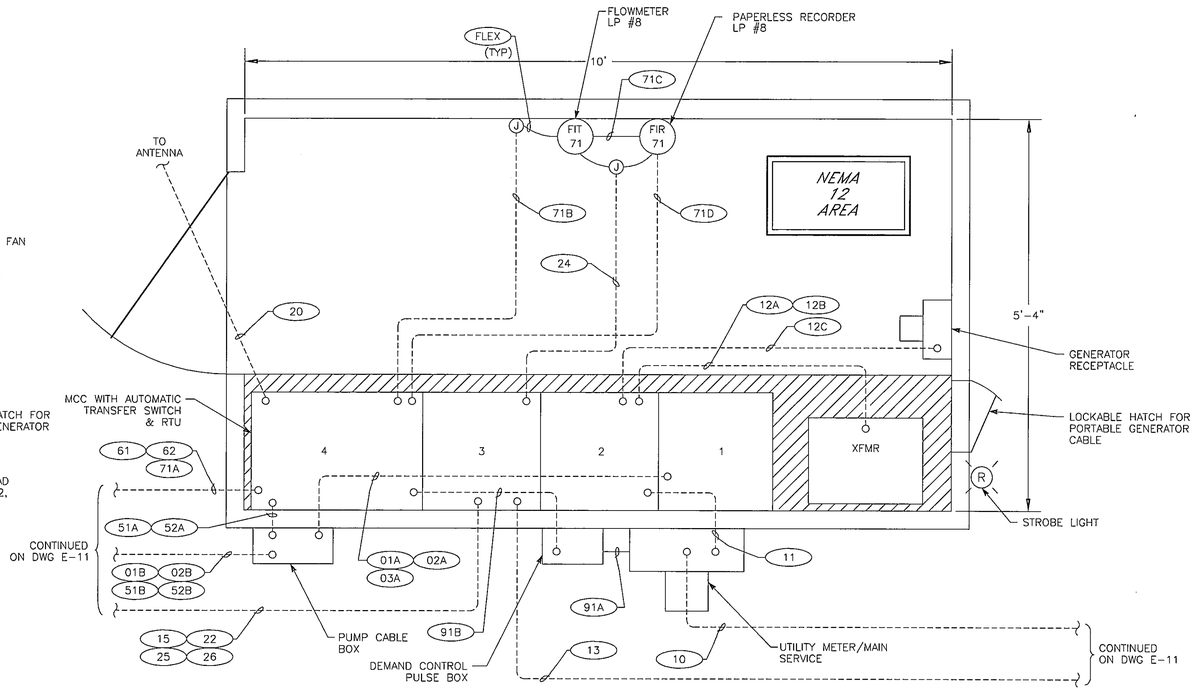
CODE LETTER	FIXTURE TYPE	FIXTURE LAMPS	WATTS/ FIXTURE	MANUFACTURER OR APPROVED EQUAL	MOUNTING ARRANGEMENT	NOTES
A	FLUORESCENT, 4' CORROSION-RESISTANT HIGH IMPACT ACRYLIC U.L. LISTED	T8 1 EACH	40	LITHONIA VRI-1-32-AR-120	CEILING SURFACE	ELECTRONIC BALLAST WET LOCATION FITTINGS
B	FLUORESCENT, WIDE UNIT CLEAR PRISMATIC LENS U.L. LISTED	F13TT 1 EACH	18	DAY-BRIGHT WFW-113-CP3	WALL MOUNT	
C	HIGH PRESSURE SODIUM, FLOODLIGHT HEAVY DUTY CORROSION RESISTANT U.L. LISTED	100 HPS 1 EACH	100	LITHONIA TFL-100S-TA2-120-CR-DBL-PWB	POLE MOUNT MOUNT AT A HEIGHT OF AT LEAST 12'-0" OUTDOOR	
E	EMERGENCY LIGHT PACK WITH CHARGER & NICKEL CADMIUM BATTERIES & TEST SWITCH	9W HIGH INTENSITY TUNGSTEN 2 EACH	18	EMERGI-LITE LSC 18-2	WALL MOUNT	
EF	EXHAUST FAN					SPECIFIED IN MECHANICAL SECTIONS

CONDUIT & WIRE ROUTING SCHEDULE

COND. NO.	FROM	TO	COND. QTY	COND. SIZE	CONDUIT TYPE	WIRE QTY	WIRE SIZE	GND SIZE	NOTES
01A	MCC	PUMP CABLE BOX	1	1-1/2"	GRS-PVC	3	#8	#8	
01B	PUMP CABLE BOX	PUMP NO. 1	1	2-1/2"	GRS-PVC	1	MNFR CABLE		
02A	MCC	PUMP CABLE BOX	1	1-1/2"	GRS-PVC	3	#8	#8	
02B	PUMP CABLE BOX	PUMP NO. 2	1	2-1/2"	GRS-PVC	1	MNFR CABLE		
03A	MCC	PUMP CABLE BOX	1	1"	GRS-PVC	10	#14	#12	
10	POWER POLE RISER	METER/MAIN	1	4"	PVC-40	1	PULL ROPE		INSTALL PER UTILITY ENG DWGS
11	METER/MAIN	MCC	1	3"	PVC-40	4	#3/0	#3	
12A	MCC	GENERATOR XFMR	1	2"	GRS	4	#1/0	#6	
12B	GENERATOR XFMR	MCC	1	2"	GRS	3	#3	#8	
12C	MCC	GENERATOR RECEPTACLE	1	2"	GRS	3	#3	#8	
13	MCC	TELCO POLE RISER	1	2"	PVC-40	1	TELCO CABLE		
15	MCC	VAULT SUMP PUMP	1	1"	GRS-PVC	2	#12	#12	LP# 5
20	MCC	ANTENNA	1	2"	GRS-PVC	1	COAX CABLE		+ #8 GND
21	MCC	STROBE LIGHT	1	3/4"	EMT	2	#12	#12	
22	MCC	AREA LIGHT	1	1"	GRS-PVC	2	#10	#10	LP# 2
24	MCC	FIT/ FIR-71 J-BOX	1	1"	GRS-PVC	2	#12	#12	LP# 14
25	MCC	VALVE VAULT LIGHT & RECEPT	1	1"	GRS-PVC	4	#10	#10	LP# 13,15
26	MCC	PULL BOX	1	1"	GRS-PVC	1	PULL ROPE		
51A	MCC	PUMP CABLE BOX	1	1"	GRS-PVC	1	MNFR CABLE		
51B	PUMP CABLE BOX	LIT-51	1	1"	GRS-PVC	1	MNFR CABLE		
52A	MCC	PUMP CABLE BOX	1	1"	GRS-PVC	6	#14	#12	
52B	PUMP CABLE BOX	LSHH-52, LSLL-53 J-BOX	1	1"	GRS-PVC	2	MNFR CABLES		
61	MCC	PIT-61 J-BOX	1	1"	GRS-PVC	1	#16 TSPR	#12	
62	MCC	PIT-62 J-BOX	1	1"	GRS-PVC	1	#16 TSPR	#12	
71A	MCC	FE-71	1	1"	GRS-PVC	1	MNFR CABLES		+ #6 GND
71B	MCC	FIT-71	1	1"	GRS	1	MNFR CABLES		
71C	FIT-71	FIR-71	1	3/4"	GRS	1	#16 TSPR	#12	
71D	FIR-71	MCC	1	1"	GRS	1	#16 TSPR	#12	
91A	METER/MAIN	DEMAND CNTRL PULSE BOX	1	3/4"	GRS-PVC	2	#16 TSPR	#12	
91B	DEMAND CNTRL PULSE BOX	MCC	1	3/4"	GRS-PVC	2	#16 TSPR	#12	
93	MCC	ZS-93	1	3/4"	EMT	2	#14	#12	



CONTROL BUILDING FAN, LIGHTING, RECEPTACLE & GROUNDING FLOOR PLAN



CONTROL BUILDING POWER FLOOR PLAN

NOTES:
1. PROVIDE 3/4" EMT CONDUITS AND #12 WIRE FOR ALL LIGHTS, FANS & RECEPTACLES SHOWN TO PANEL LP.
2. WALL MOUNT RECEPTACLE AT 48".
3. NEMA 3R SCREW COVER 8" x 8" x 4" (MIN).
4. RETROFIT GALVANIZED STEEL PADLOCKABLE HINGED DOOR WITH 12" x 12" OPENING THROUGH SIDE OF BUILDING FOR PORTABLE GENERATOR CABLE PASS THROUGH.

T.E.E.m.
(916) 457-8144

REGISTERED PROFESSIONAL ENGINEER RICHARD L. VOGLER NO. 11840 Exp.9-30-2004 ELECTRICAL STATE OF CALIFORNIA

FILE: 0110BE07

BID SET

CREEGAN+D'ANGELO
Consulting Civil and Structural Engineers
6800 KOLL CENTER PARKWAY, SUITE 150
PLEASANTON, CALIFORNIA 94566-7022
PHONE: 925 417-5260 FAX: 925 249-1264
SAN JOSE, FAIRFIELD, MONTEREY, PLEASANTON, SAN FRANCISCO

Rev. No.	Date	Sheet No.	Approved by City	Date

THE CITY OF PLEASANTON

CITY OF PLEASANTON
Department of Public Works

GOLF COURSE PROJECT
PROJECT 968036

ALISAL STREET SEWER LIFT STATION
CONTROL BUILDING SITE PLAN

DRAWN: ZK
CHECKED: RLV
TRAFFIC MANAGER:
DEPUTY DIRECTOR:

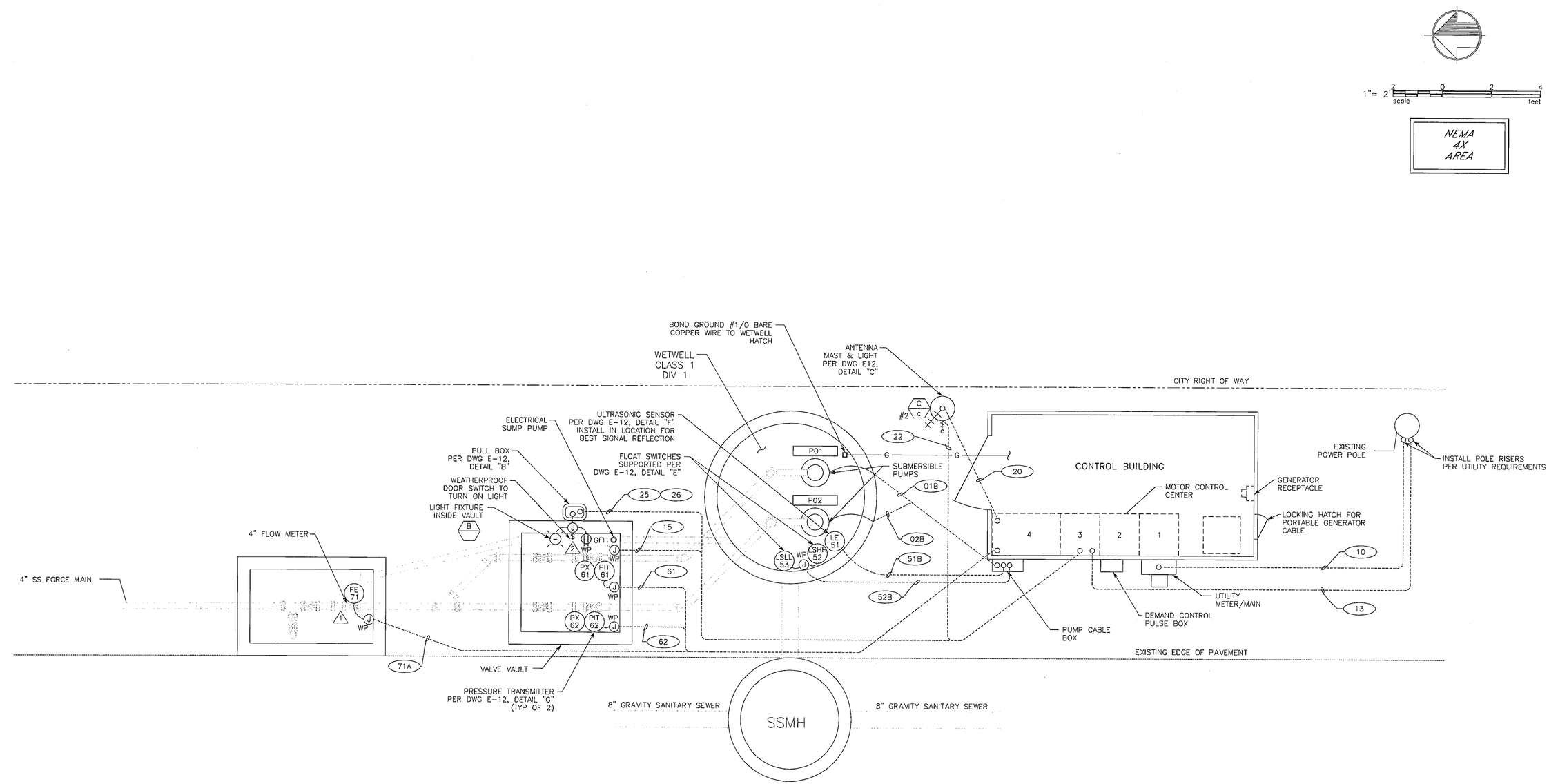
PHILIP A. GRUBSTICK
CITY ENGINEER
C22489, EXP: 9/30/01

APPROVED:

RANDALL A. LUM
DIRECTOR OF PUBLIC WORKS
RCE #28060

DATE: FEB. 2002
SCALE: NONE
JOB NO.: 497022

E-10
SHEET 29 OF 42



ELECTRICAL SITE PLAN

NOTES: 1 INSTALL COMPOUND ON FLOW ELEMENT TERMINALS & WIRING TO MAKE METER ELEMENT SUBMERGANCE PROOF.

2 GFI RECEPTACLE TO HAVE 30mA SENSITIVITY, FED FROM PANEL LP #15.

BID SET

T.E.E.M.
(916) 457-8144

REGISTERED PROFESSIONAL ENGINEER RICHARD L. NOONAN NO: 11840 Exp.9-30-2004 ELECTRICAL STATE OF CALIFORNIA

FILE: 0110BE11

Consulting Civil and Structural Engineers
CREEGAN+D'ANGELO
6800 KOLL CENTER PARKWAY, SUITE 150
PLEASANTON, CALIFORNIA 94566-7022
PHONE: 925 417-5260 FAX: 925 249-1264
SAN JOSE, FAIRFIELD, MONTEREY, PLEASANTON, SAN FRANCISCO

Rev. No.	Date	Sheet No.	Approved by City	Date

THE CITY OF PLEASANTON

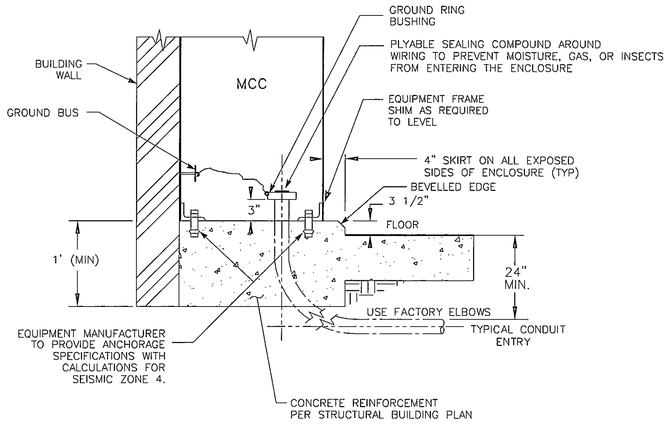
CITY OF PLEASANTON
Department of Public Works

GOLF COURSE PROJECT
PROJECT 968036

ALISAL STREET SEWER LIFT STATION
ELECTRICAL SITE PLAN

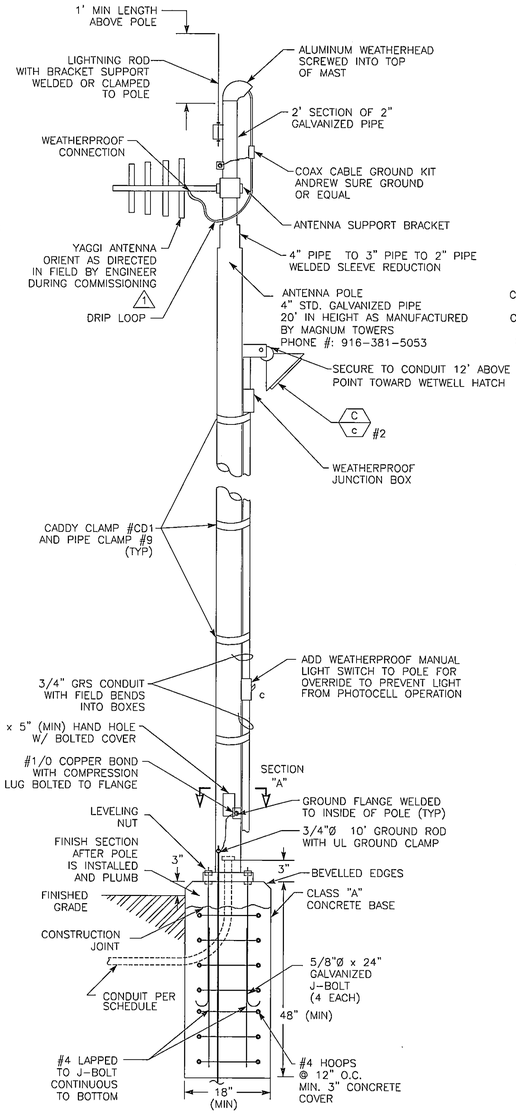
DRAWN: ZK		APPROVED:	DATE: FEB. 2002
CHECKED: RLV			SCALE: NONE
TRAFFIC MANAGER:			
DEPUTY DIRECTOR:	PHILIP A. GRUBSTICK CITY ENGINEER C22489, EXP: 9/30/01	RANDALL A. LUM DIRECTOR OF PUBLIC WORKS RCE #28060	JOB NO.: 497022

E-11
SHEET 30 OF 42

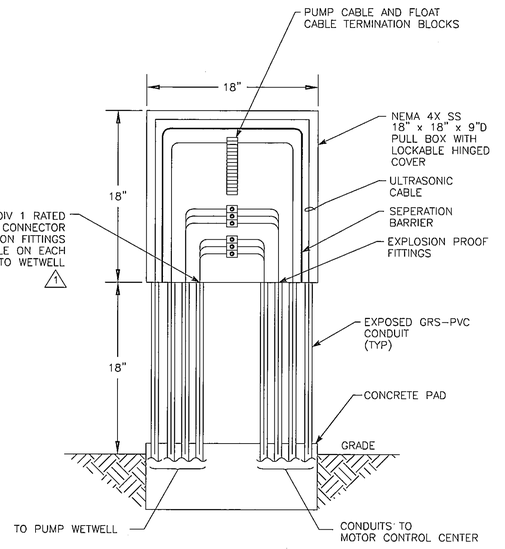


MCC PAD DETAIL "A"

NOT TO SCALE



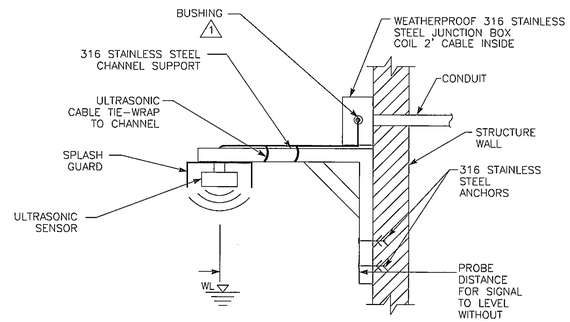
ANTENNA MAST INSTALLATION DETAIL "C"



PUMP CABLE BOX DETAIL "D"

NOT TO SCALE

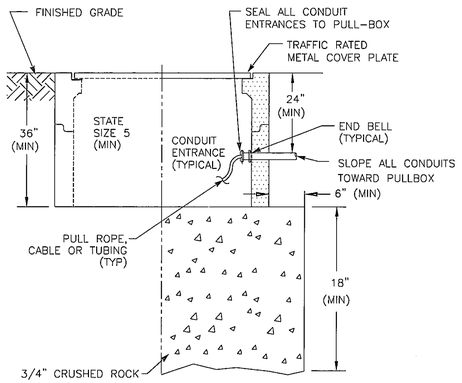
NOTES: 1 HUBBELL CORROSSION - RESISTANT STRAIGHT NYLON CONNECTORS, MODEL SHC SERIES.



ULTRASONIC SENSOR DETAIL "F"

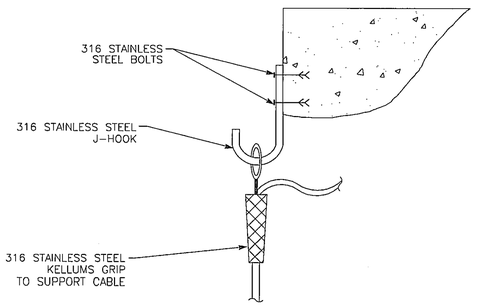
NOT TO SCALE

NOTES: 1 HUBBELL CORROSSION - RESISTANT STRAIGHT NYLON CONNECTORS, MODEL SHC SERIES.



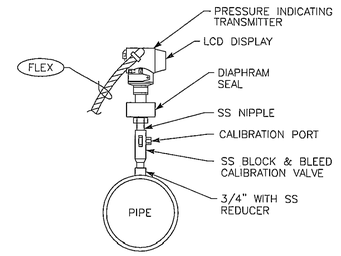
PULLBOX DETAIL "B"

NOT TO SCALE



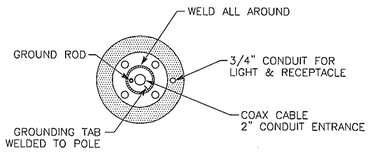
CABLE SUPPORT DETAIL "E"

NOT TO SCALE



PRESSURE TRANSMITTER MOUNTING DETAIL "G"

NOT TO SCALE



ANTENNA BASE
SECTION "A"

NOT TO SCALE

NOTES: 1 OMNI ANTENNA AT LAB/ADMIN BUILDING

T.E.E.M.
(916) 457-8144

REGISTERED PROFESSIONAL ENGINEER
RICHARD L. VOGEL
NO. 11940
Exp.9-30-2004
ELECTRICAL
STATE OF CALIFORNIA

FILE: 0110BE12

BID SET

CREEGAN+D'ANGELO
Consulting Civil and Structural Engineers
6800 KOLL CENTER PARKWAY, SUITE 150
PLEASANTON, CALIFORNIA 94566-7022
PHONE: 925 417-5260 FAX: 925 249-1264
SAN JOSE, FAIRFIELD, MONTEREY, PLEASANTON, SAN FRANCISCO

Rev. No.	Date	Sheet No.	Approved by City	Date

THE CITY OF PLEASANTON

CITY OF PLEASANTON
Department of Public Works

GOLF COURSE PROJECT
PROJECT 968036

ALISAL STREET SEWER LIFT STATION
MISCELLANEOUS DETAILS

DRAWN:	ZK
CHECKED:	RLV
TRAFFIC MANAGER:	
DEPUTY DIRECTOR:	

PHILIP A. GRUBSTICK
CITY ENGINEER
C22489, EXP: 9/30/01

APPROVED:

RANDALL A. LUM
DIRECTOR OF PUBLIC WORKS
RCE #28060

DATE: FEB. 2002
SCALE: NONE
JOB NO.: 497022

E-12
SHEET 31 OF 42