CROCKETT SANITARY DEPARTMENT
CROCKETT COMMUNITY SERVICES DISTRICT
CONTRA COSTA COUNTY
CALIFORNIA

LIFT STATION MOTOR CONTROL CENTER UPGRADE PROJECT

Project No.C-VSan-2206-MCC

JUNE 2023

CROCKETT CSD
P.O. BOX 578
CROCKETT, CA 94525

PHONE NO. (510) 787-2992

CROCKETT CSD LIFT STATION MCC

GENERAL MANAGER Gaunt Murdock (510) 787-2992
engineer@town.crockett.ca.us

Sanitary Department Manager James Barnhill

UPGRADE PROJECT

Project Personnel

CROCKETT SANITARY COMMISSION:

D'Arcy Trask, (Chair), Howard Adams, Scott Bartlebaugh, Mark Manzione, Mary Wais

STAFF:

Gaunt Murdock, General Manager engineer@town.crockett.ca.us
James Barnhill, Sanitary Department
Vaughn Gunkelman, Administrative Manager

CONTRACTOR: _____

_____

_____

_____

Office: _____
Cell phone: _____
Fax: _____
E-mail: _____

PART I

BID DOCUMENTS

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CROCKETT CSD OF
CROCKETT COMMUNITY SERVICES DISTRICT
CONTRA COSTA COUNTY, CALIFORNIA

NOTICE TO CONTRACTORS
INVITING SEALED PROPOSALS

NOTICE IS HEREBY GIVEN that sealed proposals or bids will be received by the Crockett CSD at the District's office at 850 Pomona Avenue, Crockett, California 94525 until **10:00 A.M. local time on Wednesday, August 16, 2023,** at which time they will be publicly opened and read aloud, for performing work as follows:

LIFT STATION MOTOR CONTROL CENTER UPGRADE PROJECT

Bids may be delivered in advance of the bid date and time to the General Manager at the District office at the above address between 8:00 A.M. and 5:00 P.M., Monday through Friday or mailed to Crockett CSD at P.O. Box 578, Crockett, California 94525.

The principal items of work are:

Replace motor controls with full speed starters and VFDs including design, assembly, testing, and commissioning. Design, furnish, assemble, test, and commission PLC/control panel and instrumentation, and all conduit, junction boxes, pull boxes, wire, electrical devices, lights, receptacles, supporting equipment, and grounding system as required for equipment interconnection, and operation. Coordinate with PG&E as required for connection of power utility and telephone services.

No bid will be received unless it is made on the proposal form furnished by the Owner in the bid documents. The contract, if awarded, will be awarded within ninety (90) days from the opening of the bids.

No bidder may withdraw his proposal for a period of ninety (90) days after the date set for opening of proposals.

All bids are to be compared on the basis of the District's estimate of the quantities of work to be done.

Bids must be accompanied by a proposal guaranty in the amount of ten (10) percent of the bid as described in the specifications. Such guaranty shall be in the form of a certified check, cashier's check, or bid bond executed on the prescribed form in the amount not less than ten (10) percent of the amount bid. Said guaranty shall be forfeited to the Owner in case the bidder depositing the same does not, within ten (10) days after written notice that the contract has been awarded to him, 1) enter into a contract with the District, and 2) furnish Performance and Labor and Materials Bonds and insurance certificates as described in the specifications.

The special attention of prospective bidders is called to the "Instructions to Bidders" of the specifications for full directions as to bidding and related matters.

The Owner reserves the right to reject any or all proposals or to waive any irregularities or informalities in any proposal or in the bidding.

A pre-bid meeting will be held at 10:00 AM, Wednesday, June 21 , at the C&H truck yard, 1916 Dowrelio Drive, Crockett CA, followed by a tour of the project site(s). Attendees must park outside the gate and walk in. Attendance at the pre-bid meeting and site(s) tour is mandatory. **Any bid submitted by a contractor who did not attend the pre-bid meeting will be deemed to be non-responsive and shall be rejected.**

Time of completion for this work is seven hundred and 30 days from the date of the start of work designated in the "Notice to Proceed".

CROCKETT COMMUNITY SERVICES DISTRICT
Contra Costa County, California

INSTRUCTION TO BIDDERS

1. Bidder's attention is directed to the conditions of the "General Conditions" for the requirements and conditions, which must be adhered to in the preparation of the proposal form and submission of this proposal.

2. Proposals shall be submitted in a sealed envelope, addressed to CROCKETT CSD. Each sealed envelope containing a Bid must be plainly marked on the outside as PROJECT NO. C-VSan-2206-MCC, LIFT STATION MOTOR CONTROL CENTER UPGRADE PROJECT, and the envelope should bear the Bidder's address, and license number on the outside. If forwarded by mail, the sealed envelope containing the Bid must be addressed to CROCKETT COMMUNITY SERVICES DISTRICT, SANITARY DEPARTMENT, P.O. Box 578, Crockett, California 94525. The District is not responsible for any delays in the U.S. Postal Service, or any other delays that may result in a mailed bid or any bid being received after the designated bid date and time.

3. Bidder's attention is directed to the requirements to complete and sign the following documents WHICH ARE TO BE SUBMITTED WITH THE BID:

    1. List of Subcontractors.
    2. Receipt of Addenda.
    3. Statement of Inspection of Sites.
    4. Bidder's Experience Statement.
    5. Personnel Experience Statement.
    6. Contractor's License Statement.
    7. Non-Collusion Affidavit.
    8. Security for Compensation Certification.
    9. Bid Bond.
    10. Certification Concerning State Labor Standards and Prevailing Wages.
    11. Non-Discrimination Clause.

    The forms for the Performance, Labor and Material Bonds and the Contract are attached herein for information and reference only and are to be filled out by the successful bidder upon instructions by the Owner.

4. **BID FORMS:** All Bids shall be made on the required Bid forms supplied herein. All blank spaces for Bid prices must be filled in, in ink or typewritten, and the Bid forms must be fully completed and executed when submitted. Only one copy of each Bid form is required.

5. **BIDS:** The Crockett CSD (the OWNER) may waive any informalities or minor defects or reject any or all Bids. Any Bid may be withdrawn prior to the scheduled time for the opening of Bids or authorized postponement thereof. Any Bid received after the time and date specified shall not be considered. Should there be reasons why the contract cannot be awarded within the specified period, the time may be extended by mutual agreement between the OWNER and the Bidder.

6. **PRE-BID MEETING AND SITE INSPECTION:** Bidders must satisfy themselves of the accuracy of the estimated quantities in the Bid schedule by examination of the site and a review of the drawings and specifications including Addenda. After Bids have been submitted, the Bidder shall not assert that there was a misunderstanding concerning the quantities of work or of the nature of the work to be done or the existing site conditions.

The District has obtained the general prevailing rate of per diem wages in the locality in which this work is to be performed for each craft or type of work needed to execute the contract, as published by the State of California, Department of Industrial Relations, Division of Labor Statistics and Research, a copy of which is on file in the office of the District and which shall be made available to any interested party on request.

It shall be mandatory upon the Contractor to whom the contract is awarded and upon any subcontractor working under his or her supervision to pay not less than the prevailing wage for each craft to all workers employed by them in the execution of the contract. The successful bidder shall post a copy of such determinations at each job site. The successful bidder intending to use a craft or classification not shown on the prevailing rate determinations may be required to pay the rate of the craft or classification most closely related to it.

The Contract Documents may be examined via the internet at the Bay Area Builder's Exchange website: www.bayareabx.com

Copies of the plans and specifications, forms of proposals, bonds and contract may be downloaded from the Crockett Community Services website at https://www.town.crockett.ca.us/

Bid documents may also be obtained at the office of the Crockett CSD, 850 Pomona Avenue, Crockett, CA 94525, upon payment of $140 per set. All payments are non-refundable.

In accordance with the provisions of California Public Contract Code Section 3300, the Owner has determined that the Contractor shall possess a valid Class A license at the time that the contract is awarded. Failure to possess the specified license shall render the bid as non-responsive and shall act as a bar to award of the contract to any bidder not possessing said license at the time of award.

DISTRICT'S ESTIMATE: $1.1M

Crockett CSD Date:

Gaunt Murdock, General Manager

7. **EXAMINATION OF CONTRACT DOCUMENTS:** The Contract Documents contain the conditions required for the construction of the Project. Information obtained from an officer, agent, or employee of the OWNER or any other person shall not affect the risks or obligations assumed by the Contractor or relieve the Contractor from fulfilling any of the conditions of the contract.

8. **BID GUARANTY:** Each Bid must be accompanied by a Proposal Guaranty payable to the OWNER in the amount of not less than ten (10) percent of the Bid. Said guaranty shall be in the form of a certified check, cashier's check, or bid bond executed on the prescribed form in the amount not less than ten (10) percent of the amount bid. As soon as the Bid prices have been compared and reported to the Owner, the Owner will

return the Proposal Guaranties of all except the three lowest responsive, responsible Bidders. When the Contract is executed the Proposal Guaranties of the two remaining Bidders will be returned.

9. **BONDS:** A Performance Bond and a Labor and Material Bond each in the amount of one hundred (100) percent of the Contract Price, with an admitted surety approved by the OWNER will be required for the faithful performance of the contract. The bond forms provided in this document must be used. Attorneys-in-fact who sign Bid Bonds or Labor and Material Bonds and Performance Bonds must file with each Bond a certified and effective dated copy of their power of attorney.

10. **EXECUTION OF CONTRACT:** The party to whom the contract is awarded will be required to execute the Contract and provide the necessary insurance certifications within ten (10) calendar days from the date the Notice of Award is delivered to the Bidder. The Notice of Award shall be accompanied by the necessary Contract. In case of failure of the Bidder to execute the Contract, the OWNER may consider the Bidder in default, in which case the Proposal Guaranty accompanying the proposal shall become the property of the OWNER.

11. **NOTICE TO PROCEED:** The OWNER within ten (10) days of receipt of an acceptable Performance Bond, Labor and Material Bond and Contract signed by the party to whom the Contract was awarded, shall sign the Contract and return to such party an executed duplicate of the Contract along with a written notice to proceed. Should the OWNER not execute the Contract within such period, the Bidder may by Written Notice withdraw the signed Contract. Such notice of withdrawal shall be effective upon receipt of the notice by the OWNER.

12. **QUALIFICATION OF BIDDER:** The OWNER may make such investigations as deemed necessary to determine the ability of the Bidder to perform the work, and the Bidder shall furnish to the OWNER all such information and data for this purpose as the OWNER may request. A Bidders prior history of unsatisfactory performance on work of any kind shall constitute grounds for disqualifying a Bidder.

13. **REJECTION OF BIDS:** The OWNER reserves the right to reject any Bid if the evidence submitted by, or investigation of such Bidder fails to satisfy the OWNER that such Bidder is properly qualified to carry out the obligations of the Contract and to complete the work contemplated therein.

14. **LIST OF SUBCONTRACTORS:** In accordance with Section 4104 of the California Public Contract Code, each bidder, in its Bid, shall set forth: (1) the name and location of the place of business of each subcontractor who will perform work or labor, render services to the contractor in or about the construction of the work, or improvement, in an amount in excess of one-half of one percent of the Contractor's total bid; and (2) the portion of the work which will be done by each such subcontractor. In accordance with Section 4107 of the California Public Contract Code, no Contractor whose bid is accepted shall without consent of the OWNER either: (1) substitute any person as a subcontractor in place of the subcontractor designated in the original bid, or (2) permit any such subcontract to be assigned or transferred, or allowed it to be performed by anyone other than the original subcontractor listed in the bid; or (3) sublet or subcontract any portion of the work in excess of one-half of one percent of the Contractor's total bid as to which his original bid did not designate a subcontractor. Penalties for failure to comply with the foregoing sections of the California Public Contract Code are set forth in Section's 4106, 4110 and 4111 of the Public Contract Code.

15. **LABOR STANDARDS:** Notice is hereby given that, pursuant to Section 1773 of the Labor Code of the State of California, the Owner has obtained from the Director of the Department of Industrial Relations the general prevailing rate of per diem wages and the general prevailing rate for holidays and overtime work for each craft, classification, or type of worker required to execute the contract. A copy of said prevailing rate of per diem wages is on file in the principal office of the OWNER, to which reference is hereby made for further particulars. Said prevailing rate of per diem wages will be made available to any interested party upon request, and a copy thereof shall be posted at each job site.

Bid specifications and contracts and other procedures in connection with bids or contracts shall be subject to modification to comply with revisions in federal minimum wage schedules without the necessity of republication of duplication of other formal statutory requirements.

In accordance with Section 1775 of the California Labor Code, the Contractor shall as a penalty to the State of political subdivision on whose behalf a contract is made or awarded, forfeit no less than forty dollars ($40,00) and no more than two hundred dollars ($200) for each calendar day or portion thereof, for each worker paid less than the stipulated prevailing rates for any public work done under the Contract by the Contractor or by any subcontractor under the Contractor. The amount of the penalty shall be determined by the Labor Commissioner based on conditions stipulated in Section 1775 of the California Labor Code.

In accordance with Section 1813 of the California Labor Code, the Contractor shall as a penalty to the State or political subdivision on whose behalf the Contractor is made or awarded, forfeit twenty-five ($25.00) dollars for each worker employed in the execution of the Contract by the Contractor or by any subcontractor for each calendar day during which said worker is required or permitted to work more than eight (8) hours in any one calendar day and forty (40) hours in any one calendar week in violation of Section's 1810-1817 of the California Labor Code.

As required by Section 1860 of the California Labor Code and in accordance with the provisions of Section 3700 of the Labor Code. every Contractor will be required to secure the payment of worker's compensation to its employee.

In accordance with Section 1861 of the California Labor Code, the Contractor shall furnish the Owner a notarized statement as follows: "I am aware of the provisions of Section 3700 of the Labor Code which requires 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."

Contractor agrees to comply with Section's 1777.5, 1777.6 and 1777.7 (as amended) of the California Labor Code relating to the employment of apprentices. The responsibility for compliance with these provisions is fixed with the prime contractor for all apprenticeable occupations. Under these sections of the law, contractors and sub-contractors must employ apprentices in apprenticeable occupations, where journeymen in the craft are employed on the public work, in a ration of not less than one hour of apprentice work for every five hours of labor performed by a journeyman (unless an exemption is granted in accordance with Section 1777.5) and contractors and subcontractors shall not discriminate among otherwise qualified employees as indentured apprentices on any public work solely on the ground of race, religious creed, color, national origin, ancestry, sex, or age, except as provided in Section 3077 of the Labor Code. Only apprentices as defined in Section 3077, who are in training under apprenticeship standards and who have signed written apprentice agreements, will be employed on public works in apprenticeable occupations.

16. **SPECIAL CONDITIONS:** The Bidders' attention is directed to Part III of the Specifications, "Special Conditions," associated with this project. The bidders shall review and understand the additional requirements of the project as described under this section.

17. Instructions to Bidders is hereby made a part of the contract document.

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BID PROPOSAL

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PROPOSAL FORM

CROCKETT CSD OF
CROCKETT COMMUNITY SERVICES DISTRICT
CONTRA COSTA COUNTY, CALIFORNIA
FOR CONSTRUCTION OF

LIFT STATION MOTOR CONTROL CENTER UPGRADE PROJECT

To the Honorable Sanitary Commissioners
Crockett Sanitary Commission
P.O. Box 578
Crockett, California 94525

Attention: Mr. Gaunt Murdock, General Manager

Gentlemen:

Pursuant to the contract plans and specifications, the undersigned, as bidder, declares that he has carefully examined the location of the proposed work as evidenced by the attached executed statement of inspection of site, and the specifications pertaining thereto, and he proposes and agrees if this proposal is accepted that he will contract with the Crockett Community Services District to provide all the labor, materials, necessary machinery tools, apparatus, and other means of construction and do all the work specified in the contract in the manner and time herein set forth required for the completion of work:

LIFT STATION MOTOR CONTROL UPGRADE PROJECT

Construction shall be in strict conformity with the plans and specifications prepared by the Crockett CSD and on file at the District office at 850 Pomona Street, Crockett, CA 94525. Said plans and specifications are hereby made a part hereof.

The bidder proposes to contract with the Crockett Community Services District to perform all of the above work, including subsidiary obligations as defined in said specifications, for the following prices, to wit:

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BID SCHEDULE

ITEM	QTY	UNIT	DESCRIPTION	UNIT PRICE	TOTAL AMOUNT
1	1	ea	Lump sum all project requirements.		
2	1	ea	Mobilization and demobilization (not to exceed 5% of Item 1)		
				TOTAL BID	

Total Bid in words: _____

_____

BASIS OF AWARD:

The basis of Award of Contract is the lowest Total Amount bid by a responsible Contractor. The Owner reserves the right to reject any and all proposals and to waive any informalities in any proposal or bid. A Bidder's prior history of unsatisfactory performance on work of any kind shall constitute grounds for disqualifying a Bidder.

The undersigned understands the estimate of construction items hereinbefore set forth is approximate only, being given as a basis for the comparison of bids and the Crockett Community Services District does not expressly or by implication agree that the actual amount of work will correspond therewith, but reserves the right to increase or decrease the extent of any item of the work or to omit items of the work as may be deemed necessary or expedient by the District and/or required by funding limitations.

The undersigned understands all bids will be compared on the basis of the District's estimate of the items of the work to be done.

The undersigned has checked carefully all of the above figures and understands that the Crockett Community Services District shall not be responsible for any errors or omissions on the part of the undersigned in making up this bid.

In accordance with Section 4552 of the California Public Contract Code, the bidder agrees that if the bid is accepted, it will assign to the Owner 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. Section 15) or under the Cartwright Act (Chapter 2 (commencing Section 16700) of Part 2 of Division 7 of the California Business and Professions Code), arising from purchase of goods, materials, or services by the bidder for sale to the Owner pursuant to the bid. Such assignment shall be made and become effective at the time the Owner tenders final payment to the bidder.

It is agreed that this bid may not be withdrawn for a period of ninety (90) days from the opening thereof.

The terms and conditions of the final contract when executed shall control and supersede anything herein to the contrary or inconsistent with such contract.

Attached is the proposal guaranty bond form bound herewith, duly executed in the amount of at least ten (10) percent of the total amount of our proposal; or alternately there is attached a certified or cashier's check payable to the Owner in the amount of at least ten (10) percent of the amount of our proposal. If we choose to attach a proposal bond, we understand and agree that the Owner may reject our proposal if the surety does not meet the requirements of Section G2.09, or if Owner has cause to believe the surety is likely to be incapable of fulfilling its obligations under the bond.

In accordance with the specifications, the undersigned further agrees to so plan the work and to prosecute it with such diligence that said work shall be completed on or before the expiration of **730 Days** beginning one (1) calendar day after the date of the "Notice to Proceed".

As part of this proposal the undersigned has filled out, executed and notarized where indicated the forms included herein and listed as follows:

1. List of Subcontractors
2. Receipt of Addenda.
3. Statement of Inspection of Site.
4. Bidder's Experience Statement.
5. Personnel Experience Statement.
6. Contractor's License Statement.
7. Non-Collusion Affidavit.
8. Security for Compensation Certification.
9. Bid Bond.
10. Certification Concerning State Labor Standards and Prevailing Wages.
11. Non-Discrimination Clause.

Name under which business is conducted _____

_____

Business Address : _____ ZIP: _____
Telephone No.: _____ Fax: _____
Contractor's License No.: _____ Expir. Date: _____

NOTE: If bidder, or other interested person is a corporation, the legal name of the corporation shall be set forth together with the names of the president, secretary, treasurer, and manager thereof; also, signature of the officer or officers authorized to sign contracts on behalf of the corporation.

If the bidder is a partnership or a joint venture, state true name of firm or joint venture entities; also, names of all individual partners composing the firm and the signature of the partner or partners authorized to sign contracts on behalf of the partnership or joint venture entities.

If the bidder is an individual, state first and last name in full, together with signature.

_____

_____

IF SOLE OWNER, sign here:

I sign as sole owner of the business named above.

_____ Date: _____

IF PARTNERSHIP, sign here:

The undersigned certify that they sign the contract proposal with full and proper authorization so to do. (One or more partners sign)

_____ Date: _____

_____ Date: _____

IF CORPORATION, execute here:

The undersigned certify that they sign this contract proposal with full and proper authorization so to do:

Corporate Name: _____

By: _____ Title: _____

By: _____ Title: _____

Incorporated under the laws of the State of _____

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LIST OF SUBCONTRACTORS

In compliance with the provisions of Sections 4100-4107 of the Public Contract Code of the State of California and any amendments thereof, the name and location of the mill, shop or office of each Subcontractor who will perform work or labor or render services to the Contractor in or about the construction of the work or improvement to be performed under these specifications and which work will be in excess of 1/2 of 1 percent of the total proposal and the portion of the work which will be done by each Subcontractor are set forth below.

NAME AND PLACE OF BUSINESS OF SUBCONTRACTOR	DOLLAR VALUE OF WORK TO BE DONE
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____

_____
Signature of Bidder

_____
Company Name

_____
Date

RECEIPT OF ADDENDA

The following is a list of the addenda received prior to Bid Opening:

ADDENDA NUMBER	DATED	SUBJECT	DATE OF RECEIPT

Signature of Bidder

Company Name

Date

STATEMENT OF INSPECTION OF SITE

The undersigned, as bidder, states that he has inspected the site of the proposed work in order to satisfy himself, by personal examination, or by such other means as he prefers, of the location of the proposed work and as to the actual conditions of and at the site of the work, and has included the cost impacts of any surface variations from those shown on the plans in his bid for the Project.

_____

Signature of Bidder

_____

Company Name

_____

Address

_____

State of Incorporation (If Applicable)

BIDDER'S EXPERIENCE STATEMENT

The following outline is a record of the Bidder's experience in construction of a type similar in magnitude and character to that contemplated under this contract, particularly in _____ . Additional numbered pages outlining this portion of the proposal may be attached to this page. The Contractor shall include below sufficient documentation of prior similar projects and experiences and/or other information and data that, in the opinion of the Owner, constitutes sufficient evidence of the ability of the Contractor to perform and complete the same nature and magnitude of work by the method specified by the Owner for this project.

_____

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_____

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_____

_____

_____

Signature of Bidder

_____

Company Name

_____

Date

PERSONNEL EXPERIENCE STATEMENT

The following is a list of personnel, including a record of each person's experience, knowledge and ability, who, if the Bidder is awarded the Contract, will be available to **actively supervise the work;** it is understood the work will be directed by one of these persons. Additional numbered pages outlining this portion of the proposal may be attached to this page.

Signature of Bidder

Company Name

Date

CONTRACTOR'S LICENSE STATEMENT

Contractor: _____

Address: _____

_____

Telephone No. (_____) _____

License No.: _____

Classification: _____

License Expiration Date: _____

"I declare under the penalty of perjury under the laws of the State of California that the foregoing is true and correct."

Executed this _____ day of _____, 2023, at _____, California.

_____
Signature of Contractor

NON-COLLUSION AFFIDAVIT

NON-COLLUSION AFFIDAVIT TO BE EXECUTED BY BIDDER AND SUBMITTED WITH BID

State of California)
) SS
County of _____)

_____, being first duly sworn, deposes and says that he or she is
(Name)

_____ of _____, the party making the foregoing bid, that
(Title) (Company name)

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

_____
Signature of Contractor

Subscribed and sworn to before me this _____ day of _____, 2023.

_____
Notary Public

SECURITY FOR COMPENSATION CERTIFICATE

TO:_____

I am aware of the provisions of Section 3700 of the Labor Code of the State of California which require every employer to be insured against liability for workman'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.

_____

(Signature of Bidder)

_____

Business Address

_____

Place of Residence

The successful bidder prior to the award of contract must execute this certificate. The bidder shall execute the certificate on this page at the time of submitting his bid proposal.

BID BOND
(10% of Contract Price)

KNOW ALL MEN BY THESE PRESENTS:

THAT _____, hereinafter called the Principal, and _____ _____, hereinafter called the Surety, are jointly and severally held and firmly bound unto Crockett Community Services District, hereinafter call the Obligee, each in the penal sum of ten percent of the total amount of the bid proposal of the Principal for the work, this sum not to exceed _____ _____dollars of lawful money of the United States for the payment whereof unto the Obligee the Principal and Surety jointly and severally bind themselves forever by these presents.

WHEREAS the Principal is herewith submitting its offer for the fulfillment of the Crockett Community Services District contract to construct the Lift Station Motor Control Center Upgrade Project as provided for in the Contract Documents.

NOW THEREFORE, the condition of the obligation is such that if the Principal is awarded the contract, and if the Principal within the time specified in the proposal for such contract enters into, executes and delivers to the Obligee an agreement in the form provided herein complete with evidences of insurance, then this obligation shall be void; otherwise, the Principal and Surety will pay unto the Obligee the difference in money between the total amount of the proposal of the principal and the amount for which the Obligee legally contracts with another party to fulfill the contract if the latter amount be in excess of the former, but in no event shall the Surety's liability exceed the penal sum hereof.

AND IT IS HEREBY DECLARED AND AGREED that the Surety shall be liable under this obligation as Principal and that nothing of any kind or nature whatsoever that will not discharge the Principal shall operate as a discharge or a release of liability of the Surety.

IT IS HEREBY FURTHER DECLARED AND AGREED that this obligation shall be binding upon and inure to the benefit of the Principal, the Surety and the Obligee and their respective heirs, executors, administrators, successors and assigns.

SIGNED AND SEALED THIS _____ day of _____, 2023.

_____
_____
_____

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CONTRACTOR'S/SUBCONTRACTOR'S CERTIFICATION
CONCERNING STATE LABOR STANDARDS AND PREVAILING WAGES

All contractors and subcontractors shall give the following certifications to the Owner and forward this certification to the Owner within ten (10) days after the execution of any contract or subcontract.

A. "I am aware of the provisions of Section 1720 et seq. of the California Labor Code which requires that the State prevailing wage rate shall be paid to employees where this rate exceeds the federal wage rate."

B. "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."

C. "Contractor stipulates and agrees to conform with all provisions of Labor Code, Sections 1810 through 1817, eight (8) hours labor shall constitute a legal day's work, and no worker shall be required or permitted to work more than eight (8) hours in any one (1) calendar day and forty (40) hours in any one (1) calendar week, except as provided for under Section 1815. Nothing in this provision shall be construed to relate to wage determination or in any way affect contractual provisions related to compensation.

Nothwithstanding the Labor Code provision set forth above, pursuant to Labor Code, Section 1815, work performed by employees of Contractor in excess of eight (8) hours per day and forty (40) hours during any one (1) week shall be permitted provided that compensation shall be made for all hours worked in excess of eight (8) hours per day at not less than one and one-half (1-1/2) times the basic rate of pay.

_____
(Contractor/Subcontractor)

by:_____ _____
(Signature) (Typed Name and Title)

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BOND OF FAITHFUL PERFORMANCE

KNOW ALL MEN BY THESE PRESENTS that, WHEREAS Crockett Community Services District, P.O. Box 578 Crockett, California 94525 has awarded to _____ _____hereinafter designated as the "Principal," a contract for the Construction of the Lift Station Motor Control Upgrade Project.

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

NOW, THEREFORE, WE the principal, and Crockett Community Services District as Surety, are held and firmly bound unto the Crockett Community Services District, State of California, 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, executors, administrators and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH that if the above bounden Principal, his or its heirs, executors, administrators, successors, or assigns, shall in all things stand to and abide by, and well and truly keep and faithfully perform the covenants, conditions and agreements in the said contract and any alterations made as therein provided, on his or their part, to be 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 Crockett Community Services District, its Directors, officers and agents as therein stipulated, then this obligation shall become null and void; otherwise it shall be and remain in full force and virtue and Principal and Surety, in the event suit is brought on this bond, will pay to Crockett Community Services District such reasonable attorney's fees as shall be fixed by the court.

As a condition precedent to the satisfactory completion of the said contract, the above obligation in said amount shall hold good for a period of one (1) year after the completion and acceptance of the said work, during which time if the above bounden Principal, his or its heirs, executors, administrators, successors or assigns shall fail to make full, complete and satisfactory repair and replacements or totally protect Crockett Community Services District from loss or damage made evident during said period of one (1) year from the date of acceptance of said work, and resulting from or caused by defective materials or faulty workmanships in the prosecution of the work done, the above obligation in the said sum shall remain in full force and effect. However, nothing in this paragraph to the contrary notwithstanding, the obligations of the Surety hereunder shall continue so long as any obligation of the Principal remains.

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

IN WITNESS WHEREOF the bounden parties have executed this instrument under their seals this _____ _____day of _____, 2023, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

_____

(Seal) By: _____
Principal

_____

(Seal) By: _____
Surety

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LABOR AND MATERIAL BOND

KNOW ALL MEN BY THESE PRESENTS that, WHEREAS Crockett Community Services District, P.O. Box 578, Crockett, California 94525, has awarded to _____ _____hereinafter designated as the "Principal," a contract for the construction of the Lift Station Motor Control Center Upgrade Project.

WHEREAS said Principal is required to furnish a bond in connection and with said contract, providing that if said Principal or any of his or its subcontractors, shall fail to pay for any materials provisions, provender, or other supplies or teams used in, upon, for or about the performance of the work contracted to be done, or for any work or labor done thereon of any kind, the Surety of this bond will pay the same to the extent hereinafter set forth:

NOW, THEREFORE, WE the principal, and _____ as Surety, are held and firmly bound unto the Crockett Community Services District, State of California, 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, executors, administrators and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH that if said Principal, his, or its heirs, executors, administrators, successors, or assigns, shall fail to pay for any materials, provisions, provender, or other supplies or teams used in, upon, for, or about the performance of the work contracted to be done, or for any work or labor thereon of any kind or for amount due under the Employment Act with respect to such work or labor, as required by the provisions of Chapter 7, Title XV, Part 4, Division III of the Civil Code of the State of California, and provided that the persons, companies or corporations so furnishing said materials, provisions, provender or other supplies, teams, appliances or power used, in, upon, of or about the performance of the work contracted to be executed or performed, or any person who supplies both work and materials thereto, shall have complied with the provisions of said Civil Code, then said Surety will pay the same in or to an amount not exceeding the amount hereinabove set forth, and also will pay in case suit is brought upon this bond, such reasonable attorney's fee to Crockett Community Services District as shall be fixed by the court.

The bond shall inure to the benefit of any and all persons, companies, and corporations entitled to file claims under said Civil Code, so as to give a right of action to them or their assigns in any suit brought upon this bond.

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

IN WITNESS WHEREOF the bounden parties have executed this instrument under their seals this _____ _____day of _____, 2023, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

_____

(Seal) By: _____
Principal

_____

(Seal) By: _____

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NON-DISCRIMINATION CLAUSE

1. During the performance of this contract, contractor and its subcontractors shall not unlawfully discriminate against any employee or applicant for employment because of race, religion, color, national origin, ancestry, physical handicap, medical conditions, martial status, age (over 40) or sex. Contractors and subcontractors shall insure that the evaluation and treatment of their employees and applicants for employment are free of such discrimination. Contractors and subcontractors shall comply with the provisions of the Fair Employment and Housing Act (Government Code, Section 12900 et seq.) and the applicable regulations promulgated thereunder (California Administrative Code, Title 2, Section 7285.0 et seq.). The applicable regulations of the Fair Employment and Housing Commission implementing Government Code, Section 12990, set forth in Chapter 5 of Division 4 of Title 2 of the California Administrative Code are incorporated into this contract by reference and made a part hereof as if set forth in full. Contractor and its subcontractors shall give written notice of their obligations under this clause to labor organizations with which they have a collective bargaining or other agreement.

2. This contractor shall include the non-discrimination and compliance provisions of this clause in all subcontractors to perform work under the contract.

THE UNDERSIGNED CERTIFIES THAT THE CONTRACTOR WILL COMPLY WITH THE ABOVE REQUIREMENTS.

Contractor or
Subcontractor Name:_____

Certified By:_____ _____
Name Title

_____ _____
Signature Date

STD. 17A (NEW 5-83)

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CONTRACT

THIS CONTRACT, made this _____ day of _____, 2023, by and between the Crockett Community Services District, P.O. Box 578, Crockett, California 94525, hereinafter called the "Owner" and _____ _____hereinafter called the "Contractor".

WITNESSETH:

WHEREAS the Owner has caused specifications, drawings and other contract documents to be prepared for certain work as described therein entitled Lift Station Motor Control Center Upgrade Project.

WHEREAS the Contractor has offered to perform the proposed work in accordance with the terms of the contract documents.

NOW THEREFORE, in consideration of the mutual covenants and agreements of the parties herein contained and to be performed, the Contractor hereby agrees to complete the work described in the proposal at the price and on the terms and conditions herein contained, and the Owner agrees to pay the Contractor the contract price provided herein at the unit prices shown in the bid proposal for the fulfillment of the work described and the performance of the covenants set forth herein:

_____ dollars.

The further terms, conditions and covenants of the contract are set forth in the following exhibits, each of which is attached hereto or referenced and made a part hereof:

Notice Inviting Sealed Proposals
Instruction to Bidders
Bid Proposal
General Conditions (Sections 1 through 9)
Special Conditions
Technical Conditions (Sections 1A through 2D)
Drawings
Issued Addenda to the Contract Documents

IN WITNESS WHEREOF, this agreement has been executed in quadruplicate this _____ day of _____ _____, 2023.

Crockett Community Services District:

_____

Attest: _____

Contractor:

_____

_____

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PART II

GENERAL CONDITIONS

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SECTION 1

DEFINITIONS AND TERMS

G1.01 GENERAL. Whenever the following abbreviations and terms, or pronouns in place of them, appear in the Contract Documents, the intent and meaning shall be interpreted as provided in this Section 1. Working titles having a masculine gender, such as "workman" and "flagman" and the pronoun "he," are utilized for the sake of brevity, and are intended to refer to persons of either sex.

G1.02 DEFINITIONS. As used herein, unless the context otherwise requires, the following terms have the following meaning:

Acceptance: The formal written acceptance by the Owner of an entire contract that has been completed in all respects in accordance with the Contract Documents.

Addenda: Written interpretations or revisions to any of the Contract Documents issued by the Owner before the bid opening.

As Approved: The words "as approved," unless otherwise qualified, shall be understood to be followed by the words "by the General Manager for conformance with the Contract Documents."

As-Built Drawings: Contract Plans revised to reflect any modifications resulting during the construction phase.

As Shown and As Indicated: The words "as shown" and "as indicated" shall be understood to be followed by the words “Contract Documents" as appropriate.

Bidder: Any individual, firm, partnership, corporation or combination thereof, submitting a proposal for the work contemplated, acting directly or through a duly authorized representative.

CalTrans: The Department of Transportation, State of California.

Contract Change Order: An order authorized by the Owner and issued to the contractor amending the Contract Documents. An "approved Contract Change Order" is an order signed by the Engineer and the General Manager. An "executed Contract Change Order" is an order signed by the Engineer, the General Manager and the Contractor.

Contract: The written agreement covering the performance of the work and the furnishing of labor, materials, tools and equipment in the construction of the work. The Contract shall include the Contract Documents, and any and all supplemental agreements. Supplemental agreements are written agreements covering alterations, amendments or extensions to the Contract and include contract change orders.

Contract Completion: The date the Owner accepts the entire work as being in compliance with the Contract Documents, or formally waives non-conforming work to the extent that non-conforming work does not adversely affect performance of the improvements, and issues the final payment in accordance with Section 9 of the General Conditions. “Contract completion” shall mean the occupation and beneficial use and enjoyment of the facility (excluding operation for testing) accompanied by a cessation of all labor, including punch list items, as well as acceptance of the work by the District.

Contract Documents: The Contract Documents consist of the Notice to Contractors; Instruction to Bidders; Bid Proposal; Contract; General Conditions; Special Conditions; Technical Conditions; Contract Drawings; Addenda; and Change Orders.

Contractor: The person or persons, firm, partnership, corporation or combination thereof, private or municipal, who enters into the Contract with the Owner.

Contract Drawings: The official plans, profiles, cross sections, elevations, details, and supplemental drawings

furnished by the Engineer, which show the locations, character, dimensions and details of the work to be performed. Contract Plans may either be bound in the same book as the balance of the Contract Documents or bound in separate sets, and are a part of the Contract Documents regardless of the method of binding. Also referred to as "Contract Plans," "Plans," and "Drawings."

Days: Unless otherwise designated, "days" will be understood to mean calendar days.

General Manager: The General Manager of the Crockett Community Services District, acting directly for the Owner as the Owner's Representative.

Engineer: The person or organization identified as such in the Contract Documents, acting directly for the Owner and within the scope of the particular duties delegated to him.

Engineer's Estimate: The list of estimated quantities of work to be performed as contained in the Proposal Form, also known as the District's Estimate.

Federal Agencies: Whenever, in the Specifications, reference is made to any Federal agency or officer, such reference shall be deemed made to any agency or officer succeeding, in accordance with law, to the powers, duties, jurisdiction and authority of the agency or officer mentioned.

Fixed Costs: Any necessary labor, material and equipment costs directly expended on the item or items under consideration which remain constant regardless of the quantity of the work done.

General Notes: The written instructions, provisions, conditions or other requirements appearing on the Contract Drawings, and so identified thereon, which pertain to the performance of the work.

Inspector/Construction Manager: The engineering or technical inspector(s) duly authorized or appointed by the General Manager or Owner, limited to the particular duties entrusted to him or them.

Legal Holidays: Those days designated as State holidays by the Public Contract Code or declared by the Owner.

Liquidated Damages: The amount prescribed in the Contract Documents to be paid to the Owner or to be deducted from any payments due or to become due the Contractor for each calendar day's delay in completing the whole, or any specified portion, of the work beyond the time allowed in the Contract Documents.

Notice to Proceed: A written notice given by the Owner to the Contractor fixing the date on which the Contract time will commence to run and on which the Contractor shall start to perform his obligation under the Contract Documents.

Or Equal: The term "or equal" shall mean that the "equal" product is the same or better than the product named in function, performance, reliability, quality and general configuration. Determination of equality in reference to the project design requirements will be made by the General Manager. Such equal products shall not be purchased or installed by the Contractor without written acknowledgment of the General Manager.

Owner: As described in the Contract Documents, shall be the Crockett CSD or any person or persons to whom the power belonging to the Owner shall be duly delegated.

Plans: Refer to Contract Drawings.

Professional Engineer: An engineer licensed by the Board of Registration for Professional Engineers, State of California.

Proposal: The offer of the bidder for the work, when made out and submitted on the prescribed proposal form, properly signed and guaranteed, also referred to as the Bid.

Proposal Form: The approved form upon which the Owner requires formal bids be prepared and submitted for the

work.

Proposal Guaranty: The cash, cashier's check, certified check or bid bond accompanying the proposal submitted by the bidder, as a guaranty that the bidder will enter into a contract with the Owner for the performance of the work, if the Contract is awarded to him.

Provide: The term "provide" shall be understood to mean "furnish and install, complete in place."

Record Drawings: Contract Plans revised to reflect any modifications resulting during the construction phase.

Responsive: A "responsive" Proposal is one that complies with the requirements prescribed herein and by California law for Proposals.

Special Conditions: The Special Conditions are specific clauses setting forth conditions or requirements of the work and supplementary to these General Conditions. Also referred to as "Supplementary Conditions."

Specifications: The term "Specifications" refers to those portions of the Contract Documents consisting of written technical descriptions of materials, equipment, construction systems, standards, and workmanship as applied to the work and certain administrative details applicable thereto. Where standard specifications, such as those of ASTM, AASHTO, etc., have been referred to, the applicable portions of such standard specifications shall become a part of these Contract Documents. If referenced specifications conflict with Specifications contained herein, the requirements contained herein shall prevail.

Standard Details: The construction details included in PART V, DRAWINGS, (if any) plus the standard details being used by the Crockett CSD at the time of invitation to bidders: generally the Standard Specifications of the Crockett Community Services District.

State: The State of California.

Topsoil: Surface soil suitable for growing grass lawns, or amended soil products sold as “topsoil” for that purpose.

Work: The word "work" includes all material, labor, tools, and all appliances, machinery, transportation, and appurtenances necessary to perform and complete the Contract, and such additional items not specifically indicated or described which can be reasonably inferred as belonging to the item described or indicated and as required by good practice to provide a complete and satisfactory system or structure.

Work site: The area of actual construction and the areas immediately adjacent thereto.

G1.03 ACRONYMS. As used herein, unless the context otherwise requires, the following acronyms have the following meanings:

AAMA	Architectural Aluminum Manufacturers' Association
AAN	American Association of Nurserymen
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AGA	American Gas Association
AIA	American Institute of Architects
AIEE	American Institute of Electrical Engineers
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Movement and Control Association
ANSI	American National Standards Institute
APA	American Plywood Association
APWA	American Public Works Association
API	American Petroleum Institute

AREA	American Railway Engineering Association
ARI	American Refrigeration Institute
ASA	American Standards Association
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AT&T	American Telephone and Telegraph
AWG	American Wire Gage
AWPA	American Wood Preservers' Association
AWS	American Welding Society
AWWA	American Water Works Association
CS	Commercial Standards (US Department of Commerce)
CSI	Construction Specifications Institute
DOT	United States Department of Transportation
EIA	Electronic Industries Association
EPA	Environmental Protection Agency
FGMA	Flat Glass Marketing Association
FHwA	Federal Highway Administration
FM	Factory Mutual
FS	Federal Specification
IAMPO	International Association of Mechanical and Plumbing Officials
ICBO	International Conference of Building Officials
IEEE	Institute of Electrical and Electronics Engineers
NAAMM	National Association of Architectural Metal Manufacturers
NBFU	National Board Fire Underwriters
NEC	National Electrical Code
NEMA	National Electrical Manufacturers' Association
NFC	National Fire Code
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Administration
PEI	Porcelain Enamel Institute
PG&E	Pacific Gas and Electric Company
PS	Product Standard (US Department of Commerce)
PacBell	Pacific Bell
SAE	Society of Automotive Engineers
SCPO	Structural Clay Products Institute
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SSPC	Steel Structures Painting Council
TCA	Tile Council of America
TPI	Truss Plate Institute
UBC	Uniform Building Code
UL	Underwriters Laboratory
UMC	Uniform Mechanical Code
UPC	Uniform Plumbing Code
WCLIB	West Coast Lumber Inspection Bureau
WIC	Woodwork Institute of California
WWPA	Western Wood Products Association

SECTION 2

PROPOSAL REQUIREMENTS

G2.01 OBTAINING PROPOSAL FORMS. Proposal forms and other bid documents may be obtained from the Owner or General Manager.

G2.02 ENGINEER'S ESTIMATE. If an Engineer's Estimate of quantities is given in the Proposal, the quantities are approximate only, being given as a basis for the comparison of bids. The Owner does not, expressly or by implication, agrees that the actual amount of work will correspond to the estimate. The Owner reserves the right to increase or decrease the amount of any class or portion of the work or to omit portions of the work.

G2.03 EXAMINATION OF CONTRACT DOCUMENTS AND SITE OF WORK. The bidder shall examine carefully the Contract Documents and the site of work and shall inform himself of the conditions relating to the execution of the work. Failure to do so will not relieve the successful bidder of his obligation to enter into a Contract and complete the work in strict accordance with the Contract Documents. "Conditions relating to the execution of the work" include the requirements of federal, state and local laws, statutes and ordinances relative to the execution of the work, including, but not limited to, applicable regulations concerning minimum wage rates, non-discrimination in the employment of labor, protection of public and employee health and safety, and environmental protection. The submission of a Proposal shall be conclusive evidence that the bidder has investigated and is satisfied as to the conditions to be encountered, the character, quality and scope of work to be performed, the quantities of materials to be furnished and the requirements of the Contract Documents.

G2.04 SURFACE TOPOGRAPHY; SUBSURFACE CONDITIONS DATA. Where an investigation of surface topography and/or subsurface conditions has been conducted in areas where work is to be performed, prospective bidders may inspect the records of such investigations at the Owner's office.

G2.05 EXPLANATIONS. Any explanation of the Contract Documents desired by a prospective bidder shall be requested in writing from the General Manager, and delivered to Owner no less than 14 calendar days prior to the date for opening of proposals. Any explanation, instruction, or change to Contract Documents will be made by written addendum, which will be mailed or delivered to each firm receiving a set of the Contract Documents. Upon mailing or delivery, such addendum will become a part of Contract Documents and binding on all bidders. The receipt of the addendum by the bidder shall be acknowledged and so noted in the space provided on the Proposal Form. All addenda shall be attached to the Proposal. Only written explanations, instructions or changes so given by the Owner will be effective. Verbal explanations or instructions will not be binding on the Owner.

G2.06 PREPARATION OF PROPOSALS. The form of Proposal in this book, when filled out and executed by the bidder, shall be submitted as his bid. Bids not presented on such forms will be disregarded.

All blank spaces in the Proposal form must be filled in, as required, preferably in black ink. All price information shall be shown, clearly legible, in both words and figures, where required. No changes shall be made in the phraseology of the forms. Written amounts shall govern in the case of discrepancy between the amounts stated in writing and the amounts stated in figures. In case of discrepancy between unit prices and extended totals, unit prices shall prevail.

The bid submitted must not contain any erasure, interlineations, or other corrections unless each correction is suitably authenticated by affixing in the margin immediately opposite the correction the signature or signatures of the person or persons submitting the bid.

The bidder shall sign his Proposal in the blank space provided therefor. If bidder is the sole owner, the owner shall sign the Proposal. If bidder is a corporation, the legal name of the corporation and its State of incorporation shall be set forth above and the Proposal shall be signed by the officer or officers authorized to sign contracts on behalf of the corporation. If bidder is a partnership, the true name of the firm shall be set forth above, the names and addresses of all partners shall be given and a partner in the firm shall sign the Proposal authorized to sign contracts on behalf of the partnership. If the bidder is a joint venture, the Proposal shall be signed by each participating company by officers or other individuals who have the full and proper authorization to do so. If the Proposal is signed by an

agent of the bidder other than an officer of a corporation or a member of a partnership, a notarized power-of-attorney must be on file with the Owner prior to opening of Proposals or must be submitted with the Proposal. If requested by the Owner, the bidder shall promptly submit evidence satisfactory to the Owner of the authority of the person signing the Proposal.

G2.07 SUBMISSION OF PROPOSALS. All Proposals must be submitted not later than the time prescribed, at the place, and in the manner set forth in the Notice to Contractors. Proposals may be made on the separate Proposal forms provided herewith. Any Proposal received after the prescribed time shall be rejected, regardless of whether or not Proposals are opened exactly at the prescribed time.

Each Proposal must be submitted in a sealed envelope. The envelope must be clearly marked to show the bidder's name and the Contract name, without being opened, and be addressed in conformance with the instructions in the Notice to Contractors.

G2.08 LIST OF SUBCONTRACTORS. Refer to "Instruction to Bidders" paragraph 14.

G2.09 PROPOSAL GUARANTY. The proposal shall be accompanied by a proposal guaranty bond duly completed on the form bound herewith, by a corporation which is listed in the latest Form 356 of the United States Treasury Department as being acceptable as surety on Federal bonds and is duly licensed and admitted by the State of California to be a surety insurer in the State, in the sum of at least 10 percent of the total bid amount as described in the bidding schedule and/or other parts of the contract documents; or alternatively there is attached a certified or cashier's check payable to the Owner in the amount of at least 10 percent of the total bid amount.

The amount payable to the Owner under the proposal guaranty bond, or the certified or the cashier's check and the amount thereof, as the case may be, shall be forfeited to the Owner as liquidated damages in case of a failure or neglect of the bidder to furnish, execute and deliver to the Owner the required performance bond, labor and material bond, evidence of insurance, and to enter into, execute and deliver to the Owner the Contract on the form provided herewith **within 10 days** after being notified in writing by the Owner that the award has been made and the Contract is ready for execution.

G2.10 WITHDRAWAL OF PROPOSALS. A bidder may withdraw his Proposal at any time prior to the time fixed in the Notice to Contractors for the opening of bids only by filing a written notice with the Owner. The notice shall be executed by the bidder in conformance with Section G2.06. A telegraphic notice of withdrawal is not effective. Withdrawal of a Proposal does not prejudice the right of a bidder to submit a new Proposal. No Proposal may be withdrawn after the time for opening of Proposals, unless and until the time specified in Section G3.02, Time of Award has elapsed.

G2.11 PUBLIC OPENING OF PROPOSALS. Proposals will be opened and read aloud publicly at the date, time and place designated in the Notice Inviting Sealed Proposals. Bidders and their authorized representatives are invited to be present.

G2.12 REJECTION OF PROPOSALS. Refer to "Instruction to Bidders" paragraph 13.

The OWNER reserves the right to reject any Bid if the evidence submitted by, or investigation of such Bidder fails to satisfy the OWNER that such Bidder is properly qualified to carry out the obligations of the Contract and to complete the work contemplated therein.

The Owner reserves the right to reject any and all proposals and to waive any informality in any proposal or bid.

G2.13 LICENSING OF BIDDERS. Bidders and their proposed subcontractors shall hold such licenses as may be required by the laws of the State of California for the performance of the work specified in the Contract Documents. In addition, licensing requirements for Bidders are as set forth in Special Conditions, Section S1.06.

G2.14 ENGINEER OF WORK. (Reserved)

SECTION 3

AWARD AND EXECUTION OF CONTRACT

G3.01 AWARD OF CONTRACT. The Owner reserves, in its sole discretion, the right to reject any or all Proposals and to waive any informalities and irregularities in Proposals received, other conditions in the Contract Documents notwithstanding.

The Proposals will be compared on the basis of Contract Total Bid Price. The Total Bid Price is the sum of the lump sum bid items and, for unit price items, the sum of the products of the Engineer's Estimate of quantities shown in the Proposal multiplied by the unit bid price. In the event of a discrepancy between the unit bid price and the extension price, the unit price shall govern.

The award of the Contract, if awarded, will be made to the lowest responsible, responsive bidder or bidders.

G3.02 TIME OF AWARD. Within ninety (90) days after the opening of Proposals, the Owner will either reject all Proposals or award the Contract to the lowest responsible, responsive bidder. If the lowest responsible, responsive bidder refuses or fails to execute the Contract and provide an acceptable Performance Bond, Labor and Material Bond and insurance certificate(s), the Owner may award the Contract to the second lowest responsible, responsive bidder. Such award, if made, will be made within ninety (90) days after the opening of Proposals. If the second lowest responsible, responsive bidder refuses or fails to execute the Contract and provide an acceptable Performance Bond, Labor and Material Bond and insurance certificate(s), the Owner may award the Contract to the third lowest responsible, responsive bidder. Such award, if made, will be made within ninety (90) days after the opening of Proposals. The periods of time specified above within which an award of Contract may be made shall be subject to extension for such further period as may be agreed upon in writing by the Owner and the bidder or bidders concerned.

G3.03 EXECUTION OF CONTRACT. **(This section is modified by the Special Conditions.)** The successful bidder shall, within ten (10) days after having received notice that the Contract has been awarded, sign and deliver to the Owner a Contract in the form hereto attached together with the Contract Bonds and insurance certificates executed as required in the Contract Documents. Within 10 days after receiving the signed Contract with acceptable bonds and insurance certificates from the successful bidder, the Owner will sign the Contract.

G3.04 CONTRACT BONDS. The Contractor shall furnish two bonds each in the amount of 100 percent of the contract price, one as security for the faithful performance of the work, and the other as security for the faithful payment and satisfaction of all persons furnishing materials and performing labor on the work. The Contractor shall use the bond forms found at pages BP.19 and BP.21 of these contract specifications. However, the scope of the bonds or the bond forms prescribed in those pages shall in no way affect or alter the liabilities of the Contractor to the Owner under Section G7.21.

The bonds shall be issued by a corporation, which is duly licensed and admitted by the State of California to be a surety insurer in the State.

Notwithstanding the language of the preceding paragraph, Owner may disqualify the Contractor's proposed surety if the Owner has cause to believe the surety is likely to be incapable of fulfilling its obligations under the bonds.

The bonds shall remain in force throughout the period required to complete the work and thereafter for a period of 365 days after final completion and acceptance of the work by the Owner to cover any defects in workmanship, materials, or equipment which develop in that time.

G3.05 FAILURE TO EXECUTE CONTRACT. **(This section is modified by the Special Conditions.)** Failure of a bidder to whom the Contract is awarded to execute the Contract or furnish acceptable Contract bonds or furnish certificates of insurance within ten (10) days of delivery of Notice of Award to bidder shall be just cause for the annulment of the award and the forfeiture of such bidder's Proposal Guaranty. The Proposal Guaranty shall be retained by the Owner as liquidated damages and it is agreed that this sum is a fair estimate of the amount of

damages the Owner will sustain in case the successful bidder fails to enter into a Contract.

G3.06 RETURN OF PROPOSAL GUARANTY. Upon inspection and comparison of Bid prices by the Owner, the Owner will return the Proposal Guaranties of all except the three lowest responsive, responsible Bidders for the Contract. Retained Proposal Guaranties will be held until ninety (90) days after opening of Proposals or until the Contract has been executed, whichever occurs first, after which all Proposal Guaranties other than those that have been forfeited shall be returned. The Proposal Guaranty of the successful Bidder will be retained until the performance bond and labor and material bond have been executed and approved, after which it will be returned.

SECTION 4

SCOPE OF WORK

G4.01 INTENT OF CONTRACT DOCUMENTS. The Contract Documents are complementary, and what is called for by one shall be as binding as if called for by all. The intent of the Contract Documents is to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents. When the Contract Documents describe portions of the work in general terms, but not in complete detail, it is understood that the best general practice shall be followed and only materials and workmanship of the best standard quality shall be used. Any work, materials or equipment that may reasonably be inferred from the Contract Documents as being required to produce the intended result shall be supplied, whether or not specifically called for. When words, which have a well-known technical or trade meaning are used to describe work, materials or equipment, such words shall be interpreted in accordance with that meaning.

Reference to standard specifications, manuals or codes of any technical society, organization or association, or to the laws or regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard specification, manual, code or laws or regulations in effect on the first published date of the Notice to Contractors, except as may be otherwise specifically stated. However, no provision of any referenced standard specification, manual or code (whether or not specifically incorporated by reference in the Contract Documents) shall be effective to change the duties and responsibilities of Owner or Contractor, or any of their consultants, agents or employees from those set forth in the Contract Documents, nor shall it be effective to assign to Owner, or any of Owner's consultants, agents or employees, any duty or authority to supervise or direct the furnishing or performance of the work or any duty or authority to undertake responsibility contrary to the other conditions of the Contract Documents.

The Contract Documents are divided into parts, divisions and sections for convenient organization and reference. Generally, there has been no attempt to divide the specification sections into work performed by the various building trades, work by separate subcontractors, or work required for separate facilities in the project.

G4.02 EXAMINATION AND VERIFICATION OF CONTRACT DOCUMENTS. The Contractor shall thoroughly examine and become familiar with all of the various parts of these Contract Documents and determine the nature and location of the work, the general and local conditions, and all other matters that can in any way affect the work under this Contract. Failure to make an examination necessary for this determination shall not release the Contractor from the obligations of this Contract. No oral agreement or conversation with any officer, agent or employee of the Owner, or with the Engineer either before or after the execution of this Contract, shall affect or modify any of the terms or obligations herein contained.

G4.03 CHANGES; CONTRACT CHANGE ORDER. The Owner may, without notice to the sureties, and without invalidating the Contract, at any time make alterations, deviations, additions to or deletions from the Contract Documents, and may increase or decrease the quantity of any item or portion of the work, or delete any item or portion of the work, and may require extra work, as determined by the Owner to be necessary or advisable. All such work shall be performed under applicable conditions of the Contract Documents, unless specifically provided otherwise at the time the change is ordered.

Any such changes will be set forth in a written Contract Change Order issued by the Owner. The Contract Change Order will specify: (1) the work to be done in connection with the change to be made; (2) the amount of the adjustment of the Contract price, if any, and the basis for compensation for the work ordered; and (3) the extent of the adjustment in the Contract time, if any. A Contract Change Order shall not become effective until the General Manager has signed it; when signed by General Manager it is an "approved Contract Change Order."

No changes or deviations from the Contract Documents shall be made without the authority of an approved Contract Change Order, except that in cases of emergency the General Manager may direct a change in writing. Upon receipt of such written directive, the Contractor shall proceed with the ordered work and the General Manager will prepare a written Contract Change Order for approval by the Owner and issuance to the Contractor as soon thereafter as practicable. Compensation for Emergency Work shall be determined on a time and materials basis.

Upon receipt of an approved Contract Change Order, the Contractor shall sign approved Contract Change Order and promptly proceed with the ordered work, unless otherwise provided in the approved Contract Change Order.

When ordered by the General Manager, the Contractor shall halt work in the area affected by a proposed change. Whenever it appears to the Contractor that a change is necessary, the Contractor shall immediately notify the General Manager of the change he believes necessary and the reasons for such change; however, work in the area affected shall not be discontinued unless ordered by the General Manager.

G4.04 REQUEST FOR QUOTATIONS FOR CHANGE IN WORK. Owner may request Contractor to provide quotations for performing proposed changes to the work. Such requests for quotations shall not be considered authorization to proceed with the change prior to issuance of an approved Contract Change Order, nor shall such request justify any delay in executing existing work. Contractor shall, upon such a request, provide quotations for increases or decreases in the Contract Price and the Contract time associated with performing the proposed change. Quotations shall include substantiating documentation with an itemized breakdown of Contractor and Subcontractor costs, including labor, materials, rentals, services, overhead and profit. The cost of preparing such quotations is included in the Contract price and Contractor shall not be entitled to any additional compensation for preparing them.

G4.05 PROPOSED CONTRACT CHANGE ORDER. A Contract Change Order may be presented to the Contractor for his consideration prior to its having been signed by the Owner. If the Contractor accepts the terms and conditions of such proposed Contract Change Order, and if the Contract Change Order is thereafter signed by the Owner and issued to the Contractor, the Contract Change Order shall be considered to be an executed Contract Change Order for all purposes to the same extent as if the Contract Change Order had been initially issued to the Contractor as an approved Contract Change Order. The Owner need not present a proposed Contract Change Order to the Contractor for his review prior to issuing it as an approved Contract Change Order.

G4.06 EXECUTED CONTRACT CHANGE ORDER. An approved Contract Change Order, which has been signed by the Contractor, is an "executed Contract Change Order." Compensation paid pursuant to Contract Change Orders shall comprise the total compensation for the work described in the Contract Change Order. By signing the Contract Change Order, the Contractor agrees that the specified compensation constitutes full compensation for the work or change, including payment for interruption of schedules, extended overhead, delay or any other "impact" claim or "ripple effect" claim, and by signing, the Contractor specifically waives any reservation or claim for additional compensation in respect to the Contract Change Order.

G4.07 CONTRACT PRICE ADJUSTMENT. If a Contract Change Order provides for an adjustment to the Contract price, the increased payment to Contractor, or the deduction to the credit of the Owner, shall be determined by one of the following methods, or a combination thereof, as determined by the Owner and at its sole option:

A. Unit Prices. The unit prices set forth in the Proposal shall be utilized where they are applicable. If the Contract Change Order increases or decreases the quantity of an item of work by more than twenty-five percent (25%), such that the application of unit prices in the Proposal will cause substantial inequity to the Owner or Contractor, unit prices will be adjusted by mutual agreement. Unit prices for new items included in the Contract Change Order shall be as mutually agreed upon.

   Payment for any contract item of work which has a final total value of less than five percent of the total contract bid price will be made at the contract unit price regardless of increased or decreased quantities.

B. Lump Sum. A total lump sum addition or deduction from the Contract Price as mutually agreed upon.

   Lump sum quotations for changes to the work shall include substantiating documentation with an itemized breakdown of Contractor and Subcontractor costs, including labor, materials, equipment rental, approved services, overhead and profit, all calculated as set forth in Section G9.03, "Force Account Payment."

C. Force Account Payment. Payment for the work will be made on a time and expense basis, that is, on an accounting of the Contractor's forces, materials, equipment and other items of cost as required to do the work.

If compensation for work done under a Contract Change Order is to be made on a force account basis, the compensation will be calculated as set forth in Section G9.03, "Force Account Payment." Contractor agrees that the markups provided in Section G9.03 are adequate.

In any case in which the method of payment cannot be agreed upon prior to the beginning of the work, the Owner may direct that the work be done on a force account basis.

G4.08 PROTEST PROCEDURE. If the Contractor disagrees with any terms or conditions set forth in an approved Contract Change Order, which he has not executed, he shall submit a written protest to the General Manager within 15 days after receipt of such approved Contract Change Order. The protest shall state the points of disagreement, Contract Document references, and quantities and costs involved and shall propose a modification of the items with which he does not agree. If a written protest is not submitted within this 15-day period, payment will be made as set forth in the approved Contract Change Order. Approved Contract Change Orders which are not protested within 15 days will be considered as executed Contract Change Orders and such payment will constitute full compensation for all work included therein or required thereby.

When the protest of an approved Contract Change Order relates to compensation, the Contractor shall keep full and complete records of such work and shall permit the Owner and the Engineer to have access to all records relating to the protested Contract Change Order to determine the compensation payable. The Contractor shall cooperate with the General Manager to reach agreement at the earliest practical date on the terms of compensation for the Contract Change Order. When agreement has been reached, a revised Contract Change Order may be approved by the Owner and issued to the Contractor for signature. Unless and until the Owner and Contractor agree upon other terms of compensation incorporated in a revised executed Contract Change Order, the compensation shall be as specified under the protested approved Contract Change Order.

When the protest of an approved Contract Change Order relates to the adjustment of Contract Time for the completion of the work, the time will be determined in accordance with the conditions of Section G8.12.

G4.09 CONTINUANCE OF CONSTRUCTION. Disagreement by the Contractor with the Owner's determination of the need for, or amount of, an adjustment in Contract price or Contract time associated with an approved Contract Change Order (or disagreement by the Contractor with the Owner's determination that a change has not occurred and no Contract Change Order is needed) shall not, under any circumstances, relieve the Contractor from its obligation to promptly begin and diligently prosecute the work, including the change, as described in the approved Contract Change Order.

G4.10 DETOURS. When required by the Special Conditions, Technical Conditions, or shown on the Contract Plans, or required by responsible public agencies, the Contractor shall construct, maintain and remove detours for the use of public traffic, without additional cost to the Owner, unless separate payment is specified in the Special Conditions or Technical Conditions.

The failure or refusal of the Contractor to construct and maintain detours at the proper time shall be sufficient cause for closing down the work until such detours are in satisfactory condition for use by public traffic.

G4.11 ARCHAEOLOGICAL DISCOVERIES. All articles of archaeological interest, which may be uncovered by the Contractor during the progress of the work, shall be reported immediately to the General Manager. Progress of the Work with respect to said find shall be in accordance with the requirements of the Special Conditions to this Contract.

G4.12 PRESERVATION AND CLEANING. The Contractor shall clean up the work at intervals with a minimum frequency of street sweeping of two (2) times per week and at other times as directed by the General Manager.

Before final inspection of the work, the Contractor shall clean the project site, material sites and all ground occupied by him in connection with the work, of all rubbish, excess materials, false work, temporary structures and equipment. All parts of the work shall be left in a neat and presentable condition. Full compensation for final cleaning up will be considered as included in the prices paid for the various Contract items of work and no separate payment will be made therefor.

G4.13 GUARANTY OF WORK. Notwithstanding inspections and acceptance by the Owner of work furnished under this Contract, the Contractor warrants to the Owner for a period of one (1) year from the date of Contract completion that all materials and equipment furnished under the Contract, including that provided pursuant to Change Orders, will be of good quality and new, that the work will be free from defects in material or workmanship, and that the work will conform to the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective.

This warranty by the Contractor is in addition to any warranties or guarantees required by the Special Conditions or Technical Conditions for specified items of equipment or materials. This warranty shall be in effect notwithstanding any disclaimers, or limiting or conditional terms contained in such separate warranties furnished by manufacturers or suppliers.

G4.14 CORRECTION OF WORK DURING WARRANTY PERIOD. If, within the warranty period stated in the Performance Bond after the date of final acceptance of the work by the Owner, any of the work is found not to be in accordance with the Contract Documents, specifically including Section G4.13 ("Guaranty of Work") the Contractor shall correct it promptly after written notice from the Owner to do so, and pay for any damage to other property resulting from such non-conforming work. If the Contractor fails to make the repairs or replacements promptly, or in an emergency when delay could cause risk of damage or loss, the Owner may have the non-conforming work removed, replaced or corrected at the expense of the Contractor and his surety. Non-conforming work that is remedied under this Section shall be subject to an extended warranty obligation, identical in terms to that provided by Section G4.13 and this Section after the non-conforming work has been remedied.
Nothing contained in this Section G4.14 shall be construed to establish a period of limitation with respect to other obligations the Contractor may have under the Contract Documents. Establishment of the warranty period stated in the Performance Bond as described in this Section relates only to the specific obligation of the Contractor to correct the work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the work.

SECTION 5

CONTROL OF WORK

G5.01 AUTHORITY OF GENERAL MANAGER. The General Manager shall decide all questions that may arise as to the quality or acceptability of materials furnished and work performed and as to the manner of performance and rate of progress of the work; all questions which may arise as to the interpretation of the Contract Documents; all questions as to the acceptable fulfillment of the Contract on the part of the Contractor; and all questions as to compensation. The General Manager shall have authority to reject work that does not conform to the Contract Documents. His decision shall be final and he shall have authority to enforce and make effective such decisions and orders which the Contractor fails to carry out promptly.

G5.02 CONTRACT DRAWINGS. Upon written request, the Owner will furnish to the Contractor for his use, at no expense to the Contractor, five (5) copies of all Contract Documents, including the Contract Drawings. Additional copies may be obtained at cost.

G5.03 SHOP DRAWINGS. **(This section is amended by the Special Conditions.)** The Contract Drawings shall be supplemented by shop drawings furnished by the Contractor. The General Manager shall have reviewed shop drawings before any work involving such drawings is performed or equipment purchased. The Contractor shall make no change in any shop drawing after it has been reviewed by the General Manager and stamped "No Exceptions Taken."

Shop drawing submittals shall contain adequate information to permit the General Manager to evaluate each submission for conformance with the Contract Documents. Each submittal shall be complete; partial submittals will not be reviewed. All drawings shall include a graphical scale and indicate the amount of reduction used, if any. The quality of lettering and draftsmanship shall be such as to insure easily read reproductions by microfilming process.

Each shop drawing submitted by the Contractor shall bear the approval stamp of the Contractor, and shall be marked to indicate any deviation in the shop drawing from the requirements of the Contract Documents. By approving and submitting shop drawings, the Contractor thereby represents that he has determined and verified all field measurements, field construction criteria, materials, catalog numbers and similar data, and that he has checked and coordinated each shop drawing with the requirements of the work and the Contract Documents. Where applicable, shop drawings will be certified for construction by the manufacturer.

Each submittal shall be accompanied by a transmittal letter from the Contractor stating the name of the material or equipment items as shown on the Contract Documents, a specification reference consisting of a section number, and any proposed deviations from the Contract Documents requested or shown on the submittal.

Review of shop drawings is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Review of the Contractor's shop drawings shall not relieve Contractor of any of his responsibility for the successful completion of the work in conformity with the requirements of the Contract Documents. The Contractor is responsible for conformance with all requirements of the Contract Documents, including, but not limited to, dimensions which shall be conformed and correlated at the job site, fabrication processes and techniques of construction, coordination of work with that of all others, and satisfactory performance of all work. Review of shop drawings shall not waive any requirement of the Contract Documents and defective work may be rejected notwithstanding such review.

It is the Contractor's responsibilities to submit shop drawings and other submittals so as to allow sufficient time for review, and for possible revisions and resubmits. Normal review time by the General Manager shall be 30 calendar days; complex submittals may require up to 45 days. Contractor shall submit all shop drawings to the General Manager within forty-five (45) days after date of Award of Contract.

Owner will make its best efforts to review submittals within the time period scheduled by the Contractor, provided it is consistent with the time period specified in the preceding paragraph, but the Owner's inability to do so shall not automatically entitle the Contractor to additional time to complete the Contract. If the General Manager fails to

complete his review of shop drawing submittals within a reasonable time (not to be less than the time period specified in this section), and if the Contractor's controlling operation is delayed by reason of the delay in review, an extension of time commensurate with the delay in completion of the work thus caused will be granted pursuant to Section G8.12, but no additional compensation will be allowed for such delay.

Shop drawings reviewed by the General Manager will be returned to the Contractor. The General Manager's action on each submittal will consist of one of the following: "No Exceptions Taken," "Exceptions Taken as Noted," "Revise and Resubmit" or "Rejected." If the General Manager takes exception to any drawings, the Contractor shall make the necessary revisions and resubmit them to the General Manager for review. When shop drawings are required to be resubmitted, the revisions are to be clearly defined on the revised drawings. Resubmits will be reviewed in accordance with the provisions applicable to initial submittals and the time period for the General Manager's review shall be equal to that for initial submittals.

Submittal and processing of shop drawings shall conform to the requirements of the Special Conditions and Technical Conditions.

Full compensation for furnishing all shop drawings shall be considered as included in the prices paid for the Contract items of work to which such drawings relate and no additional compensation will be allowed therefor.

When the shop drawings have been completed to the satisfaction of the General Manager, the Contractor shall carry out the construction in strict accordance therewith. Any further changes will require a resubmits of the drawings.

Contractor shall be charged for the review of submittals for items that have been previously rejected by the General Manager two or more times. Contractor shall be charged for the review of submittals as a result of a request for substitution by the Contractor. The basis for such charges shall be the cost actually incurred by the Owner for the review of the submittal.

G5.04 CONFORMITY WITH CONTRACT DOCUMENTS. Work and materials shall conform to the lines, grades, cross sections, dimensions and material requirements, including tolerances, shown on the Contract Drawings or indicated in the Specifications. Although measurement, sampling and testing may be considered evidence as to such conformity, the General Manager shall be the sole judge as to whether the work or materials deviate from the Contract Drawings and Specifications, and his decision as to any allowable deviations therefrom shall be final.

G5.05 COORDINATION AND INTERPRETATION OF CONTRACT DOCUMENTS. The General Conditions, Special Conditions, Technical Conditions, Contract Drawings, Contract Change Orders and all supplementary documents are essential parts of the Contract, and a requirement occurring in one is as binding as though occurring in all. They are intended to be complementary, and to describe and provide for a complete work.

If there is a conflict between Contract Documents, the document highest in precedence shall control. The precedence shall be:

1. Permit requirements of the other agencies.
2. Special Conditions.
3. Technical Conditions.
4. Plans.
5. General Conditions.
6. Standard Specifications.

Change Orders, Supplemental Agreements and approved revisions to Plans and Specifications will take precedence over Items 2 through 6 above.

The Contract Documents of the highest precedence shall in no way nullify non-conflicting portions of the Contract Documents of lower precedence.

In the event of inconsistencies between requirements in the Special Conditions and requirements in the General Conditions, the Special Conditions shall govern.

In case of differences between small and large-scale drawings, the large-scale drawings shall govern. Schedules or drawings shall take precedence over conflicting notations on drawings. In the event of discrepancy between any drawing and the figures written thereon, the figures, unless otherwise directed, will govern over scaled dimensions.

Should it appear that the work to be done or any of the matters relative thereto is not sufficiently detailed or explained in the Contract Documents, the Contractor shall apply to the General Manager for such further written explanations as may be necessary and shall conform to them as part of the Contract. In the event of any doubt or question arising respecting the true meaning of the Contract Documents, clarification shall be sought from the General Manager, whose decision thereon shall be final.

G5.06 ORDER OF WORK. When required by the Special Conditions or Contract Drawings, the Contractor shall follow the sequence of operations as set forth therein.

Full compensation for conforming to such requirements will be considered as included in the prices paid for the various Contract items of work and no additional compensation will be allowed therefor.

G5.07 SUPERINTENDENCE. The Contractor shall supervise and direct the work using his best skill and attention and shall keep at the project site competent supervisory personnel at all times while work is in progress. The Contractor shall designate, in writing, before starting work, a project superintendent who shall be an employee of Contractor and shall have complete authority to represent and act for the Contractor. The Contractor shall notify the General Manager in writing prior to any change in superintendent assignment.

The Contractor shall be solely responsible for and have control over construction means, methods, techniques and procedures for providing adequate safety precautions and coordinating all portions of the work under the Contract, unless the Contract Documents give other specific instructions concerning these matters.

G5.08 LINES AND GRADES. Only such primary control lines, monuments and bench marks will be set by the General Manager as he determines to be necessary to control establishment of the lines and grades required for the completion of the work. In general, these will consist of the primary horizontal and vertical control points shown on the Contract Drawings. The Contractor shall notify General Manager a minimum of ten (10) working days before such stakes or marks are needed.

The Contractor shall carefully preserve monuments, stakes and marks set by the General Manager. If such monuments, stakes or marks are destroyed or damaged, the General Manager at his earliest convenience will replace them. The Contractor shall be charged for the cost of replacing or restoring monuments, stakes and marks destroyed or damaged by reason of his operations. This charge will be deducted from any monies due or to become due the Contractor.

The Contractor shall temporarily suspend work at such points and for such reasonable times as the General Manager may require for transferring or setting monuments, stakes or marks, and the Contractor shall not be entitled to any additional compensation or extension of time therefor.

All other stakes or marks required to establish the lines and grades required for the completion of the work shall be the responsibility of the Contractor. Payment for such work shall be considered as included in the prices paid for the various Contract items of work and no additional compensation will be allowed therefor.

Contractor shall take field measurements and verify field conditions consistent with prudent construction industry standards and shall carefully compare such field measurements and conditions and other information known to Contractor with the Contract Documents before commencing construction activities on the work site. Errors, inconsistencies or omissions in the Contract Documents discovered by Contractor shall be reported to the General Manager at once.

G5.09 INSPECTION. The General Manager, and all authorized representatives of the Owner, shall at all times have safe access to the work during its construction, and shall be furnished with every reasonable facility for ascertaining that the materials and the workmanship are in accordance with the requirements and intentions of the Contract

Documents. All work done and all materials furnished shall be subject to the General Manager's on-site and off-site inspection.

The inspection and observation of the work or materials by the General Manager shall not relieve the Contractor of any obligations to fulfill his Contract as prescribed. Work and materials not meeting such requirements shall be corrected, and unsuitable work or material may be rejected, notwithstanding that such work or materials have been previously inspected by the General Manager, or that payment therefor has been included in a progress estimate.

The General Manager may order re-examination of questioned work at any time before final acceptance. If so ordered, the Contractor shall uncover the work. If such work is found to be in accordance with the Contract Documents, the Owner will pay for the cost of uncovering; removal, recovering and replacing of the parts removed; but if such work so exposed or examined is not in accordance with the Contract Documents, the uncovering, removal, recovering and replacement shall be at the Contractor's expense. Work that has been covered prior to observation by the General Manager does not qualify as re-examined work; the Owner may order it uncovered for observation without payment of costs.

The Contractor shall give due notice to the General Manager before backfilling so that the General Manager may observe the materials and installation.

The Contractor shall notify the General Manager in advance as to those times when no construction activities will take place. Absent such notification, all costs incurred by the Owner as a result of attending to the project site at times when no construction is taking place will be charged to the Contractor.

Whenever the Contractor intends to perform work on Saturday, Sunday, or a legal holiday, he shall give notice to the General Manager of such intention 24 hours prior to performing such work, or such longer period as may be specified, so that the General Manager may make necessary arrangements.
The observations and inspections performed by the General Manager shall not relieve the Contractor of his responsibility to conduct comprehensive inspections of the work and to furnish materials and perform work in conformance with the Contract Documents.

G5.10 DOCUMENTS ON JOB SITE. The Contractor shall keep one copy of all Contract Documents (including Change Orders), approved Shop Drawings and approved progress payments on the job site, in good order, available to the General Manager and all authorized representatives of the Owner.

G5.11 CORRECTION, REMOVAL OF REJECTED WORK. The Contractor shall promptly correct work rejected by the General Manager as failing to conform to the requirements of the Contract Documents, whether or not fabricated, installed or completed, so that it does comply with the Contract Documents. The Contractor shall bear the costs of correcting such rejected work, including additional testing, inspections and compensation for the Engineer's services and expenses made necessary thereby.

The Contractor shall remove, at his cost, from the site portions of the work which are not in accordance with the Contract Documents or which are not corrected by the Contractor.

The Contractor shall correct, at his cost, damaged or destroyed construction, whether completed or partially completed.

Any work done beyond the lines shown on the Contract Drawings or established by the General Manager, and all extra work done without written authority, will be considered as unauthorized work. Upon order of the General Manager, unauthorized work shall be remedied, removed or replaced at the Contractor's cost.

If the Contractor fails to promptly correct non-conforming or rejected work, or to comply promptly with any order of the General Manager under this Section, the Owner may cause such work to be remedied, removed or replaced and the costs thereof will be deducted from any monies due or to become due the Contractor.

Failure on the part of the General Manager to reject non-conforming work shall not be construed to imply acceptance of such work.

G5.12 EQUIPMENT AND PLANTS. The Contractor shall use or permit only equipment and plants suitable to produce the quality of work and materials required, and meeting all State and Federal safety requirements.

Plants shall be designed and constructed in accordance with general practice for such equipment and shall be of sufficient capacity to insure the production of materials needed to complete the work in accordance with the Contractor's schedule and the Contract time.

When ordered by the General Manager, the Contractor shall remove unsuitable equipment from the work and discontinue the operations of unsafe or unsatisfactory plants.

All equipment used shall be selected such that construction loads do not exceed the bearing capacity of structures, highways, streets, and subsurface conduits. The Contractor's attention is directed to Section G7.08 of these General Conditions.

G5.13 CHARACTER OF WORKERS. The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Contract. The Contractor shall not permit employment of unfit persons nor persons unskilled in tasks assigned to them. General Manager shall have the authority to require Contractor to remove undisciplined workers from the work.

G5.14 FINAL INSPECTION. When the work has been completed, the General Manager will make the final inspection. The Contractor shall notify the General Manager in writing when it considers the work complete and shall request a final inspection.

G5.15 SUBMITTAL OF AS-BUILT DATA. The Contractor shall submit to the General Manager all information required by the General Manager to verify as-built drawings for all permanent Contract work.

In order to provide for the timely submission of data, and avoid loss of information, the Contractor shall submit acceptable as-built data to the General Manager on a monthly basis.

G5.16 EMERGENCIES. In an emergency affecting the safety of life, the work, or adjoining property, the Contractor, without special instructions or authorization from the General Manager, shall act at his discretion to prevent such threatened loss or injury. In such an emergency, the Contractor shall perform such additional work as is required. Any compensation claimed by the Contractor on account of emergency work shall be determined in accordance with the conditions of Section G9.

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SECTION 6

CONTROL OF MATERIALS

G6.01 SOURCE OF SUPPLY AND QUALITY OF MATERIALS. The Contractor shall furnish all materials required to complete the work, except materials that are designated in the Specifications to be furnished by the Owner and materials furnished by the Owner in accordance with force account work as described in Section G9.03. As used in this Section, the term "materials" shall mean materials and equipment furnished for incorporation in the work.

Notwithstanding any prior inspection, only materials conforming to the requirements of the Contract Documents shall be incorporated in the work.

The materials furnished and used shall be new, except as may specifically be provided elsewhere in the Contract Documents. The materials shall be manufactured, handled, and used in a workmanlike manner to ensure completed work in accordance with the Contract Documents.

Whenever it is provided that the Contractor shall furnish materials or manufactured articles, or shall do work, for which no detailed specifications are set forth, the materials or manufactured articles shall be of the best grade in quality and workmanship obtainable in the market from firms of established good reputation; or if not ordinarily carried in stock, shall conform to the usual standards for first-class materials of the kind required, with due consideration for the use they are to be put to.

The Contractor shall submit to the General Manager a list of his sources of materials and the locations at which such materials will be available for inspection. The list shall be submitted in sufficient time to permit proper inspection and testing of materials to be furnished from such listed sources in advance of their use. The Contractor shall assure that the General Manager or his authorized representative has free access at all times to the material to be inspected, sampled or tested. The General Manager may inspect, sample or test materials at the source of supply or other locations. It is understood that such inspections and tests in no way shall be considered as a guaranty of acceptance of such material nor of continued acceptance of material presumed to be similar to that upon which inspections and tests have been made, and that inspection and testing performed by the Owner shall not relieve the Contractor or his suppliers of responsibility for quality control.

Manufacturers' warranties, guaranties, instruction sheets and parts lists, which are furnished with certain materials incorporated in the work, shall be delivered to the General Manager before acceptance of the Contract.

Reports and records of inspections made and tests performed, when available at the site of the work, may be examined by the Contractor and the General Manager.

G6.02 OWNER-FURNISHED MATERIALS. Materials furnished by the Owner will be available at locations designated in the Specifications, or if not designated in the Specifications, they will be available at the Owner’s Office. The Contractor, at his own expense, including any necessary loading and unloading that may be involved shall haul them to the site of the work. The cost of handling and placing Owner-furnished material shall be considered as included in the price paid for the Contract item involving such Owner-furnished material.

The Contractor shall be held responsible for all materials furnished to him, and he shall pay all demurrage and storage charges. Owner-furnished materials lost or damaged from any cause whatsoever shall be replaced by the Contractor, at his expense. The Contractor will be liable to the Owner for the cost of replacing Owner-furnished material, and such costs may be deducted from any monies due or to become due the Contractor. All Owner-furnished materials that are not used on the work shall remain the property of the Owner and will be delivered to the Owner's corporation yard.

G6.03 STORAGE OF MATERIALS. Materials shall be stored by the Contractor in such a manner as to ensure the preservation of their quality and fitness for the work and to facilitate inspection.

G6.04 DEFECTIVE MATERIALS. All Contractor-furnished materials not conforming to the requirements of the Contract Documents may be rejected, whether in place or not. They shall be removed immediately from the site of the work unless otherwise permitted by the General Manager. No rejected material, the defects of which have been subsequently corrected, shall be used in the work unless approval in writing has been given by the General Manager. Upon failure of the Contractor to comply promptly with any order of the General Manager made under the conditions of this Section, the General Manager may cause the removal and replacement of rejected material and deducts the cost thereof from any monies due or to become due the Contractor.

G6.05 MATERIAL AND EQUIPMENT SPECIFIED BY NAME. Whenever any material or equipment is specified by two patent or proprietary names or by the names of two manufacturers, such specifications shall be considered as used for the purpose of describing the material or equipment desired and shall be considered as if followed by the words "or acceptable equal", whether or not such words appear. The Contractor may offer material or equipment with equal or better qualities and performance in substitution for those specified that he considers would be in the District's interest to accept. No offers for substitution will be acknowledged or considered from suppliers, distributors, manufacturers or subcontractors. Any such offer shall be made in writing to the General Manager for his consideration within thirty-five days after award of the contract. The Contractor shall include with his offer sufficient data which, together with any other data the District may require, will enable the District to assess the acceptability of the material or equipment. When the substitute equipment or material necessitates changes to or coordination with any other portion of the work, the data submitted shall include drawings and details showing all such changes, and the Contractor shall perform these changes as part of any acceptance of substitute material or equipment. The use of any material or equipment so offered will be permitted only after written acceptance of his offer by the District. Such acceptance by the District shall not relieve the Contractor from full responsibility for the efficiency, sufficiency and quality and performance of the substitute material or equipment, in the same manner and degree as the material and equipment specified by name.

Whenever any material or equipment is specified by only one patent or proprietary name or by the name of only one manufacturer, such material or equipment shall be so specified for the purpose of standardization with existing equipment or materials or has no known equal.

G6.06 PLANT INSPECTION. The General Manager may inspect the production of material, or the manufacture of products, at the source of supply. Plant inspection, however, will not be undertaken until the General Manager is assured of the cooperation and assistance of both the Contractor and the material producer. The General Manager or his authorized representative shall have free entry at all times to such parts of the plant as concern the manufacture or production of the materials. Adequate facilities shall be furnished free of charge to make the necessary inspection. The General Manager assumes no obligation to inspect materials at the source of supply. The responsibility of incorporating satisfactory materials in the work rests entirely with the Contractor, notwithstanding any prior inspections or tests.

G6.07 PRODUCT AND REFERENCE STANDARDS. When descriptive catalog designations, including manufacturer's name, product brand name or model number are referred to in the Contract Documents, such designations shall be considered as being those found in industry publications in effect on the day the Notice to Contractors for the work is dated.

G6.08 SAMPLES. After the award of the Contract, the Contractor shall furnish to the General Manager samples indicated in the Specifications or requested by the General Manager. Samples shall be submitted without charge, with shipping charges prepaid. Materials for which samples are required shall not be used in the work until approved in writing by the General Manager.

Each sample shall be submitted in duplicate unless otherwise directed, and shall be labeled with the following data: name of project; name of Contractor; material represented and location in the project including specification reference; and producer information including brand, model, place of origin, and other pertinent information.

The Contractor shall forward a transmittal letter to the General Manager with each shipment of samples containing the information required in the previous paragraph. Approval of a sample shall be only for the characteristics and use named in the submittal and approval shall not be construed to change or modify any Contract requirement.

Before submitting samples, the Contractor shall assure himself that the materials or equipment will be available in the quantities required in the project, as no change or substitution will be permitted after a sample has been approved unless approved by the General Manager in writing.

Samples of material from local sources shall be taken by or in the presence of the General Manager if so required by the General Manager; otherwise the samples will not be considered for testing.

Approved samples not damaged in testing may be incorporated in the finished work if marked for identification and approved by the General Manager. Materials incorporated in the work shall match the approved samples.

Failure of any material to pass the specified tests will be sufficient cause for refusal to consider under this Contract any further samples of the same brand, make or source of that material. The General Manager reserves the right to disapprove any material which has previously proven unsatisfactory in service.

Samples of material delivered on the site or in place may be taken by the General Manager for testing. Failure of samples to meet Contract requirements will annul previous approvals of the item tested.

G6.09 TESTING OF MATERIALS OR WORK. Materials to be used in the work will be subject to inspection and tests by the General Manager or his designated representative. The Contractor shall furnish, without charge, such samples as may be required.

Materials and work shall be tested in accordance with the methods in use by the State of California, Department of Transportation, or by nationally recognized testing organizations or as specified in the Contract Documents. The General Manager will make or approve all testing. Unless otherwise noted in the Specifications, testing will be made at the expense of the Owner. In the event that any materials and work fail to pass tests, the cost of subsequent testing of similar materials and work as may be required by the General Manager shall be borne by the Contractor.

Test methods developed by the State of California, Department of Transportation are identified by the prefix Calif., followed by the serial number. Copies of individual test methods are available at the Transportation Laboratory, Sacramento, California.

Whenever a reference is made in the Specifications to a test method by California number, it shall mean the test method in effect on the date of the Notice to Contractors for the work. Whenever a reference is made in the Specifications to a specification or test designation of the American Society for Testing and Materials, the American Association of State Highway Officials, Underwriters' Laboratories, Inc., or any other recognized national organization, and the number accompanying the test designation representing the year of adoption of the test has been omitted, the reference shall mean the test method in effect on the date of the Notice to Contractors for the work.

Whenever the Contract Documents provide an option between two or more test methods, the General Manager will determine the test method to be used.

Whenever a specification, manual or test designation provides for test reports (such as certified mill test reports) from the manufacturer, copies of such reports, identified as to the lot of material, shall be furnished to the General Manager. The manufacturer's test report shall supplement the inspection, sampling and testing conditions of this Section and shall not constitute a waiver of the Owner's right to inspect. When material that cannot be identified with specific test reports is proposed for use, the General Manager may, at his discretion, select random samples from the lot for testing. Testing specimens from the random samples, including those required for retest, shall be prepared in accordance with the referenced specification and furnished by the Contractor at his expense. The number of such samples and test specimens shall be entirely at the discretion of the General Manager.

G6.10 CERTIFICATE OF COMPLIANCE. A Certificate of Compliance shall be furnished prior to the use of any materials for which the Special Conditions or Specifications require that such Certificate be furnished. In addition, the General Manager may permit the use of certain materials prior to sampling and testing if accompanied by a Certificate of Compliance stating that the materials involved comply in all respects with the requirements of the

Specifications. The Certificate shall be signed by the manufacturer of the material. A Certificate of Compliance shall be furnished with each lot of material delivered to the work and the lots so certified shall be clearly identified in the Certificate.

All materials used on the basis of a Certificate of Compliance may be sampled and tested at any time. The fact that material is used on the basis of a Certificate of Compliance shall not relieve the Contractor of responsibility for incorporating material in the work which conforms to the requirements of the Contract Documents, and any such material not conforming to such requirements will be subject to rejection whether in place or not.

The Owner reserves the right to refuse to permit the use of material on the basis of a Certificate of Compliance.

The form of the Certificate of Compliance and its disposition shall be as approved by the General Manager.

SECTION 7

LEGAL RELATIONS AND RESPONSIBILITIES

G7.01 LAWS TO BE OBSERVED. The Contractor shall keep himself fully informed concerning all requirements of law, including but not limited to all State and Federal laws and county and municipal ordinances and regulations which in any manner affect those engaged or employed in the work, the materials used in the work, or which in any way affect the conduct of the work, and of all such orders and decrees of bodies or tribunals having any jurisdiction or authority over the same. The Contractor shall at all times observe, and shall cause all his agents and employees to observe, all such requirements of laws and shall protect, indemnify and hold harmless the Owner, the Engineer, and all of their respective officers, agents and employees against all claims and liabilities arising from or based on the violation of any such requirement of law whether by the Contractor or his employees. If any discrepancy or inconsistency is discovered in the Contract Documents for the work in relation to any such requirements of laws, the Contractor shall immediately report the same to the General Manager in writing. The Contract Documents shall be governed by the laws of the State of California.

G7.02 LABOR CODE REQUIREMENTS. Attention is directed to the following requirements of the Labor Code:

A. Hours of Labor. Eight hours labor constitutes a legal day's work. The Contractor shall forfeit, as penalty to the Owner, twenty-five ($25.00) for each workman employed in the performance of the Contract by the Contractor or by any subcontractor under him for each calendar day during which such workman is required or permitted to work more than eight (8) hours in any one day and forty (40) hours in any one calendar week in violation of the provisions of the California Labor Code and in particular, Sections 1810 to 1815 thereof, inclusive, except that work performed by employees of the Contractor in excess of eight (8) hours per day and forty (40) hours during any one week shall be permitted upon compensation for all hours worked in excess of eight (8) hours per day at not less than one-and-one-half (1½) times the basic rate of pay, as provided in said Section 1815.

B. Labor Non-Discrimination. Attention is directed to Section 1735 of the Labor Code which provides the Contractor shall not discriminate against any employee who is employed on the work because of race, religious creed, color, national origin, ancestry, physical handicap, medical condition, marital status, sex or age of such persons, except as provided in Section 12940 of the Government Code.

C. Prevailing Wages. The Contractor shall comply with California Labor Code Sections 1770 to 1780, inclusive. In accordance with said Section 1775, the Contractor shall forfeit as a penalty to the Owner fifty ($50.00) for each calendar day or portion thereof for each workman paid less than stipulated prevailing wage rates for such work or craft in which such worker is employed for any work done under the Contract by him or by any subcontractor under him in violation of the provisions of the Labor Code and in particular, Labor Code Sections 1770 to 1780, inclusive. In addition to said penalty and pursuant to said Section 1775, the difference between such stipulated prevailing wage rates and the amount paid to each worker for each calendar day or portion thereof for which each worker was paid less than the stipulated prevailing wage rate shall be paid to each worker by the Contractor.

Pursuant to the provisions of Section 1773 of the Labor Code, the Owner has obtained the general prevailing rate of per diem wages and the general prevailing rate for holiday and overtime work applicable to the work to be done from the Director of the Department of Industrial Relations. Copies of the prevailing rates are on file at the Owner Office and are available to any interested party on request. Such wage rates must be prominently posted at the construction site.

The Owner will not recognize any claim for additional compensation because of the payment by the Contractor of any wage rate in excess of the prevailing wage rate set forth in the Contract. The possibility of wage increases is one of the elements to be considered by the Contractor in

determining his bid, and will not under any circumstances be considered as the basis of a claim against the Owner on the Contract.

Attention is directed to the requirements of Section 1773 of the Labor Code. The Contractor shall make travel and subsistence payments to each worker needed to execute the work in accordance with the requirements of said Section 1773.

D. Payroll Records. The Contractor's attention is directed to the following provisions of Labor Code Section 1776. The Contractor shall be responsible for the compliance with these provisions by his subcontractors.

(a) 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 under subdivision (a) 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 subdivision (a) shall be made available for inspection or furnished upon request to the Owner, 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 subdivision (a) shall be made available upon request to the public for inspection or copies thereof made; provided, however, that a request by the public shall be made through either the Owner, the Division of Apprenticeship Standards, or the Division of Labor Standards Enforcement. If the requested payroll records have not been provided pursuant to paragraph (b)(2), herein, the requesting party shall, prior to being provided the records, reimburse the costs of preparation by the Contractor, subcontractor and the entity through which the request was made. The public shall not be given access to such records at the principal office of the Contractor.

(c) Each contractor shall file a certified copy of the records enumerated in subdivision (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 Owner, 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 Owner of the location of records enumerated under subdivision (a), including the street address, city and county, and shall, within five (5) working days, provide a notice of a change of location and address.

(f) In the event of noncompliance with the requirements of this Section, 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 Section. Should noncompliance still be evident after the ten-day (10) period, the Contractor shall, as a penalty to the State or the Owner, forfeit twenty-

five ($25.00) 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 (a) through (f) lies with the Contractor.

The penalties specified in subdivision (f) of Labor Code Section 1776 for noncompliance with the provisions of said Section 1776 may be deducted from any monies due or which may become due to the Contractor.

The Contractor and each subcontractor shall preserve their payroll records for a period of 3 years from the date of completion of the Contract.

E. Apprentices. The Contractor shall fully comply with the requirements of Sections 1777.5, 1777.6 and 1777.7 (as amended) of the California Labor Code and the regulations of the California Apprenticeship Council. In accordance with Section 1777.5, the Contractor shall secure the necessary certificates and shall contribute to the apprenticeship fund or funds, as provided for therein. The Contractor shall require each subcontractor who will perform work or labor or render service to the Contractor in or about the construction of the work to comply fully with Sections 1777.5 and 1777.6 of the Labor Code. Information relative to apprenticeship standards, wage schedules and other requirements may be obtained from the State Division of Apprenticeship Standards and its branch offices.

F. Worker's Compensation. Pursuant to the requirements of Section 1860 of the California Labor Code, the Contractor will be required to secure the payment of workers' compensation to his employees in accordance with the provisions of Section 3700 of the Labor code.

Prior to commencement of work, the Contractor shall sign and file with the Owner, a certification in the following form:

"I am aware of the provisions of Section 3700 of the California Labor Code which require every employer to be insured against liability for workers' compensation or to undertake self accordance with the provisions of that code, and I will comply with such provisions before commencing the performance of the work of this contract."

Said certification is included in the Contract, and signature and return of the Contract as provided in Section G3.03, "Execution of Contract," of the General Conditions, shall constitute signing and filing of the said certificate.

G7.03 CONTRACTORS' LICENSING LAWS. Attention is directed to the provisions of Chapter 9 of Division 3 of the California Business and Professions Code concerning the licensing of contractors. All bidders and contractors shall be licensed in accordance with the laws of the State of California and any bidder or contractor not so licensed is subject to the penalties imposed by such laws.

G7.04 AIR POLLUTION CONTROL. The Contractor shall comply with all air pollution control rules, regulations, ordinances and statutes which apply to any work performed pursuant to the Contract, including any air pollution control rules, regulations, ordinances and statutes specified in Section 11017 of the Government Code.

Material to be disposed of shall not be burned, either inside or outside the work site.

G7.05 WATER POLLUTION CONTROL. The Contractor shall exercise every reasonable precaution to protect streams, lakes, reservoirs, bays and coastal waters from pollution with fuels, oils, bitumen, calcium chloride and other harmful materials and shall conduct and schedule his operations so as to avoid or minimize muddying and silting of said streams, lakes, reservoirs, bays and coastal waters. Care shall be exercised to preserve roadside vegetation beyond the limits of construction.

Water pollution control work is intended to provide prevention, control, and abatement of water pollution to streams,

waterways and other bodies of water, and shall consist of constructing those facilities which may be shown on the Plans, specified herein or in the Special Conditions, or directed by the General Manager.

In order to provide effective and continuous control of water pollution it may be necessary for the Contractor to perform the Contract work in small or multiple units, on an out of phase schedule, and with modified construction procedures. The Contractor shall provide temporary water pollution control measures, including but not limited to, dikes, basins, ditches, and applying straw and seed, which become necessary as a result of his operations. The Contractor shall coordinate water pollution control work with all other work done on the Contract.

Before starting any work on the project, the Contractor shall submit, for acceptance by the General Manager, a program to control water pollution effectively during construction of the project. Such program shall show the schedule for the erosion control work and for all water pollution control measures which the Contractor proposes to take in connection with construction of the project to minimize the effects of his operations upon adjacent streams and other bodies of water. The Contractor shall not perform any clearing and grubbing or earthwork on the project, other than that specifically authorized in writing by the General Manager, until such program has been accepted.

If the measures being taken by the Contractor are inadequate to control water pollution effectively, the General Manager may direct the Contractor to revise his operations and his water pollution control program. Such directions will be in writing and will specify the items of work for which the Contractor's water pollution control measures are inadequate. No further work shall be performed on said items until the water pollution control measures are adequate and, if also required, a revised water pollution control program has been accepted.
The General Manager will notify the Contractor of the acceptance or rejection of any submitted or revised water pollution control program in not more than 5 days.

The Owner will not be liable to the Contractor for failure to accept all or any portion of an originally submitted or revised water pollution control program, nor for any delays to the work due to the Contractor's failure to submit an acceptable water pollution control program.

The Contractor may request the General Manager to waive the requirement for submission of a written program for control of water pollution when the nature of the Contractor's operation is such that erosion is not likely to occur. Waiver of this requirement will not relieve the Contractor from responsibility for compliance with the other conditions of this Section. Waiver of the requirement for a written program for control of water pollution will not preclude requiring submittal of a written program at a later time if the General Manager deems it necessary because of the effect of the Contractor's operations.

Where erosion that will cause water pollution is probable due to the nature of the material or the season of the year, the Contractor's operations shall be so scheduled that permanent erosion control features will be installed concurrently with or immediately following grading operations.

Nothing in the terms of the Contract or in the conditions in this Section shall relieve the Contractor of the responsibility for compliance with Sections 5650 and 12015 of the Fish and Game Code, or other applicable statutes relating to prevention or abatement of water pollution.

The Contractor shall also conform to the following conditions:

1. Where working areas encroach on live streams, barriers adequate to prevent the flow of muddy water into streams shall be constructed and maintained between working areas and streams, and during construction of such barriers, muddying of streams shall be held to a minimum.

2. Removal of material from beneath a flowing stream shall not be commenced until adequate means, such as a bypass channel, are provided to carry the stream free from mud or silt around the removal operations.

3. Should the Contractor's operations require transportation of materials across live streams, such operations shall be conducted without muddying the stream. Mechanized equipment shall not be operated in the stream channels of such live streams except as may be necessary to construct

crossings or barriers and fills at channel changes.

4. Water containing mud or silt from aggregate washing or other operations shall be treated by filtration, or retention in a settling pond, or ponds, adequate to prevent muddy water from entering live streams.

5. Oily or greasy substances originating from the Contractor's operations shall not be allowed to enter or be placed where they will later enter a live stream.

6. Portland cement or fresh portland cement concrete shall not be allowed to enter flowing water of streams.

7. When operations are completed, the flow of streams shall be returned as nearly as possible to a meandering thread without creating possible future bank erosion and settling, pond sites shall be graded so they will drain and will blend in with the surrounding terrain.

8. Material derived from roadway work shall not be deposited in a live stream channel where it could be washed away by high stream flows.

9. Where there is possible migration of anadromous fish in streams affected by construction on the project, the Contractor shall conduct his operations so as to allow free passage of such migratory fish.

Compliance with the requirements of this Section shall in no way relieve the Contractor from his responsibility to comply with the other conditions of the Contract, in particular his responsibility for damage and for preservation of property.

Full compensation for conforming to the requirements of this Section shall be considered as included in the prices paid for the various items of work and no additional compensation will be allowed therefore.

G7.06 SOUND CONTROL REQUIREMENTS. The Contractor shall comply with all local sound control and noise level rules, regulations and ordinances that apply to any work performed pursuant to the Contract.

Each internal combustion engine, used for any purpose on the job or related to the job, shall be equipped with a muffler of a type recommended by the manufacturer. No internal combustion engine shall be operated on the project without said muffler.

G7.07 USE OF PESTICIDES. The Contractor shall comply with all rules and regulations of the Department of Food and Agriculture, the Department of Health, the Department of Industrial Relations and all other agencies that govern the use of pesticides required in the performance of the work on the Contract.

Pesticides shall include but shall not be limited to herbicides, insecticides, fungicides, rodenticides, germicides, nematocides, bactericides, inhibitors, fumigants, defoliants, desiccants, soil sterilants, and repellents.

Any substance or mixture of substances intended for preventing, repelling, mitigating or destroying weeds, insects, diseases, rodents or nematodes and any substance or mixture of substances intended for use as a plant regulator, defoliant or desiccant shall be considered as pesticide.

G7.08 WEIGHT LIMITATIONS. Unless expressly permitted in the Technical Conditions, the Contractor shall not operate construction equipment or vehicles of any kind which, laden or unladen, exceed the maximum weight limits set forth in Division 15 of the Vehicle Code, over completed or existing base, surfacing, pavement or structures.

Contractor shall be responsible for any damage he may cause to bridges, culverts, and road structures. He shall determine in advance the allowable safe load for each structure and, if necessary, provide special shoring and support at his expense. Contractor shall seek approval from appropriate jurisdictions for use of designated routes for

access to and from the project site.

G7.09 PAYMENT OF TAXES. The Contract prices paid for the work shall include full compensation for all taxes that the Contractor is required to pay, whether imposed by Federal, State or local government, including, without being limited to, Federal excise tax. No tax exemption certificate nor any document designed to exempt the Contractor from payment of any tax will be furnished to the Contractor by the Owner, as to any tax on labor, services, materials, transportation, or any other items furnished pursuant to the Contract.

The Contractor shall withhold and pay any and all sales and use taxes, withholding taxes, whether State or Federal, Social Security taxes, State Unemployment Insurance charges and all other taxes which are now or hereafter may be required to be paid or withheld under any laws.

G7.10 PERMITS AND LICENSES. The Contractor shall procure all permits and licenses (except those procured or to be procured by the Owner which are listed in the Special Conditions or Specifications), pay all charges and fees, and give all notices necessary and incident to the due and lawful prosecution of the work.

The Environmental Quality Act (Public Resources Code, Section 21000 to 21177) may be applicable to permits, licenses and other authorizations which the Contractor must obtain from State or local agencies in connection with performing the work of the Contract. The Contractor shall comply with the provisions of that Act in obtaining such permits, licenses and other authorizations and they shall be obtained in sufficient time to prevent delays to the work.

The Contractor shall comply with permits obtained by the Owner for the work, which are listed in the Special Conditions or Specifications.

G7.11 SUBSURFACE EXCAVATIONS, NOTIFICATION. Attention is directed to Government Code Section 4216, which provides, in part:

"Except in an emergency, an excavator planning to conduct an excavation shall notify the appropriate regional notification center of the excavator's intent to excavate at least two working days, and not more than 14 calendar days, before beginning that excavation. The date of the notification shall not count as part of the two-working-day notice. If an excavator gives less notice than the legal excavation start date and time and the excavation is not an emergency, the regional notification center will take the information and provide a ticket, but an operator has until the legal excavation start date and time to respond. However, an excavator and an operator may mutually agree to a different notice and start date. The contact information for operators notified shall be available to the excavator."

"When the excavation is proposed within 10 feet of a high priority subsurface installation, the operator of the high priority subsurface installation shall notify the excavator of the existence of the high priority subsurface installation to set up an onsite meeting prior to the legal excavation start date and time or at a mutually agreed upon time to determine actions or activities required to verify the location and prevent damage to the high priority subsurface installation. As part of the meeting, the excavator shall discuss with the operator the method and tools that will be used during the excavation and the information the operator will provide to assist in verifying the location of the subsurface installation. The excavator shall not begin excavating until after the completion of the onsite meeting."

"The regional notification center shall provide a ticket to the person who contacts the center pursuant to this section and shall notify any member, if known, who has a subsurface installation in the area of the proposed excavation. A ticket shall be valid for 28 days from the date of issuance. If work continues beyond 28 days, the excavator shall renew the ticket either by accessing the center's Internet Web site or by calling "811" by the end of the 28th day"

"Unless an emergency exists, an excavator shall not begin excavation until the excavator receives a response from all known operators of subsurface installations within the delineated boundaries of the proposed area of excavation pursuant to subdivision (a) of Section 4216.3 and until the completion of any onsite meeting, if required by subdivision (c)."

The Contractor shall contact the regional notification center, "Underground Service Alert," and schedule the work to

allow ample time for the center to notify its members and, if necessary, for any member to field locate and mark its facilities.

G7.12 PATENTS. The Contractor shall assume all costs arising from the use of patented materials, equipment, devices or processes, used on or incorporated in the work and shall indemnify and save harmless the Owner, the Engineer, and their duly authorized representatives from all suits at law, or actions of every nature for, or on account of, the use of patented materials, equipment, devices or processes. In case such materials, equipment, devices or processes are held to constitute an infringement and their use enjoined, the Contractor, at his expense, shall: (a) secure for the Owner the right to continue using said materials, equipment, devices or processes by suspension of the injunction or by procuring a license or licenses, or (b) replace such materials, equipment, devices or processes, or (c) modify them so that they become noninfringing or remove the enjoined materials, equipment, devices or processes and refund the sums paid therefor without prejudice to any other rights of the Owner or the Engineer.

The attention of the Contractor is also directed to Special Conditions, Section S1.01.

G7.13 SAFETY REQUIREMENTS. The Contractor shall promptly and fully comply with and carry out, and shall without separate charge therefor to the Owner, enforce compliance with the safety and first aid requirements prescribed by applicable State and Federal laws and regulations, rules and orders and as may be necessary to the end that work shall be done in a safe manner and that the safety and health of the employees and the people of local communities is safeguarded. Compliance with the conditions of this Section by subcontractors shall be the responsibility of the Contractor. All installed material, equipment and structures, without separate charge therefor to the Owner, shall fully conform with all applicable State and Federal safety laws, rules, regulations and orders and it shall be the Contractor's responsibility to furnish only such material, equipment and structures, notwithstanding any omission in the Contract Documents thereof or that a particular material, equipment or structure was indicated.

Upon the failure of the Contractor to comply with any of the requirements of this Section, the General Manager shall have the authority, but not the duty, to stop any operations of the Contractor affected by such failure until such failure is remedied. No part of the time lost due to any such stop orders shall be made the subject of a claim for extension of time or for increased costs or damages by the Contractor.

G7.14 TRENCH EXCAVATION SAFETY PLAN. Attention is directed to California Labor Code Section 6705. At least five days in advance of excavation of any trench five feet or more in depth, the Contractor shall submit to the General Manager a detailed plan showing the design of shoring, bracing, sloping and 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 State Construction Safety Orders, the plan shall be prepared and signed by a registered civil or structural engineer. Nothing in this Section shall be deemed to allow the use of a shoring, sloping or protective system less effective than that required by the Construction Safety Orders of the Division of Industrial Safety. Nothing in this Section shall be construed to impose liability on the Owner, the Engineer or any of their employees.

G7.15 SANITARY PROVISIONS. The Contractor shall conform to the rules and regulations pertaining to sanitary provisions established by the State, and to County, City and municipal laws and ordinances as may be applicable. Toilets for use of employees on the work shall be furnished where needed and shall be maintained by the Contractor. Their use shall be strictly enforced. Owner sanitary facilities will not be available for use by the Contractor's employees, except where specifically designated in writing by the General Manager.

G7.16 PUBLIC CONVENIENCE. The Contractor shall so conduct his operations as to offer the least possible obstruction and inconvenience to the public and he shall have under construction no greater length or amount of work than he can prosecute properly with due regard to the rights of the public.

All public traffic shall be permitted to pass through the work with as little inconvenience and delay as possible. The Contractor shall obtain approval of his plans for the routing and control of traffic from the appropriate city, county or State agency. Where the temporary rerouting or closing to traffic of any public street or highway is necessary, the Contractor shall make all necessary arrangements with the appropriate city, county or State agency.

All trucks coming to the site or leaving the site with materials or loose debris shall be loaded in a manner which will

prevent dropping of material or debris on public streets. Spillage resulting from hauling operations along or across any public traveled way shall be removed immediately at the Contractor's expense.

Construction operations shall be conducted in such a manner as to cause as little inconvenience as possible to owners of abutting property. Convenient access to driveways, houses and buildings along the line of work shall be maintained, and temporary approaches to roads or highways shall be provided and kept in good condition. Roadway excavations shall be conducted in such a manner as to provide a reasonably smooth and even surface satisfactory for use by public traffic at all times.

For work in public right-of-way, the Contractor shall comply with the rules and regulations of the State, County or local agency that owns the right-of-way.

All costs of complying with public convenience requirements of the Owner or other agencies shall be included in the Contract price.

The General Manager shall have the authority, but not the duty, to stop the Contractor from beginning new work until the conditions of this Section have been met.

G7.17 PUBLIC SAFETY. The Contractor shall assume all responsibility for public safety during construction, and all costs arising therefrom shall be included in the Contract amount. Whenever the Contractor's operations create a condition hazardous to traffic or to the public, he shall furnish, erect and maintain, at his expense, such fences, barricades, lights, signs and other devices and take such other protective measures as are necessary to prevent accidents or damage or injury to the public. The Contractor shall also furnish such flagmen as are necessary to give adequate warning to traffic or to the public of any dangerous conditions. For work in public right-of-way, the Contractor shall comply with the rules and regulations of the State, County or local agency that owns the right-of-way.

G7.18 PRESERVATION OF PROPERTY. Due care shall be exercised to avoid injury to existing improvements or facilities, utility facilities, adjacent property and trees, shrubs and other plants that are not to be removed without permission from the General Manager.

Trees, shrubs and other plants that are not to be removed, and pole lines, fences, signs, survey markers and monuments, buildings and structures, conduits, pipe lines, sewer and waterlines, highway facilities, and any other improvements or facilities, under or above ground, that are within or adjacent to the work limit line shall be protected from injury or damage, and the Contractor shall provide and install suitable safeguards to protect such objects from injury or damage. If such objects are injured or damaged by reason of the Contractor's operations, they shall be replaced in like size, kind and quality or restored to previous condition at the Contractor's expense. The facilities shall be replaced or restored to a condition as good as when the Contractor entered upon the work, or as good as required by the Specifications if any such objects are a part of the work being performed under the Contract. The General Manager may make or cause to be made such temporary repairs as are necessary to restore to service any damaged facility. The cost of such repairs shall be borne by the Contractor and may be deducted from any monies due or to become due to the Contractor under the Contract.

The fact that any underground facility is not shown on the Contract Plans shall not relieve the Contractor of his responsibility under Section G8.15, "Existing Utilities," of the General Conditions. It shall be the Contractor's responsibility, pursuant thereto, to ascertain the location of such underground improvements or facilities that may be subject to damage by reason of his operations.

Full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in protecting or repairing property as specified in this Section, shall be considered as included in the prices paid for the various Contract items of work and no additional compensation will be allowed therefor.

G7.19 RESPONSIBILITY FOR DAMAGE. The Owner and all Members of the Owner's governing body, officers, employees and authorized agents thereof connected with the work, including the Engineer, shall not be answerable or accountable in any manner: for any loss or damage that may happen to the work or any part thereof; for any loss or damage to any of the materials or other things used or employed in performing the work; for injury to or death of

any person (including but not limited to workers or the public) from any cause whatsoever; or damage to property from any cause whatsoever.

The Contractor shall be responsible for any liability imposed by law and for any injuries to or death of any person (including but not limited to workers and the public) and for damage to property resulting from defects or from obstructions or from any cause whatsoever during the progress of the work or at any time before its completion and final acceptance.

To the maximum extent permitted by law, the Contractor shall indemnify and save harmless the Owner and all members of the governing body, officers, employees and authorized agents thereof, including the Engineer, from all claims, suits or actions of every name, kind and description, brought for, or on account of, injuries to or death of any person (including but not limited to employees of Contractor, of subcontractors, or of any other person, firm or entity and the public) or damage to property arising from any cause whatsoever during the progress of the work or at any time before its final completion and acceptance. The duty of the Contractor to indemnify and save harmless includes the duties to defend (by legal counsel satisfactory to the indemnities) as set forth in Section 2778 of the Civil Code and to pay attorney's fees and litigation costs required by such defense.

With respect to third party claims against Contractor, the Contractor waives any and all rights to any type of express or implied indemnity against the Owner, members of its governing body, officers, employees or authorized agents, and the Engineer. It is the intent of the parties that the Contractor shall indemnify and hold harmless the Owner, members of its governing body, officers, employees and authorized agents, including the Engineer from any and all claims, suits, or actions arising from any cause whatsoever as set forth above regardless of the existence or degree of fault or negligence on the part of the Owner, the Engineer, the Contractor, a subcontractor or employee of any of these, other than the active negligence of the Owner or its Directors, officers, employees or authorized agents, and the Engineer.

G7.20 RESPONSIBILITY FOR WORK AND MATERIALS. Until the acceptance of the Contract, the Contractor shall have the charge and care of the work and of the materials to be used therein, including materials for which he has received partial payment, and shall bear the risk of injury, loss or damage to any part thereof by the action of the elements or from any other cause, whether arising from the execution or from the nonexecution of the work. The Owner will not grant relief from maintenance and responsibility for a portion of the total work. The Contractor shall rebuild, repair or restore all injuries, losses or damages to any portion of the work and materials occasioned by any cause before its completion and acceptance and shall bear the expense thereof. Where necessary, the Contractor shall, at his expense, provide suitable drainage and erect such temporary structures as are necessary to protect the work and materials from damage. The suspension of the work from any causes whatever shall not relieve the Contractor of his responsibility for the work and materials as herein specified. The Contractor shall properly store materials that have been partially paid for by the Owner. Such storage by the Contractor shall be on behalf of the Owner and the Owner shall at all times be entitled to the possession of such materials, and the Contractor shall promptly return the same to the site of the work when requested. The Contractor shall not dispose of any of the materials so stored except on written authorization from the General Manager.

G7.21 LIABILITY OF CONTRACTOR. Contractor hereby agrees to indemnify and save harmless Owner and the Engineer and their respective Boards, officers, agents and employees of and from any and all claims, suits or actions of every name, kind and description which may be brought against their respective Boards, officers, agents or employees by reason of any injury to or death of any person or property damage suffered or sustained by any person or corporation caused by, or alleged to have been caused by, any act or omission, negligent or otherwise, of Contractor, his officers, agents or employees in the performance of any work required of the Contractor by this Contract. The Owner shall not be deemed to have waived rights it may have against Contractor because of the acceptance by Owner of any of the insurance policies described in this Contract.

The duty of Contractor to indemnify and save harmless, as set forth herein, shall include a duty to defend as set forth in Section 2778 of the California Civil Code; provided, however, that nothing herein shall be construed to require Contractor to indemnify Owner and the Engineer and their respective Boards, officers, agents and employees against any responsibility or liability in contravention of Section 2782 of the California Civil Code.

G7.22 PUBLIC LIABILITY INSURANCE. The Contractor shall procure and maintain Broad Form Comprehensive General Liability or Commercial General Liability Insurance, and Code 1 or "Any Auto" Business Automobile Liability Insurance policies in amounts for each policy of not less then:

1. General Liability: One Million Dollars ($1,000,000.00) per occurrence for bodily injury, personal injury and property damage, and subject to that limitation for the injury to or death of one person of not less than Three Million Dollars ($3,000,000.00) for injury to or death of two or more persons as a result of any one accident or occurrence, with personal or bodily injury aggregate in an amount not less than Three Million Dollars ($3,000,000.00). 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 or the general aggregate limit shall be three times the required occurrence limit.

2. Automobile Liability: One Million Dollar ($1,000,000.00) per accident for bodily injury, personal injury and property damage, and subject to that limitation for the injury to or death of one person, not less than Three Million Dollars ($3,000,000.00) for injury to or death of two or more persons as a result or any one accident or occurrence, with personal or bodily injury aggregate in an amount not less than Three Million Dollars ($3,000,000.00).

Policies shall provide coverage for property damages, personal injuries, bodily injuries or death suffered or alleged to have been suffered by any person or persons by reason of or in the course of operations under the contract, whether occurring by reason of acts or omissions of the Contractor or any subcontractor or both. Coverage shall be at least as broad as Insurance Services Office Commercial General Liability coverage (occurrence form CG 0001) for general liability insurance and Insurance Services Office form number CA 0001 (Ed. 1/87) for automobile liability insurance. Such insurance shall be maintained until final acceptance of the work by the Owner and shall continue of a period of 365 days after acceptance of the work by the Owner. The general liability insurance policy required by this Section shall include explosion, collapse, underground excavation or removal of lateral support.

The general liability insurance policies shall also cover the Owner, its Board, officers, agents, employees, and servants of the Contractor, the Contractor's subcontractors, County of Contra Costa, and the District's Engineer as insureds.

The general liability insurance policies required under this Section, shall contain, or be endorsed to contain, the following other conditions:

1. The Contractor's insurance coverage shall be primary insurance. Any insurance or self-insurance maintained by the Owner, its Board, officers, agents, employees and servants of the Contractor, the Contractor's subcontractor's, C&H Sugar Co. and ASR Group, and the District's Engineer shall be excess of Contractor's insurance and shall not contribute with it.

2. The Contractor's insurance coverage shall apply separately to each insured against whom a claim is made or suit is brought, except with respect to the limits of the insurer's liability.

3. The Owner, its Board, officers, agents, employees and servants, the Contractor, the Contractor's subcontractors, County of Contra Costa, and the District's Engineer are to be covered as insureds with respect to liability arising out of automobiles owned, leased, hired or borrowed by or on behalf of the Contractor; and with respect to liability arising out of work or operations performed by or on behalf of the Contractor including materials, parts or equipment furnished in connection with such work or operations.

4. Any failure to comply with reporting provisions of the policies shall not affect coverage provided to the Owner, its Board, officers, agents, employees, and servants of the Contractor, the Contractor's subcontractors, C&H Sugar and ASR Group, and the District's Engineer.

5. The Contractor's liability insurance coverage shall not be suspended, voided, canceled, reduced in coverage or in limits except after forty-five (45) days' prior written notice by certified mail, return receipt requested, has been given to the Owner.

The contractor shall require all subcontractors, whether primary or secondary, if any, to take out and maintain General Liability and Business Automobile Liability in the amounts set out in this Section.

At least ten (10) days prior to commencing work there under, Contractor shall furnish the Owner certificates of each policy of insurance required here under, in form and substance satisfactory to Owner. Such certificates shall show the type, amount, class of operations covered, effective dates and date of expiration of policies.

G7.23 WORKER'S COMPENSATION INSURANCE. The Contractor and all subcontractors shall cover or insure under the applicable laws relating to worker's compensation or employer's liability insurance, all of their employees working on or about the construction site, regardless of whether such coverage or insurance is mandatory or merely elective under the law, and the Contractor shall defend, protect and save harmless the Owner from and against all claims, suits and actions arising from any failure of the Contractor or any such subcontractor to maintain such insurance. The Contractor shall maintain Employer's Liability Insurance with minimum limits of One Million Dollars ($1,000,000.00) per accident for bodily injury or disease.

G7.24 PROPERTY INSURANCE. Unless otherwise provided in the Special Conditions, the Contractor will purchase and maintain, in a company or companies lawfully authorized to do business in California, and acceptable to the Owner, property insurance upon the entire work, in the amount of fifty percent (50%) the Contract price. Such property insurance shall be maintained until final payment has been made.

Property insurance shall be on an all-risk policy form (commonly known as "Builder's Risk-All Risk") and shall insure against the perils of earthquake, landslide, flood, collapse, loss due to the result of faulty workmanship or design, and all other risks and shall cover reasonable compensation for Engineer's services and expenses required as a result of such insured loss. This insurance shall insure the interests of the Owner, the Contractor, and subcontractors in the work. Contractor and Owner will be named as additional insureds on the policy.

The property insurance may contain deductibles not to exceed the amounts specified in the Special Conditions. If no amounts are specified, the insurance shall be written without deductibles. The Contractor shall pay costs not covered because of such deductibles.

Complete copies of each policy of insurance and certificates of each policy, in form and substance satisfactory to Owner, shall be filed with Owner prior to the commencement of work. The policies and certificates shall provide:

1. That Owner is included as a named insured;

2. That losses shall be payable to Contractor and Owner as their interests appear; and

3. The policy will not be canceled, nor coverage materially altered, without 30 days, prior written notice to Owner.

G7.25 DEDUCTIBLES AND SELF-INSURED RETENTIONS. Any deductibles or self-insured retentions must be declared to and approved by the District. At the option of the District, either: the insurer shall reduce or eliminate such deductibles or self-insured retention's as respects the District, its Board, officers, agents, employees and servants, County of Contra Costa, and the District's Engineer, or the Contractor shall provide a financial guarantee satisfactory to the District guaranteeing payment of losses and related investigations, claim administration and defense expenses.

G7.26 EVIDENCES AND CANCELLATION OF INSURANCE AND INSURER QUALIFICATIONS. Prior to execution of the contract, the Contractor shall file with the District evidences of insurance from the insurer certifying to the coverage of all insurance required herein. All evidences of insurance shall be certified by a properly authorized officer, agents, general agent or qualified representative of the insurer and shall certify the names of the insured, the type and amount of the insurance, the location and operations to which the insurance applies, the expiration date, and that the insurer will give, by registered mail, notice to the District at least 45 days prior to the effective date of any cancellation, lapse or material change in the policy.

The Contractor shall deliver to the Owner all such policy or policies of insurance, endorsements and the receipt for payment of premiums thereon; and should the Contractor neglect to obtain and maintain in force any such insurance or deliver such policy or policies, endorsements and receipts to the Owner, then it shall be lawful for the Owner to obtain and maintain such insurance, and the Contractor hereby appoints the Owner his true and lawful attorney to do all things necessary for this purpose. All money expended by the Owner for insurance premiums under the conditions of this Section shall be charged to the Contractor. The Contractor shall use the Owner approved endorsement forms provided in the proposal section of these specifications to comply with this Section.

All insurance required by this contract shall be placed with insurers qualified by the State of California to do business in California as insurers, and all of the insurers shall have a current A.M. Best's Rating of no less than A: VII.

Notwithstanding the language of the preceding paragraph, Owner may disqualify an insurer proposed to provide insurance coverage required by these contract specifications if the Owner has cause to believe the insurer is likely to be incapable of providing that insurance coverage.

G7.27 DISPOSAL OF MATERIAL OUTSIDE THE WORK SITE. Unless otherwise specified in the Specifications, the Contractor shall make his own arrangements for disposing of materials outside the work site and he shall pay all costs involved.

When any material is to be disposed of outside the work site, the Contractor shall first obtain a written permit from the property owner on whose property the disposal is to be made and he shall file with the General Manager said permit or a certified copy thereof, together with a written release from the property owner absolving the Owner from any and all responsibility in connection with the disposal of material on said property, and before any material is disposed of on said property, the Contractor shall obtain written permission from the General Manager to dispose of the material at the location designated in said permit.

When material is disposed of as above provided and the disposal location is visible from a highway, the Contractor shall dispose of the material in a neat and uniform manner to the satisfaction of the General Manager.

G7.28 COOPERATION. Should construction be under way by other forces or by other contractors within or adjacent to the limits of the work specified, or should work of any other nature be under way by other forces within or adjacent to said limits, the Contractor shall cooperate with all such other contractors or other forces to the end that any delay or hindrance to their work will be avoided. The right is reserved to perform other or additional work at or near the site at any time, by the use of other forces.

When two or more contractors are employed on related or adjacent Owner work, each shall conduct his operations in such a manner as not to cause any unnecessary delay or hindrance to the other. Each contractor shall be responsible to the other for all damage to work, to persons or property caused to the other by his operations, and for loss caused the other due to his unnecessary delays or failure to finish the work within the time specified for completion.

G7.29 OCCUPANCY PRIOR TO ACCEPTANCE. The Owner reserves the right to occupy all or any part of the project prior to completion of the entire Contract, upon written order therefor. In such event, the Contractor will be relieved of responsibility for any injury or damage to such part as results from such occupancy and use by the Owner.

If the Contractor carries insurance against damage to such premises or against liability to third persons covering the premises so used and occupied by the Owner, and if such occupancy results in increased premiums for such insurance, the Owner will pay to the Contractor the added cost for such insurance during the period of occupancy.

Such occupancy does not constitute acceptance by the Owner either of the complete work or of any portion thereof, nor will it relieve the Contractor of full responsibility for correcting defective work or materials found at any time before the formal written acceptance of the entire Contract by the Owner or during the full guarantee period after such acceptance.

G7.30 ACCEPTANCE OF THE WORK. When the General Manager has made the final inspection as provided in

Section G5.14 and determines that the work has been completed in all respects in accordance with the Contract Documents, he will recommend that the Owner formally accept the work. Immediately upon and after such formal written acceptance by the Owner, the Contractor will be relieved of the duty of maintaining the work as a whole, and he will not be required to perform any further work thereon except as provided in Sections G4.13, "GUARANTY OF WORK" and G4.14, "CORRECTION OF WORK DURING WARRANTY PERIOD."

G7.31 PROPERTY RIGHTS IN MATERIALS. Nothing in the Contract shall be construed as vesting in the Contractor any right of property in the materials used after they have been attached or affixed to the work or soil or after partial payment has been made for material delivered on the ground or stored subject to or under the control of the Owner and unused. All such material shall become the property of the Owner upon being so attached or affixed or upon payment for materials delivered on the ground or stored subject to or under the control of the Owner and unused, as provided in Section 9. Owner retains first right of salvage on all used equipment removed from service.

G7.32 RIGHTS IN LAND AND IMPROVEMENTS. The Contractor shall make no arrangements with any person to permit occupancy or use of any land, structure or building within the limits of the work, for any purpose whatsoever, either with or without compensation, in conflict with any agreement between the Owner and any owner, former owner or tenant of such land, structure or buildings. The Contractor shall not occupy Owner-owned property outside the limit of the work as shown on the Contract Drawings unless he obtains prior approval.

G7.33 ANTITRUST CLAIMS. The Contractor's attention is directed to the following provision of Public Contract Code Section 7103.5(2)(b), which shall be applicable to the Contractor and his subcontractors:

"In entering into a public works contract or a subcontract to supply goods, services or materials pursuant to a public works contract, the Contractor or subcontractor offers and agrees to assign to the awarding body all right, 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 purchases of goods, services or materials pursuant to the public works contract or the subcontract. This assignment shall be made and become effective at the time the awarding body tenders final payment to the Contractor, without further acknowledgment by the parties."

G7.34 ACCESS TO THE WORK. The Contractor shall satisfy himself that the jurisdictions through which his operations and haul routes pass will permit such operations with respect to type of vehicle, laden weights, frequency and dimensions of loads, hours of operation and required traffic control. All necessary permits, licenses or bonds shall be obtained and paid for by the Contractor.

G7.35 PERSONAL LIABILITY. Neither the Owner's governing body, its Officers, Agents, Representatives, Employees nor Engineer shall be personally responsible for any liability arising under or by virtue of this Contract.

G7.36 THIRD PARTY RIGHTS. Nothing in the Contract is intended to create the public or any member thereof a third party beneficiary here under.

G7.37 INDEPENDENT CONTRACTOR STATUS. The Contractor shall independently perform all work under this Contract and shall not be considered as an agent or employee of the Owner, nor shall the Contractor's subcontractors or employees be considered as subagents of the Owner.

G7.38 ATTORNEY'S FEES. (Reserved)

G7.39 VEHICLE TRAFFIC TO, FROM AND AT THE WORKSITE. The Following constraints shall apply:

a. Except as allowed in writing by C&H Sugar Co, no vehicles related to this Project may park, even temporarily, outside the fenced enclosure that is the project worksite. See also Special Conditions, Section 1.11.
b. Except as allowed in writing by C&H Sugar Co, no equipment or materials related to this Project shall be placed, even temporarily, outside the fenced enclosure that is the project worksite.
c. Owner shall bear no responsibility for damage to any vehicles, equipment or materials that may occur outside the fenced enclosure that is the project worksite.

PROSECUTION AND PROGRESS

G8.01 SUBCONTRACTING. The Contractor shall give his personal attention to the fulfillment of the Contract and shall keep the work under his control.

No subcontractor will be recognized as such and nothing in the Contract Documents shall create any contractual relationship between the Owner and any subcontractor. The Contractor is as fully responsible to the Owner for the acts and omissions of his subcontractors and of persons either directly or indirectly employed by them as he is for the acts and omissions of persons directly employed by him.

Attention is directed to the requirements of Sections 4100 to 4113, inclusive, of the California Public Contract Code which are applicable to this Contract. Each bidder shall list in his Bid the name and business address of each subcontractor to whom the bidder proposes to subcontract a portion of the work, and shall list each subcontractor, licensed by the State of California, proposed by the bidder to specially fabricate and install a portion of the work. Said list shall include a description of the portion of the work that shall be done by each subcontractor. The bidder shall execute and submit with his Bid the "List of Subcontractors" on the form included in this book. Additional forms may be obtained from the General Manager. The Contractor shall not, without the consent of the Owner, either substitute any person as subcontractor in place of the subcontractor designated in the original List of Subcontractors, or sublet or subcontract any portion of the work in excess of one-half of one percent of the total amount of his proposal for which he did not originally designate a subcontractor.

When a portion of the work that has been subcontracted by the Contractor is not being prosecuted in a manner satisfactory to the Owner, the subcontractor shall be removed immediately on the request of the Owner, and shall not again be employed on the work.

The on-site production of materials produced by other than the Contractor's forces shall be considered as subcontracted. The erection, establishment or reopening of on-site plants for production of materials and the operation thereof in the production of materials for use on the work, shall conform to the requirements relating to labor set forth in the Contract Documents.

The Contractor shall require, by written agreement, each subcontractor to be bound to the Contractor by terms of the Contract Documents and to assume toward the Contractor all the obligations and responsibilities which the Contractor, by the Contract Documents, assumes toward the Owner, to the extent of the work to be performed by the subcontractor. Each subcontract agreement shall preserve and protect the rights of the Owner under the Contract Documents with respect to the work to be performed by the subcontractor, so that subcontracting will not prejudice such rights.

G8.02 ASSIGNMENT. The Owner and the Contractor, respectively, bind themselves, their partners, successors, assigns, and legal representatives to the other party hereto and to the partners, successors, assigns, and legal representatives of such other party with respect to all covenants, agreements, and obligation contained in the Contract Documents. The performance of the Contract may not be assigned except upon the written consent of the Owner. Consent will not be given to any proposed assignment that would relieve the original Contractor or his surety of their responsibilities under the Contract nor will the Owner consent to any assignment of a part of the work under the Contract.

The Contractor may assign monies due or to become due him under the Contract and such assignment will be recognized by the Owner, if given proper notice thereof, to the extent permitted by law, but any assignment of monies shall be subject to all proper set-off in favor of the Owner and to all deductions provided for in the Contract, and particularly all money withheld, whether assigned or not, shall be subject to being used by the Owner for the completion of the work in the event that the Contractor should be in default therein.

G8.03 NOTICE TO PROCEED. **(This section is amended by the Special Conditions.)** As soon as practicable after execution of the Contract by the Owner, approval by the Owner of Contract Bonds and all other documents

listed in the Contract, and after receipt of acceptable insurance certificates by the Owner, a written Notice to Proceed will be mailed to the Contractor. The effective date of the Notice to Proceed will be the date stated as such in the Notice to Proceed, provided that the effective date will not be earlier than the day following the issuance of the Notice to Proceed.

G8.04 BEGINNING OF WORK. **(This section is amended by the Special Conditions.)** The Contractor is not authorized to perform any work until he has received a Notice to Proceed from the Owner. Within ten (10) days after the effective date of such Notice to Proceed, the Contractor shall commence work and shall diligently prosecute the same to completion within the time limit provided in the Special Conditions.
The Contractor shall notify the General Manager, in writing, of his intent to begin **work at least 96 hours before work is begun** and shall specify the date the Contractor intends to start. If the project has more than one location of work, a separate notice shall be given for each location.

Should the Contractor begin work in advance of receiving the Notice to Proceed and providing notice to the General Manager, any work performed by him in advance of such notice shall be considered as having been done by him at his own risk and as a volunteer.

G8.05 SCHEDULES AND PROGRESS REPORTS. **(This section is amended by the Special Conditions.)** The Contractor shall, within ten (10) days after the effective date of the Notice to Proceed, submit to the General Manager three copies of a construction schedule covering his operations for the work. The construction schedule shall be in the form of a bar chart or arrow diagram, unless a critical path method analysis is required by the Special Conditions or Specifications. The schedule shall show the order in which the Contractor proposes to carry out the work and the dates on which he expects to start and finish each part or division of the work (including procurement of materials, plant and equipment). The construction schedule shall be consistent with the time and order of work requirements of the Contract Documents and shall provide for expeditious and practicable execution of the work. If the Contractor desires to revise his construction schedule, or if it becomes necessary to revise it due to major changes, he shall submit three copies of the revised schedule for review and comment by the General Manager.

The Contractor shall, **within ten (10) days after the effective date of the Notice to Proceed**, also submit to the General Manager three copies of a schedule of submittals which is coordinated with the Contractor's construction schedule and with the review time provided in the Contract Documents.

The Contractor shall submit to the General Manager, at the time of submittal of the invoice for work completed (See Section G9.08), a schedule summary report in a form and of sufficient detail and character as approved by the General Manager. The schedule summary report shall include the updated current construction schedule and shall specify whether the project is on schedule and, if not, the reasons therefor. The monthly schedule summary report shall also indicate the delivery status of major and critical items of purchased equipment and material, the status of shop drawings and field fabricated work.

G8.06 SITE MEETINGS. The Contractor shall schedule meetings with the General Manager and each active subcontractor at the work site weekly, or at such other frequency as is acceptable to General Manager. Each subcontractor shall have presented a competent representative to report the conditions of his work and to discuss problems.

G8.07 TIME OF COMPLETION. The Contractor shall complete all or any designated portion of the work called for under the Contract in all parts and requirements within the time set forth in the Special Conditions.

G8.08 ADDITIONAL SHIFT WORK. The time limits specified for the completion of the work contemplated may be insufficient to permit completion of the work by the Contractor working a normal number of hours per day or week on a single shift basis. Where additional shifts or premium time pay are necessary to ensure that the work will be completed within the time limits specified, any resulting additional costs will be considered to be included in the price paid for the various Contract items of work and no additional compensation will be allowed therefore.

If the Contractor desires to carry on work at night or outside regular working hours, he shall give timely notice to the General Manager to allow satisfactory arrangements to be made for observing the work in progress. In general, the Contractor shall confine site work to daytime hours from 7:00 AM to 5:00 PM so as to avoid disturbing area

residents.

G8.09 UNUSUAL MATERIALS IN EXCAVATIONS. While digging trenches or excavating, the Contractor pursuant to Public Contract Code Section 7104 shall promptly, and before the following conditions are disturbed, notify the General Manager and the Engineer, in writing, of any:

1. Material that the Contractor believes may be material that is hazardous waste, as defined in Section 25117 of the Health and Safety Code, that is required to be removed to a Class I, Class II or Class III disposal site in accordance with provisions of existing law.

2. Subsurface or latent physical conditions at the site differing from those indicated.

3. Unknown physical conditions at the site, of any unusual nature, different materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the contract.

The Owner shall promptly investigate the conditions, and if he finds that the conditions do materially so differ, or do involve hazardous waste, or cause a decrease or increase in the Contractor's cost of, or the time required for, performance of any part of the work shall issue a change order under the procedures described in Section G4.03.

In the event that a dispute arises between the Owner and the Contractor whether the conditions materially differ, or involve hazardous waste, or cause a decrease or increase in the Contractor's cost of, or time required for, performance of any part of the work, the Contractor shall not be excused from any scheduled completion date provided for by the contract, but shall proceed with all work to be performed under the contract. The Contractor shall retain any and all rights provided either by contract or by law which pertain to the resolution of disputes and protests between the contracting parties as described in Section G4.08.

G8.10 OWNER'S RIGHT TO STOP THE WORK. If the Contractor fails to promptly correct work which is not in accordance with the requirements of the Contract Documents or persistently fails to carry out work in accordance with the Contract Documents, the Engineer may, in writing, order the Contractor to stop the work, or any portion thereof, until the cause for such order has been eliminated. The Contractor shall immediately comply with a written order of the General Manager to stop the work. The work stopped shall be resumed as and when ordered by the General Manager.

G8.11 LIQUIDATED DAMAGES. It is agreed by the parties to the Contract that in case all the work called for under the Contract in all parts and requirements is not completed within the number of days as set forth in the Special Conditions, damage will be sustained by the Owner and that it is and will be impracticable and extremely difficult to ascertain and determine the actual damage which the Owner will sustain in the event of and by reason of such delay; and it is therefore agreed that the Contractor shall pay to the Owner (as liquidated damages for delay and not as a penalty) the sum set forth in the Special Conditions per day for each and every calendar day's delay in finishing the work in excess of the number of days prescribed; and the Contractor agrees to pay said liquidated damages herein provided for, and further agrees that the Owner may deduct the amount thereof from any monies due or that may become due the Contractor under the Contract. For purposes of this paragraph, “completed” means “contract completion” as defined in Section G1.02.

In addition, the Owner shall have the right to charge to the contractor and to deduct from the final payment for the work the actual cost to the Owner of engineering, inspection, administration and other overhead expenses which are directly chargeable to the contract and which accrue during the period of such delay, except that the cost of final surveys and preparation of the final estimate shall not be included in such charges.

G8.12 DELAYS AND EXTENSIONS OF TIME. The Contractor will be granted an extension of time and will not be assessed with liquidated damages or the cost of engineering and inspection for any portion of the delay in completion of the work beyond the time set forth in the Special Conditions caused by unforeseeable causes beyond the control and without the fault or negligence of the Contractor or subcontractor. Examples of such causes include acts of God or of the public enemy, fire, floods, storms, epidemics, quarantine restrictions, strikes and other work stoppages caused by a labor dispute, shortage of materials and freight embargoes, changes made under Section

G4.03 ("Changes") or acts or neglect of the Owner or Engineer not contemplated by the Contract Documents. In all cases, any extension of time is conditional on the following: (1) that the cause is not due to the fault of the Contractor or subcontractor and the Contractor has taken reasonable precautions to prevent delays due to such cause and (2) that the Contractor notifies the Engineer in writing within 15 days from the beginning of such delay specifying the nature of the delay, the number of days actually delayed and the measures taken to prevent or minimize the delay. Failure to submit written notice within this time shall constitute an absolute waiver of any claim for a time extension; failure to submit the required information will be sufficient cause for denial of the request for a time extension.

No extension of time will be granted for a delay caused by a shortage of materials, unless the Contractor furnishes to the General Manager documentary proof that he has diligently made every effort to obtain such materials from all known sources within reasonable reach of the work and further proof, in the form of schedule data as required in Section G8.05, that the inability to obtain such materials when originally planned did in fact cause a delay in final completion of the entire work which could not be compensated for by revising the sequence of the Contractor's operations. Only the physical shortage of material will be considered as a cause for extension of time, and no consideration will be given to any claim that material could not be obtained at a reasonable, practical or economical cost or price, unless it is shown to the satisfaction of the General Manager that such material could have been obtained only at exorbitant prices entirely out of line with current rates, taking into account the quantities involved and the usual practices in obtaining such quantities.

The term "shortage of materials," as used in this Section, shall apply only to materials, articles, parts or equipment which are standard items and shall not apply to materials, parts, articles or equipment which are processed, made, constructed, fabricated or manufactured to meet the specific requirements of the contract.

No extension of time will be granted for storms or adverse weather conditions which may reasonably be anticipated for the area in which the work is being performed, based on official records of monthly precipitation and other historical data.

No extensions of time will be granted for delays that have no measurable impact on the completion of the total work under the Contract. When extensions of time are granted, they will be limited to the period equivalent to the actual number of days lost on the critical path or controlling operation of construction, taking into account the extent to which that delay could be decreased by reasonable mitigation measures by the Contractor or its subcontractor.

Within a reasonable period of time after the Contractor submits the notice and information required by this Section, the General Manager will present his written opinion to the Owner as to whether an extension of time is justified and, if so, his recommendation as to the number of days for the extension. The Owner will make the final decision on all requirements for extension of time.

The Contractor shall have no claim for damage or compensation for any delay or hindrance and shall be fully compensated by an extension of time provided as set forth in this Section. Notwithstanding the preceding sentence, the Contractor may submit a claim for delay caused by acts or omissions of the Owner but only if such acts or omissions (1) cause delay which is unreasonable in the circumstances and (2) are not such as to be within the contemplation of the parties. It is expressly agreed that delays by the Owner in providing access to the work site are not within the contemplation of the parties but that delays by the Owner in reviewing shop drawings and submittals and the risk of delays due to errors or omissions in the Contract Drawings are within the contemplation of the parties as expectable events in the construction process.

G8.13 TERMINATION OF RIGHT TO PROCEED. If the Contractor should appear to the General Manager to be in default and the Contractor fails to remedy his default within 10 days after receipt from the General Manager of notice of such default, the Owner may terminate the Contractor's right to proceed with the work or that portion which the General Manager determines is most directly affected by the default.

The term "default" for purposes of this Section includes, but is not limited to, the performance of work in violation of the terms of the Contract; abandonment, assignment or subletting of the Contract without approval of the Owner; bankruptcy or appointment of a receiver for Contractor's property; refusal or failure properly to prosecute the work; use of materials, supplies, plant or equipment of improper quality or quantity; refusal or failure to use an adequate

number of properly skilled workers; failure to provide proper workmanship; failure to take effective steps to end a prolonged labor dispute; and the performance of the Contract in bad faith.

Upon the Owner's termination of the Contractor's right to proceed with the work, or a portion of it, the Owner shall have the right to complete the work, or the portion involved, by whatever means and methods it deems expedient, including the hiring of others on such terms as the Owner deems advisable. The Owner shall have the right to take possession of the Contractor's materials, plant, tools, equipment and property of any kind provided by or on behalf of the Contractor for the purpose of the work, or a portion of them, without being responsible to the Contractor for fair wear and tear. The Contractor shall have no rights in such property during its use by the Owner. The Owner shall not be required to obtain the lowest prices for completing the work or a portion of it but shall make such expenditures as, in the Owner's sole judgment, best accomplish such completion.

The expense of completing such work or portion thereof, together with a reasonable charge for engineering, managerial and administrative services, as certified by the Owner, shall be charged to the Contractor, and the expense so charged shall be deducted by the Owner out of such monies as may be due or may at any time thereafter become due to the Contractor. In case such expense is more than the sum which otherwise would have been payable to the Contractor under the Contract, then the Contractor or his surety or sureties shall promptly pay the amount of such excess so due. The Owner may, in its sole discretion, withhold all or any part of any progress payments otherwise due the Contractor until completion and final settlement of the work covered by such notice of default.

G8.14 TERMINATION OF CONTRACT. The Owner may terminate the Contract if the Contractor:

1. Persistently or repeatedly fails or refuses to supply enough properly skilled workers or proper materials;

2. Fails to make payment to subcontractors for materials or labor in accordance with the respective agreements between the Contractor and subcontractor;

3. Persistently disregards laws, ordinances or rules, regulations or orders of a public authority having jurisdiction; or

4. Otherwise is guilty of a substantial breach of a provision of the Contract Documents. A "default" as defined in Section G8.12 shall constitute a substantial breach of the Contract Documents.

When any of the above reasons exist, the Owner may, without prejudice to any other rights or remedies of the Owner under this Contract or otherwise, upon 10 days, written notice, terminate the Contract and may:

1. Take possession of the site and of all materials, equipment, tools and construction equipment and machinery thereon owned by the Contractor;

2. Finish the work by whatever means the Owner deems expedient.

When the Owner terminates the Contract under this Section, the Contractor shall not be entitled to receive any further payments until the work is completed and accepted by the Owner.

The conditions of the last two paragraphs of Section G8.13 shall apply if the Owner terminates the Contract.

The Owner will issue the Contractor a written notice specifying that the Contract is to be terminated. Upon receipt of said written notice and, except as otherwise directed in writing by the General Manager, the Contractor shall:

1. Stop all work under the Contract except that specifically directed to be completed prior to acceptance;

2. Perform work the General Manager deems necessary to secure the project for termination;

3. Remove equipment from the site of work;

4. Take such action as is necessary to protect materials from damage;

5. Notify all subcontractors and suppliers that the Contract is being terminated and that their contracts or orders are not to be further performed unless otherwise authorized in writing by the General Manager;

6. Provide the General Manager with an inventory list of all materials previously produced, purchased or ordered from suppliers for use in the work and not yet used in the work, including its storage location, and such other information as the General Manager may request;

7. Dispose of materials not used in the work as directed by the General Manager. It shall be the Contractor's responsibility to provide the Owner with good title to all materials purchased by the Owner here under, including materials for which partial payment has been made as provided in Section G9.10, "Partial Payments," of these General Conditions and with bills of sale or other documents of title for such materials;

8. Subject to the prior written approval of the General Manager, settle all outstanding liabilities and all claims arising out of subcontracts or orders for materials terminated here under. To the extent directed by the General Manager, the Contractor shall assign to the Owner all the right, title and interest of the Contractor under subcontracts or orders for materials terminated here under;

9. Furnish the General Manager with the documentation required to be furnished by the Contractor under the conditions of the Contract including, on projects as to which federal funds are involved, all documentation required under the federal requirements included in the Contract;

10. Take such other actions as the General Manager may direct.

G8.15 EXISTING UTILITIES. In general, the location of existing utilities, whether aboveground or underground, are indicated on the drawings. This information has been obtained from utility maps and from verbal descriptions provided by the various agencies involved. The Owner does not guarantee the accuracy or completeness of this information and it is to be understood that the other aboveground or underground facilities not shown on the drawings may be encountered during the course of the work.

The Contractor shall call the Underground Services Alert Agency and notify the underground utility companies of his intention to work in the vicinity of their service and shall enlist their help to pinpoint the exact location, both in plan and elevation, of their utility. Except as otherwise provided in this Article any required relocation of existing underground utility or special construction techniques required in order to avoid existing utilities shall be performed by the Contractor at no increase in cost to the Owner.

Pursuant to California Government Code Section 4215 the Owner shall assume the responsibility for the timely removal, relocation, or protection of the existing main or trunkline utility facilities located on the construction site if such utilities are not identified by the Owner in the Plans and specifications. The Owner shall compensate the Contractor for the costs of locating such utility facilities, repairing damage not due to the failure of the Contractor to exercise reasonable care, and removing or relocating such utility facilities not indicated in the Plans and specifications with reasonable accuracy; and for the cost of equipment necessarily idled. However, the Contractor shall make all reasonable efforts to minimize and or mitigate the costs he or she incurs in locating utility facilities not identified by the Owner or for equipment necessarily idled. The Contractor shall not be assessed liquidated damages for delay in completion of the work when such delay was caused by the failure of the Owner or the owner of the utility to provide for removal or relocation of such utility facilities.

Owner is not responsible for indicating the presence of existing service laterals or appurtenances whenever the presence of such utilities can be inferred from the presence of visible facilities, such as buildings, meter and junction

boxes, on or adjacent to the construction site.

If the Contractor discovers utility facilities not identified by the Owner in the contract Plans or specifications, he shall immediately notify the Owner and the utility in writing.

Existing aboveground utilities, including but not limited to, power transmission and distribution, telegraph, telephone and traffic control systems, whether shown on the drawings or not, shall be maintained, relocated, rerouted, removed and restored as may be necessary by the Contractor with the least possible interference with the use of such facilities at no increase in cost to the Owner.

The right is reserved by the owners of utilities and franchises to enter upon any street, right-of-way or easement for the purpose of maintaining their property and for making necessary repairs or changes caused by the work. The Contractor shall pay all costs thus incurred.

G8.16 TEMPORARY UTILITIES. The Contractor shall make his own arrangements with utility companies for any services he may require in performance of the work of this Contract and shall pay all costs of these services directly to these utility organizations.

G8.17 OFFICE OF CONTRACTOR AT SITE. During the performance of the Contract, Contractor shall maintain a suitable office at the site of work which shall be the headquarters of a representative authorized to receive drawings, instructions or other communications from the Owner or Owner's agents; any such thing given to said representative or delivered at the Contractor's office at the site of work in his absence shall be deemed to have been given to the Contractor. Contractor shall maintain a complete set of Plans and specifications at the site office whenever work is in progress.

G8.18 PRESERVATION OF STAKES AND MARKS. Contractor shall preserve carefully bench marks, reference points, and stakes; in case of willful or careless destruction, he will be charged with the resulting expense of replacement and shall be responsible for any mistakes that may be caused by their unnecessary loss or disturbance.

G8.19 SUGGESTIONS TO CONTRACTOR. Any plan or method of work suggested by the General Manager to the Contractor, but not specified or required, if adopted or followed by the Contractor in whole or in part, shall be used at the risk and responsibility of the Contractor, and the General Manager and the Owner shall assume no responsibility thereof.

G8.20 USE OF EXPLOSIVES. When the use of explosives is necessary for the work, Contractor shall use the utmost care not to endanger life or property. Before blasting operations are undertaken, at least twenty-four (24) hours written notice must be given to the Owner and General Manager. Contractor will be responsible for obtaining permits from appropriate authority.

No explosive material shall be transported to, stored or utilized on the site without written permission of General Manager. Only qualified persons who possess a valid permit shall do all blasting work and handling of explosives on the site.

SECTION 9

MEASUREMENT AND PAYMENT

G9.01 MEASUREMENT OF QUANTITIES. All work to be paid for at a Contract price per unit of measurement will be measured by the General Manager in accordance with United States Standard Measures. Pipelines shall be measured horizontally.

G9.02 SCOPE OF PAYMENT. The Contractor shall accept the compensation provided in the Contract as full payment for furnishing all labor, materials, tools, equipment and incidentals necessary to the completed work and for performing all work contemplated and embraced under the Contract; also for loss or damage arising from the nature of the work, or from the action of the elements, or from any unforeseen difficulties which may be encountered during the prosecution of the work until the acceptance by the Owner; and for all risks of every description connected with the prosecution of the work, also for all expense incurred in consequence of the suspension or discontinuance of the work as herein specified; and for completing the work according to the Contract Documents. Neither the payment of any estimate nor of any retained percentage shall relieve the Contractor of any obligation to make good any defective work or materials.

No compensation will be made in any case for loss of anticipated profits.

Except as specifically provided otherwise, no separate payment will be made for work covered in any of these General Conditions and the cost thereof will be considered as included in the prices paid for the various Contract items included in the Bid.

If the "payment" clause in the Contract Documents relating to any unit price in the bid schedule requires that the said unit price cover and be considered compensation for certain work or material essential to the item, this same work or material will not also be measured nor paid for under any other pay item which may appear elsewhere in the Contract Documents.

G9.03 FORCE ACCOUNT PAYMENT. When extra work or other work done pursuant to a Change Order is to be paid for on a force account basis, materials and equipment used in the performance of such work shall be subject to the approval of the General Manager and compensation will be determined as set forth below in this Section.

A. Work Performed by Contractor. The Contractor will be paid the direct costs for labor, materials and equipment used in performing the work determined as hereafter provided.

To the total of the direct costs computed as provided in Sections 9.03.A(1), "Labor," 9.03.A(2), "Materials" and 9.03.A(3), "Equipment Rental," **there will be added a markup of 24 percent to the cost of labor, 11 percent to labor surcharge, 15 percent to the cost of materials, and 15 percent to the equipment rental.**

The above markups shall constitute full compensation, covering the cost of general supervision, overhead, profit and any other general expense not specifically designated as cost or equipment rental in Sections 9.03.A(1), (2) and (3). The total payment made as provided above (i.e., direct cost plus applicable markups) shall be deemed to be the actual cost of such work and shall constitute full compensation therefor.

When work paid for on a force account basis is performed by forces other than the Contractor's organization, the Contractor shall reach agreement with such other forces as to the distribution of the payment made by the Owner for such work. No additional payment therefor will be made by the Owner by reason of the performance of the work by a subcontractor or other forces.

(1) Labor. The Contractor will be paid the cost of labor for the workmen (including foremen when authorized by the Engineer), used in the actual and direct performance of the work. The cost of labor, whether the employer is the Contractor, subcontractor or

other forces, will be the sum of the following:

(1a) Actual wages. The actual wages paid shall include any employer payments to or on behalf of the workmen for health and welfare, pension, vacation and similar purposes.

(1b) Labor surcharge. To the actual wages, as defined in Section 9.03A(la), will be added a labor surcharge set forth in the California Department of Transportation publication entitled Labor Surcharge And Equipment Rental Rates, which is in effect on the date upon which the work is accomplished and which is a part of the Contract. Said labor surcharge shall constitute full compensation for all payments imposed by State and Federal laws and for all other payments made to, or on behalf of, the workmen, other than actual wages as defined in Section 9.03A(1a) and subsistence and travel allowance as specified in Section 9.03A(1c).

(1c) Subsistence and Travel Allowance. The actual subsistence and travel allowance paid to such workmen.

(2) Materials. The Owner reserves the right to furnish such materials as it deems advisable, and the Contractor shall have no claims for costs and markup on such materials.

Only materials furnished by the Contractor and necessarily used in the performance of the work will be paid for. The cost of such materials will be the cost to the purchaser, whether Contractor, subcontractor or other forces, from the supplier thereof, except as the following are applicable:

(2a) If a cash or trade discount by the actual supplier is offered or available to the purchaser, it shall be credited to the Owner notwithstanding the fact that such discount may not have been taken.

(2b) If materials are procured by the purchaser by any method which is not a direct purchase from and a direct billing by the actual supplier to such purchaser, the cost of such materials shall be deemed to be the price paid to the actual supplier as determined by the General Manager plus the actual costs, if any, incurred in the handling of such materials.

(2c) If the materials are obtained from a supply or source owned wholly or in part by the purchaser, the cost of such materials shall not exceed the price paid by the purchaser for similar materials furnished from said source on Contract items or the current wholesale price for such materials delivered to the job site, less any discounts as provided in Section 9.03A(2a).

(2d) If the cost of such materials is, in the opinion of the General Manager, excessive, then the cost of such material shall be deemed to be the lowest current wholesale price at which such materials were available in the quantities concerned delivered to the job site, less any discounts as provided in Section 9.03A(2a).

(2e) If the Contractor does not furnish satisfactory evidence of the cost of such materials from the actual supplier thereof within 60 days after the date of delivery of the materials or within 15 days after acceptance of the Contract, whichever occurs first, the Owner reserves the right to establish the cost of such materials at the lowest current wholesale prices at which such materials were available in the quantities concerned delivered to the location of the work, less

any discounts as provided in Section 9.03A(2a).

(3) Equipment Rental. The Contractor will be paid for the use of equipment at the rental rates listed for such equipment in the California Department of Transportation publication entitled Labor Surcharge And Equipment Rental Rates, which is in effect on the date upon which the work is accomplished and which is a part of the Contract, regardless of ownership and any rental or other agreement, if such may exist, for the use of such equipment entered into by the Contractor. If it is deemed necessary by the General Manager to use equipment not listed in said publication, the General Manager will establish a suitable rental rate for such equipment. The Contractor may furnish any cost data that might assist the General Manager in the establishment of such rental rate.

The rental rates paid as above provided shall include the cost of fuel, oil, lubrication, supplies, small tools, necessary attachments, repairs and maintenance of any kind, depreciation, storage, insurance and all incidentals.

Operators of rented equipment will be paid for as provided in Section 9.03A(1), "Labor."

All equipment shall, in the opinion of the General Manager, be in good working condition and suitable for the purpose for which the equipment is to be used.

Individual pieces of equipment or tools not listed in said publication and having a replacement value of $200 or less, whether or not consumed by use, shall be considered to be small tools and no payment will be made therefor.

Rental time will not be allowed while equipment is inoperative due to breakdowns.

B. Work Performed by Special Forces or Other Special Services. When the General Manager and the Contractor, by agreement, determine that a special service or an item of extra work cannot be performed by the forces of the Contractor or those of any of his subcontractors, such service or extra work item may be performed by a specialist. Invoices for such service or item of extra work on the basis of the current market price thereof may be accepted without complete itemization of labor, materials and equipment rental costs when it is impracticable and not in accordance with the established practice of the special service industry to provide such complete itemization.

In those instances wherein a contractor is required to perform extra work necessitating a fabrication or machining process in a fabrication or machine shop facility away from the job site, the charges for that portion of the extra work performed in such facility may, by agreement, be accepted as a specialist billing.

To the specialist invoice price, less a credit to the Owner for any cash or trade discount offered or available, whether or not such discount may have been taken, will be added 15 percent in lieu of the percentages provided in Section 9.03A, "Work Performed by Contractor."

G9.04 RECORDS. The Contractor shall maintain his records in such a manner as to provide a clear distinction between the direct costs of work paid for on a force account basis and the costs of other operations.

From the above records, the Contractor shall furnish the General Manager completed daily reports, on forms furnished by or acceptable to the Owner, for each day's work to be paid for on a force account basis. The daily reports shall itemize the materials used, and shall cover the direct cost of labor and the charges for equipment rental, whether furnished by the Contractor, subcontractor, or other forces, except for charges described in Section G9.03.B, "Work Performed by Special Forces or Other Special Services," of the General Conditions. The daily reports shall provide names or identifications and classifications of workers, the hourly rate of pay and hours

worked, and also the size, type and identification number of equipment, and hours operated. Before presenting the daily reports to the General Manager for payment, the Contractor shall compile the cost of the work to be paid for on a force account basis. The report number shall be left blank for completion by the General Manager.

Material charges shall be substantiated by valid copies of vendor's invoices. Such invoices shall be submitted with the daily reports, or if not available, they shall be submitted with subsequent daily reports. Should vendor's invoices not be submitted within sixty (60) days after the date of delivery of the materials or within fifteen (15) days after the acceptance of the Contract, whichever occurs first, the Owner reserves the right to establish the cost of such materials at the lowest current wholesale prices at which said materials are available in the quantities concerned delivered to the location of the work, less any discounts provided in Section G9.03.A.

The daily reports shall be signed by the Contractor or his authorized representative.

The General Manager will compare his records with the completed daily reports furnished by the Contractor and make any necessary adjustments.

When the daily reports are agreed upon and signed by both parties, the reports shall become the basis of payment for the work performed, but shall not preclude subsequent adjustment based on the later audit by the Owner.

G9.05 NOTICE OF POTENTIAL CLAIM. The Contractor shall not be entitled to the payment of any additional compensation for any cause, including any act, or failure to act, by the General Manager (including the failure or refusal to issue a Change Order), or the happening of any event, thing or occurrence, unless he shall have given the General Manager due written notice of potential claim as hereinafter specified, provided, however, that compliance with this Section shall not be a prerequisite as to matters within the scope of the Contract Change Order protest conditions in Section G4.08, "Protest Procedure," or the notice conditions in Section G8.12, "Delays and Extension of Time," nor to any claim which is based on differences in measurement or errors of computation as to correct quantities.

The written notice of potential claim shall set forth the reasons for which the Contractor believes additional compensation will or may be due, the nature of the costs involved and, insofar as possible, the amount of the potential claim. If based on an act or failure to act by the Engineer or the Owner, such notice shall be given to the General Manager prior to the time that the Contractor has started performance of the work giving rise to the potential claim for additional compensation. In all other cases, notice shall be given within 15 days after the happening of the event or occurrence giving rise to the potential claim. With each individual claim filed with the District, the Contractor shall submit a signed declaration certifying full awareness of the False Claim Act, Gov't Code Section 12650 et seq.

It is the intention of this Section that differences between the parties arising under and by virtue of the Contract shall be brought to the attention of the General Manager at the earliest possible time in order that such matters may be settled if possible, or other appropriate action promptly taken. The Contractor hereby agrees that he shall have no right to additional compensation for any claim that may be based on any such act, failure to act, event, thing or occurrence for which a written notice of potential claim as herein required was not timely filed.

G9.06 STOP NOTICES. The Owner may, at its option and at any time, retain out of any amounts due the Contractor sums sufficient to cover claims filed pursuant to Section 8500 et seq. of the California Civil Code.

G9.07 PAYMENT SCHEDULES. The Contractor shall submit a Schedule of Anticipated Contract Payments and a Schedule of Pay Items for review and approval by the General Manager prior to the initial partial payment to the Contractor. The Schedule of Pay Items shall be prepared by the Contractor in a format approved by the General Manager and shall include such detail as directed by the General Manager. The Schedule shall be sufficiently clear and detailed so as to facilitate an accurate and realistic appraisal of monthly progress for the purpose of making partial payments. The value for each bid item shall total the bid amount. The values in the Schedule will be used only for determining partial payments.

The Schedule of Anticipated Contract Payments shall be coordinated by the Contractor's construction schedule submitted pursuant to Section G8.05 and shall show the anticipated monthly Contract payments for each of the pay

items covered in the Schedule for Pay Items, the total of monthly payments and cumulative total of payments for each month. If the construction schedule is revised, the Schedule of Anticipated Contract Payments shall also be revised and resubmitted for the General Manager's review and approval. No partial payment will be made until the General Manager has approved the Schedules required by this Section.

G9.08 INVOICE FOR WORK COMPLETED. Once each month, at a time, place and location mutually agreeable, the Contractor and General Manager shall meet to discuss the amount of work completed satisfactorily during the work period since the last invoice for partial payment was prepared. A draft invoice for work completed shall be prepared; the General Manager's judgment will be final if disputes occur regarding the amount of work completed or its value. Following the meeting, the Contractor shall formally submit the invoice for work completed in a form acceptable to the General Manager. The invoice will certify, and be supported by evidence if required by the General Manager, that the work invoiced has been done and that the materials listed are at the storage places indicated. The invoice may include the amount and value of such acceptable material as has been furnished and delivered to the site or has been furnished and stored for use in the work, provided it is stored within the general work area and is designated for incorporation in the work.

G9.09 RETENTION. In addition to amounts, if any, withheld pursuant to any other provision of these General Conditions, including the Owner's right to withhold for the estimated or actual costs of correcting defective work and amounts claimed by the Owner as liquidated damages or other offsets, **the Owner will retain an amount equal to 10 percent of the estimated value of the work done and 10 percent of the value of materials** estimated to have been furnished and delivered and unused or furnished and stored as aforesaid as part security for the fulfillment of the Contract by the Contractor.

G9.10 PARTIAL PAYMENTS. Each acceptable Contractor's invoice will be paid within 30 days of the General Manager's receipt of the invoice, after deducting all previous payments, retentions, and other sums as described in the Contract Documents. No such payment will be made when, in the judgment of the General Manager, the work is not proceeding in accordance with the conditions of the Contract, or when the total value of the work done as shown on the invoice does not exceed five hundred dollars. Partial payments shall be made contingent on receipt of all submittals required by contract, e.g. all daily work reports after each month; updated work schedules; Form UR334 if required; prevailing wage certifications from each sub-contractor.

No such invoice or payment will be construed to be an acceptance of any work or materials.

G9.11 PAYMENT OF WITHHELD FUNDS. Upon the Contractor's request, the Owner will make payment of funds withheld from progress payments as described in Section G9.09, pursuant to the requirements of Public Contract Code Section 22300, if the Contractor deposits in escrow with the Owner or with a bank acceptable to the Owner, securities eligible for investment under Government Code Section 16430, bank or savings and loan certificates of deposit, interest bearing demand deposit accounts, standby letters of credit, or any other security mutually agreed to by the Contractor and the Owner, upon the following conditions:

a. The Contractor shall bear the expense of the Owner and the escrow agent in connection with the escrow deposit made.

b. Securities or certificates of deposit to be placed in escrow shall be of a value at least equivalent to the amounts of retention to be paid to the Contractor pursuant to this section.

c. The Contractor shall enter into an escrow agreement satisfactory to the Owner, which agreement shall be substantially similar to the form provided in Public Contract Code Section 22300.

d. The Contractor shall obtain the written consent of the surety to such agreement.

G9.12 FINAL PAYMENT AND CLAIMS. After the work has been accepted by the Owner, as provided in Section G7.30, "Acceptance of Work," payment will be made to the Contractor in accordance with the conditions of this Section. Upon acceptance, the Owner will record a Notice of Completion covering the project.

Within 30 days after acceptance by the Owner, the Contractor shall prepare and submit a proposed final invoice in

writing, prepared in a form acceptable to the General Manager. The proposed final invoice will show the proposed total amount of compensation payable to the Contractor, including an itemization of that amount segregated as to Contract item quantities, extra work and other bases for payment. The proposed final invoice will also show all deductions made or to be made for prior payments and amounts to be kept or retained under the Contract.

The Contractor shall also submit, at the same time as the proposed final invoice is submitted, a statement of all claims he has arising under or by virtue of the Contract, or a statement that he does not intend to file any such claims. No claim for which a notice of potential claim or protest is required under Section G9.05, "Notice of Potential Claim," Section G4.08, "Protest Procedure," or Section G8.12, "Delays and Extension of Time," will be considered unless the Contractor has fully complied with the notice or protest requirements in said sections.

Claims filed by the Contractor shall be in sufficient detail to enable the General Manager to ascertain the basis and amount of said claims. The Engineer will consider and determine the Contractor's claims and it will be the responsibility of the Contractor to furnish within a reasonable time such further information and details as may be required by the Engineer to determine the facts or contentions involved in the claims. **Failure to submit such information and details will be sufficient cause for denying the claims.**

The General Manager will review the proposed final invoice and claims and will submit his recommendation to the Owner as to the final estimate of the amount due the Contractor and the disposition of all claims. All prior invoices and payments are subject to correction in connection with review of the proposed final invoice.

The Owner will submit any changes or corrections to the proposed final invoice to the Contractor for his consideration. Within 10 days thereafter, the Contractor shall submit a final invoice, in a form acceptable to the General Manager, incorporating any changes or corrections made by the Owner, together with any additional claims resulting therefrom. Upon approval by the Owner, this will become the approved final invoice. The Contractor shall submit with the final invoice, certificates of any insurance required to be maintained after acceptance of the work.

If the Contractor files no claims within 30 days after acceptance of the work by the Owner, and agreement is reached on all questions regarding the final invoice, the Owner will pay the entire sum found due upon the final invoice, except that the Owner will withhold sums sufficient to pay all unsettled claims for which stop notices have been filed pursuant to Section 3081 et seq. of the California Civil Code, together with the costs of administering such claims.

If the Contractor does file claims within 30 days after acceptance of the work by the Owner, then upon final determination of all the Contractor's claims, the Owner will pay the entire sum found due upon the final invoice, including the amount, if any, allowed on claims, except that the Owner will withhold sums sufficient to pay all unsettled claims for which stop notices have been filed pursuant to Section 3081 et seq. of the California Civil Code, together with the costs of administering such claims.

Final payment will be made within 30 days after receipt of an approved final invoice and determination of all Contractor's claims, or 60 days after acceptance of the work by the Owner, whichever is later, provided, however, that if an approved final invoice has not been submitted within 60 days after acceptance of the work by the Owner, the Owner may elect to make payment of sums not in dispute without prejudice to the right of either the Owner or the Contractor in connection with such disputed sums.

The acceptance by the Contractor of final payment shall constitute a waiver and release of all claims by the Contractor against the Owner related to the work, except for claims previously made in writing and identified as unsettled by the Contractor at the time of submission of the final invoice. The making of final payment, however, shall not operate to release the Contractor or his sureties from obligations arising under this Contract, the Contract bonds and warranties as herein provided. Specifically, the making of final payment shall not constitute a waiver and release of claims by the Owner arising from (a) unsettled or future liens, (b) failure of the work to comply with the requirements of the Contract Documents, (c) the terms of any warranties required by or contained in the Contract Documents, (d) the right to any insurance proceeds or the right to make any insurance or bond claims, (e) any claims with respect to Contractor's obligation of indemnity provided for in the Contract Documents, or (f) any latent defects or fraud.

PART III

SPECIAL CONDITIONS

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PART III

SPECIAL CONDITIONS

1. .

S1.02 TIME OF COMPLETION. The Contractor shall start the work promptly and prosecute the work so that all portions of the project are complete and ready for full use by the next weekday(Monday-Friday) following the **550 Days** beginning one (1) calendar day after the date of the Notice to Proceed.

S1.03 STORAGE OF MATERIALS. Construction materials shall not be stored within the public right-of-ways, or in such a manner as to impede the flow of public traffic nor create an unsafe condition, nor shall they be stored within fifteen feet (15') of a fire hydrant or in such a manner so as to impede access or visibility of any emergency facilities. No items shall be laid down outside of the gate and fence perimeter of the property occupied by the pump station(project worksite)

The Contractor shall be responsible for making whatever arrangements are necessary with private property owners to stockpile materials on private property if storage outside of project worksite is desired by the Contractor.

S1.04 Deleted

S1.05 PERMITS AND ASSOCIATED COSTS.

Any costs for County permits that the Contractor is required to obtain in connection with this project shall be paid as follows:

- The Contractor shall pay the cost of any permit up to a maximum of $1,300, as set forth in the bid schedule.

S1.06 LICENSING OF BIDDERS. All bidders shall possess a California Class A General Engineering license. Failure to possess such a license will result in a bid being considered Non-Responsive. The contractor performing electrical work must possess a valid California C-10 (Electrical)license. See also Section 16010, 1.03.5

S1.07 ARCHEOLOGICAL DISCOVERIES. General Conditions, Section G4.11, Archaeological Discoveries. Add the following paragraphs to this section:

In accordance with the National Preservation Act of 1966, (16 U.S.C. 470) and PRM 75-27, the following procedures are implemented to insure historic preservation and fair compensation to the Contractor for delays attendant to cultural resources investigations.

In the event potential Historical, Architectural, Archeological, or Cultural Resources (herein after cultural resources) are discovered during subsurface excavations at the site of construction, the following procedures shall be instituted:

1. The Engineer shall issue a "Stop Work Order" directing the Contractor to cease all construction operations at the location of such potential cultural resources find.

2. Such "Stop Work Order" shall be effective until such time as a qualified archeologist can be called to assess the value of these potential cultural resources and make recommendations to the Owner. Any "Stop Work Order" shall contain the following:

a. A clear description of the work to be suspended;
b. Any instructions regarding issuance of further orders by the Contractor for material services;
c. Guidance as to action to be taken on subcontracts;
d. Any suggestions to the Contractor as to minimization of his costs;
e. Estimated duration of the temporary suspension.

If the archeologist determines that the potential find is a bonified cultural resource, the Engineer shall extend the duration of the "Stop Work Order" in writing, and the Contractor shall suspend work at the location of the find.

Equitable adjustment of the construction contract shall be made in the following manner:

A. Time Extension. If the work temporarily suspended is on the "critical path", to total number of days for which the suspension is in effect shall be added to the number of allowable contract days.

If a portion of work at the time of such suspension is not on the 'critical path", but subsequently becomes work on the critical path, the allowable contract time will be computed from the date such work is classified as on the critical path.

B. Additional Compensation. If, as a result of a suspension of the work, the contractor sustains a loss which could not have been avoided by his judicious handling of forces, and equipment, or redirection of forces or equipment to perform other work on the contract, there shall be paid to the Contractor an amount as determined by the Engineer to be fair and reasonable compensation for the Contractor's actual loss in accordance with the following:

C. Idle Time of Equipment. Compensation for idle time of workers will be determined on a force account (time and materials) basis, and shall include the cost of extra moving of equipment and rental loss. The

right-of-way delay factor for each classification of equipment shown in the California Department of Transportation publication entitled, "Equipment Rental Rates and the General Prevailing Wage Rates", will be applied to any equipment rental rates.

D. Idle Time of Labor. Compensation for idle time of workers will be determined by the Engineer as "Labor" less any actual productivity factor of this portion of the work force.

E. Increased Costs of Labor and Materials. Increased costs of labor and materials will be compensated only to the extent such increase was in fact caused by the suspension, as determined by the Engineer.

Compensation for actual loss due to idle time of either equipment or labor shall not include markup for profit.

The hours for which compensation will be paid will be the actual normal working time during which such delay conditions exists, but will in no case exceed eight (8) hours in any one day.

The days for which compensation shall be paid shall be full or partial calendar days, excluding Saturdays, Sundays, and legal holidays, during the existence of such delay.

S1.08 OCCUPANCY PRIOR TO ACCEPTANCE. General Conditions, Section G7.29, Occupancy Prior to Acceptance. Add the following sentence to this section of the General Conditions: "Use of newly constructed sanitary sewers to carry sewage flow prior to project completion shall not constitute occupancy by the Owner. Occupancy shall not apply to newly constructed sanitary sewers unless they have been televised and passed the final inspection of the Engineer.

S1.09 LIQUIDATED DAMAGES. General Conditions, Section G8.11, Liquidated Damages. Liquidated damages for avoidable delays set forth in Article G8.11 of the General Conditions shall be in the amount of **five hundred dollars ($500.00) per day.**

S1.10 PRESERVATION OF PROPERTY AND CLEANING. General Conditions, Section G4.12, Preservation and Cleaning. Each day and as directed by the General Manager, the Contractor shall keep the project site and work areas clean and free of litter, rubbish, excess materials, false work, temporary structures, and equipment, not directly involved in the work.

All parts of the work shall be left in a neat and presentable condition at the completion of each workday. Barricades shall be placed around construction materials and equipment left on public rights-of-way. Loose backfill materials shall be removed from traveled areas.

The contractor shall, **at least two times per week and at the end of each work week**, cleanup streets, easements, and public rights-of-way by sweeping or by other methods. If cleanup is not satisfactory, the General Manager will notify the Contractor who shall remedy the situation. If the Contractor fails to remedy the cleanup deficiencies immediately, the Owner, at its discretion, can arrange cleanup to be done by others at the Contractor's expense.

The Contractor shall be responsible for preserving all properties adjacent to or directly involved in the work.

Attention is directed to the following related sections of these Specifications:

General Conditions
- G5.13 Character of Workers
- G6.03 Storage of Materials
- G7.13 Safety
- G7.16 Public Convenience
- G7.17 Public Safety
- G7.18 Preservation of Property

Special Conditions
- All sections

Technical Conditions

Section 2A.11 Dust Control

Before final inspection of the work, the Contractor shall clean the project site, material sites, storage sites, and all other areas occupied by it and restore these sites or properties to their original condition. The contractor shall obtain written releases from private property owners stating they are satisfied with their property's restoration. Full compensation for cleanup and restoration will be considered as included in the prices paid for the various contract items of work and no separate payment will be made therefore.

The attention of the Contractor is directed to General Conditions, Section G7.18 and to Drawings, Sheet D-2. The fact that a surface element on the property may not be shown on the Contract Plans shall not relieve the Contractor of his responsibility under Section G7.18, "Preservation of Property," of the General Conditions of under these Special Conditions.

S1.11 SUBMITTAL OF MONTHLY SCHEDULE OF WORK, ACCESSING PRIVATE PROPERTY. Contractor shall submit a monthly schedule of work to Owner at the start of each month noting the properties being impacted by construction. The Owner shall use the contractor's monthly schedule of work to provide notice to affected property owners of the impending construction activity.

The project worksite is located in a highly constrained fenced area measuring just 75' x 75' which sits within an industrial truckyard controlled by C&H Sugar Company. Right-of-entry to this truckyard is controlled solely by C&H Sugar Co. and not by the District.

Nothing in the Contractor's activities shall interfere with the normal operation of the truckyard except as allowed by C&H Sugar Co.

Contractor shall communicate and coordinate with C&H Sugar Co. to avoid any disruption of truckyard activities.

Contractor, subcontractors, suppliers, technicians and other agents of the Contractor shall enter and exit the truckyard only at the security gate on Port Street (just north of Wanda Ave.) upon checking in or out with the security guard on duty.

Contractor recognizes and agrees that the project worksite is a sewage lift station in constant operation around the clock, the operation of which the Contractor shall take all necessary steps to prevent and avoid interfering with.

Contractor recognizes and agrees that the project worksite is a sewage lift station operated and maintained routinely by personnel of the West County Wastewater District (WCWD) on behalf of the Owner. Contractor shall take all necessary steps to coordinate its activities with the WCWD and prevent and avoid interfering with activities of the WCWD personnel, whether routine or emergency.

Contractor recognizes and agrees that the project worksite is a sewage lift station operating under permit of the Regional Water Quality Control Board to prevent discharge of sewage to waters of the state. Contractor shall take all necessary steps to prevent any such discharge(s) resulting from activities of Contractor, subcontractors, suppliers, technicians or other agents of the Contractor.

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S1.17 SAFETY. Attention is directed to Section G7.13 of the General Conditions. In connection with said sections, CONTRACTOR shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs. In addition, CONTRACTOR shall prepare, implement, and maintain a safety and health program and plan.

S1.18 MAINTAINING TRAFFIC. Attention is directed to Sections G7.16 and G7.17 of the General Conditions. In connection with said sections, it is understood that all lights, signs, barricades, flagmen or other necessary devices for road traffic safety shall be furnished and maintained by the Contractor at his own expense. In connection with railroad traffic, if applicable, Contractor shall arrange with Union Pacific RR for the provision of railroad flagmen during the Project, as needed. Owner shall pay directly to Union Pacific RR, upon successful completion of Project, the costs for railroad flagmen.

Construction operations shall be conducted in such a manner as to cause as little inconvenience as possible to abutting property owners; convenient access to any driveways, houses, buildings, public buildings and stores along the line of work shall be maintained. No driveway shall be closed for a period exceeding 6 hours unless such requirement is waived in writing by the General Manager.

Lane closures shall conform to the provisions set forth in the Manual of Traffic Controls of the State of California Department of Transportation. No other Caltrans standards or specifications shall apply to this LIFT STATION MOTOR CONTROL CENTER UPGRADE PROJECT unless specifically incorporated into this Contract..

S1.19 VITRIFIED CLAY PIPE SANITARY SEWERS. Where noted on the Plans as "VCP," new replacement sewer pipeline materials used shall be high strength vitrified clay pipe. Extra strength pipe shall not be accepted.

S1.20 HDPE GRAVITY SANITARY SEWERS. High-Density Polyethylene (HDPE) pipe may be substituted for vitrified clay pipe. Where HDPE material is used in replacement of a section of pipe, it shall follow Section 18 of the District Standard Specifications.

S1.21 JOINTS. Notwithstanding other conditions in this document including Technical Conditions, vitrified clay pipe joints shall be flexible compression bell and spigot joints. All joints on HDPE pipe shall be fuse welded in accordance with the pipe manufacturer recommendations. Manhole connections and intermediate point repairs shall be joined and installed as per the contract drawings and details.

S1.22 SEWAGE BYPASSING. The Contractor shall be responsible for containing all sanitary sewage flows within the sewage collection system. Construction activities will require that the upstream flow be interrupted, therefore a sewage bypass system shall be implemented to divert rather than stop the flow in the system.

The bypass shall be made by temporarily plugging the existing upstream manhole and pumping the sewage into a downstream manhole or adjacent system. The pump and bypass lines shall be adequate capacity and size to handle the flow volume and avoid sewage backup damage that can be created in the upstream system when the line is plugged. Any costs associated with providing and maintaining the temporary bypass facilities by the Contractor shall be included in the unit prices bid for the work and no additional costs will be allowed therefore.

Under no circumstances will the dumping of raw sewage on private property, in the city streets or in any location other than an approved sanitary sewer be allowed.

S1.24 MEASUREMENT AND PAYMENT: General Conditions, Section G9.02, Scope of Payment. Add the following paragraphs to this section.

A. All bid items shall include all miscellaneous items of work as shown and specified, but not otherwise specifically included in any other bid item in this contract.

B. Lump sum, all construction materials, labor, and activities except for activities described under mobilization and demobilization.

C. Lump sum, mobilization of the Contractor's personnel, equipment, and operating supplies; establishment of offices, buildings, and other necessary general facilities for the Contractor's operations; premiums paid for performance and payment bonds and insurance. Demobilization of

the Contractors' personnel, equipment, and operating supplies from the site, including disassembly, removal, and site cleanup of all facilities assembled on the site specifically for this contract.

PART IV

TECHNICAL CONDITIONS

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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 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. Motor Controls:
    a. Motor Control Center with full speed starters and VFDs.
    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.
2. Control panel(s):
    a. Systems Integrator to design, furnish, assemble, wire, test, and complete all test forms pertaining to control panels as part of their scope of work.
    b. Contractor 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.
3. 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.

4. Instrumentation
   a. Systems Integrator to design, furnish, assemble, wire, test, and complete all 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.
5. 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.
6. All necessary process piping, shut off, sample and calibration valves, drains, pressure reducers and calibration equipment for connection of instrumentation.
7. Trenching, backfilling, compaction and resurfacing for all new underground conduit routes, concrete pads, and pull boxes.
8. Coordination and equipment for connection of power utility and telephone services per utility Drawings and standards.
9. Site electrical devices, lights and receptacles.
10. Seismic Anchorage Design Calculations and conforming installation.
11. 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
16450	Grounding
16480	Motor Control Center
16481	Variable Frequency Drive
16600	Factory and Field Testing
16905	Control Panels
16910	PLC & OI Hardware
16915	PLC & OI Applications Programming
16940	Instrumentation
16960	Bubbler System

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 Crockett Community Services District.

1.03 QUALIFICATIONS AND REQURIED WORK SCOPE

A. Electrical Contractor

1. Management and installation of the entire electrical and control system required for this project shall be by an Electrical Contractor meeting qualifications as defined herein.
    a. Contractor shall be capable of looking at electrical equipment submittals, prior to installation, comparing hookup requirements to the Drawings, and noting any deficiencies.
2. Electrical Contractor 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.

3. Electrical Contractor shall be competent in and familiar with management and subcontracting of specialty electrical and instrumentation supply and engineering work as requires of a Systems Integrator as described herein.
4. Electrical Contractor must be competent in performance, supervision and coordination of work required and performed by equipment suppliers and Systems Integrator (Subcontractors).
5. The Electrical Contractor (EC) shall meet the following minimum qualifications:
    a. Has a current C10 Electrical Contractor’s License issued by the State of California Department of Consumer Affairs.
    b. EC shall be regularly engaged in similar industrial power and controls electrical contracting for the Water and Wastewater Industry.
    c. EC 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.
    d. EC shall carry all insurances as defined and required by the special provisions and as required by law.
    e. EC shall be competent in methods and materials execution and selection associated in the type of electrical and instrumentation work specified in this Division.
        1) EC shall be familiar with and understand codes and requirements from NFPA70, NFPA110, and all other governing national or local codes as required for work scope as described in the Drawings and Specifications.
        2) EC 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.
    f. EC 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.” Apprentices may install electrical components only under direct supervision of a certified Electrician.

B. System Integrator
    1. Systems Integrator shall be a supplier to the Electrical Contractor 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 all 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 the Municipal Water and Wastewater Industry.
    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 Centers, 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 as applied to the Water and Wastewater industry.
    f. SI shall employ personnel on this project who have successfully completed ISA or equal training courses on general purpose instrumentation.
    g. 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 and are pre-qualified for providing bids as System Integrators on the project. Other System Integrators that

wish to be added to the list of pre-qualified Systems Integrators 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 will 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.	Technical Systems, Inc (TSI)	(707) 678-4444

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 using the following coloring scheme:

1. Additions - red
2. Deletions - green
3. Comments - blue
4. Dimensions - black

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 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.

B. Where connections must be made to existing or new operational facilities, the Contractor shall schedule all the required work with Engineer, including the power shutdown period. Carry out each shutdown so as to cause the least disruption to the operation of the installation.

1. No shutdown shall occur that will result in overflow or release of sewage, either to the waters of the state or to open ground. Any shutdown shall be undertaken at a time of low flow, and avoid inclement weather that would result in increased likelihood of overflow.
2. The Contractor shall limit all unscheduled shutdown periods to less than 10 minutes and only with prior approval of the Station operator.
3. Carry out shut downs of durations greater than 10 minutes only after the time and date schedule and sequence of work proposed to be accomplished during shutdown has been favorably reviewed by the Engineer. Submit shutdown plans at least 2 days in advance of when the scheduled shutdown is to occur.
4. Provide temporary power to all existing facilities utilizing a portable generator. The generator shall be utilized for all shutdowns that exceed 15 minutes and run continuously for the duration of the primary power shutdown. All cost for operating the generator including equipment, fuel and labor shall be provided.
5. The Engineer reserves the right to delay, change, or modify any scheduled shutdown at any time, at no additional cost to the Owner, when the risk of such a shutdown would jeopardize the operation of the water distribution system and/or water plant operation.

1.06 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.

1.07 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.

1.08 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.

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.
   4. The Contractor assumes all liability for the security of tools and materials on site. All items of value shall be safely secured against theft. The door/gate of the premesis shall be locked by the contractor when they leave the site, unless the owner or their representatives are present to take responsibility.
   5. Except as allowed in writing by C&H Sugar Co, no vehicles related to this project may park, even temporarily, outside the fenced enclosure that is the project worksite. See also Special Conditions, Section 1.11.
   6. Except as allowed in writing by C&H Sugar Co, no equipment or materials related to this project shall be placed, even temporarily, outside the fenced enclosure that is the project worksite.
   7. Owner shall bear no responsibility for damage to any vehicle equipment or materials that may occur outside the fenced enclosure that is the project worksite.

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%.

1.09 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.

1.10 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.
    a. Like equipment shall be submitted complete in a single submittal. For instance, all general electrical materials shall be in a single submittal. All instrumentation, all control panels, or all MCCs and so on shall be submitted complete where possible.
    b. Submittals that are broken down without sufficient cause will be rejected for future inclusion into a combined submittal.
    c. Do not separate submittals by area.
    d. Do not separate submittals by specification division unless agreed to in advance.
    e. Submittals for work scope covered in this contract are expected to be as follows. This list is intended to be a guideline and not to be specific of all submittals required. Project circumstances or leadtimes or availability will each impact the order and division of submittals.
        1) General electrical materials – conduit, wire, labels, etc.
        2) Power Distribution and Motor Controls
        3) PLC and Control Panels
        4) Seismic Calculations
        5) Instrumentation
        6) Factory and Field Testing forms and procedures
        7) Installation details or procedures
        8) O&M Manuals
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. 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. Shop Drawings:
   a. Equipment elevations with enclosure details drawn to scale or dimensioned with relative scale.
   b. Electrical One-line, Elementary, and wiring diagrams
   c. PLC I/O wiring diagrams
5. 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

D. 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.

E. All 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.

F. 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:
   1. 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.
   2. 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.

3. 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.
4. 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.
5. Drawings shall show UL required information as needed to UL label the equipment in accordance with UL procedures for label applied.
6. 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.

G. 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 structural engineer registered in the State of California shall be submitted in accordance with code requirements for earthquakes forces on all specified equipment. Calculations shall include wind loading forces for equipment installed outdoors.
3. Provide a submittal, minimum 3 weeks prior to equipment installation, of calculations, materials needed, and supporting drawings and details for installation by Contractor.

1.11 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, etc. 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.

2.03 FASTENERS

A. Fasteners for securing equipment to walls, floors, or ceilings, shall be stainless steel. The minimum size fastener shall be 3/8 inch diameter.

2.04 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 as required.
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 as required.
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. TR – Timing relay
   c. TDOE – Time delay on energization
   d. TDOD – Time delay on de-energization
   e. PR – Power Relay
   f. PFR – Phase Fail 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. 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.
5. 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.

6. 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 30A or 1.0 HP at 240 VAC, furnish Magnecraft Type 389FXHXC1-120A, or equal.
   c. Furnish compatible blade type relay socket model 70-788EL11-1 or equal.
7. (FOR MCC BUCKET) Phase fail relay (PFR) shall continuously monitor the three phases for power loss, low voltage, phase loss, and phase reversal. The PFR shall interface to the control circuit with SPDT contacts rated for 4 Amps at 120 VAC. The phase fail relay shall have a drop out voltage adjustment, and status indicating LEDs. Phase fail relay shall be Time Mark 258 with 8 pin octal smart socket and hold down clamp, or equal.

2.05 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 shall be UL listed for series application.
7. Where indicated circuit breakers shall be current limiting.
8. Where indicated on Drawings, provide UL listed circuit breakers for continuous duty at 100% of their ampere rating in the intended enclosure.
9. 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 shall have shall have non-electronic thermal-magnetic (TM) trip units with inverse time-current characteristics.
2. 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.

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.

2.06 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. Contactor:

1. Contactors shall be IEC amperage rated as shown on the Drawings or as needed for load. Coil voltage shall be 120 volts AC or as shown otherwise in elementary drawings. Provide auxiliary contacts as required per the elementary diagrams and/or as shown in the P&IDs. If operating motors, contactors shall include overload relay as a package unit or as separate pieces to accommodate for special switching requirements. Motor starters shall be Cutler Hammer XT, Square D, GE or equal.

C. Motor Starter:

1. Motor starters shall be NEMA rated of size shown on the Drawings. Coil voltage shall be 120 volts AC or as shown otherwise in elementary drawings. Provide auxiliary contacts as required per the elementary diagrams and/or as shown in the P&IDs. Motor starters shall include contactor and overload relay as a package unit or as separate pieces to accommodate for special switching requirements. Motor starters shall be Cutler Hammer Freedom, Square D, GE or equal.

D. Motor Overload:

1. External motor overload protection shall be required per Drawings. External overload shall use bimetallic heating strips and provide +/-15% adjustment for full load amperage. Provide Cutler Hammer Freedom or equal.
2. .

E. 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.

2.07 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. Devices and Accessories, or equal.

C. Surge Protective Device (SPD):
1. The surge protective device shall be rated for use on a 480 VAC, 3 phase WYE system or 240 VAC, 3 phase Delta system. The nominal line voltage of the device shall be 277V L-N with a maximum continuous line voltage of 320V L-N. The unit shall dissipate a minimum of 80,000 amps single pulse surge current over a 8x20 usec period. The device shall dissipate a minimum of 2560 joules transient energy per phase. Provide external fusing as required by the manufacturer for proper operation. Furnish Leviton 32277-DY3, or equal.

2.08 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

B. CT Shorting Terminal Block
1. Panel mount inside control equipment with front screw terminal connections. Inserting a thumb screw shall short terminals to a top mounted ground bar. Provide quantity of terminal poles as required for function and as shown in Drawings. Furnish Flex Core 170xSC or equal.

C. Current Transformers
1. Furnish mounted (preferable) or unmounted current transformers based on space allocated and installation requirements. The current transformer shall have wire leads or binding posts and ratio as shown on the Drawings. The accuracy shall be metering accuracy class 0.6 at a minimum burden at 60 hz shall be 2.5 VA and as required to meet specified accuracy of device(s) fed.

2.09 RADIO SYSTEM

A. TRANSMISSION CABLE
1. Provide 50 Ohm, 3/8” 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 3.75 inches. The cable shall be installed as one continuous length from

the antenna to the lighting arrestor. Antenna cable shall be Andrew LDF2P-50-3 3/8" 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. Times Microwave EZ-400-NM4-X 3190-2590. Confirm compatibility with cable provided.
3. 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.
4. 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.
5. 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.
6. 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.
7. 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.

2.10 BROADBAND WIRELESS CELLULAR ROUTER

A. Acceptable products: AirLink GX440 4G LTE intelligent gateway, or equal. Compatible with Verizon.

B. General Specifications
1. WiFi not required.
2. Internet Connections Supported: 1 Embedded 3G/4G connection
3. Networks Supported for Embedded Modem: Verizon 2G, 3G, and 4G
4. Ethernet ports: 1 LAN, 10/100.
5. AC wall pack power supply
6. Size: 5.6" x 3.8" x 1.7"

C. Security:
1. Onboard IPSec SSL VPN client
2. VPN pass-through (AH protocols)
3. GRE tunneling
4. MAC address filtering
5. IP filtering

6. Port filtering
7. SSH
8. HTTPS

D. GPS:
1. Precision GPS with active antenna port
2. Garmin FMI support

E. Technology:
1. LTE with failback to EVDO Rev-A, CMDA EVDO Rev-0, CDMA 1xRTT

F. Bands:
1. LTE 700mhz
2. CDMA/EVDO 800/1900mhz

G. Environmental:
1. Operating Temperature: -30˚C to +70˚C (-22 to 158˚F)
2. Storage Temperature: -40 to 85˚C (-40 to +185˚F)

H. Size:
1. Dimensions: 5.6 in x 3.8 in x 1.7 in
2. Weight: 12oz

I. Standards & Approvals:
1. FCC, Industry Canada
2. RoHS Compliant
3. CE, E-Mark
4. Mil-Spec 810-F IP64
5. Clas 1 Div 2
6. Carrier specific approvals

J. Host Interfaces:
1. 10/100 Base-T RJ45 Ethernet
2. RS-232 Serial Port
3. USB On The Go
4. 1 Digital I/O Port
5. Expansion Card Slot for Additional Options
6. 3 SMA/Female Antenna Connectors (RF, GPS, MIMO LTE or Rx Diversity EV-DO)

K. Application Interfaces:
1. TCP/IP, UDP/IP, DHCP, HTTP, NMEA, TAIP, GPS

L. LED Indicators:
1. Network

2. Signal strength
3. Activity
4. Power/GPS

M. Warranty:
1. 5 year manufacturer warranty

N. Minimum Requirements:
1. SIM card with active 3G/4G mobile broadband plan from Verizon
2. 2mm Hex L-wrench (required to access the SIM card slot)

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

2.11 SPARE PARTS

A. The Contractor shall supply all spare parts prior to start of field tests. All parts shall be sealed in plastic bags and delivered to the site in a heavy duty plastic storage bag. Bag shall be clearly labeled with part name & number and the corresponding equipment tagname.

B. The Contractor shall make available any replacement parts that are not manufacturer's normal stock items for immediate service and repair of all the instrumentation equipment throughout the warranty period.

C. The following spare parts shall be provided as part of this Contract:
1. Ten fuses for each type of fuse below 31 amps, 3 of each type above
2. Ten lamps for each type of light, two lamps per color if LED type.
3. Two relays for each type of control, and time delay relay.
4. One voltage monitoring relay or power fail relay.

PART 3 EXECUTION

7.01 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. Electrical plugs, receptacles, cords, and connectors required to power or interface the equipment and panels shall be furnished and installed by the Contractor.

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

7.02 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.

7.03 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.

7.04 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.

7.05 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. 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.

7.06 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. 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.
   4. Provide additional devices, wiring, conduits, relays, signal converters, isolators to complete interfaces of the electrical and instrumentation system.
   5. Changing normally open contacts to normally closed contacts or vice versa
   6. Adding additional relays to provide more contacts as necessary.
   7. 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.
   8. Coordinate with the Engineer and setup all alarm, process, and operation setpoints.
   9. 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. 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).

D. 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.

E. 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.

F. 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.

7.07 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.

7.08 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.

7.09 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. Removal of existing wiring for those conduits getting new wiring.
   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 transition 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. Installers of PVC Coated Conduit must be certified by the manufacturer and be able to present a valid, unexpired certified installer card.
12. 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. A copper bonding conductor shall be pulled in each raceway and bonded to equipment at each end with approved lugs.
3. Each underground run shall be placed in a trench with a five (5) inch sand bed evenly compacted on all sides, top and bottom unless otherwise noted.
4. Elbows, and risers shall be per exposed conduit transition detail. PVC conduit is not allowed above ground except where specifically called out on the Drawings.
5. 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.
6. 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.
7. PVC conduit shall be stored on a flat surface and shielded from the sun.

E. Liquid Tight Flexible Non-metallic Conduit (up to 2") - (FLEX)
1. Liquid tight flexible Nonmetallic Conduit shall be constructed of flexible PVC and have a smooth inner surface with integral crush resistant reinforcement within the conduit and be designated as a Type LFNC-B (for FNMC-B).
2. Liquid tight Flexible Nonmetallic 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 UL1660.
4. Liquid tight flexible non-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 Nonmetallic Conduit and shall be marked LFNC-B (FNMC-B).
6. Flexible Non-Metallic Conduit shall be Carlon Carflex or equal.

F. 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.

2.02 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.

2.03 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 Back Filling:
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. 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. Excavation and back fill of conduits shall conform to the requirements of other applicable Specifications sections unless modified on plans, and to other entities (Utilities, etc.) as required.

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. 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. 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.

F. 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

G. 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 Representative 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.
    d. Motors with pigtail leads: Install terminal connectors on the motor pigtails and the cable to be connected. Terminals shall be non-insulated crimp-on type applied with a rachet-type crimping tool. The terminals shall be bolted together with a nut, bolt and lock washer combination. The connection shall be booted with 3/16” thick rubber boot. Boot kit shall include rubber boot for each motor connection, plastic locking pins, silicone grease, and mastic sealing strips, Boot kits shall be 3M Motor Lead Pigtail Splice #5302, #5303,or #5404 as applicable for wire size applied.
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 #6 and smaller in underground pullboxes shall have wire-nut connections which are sealed with non-hardening silicone based sealant that protects the connection from moisture and corrosion. The wire nuts shall be factory filled with sealant and UL listed for waterproof connections. Provide Ideal Model 60 or equal.

e. Non-Motor Splices #4 and larger in underground pullboxes shall have double hex crimp barrel connections applied with adhesive/sealant filled heat shrinkable rubber insulation applied over the exposed connection. The cross-linked polyolefin shrink tube shall extend 4" on each side of the exposed connection minimum. Heat shrink tubing shall be 3M ITCSN 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 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. The utility service ground shall be tied to a building ground grid consisting of a "UFER" and/or ground rod type grounding system.
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.

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 PVC conduits

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. Every piece of equipment shall be grounded per NEC.
5. 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. Each nonmetallic conduit shall contain a code sized grounding conductor.
   3. 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.
   4. 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.
   5. Utilize mechanical connections in accessible locations and exothermic connections in non-accessible or buried locations.
   6. The secondary on all transformers shall be grounded.
   7. All raceway systems, supports, enclosures, panels, motor frames, and equipment housings shall be permanently and effectively grounded.
   8. 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
   9. All receptacles shall have their grounding contact connected to a grounding conductor.
   10. 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.
   11. 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.

12. 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.

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 16480 - MOTOR CONTROL CENTER

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Provide Motor Control Center(s) (MCC)(s) as specified herein and shown on the drawings.

B. Custom control wiring for MCC per the Drawings. MCC manufacturer's standard control (not power) wiring shall be removed and replaced by Control System Integrator to meet the custom requirements of the Drawings and these specifications. The Control System Integrator (panel shop) shall perform and be responsible for all control wiring within the MCC. System Integrator is defined in Electrical Specifications [Electrical General].

C. All wiring, wire color codes, wire labeling and terminal blocks within MCC shall be as specified in Electrical Specifications [Wire, Fuses and Terminal Blocks].

D. The MCC scope of work includes:
1. Providing MCC structure and all internal components.
2. Installation of the MCC and concrete pad per details.
3. Submittal data and drawings.
4. Startup assistance.
5. Factory and field testing.
6. Operation and maintenance manuals.
7. Warranty of all components.

E. Startup and configuration of MCC with actual motor load.

F. 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 [Low Voltage Wire & Data Cable]

C. Electrical Specifications [Panelboard and Power Transformer]

D. Electrical Specifications [Variable Frequency Drive]

E. Electrical Specifications [Factory and Field Testing]

1.03 SUBMITTALS REQUIREMENTS

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

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

C. Submit base plan of MCC showing conduit entry areas.

1.04 OPERATING AND MAINTENANCE INFORMATION

A. Provide operation and maintenance instructions as specified in Electrical Specifications [Electrical General].

PART 2 PRODUCTS

2.01 MOTOR CONTROL CENTER

A. General
1. The motor control center (MCC) shall be Allen Bradley Centerline, Cutler Hammer Freedom, Square D Model 6 or approved equal.
2. The motor control center (MCC) shall be built and tested in accordance with:
   a. NEMA Standards
   b. ANSI
   c. Underwriters Laboratories, Inc.
3. The MCC shall comply with all provisions of UL 845, and bear a separate U.L. label on each individual MCC section. All wiring, devices, and components contained within the MCC shall be individually U.L. listed. An overall UL approval and labels shall be provided for the individual MCC sections prior to delivery from the factory, field UL labeling will not be allowed.
4. The MCC shall be 600 volt rated and built to operate from incoming voltage as shown on the electrical one-line drawings.
5. The MCC shall be provided with the type, capacity, and ratings of components shown on the Drawings or otherwise specified. The breakers shall be rated to withstand the fault current of 42,000 RMS symmetrical amperes or as otherwise shown in the drawings.
6. MCP breakers shall be selected to have trip and breaker size based on the service factor amperage to meet NEC. When the MCP breaker size changes due to a different motor size and amperage than that shown on

the Drawings, the Contractor shall provide the properly sized MCP breaker at no additional cost.

7. All breakers shall be provided with handle padlock provisions or thru-door operators with padlock provisions.
8. MCC structures shall provide for all equipment detailed on the single line Drawings including all spares and spaces. Where possible the MCC shall be built in strict accordance with overall sizing and component layouts as detailed on the Drawings and no deviations will be allowed without prior approval.
9. When physical size requirements for individual components are different than that detailed on the MCC elevation Drawings, the single line drawing shall supersede the elevation drawing and the Contractor shall furnish additional vertical and/or horizontal sections as needed to fit the electrical equipment as shown in the one-line diagram. 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 on the one-line diagram.
10. All devices and component of a similar type of function (i.e., circuit breakers, contactors, control relays, timers, etc.), shall be the product of one manufacturer.
11. All starters and contactors shall be rated and designated in accordance with NEMA standards. Starters and contactors rated in amperes without manufactures published data indicating the corresponding NEMA sizes are not acceptable. Submittals shall provide cross reference data which includes details of the manufacturer compliance with NEMA standards and tests.

B. Construction

1. MCC section construction shall consist of a NEMA 1A enclosure fabricated from 12 ga. formed steel channels. The subframes shall be welded and bolted to longitudinal members to form the complete rigid self supporting frame. Side, back and roof covers of 14 ga. steel shall be mounted with screw fasteners for quick and easy removal. All cubicle and wireway doors shall be hinged and made of 14 ga. steel with a ½" flange to provide rigidity.
2. The MCC shall consist of standard metal enclosed, freestanding, dead front and dead back vertical sections, not more than 90 inches in height and not less than 20 inches deep. The composite MCC shall consist of vertical sections that are of equal height.
3. Usable space for control equipment excluding the upper and lower wireways of MCC shall be 72 inches. Cubicles shall be spaced in increments of six inches. Minimum Cubicle height shall be six inches.
4. Each section shall be provided with a horizontal top and bottom wireways. Wireways shall be readily accessible and isolated from all

busing by grounded steel barriers. The bottom wireways shall have adequate conduit entrance area and shall not be obstructed by transformers, capacitors or other devices. The wireways in each section shall line up horizontally with wireways in the adjacent sections. The side panels shall be eliminated between adjacent sections so that wires may be pulled through wireways the entire MCC length.

5. Where shown on the Drawings, isolated (4" minimum width) vertical wireways shall be provided in each section with a dedicated door(s). Vertical wireways shall connect the top and bottom horizontal wireways for cable routing. Vertical wireways shall have wire hangers for wire tie down spaced throughout the complete vertical trough. Vertical wireway doors shall be latched by quarter turn indicating type fasteners.
6. The MCC shall be designed for front access maintenance. All wiring, bus joints, and other mechanical parts requiring tightening or other maintenance shall be accessible from the front. Rear or side access shall not be necessary for inspection or maintenance.
7. All steel work shall be immersion cleaned and phosphated to inhibit rust prior to painting. A 2 mil thick (minimum) electrostatic powder paint coat shall be applied to all surfaces and baked to thermoset. MCC compartment interior color shall be white. All other interior MCC structure surfaces shall be finished in ANSI 61 light gray color. MCC painting process shall meet UL 1332 for electrical equipment steel enclosures. No field painting will be allowed except for "touching up" of damaged areas.
8. A manufacturer's nameplate shall be attached to the MCC giving the model number, serial number, bus amps, voltage, and other manufacturer's information pertaining to the MCC construction.
9. The MCC shall be furnished completely factory assembled and shipped to the jobsite in with multiple MCC sections bolted together, maximum 100 inch wide pieces. Removable lifting angles or eyes shall be provided on the top of each MCC shipping section. Quick disconnecting terminal blocks shall facilitate field re-assembly of multiple shipping sections.
10. The MCC shall be factory inspected and witness tested prior to it being shipped to the jobsite. If the MCC is shipped to the jobsite without witnessed factory inspection and testing, then the Contractor shall remove the MCC from the jobsite, and return it to the factory for factory inspection and witness testing, all at the expense of the Contractor.

C. Bus System

1. All vertical and horizontal bus material shall be tin plated copper. Aluminum bus will not be considered equal to copper bus. All buses, except ground buses, shall be completely isolated from front Cubicles by steel plates or insulating material.

2. A continuous horizontal bus shall be furnished and rated as shown on the Drawings.
3. A full length vertical bus shall be furnished in each section and rated as shown on the Drawings. Current rating shall apply to the full length of the vertical bus, tapered bus shall not be allowed. Vertical buses shall be insulated and isolated with glass polyester or equivalent continuous barriers. Cutouts in the insulation covering the bus shall be provided for plug in connections. Unused plug-in openings shall be covered with removable insulating material. Lower ends of vertical buses shall be insulated from wireway access.
4. Buses shall be sized and braced to withstand a fault of 42KAIC minimum, or as otherwise shown in the drawings, whichever is higher. The MCC, breakers and other components all shall be individually and as a group, rated to isolate a fault current of this magnitude.
5. Vertical section buss ratings shall be sized by manufacturer for loads as defined in the drawings, as re-configured by the system integrator, or as needed for a robust and properly designed system. Vertical section ratings, if shown, are minimum requirements only.
6. A ground bus shall be provided in the bottom horizontal wireway of each section. The ground bus shall be rated as shown on the Drawings. It shall be electrically continuous the entire width of the MCC. Provide cable lugs on each end of the ground bus.

D. Cubicles
1. Cubicles shall be isolated from each other by horizontal steel plates without openings that are a part of the structure itself. Draw out units shall totally isolate enclosed equipment. All unused openings to the adjacent vertical wiring space shall be plugged. All openings used for wiring shall have insulating grommets.
2. Doors for each cubicle shall be fabricated from formed sheet steel of not less than 14 gauge thickness. The door opening shall be of sufficient size to permit ready removal of any of the devices in the cubicle. Doors shall be mounted on adjustable and removable pin type concealed hinges so arranged that cubicle doors may be removed without disturbing cubicle doors above or below. Door latches shall be quarter turn indicating type fasteners. Overload relays shall be reset from outside the enclosure by means of an insulated button mounted on the door.
3. An operator mechanism mounted on the draw out unit shall provide the means for operating the cubicle breaker or disconnect switch. The operator shall extend through an opening in the cubicle door and shall clearly indicate whether the disconnect is "on", "off", or "tripped". This indication shall function whether the door is open or closed. The operating mechanism shall not be attached to the cubicle door.

4. Each cubicle for combination starters, breakers, and disconnect switches shall be draw out construction, containing individual units. Draw out provisions shall include a positive guide rail system and stab shrouds to absolutely ensure alignment of stabs with the vertical bus. The stabs shall be tin plated copper alloy and shall provide a self aligning pressure connection. The stab design shall assure a consistent low resistance contact with the vertical bus even after repeated insertions and removals. Power wiring to stabs shall be contained within the draw out unit; no wire shall extend behind the unit.
5. All similar cubicles shall have the same structural features and the units shall be interchangeable.
6. A mechanical interlock shall prevent opening of the door when the disconnect is in the "on" position,. This interlock shall be provided with a defeater so that authorized personnel may gain access to the cubicle without interrupting service. This interlock shall also prevent unintentional closing of the disconnect when the cubicle door is open. A second mechanical interlock shall prevent any possibility of removing or reinserting the draw out unit while the disconnect is in the "on" position.
7. The operator handle mechanism shall allow padlocking of the disconnect in the "off" position with up to three padlocks.
8. Cubicle interconnect wiring shall be to unit mounted, class B, pull apart terminal blocks located on the right side of the cubicle between the cubicle and the wireway.
9. Pushbuttons, selector switches, and indicating lights shall mount on a removable device panel which is part of the draw out unit unless otherwise shown in the drawings. The device panel shall not be part of the door.
10. Cubicles containing panelboards shall have a card holder on the inside of the door.
11. Cubicles containing motor starters shall each have an overload heater selection table posted inside the door.
12. MCC Cubicles labeled as space shall have a blank hinged door and drawout relay panel installed, occupying the full space area.

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. Factory control wiring (not power) shall be removed and rewired by the local MCC supplier per control diagrams as shown in the Drawings. Factory control wiring as a standard of a major MCC manufacturer is not of acceptable quality or

customization as required per Electrical Specifications [Electrical General].and Drawings. The UL label from the MCC Manufacturer is required to extend to the new wiring furnished by the System Integrator.

1. All work in this Section shall conform to the codes and standards specified in Electrical Specifications [Electrical General].
2. Wire, terminal blocks and wire labeling shall conform to Electrical Specifications [Wire, Fuses and Terminal Blocks].

C. Requirements of related electrical sections apply to design, submittals, materials, construction, and testing.

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

3.02 INSTALLATION

A. Vertical sections shall be mounted on steel channel sills continuous on two sides. The steel channel sills shall be heavy duty to meet the specific seismic requirements of this project location. These sills shall be mounted on the concrete pad to be installed per the Drawings.

B. Conduit entering MCC shall be stubbed up 1" into the bottom horizontal wireway (typically) directly below the vertical section in which the conductors are to be terminated.

C. All motor starters that utilize changeable overload heater elements shall be installed prior to shipment to the project site. The Electrical Contractor shall perform check and adjustment per the motor nameplates for the full load amperage (FLA) rating of motors.

D. Field interconnect wiring to the MCC shall be neatly grouped by cubicle and bound by plastic tie wraps. All wiring shall be supported so that circuit terminations are not stressed.

E. Provide extension handles for breakers with center of the grip of the operating handle, when in its highest position, is above 78" from floor in order to conform with NEC article 380-8.

F. The as-built electrical drawings shall be placed in a water tight plastic wrap and shipped with the MCC to the jobsite.

G. MCC supplier to provide all necessary lugs for connection of power cables to MCC bus, breakers and motors.

H. Base of MCC shall be adequately grouted, caulked or sealed to prevent the entry of insects and rodents.

3.03 FIELD ASSISTANCE

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

B. The results from all testing shall be recorded and submitted for record.

3.04 WARRANTY

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

END OF SECTION

SECTION 16481 - VARIABLE FREQUENCY DRIVE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Provide each variable frequency drive as shown on elementary and one-line Drawings. Variable frequency drive shall be provided with full speed bypass, harmonic conditioner, line and/or load reactor, RFI filter and/or other accessories where shown on The Drawings. All VFDs shall be of the same manufacturer.
   1. The System Integrator shall perform and be responsible for procurement, submittals, shop drawings, testing, and all control wiring for the VFD. System Integrator is defined in Electrical Specifications [Electrical General].

B. Provide enclosure (and side mounted wire chase as required) for top or bottom feed conduit connection as shown in the Drawings. Enclosure size shall not exceed the space allocated in the Drawings for such use.

C. Provide cooling/ventilation system, mounting hardware, associated components, devices, and field control stations. Some components may be specified in other Electrical Specifications such as terminal blocks, wire, buttons, etc.

D. Installation of the VFD with components as specified in Electrical Specifications [Electrical General]. The VFD scope of work includes:
   1. Providing and installing VFD(s) of rating shown on The Drawings.
   2. Submittal data and drawings.
   3. Startup assistance.
   4. Factory and field testing.
   5. Operation and maintenance manuals.
   6. Warranty of all components.

E. Startup and configuration of VFD with actual motor load.

F. 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 [Low Voltage Wire & Data Cable]

C. Electrical Specifications [Factory and Field Testing]

1.03 SUBMITTALS REQUIREMENTS

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

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

1.04 OPERATING AND MAINTENANCE INFORMATION

A. Provide operation and maintenance instructions as specified in Electrical Specifications [Electrical General].

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

PART 2 PRODUCTS

2.01 GENERAL

A. 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 stayed and 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 industrial grade 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.

B. The VFD is inclusive of the input stage, buss, output stage, input filters, output filters, and all other assemblies, boards, or conditioning equipment, that make up the entire VFD system. The VFD system is herein referred to simply as “VFD” and is not to be parsed in any way to meet a specification as a specific part or assembly where it cannot be met as a system.

C. Products that are specified by manufacturer, trade name, or catalog number establish a standard of quality and do not prohibit the use of equal products of other manufacturers provided they are favorably reviewed by the Owner and/or Engineer prior to installation.

D. Underwriter’s Laboratories (UL) listing is required for all substituted equipment when such a listing is available for the first named equipment.

2.02 QUALITY

A. All equipment and materials shall be new 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. 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 stayed and 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.

C. Products that are specified by manufacturer, trade name, or catalog number establish a standard of quality and do not prohibit the use of equal products of other manufacturers provided they are favorably reviewed by the Owner and/or Engineer prior to installation.

D. Underwriter's Laboratories (UL) listing is required for all substituted equipment when such a listing is available for the first named equipment.

2.03 VARIABLE FREQUENCY DRIVE

A. This specification is based on Allen Bradley PowerFlex, Fuji Eco Drive, ABB ACS, or equal.

B. The VFD shall be of the latest technology used to control and maintain a process variable (level, flow, pressure, speed, etc.) by varying the motor speed. The VFD shall be available from a single manufacturer in the horsepower range of 1 to 500 HP.

C. Performance Requirements
   1. Harmonic Attenuation (applies to 6 pulse drives as shown in Drawings)
      a. First order harmonic mitigation shall be provided in the form of DC choke or Line Reactor for all installations. An internally mounted AC line reactor or DC choke shall be provided to reduce input current harmonic content, provide protection from power line transients such as utility power factor correction capacitor switching transients and reduce RFI emissions.

b. Provide a DC choke to mitigate harmonics and provide equivalent to 5% impedance. A 5% impedance DC choke may be provided in lieu of a line reactor.
c. If the provided DC choke cannot provide an equivalent 5% input impedance, then an external 5% line reactor shall be provided.

2. Harmonic Attenuation (applies to Ultra Low Harmonic (ULH) as shown in Drawings)
   a. The VFD shall have an active filter line supply unit which controls the low order harmonic current to reduce the harmonic current impressed on the incoming power feeder.
   b. The input current to the VFD shall limit the total harmonic content to less than 5% of the VFD's rated input on any power system and under all operating conditions.
   c. The VFD shall comply with IEEE 519 requirements.
3. Open loop static speed regulation shall be 0.5 % to 1% of rated motor speed. When motor speed feedback is provided from a suitable encoder, closed loop speed regulation shall be 0.1% of motor nominal speed. Dynamic speed accuracy shall be less than 1%-sec with 100% torque step open loop and 0.5%-sec closed loop with 100% torque step. 2. Torque control response time shall be less than 10 ms with nominal torque. In the torque regulating mode, torque regulating accuracy open loop shall be +/- 5%; torque regulating accuracy closed loop shall be +/- 2%;

D. Ratings
1. The VFD shall employ a full wave rectifier to prevent input line notching and operate at a fundamental (displacement) input power factor of 0.98 at all speeds and nominal load.
2. The VFD efficiency shall be 97.5% or better at full speed and load. Efficiency is defined as the output power divided by the input power in terms of percentage. All internal system losses recognized.
3. Load The VFD shall be designed to continuously operate the following motor/pump load:
   a. Motor NEMA design B, squirrel-cage induction or specialty specific use motor per Mechanical Division Specification as shown in Drawings.
   b. Horsepower at full speed R.P.M. of submitted/approved motor.
   c. Voltage, 230/460 VAC, three phase, 60 Hz.
   d. Service factor, 1.15 S.F.
4. Input Power The VFD shall be rated to continuously operate under the following input power conditions:
   a. The Drive shall be rated to operate from 3-phase power at nominal voltage (208VAC to 600VAC, +10% /-15% as shown in Drawings), 48Hz to 63Hz.

b. The overvoltage trip level shall be a minimum of 30% over nominal, and the undervoltage trip level shall be a minimum 35% under the nominal voltage.
c. Three phase, phase rotation insensitive.
d. Displacement power factor, 0.95 lagging at all loads and speeds above 10% rated load.

5. Output Power The VFD shall be rated to continuously operate while providing the following output power conditions:
a. Voltage, 0 to 500 VAC.
b. Frequency, 3 to 60 Hz.
c. Continuous motor horsepower.
d. VFD amp output (minimum).
e. Continuous current - as shown in Drawings or 115% of rated motor nameplate amps, whichever is higher.
f. Short term normal current, 110% of continuous rated current for a minimum duration of 1 minute per every 10 minutes running.
g. Short term heavy duty overload current, 150% of continuous rated current for a minimum duration of 1 minute per every 10 minutes running.
h. Waveform - sine coded PWM.
i. The drive's switching pattern shall be continually adjusted to provide optimum motor flux and avoid the high-pitched audible noise.
j. Diodes and transistors shall have a minimum withstand of 1,200 peak inverse voltage (PIV).

6. Environmental The VFD shall be rated to continuously operate under the following environmental conditions:
a. Ambient temperature, 5°F to 122°F (-15°C to 50°C).
b. Altitude, no derating below 3,300 ft.
c. Relative humidity, 95% non condensing.
d. The drive shall be protected from atmospheric contamination by chemical gasses and solid particles pre IEC 60721-3-3, chemical gasses Class 3C2 and solid particles Class 3S2.
e. The drive shall be protected from vibration per IEC 60721-3-3 Class 3M4 (sinusoidal displacement 3.0 mm, 2Hz to 9Hz; acceleration 10m/s2, 9Hz to 200Hz).

E. Protection The VFD shall be provided with the following protection:
1. For each programmed warning and fault protection function, the Drive shall display a message in complete English words or Standard English abbreviations. The three (3) most recent fault messages along with time, current, speed, voltage, frequency and DI Status shall be stored in the Drive's fault history. The last ten (10) fault names shall be stored in Drive memory.

2. The Drive shall include internal MOV's for phase to phase and phase to ground line voltage transient protection.
3. Output short circuit withstand rating and ground fault protection rated for 100,000 AIC shall be provided per UL508C without relying on line fuses. Motor phase loss protection shall be provided.
4. The Drive shall provide electronic motor overload protection qualified per UL508C.
5. Protection shall be provided for AC line or DC bus overvoltage at 130% of max. rated or undervoltage at 65% of min. rated and input phase loss.
6. A power loss ride through feature will allow the Drive to remain fully operational after losing power as long as kinetic energy can be recovered from the rotating mass of the motor and load.
7. Stall protection shall be programmable to provide a warning or stop the Drive after the motor has operated above a programmed torque level for a programmed time limit.
8. Underload protection shall be programmable to provide a warning or stop the Drive after the motor has operated below a selected underload curve for a programmed time limit.
9. Over-temperature protection shall provide a warning if the power module temperature is less than 5°C below the over-temperature trip level.
10. The VFD shall constantly monitor the load current with an electronic thermal overload relay and trip the drive on motor overload. The electronic overload relay shall be adjustable and compensate for the reduced cooling of the motor at reduced speeds. This protection provides an orderly shutdown should the motor's thermal capabilities be exceeded and eliminates the requirement for conventional motor overload relays.

F. Digital programmer/controller –The VFD shall be equipped with a front mounted operator control panel (keypad) consisting of a backlit, alphanumeric, graphic display and a keypad with keys for Start/Stop, Local/Remote, Up/Down and Help. Two (2) Softkeys will be provided which change functionality depending upon the position within the parameter hierarchy or state of panel.
1. All parameter names, fault messages, warnings and other information shall be displayed in complete English words or standard English abbreviations to allow the user to understand what is being displayed without the use of a manual or cross-reference table.
2. The Display shall have contrast adjustment provisions to optimize viewing at any angle.
3. The control panel shall provide a real time clock for time stamping events and fault conditions.
4. The control panel shall include a feature for uploading parameter settings to control panel memory and downloading from the control panel to the same Drive or to another Drive.

5. All Drives throughout the entire power range shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating.
6. The keypad is to be used for local control, for setting all parameters, and for stepping through the displays and menus.
7. The keypad shall be removable and insertable under Drive power, capable of remote mounting, and shall have its own non-volatile memory.
8. Digital Programmer/Controller (HIM) shall be capable of remote door mounting. Cable for remote digital programmer/controller shall be supplied as shown in the Drawings. The HIM shall be mounted and housed to maintain the NEMA 12 door rating.
9. The standard operator panel shall provide a start-up, maintenance and diagnostic assistants that guides a new user through initial start-up and commissioning of the Drive as well as provide indications for maintenance and help to diagnose a fault. In addition, a PID assistant, Real-time Clock assistant, Serial Communications assistant, and Drive Optimizer assistant shall be included. A Drive Optimizer assistant permits the user to choose Drive set-up for low nose, drive & motor efficiency or motor control accuracy.
10. The door mounted human interface module (HIM) display shall be capable to view and adjust the following diagnostic and status indicators:
    a. VFD Speed % or Frequency
    b. Instantaneous overcurrent.
    c. Ground fault.
    d. Overtemperature.
    e. Overvoltage.
    f. Undervoltage.
    g. Overload.
    h. Overfrequency.
    i. Amps.
    j. Voltage.
    k. Temperature.
    l. Auxiliary Fault.
    m. Phase loss.
    n. Current limit.
    o. Power and kilowatt hours
    p. Power up delay.
    q. Status of discrete inputs and outputs.
    r. Values of analog input and output signals
    s. Values of PID controller reference, feedback and error signals.
11. Adjustments The following setting ranges shall be provided and made independently accessible for operator adjustment:
12. Speed/Torque control functions shall include:

a. Minimum speed/torque limits.
b. Maximum speed/torque limits.
c. Selection of up to seven (7) preset speed settings or external speed control
d. Two (2) independent built-in PID controllers to control a process variable such as pressure, flow or fluid level.
e. Two (2) analog inputs shall be programmable to form a reference by addition, subtraction, multiplication, minimum selection or maximum selection.

13. Output control functions shall include:
    a. Current and torque limit adjustments to limit the maximum Drive output current and the maximum torque produced by the motor. These limits shall govern the inner loop torque regulator to provide tight conformance with the limits with minimum overshoot.
    b. A torque regulated operating mode with adjustable torque ramp up/down and speed/torque limits.

G. Input and Output Terminations The VFD shall have terminals for input and output cabling as defined in the Conduit and Wire Schedule as shown on the Contract Electrical Drawings.

1. Provide power terminal blocks for motor lead connections where drive terminals are hard to reach or require drive cabinet disassembly to connect.
2. Five (5) digital inputs, all independently programmable with at least twenty-five (25) input function selections. Inputs shall be designed for 120 volts AC input or as otherwise shown in the Drawings. Input functions must include time delay start and hand and auto (Ethernet) control.
3. Two (2) form C relay contact digital outputs, all independently programmable with at least thirty (30) output function selections. Relay contacts shall be rated to switch a maximum two (2) Amps rms continuous current at a maximum switching voltage of 30VDC or 250VAC. Function selections shall include indications that the drive is ready (no faults and in remote), running, and are addressable from Ethernet as users choice.
4. Two (2) analog inputs, each selectable for 0VAC - 10VAC or 4mA - 20mA, and independently programmable with at least ten (10) input function selections. Analog input signal processing functions shall include scaling adjustments, adjustable filtering and signal inversion. If the input reference (4-20mA or 0-10V) is lost, the VFD shall give the user the option of the following: (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the VFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected

by the user. The Drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus.

5. Two (2) analog outputs providing 0 (4) to 20mA signals. Outputs shall be independently programmable to provide signals proportional to at least twelve (12) output function selections including output speed, frequency, voltage, current and power.
6. Provide I/O input and relay output expansion card(s) as needed to accommodate the I/O wiring as shown in the Drawings. The option card shall be integrally mounted to the drive.

H. Communications – The VFD shall include communications module for interface to the PLC. All settable parameters and instantaneous operational registers shall be accessible from the communications port.

1. Type
   a. Ethernet TCP/IP (Allen Bradley Ethernet/IP)
2. Add-On Instructions
   a. The VFD manufacturer must have an add-on instruction that is compatible with the PLC on this project. The add-on instruction provides a preconfigured message command to send and receive information from the drive. The add-on instruction must be a free download available from the manufacturer website at the time of bid and thereafter.
3. Command and Metering registers to include:
   a. Digital input reads (giving status of inputs)
   b. Digital output commands (to relay DOs)
   c. 3 phase voltage and current
   d. Power in KW, KWH and Power factor
   e. Elapsed motor run time
   f. Start/Stop
   g. Running
   h. Fault conditions
   i. Heat Sink Temperature
   j. Others as available.

I. Features The VFD shall have the following features:

1. Connection of the three incoming line leads and three-motor leads shall be the only connections necessary for manual operation of the VFD unit. All other wiring shall be prewired at the factory and self contained within the VFD unit. A 120 VAC control power transformer and other auxiliary power supplies shall be provided with the VFD for power to pilot lights, meters, relays, and miscellaneous devices specified to be supplied with the VFD. Lugs shall be provided for connection of all power leads;

terminal blocks shall be provided for all other wiring. Relay logic, wiring and enclosure layout shall be equivalent to that shown on the Drawings.

2. The VFD shall be protected by a circuit breaker disconnect unless otherwise shown in the Drawings. The disconnect shall be externally operated and shall have an operator mechanism that is an integral part of the enclosure. An operator mechanism shall be provided to allow padlocking the disconnect in the "off" position with up to two padlocks.
3. AC input fuses shall be provided on the line and/or load side of the VFD (if required by the manufacturer) to isolate the VFD power circuitry upon a fault condition.
4. Three (3) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed.
5. Transient and surge voltage power line input protection shall be provided for the VFD through use of metal oxide varistors (MOVs), surge protective module, or other approved equal methods. Transient protection integral to the VFD shall be provided to a minimum of 10,000 volts, 50 joules without failure. The transient protection shall meet or exceed ANSI C7, 90 1971 and IEEE 472 1974 Standards without failure. Failure is defined as loss of components in the VFD including power semiconductors and fuses. The VFD shall be protected from the following, as a minimum, power line transients and recover to automatically restart and resume normal operation without posting a fault:
    a. Switching the primary of a power transformer.
    b. Switching power factor correction capacitors “ON” and “OFF” line.
    c. De energization or energization of contactors, relays, and other power equipment from the power line.
    d. Starting and stopping of other motors when powered from Utility.
6. The VFD shall not be affected by or generate excessive electro magnetic interference (EMI). The VFD shall be provided with a radio interference filter (RIF) to meet the following requirements:
    a. The use of a 4 Watt hand held VHF/UHF transceiver within three feet of the VFD with its doors closed shall not cause erratic operation, loss of configuration, or any other deviation from normal operation.
    b. The worst case conducted and radiated EMI generated by the VFD shall not be enough to prevent the use of hand held VHF UHF transceivers within three feet of the VFD with its doors closed.
7. Opening of the VFDs input switches, circuit breakers, or output contactors while the VFD is operating under load shall not result in damage to the VFD power or control circuit components.
8. The VFD shall be capable of starting and operating without a motor load connected.
9. Phase loss protection shall be provided to prevent single phasing of the motor load.

10. The VFD shall have an instantaneous electronic trip circuit to protect the VFD from output line-to-line and line-to-ground short circuits. Output line-to-line and line-to-ground short circuits shall not damage the VFD.
11. Automatic fault reset to automatically restart the drive after any type of fault condition. This automatic restart shall repeat up to three attempts. This automatic reset shall be provided to prevent a drive fault from completely locking out on isolated nuisance fluctuations. When the drive is locked out after its automatic reset attempts the operator shall be able to reset the VFD by a local or remote manual reset pushbutton. Fault lockout shall be indicated on the door mounted drive fail pilot light.
12. The VFD shall be capable of continued operation during an intermittent loss of incoming line power up to five cycles.
13. The VFD shall automatically restart upon reapplication of power after a loss of line power. Momentary or sustained power failures shall not fault trip out the VFD or blow any fuses.
14. Any configuration of adjustments or controls not set by a switch or potentiometer shall be stored in nonvolatile memory. No configuration information shall be lost due to power failures of any duration.
15. The VFD shall be capable of starting into a rotating motor without tripping out on a fault.
16. The drive shall have an adjustable voltage boost control capable of providing additional starting torque to the motor at start. This control shall provide the additional voltage only at the frequency range required to start the motor thus reducing the additional motor heating excess voltage would cause at normal operating speeds.
17. The drive shall be equipped with critical frequency jump circuitry which allows the VFD to be setup to skip two bands of frequencies which cause excessive vibration or noise.

J. Enclosure The enclosure type shall be as shown in the Drawings - freestanding, wall mount, motor control center full section, or MCC cubicle mount construction. All components shall be accessible from the front of the enclosure. Rear or side access shall not be required in order to remove or service any component. The enclosure shall include the following in its construction:
1. The VFD shall incorporate thermostat/run controlled fans for cooling. The air flow through the VFD compartment shall provide proper cooling of the operating VFD at an (external cabinet) ambient temperature of 104°F. Fan mounting shall include reusable air filters on suction. Provide fans for suction and discharge vents as required maintaining air flow and forcing circulation.
2. Provide specific use fans located within the enclosure to cool, directly, specific components such as line filters or DV/DT filters.
3. Thermostat shall have bi-metallic adjustable set point range of 30° to 140°F. Thermostat shall have a switching capacity of 10A at 120 VAC.

Provide Hoffman A-TEMNO temperature switch or approved equal to operate fans. Thermostat shall operate fans in parallel with motor running output of VFD.

4. The VFD, including the enclosure and input protection, shall be UL listed for a minimum of 42,000 RMS symmetrical ampere fault withstand capability. VFDs consisting of the VFD, enclosure, and all accessories, that are not UL listed will not be approved.

2.04 SINGLE TURN POTENTIOMETER

A. Provide manual single turn potentiometer. Potentiometer shall be compatible with the VFD input for manual speed control. Potentiometers shall be Allen-Bradley 800H, Cutler Hammer or equal.

2.05 HARMONIC LINE/LOAD REACTOR

A. Provide three phase AC reactor intended for use as an input or output filter for AC-PWM variable frequency drives. Line reactor shall be current rated to maximum continuous VFD amp rating or as shown in the Drawings. The impedance of the reactor shall be 5% or as shown otherwise in the Drawings.

B. The line reactor shall be TCI KLR series, MTE, 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. Requirements of Related Electrical Sections apply to design, documentation construction and assembly of Variable Frequency Drives.

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

3.02 FIELD ASSISTANCE

A. Testing, checkout and start-up of the variable frequency drive equipment shall be performed under the technical direction of a factory trained authorized manufacturer representative.

1. The setup and programming of the VFD shall be provided by a factory-trained representative who is authorized by the VFD manufacturer to perform the startup. This setup and programming shall be done prior to and during the first application of power to the motor. The VFD

electronic motor overload protection shall be set to meet the motor nameplate and NEC Code requirements.

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

B. Provide 1 hour of “VFD 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 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, Application Programmer, 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, Application Programmer, 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. Testing will require combined efforts of the Contractor, System Integrator, Application-Programmer, and Construction-Manager. 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 testing of system operational testing (PLC and/or SCADA checkout) is going to require 1 week after pre-operational tests are done. Contractor and System Integrator shall assist in this start-up. Coordinate with Construction Manager to schedule this testing and 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 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 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 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 re-used 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 re-mounted, reconnected and made operational again. Troubleshoot existing MDS 900MHZ SS system.

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 Construction Manager. Completed test forms shall be given to the Construction Manager 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 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.

10. During the testing period, under the supervision of the System Integrator, the Construction Manager shall have unlimited and unrestricted access to the usage and testing of system hardware, configuration, software, meters and tools.
11. 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.
12. Acceptance and witnessing of the factory tests does not relieve or exclude the Contractor from conforming to the requirements of the Contract Documents.
13. 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.
14. 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.
15. 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 Construction Manager. 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 Construction Manager. The Construction Manager 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 Construction Manager 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, 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 Construction Manager shall be present during testing. Operational testing shall be performed by Contractor in the presence of the Construction Manager.
    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 Construction Manager 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
MCO	MCC Operational Test Form
CPO	Control Panel Operational Test Form
MOTOR	Motor 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 (30 seconds 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

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

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:

SIGNATUR

E

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.

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 and install Control Panels, Terminal Panels, and custom specific purpose panels per Drawings and Specifications.

B. Provide complete wired and tested panel with all devices installed per the contract Drawings and as stated herein.

C. 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, 5 spacing, 300 volt, minimum rating of 20 amps, and mounted on 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 an by PLC I/O card. 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.
7. Terminal blocks shall be gray in color unless otherwise shown on the Drawings.
8. Provide a ground terminal or connection point for each grounding conductor.
9. Provide a separate signal, common, and/or neutral terminal for every wire and PLC or remote device connection at minimum.

B. CP – Control Panel Terminal Blocks

Description	**Model number, Allen Bradley or equal**
General Purpose Terminal Block, 20A	1492-W3
Disconnecting Terminal Block, 20A	1492-JKD3
Grounding Terminal Block	1492-JG4
PLC AI Sensor Block, 3 Level. Use upper terminal for AI +/- and lower blocks for 24+ and 24-.	1492-WTS3 (2 per AI)
PLC Digital Output Relays, 120VAC, 6A, SPDT	700-HLT1U1

Note 1: General purpose relays are defined in ELECTRICAL – GENERAL

Note 2: Utilize two terminal blocks for each AI. Upper terminal shall be the analog signal, the middle block shall be 24v +, and the lower terminal shall be 24v -. Buss each terminal 24+ to each other, and buss each 24 – to each other utilizing terminal jumpers (copper finger buss or center screw type)

Note 3: 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.

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 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.

2.06 INTRINSICALLY SAFE BARRIER AND RELAY

A. Intrinsically safe relay

1. Intrinsically safe relay shall be UL listed for use where the probes and/or wiring is located in Class I or II, Division 1, Groups A-G hazardous atmospheres. The sensor circuit shall be incapable of igniting flammable gasses or dust. The relay shall be 120 VAC powered and have one 8 amp SPDT relay output. The relay shall be capable of single level or differential level service. The relay shall be wired to use two probe devices (latch device and unlatch device) for differential level service. The relay shall be wired to use a single probe device for single level service. Provide UL listed Warrick Series 27 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. 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.

C. 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.

D. 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.

E. 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.

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.

C. Wiring:

1. Panel Wiring: All wiring shall be installed in wireways between terminal blocks, PLC, and devices. Reference Contract Drawings for control panel power distribution diagram and control panel elementary diagrams.

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]

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.

2.02 PLC COMPONENTS

A. The following components (Allen Bradley, no equal) 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 (Main PLC at SLS)

1.	Processor – (1MB, 8 I/O, 24 IP nodes)	5069-L310ER
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-OF8
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

C. Micro Logix (SLS Backup PLC, and Equalization PLC)

1.	Processor – 1400	1766-L32AWA
	a. 120 VAC power	
	b. 20 – 120 VAC DI, 12 relay DO	
2.	Analog Input Module	1762-IF4
3.	Serial Cable, 45 CM	1761-CBL-PM02

2.03 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.

2.04 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.

2.05 BROADBAND WIRELESS CELLULAR ROUTER

A. Acceptable products: Sierra Wireless RV50NX 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

2.06 IP SERVICE ROUTER

A. Acceptable products: Netgate SG-2100.

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.

2.07 OPERATOR INTERFACE (OI)

1. Automation Direct C-More Model EA9-T15CL or equal.
2. Touch Screen
   a. 15 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. Modbus RS232, RS485 and Ethernet communication options. Provide cables for connection to PLC.
   b. Built in Web server for remote access and viewing screens on a network Windows computer.
   c. Remote control of process through web server interface.
   d. Type B USB port for programming.
   e. 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)

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 for automatic control of the station.

1.02 REFERENCES

A. Electrical Specifications [Electrical General]

B. 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 SUBMITTAL REQUIREMENTS

A. No submittals pertaining to this section are required.

PART 2 PRODUCTS

2.01 APPLICATIONS PROGRAM CODE

A. The Application Programmer will provide, install and test (with Contractor assistance) application programming.

2.02 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. (*YNRFA).
      3) All equipment (as marked on P&ID drawings) shall have a non-running alarm. (*YNRNA)
      4) Not in Auto alarm: All devices (valves, gates, pumps) with auto switch monitoring shall have associated "Not in auto" alarms. (*HNAFA).
      5) Moisture / Temperature alarms: All submersible pumps shall have "Moisture" and "Over temperature" alarms. (*SMFA and *SOTFA)
      6) Seal Water Fail alarm: All sludge type pumps shall have "Seal water fail" alarms. (*SWFA).
      7) Pressure alarm: All sludge type pumps shall have "Inlet and Outlet pressure" alarms. (*IPFA and *OPFA).
      8) Temperature alarm: All sludge type pumps shall have a pump body "Over Temp" alarm. (*OTFA).
      9) Differential pressure alarm: All filters shall have "Differential pressure" alarms. (*DPFA)
      10) Low oil alarm: All lubricated mechanical devices (gearboxes etc.) shall have a "Low oil" alarm. *LOFA)
      11) Vibration alarm: All moving mechanical devices (gearboxes, aerators, pumps etc.) shall have a "Vibration" alarm. (*VFA).
      12) Over torque alarm: All geared mechanical devices (clarifiers etc.) shall have an "Over torque" alarm. (*OTQFA)
      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. (*UAFA).

14) Flow, level, pressure, analytical and other analog alarms: All analog values will have at a minimum an associated alarm structure as defined in section 2.03.A.4.b.5 below.

15) All digital alarm values will have at a minimum an associated alarm structure as defined in section 2.03.A.4.c.3 below.

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 (Fxxxx) is positive, then increment the flow totalizers (FxxxxNRTOT, FxxxxRTOT and FxxxxTTOT) for each 1000 gallons of accumulated flow.
      2) If internal flow reset status (FxxxxRST) is set, then set resettable flow totalizer (FxxxxRTOT) to zero and reset FxxxxRST.
      3) Similar for all flowmeters / totalizers.
   b. Hour Meters (Example):
      1) If Generic Pump #1 running (PxxxxYNR) is set, then start hour timers PxxxxHRS, PxxxxRHRS and PxxxxTHRS.
      2) If internal run time hours reset status (PxxxxRHRSRST) is set, then set resettable run time hours (PxxxxRHRS) to zero and reset PxxxxRHRSRST.
      3) Similar for all device run time hours.
   c. Starts Counters (Example):
      1) If Generic Pump #1 running input (PxxxxYNR) is set or Generic Pump #1 start command (PxxxxXCS) is set (if

running input is not available), then increment starts counters PxxxxS, PxxxxRS and PxxxxTS.

2) If internal starts reset status (PxxxxSRST) is set, then set resettable starts counter (PxxxxRS) to zero and reset PxxxxSRST.

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

1. The Application programmer and Engineer will determine specific programming requirements during construction.
2. The functional details will not impact the construction means or methods.

2.03 OPERATOR INTERFACE (OI)

A. The Application Programmer shall configure the OI for access to the PLC, display of station information, and alarm notification.

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.

END OF SECTION

SECTION 16940 – INSTRUMENTATION

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The major components in the instrumentation scope of work are:
   1. Furnish, configure, test, commission, and warrant instrumentation as shown in the P&IDs, plans, and/or listed in specification section.
      a.
   2. Include necessary piping, valves, pressure reducers, mounting brackets or flanges, supports, and anchors to complete installation.
   3. Provide sunshades for instrumentation for all instruments that are exposed to direct sunlight.

B. 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.

C. 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.

D. 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.

E. The Contractor shall furnish all tools, calibration equipment, calibration materials, specialized parts and incidentals necessary to integrate the instrument to the application.

F. 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. 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 hermetically sealed 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 16A at 250 VAC shall be integrally mounted in the float and connected to a control box by a PVC jacketed waterproof electric cable with three finely stranded No.17 conductors. The weight shall be integrally mounted so that no metals shall contact the process liquid. Tilting type level switch shall be MJK Model 7030, or equal.

B. Ultrasonic Level Transmitter:
   1. The ultrasonic level transmitter shall utilize non-contacting ultrasonic signal reflection technology to provide level monitoring for up to 50 ft range.
   2. The transmitter shall feature advanced echo processing algorithms that can be configured to ignore selected echos.
   3. The transmitter shall be capable of controlling two pumps in a lead/lag configuration or using outputs for high and low level alarm outputs.
   4. 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.

5. 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.
6. The calibration of the level transmitter and cable length shall be as shown in the instrument schedule.
7. Provide one hand held or integral programming interface with each transmitter provided.
8. The ultrasonic level transmitter shall be Pulsar Ultra 4, 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.

2.04 PRESSURE COMPONENTS

A. Gauge, Absolute, or Differential Pressure Transmitter:
    1. Tag names: PIT-262 / 0-300 psi, LIT-252 / 0-30 psi.
    2. The pressure indicating transmitter shall be a loop powered, two wire, 4 20 mA signal transmitting device with signal derived from the applied sensor pressure. Transmitter shall be capable of driving 0 to 500 ohm loads with 24 VDC supply.
    3. The transmitter shall have the following features:
        a. Programmable 4-digit Liquid Crystal Display (LCD) process indicator.
        b. HART programming with programming selections for square root extraction, output calibration, and adjustable dampening 0.0 to 36.0 seconds, minimum.
        c. Integral microprocessor based circuitry with RFI filtering and shielding.
        d. The transmitter shall have accuracy of +/- 0.1% of span over a range of minimum 10 to 1 turndown. Elevated zero setting capable of 0-30% upper calibration limit.
        e. Operating temperature range shall be -40 to 185°F (minimum). Process wetted materials shall be compatible with fluid being measured with minimum hastalloy or ceramic diaphragm and 316 stainless steel wetted parts.
        f. Process connection shall be as follows:
            1) Low solids content - 1/2" MNPT with calibration valve.
            2) High solids content - 1-1/2” or 2” flange with flushing ring and valve.
            3) And as required per installation detail.

g. The transmitter shall be scaled as shown in the instrument schedule.

4. Provide mounting bracket per mounting requirements shown in Contract drawings.
5. The gauge pressure transmitter shall be Endress and Hauser Cerabar M PMC 71, Rosemount Smart 3051, or equal.

2.05 FLOW COMPONENTS

A. Magnetic Flow Meter:
1. Tag names: FIT-271 / 6" flanged, 0-2000 GPM, replacement of existing. Note lay length dimensions on drawings.
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 0.30% 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. The flow meter shall not require more than three diameters of straight pipe length from the center of the meter to upstream or downstream obstructions to obtain specified accuracies.
5. Flow Element (FE)
   a. The flow element shall be based on a 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 transmitter shall be provided in a NEMA rated enclosure per the Instrumentation Schedule.

b. 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.

c. 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.

d. The transmitter shall incorporate a high impedance amplifier of 100,000 Megohms or greater, eliminating the need for electrode cleaning systems.

e. 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.

f. 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.

g. 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.

h. 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.

i. 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.

j. 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.

k. 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).
    b. Flow Totalization Pulse: The Flowmeter shall feature a pulse output that is scaled to 1000 gallons per pulse unless otherwise shown.
        1) Provide solid state interfacing relay within control panel (as required) between flow meter voltage output and PLC discrete voltage input. Provide any necessary interfacing devices to make flow meter pulse duration and output rate compatible with PLC discrete pulse input rate.
    c. Meter Positive Zero Return: This contact input shall force the flow reading and output flow signal to zero flow.
    d. Flow direction digital output: Open collector transistor or relay output capable of driving 24 volt interface relay up to 100 mA. Output shall be configurable for either forward or reverse flow directions.
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 Sparling Tiger Mag, Endress and Hauser Promag, ABB Watermaster, Rosemount 8705, or equal. Lay length specified per drawings.

2.06 EVENT, STATE OR POSITION DEVICES

A. Position Switch:

1. Door switch – door intrusion switch shall have a wide gap magnetic sensor with S.P.D.T. contacts mounted in 1535an extruded aluminum housing with integral 3 foot stainless steel armored cable for wiring to a junction box. Switch contacts shall have 0.25A at 30VAC/VDC minimum capability. When attaching to a ferrous metal surface, space sensor components away from metal by minimum ¼" using plastic spacer in order to maintain magnetic gap. Intrusion door switches shall be Sentrol 2507-A 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.

B. The Contractor shall coordinate with each supplier of instrumentation to confirm that primary elements are provided in a timely manner, meeting critical path scheduling. The Contractor shall coordinate process connection size, equipment size, and material type when applicable and oversee the installation, calibration, and acceptance testing.

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

SECTION 16960 - BUBBLER SYSTEM

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This specification covers work required for bubbler level control system.

B. Bubbler System shall be fully assembled and functional with interconnecting tubing, instrumentation, fittings and valves.

1.02 REFERENCES

A. Electrical Specifications [Electrical General]

B. Electrical Specifications [Control Panels]

1.03 SUBMITTAL REQUIREMENTS

A. Provide submittals and drawings as specified in Electrical Specifications [Electrical General, Submittal Requirements]. Submit additional detailed information as listed below:
   1. System configuration with pipe riser areas defined.
   2. Detailed descriptions of equipment including weights, dimensions, installation requirements, and heat dissipations.
   3. Internal panel layouts indicating spacing and dimensions.

1.04 MANUFACTURER'S SERVICES

A. Provide equipment manufacturers services at the job site for the minimum man days listed below, travel time excluded:

B. One man-day to check the installation, calibrate the equipment, supervise start-up and supervise testing of the system.

1.05 OPERATION AND MAINTENANCE INFORMATION

A. Provide operating instructions as specified in Electrical Specifications [Electrical General, Operating and Maintenance Instructions].

B. Provide operation and maintenance manuals in accordance with Electrical Specifications [Electrical General].

PART 2 PRODUCTS

2.01 GENERAL

A. Bubbler system products shall be provided as required to meet the intent of the specifications. Some minor components are not listed or specified but shall be provided for an operational system. Those components shall be of similar quality, compatibility, and manufacturer catalog series where possible.

2.02 NAMEPLATES

A. Nameplates shall be per Electrical Specifications [Electrical General].

2.03 BUBBLER TUBING AND FITTINGS

A. Tubing: ¼" inch flexible nylon tubing with minimum 300 psi rating.

B. Wetwell (LE):
1. Dip tube – re-connect and reuse existing dip tube and existing ¼" nylon tube to bubbler panel.

C. Fittings, tees, connectors:
1. Stainless steel compression type tube fittings complete with body nut and plastic ferrule. Provide Parker CPI tube fittings or equivalent.

2.04 VALVES

A. Provide the following valves
1. Solenoid Valve, 3 way, plastic body, ¼" compression connection, normally closed, with fittings for plastic ASCO Red-Hat Series 8360, or equal.

2.05 AIR REGULATION DEVICES

A. Pressure Filter/Regulator: Anodized aluminum with ¼" FNPT ports and anodized aluminum bowl. Filter element shall be 1 micron coalescing filter. Regulator shall be adjustable from 10 to 30 psi and be able to withstand pressures of 250psi. Pressure gauge shall be rear mount 1/8" NPT, 1" diameter with 0-30 psi gauge. Provide Balston #AFR-940A-30 with mounting bracket 11536 or equal.

B. Air Flow Regulator: Polycarbonate plastic 4% accuracy, 2-inch scale, 0.1 to 1 standard cubic feet per hour (SCFH) range, with stainless metering valve. Provide Dwyer RM Rate-Master flow meters, catalog number RMA-2-SSV or equal.

2.06 GAUGES

A. Regulated Air Supply Gauge: Provide 0 to 160 psig air pressure gauge for monitoring regulated supply air pressure. Provide ASHCROFT # 25-1009 AWO2BX, VC-60 psig or equal.

2.07 LEVEL INSTRUMENTATION

A. Pressure/Level Transmitter
   1. The pressure indicating transmitter shall be a loop powered, two wire, 4 20 mA signal transmitting device with signal derived from the applied sensor pressure. Transmitter shall be capable of driving 0 to 500 ohm loads with 24 VDC supply.
   2. The transmitter shall have the following features:
      a. Programmable 4-digit Liquid Crystal Display (LCD) process indicator.
      b. HART programming with programming selections for square root extraction, output calibration, and adjustable dampening 0.0 to 36.0 seconds, minimum.
      c. Integral microprocessor based circuitry with RFI filtering and shielding.
      d. The transmitter shall have accuracy of +/- 0.1% of span over a range of 10 to 1 turndown. Elevated zero setting capable of 0-50% upper calibration limit.
      e. Operating temperature range shall be -40 to 185°F (minimum). Process wetted materials shall be hastalloy diaphragm and 316 stainless steel body. Process flanges shall be 316 stainless steel, 1/2" NPT.
      f. The transmitter shall be scaled for wetwell depth.
   3. Provide backpan mounting bracket as shown in Contract drawings.
   4. The gauge pressure transmitter shall be Endress and Hauser Cerabar M PMC 71, Rosemount Smart 3051, 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 INSTALLATION

A. Equipment Mounting:

1. Mount all equipment using manufacturers mounting tabs/holes 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. Wiring:
1. Install all products per Electrical Specifications [Electrical General, Installation].
2. All field wires and panel wires shall be per Electrical Specifications [Wire, Fuses & Terminal Blocks].
3. Panel Wiring: All wiring shall be installed in wireways between terminal blocks, PLC and devices. Reference Contract drawings for Control panel power distribution diagram and control panel elementary diagrams.

C. 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. The Contractor shall exercise care when using a vacuum cleaner or compressed air such as not to permanently damage any component within the panel.

3.03 FIELD ASSISTANCE

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

3.04 WARRANTY

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

END OF SECTION

PART V

DRAWINGS

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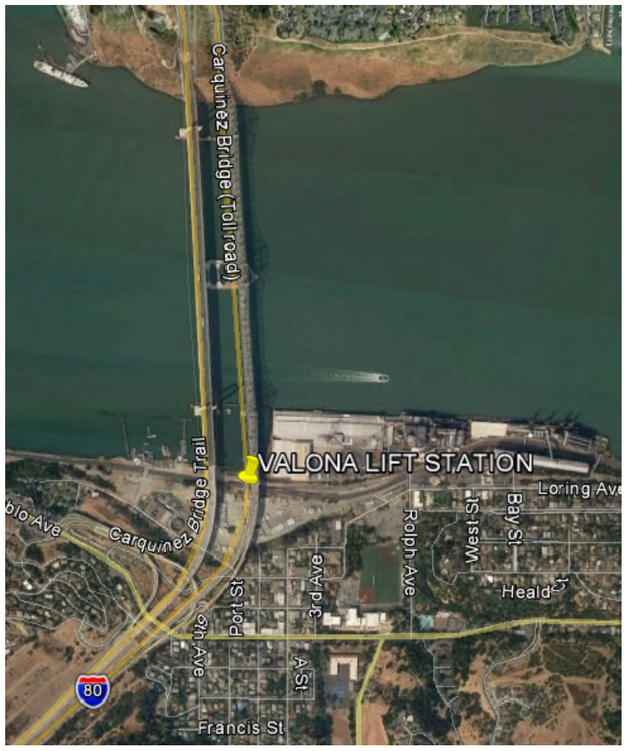
CROCKETT COMMUNITY SERVICES DISTRICT
CONSTRUCTION DRAWINGS
FOR
VALONA LIFT STATION
MCC UPGRADE

FEBUARY 2018



LOCATION MAP

SHEET INDEX

DRAWING	SHEET NO.	DESCRIPTION
E-00	1	TITLE SHEET
E-01	2	ELECTRICAL SYMBOLS AND ABBREVIATIONS
E-02	3	EXISTING SWITCHBOARD/MCC ONE-LINE DIAGRAM AND ELEVATION
E-03	4	NEW MCC ONE-LINE DIAGRAM AND ELEVATION
E-04	5	FVNR STARTER ELEMENTARY
E-05	6	VFD PUMP ELEMENTARY
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DRAWING NO.

E-00

COMPONENTS

SYMBOL	DESCRIPTION
RES	RESISTOR
SV	SOLENOID COIL
HTR	HEATER
	CAPACITOR
	DIODE
	DIODE, ZENER
MOV	METAL OXIDE VARISTOR
	AUDIBLE ALARM
?	3 PHASE MOTOR ? = MOTOR HP
M	3 PHASE MOTOR
M	SINGLE PHASE MOTOR
	TRANSFORMER SIZE AND VOLTAGE AS SHOWN
M	UTILITY POWER METER
	UFER GROUND
	GROUND ROD
	CURRENT TRANSFORMER RATIO AS NOTED

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 (DECREASING VACUUM)
PS	PRESSURE SWITCH – OPENS UPON INCREASING PRESSURE (DECREASING 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
WS	TORQUE SWITCH – CLOSES UPON INCREASING TORQUE
WS	TORQUE SWITCH – OPENS UPON INCREASING TORQUE

DEVICES – RELAY

SYMBOL	DESCRIPTION
M1	CONTACTOR OR STARTER M1
CR	CONTROL RELAY CR1
TR 2	TIME DELAY RELAY TR2 – ADJUSTABLE TIME DELAY RANGE & SETTING AS SHOWN
TDOE	TIME DELAY ON ENERGIZATION
TDOD	TIME DELAY ON DE–ENERGIZATION
107, 121	REFERENCED RELAY WITH N.O. CONTACT ON LINE 107 N.C. CONTACT ON LINE 121
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
TR2	CONTACT OPENS AND CLOSES IN A TIMED REPEAT CYCLE

WIRING – CONNECTIONS

SYMBOL	DESCRIPTION
	PANEL OR EQUIPMENT WIRING
	FIELD WIRING
	CONDUCTORS – NOT CONNECTED
	CONDUCTORS – CONNECTED
	GROUND CONNECTION
	PLUG AND RECEPTACLE
	INCOMING LINE
123 123 123	TERMINAL BLOCKS WITH TERMINAL NUMBER AS SHOWN
	TERMINAL BLOCKS WITH TERMINAL NUMBER DETERMINED BY SUBMITTAL
SHIELD CONDUCTOR	SHIELDED CABLE

PLAN – SYMBOLS

SYMBOL	DESCRIPTION
	CONDUIT, EXPOSED
	CONDUIT, IN SLAB OR BELOW GRADE
	CONDUIT, CONCEALED IN WALL OR CEILING
	CONDUIT STUBBED OUT & CAPPED
	CONDUIT BENDS TOWARD OBSERVER
	CONDUIT BENDS AWAY FROM OBSERVER
	CONDUIT ENDS
J	FLEXIBLE CONDUIT CONNECTION FROM J–BOX TO EQUIPMENT
	CONDUIT CHANGE IN ELEVATION
G	BARE COPPER GROUND WIRE
G	GROUND CONNECTION BOLTED TYPE
G	GROUND CONNECTION EXOTHERMIC WELD TYPE
	DISCONNECT SWITCH
	FIELD MOUNTED DEVICE
	SPECIAL RECEPTACLE
	TELEPHONE/DATA RECEPTACLE 2 PORT TA568A, 2 CAT 6 CABLES
#	CONDUIT REFERENCE TO SCHEDULE
T	THERMOSTAT
E	EYS SEAL
J	JUNCTION BOX
	PULL BOX OF SIZE SHOWN (CHRISTY BOX SIZE MINIMUM)
A a/#	LIGHTING FIXTURE # – CIRCUIT BREAKER NUMBER A – FIXTURE SCHEDULE REF. a – CONTROL SWITCH REFERENCE
WP #7 WP	DUPLEX RECEPTACLE # – CIRCUIT BREAKER NUMBER WP – WEATHERPROOF (IF SHOWN) GFI – GROUND FAULT TYPE
aM	TOGGLE SWITCH a – FIXTURES CONTROLLED 3 – 3 WAY M = MOTION DETECTOR T = TIMER SWITCH

SWITCHES – OPERATOR

SYMBOL	DESCRIPTION
SW	TOGGLE OR DISCONNECT SWITCH
PB	PUSHBUTTON – NORMALLY OPEN, MOMENTARY ACTION
PB	PUSHBUTTON – NORMALLY CLOSED, MOMENTARY UNLESS LOS (LOCK OUT STOP) WHERE MECHANICALLY HELD
PB	PUSHBUTTON, MECHANICALLY CONNECTED, DOUBLE CIRCUIT – NORMALLY CLOSED AND NORMALLY OPEN
HAND OFF AUTO	SELECTOR SWITCH, 3 POSITION – CONTACT STATUS SHOWN EXISTS I.E. AT POSITION OF HAND, OFF, OR AUTO SELECTOR SWITCH, 2 POSITION – MIDDLE POSITION IS DELETED
	POTENTIOMETER

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
ETM	ELAPSED TIME METER

DEVICES – PROTECTIVE

SYMBOL	DESCRIPTION
Y xA xP xT	LOW VOLTAGE MOLDED CASE, INSULATED CASE OR POWER CIRCUIT BREAKER. RATINGS AS SHOWN IN DRAWINGS AND AS DEFINED BELOW: xA: CIRCUIT BREAKER AMERAGE xAT: AMPERAGE TRIP xAF: AMPERAGE FRAME xP: NUMBER OF POLES xT: TRIP PROTECTION MCP: MOTOR CIRCUIT PROTECTION TM: THERMAL MAGNETIC L: LONG TIME DELAY S: SHORT TIME DELAY I: INSTANTANEOUS TRIP G: GROUND FAULT A: ARC FLASH PROTECTION 100% DUTY RATED
100%	y: BREAKER FEATURES / OPTIONS
S	– SHUNT TRIP
K	– KIRK–KEY INTERLOCK
M	– MANUALLY CHARGED PUSHBUTTON OPERATION
E	– ELECTRICALLY CHARGED PUSHBUTTON OPERATION
OL	THERMAL OVERLOAD CONTACT
	THERMAL OVERLOAD ELEMENT
	FUSE MEDIUM VOLTAGE CIRCUIT BREAKER
52	TRIP FUNCTIONS PER DRAWINGS AND SPECIFICATIONS
MFR	MULTIFUNCTION RELAY PER SPECIFICATIONS

MISCELLANEOUS ABBREVIATIONS

&	AND	MTR	MOTOR
@	AT	MUX	MULTIPLEXER
A	AMBER, AMPERES	MV	MERCURY VAPOR, MEDIUM VOLTAGE
AC	ALTERNATING CURRENT	N	NEUTRAL
ACK	ACKNOWLEDGE	NC	NORMALLY CLOSED
AFF	ABOVE FINISHED FLOOR	NHC	NORMALLY HELD CLOSED
AH	AMP HOUR	NHO	NORMALLY HELD OPEN
AI	ANALOG INPUT	NIC	NOT IN CONTRACT
AIC	AMP INTERRUPTING CAPACITY SYMMETRICAL	NL	NIGHT LIGHT
AM	AMP METER	NO	NORMALLY OPEN
AO	ANALOG OUTPUT	NTS	NOT TO SCALE
AWG	AMERICAN WIRE GUAGE	(N)	NEW
ATS	AUTOMATIC TRANSFER SWITCH	OC	ON CENTER
BATT	BATTERY	OI	OPERATOR INTERFACE
(B)	PROVIDED BY OWNER – INSTALLED BY CONTRACTOR	OL	OVERLOAD
BFC	BELOW FINISHED CEILING	ORP	OXIDATION REDUCTION POTENTIAL
BOD	BIOCHEMICAL OXYGEN DEMAND	P	POLE
BPF	BAND PASS FILTER	PB	PUSHBUTTON
BYP	BYPASS	PBX	PULL BOX
C	CONDUIT	PF	POWER FACTOR
CAP	CAPACITOR	PFR	POWER FAIL RELAY
CB	CIRCUIT BREAKER	PH	HYDROGEN ION CONCENTRATION
CKT	CIRCUIT	PLC	PROGRAMMABLE LOGIC CONTROLLER
COAX	COAXIAL CABLE	PM	POWER MONITOR
COMM	COMMUNICATION	PNL	PANEL
CR	CONTROL RELAY	POT	POTENTIOMETER
CT	CURRENT TRANSFORMER	PRESS	PRESSURE
CS	CONSTANT SPEED	PR	PAIR, TWISTED AND SHIELDED
CU	COPPER	PRI	PRIMARY
DC	DIRECT CURRENT	PROVIDE	FURNISH, INSTALL, AND CONNECT
DET	DETAIL	PS	PRESSURE SWITCH
DI	DIGITAL INPUT	PT	POTENTIAL TRANSFORMER
DISC	DISCONNECT	PTT	PUSH TO TEST
DO	DIGITAL OUTPUT	PVC	POLYVINYLCHLORIDE
DPDT	DOUBLE POLE DOUBLE THROW	PWR	POWER
DWG	DRAWING	REF	REFERENCE
E–DTL	ELECTRICAL DRAWING DETAIL	RFI	RADIO FREQUENCY INTERFERENCE
ELEV	ELEVATION	RMS	ROOT MEAN SQUARE
ENET	ETHERNET	RTD	RESISTANCE TEMPERATURE DETECTOR
ETM	ELAPSED TIME METER	RST	RESET
ESW	ETHERNET SWITCH	RVAT	REDUCE VOLTAGE AUTO TRANSFORMER
(E)	EXISTING	RTU	REMOTE TERMINAL UNIT
FCS	FIELD CONTROL STATION	(R)	REWIRE, RELOCATE, REVISE, REUSE
FLA	FULL LOAD AMPS	SCH	SCHEDULE
FLEX	FLEXIBLE LIQUID TIGHT CONDUIT	SEC	SECONDARY, SECOND
FRP	FIBERGLASS REINFORCED PLASTIC	SECS	SECONDS
FS	FULL SPEED	SEL	SELECTOR
FVNR	FULL VOLTAGE NON–REVERSING	SFA	SERVICE FACTOR AMPS
FVR	FULL VOLTAGE REVERSING	SPEC	SPECIFICATION
FWD	FORWARD	SS	STAINLESS STEEL
(F)	FUTURE	SSRC	STAINLESS STEEL RIGID CONDUIT
GALV	GALVANIZED	SSS	SOLID STATE STARTER
GFI	GROUND FAULT INTERRUPTER	STT	START
GND	GROUND	STP	STOP
GRS	GALVANIZED RIGID STEEL CONDUIT	SV	SOLENOID VALVE
GRS–PVC	PVC COATED GRS CONDUIT	SW	SWITCH
HI	HIGH	SWBD	SWITCHBOARD
HIM	HUMAN INTERFACE MODULE	SYMM	SYMMETRICAL
HOA	HAND OFF AUTO	TB	TERMINAL BLOCK
HP	HORSE POWER	TC	TIME CLOCK
HPS	HIGH PRESSURE SODIUM	TDOD	TIME DELAY ON DE–ENERGIZATION
HS	HAND SWITCH	TDOE	TIME DELAY ON ENERGIZATION
HTR	HEATER	TELCO	TELEPHONE COMPANY
HZ	HERTZ	TM	THERMAL MAGNETIC
HZD	HAZARD	TEMP	TEMPERATURE
I	INTERLOCK	TR	TIME DELAY RELAY
I–DTL	INSTRUMENTATION DRAWING DETAIL	TRIAD	TWISTED AND SHIELDED 3 CONDUCTOR
I/O	INPUT/OUTPUT	TS	TEMPERATURE SWITCH
INST	INSTANTANEOUS	TSPR	TWISTED AND SHIELDED PAIR
ISR	INTRINSICALLY SAFE RELAY	TVSS	TRANSIENT VOLTAGE SURGE SUPPRESSOR
IS	INTRINSICALLY SAFE	TYP	TYPICAL
J	JUNCTION BOX	UG	UNDERGROUND
K	KILO, PREFIX	ULH	ULTRA LOW HARMONIC
LA	LIGHTNING ARRESTOR	UON	UNLESS OTHERWISE NOTED
LC	LIGHTING CONTACTOR	UPS	UNINTERRUPTIBLE POWER SUPPLY
LEL	LOWER EXPLOSION LIMIT	V	VOLTAGE
LO	LOW	VA	VOLT AMPS
LOS	LOCK OUT STOP	VAR	VOLT AMPS REACTIVE
LR	LATCHING RELAY	VFD	VARIABLE FREQUENCY DRIVE
LS	LIMIT SWITCH	VLV	VALVE
M	MOTOR CONTACTOR	VM	VOLTMETER
MAG	MAGNETIC FLOWMETER	VMR	VOLTAGE MONITOR RELAY
MAX	MAXIMUM	VR	VOLTAGE RELAY
MCM	THOUSAND CIRCULAR MILS	W	WATTS
MCP	MOTOR CIRCUIT PROTECTOR	WP	WEATHER PROOF, NEMA 3R
MCS	MOLDED CASE SWITCH	WTP	WATER TREATMENT PLANT
MH	MANHOLE	WWTP	WASTE WATER TREATMENT PLANT
MIN	MINIMUM, MINUTE	XFMR	TRANSFORMER
MODEM	MODEM	Z	IMPEDANCE
MOV	MOTOR OPERATED VALVE	ZS	LIMIT SWITCH

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VALONA LIFT STATION MCC UPGRADE
ELECTRICAL
SYMBOLS AND ABBREVIATIONS

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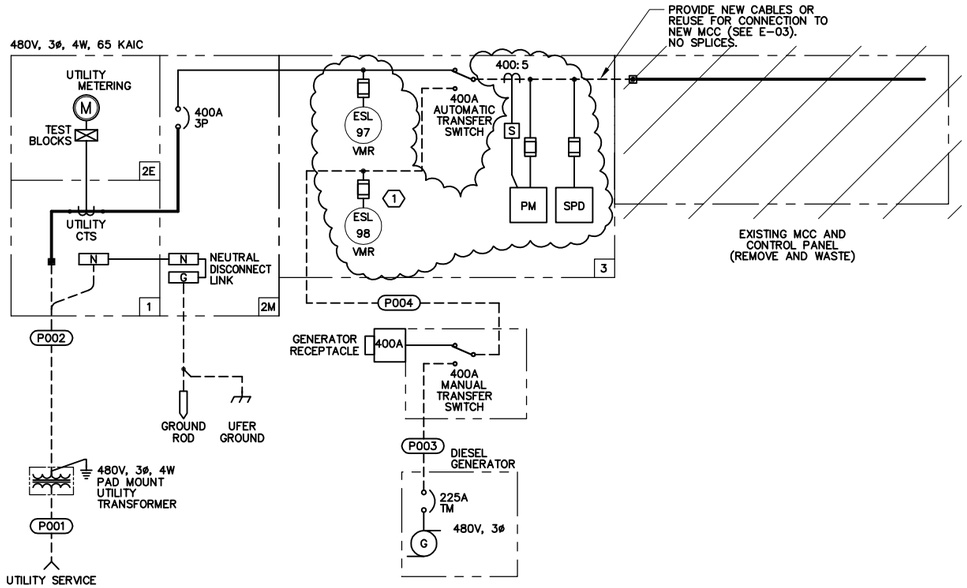
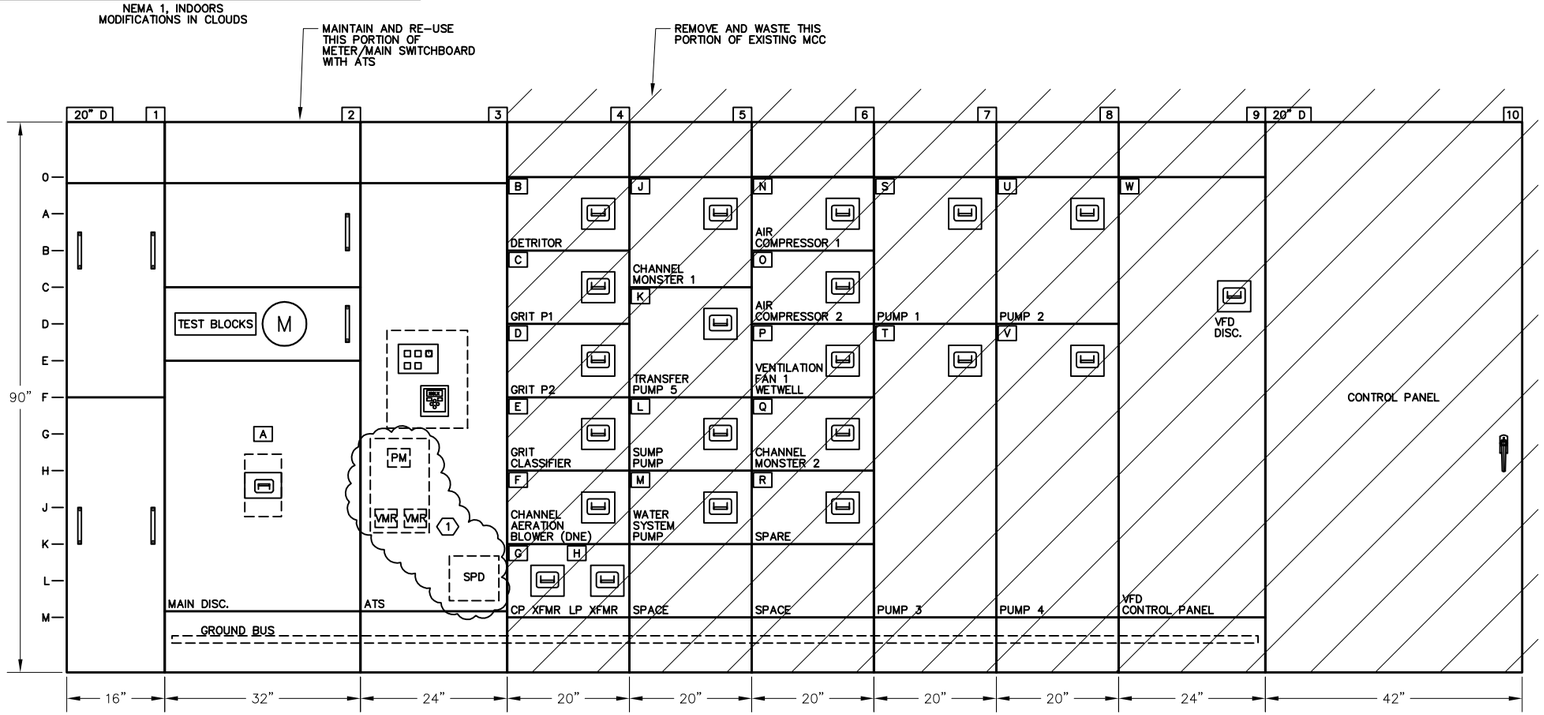
E-01
2 OF 23 SHEETS



LOAD CALCULATIONS

LOAD DESCRIPTION		CONNECTED LOAD LOAD	QTY	TOTAL	DEMAND LOAD LOAD	QTY	TOTAL	GENERATOR LOAD LOAD	QTY	TOTAL
60HP SEWAGE PUMP 3, 4		77.00 A	2	128033.2 VA	77.00 A	2	128033.2 VA	77.00 A	1	64016.6 VA
15HP SEWAGE PUMP 1, 2		21.00 A	2	34918.1 VA	21.00 A	1	17459.1 VA	21.00 A	0	0.0 VA
20HP SEWAGE PUMP 5		27.00 A	2	44894.8 VA	27.00 A	1	22447.4 VA	27.00 A	1	22447.4 VA
7.5HP AIR COMPRESSORS		11.00 A	2	18290.5 VA	11.00 A	1	9145.2 VA	11.00 A	1	9145.2 VA
7.5HP GRIT PUMP		11.00 A	2	18290.5 VA	11.00 A	1	9145.2 VA	11.00 A	1	9145.2 VA
5HP WATER PUMP		7.60 A	1	6318.5 VA	7.60 A	1	6318.5 VA	7.60 A	1	6318.5 VA
5HP GRINDER		7.60 A	2	12637.0 VA	7.60 A	2	12637.0 VA	7.60 A	2	12637.0 VA
3HP GRIT WASHER		4.80 A	2	7981.3 VA	4.80 A	1	3990.6 VA	4.80 A	1	3990.6 VA
2HP SUMP PUMP		3.40 A	1	2826.7 VA	3.40 A	1	2826.7 VA	3.40 A	1	2826.7 VA
PANELBOARD LP	120/240	11.52 A	1	9580.0 VA	9.22 A	1	7664.0 VA	9.22 A	1	7664.0 VA
TOTAL LOAD =		341.32 A	<	283770.6 VA	264.22 A	<	219667.0 VA	166.22 A	<	138191.3 VA
LOAD CORRECTION FACTORS								GENERATOR SIZE		
LARGEST MOTOR LOAD x 25%								NAMEPLATE = 155 KW 193.75 KVA		
60HP HP => 0.25 x 64016.6 VA	=	19.25 A		16004.1 VA	19.25 A		16004.1 VA	@ TEMP OF 100 deg F		
80% BREAKER DERATING = TOTAL x 0.25 =		90.14 A		74943.7 VA	70.87 A		58917.8 VA	ELEVATION OF 200 FT ASL		
FOR CONTINUOUS LOADS NEC 210-20								DERATED SIZE = 151.4 KW 189.3 KVA		
SERVICE SIZE (MIN) =		450.72 A		374718.4VA	354.34 A		294589.0VA	AMPERAGE = 228 A @ 0.8 PF		
UTILITY SERVICE SIZE EXISTING =					400 AMP			UTLIZATION % = 82 % @ 0.90 PF		
480V, 3 PHASE, 4 WIRE										

EXISTING SWITCHBOARD ONE-LINE DIAGRAM



EXISTING SWITCHBOARD ELEVATION | EXISTING MCC ELEVATION | EXISTING CONTROL PANEL ELEVATION

EXISTING SWITCHBOARD/MCC ELEVATION

MODIFICATIONS IN CLOUDS

GENERAL NOTES:

1. REMOVED WIRING FROM CONDUITS ENTERING MCC PORTION TO BE WASTED. WIRE TO BE REPLACED PER CONDUIT AND WIRE SCHEDULE.
2. TAG CONDUIT WITH NEW TAGS DURING REMOVAL OF WIRE.

NOTES REFERENCED IN DRAWING:

(1) FURNISH BACKPAN (10"X15") WITH VMR'S AND PM MOUNTED FOR INSTALLATION IN FIELD. MOUNT SPD ON BOTTOM SIDEPAN.

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VALONA LIFT STATION MCC UPGRADE
EXISTING SWITCHBOARD/MCC
ONE-LINE DIAGRAM AND ELEVATAIN

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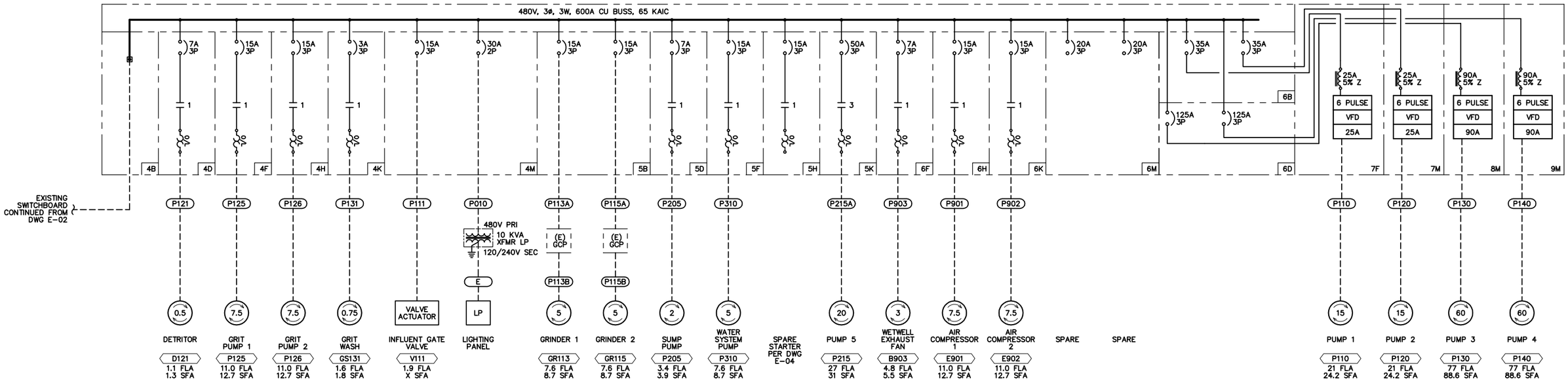
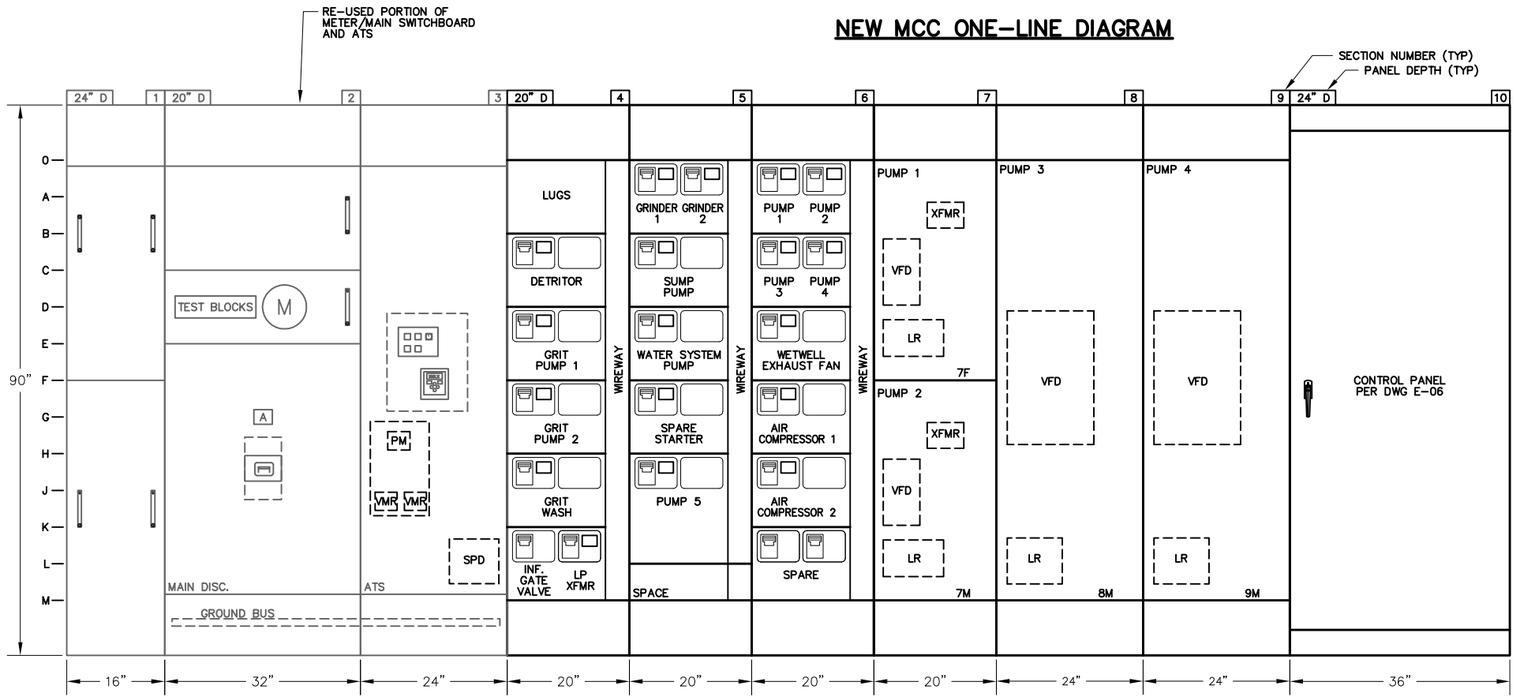
E-02
3 OF 23 SHEETS



NEW MCC ONE-LINE DIAGRAM



EXISTING SWBD ELEVATION

NEW MCC ELEVATION

NEW CONTROL PANEL ELEVATION

NEW SWBD/MCC ELEVATION

NEMA 1, INDOORS

GENERAL NOTES:

1. MOTORS AND EQUIPMENT OUTSIDE OF MCC ARE EXISTING
2. FURNISH NEW WIRING TO ALL DEVICES PER CONDUIT SCHEDULE.

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VALONA LIFT STATION MCC UPGRADE
NEW MCC
ONE-LINE DIAGRAM AND ELEVATAIN

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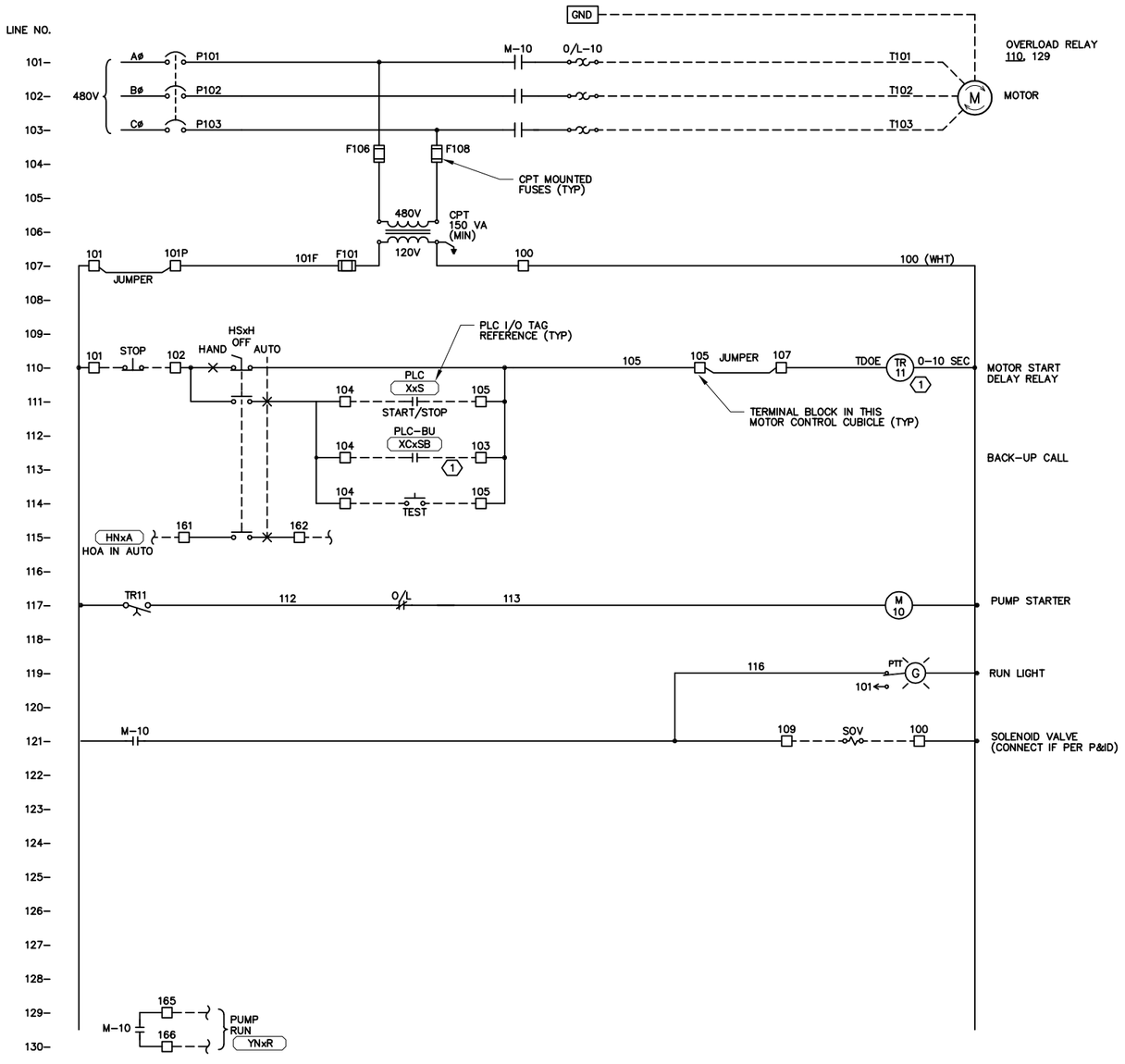
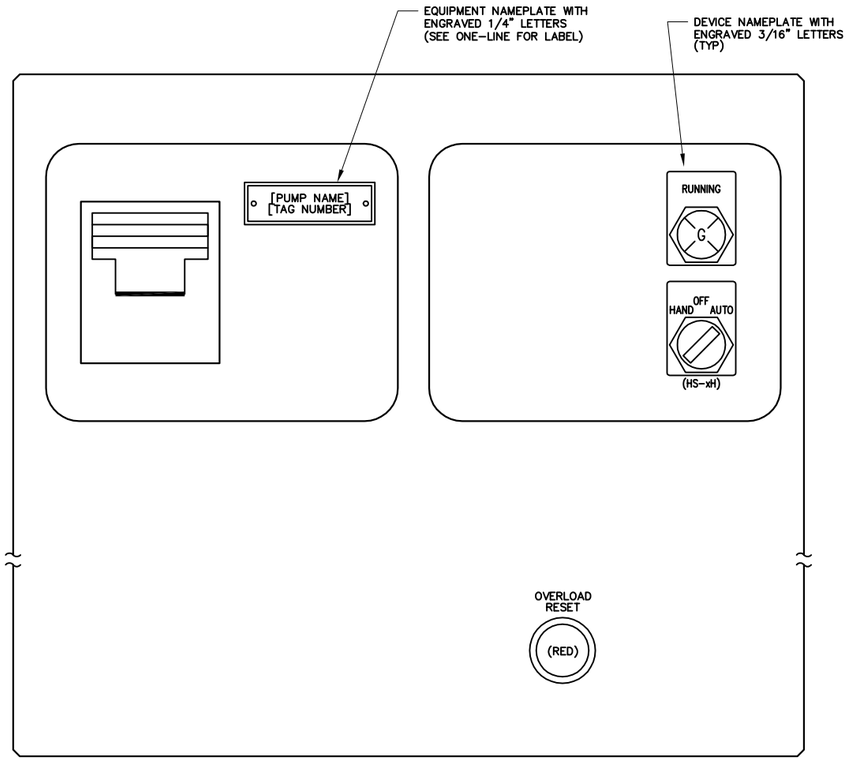
E-03
4 OF 23 SHEETS



FVNR ELEMENTARY DIAGRAM

D121 P125 P126 GS131
P215 B903 P205 P310
E901 E902



CUBICLE DOOR LAYOUT

(NOT TO SCALE)

NOTES REFERENCED IN DRAWING:

(1) SET TIME DELAY 0.5 SECONDS APART FROM EACH OTHER

GENERAL NOTES:

1. SIMILAR DIAGRAM FOR EQUIPMENT DEFINED PER PID
2. TERMINAL BLOCKS AND WIRES SHALL BE LABELED SAME EXCEPTION: WIRES TO PLC SHALL BE NUMBERED PER CONTROL PANEL TERMINAL BLOCK NUMBER.

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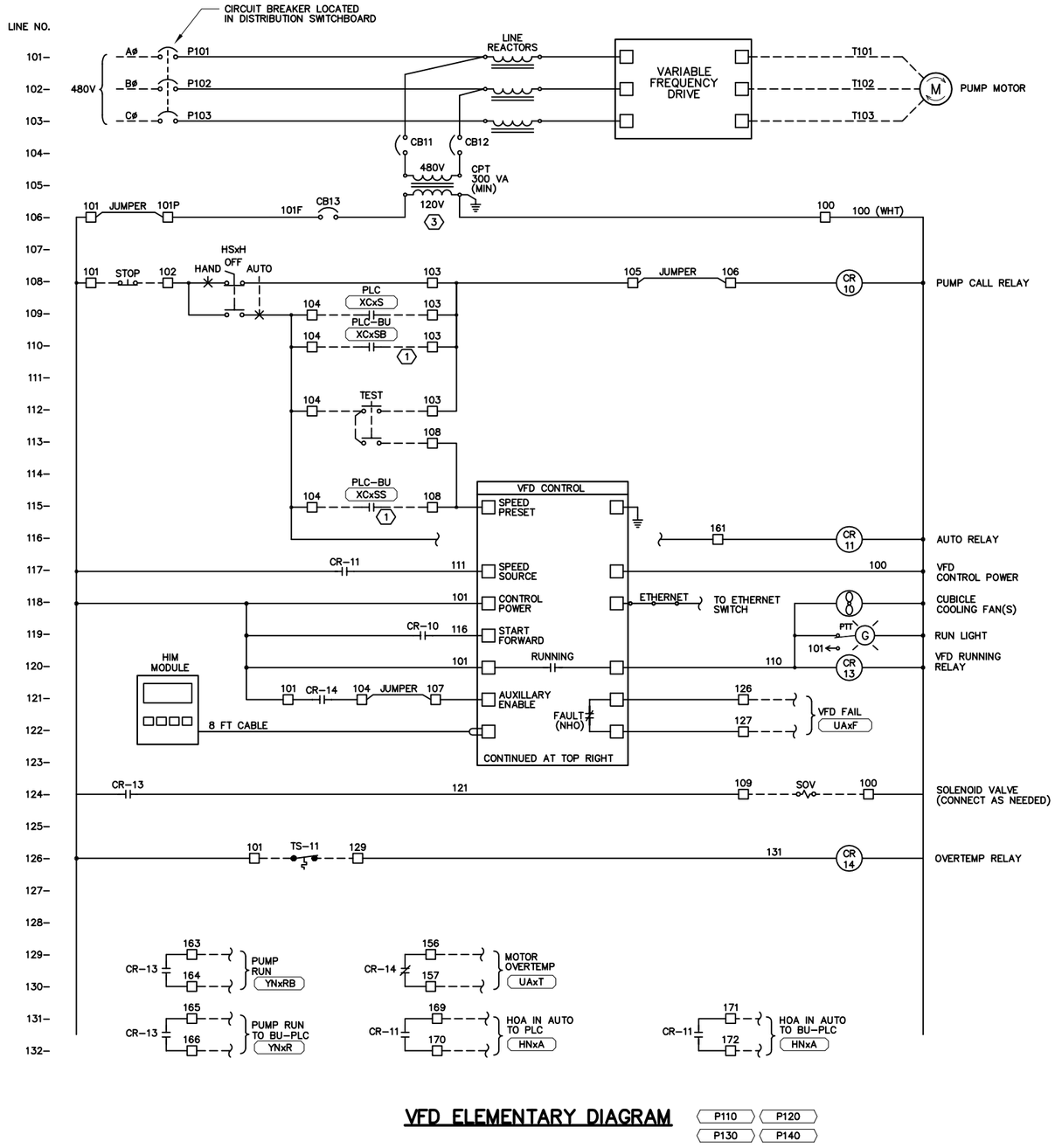
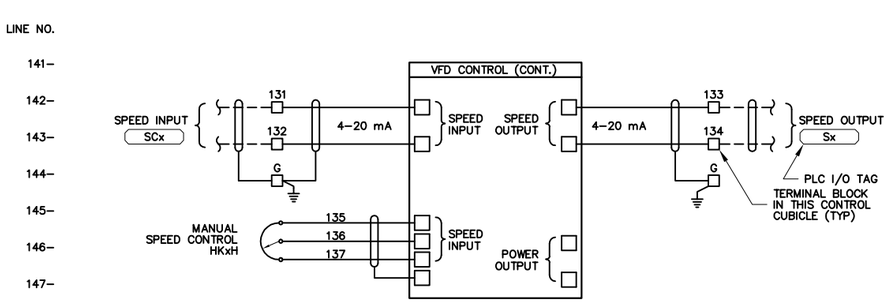
VALONA LIFT STATION MCC UPGRADE
FVNR STARTER
ELEMENTARY

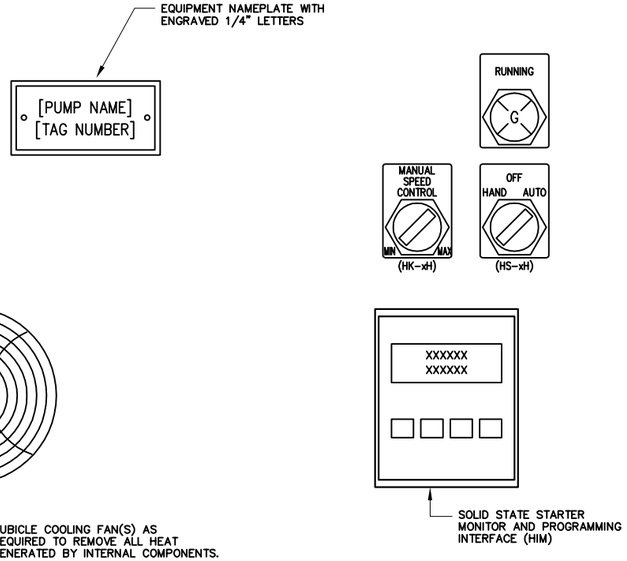
DRAWING NO.
E-04
5 OF 23 SHEETS



VFD ELEMENTARY DIAGRAM

P110 P120 P130 P140





DOOR LAYOUT

NOTES REFERENCED IN DRAWING:

1. FROM BACK-UP CONTROLS. SEE DWG E-09.

GENERAL NOTES:

1. SIMILAR DIAGRAM FOR PUMP NO. 1 ~ 4.
2. TERMINAL BLOCKS AND WIRES SHALL BE LABELED SAME EXCEPTION: WIRES TO PLC SHALL BE NUMBERED PER CONTROL PANEL TERMINAL BLOCK NUMBER.
3. PROVIDE VFD WITH 115 VAC CONTROL CIRCUIT INTERFACE. NO EXCEPTIONS.
4. PROVIDE COOLING FANS AS REQUIRED TO REMOVE HEAT GENERATED BY INTERNAL COMPONENTS AND MAINTAIN TEMPERATURE WITHIN DRIVE MANUFACTURER RATINGS.
5. PROVIDE DUST FILTERS FOR EACH FAN INPUT.

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DRAWING NO:

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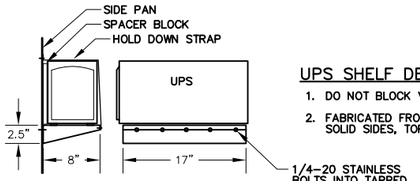
CROCKETT COMMUNITY SERVICES DISTRICT

VALONA LIFT STATION MCC UPGRADE
VFD PUMP
ELEMENTARY

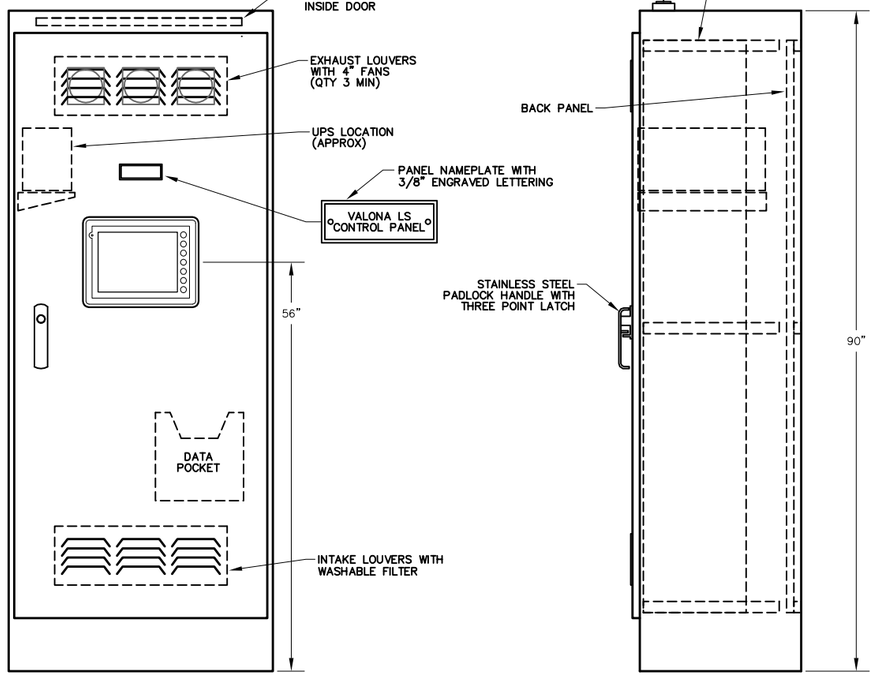
DRAWING NO.
E-05
6 OF 23 SHEETS



UPS SHELF DETAIL

UPS SHELF DETAIL NOTES:

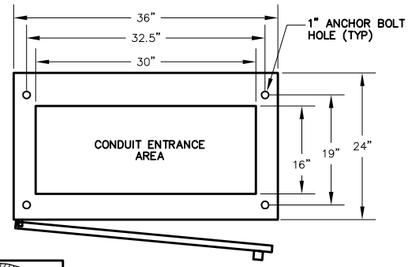
1. DO NOT BLOCK VENTS WITH SPACER BLOCK. USE TWO.
2. FABRICATED FROM 14 GA (MIN) PAINTED GALVANEAL OR STAINLESS STEEL SOLID SIDES, TOP, BACK AND FRONT WITH CONTINUOUS WELDED SEAMS.



FRONT ELEVATION

SIDE ELEVATION

ELEVATION



BASE PLAN

PANEL FABRICATION METHODS

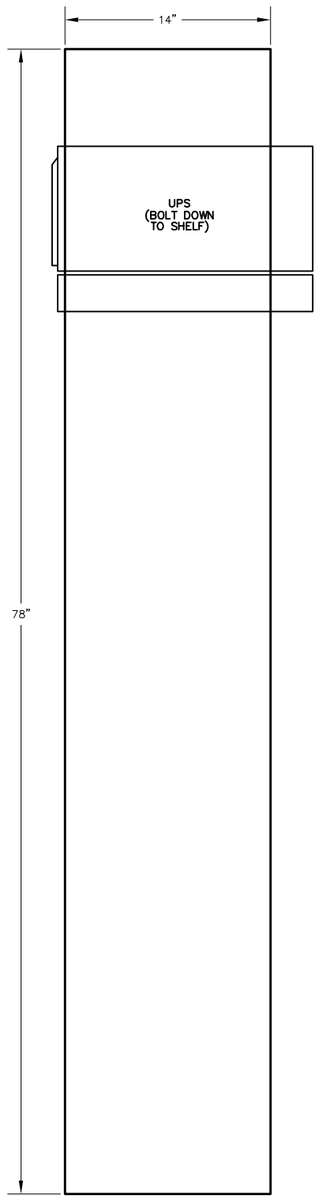
1. NEMA 1A, OPEN BOTTOM.
2. OUTER DOOR SEALED WITH RUBBERIZED FOAM GASKET.
3. PANEL SHALL BE FABRICATED FROM PAINT BOND GALVANEAL SHEET STEEL.
4. 12 GAUGE EXTERIOR AND 14 GAUGE INTERIOR.
5. ALL SEAMS SHALL HAVE CONTINUOUS WELD GROUND SMOOTH.
6. DOOR TO BE PADLOCKABLE WITH HEAVY DUTY 3 POINT LATCH.
7. DOOR HINGES AND PINS SHALL BE CONTINUOUS, HEAVY DUTY.
8. NO SCREWS, RIVETS, OR BOLTS SHALL PROTRUDE EXTERNALLY.
9. INTERNAL SCREWS, RIVETS, BOLTS, AND NUTS SHALL BE MACHINE THREAD INTO TAPPED BACKPAN.
10. EXTERIOR PANEL COLOR: ANSI 61 GRAY.
11. MOUNTING PAN AND INTERIOR DOOR COLOR: WHITE.
12. FABRICATION AND WIRING SHALL CONFORM TO U.L. AND NEMA STANDARDS.
13. ALL WIRING SHALL BE PERMANENTLY LABELED WITH WIRE MARKERS ON BOTH ENDS.
14. WIRING DIAGRAMS SHALL BE PLACED IN A PLASTIC DRAWING HOLDER PERMANENTLY ATTACHED TO THE INSIDE OF THE FRONT DOOR.
15. AS – BUILT WIRING DIAGRAMS SHALL BE SHIPPED WITH EQUIPMENT.
16. HOFFMAN TYPE 12 FREE–STANDING, OR EQUAL.

GENERAL NOTES:

1. REPRESENTATIVE OF MAJOR COMPONENTS ONLY. ACTUAL BACKPAN LAYOUT SHALL BE SIMILAR TO LAYOUT SHOWN. SUBMIT SCALED BACKPAN LAYOUT FOR REVIEW BY ENGINEER.
2. QUANTITY OF TERMINAL BLOCKS AND RELAYS SHALL BE AS DETERMINED BY P&IDS AND EXAMPLE I/O WIRING DIAGRAM

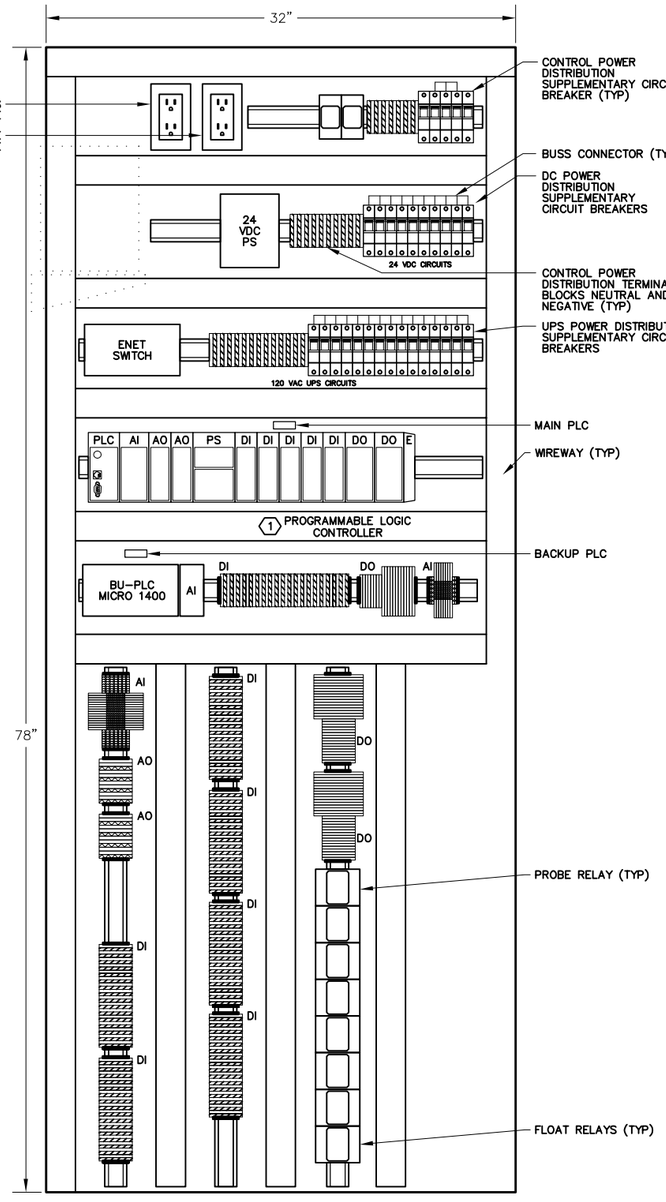
LAYOUT REFERENCED NOTES:

(1) WIRE PLC I/O TO TERMINAL BLOCK PER EXAMPLE I/O WIRING DIAGRAMS.
(2) SAVE AND REUSE UNIT IN NEW CONTROL PANEL.



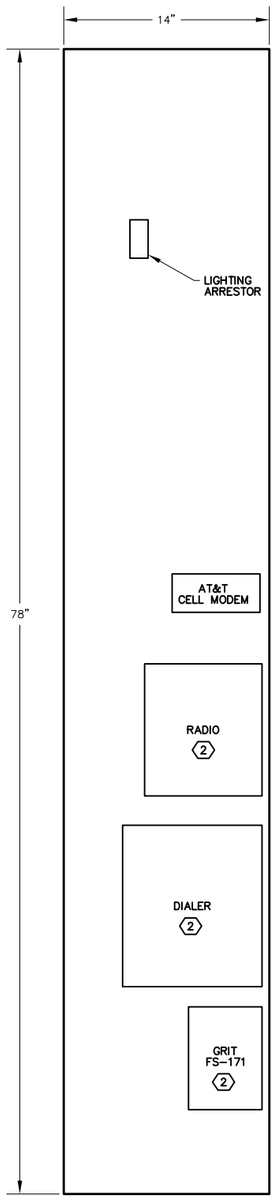
LEFT

SIDEPAN LAYOUT



CENTER (1)

BACKPAN LAYOUT



RIGHT

SIDEPAN LAYOUT

LEGEND:

AI = ANALOG INPUT CARD
DI = DIGITAL INPUT CARD
DO = DIGITAL OUTPUT CARD
PS = POWER SUPPLY
PR = PROCESSOR
SP = SPARE SLOT
MB = MODBUS TCP CARD
E = END CAP BUS EXTENSION

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VALONA LIFT STATION MCC UPGRADE CONTROL PANEL ELEVATION AND BACKPAN LAYOUT

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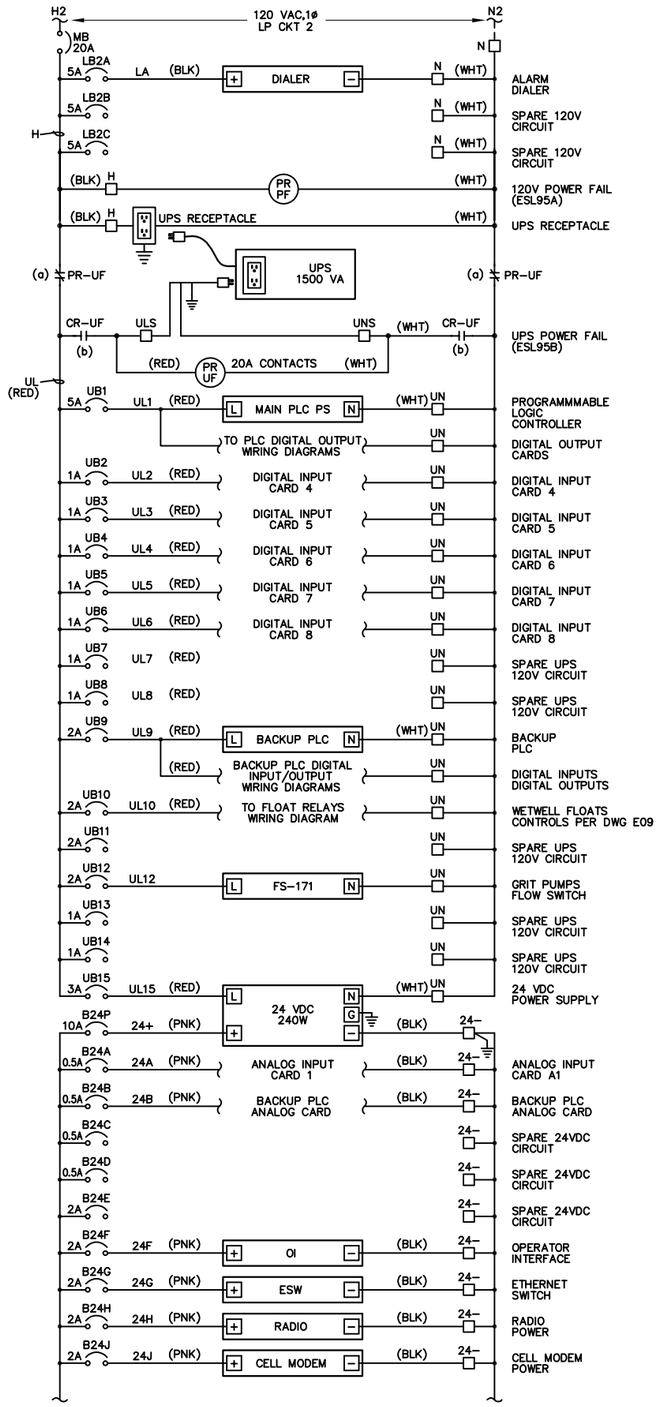


POWER DISTRIBUTION DIAGRAM

PANEL "LP"

EXISTING

LOCATION:SURFACE MOUNT
ENCLOSURE:NEMA 1
AIC RATING:10 KAIC

120/ 240 VOLTS, 1 PHASE, 3 WIRE
100 AMP BUS
100 AMP MAIN BREAKER

	BKR NO.	DESCRIPTION	LOAD VA	LINE AMPS		AMPS/ POLE	BKR NO.
	1	LTG – CONT – PUMP – RMS	400	3.3		20/1	1
	3	LTG – F.C – BOX – OUT DOOR	400		3.3	20/1	3
	5	LTG – WELL – GRIT – COM – RMS	400	3.3		20/1	5
	7	FLOW – INDICATOR	40		0.3	20/1	7
	9	EMERGENCY LIGHTING	50	0.4		20/1	9
	11	DIESEL FUEL LIGHT	100		0.8	20/1	11
	13	PUMP 5 LIGHT	100	0.8		20/1	13
	15	BACKUP BUBBLER	50		0.4	20/1	15
1	17	CONTROL PANEL POWER	1200	10.0		20/1	17
	19	SPARE	0		0.0	20/1	19
	21	SPARE	0	0.0		20/1	21
	23	SEISMOGRAPHIC EQUIPMENT	0		0.0	20/1	23

BKR NO.	AMPS/ POLE	LINE AMPS		LOAD VA	DESCRIPTION	BKR NO.
2	20/1	6.7		800	RECEPT – CONT –I.P – RMS	2
4	20/1		6.7	800	GRIT – CONT – LIGHT POLE – EXHAUST FAN	4
6	20/1	12.5		1500	HOT WATER HEATER	6
8	20/1		3.3	400	INF PUMP – PUMP ROOM FAN – DRIVEWAY SIDE	8
10	20/1	0.8		100	FLOW – STRUCTURE – FAN – BESIDE GRIT SCREW	10
12	20/1		1.7	200	DAY – TANK	12
14	20/1	0.2		20	SPARE	14
16	20/1		0.2	20	VELONA FM MILLTRONICS	16
18	20/2	16.7		2000	WATER – JACKET – HEATER (GENERATOR ENGINE)	18
20			16.7	2000		20
22	20/2	0.8		100	BATTERY – CHARGER	22
24			0.8	100		24

PHASE	A	B
LEFT SIDE AMPS	17.92	4.92
LEFT SIDE KVA	2.15	0.59
TOTAL PHASE KVA	6.67	4.11
TOTAL PHASE AMPS	56	34
% OF AVERAGE	124	76

NEUTRAL

GROUND

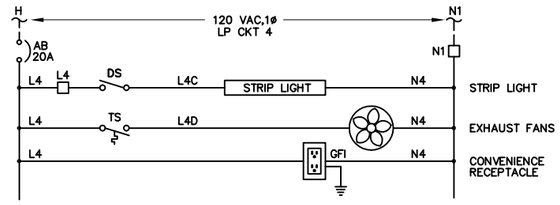
A	B	PHASE
37.67	29.33	RIGHT SIDE AMPS
4.52	3.52	RIGHT SIDE KVA

10.78	TOTAL KVA
44.92	TOTAL AMPS @ 240V, 1P
0.80	DIVERSITY FACTOR
8.62	LOAD KVA

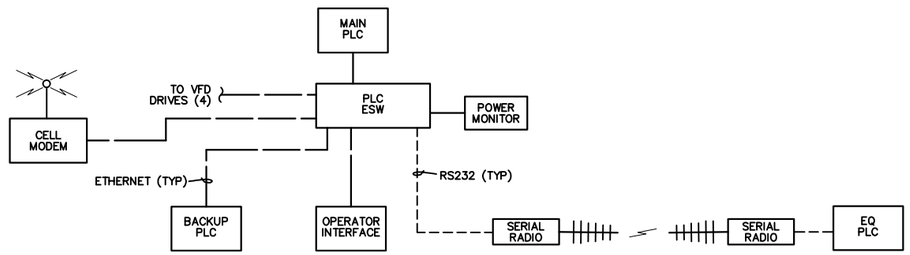
NOTES:
1 MEANS OF WIRE COLOR CODING SHALL BE POSTED ON PANELBOARD PER NEC 210 (4)
2 ASTERISK (*) DENOTES GFI BREAKER REQUIRED WITH 5 MA SENSITIVITY
3 TILDA (~) DENOTES GFI BREAKER REQUIRED WITH 30 MA SENSITIVITY

NOTES REFERENCED IN DRAWING:

(1) CONNECT NEW CIRCUITS PER PLANS AND AS SHOWN ABOVE.



AUXILLIARY POWER DIAGRAM



NETWORK DIAGRAM

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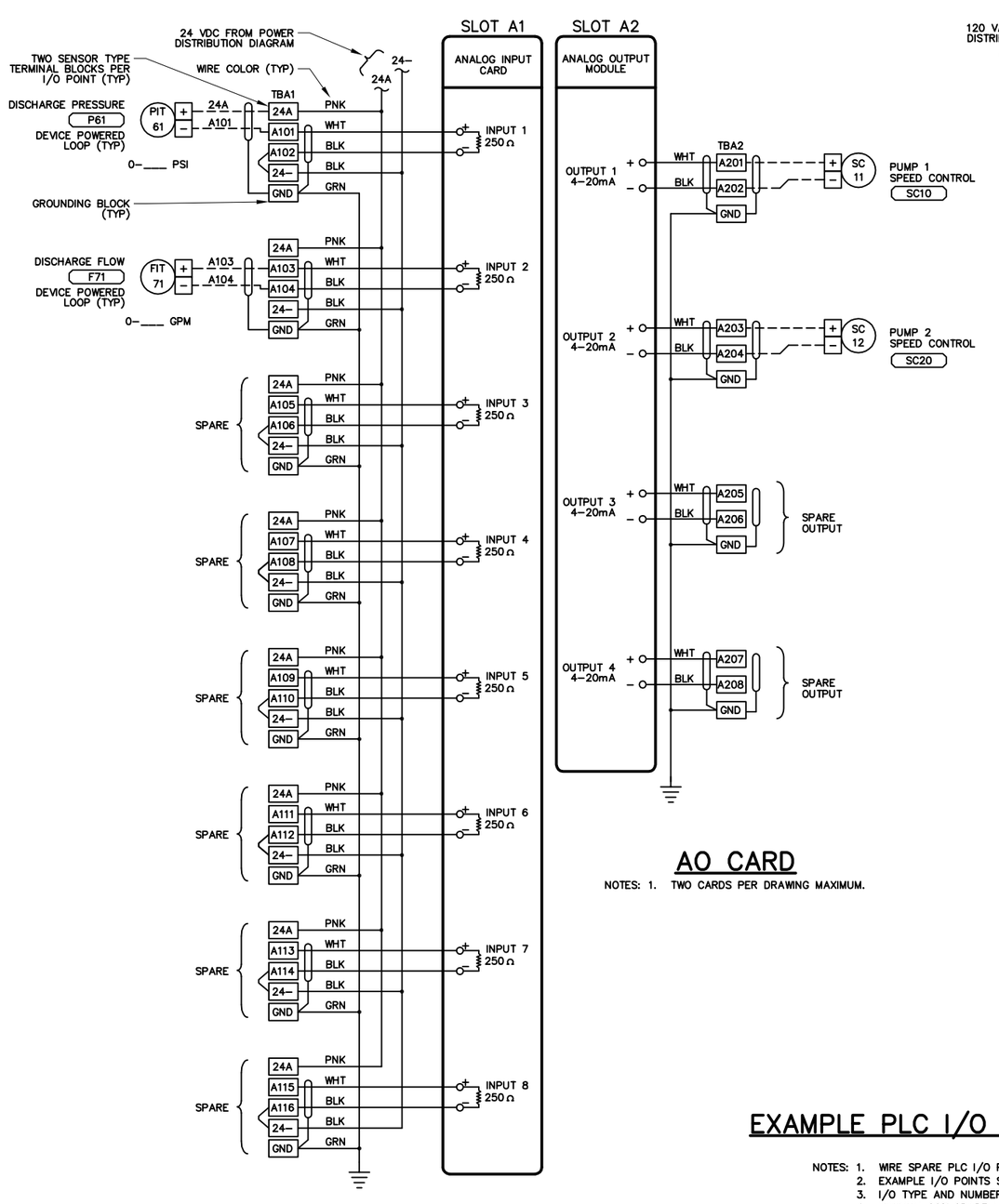
APPROVED BY: T. FRISCH
DRAWING NO:

Crockett COMMUNITY SERVICES DISTRICT

CROCKETT COMMUNITY SERVICES DISTRICT
VALONA LIFT STATION MCC UPGRADE
CONTROL PANEL
POWER DISTRIBUTION DIAGRAM

DRAWING NO.
E-07
8 OF 23 SHEETS

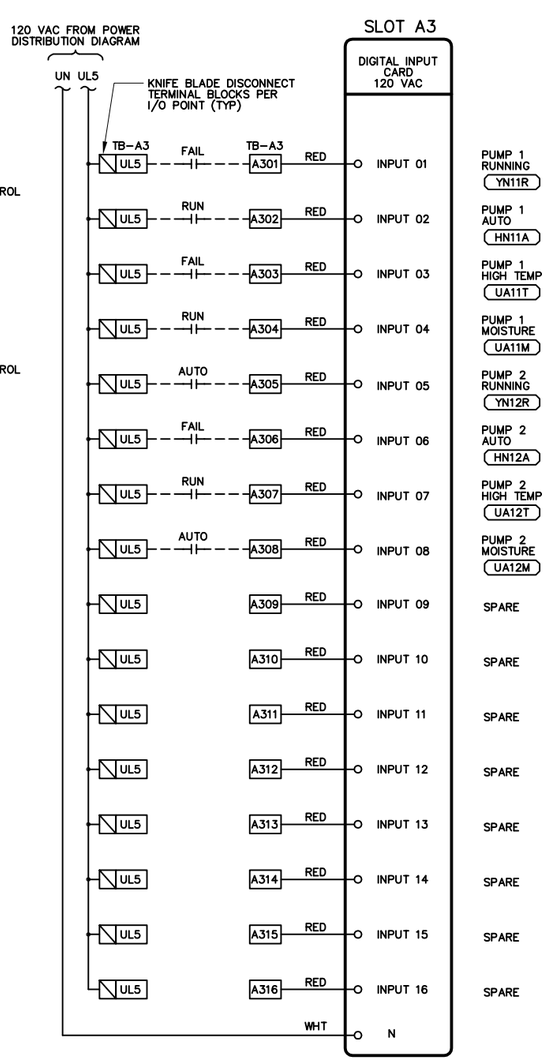


AI CARD

NOTES: 1. TWO CARDS PER DRAWING MAXIMUM.
2. USE MANUFACTURED TERMINAL BLOCK JUMPERS WHERE POSSIBLE

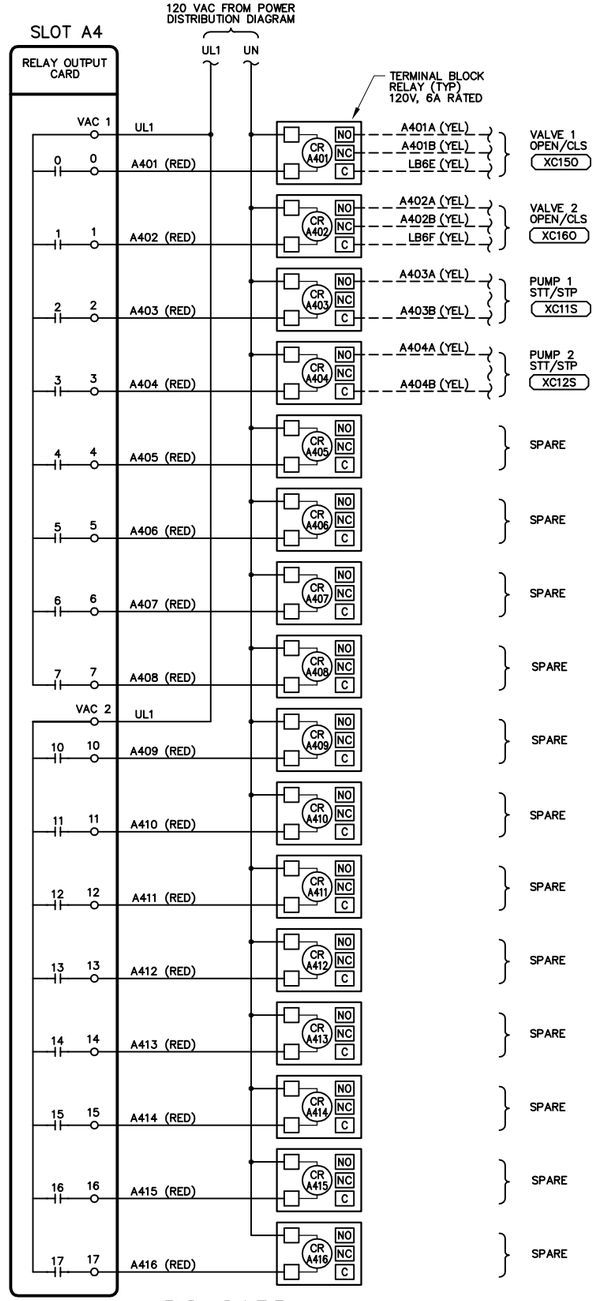
AO CARD

NOTES: 1. TWO CARDS PER DRAWING MAXIMUM.



DI CARD

NOTES: 1. TWO CARDS PER DRAWING MAXIMUM.



DO CARD

NOTES: 1. TWO CARDS PER DRAWING MAXIMUM.

EXAMPLE PLC I/O WIRING DIAGRAMS

NOTES: 1. WIRE SPARE PLC I/O POINTS TO TERMINAL BLOCKS.
2. EXAMPLE I/O POINTS SHOWN. THIS DRAWING INTENDED TO SHOW I/O WIRING ONLY.
3. I/O TYPE AND NUMBER OF POINTS AND CARDS REQUIRED IS DETERMINED BY P&ID DRAWINGS.
4. MINIMUM 20% SPARE I/O POINTS PER I/O TYPE.
5. PLC I/O CARD WIRE NUMBERS SHALL BE BUILT AS SHOWN IN EXAMPLE BELOW. FIELD WIRES SHALL HAVE SAME NUMBER AS TERMINAL NUMBER.

A101
- RACK LETTER
- SLOT NUMBER
- INPUT NUMBER

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CROCKETT COMMUNITY SERVICES DISTRICT
VALONA LIFT STATION MCC UPGRADE
CONTROL PANEL
PLC EXAMPLE I/O WIRING DIAGRAM

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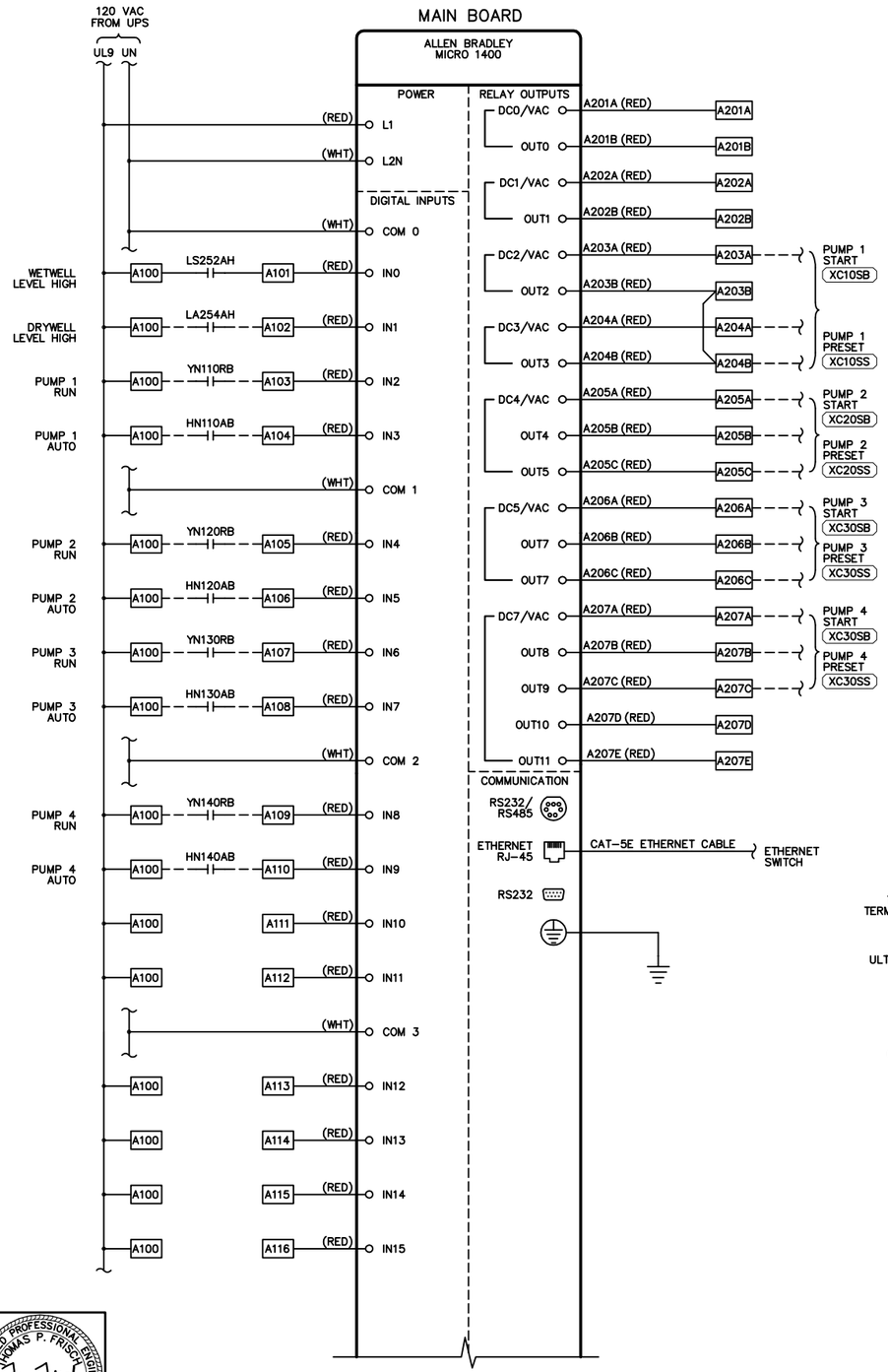
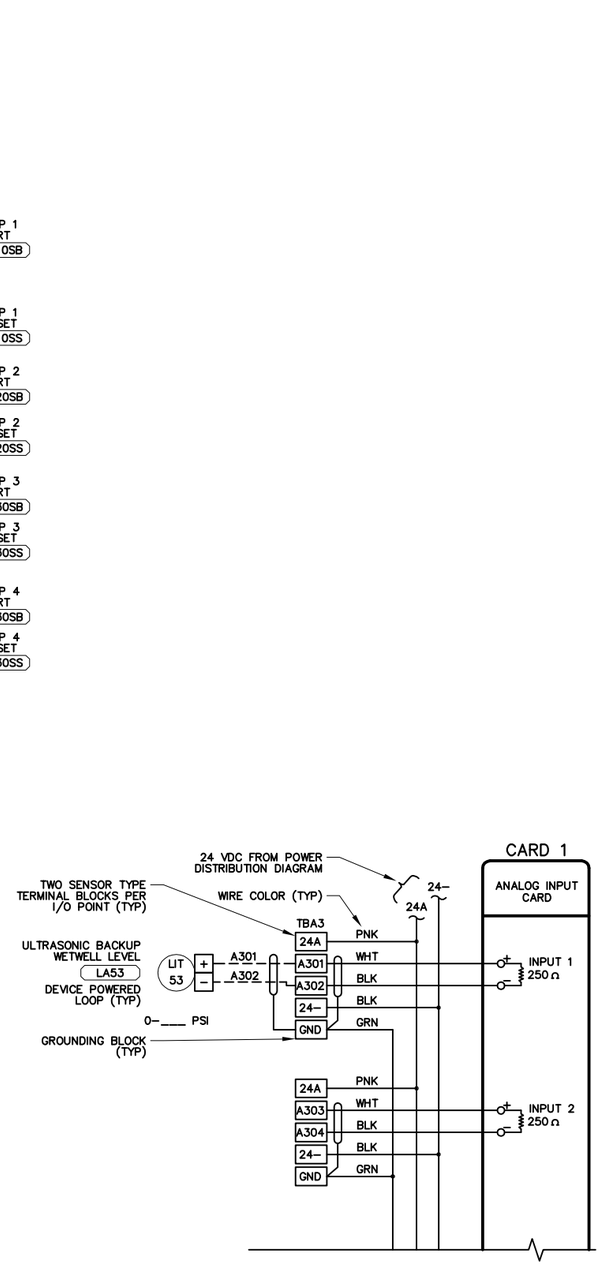
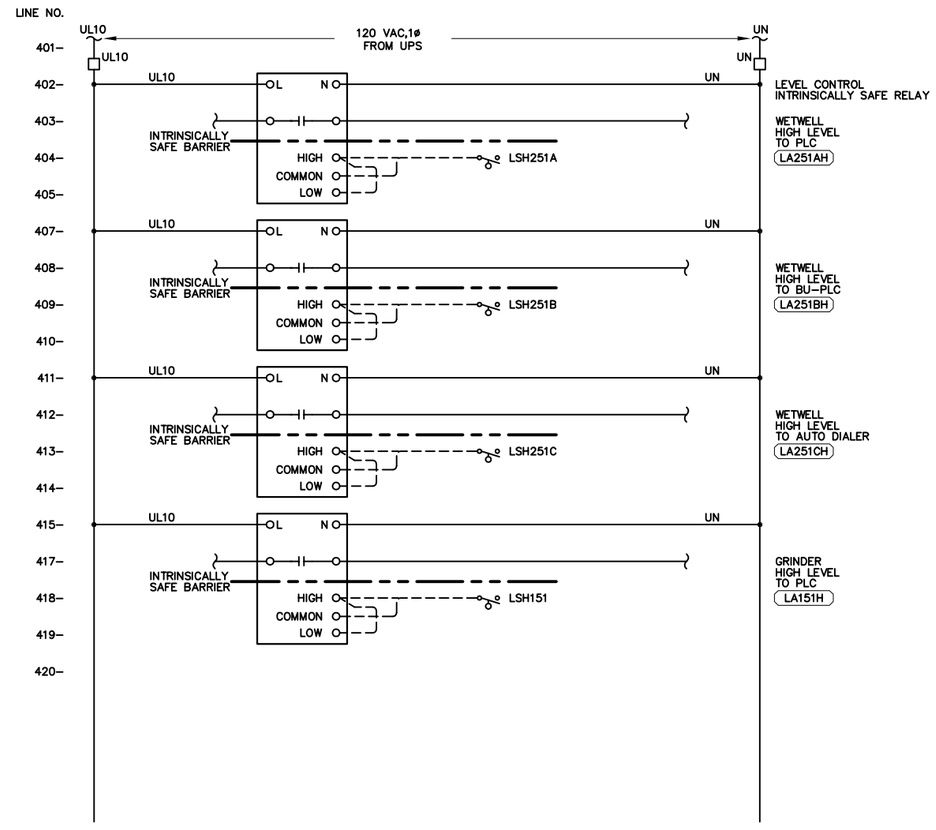


BU-PLC CONTROLLER I/O



BU-PLC ANALOG INPUT CARD I/O



WETWELL FLOAT ISR RELAYS

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VALONA LIFT STATION MCC UPGRADE
CONTROL PANEL
BACK-UP CONTROL SYSTEMS

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E-09
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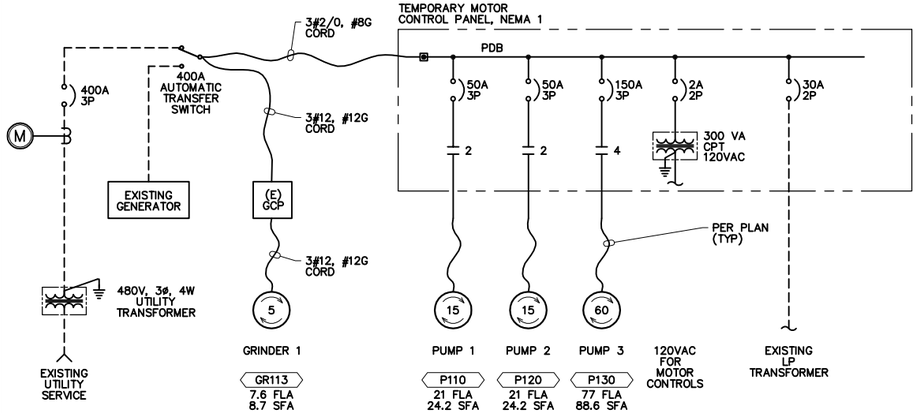
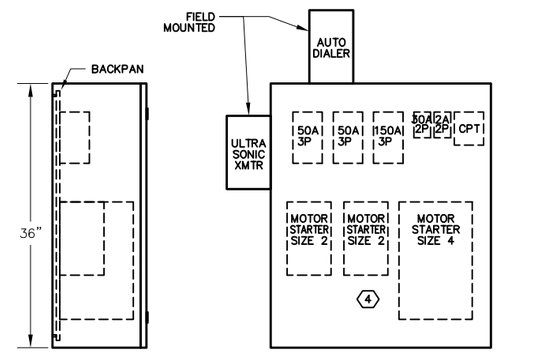
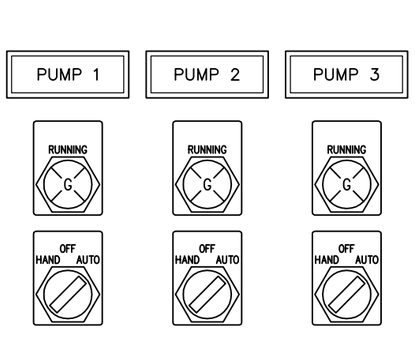


TEMPORARY SYSTEM ONE-LINE DIAGRAM

MODIFICATIONS IN CLOUDS

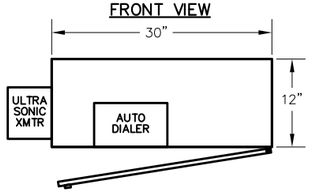


SIDE ELEVATION
(SELECTED COMPONENTS SHOWN)



DOOR LAYOUT DETAIL
NOT TO SCALE

FRONT VIEW



TOP VIEW

TEMPORARY MOTOR CONTROL PANEL ELEVATION

DRAWING REFERENCED NOTES:

1. INSTALL TEMPORARY PUMP CONTROL PANEL PRIOR TO MCC REMOVAL. SWING ONE PUMP TO THE TEMP PANEL. POWER PANEL AS SHOWN AND TEST FIRST PUMP. SWING REMAINING PUMPS ONE BY ONE AND TEST.
2. UTILIZE NEW SONIC LEVEL TRANSMITTER IN TEMPORARY PUMP CONTROL. INSTALL AND TEST TRANSMITTER PER E15/BWD PRIOR TO MCC REMOVAL.
3. MOUNT DIALER ON WALL ABOVE PANEL AND CONNECT POWER, HIGH FLOAT AND LEVEL TRANSMITTER OUTPUT HIGH LEVEL TO IT FOR TEMPORARY ALARM. PROGRAM DAILER FOR NEW INPUT ASSIGNMENTS.
4. PROVIDE HOA CONTROL CIRCUIT FOR EACH PUMP. CONNECT RUN LIGHT TO STARTER AUXILLIARY CONTACT.

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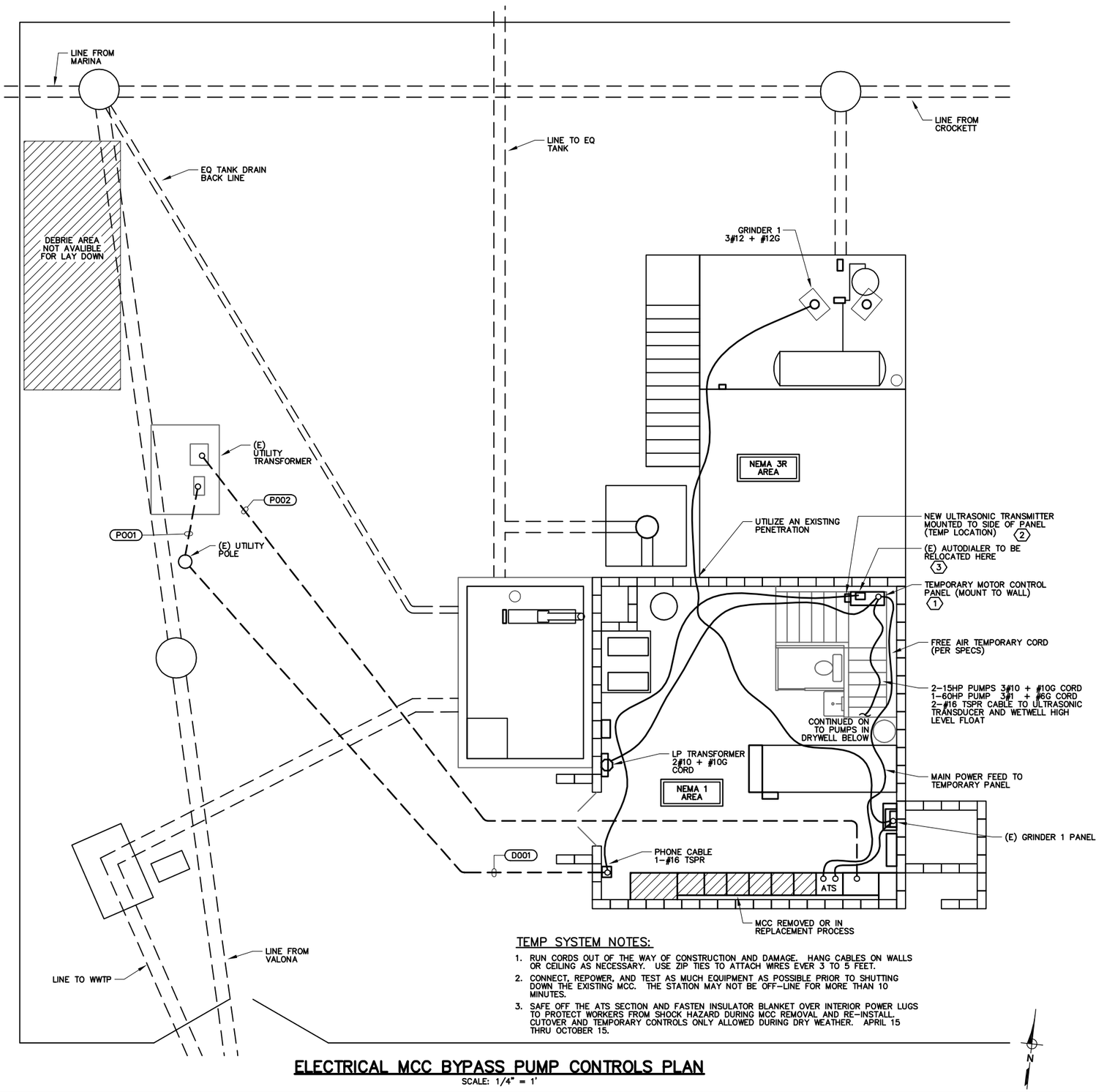

TEMP SYSTEM NOTES:

1. RUN CORDS OUT OF THE WAY OF CONSTRUCTION AND DAMAGE. HANG CABLES ON WALLS OR CEILING AS NECESSARY. USE ZIP TIES TO ATTACH WIRES EVER 3 TO 5 FEET.
2. CONNECT, REPOWER, AND TEST AS MUCH EQUIPMENT AS POSSIBLE PRIOR TO SHUTTING DOWN THE EXISTING MCC. THE STATION MAY NOT BE OFF-LINE FOR MORE THAN 10 MINUTES.
3. SAFE OFF THE ATS SECTION AND FASTEN INSULATOR BLANKET OVER INTERIOR POWER LUGS TO PROTECT WORKERS FROM SHOCK HAZARD DURING MCC REMOVAL AND RE-INSTALL. CUTOVER AND TEMPORARY CONTROLS ONLY ALLOWED DURING DRY WEATHER. APRIL 15 THRU OCTOBER 15.

ELECTRICAL MCC BYPASS PUMP CONTROLS PLAN

SCALE: 1/4" = 1'

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APPROVED BY: T. FRISCH
DRAWING NO:

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CROCKETT COMMUNITY SERVICES DISTRICT

VALONA LIFT STATION MCC UPGRADE ELECTRICAL SITE PLAN WITH TEMPORARY ELECTRICAL SYSTEM

DRAWING NO.
E-10
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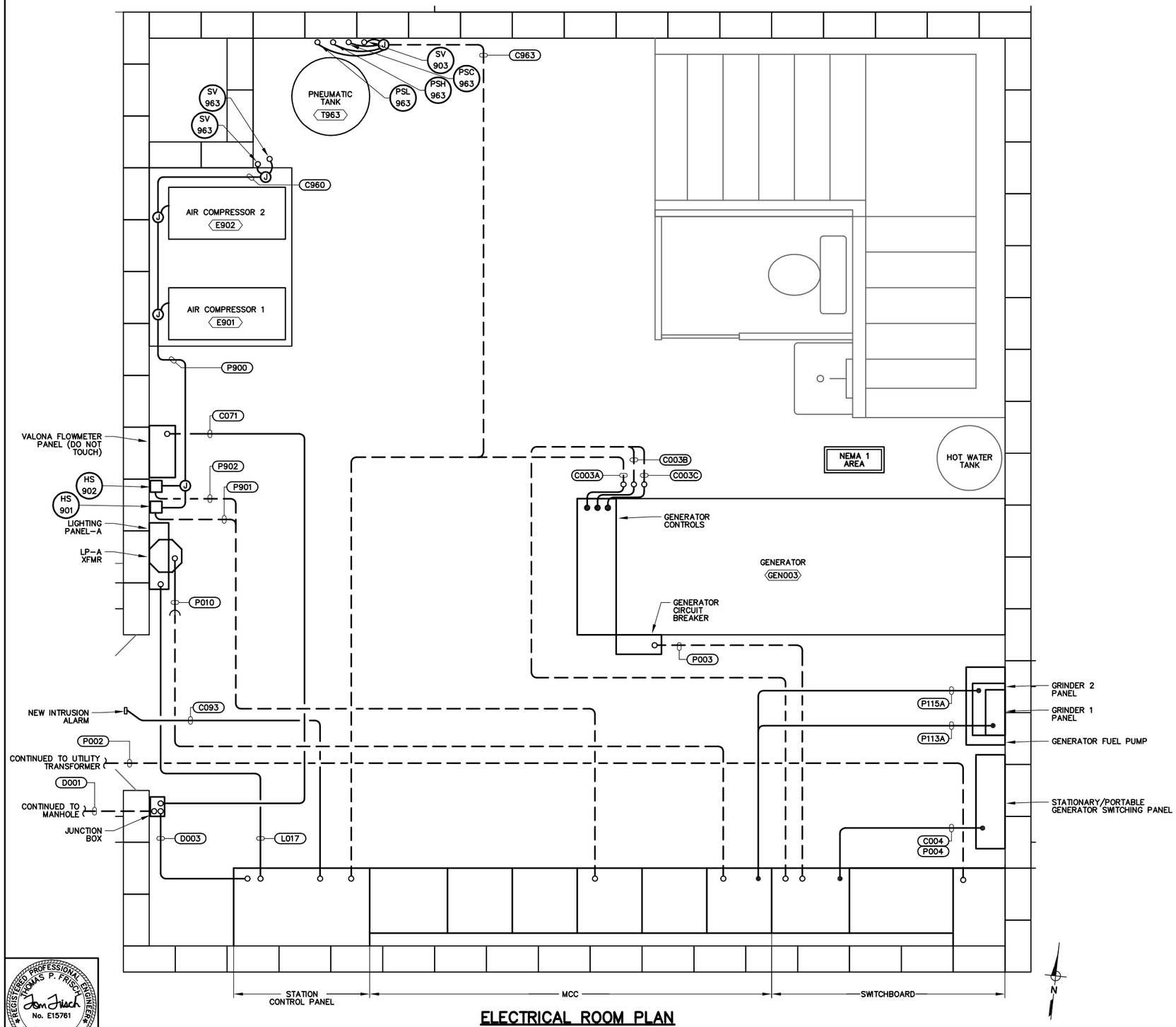

ELECTRICAL ROOM PLAN

SCALE: 3/4" = 1'

NOTES
1. NO CHANGE TO LIGHTING AND RECETPACLES.
2. DEMOLISH EXISTING SCADA COMPUTER WITH OLD MCC AND CONTROL PANEL.
3. RECONNECT EXISTING OVERHEAD CONDUITS.

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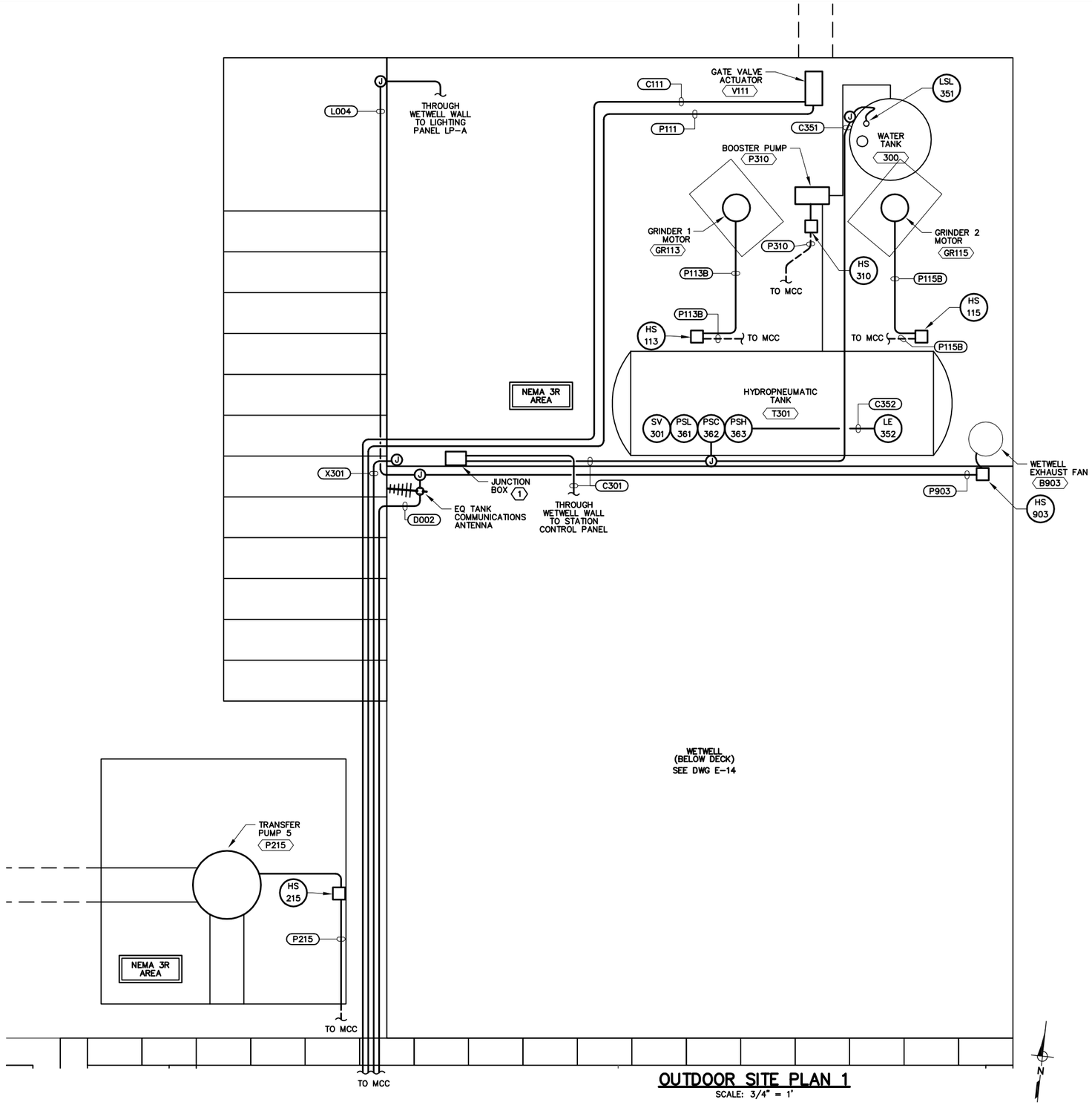
VALONA LIFT STATION MCC UPGRADE
ELECTRICAL ROOM PLAN

DRAWING NO.
E-11
12 OF 23 SHEETS



OUTDOOR SITE PLAN 1

SCALE: 3/4" = 1'

DRAWING REFERENCED NOTES:

(1) BYPASS AND REMOVE TERMINAL BLOCK LOCATED IN JUNCTION BOX.

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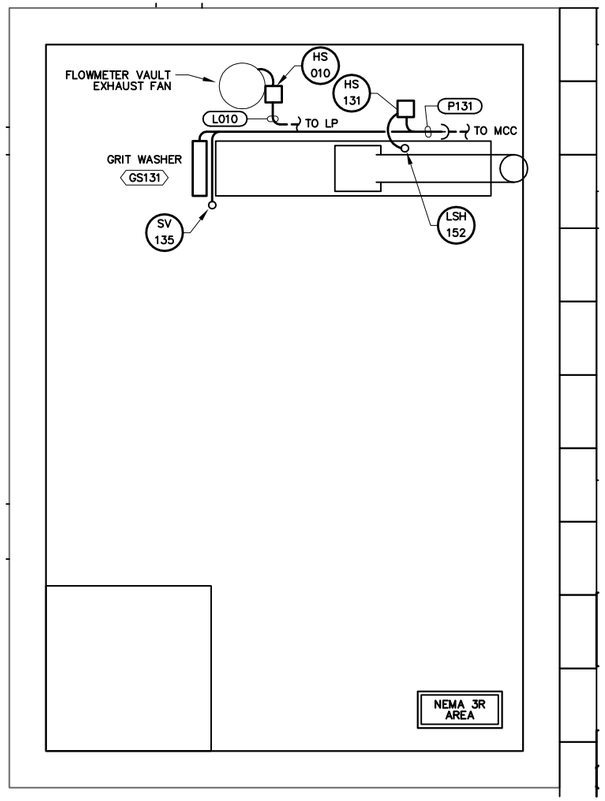
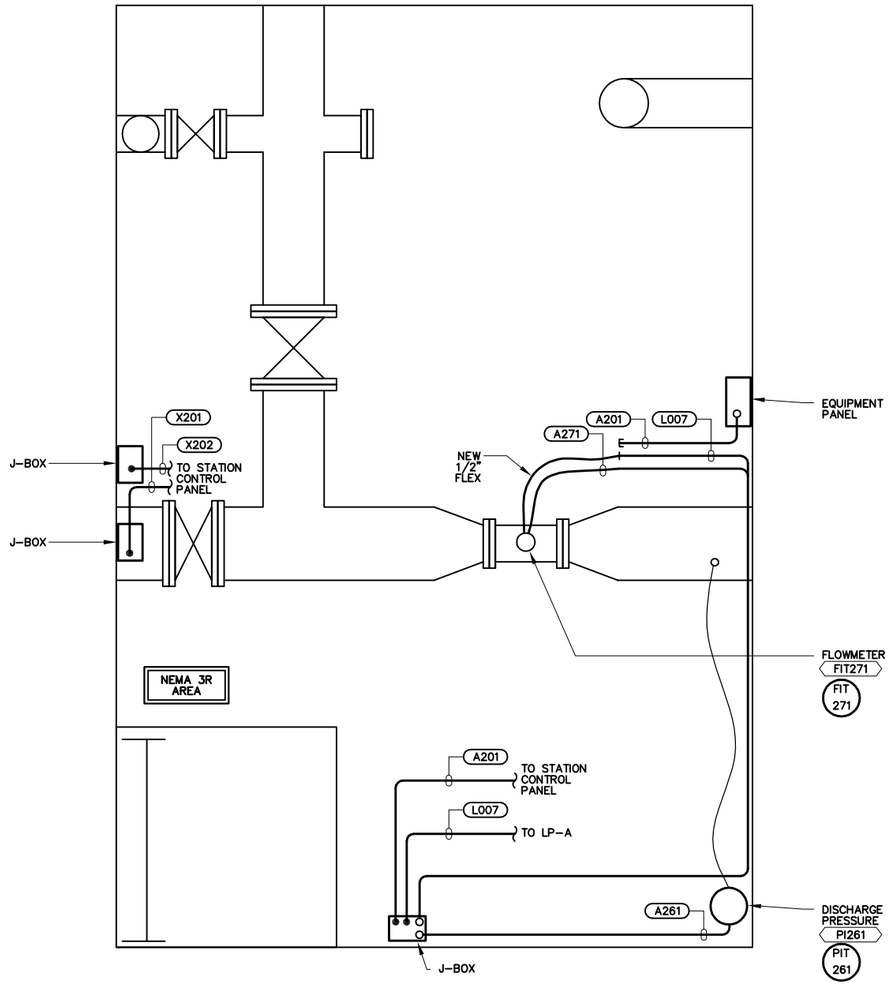
VALONA LIFT STATION MCC UPGRADE
OUTDOOR
ELECTRICAL PLAN 1

DRAWING NO.
E-12
13 OF 23 SHEETS



GRIT WASHER PLAN

SCALE: 3/4" = 1'



FLOWMETER VAULT PLAN

SCALE: 1" = 1'

NOTES:

1. EXTEND WIRING TO ALL DEVICES AND MOTORS SHOWN.

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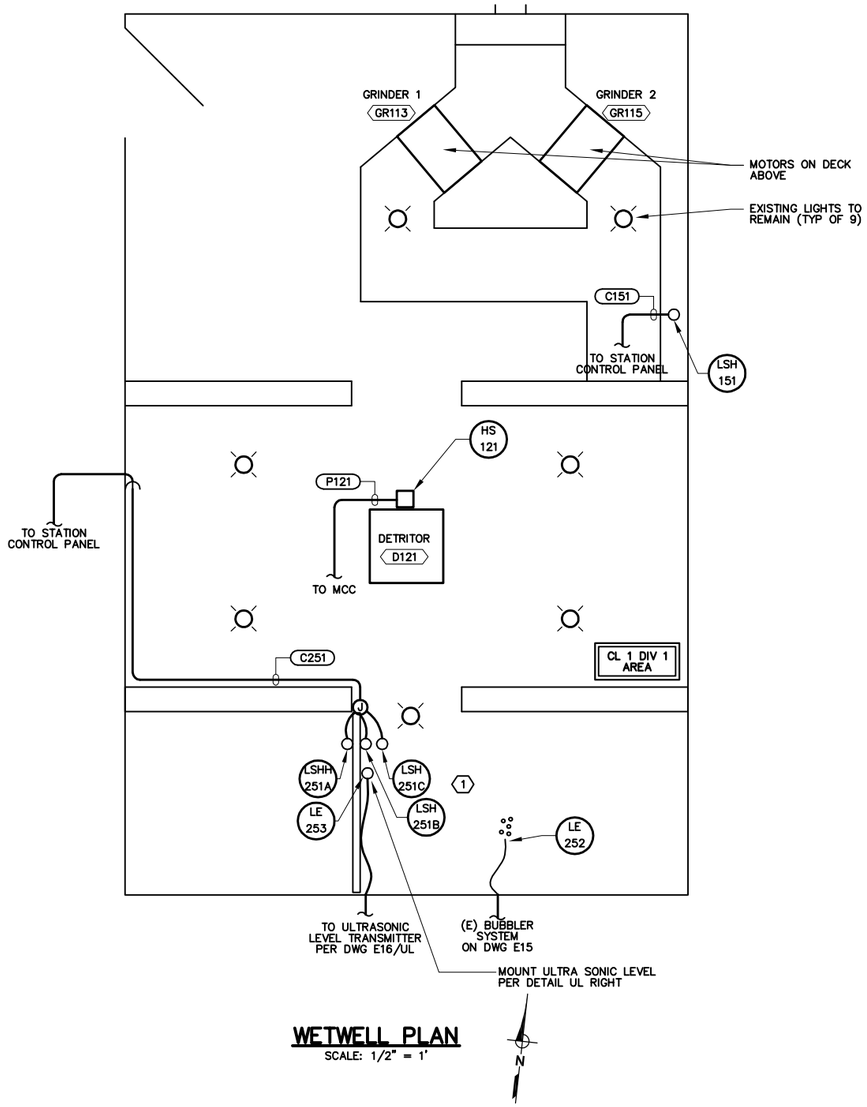
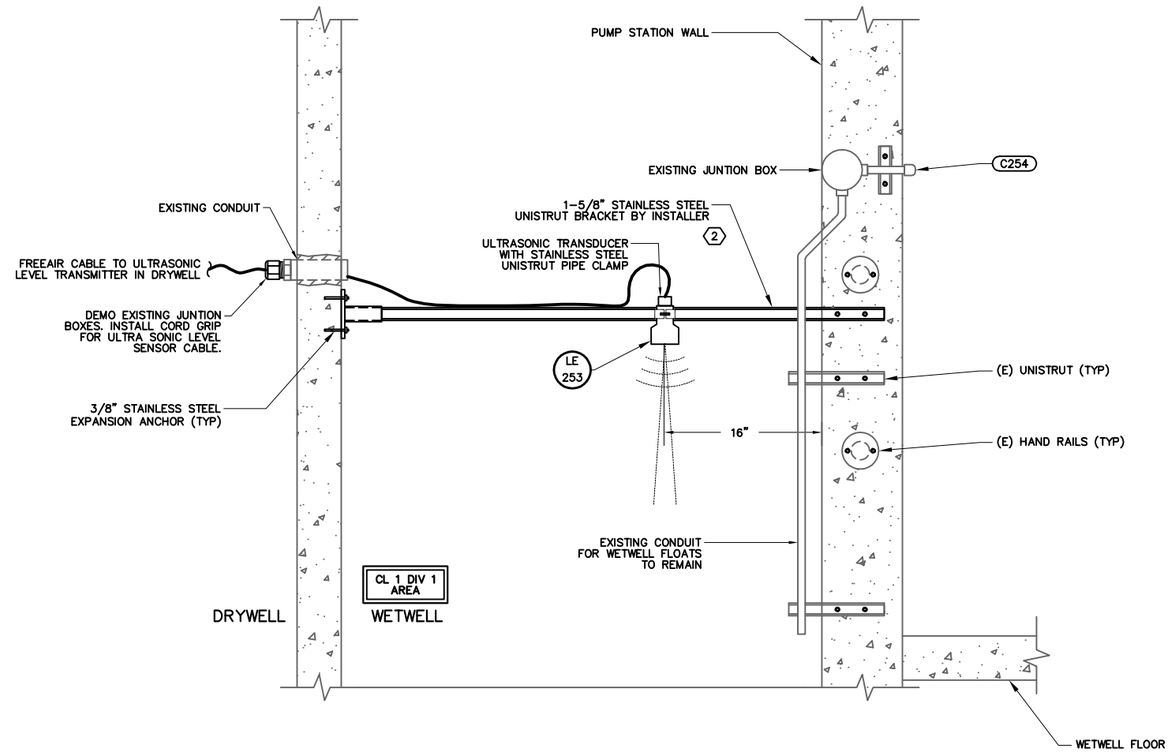
VALONA LIFT STATION MCC UPGRADE
OUTDOOR
ELECTRICAL PLAN 2

DRAWING NO.
E-13
14 OF 23 SHEETS



WETWELL PLAN
SCALE: 1/2" = 1'



SECTION VIEW

UL ULTRASONIC LEVEL DETAIL
NOT TO SCALE

DRAWING REFERENCED NOTES:

1. REMOVE EXISTING UNUSED WETWELL FLOATS
2. INSTALL NEW CROSS CHANNEL UNISTRUT BRACKET

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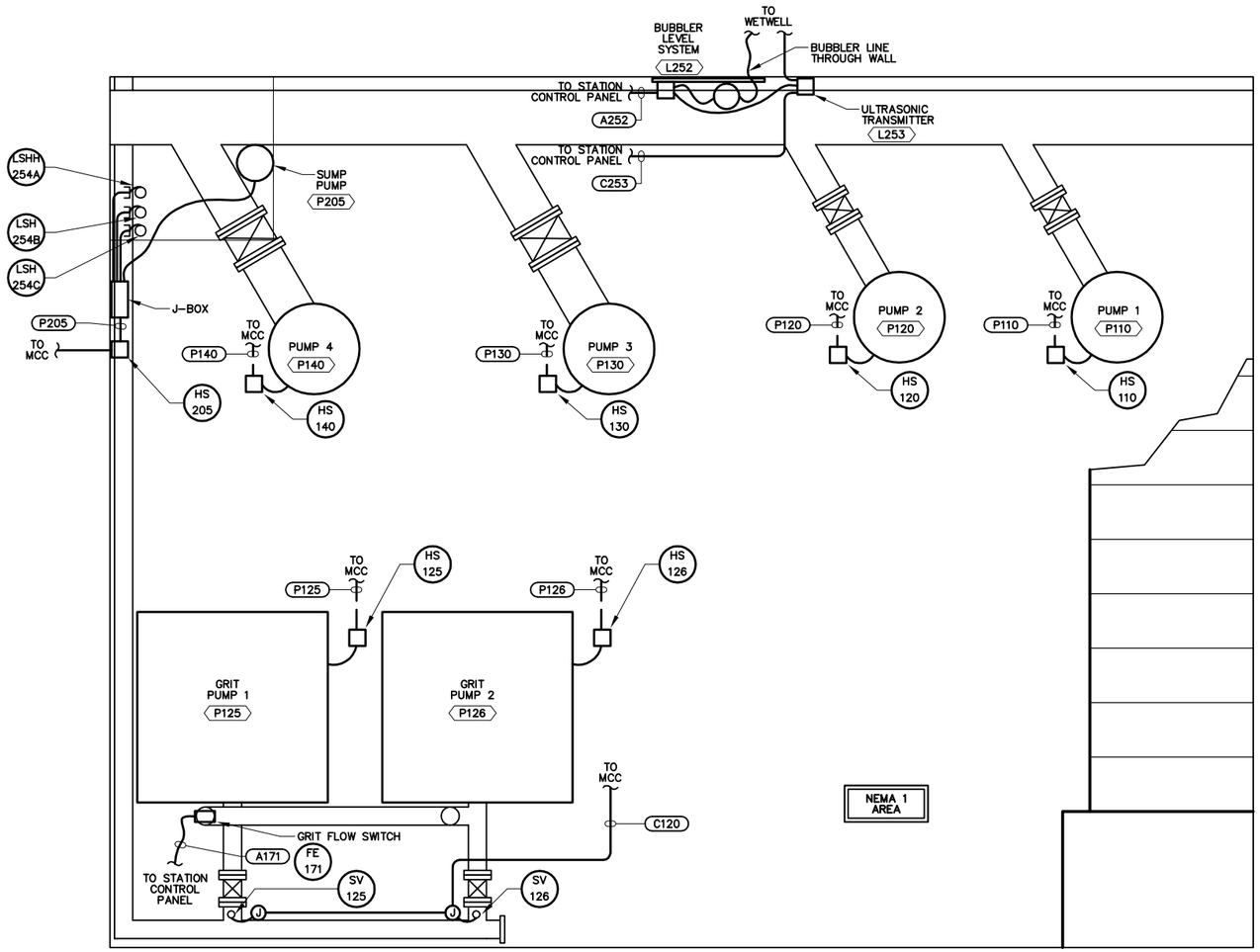
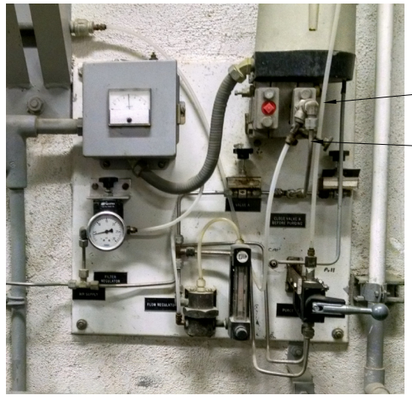
VALONA LIFT STATION MCC UPGRADE
WETWELL
ELECTRICAL PLAN

DRAWING NO.
E-14
15 OF 23 SHEETS

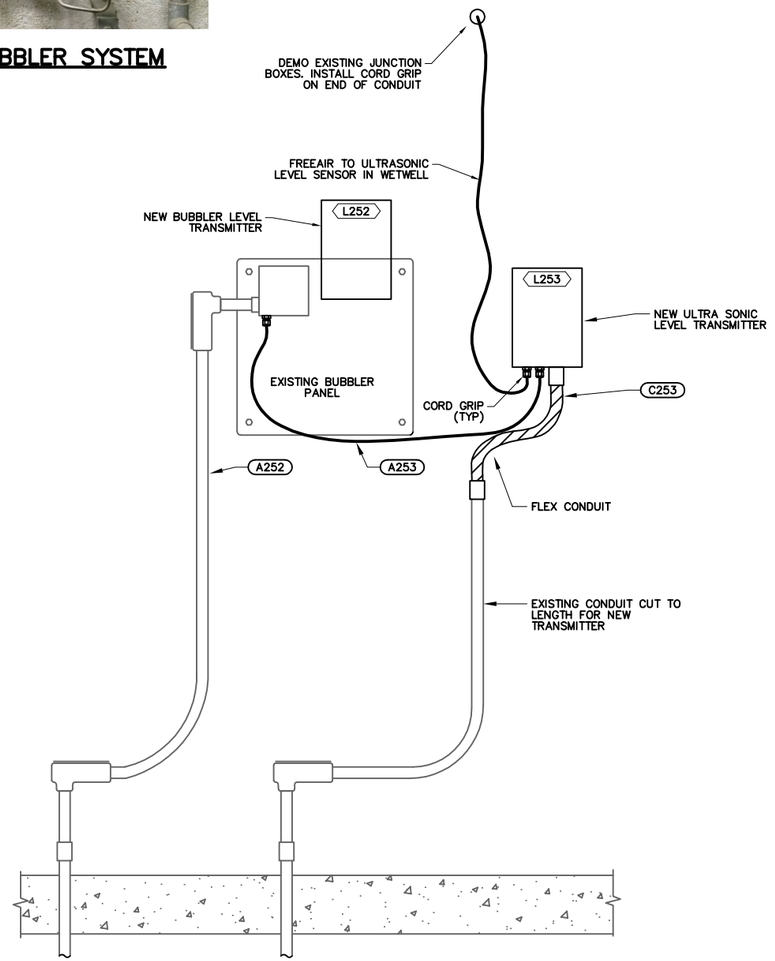


DRYWELL PLAN

SCALE: 3/4" = 1'



EXISTING BUBBLER SYSTEM



BWD — NOT TO SCALE

BUBBLER WALL DETAIL

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VALONA LIFT STATION MCC UPGRADE
DRYWELL
ELECTRICAL PLAN

DRAWING NO.
E-15
16 OF 23 SHEETS

CONDUIT & WIRE ROUTING SCHEDULE

REV	CONDUIT DETAILS TAG NO.	FROM	TO	QTY	SIZE	TYPE	POWER WIRE QTY	POWER WIRE SIZE	CONTROL WIRE QTY	CONTROL WIRE SIZE	GROUND SIZE	NOTES
	A171	CONTROL PANEL	GRIT FLOW SWITCH FE171	1	3/4"	EXISTING	–	–	1	#18 TSPR	–	
	A201	FLOWMETER VAULT EQUIPMENT PANEL	FLOWMETER VAULT	1	3/4"	EXISTING	–	–	–	–	–	NO CHANGES
	A252	CONTROL PANEL	LEVEL TRANSMITTERS LIT-252, LIT-253	1	3/4"	EXISTING	–	–	2	#18 TSPR	#14	
	A253	BUBBLER J-BOX	ULTRASONIC TRANSMITTER LIT-253	1	–	NONE	–	–	1	#18 TSPR	–	FREE AIR CABLE
	A261	FLOWMETER VAULT J-BOX	DISCHARGE PRESSURE PI261	1	3/4"	EXISTING	–	–	1	#18 TSPR	–	
	A271	FLOWMETER VAULT J-BOX	FLOWMETER FIT271	1	3/4"	EXISTING	–	–	1	#18 TSPR	#14	
	C003A	CONTROL PANEL	GENERATOR CONTROLS	1	3/4"	EXISTING	–	–	6	#14	#14	
	C003B	SWITCHBOARD ATS	GENERATOR CONTROLS	1	3/4"	EXISTING	–	–	–	–	–	NO CHANGES
	C003C	SWITCHBOARD ATS	GENERATOR CONTROLS	1	3/4"	EXISTING	–	–	–	–	–	NO CHANGES
	C004	SWITCHBOARD ATS	STATIONARY/PORTABLE GEN SWITCHING PNL	1	3/4"	EXISTING	–	–	–	–	–	NO CHANGES
	C071	CONTROL PANEL	VELONA FLOWMETER PANEL	1	3/4"	EXISTING	–	–	–	–	–	NO CHANGES
	C093	CONTROL PANEL	INTRUSION ALARM	1	3/4"	GRS	–	–	2	#14	#14	NEW CONDUIT
	C111	CONTROL PANEL	INFLUENT GATE VALVE ACUTATOR	1	3/4"	EXISTING	–	–	8	#14	#14	
	C120	MCC	GRIT PUMP SOV VALVES	1	3/4"	EXISTING	–	–	4	#14	#14	
	C135	MCC	GRIT WASHER SV	1	3/4"	EXISTING	–	–	2	#14	#14	
	C151	CONTROL PANEL	WETWELL LSH151	1	3/4"	EXISTING	–	–	2	#14	#14	
	C251	WETWELL J-BOX	WETWELL FLOAT SWITCHES	1	3/4"	EXISTING	–	–	6	#14	#14	
	C253	CONTROL PANEL	WETWELL ULTRASONIC TRANSMITTER	1	3/4"	EXISTING	–	–	2	#14	#14	
	C301	CONTROL PANEL	HYDRO TANK J-BOX DEVICES	1	3/4"	EXISTING	–	–	18	#14	#14	
	C351	HYDRO TANK J-BOX	WATER TANK J-BOX LSL351	1	3/4"	EXISTING	–	–	4	#14	#14	
	C352	HYDRO TANK J-BOX	HYDRO TANK LEVEL ELEMENT	1	3/4"	EXISTING	–	–	3	#14	#14	
	C960	AIR COMPRESSOR J-BOX	SOLENOID VALVES SV-961, SV-962	1	3/4"	EXISTING	–	–	4	#14	#14	
	C963	CONTROL PANEL	PNEUMATIC TANK PSL963, PSH963, PSC963, SV903	1	3/4"	EXISTING	–	–	8	#14	#14	
	D001	UTILITY POLE	TELEPHONE BOX	1	3/4"	EXISTING	–	–	–	–	–	NO CHANGES
	D002	CONTROL PANEL	EQ TANK COMM ANTENNA	1	NONE	NONE	–	–	–	–	–	RE-USE CABLE (PROTECT)
	D003	TELEPHONE PANEL	CONTROL PANEL	1	3/4"	EXISTING	–	–	2	CAT 6	–	
	L007	LP-A CKT 7	FLOWMETER	1	3/4"	EXISTING	2	#12	–	–	#12	NEW FLEX CONDUIT TO FM
	L004	LP-A CKT 4	OUTDOOR WW LIGHT	1	3/4"	EXISTING	–	–	–	–	–	NO CHANGES
	L010	LP-A CKT 10	FLOWMETER VAULT EXHAUST FAN	1	3/4"	EXISTING	–	–	–	–	–	NO CHANGES
	L017	LP-A CKT 17	CONTROL PANEL	1	3/4"	GRS	2	#12	–	–	#12	NEW CONDUIT
	P001	UTILITY POLE	UTILITY TRANSFORMER	–	–	EXISTING	–	–	–	–	–	NO CHANGES
	P002	UTILITY TRANSFORMER	SWITCHBOARD	–	–	EXISTING	–	–	–	–	–	NO CHANGES
	P003	SWITCHBOARD ATS	GENERATOR CIRCUIT BREAKER	1	3"	EXISTING	–	–	–	–	–	NO CHANGES
	P004	MCC	STATIONARY/PORTABLE GEN SWITCHING PNL	1	3"	EXISTING	–	–	–	–	–	NO CHANGES
	P010	MCC	XFMR A	1	3/4"	EXISTING	2	#10	–	–	#12	
	P110	MCC	PUMP 1 AND HS110	1	3/4"	EXISTING	3	#10	8	#14	#12	REPLACE HS BUTTONS
	P111	MCC	INFLUENT GATE VALVE ACUTATOR	1	3/4"	EXISTING	3	#12	–	–	#12	
	P113 A	MCC	GRINDER 1 PANEL	1	3/4"	EXISTING	6	#12	10	#14	#12	
	P113 B	MCC	GRINDER 1 MOTOR AND CONTROL STATION	1	3/4"	EXISTING	3	#12	6	#14	#12	VIA MCC TO GRINDER PANEL
	P115 A	MCC	GRINDER 2 PANEL	1	3/4"	EXISTING	6	#12	10	#14	#12	
	P115 B	GRINDER 2 PANEL	GRINDER 2 MOTOR AND CONTROL STATION	1	3/4"	EXISTING	3	#12	6	#14	#12	VIA MCC TO GRINDER PANEL
	P120	MCC	PUMP 2 AND HS120	1	3/4"	EXISTING	3	#10	8	#14	#12	REPLACE HS BUTTONS
	P121	MCC	DETRITOR	1	3/4"	EXISTING	3	#12	2	#14	#12	
	P125	MCC	GRIT PUMP 1 AND HS125	1	3/4"	EXISTING	3	#12	6	#14	#12	
	P126	MCC	GRIT PUMP 2 AND HS 126	1	3/4"	EXISTING	3	#12	6	#14	#12	
	P130	MCC	PUMP 3 AND HS130	1	1-1/2"	EXISTING	3	#2	10	#14	#6	REPLACE HS BUTTONS
	P131	MCC	GRIT WASHER DEVICES	1	3/4"	EXISTING	3	#12	8	#14	#12	REPLACE HS BUTTONS
	P140	MCC	PUMP 4 AND HS140	1	1-1/2"	EXISTING	3	#2	10	#14	#6	REPLACE HS BUTTONS
	P205	MCC	SUMP PUMP	1	3/4"	EXISTING	3	#12	12	#14	#12	FLOAT WIRES TO PLC
	P215	MCC	TRANSFER PUMP 5 AND HS215	1	1"	EXISTING	3	#8	10	#14	#10	
	P310	MCC	BOOSTER PUMP P310 AND HS310	1	3/4"	EXISTING	3	#12	4	#14	#12	REPLACE HS BUTTONS
	P900	AIR COMPRESSOR HS BOXES	AIR COMPRESSOR 1 & 2 SV 961 AND SV 962	1	3/4"	EXISTING	6	#12	4	#14	2#12	
	P901	MCC	AIR COMPRESSOR AND HS901	1	3/4"	EXISTING	3	#12	6	#14	#12	
	P902	MCC	AIR COMPRESSOR AND HS902	1	3/4"	EXISTING	3	#12	6	#14	#12	
	P903	MCC	WETWELL EF HS903	1	3/4"	EXISTING	3	#12	–	–	–	
	X201	CONTROL PANEL	FLOWMETER VAULT J-BOX	1	1"	EXISTING	–	–	–	–	–	SPARE, REMOVE WIRE
	X202	CONTROL PANEL	FLOWMETER VAULT J-BOX	1	1"	EXISTING	–	–	–	–	–	SPARE, REMOVE WIRE
	X301	CONTROL PANEL	OUTDOOR JBOX	1	3/4"	EXISTING	–	–	–	–	–	SPARE

NOTES:
1. WIRE WITHIN MCC (FROM CONTROL PANEL TO MCC CUBICLES) IS NOT SHOWN. FURNISH CONNECTIONS PER P&ID DRAWINGS AND ELEMENTARY DIAGRAMS.
2. ALL CONDUITS LISTED IN SCHEDULE SHALL BE LABELED WITH CONDUIT TAGS PER SPECIFICATIONS.
3. FLEXIBLE CONDUIT AND CONNECTORS SHALL BE REPLACED IN OUTDOOR LOCATIONS.
4. FURNISH WIRE IN CONDUITS AS SHOWN. NEW WIRE REQUIRED FOR ALL EXISTING CONDUITS WITH WIRE SHOWN.

NOTES PERTAINING TO CONDUIT SCHEDULE:
1. CONDUIT TYPE "SPEC" IS AS DEFINED IN SPECIFICATIONS SECTION 16110 FOR NON-EXPOSED AND EXPOSED PORTIONS OF CONDUIT RUN.
2. SEE SPECIFICATIONS AND EXPOSED TRANSITION DETAIL OR EQUIPMENT SPECIFIC DETAIL FOR CONDUIT TRANSITION MATERIALS AND METHODS FROM BELOW GROUND TO EXPOSED PORTIONS OF RUN.
3. CONDUITS OVER 15 FT LENGTH (EITHER EMPTY OR WITH CONDUCTORS SIZED LESS THAN #8 AWG), SHALL INCLUDE A POLY PULL STRING. STRING SHALL BE TIED OFF AT EACH END.
4. FITTINGS, CONDULETS, BOXES AND COVERS SHALL MATCH DUTY OF ADJACENT PIPE, SEE SPECIFICATIONS 16110.
5. WIRING AND CONDUIT USED FOR LIGHTS, RECEPTACLES, AND FANS ARE TO REMAIN IN PLACE WITHOUT MODIFICATION.

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VALONA LIFT STATION MCC UPGRADE
CONDUIT SCHEDULE

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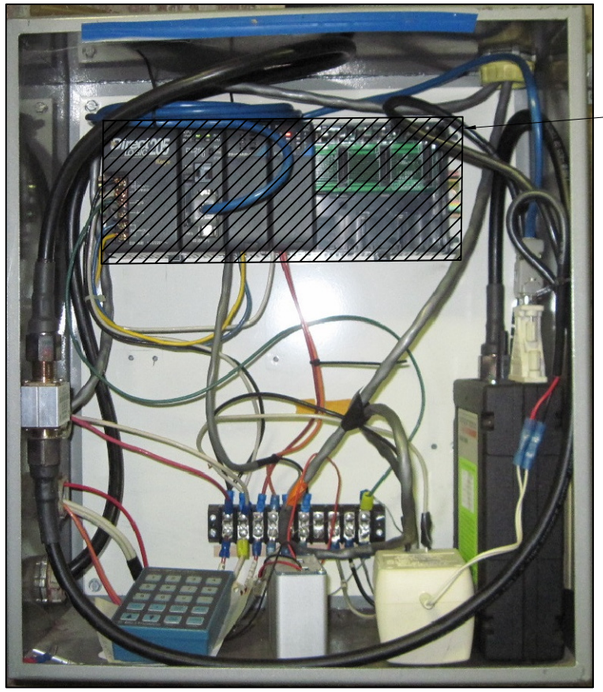
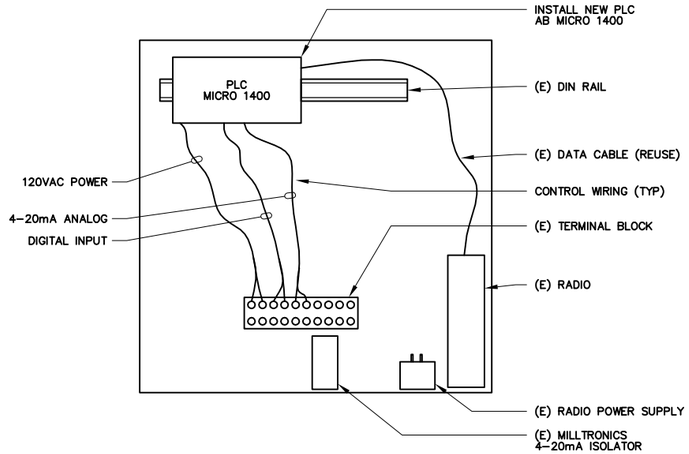
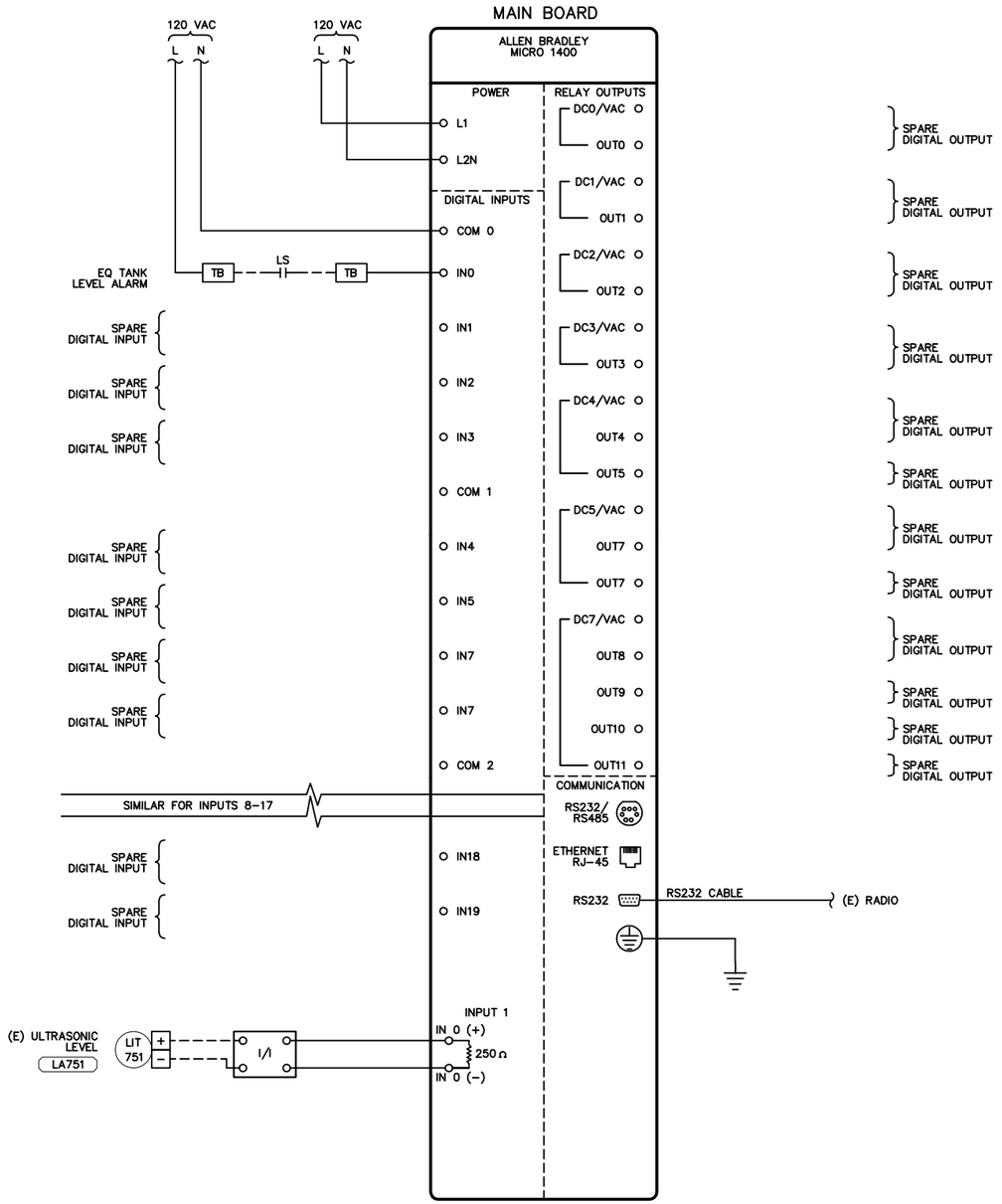


EXISTING EQ TANK CONTROLS



EQ TANK CONTROL PANEL LAYOUT



PLC INTEGRAL I/O

EQ TANK PLC-EQ I/O WIRING DIAGRAMS

GENERAL NOTES:

1. REPLACE WIRING AS NEEDED BETWEEN TERMINAL BLOCK AND PLC.
2. EXISING EQUIPMENT TO BE LEFT IN PANEL. REWIRING PLC ONLY.

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VALONA LIFT STATION MCC UPGRADE
EQ TANK PLC
REVISIONS

DRAWING NO.
E-17
18 OF 23 SHEETS

P&ID SYMBOLS

ISA SYMBOLS

SYMBOL	DESCRIPTION
XXX / XXX	FIELD MOUNTED INSTRUMENT
XXX / XXX	INSTRUMENT MOUNTED ON DOOR OF LOCAL PANEL, OPERATOR ACCESSIBLE
XXX / XXX	INSTRUMENT MOUNTED ON DOOR OF FIELD PANEL, OPERATOR ACCESSIBLE
XXX / XXX	INSTRUMENT MOUNTED WITHIN PANEL, OPERATOR INACCESSIBLE
XXX / XXX	INSTRUMENT MOUNTED WITHIN FIELD PANEL, OPERATOR INACCESSIBLE
I	OPERATION PERFORMED WITH LOGIC OR HARDWIRED DEVICES
MCE–XX	ASSOCIATED MOTOR CONTROL ELEMENTARY IF APPLICABLE
UNIT XXX / XXX	VISUAL DISPLAY OF PLC ANALOG REGISTER SCALE TO UNITS AS SHOWN
XXX / XXX	VISUAL DISPLAY OF PLC ANALOG ALARM REGISTER
XXX / XXX	VISUAL DISPLAY OF PLC DIGITAL REGISTER
XXX / XXX	VISUAL DISPLAY OF PLC DIGITAL ALARM REGISTER
X / X	TAG DESCRIPTION
XXXX	PLC I/O TAG
	PLC DIGITAL INPUT
	PLC DIGITAL OUTPUT
	ANALOG INPUT
	ANALOG OUTPUT
	AUDIBLE ALARM (BUZZER OR HORN)
X	LAMP INDICATION COLOR DENOTED BY "x" RED, BLU, GRN, WHT, AMBER
a XXXX	CONTINUATION TAG FROM ONE AREA TO ANOTHER AREA OF DIFFERENT DRAWINGS "a" TAG IDENTIFIER TO POINT ON DRAWING NUMBER XXXX.
I–X	CONTINUED ON DWG I–X

LINE TYPES

———	PRIMARY PROCESS LINE
———	SECONDARY PROCESS LINE
— — —	ELECTRICAL SIGNAL LINE (DIGITAL OR ANALOG)
.....	SOFTWARE OR DATA LINK
—— - ——	BOUNDARY OF EQUIPMENT PACKAGE SYSTEM
—o—o—	COMMUNICATION CONNECTION

VALVES

SYMBOL	DESCRIPTION
	GATE VALVE
	CHECK VALVE
	PLUG VALVE
	BALL VALVE
	BALL CHECK VALVE
	BUTTERFLY VALVE
	ANGLE VALVE
	NEEDLE VALVE
	RELIEF VALVE
	DIAPHRAGM VALVE
	3–WAY VALVE
	FLOW CONTROL VALVE
	PINCH VALVE
S	SOLENOID VALVE (2–WAY) (S→M FOR MOTORIZED VALVE)
S	SOLENOID VALVE (3–WAY) (S→M FOR MOTORIZED VALVE)
S	SOLENOID VALVE (4–WAY) (S→M FOR MOTORIZED VALVE)
	PNEUMATIC DIAPHRAGM CONTROL VALVE
	PRESSURE SUSTAINING VALVE
	PRESSURE REGULATING VALVE
	MULTIFUNCTION VALVE
	SLUICE GATE (SG) OR SLIDE GATE (SLG)
	AIR RELIEF VALVE (ARV)
	FLOAT VALVE
	STRAINER
	BACKFLOW PREVENTER
CV	CALIBRATION VALVE
	CALIBRATION COLUMN
	ROTAMETER
	UNION

ACTUATORS

M	MOTORIZED
S	SOLENOID
S / A	PNEUMATIC OPERATOR S– SOLENOID – OPEN/CLOSE A– POSITIONER – MODULATING

PUMPS

SYMBOL	DESCRIPTION
	CENTRIFUGAL PUMP OR BLOWER
	SUBMERSIBLE SEWAGE PUMP
	VERTICAL TURBINE PUMP OR WELL PUMP
	SUBMERSIBLE WELL PUMP
	GEAR PUMP
	POSITIVE DISPLACEMENT PUMP OR BLOWER
	DIAPHRAGM PUMP
	PERISTALTIC PUMP
M M	MOTOR

SENSORS

SYMBOL	DESCRIPTION
	ORIFICE PLATE
MAG	MAGNETIC FLOWMETER
%	DENSITY METER
~	ULTRASONIC FLOWMETER
	TURBINE OR PROPELLER METER
	VENTURI TUBE
	THERMAL DISPERSION FLOWMETER OR SWITCH
	PADDLE WHEEL FLOWMETER
LIT XXX	ULTRASONIC LEVEL TRANSMITTER (FLOW IF OVER FLUME OR WEIR)
LE XXX	CONDUCTANCE TYPE LEVEL ELEMENTS
LIT XXX	RADAR TYPE LEVEL TRANSMITTER
	GUIDED OPTION
LIT XXX	CAPACITANCE TYPE LEVEL TRANSMITTER

MISCELLANEOUS MECHANICAL ITEMS

SYMBOL	DESCRIPTION
	PIPE REDUCER
	RUPTURE DISC
	PRESSURE OR VACUUM RELIEF VALVE
	DIAPHRAGM SEAL
	ANNUALAR SEAL
	DRAIN TO WASTE
M	MIXER
F OR F	FILTER
	VENT W/CAP OR SCREEN
	FLEXIBLE HOSE OR TUBING
	SPRAY NOZZLE SYSTEM
	EXPANSION JOINT
	STATIC MIXER
	EJECTOR / EDUCTOR
	HOSE COUPLING
	PULSATION DAMPENER
	OMNI ANTENNA NON–DIRECTIONAL
	YAGI ANTENNA DIRECTIONAL

P&ID ABBREVIATIONS

INSTRUMENTATION SYBMOLS

	FIRST LETTER: MEASURED OR INITIATING VARIABLE	FIRST LETTER: MODIFIER	SUCCEEDING LETTERS: READOUT PASSIVE FUNCTION	SUCCEEDING LETTERS: OUTPUT FUNCTION	SUCCEEDING LETTERS: 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	RATIO			
G	GENERAL		GLASS VIEWING DEVICE		
H	HAND				HIGH, OPENED
I	CURRENT		INDICATING, INDICATOR		
J	POWER	SCAN			
K	TIME, TIME SCHEDULED	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	OPERTOR		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			VAVE, DAMPER, LOUVER	
W	WEIGHT		WELL		
X	SWITCH	X AXIS	UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED
Y	EVENT, STATE OF PRESENCE	Y AXIS		RELAY, COMPUTER, CONVERTER	
Z	POSITION, DIMENSION	Z AXIS		DRIVER, ACTUATOR, UNCLASSIFIED FINAL CONTROL ELEMENT	

P&ID ABBREVIATIONS

SWITCH IDENTIFIER

F/R	FORWARD/REVERSE	OPN	OPEN
HOA	HAND–OFF–AUTO	CLS	CLOSE
HOR	HAND–OFF–REMOTE	SEL	SELECTOR
LOS	LOCK OUT STOP	S/S	START / STOP
L/R	LOCAL / REMOTE	%	PERCENT ADJUSTMENT
MOA	MANUAL–OFF–AUTO		
OCA	OPEN–CLOSE–AUTO		
O/C	OPEN / CLOSE		
O/O	ON / OFF		

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IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

No.	REVISION	DATE	BY

DATE: 2/21/2018
DESIGN BY: N. CONANT
DRAWN BY: B. WOODIN
APPROVED BY: T. FRISCH
DRAWING NO:

Crockett COMMUNITY SERVICES DISTRICT

CROCKETT COMMUNITY SERVICES DISTRICT

VALONA LIFT STATION MCC UPGRADE
P&IDS
SYSBOLS AND ABREVIATIONS

DRAWING NO.
I-01
19 OF 23 SHEETS

OPERATOR INTERFACE

PLC

CROCKETT LS MCC

FIELD

YNR 113 | UAF 113 | YNR 115 | UAF 115 | LAH 151 | YNR 121 | HNA 121 | YNR 125 | HNA 125 | YNR 126 | HNA 126 | FS 171 | LAH 152 | YNR 131 | HNA 131

VALVE OPEN XC111O | VALVE CLOSE XC111C | OPEN ZS111O | CLOSED ZS111C

RUN YN113R | FAIL UA113F

RUN YN115R | FAIL UA115F

GRINDER LEVEL HIGH LA151H

RUN YN121R | AUTO HN121A | STT/STP XC121S

RUN YN125R | AUTO HN125A | STT/STP XC125S

RUN YN126R | AUTO HN126A | STT/STP XC126S

FLOW DETECT FS171

WASHER LEVEL HIGH LA152H | OPEN XC135O

RUN YN131R | AUTO HN131A | STT/STP XC131S

HOA HS 121 H — RUN (G) — I — DWG E04 — FVNR

HOA HS 125 H — RUN (G) — I — DWG E04 — FVNR

HOA HS 126 H — RUN (G) — I — DWG E04 — FVNR

FS 171 — REUSE AND RELOCATE TO NEW CONTROL PANEL

HOA HS 131 H — RUN (G) — I — DWG E04 — FVNR

OPEN HC 111 | STOP HC 111 | CLOSE HC 111 — ZSO 111 | ZSC 111 — M

GRINDER 1 CONTROL PANEL

(N) STOP HC 113 — M

GRINDER 2 CONTROL PANEL

(N) TEST HC 115 | (N) STOP HC 115 — M

OUTSIDE ABOVE GRADE

STOP HC 121 — M — WETWELL DECK

LSH 151

GRINDER 2 GR115

GRINDER 1 GR113

GRINDER CHANNELS

FROM CROCKETT/C&H — FROM MARINA — FROM VALONA

GATE VALVE V111

DETRITOR D121

DETRITOR BASIN

DECANT

I-03 TO WETWELL

DRYWELL

(N) TEST HC 125 | STOP HC 125 — S SV125 — M GRIT PUMP 1 P125

(N) TEST HC 126 | STOP HC 126 — S SV126 — M GRIT PUMP 2 P126

FE 171 — SONIC (E)

GRIT

SEAL WATER

S SV135 — TEST HC 131 | STOP HC 131 — M INCLINED GRIT SCREW GS131

FROM WATER SYSTEM I-04

CYCLONE

LSH 152

WASHER

GRIT BIN

DRAIN TO WELL

OUTSIDE ABOVE GRADE

GRIT WASHER

PUMP STATION P&ID 1 (1)

NOTES REFERENCED IN DRAWING:

(1) ALL FIELD COMPONENTS EXISTING EXCEPT WHERE NOTED. RECONNECT TO ALL FIELD EQUIPMENT WITH NEW MCC AND CONTROLS.

REGISTERED PROFESSIONAL ENGINEER — THOMAS P. FRISCH — No. E15761 — ELECTRICAL — STATE OF CALIFORNIA

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CROCKETT COMMUNITY SERVICES DISTRICT

VALONA LIFT STATION MCC UPGRADE
PUMP STATION
P&ID 1

DRAWING NO. I-02

20 OF 23 SHEETS

OPERATOR INTERFACE | PLC | CROCKETT LS MCC | FIELD

LAH 251A | LAHH 251B | HNAB 140 | YNRB 140 | *LAH 252 | *LA*L 252 FT | *LI 252 | LAH 253 | LAL 253 FT | LI 253 | SI 140 % | JI 140 KW | YNR 140 | HNA 140 | UAF 140 | LAH 254A | LAH 254B | LAH 254C | YNR 205 | HNA 205 | UAF 205 | PAH 261 | PAL 261 PSI | PI 261 | YNR 121 | HNA 121 | FAH 271 | FAL 271 GPM | FI 271

SIMILAR FOR PUMPS 1–3

SIMILAR FOR PUMPS 1–3

PLC																												
WETWELL LEVEL HIGH	WETWELL LEVEL HIGH HIGH	PUMP 4 STT/STP	PUMP 4 AUTO	PUMP 4 RUN	PUMP 4 SPEED PRESET	WETWELL LEVEL	WETWELL LEVEL	CONTROL SPEED	PUMP SPEED	MOTOR POWER	RUN	AUTO	STT/STP	VFD FAIL	DRYWELL LEVEL HIGH	SUMP PUMP HIGH/START	SUMP PUMP STOP	RUN	AUTO	STT/STP	FAIL	DISCHARGE PRESSURE	RUN	AUTO	STT/STP	FLOW
LA251AH	LA251BH	XC140SB	HN140AB	YN140RB	XC140SB	L252	L253	SC140	S140	J140	YN140R	HN140A	XC140S	UA140F	LA254AH	LA254BH	LA254CH	YN205R	HN205A	XC205S	UA205F	P261	YN121R	HN121A	XC121S	F271

(R) AUTO DIALER

FLOAT RELAYS PER DWG E09

P140 START/PRESET
P140 RUNNING
P140 AUTO
P140 START

OT LEAK (A) | RUN (G) | HS 140 H HOA

DWG E05 | HC 140 % SC

VFD | HIM

TO VFD ESW

RUN (G) | HS 205 H HOA

DWG E04

RUN (G) | HS 121 H HOA

DWG E04

FVNR

LIT 252 (N) | EXISTING BUBBLER LEVEL SYSTEM | LIT 253 (N)

LE 252 | LE 253 (N)

FROM DETRITOR BASIN I–02

FROM EQ TANK –

WS

LSHH 251C | LSH 251B | LSH 251A

	PUMP 1	PUMP 2	PUMP 3	PUMP 4
	P110	P120	P130	P140
	15 HP	15 HP	60 HP	60 HP
(N) TEST	HC 110	HC 120	HC 130	HC 140
STOP	HC 110	HC 120	HC 130	HC 140

PIT 261

VAULT

FIT 271 | MAG | FLOWMETER FM271

TO WWTP

PUMP VAULT

HC 215 STOP

TRANSFER PUMP 5 P215 20 HP

TO EQ TANK

TO HEADWORKS DRAIN BACK

TEST HC 205 | STOP HC 205

LSHH 254A | LSH 254B | LSH 254C

SUMP PUMP P205

DRAIN

WETWELL

DRYWELL

PUMP STATION P&ID 2 (5)

NOTES REFERENCED IN DRAWING:

1. TYPICAL I/O CONTROLS AND VFDS FOR ALL PUMPS
2. LOCATED IN REMOTE PANEL
3. NOT ALL I/O SHOWN. SEE PLC–BU WIRING DIAGRAMS.
4. INPUTS TO BACKUP PLC.
5. ALL FIELD COMPONENTS EXISTING EXCEPT WHERE NOTED. RECONNECT TO ALL FIELD EQUIPMENT WITH NEW MCC AND CONTROLS.

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CROCKETT COMMUNITY SERVICES DISTRICT

VALONA LIFT STATION MCC UPGRADE
PUMP STATION
P&ID 2

DRAWING NO. I-03

21 OF 23 SHEETS

OPERATOR INTERFACE

PLC

CROCKETT LS MCC

FIELD

YNR 121 | HNA 121 | YNR 121 | HNA 121 | YNR 121 | HNA 121 | PAL 963 | LAL 351 | YNR 310 | HNA 310 | PAL 361 | PAC 362 | PAH 362

RUN YN121R | AUTO HN121A | STT/STP XC121S | RUN YN121R | AUTO HN121A | STT/STP XC121S | RUN YN121R | AUTO HN121A | STT/STP XC121S | OPEN XC9030 | LOW ALARM PA963L | LEAD PUMP PA963LD | LAG PUMP PS963LG | LEVEL LOW LA351L | RUN YN310R | AUTO HN310A | STT/STP XC310S | ADD AIR XC3010 | LOW AIR ALARM PA361L | PUMP START PA362C | HIGH ALARM PA362H | AIR REQ'D LS352H | SERIAL COMMUNICATIONS

HOA HS 215 H — RUN G — I — DWG E04 — FWNR

HOA HS 901 H — RUN G — I — DWG E04 — FWNR

HOA HS 902 H — RUN G — I — DWG E04 — FWNR

HOA HS 310 H — RUN G — I — DWG E04 — FWNR

LS 352 (3)

RS232 — EXISTING RADIO

HC 215 TEST / HC 215 STOP — M — WETWELL EXHAUST FAN B903

HC 901 TEST / HC 901 STOP — M — AIR COMPRESSOR 1 E901 — S — AC1 VALVE SV901

HC 902 TEST / HC 902 STOP — M — AIR COMPRESSOR 2 E902 — S — AC2 VALVE SV902

RECEIVER — S — DRAIN VALVE SV903 — DRAIN

PSL 963 | PS1 963 | PS2 963 — TO BUBBLER/ HYDRO PNEUMATIC TANK

FROM WATER SOURCE — FLOAT FILL — LSL 351 — WATER TANK T300 — OF

HC 310 TEST / HC 310 STOP — M — BOOSTER PUMP P310

FROM COMPRESSED AIR SYSTEM — S — PSL 361 | PSC 362 | PSH 363 | LE 352 — HYDROPNEUMATIC TANK T301 — W3 WATER

EXISTING RADIO — EXISTING RADIO — EQ PLC (2) — LSH — LEVEL — EXISTING PUMP CONTROLS — LIT 751 — LSH 751 — LE 751 — LSL 752 — LSLL 753 — EQ TANK T710

FROM VELONA PUMP STATION — M — SUMP PUMP P701 — TO VELONA PUMP STATION

COMPRESSED AIR SYSTEM (1)

WATER SYSTEM (1)

EQ TANK (1)

NOTES REFERENCED IN DRAWING:

(1) ALL FIELD COMPONENTS EXISTING EXCEPT WHERE NOTED. RECONNECT TO ALL FIELD EQUIPMENT WITH NEW MCC AND CONTROLS.

(2) REPLACE PLC PER DWG E17.

(3) FURNISH NEW PROBE RELAY FOR EXISTING LEVEL PROBE. WARRICK SERIES 16 OR EQUAL.

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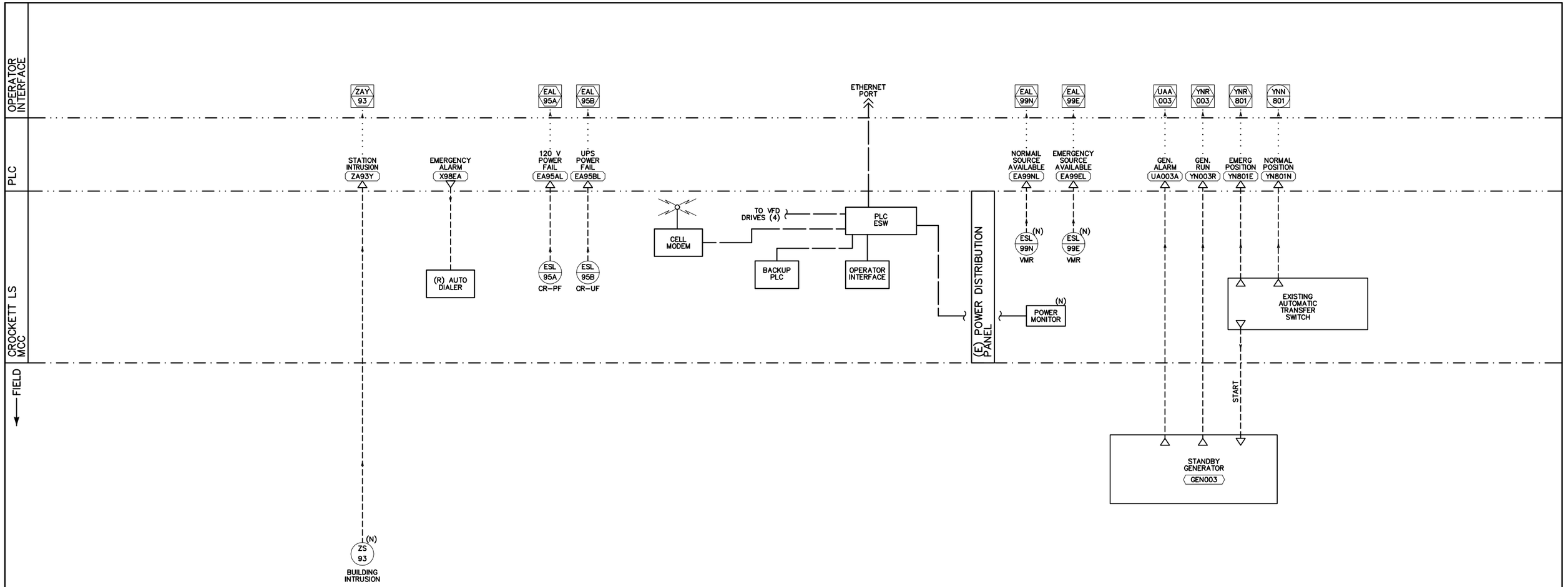
CROCKETT COMMUNITY SERVICES DISTRICT

VALONA LIFT STATION MCC UPGRADE
PUMP STATION
P&ID 3

DRAWING NO. I-04

22 OF 23 SHEETS



INTRUSION ALARM P&ID

COMMUNICATIONS P&ID

BACK-UP POWER P&ID ⟨1⟩

REGISTERED PROFESSIONAL ENGINEER
THOMAS P. FRISCH
No. E15761
ELECTRICAL
STATE OF CALIFORNIA

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VALONA LIFT STATION MCC UPGRADE
PUMP STATION
MISC. P&ID

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I-05
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