LEXINGTON

Lexington-Fayette Urban County Government

Lexington, Kentucky
Horse Capital of the World

Division of Procurement

Date of Issue: March 10, 2025

INVITATION TO BID #35-2025 Low Voltage Electrical Maintenance

Bid Opening Date: **Marcxh 24, 2025** **Bid Opening Time: 2:00 PM**
Address: All bids must be submitted on line at https://lexingtonky.ionwave.net/

Type of Bid: Price Contract

Pre Bid Meeting: N/A Pre Bid Time: N/A
Address: N/A

Sealed bids will ONLY be received online at https://lexingtonky.ionwave.net/ until **2:00 PM**, prevailing local time on **03/24/2025.** Bids must be submitted/uploaded by the above-mentioned date and time.

Bids are to include all shipping, handling and associated fees to the point of delivery (unless otherwise specified in the bid documents below) located at: Various locations Fayette and Jessamine Counties.

Check One:	**Proposed Delivery:**
_____Bid Specifications Met _____Exceptions to Bid Specifications. *Exceptions shall be itemized and attached to bid proposal submitted.*	_____days after acceptance of bid.
Procurement Card Usage—The Lexington-Fayette Urban County Government may be using Procurement Cards to purchase goods and services and also to make payments. Will you accept Procurement Cards? _____Yes _____ No	

To expedite award, the forms in this document should be completed and uploaded with your bid.

Submitted by: P&C Prime, LLC.
Firm Name

9879 S. Bullington Rd.
Address

Fredericksburg, IN 47120
City, State & Zip

Bid must be signed: Sr Tech Advisor
Signature of Authorized Company Representative – Title

Jim Johnson
Representative's Name (Typed or printed)

502-750-4551
Area Code - Phone – Extension *Fax #*

E-Mail Address

The Affidavit in this bid must be completed before your firm can be considered for award of this contract.

AFFIDAVIT

Comes the Affiant, James Johnson, and after being first duly sworn under penalty of perjury as follows:

1. His/her name is James Johnson and he/she is the individual submitting the bid or is the authorized representative of P&C Prime, LLC., the entity submitting the bid (hereinafter referred to as "Bidder")
2. Bidder will pay all taxes and fees, which are owed to the Lexington-Fayette Urban County Government at the time the bid is submitted, prior to award of the contract and will maintain a "current" status in regard to those taxes and fees during the life of the contract.
3. Bidder will obtain a Lexington-Fayette Urban County Government business license, if applicable, prior to award of the contract.
4. Bidder has authorized the Division of Procurement to verify the above-mentioned information with the Division of Revenue and to disclose to the Urban County Council that taxes and/or fees are delinquent or that a business license has not been obtained.
5. Bidder has not knowingly violated any provision of the campaign finance laws of the Commonwealth of Kentucky within the past five (5) years and the award of a contract to the Bidder will not violate any provision of the campaign finance laws of the Commonwealth.
6. Bidder has not knowingly violated any provision of Chapter 25 of the Lexington-Fayette Urban County Government Code of Ordinances, known as "Ethics Act."
7. Bidder acknowledges that "knowingly" for purposes of this Affidavit means, with respect to conduct or to circumstances described by a statute or ordinance defining an offense, that a person is aware or should have been aware that his conduct is of that nature or that the circumstance exists.

Further, Affiant sayeth naught. _____

STATE OF _____

COUNTY OF _____

The foregoing instrument was subscribed, sworn to and acknowledged before me by Ben Fisher on this the 20th day of March, 2025.

My Commission expires: January 25, 2031

Ben Fisher Emmet County, Michigan

NOTARY PUBLIC, STATE AT LARGE

Please refer to Section II. Bid Conditions, Item "U" prior to completing this form.

I. GREEN PROCUREMENT

A. ENERGY

The Lexington-Fayette Urban County Government is committed to protecting our environment and being fiscally responsible to our citizens.

The Lexington-Fayette Urban County Government mandates the use of Energy Star compliant products if they are available in the marketplace (go to **www.Energystar.gov**). If these products are available, but not submitted in your pricing, your bid will be rejected as non-compliant.

ENERGY STAR is a government program that offers businesses and consumers energy-efficient solutions, making it easy to save money while protecting the environment for future generations.

Key Benefits

These products use 25 to 50% less energy
Reduced energy costs without compromising quality or performance
Reduced air pollution because fewer fossil fuels are burned
Significant return on investment
Extended product life and decreased maintenance

B. GREEN SEAL CERTIFIED PRODUCTS

The Lexington-Fayette Urban County Government is also committed to using other environmentally friendly products that do not negatively impact our environment. Green Seal is a non-profit organization devoted to environmental standard setting, product certification, and public education.

Go to **www.Greenseal.org** to find available certified products. These products will have a reduced impact on the environment and on human health. The products to be used must be pre-approved by the LFUCG prior to commencement of any work in any LFUCG facility. If a Green Seal product is not available, the LFUCG must provide a signed waiver to use an alternate product. Please provide information on the Green Seal products being used with your bid response.

C. GREEN COMMUNITY

The Lexington-Fayette Urban County Government (LFUCG) serves as a principal, along with the University of Kentucky and Fayette County Public Schools, in the Bluegrass Partnership for a Green Community. The Purchasing Team component of the Partnership collaborates on economy of scale purchasing that promotes and enhances environmental initiatives. Specifically, when applicable, each principal is interested in obtaining best value products and/or services which promote environment initiatives via solicitations and awards from the other principals.

If your company is the successful bidder on this Invitation For Bid, do you agree to extend the same product/service pricing to the other principals of the Bluegrass Partnership for a Green Community (i.e. University of Kentucky and Fayette County Schools) if requested?

Yes ✓ **No**_____

II. Bid Conditions

A. No bid may be withdrawn for a period of sixty (60) days after the date and time set for opening.

B. No bid may be altered after the date and time set for opening. In the case of obvious errors, the Division of Procurement may permit the withdrawal of a bid. The decision as to whether a bid may be withdrawn shall be that of the Division of Procurement.

C. Acceptance of this proposal shall be enactment of an Ordinance by the Urban County Council.

D. The bidder agrees that the Urban County Government reserves the right to reject any and all bids for either fiscal

or technical reasons, and to award each part of the bid separately, all parts to one vendor or all parts to multiple vendors.

E. Minor exceptions may not eliminate the bidder. The decision as to whether any exception is minor shall be entirely that of the head of the requisitioning Department or Division and the Director of the Division of Procurement. The Urban County Government may waive technicalities and informalities where such waiver would best serve the interests of the Urban County Government.

F. Manufacturer's catalogue numbers, trade names, etc., where shown herein are for descriptive purposes and are to guide the bidder in interpreting the standard of quality, design, and performance desired, and shall not be construed to exclude proposals based on furnishing other types of materials and/or services. However, any substitution or departure proposed by the bidder must be clearly noted and described; otherwise, it will be assumed that the bidder intends to supply items specifically mentioned in this Invitation for Bids.

G. The Urban County Government may require demonstrations of the materials proposed herein prior to acceptance of this proposal.

H. Bids must be submitted on this form and must be signed by the bidder or his authorized representative. Unsigned bids will not be considered.

I. Bids must be submitted prior to the date and time indicated for opening. Bids submitted after this time will not be considered.

J. All bids mailed must be submitted in the Ion Wave online portal at https://lexingtonky.ionwave.net/

K. Bidder is requested to show both unit prices and lot prices. In the event of error, the unit price shall prevail.

L. A certified check or Bid Bond in the amount of **XX** percent of the bid price must be attached hereto. This check must be made payable to the Lexington-Fayette Urban County Government, and will be returned when the material and/or services specified herein have been delivered in accordance with specifications. In the event of failure to perform within the time period set forth in this bid, it is agreed the certified check may be cashed and the funds retained by the Lexington-Fayette Urban County Government as liquidated damages. Checks of unsuccessful bidders will be returned when the bid has been awarded.

M. The delivery dates specified by bidder may be a factor in the determination of the successful bidder.

N. Tabulations of bids received may be mailed to bidders. Bidders requesting tabulations must enclose a stamped, self-addressed envelope with the bid.

O. The Lexington-Fayette Urban County Government is exempt from Kentucky Sales Tax and Federal Excise Tax on materials purchased from this bid invitation. Materials purchased by the bidder for construction projects are not tax exempt and are the sole responsibility of the bidder.

P. All material furnished hereunder must be in full compliance with OSHA regulations.

Q. If more than one bid is offered by one party, or by any person or persons representing a party, all such bids shall be rejected.

R. Signature on the face of this bid by the Bidder or his authorized representative shall be construed as acceptance of and compliance with all terms and conditions contained herein.

S. The Entity (regardless of whether construction contractor, non-construction contractor or supplier) agrees to provide equal opportunity in employment for all qualified persons, to prohibit discrimination in employment because of race, color, religion, sex (including pregnancy, sexual orientation or gender identity), national origin, disability, age, genetic information, political affiliation, or veteran status, and to promote equal employment through a positive, continuing program from itself and each of its sub-contracting agents. This program of equal employment opportunity shall apply to every aspect of its employment policies and practices.

T. The Kentucky Equal Employment Opportunity Act of 1978 (KRS 45.560-45.640) requires that any county, city, town, school district, water district, hospital district, or other political subdivision of the state shall include in directly

or indirectly publicly funded contracts for supplies, materials, services, or equipment hereinafter entered into the following provisions:

During the performance of this contract, the contractor agrees as follows:

(1) The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, age or national origin;

(2) The contractor will state in all solicitations or advertisements for employees placed by or on behalf of the contractors that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, age or national origin;

(3) The contractor will post notices in conspicuous places, available to employees and applicants for employment, setting forth the provisions of the non-discrimination clauses required by this section; and

(4) The contractor will send a notice to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding advising the labor union or workers' representative of the contractor's commitments under the nondiscrimination clauses.

The Act further provides:

KRS 45.610. Hiring minorities - Information required

(1) For the length of the contract, each contractor shall hire minorities from other sources within the drawing area, should the union with which he has collective bargaining agreements be unwilling to supply sufficient minorities to satisfy the agreed upon goals and timetable.

(2) Each contractor shall, for the length of the contract, furnish such information as required by KRS 45.560 to KRS 45.640 and by such rules, regulations and orders issued pursuant thereto and will permit access to all books and records pertaining to his employment practices and work sites by the contracting agency and the department for purposes of investigation to ascertain compliance with KRS 45.560 to 45.640 and such rules, regulations and orders issued pursuant thereto.

KRS 45.620. Action against contractor - Hiring of minority contractor or subcontractor

(1) If any contractor is found by the department to have engaged in an unlawful practice under this chapter during the course of performing under a contract or subcontract covered under KRS 45.560 to 45.640, the department shall so certify to the contracting agency and such certification shall be binding upon the contracting agency unless it is reversed in the course of judicial review.

(2) If the contractor is found to have committed an unlawful practice under KRS 45.560 to 45.640, the contracting agency may cancel or terminate the contract, conditioned upon a program for future compliance approved by the contracting agency and the department. The contracting agency may declare such a contractor ineligible to bid on further contracts with that agency until such time as the contractor complies in full with the requirements of KRS 45.560 to 45.640.

(3) The equal employment provisions of KRS 45.560 to 45.640 may be met in part by a contractor by subcontracting to a minority contractor or subcontractor. For the provisions of KRS 45.560 to 45.640, a minority contractor or subcontractor shall mean a business that is owned and controlled by one or more persons disadvantaged by racial or ethnic circumstances.

KRS 45.630 Termination of existing employee not required, when

Any provision of KRS 45.560 to 45.640 notwithstanding, no contractor shall be required to terminate an existing employee upon proof that that employee was employed prior to the date of the contract.

KRS 45.640 Minimum skills

Nothing in KRS 45.560 to 45.640 shall require a contractor to hire anyone who fails to demonstrate the minimum skills required to perform a particular job.

It is recommended that all of the provisions above quoted to be included as special conditions in each contract.

In the case of a contract exceeding $250,000, the contractor is required to furnish evidence that his work-force in Kentucky is representative of the available work-force in the area from which he draws employees, or to supply an Affirmative Action plan which will achieve such representation during the life of the contract.

U. Any party, firm or individual submitting a proposal pursuant to this invitation must be in compliance with the requirements of the Lexington-Fayette Urban County Government regarding taxes and fees before they can be considered for award of this invitation and must maintain a "current" status with regard to those taxes and fees throughout the term of the contract. The contractor must be in compliance with Chapter 13 from the Code of Ordinances of the Lexington-Fayette Urban County Government. The contractor must be in compliance with Ordinance 35-2000 pursuant to contractor registration with the Division of Building Inspection. If applicable, said business must have a Fayette County business license.

Pursuant to KRS 45A.343 and KRS 45A.345, the contractor shall

(1) Reveal any final determination of a violation by the contractor within the previous five year period pursuant to KRS Chapters 136 (corporation and utility taxes), 139 (sales and use taxes), 141 (income taxes), 337 (wages and hours), 338 (occupational safety and health of employees), 341 (unemployment and compensation) and 342 (labor and human rights) that apply to the contractor; and

(2) Be in continuous compliance with the above-mentioned KRS provisions that apply to the contractor for the duration of the contract.

A contractor's failure to reveal the above or to comply with such provisions for the duration of the contract shall be grounds for cancellation of the contract and disqualification of the contractor from eligibility for future contracts for a period of two (2) years.

V. Vendors who respond to this invitation have the right to file a notice of contention associated with the bid process or to file a notice of appeal of the recommendation made by the Director of Procurement resulting from this invitation.

Notice of contention with the bid process must be filed within 3 business days of the bid/proposal opening by (1) sending a written notice, including sufficient documentation to support contention, to the Director of the Division of Procurement or (2) submitting a written request for a meeting with the Director of Procurement to explain his/her contention with the bid process. After consulting with the Commissioner of Finance the Chief Administrative Officer and reviewing the documentation and/or hearing the vendor, the Director of Procurement shall promptly respond in writing findings as to the compliance with bid processes. If, based on this review, a bid process irregularity is deemed to have occurred the Director of Procurement will consult with the Commissioner of Finance, the Chief Administrative Officer and the Department of Law as to the appropriate remedy.

Notice of appeal of a bid recommendation must be filed within 3 business days of the bid recommendation by (1) sending a written notice, including sufficient documentation to support appeal, to the Director, Division of Procurement or (2) submitting a written request for a meeting with the Director of Procurement to explain his appeal. After reviewing the documentation and/or hearing the vendor and consulting with the Commissioner of Finance and the Chief Administrative Officer, the Director of Procurement shall in writing, affirm or withdraw the recommendation.

III. Procurement Contract Bid Conditions

A. The terms of this agreement shall be for **1** year(s) from the date of acceptance of this contract by the Lexington-Fayette Urban County Government. This agreement may be automatically extended for an additional **3-1** year(s) renewal. This contract may be canceled by either party thirty (30) days after delivery by canceling party of written notice of intent to cancel to the other contracting party.

B. Price Changes **(Space Checked Applies)**

(XXX)1. Prices quoted in response to the Invitation shall be firm prices for the first 365 days of the Procurement Contract. After 365 days, prices may be subject to revision and such changes shall be based on general industry changes. Revision may be either increases or decreases and may be requested by either party. There will be no more than one (1) price adjustment per year. Requests for price changes shall be received in writing at least twenty (20) days prior to the effective date and are subject to written acceptance before becoming effective. Proof of the validity of a request for revision shall be responsibility of the requesting party. The Lexington-Fayette Urban County Government shall receive the benefit of any decline that the seller shall offer his other accounts.

() 2. No provision for price change is made herein. Prices are to be firm for the term of this contract.

() 3. See bid specifications.

C. If any contract item is not available from the vendor, the Lexington-Fayette Urban County Government, at its option, may permit the item to be back-ordered or may procure the item on the open market.

D. All invoices must bear reference to the Lexington-Fayette Urban County Government Purchasing document numbers which are being billed.

E. This contract may be canceled by the Lexington-Fayette Urban County Government if it is determined that the Bidder has failed to perform under the terms of this agreement, such cancellation to be effective upon receipt of written notice of cancellation by the Bidder.

F. No substitutions for articles specified herein may be made without prior approval of the Division of Procurement.

EQUAL OPPORTUNITY AGREEMENT

Standard Title VI Assurance

The Lexington Fayette-Urban County Government, (hereinafter referred to as the "Recipient") hereby agrees that as a condition to receiving any Federal financial assistance from the U.S. Department of Transportation, it will comply with Title VI of the Civil Rights Act of 1964, 78Stat.252, 42 U.S.C. 2000d-4 (hereinafter referred to as the "Act"), and all requirements imposed by or pursuant to Title 49, Code of Federal Regulations, U.S. Department of Transportation, Subtitle A, Office of the Secretary, (49 CFR, Part 21) Nondiscrimination in Federally Assisted Program of the Department of Transportation – Effectuation of Title VI of the Civil Rights Act of 1964 (hereinafter referred to as the "Regulations") and other pertinent directives, no person in the United States shall, on the grounds of race, color, national origin, sex, age (over 40), religion, sexual orientation, gender identity, veteran status, or disability be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity for which the Recipient receives Federal financial assistance from the U.S. Department of Transportation, including the Federal Highway Administration, and hereby gives assurance that will promptly take any necessary measures to effectuate this agreement. This assurance is required by subsection 21.7(a) (1) of the Regulations.

The Law

- Title VII of the Civil Rights Act of 1964 (amended 1972) states that it is unlawful for an employer to discriminate in employment because of race, color, religion, sex, age (40-70 years) or national origin.

- Executive Order No. 11246 on Nondiscrimination under Federal contract prohibits employment discrimination by contractor and sub-contractor doing business with the Federal Government or recipients of Federal funds. This order was later amended by Executive Order No. 11375 to prohibit discrimination on the basis of sex.

- Section 503 of the Rehabilitation Act of 1973 states: *The Contractor will not discriminate against any employee or applicant for employment because of physical or mental disability.*

- Section 2012 of the Vietnam Era Veterans Readjustment Act of 1973 requires Affirmative Action on behalf of disabled veterans and veterans of the Vietnam Era by contractors having Federal contracts.

- Section 206(A) of Executive Order 12086, Consolidation of Contract Compliance Functions for Equal Employment Opportunity, states: T*he Secretary of Labor may investigate the employment practices of any Government contractor or sub-contractor to determine whether or not the contractual provisions specified in Section 202 of this order have been violated.*

The Lexington-Fayette Urban County Government practices Equal Opportunity in recruiting, hiring and promoting. It is the Government's intent to affirmatively provide employment opportunities for those individuals who have previously not been allowed to enter into the mainstream of society. Because of its importance to the local Government, this policy carries the full endorsement of the Mayor, Commissioners, Directors and all supervisory personnel. In following this commitment to Equal Employment Opportunity and because the Government is the benefactor of the Federal funds, it is both against the Urban County Government policy and illegal for the Government to let contracts to companies which knowingly or unknowingly practice discrimination in their employment practices. Violation of the above mentioned ordinances may cause a contract to be canceled and the contractors may be declared ineligible for future consideration.

Please sign this statement in the appropriate space acknowledging that you have read and understand the provisions contained herein. Return this document as part of your application packet.

Bidders

I/We agree to comply with the Civil Rights Laws listed above that govern employment rights of minorities, women, veteran status, disability and age.

Signature

P&C Prime, LLC.

Name of Business

GENERAL PROVISIONS OF BID CONTRACT

By signing the below, bidder acknowledges that it understands and agrees with the following provisions related to its bid response and the provision of any goods or services to LFUCG upon selection by LFUCG pursuant to the bid request:

1. Bidder shall comply with all Federal, State & Local regulations concerning this type of service or good. All applicable state laws, ordinances and resolutions (including but not limited to Section 2-33 (Discrimination due to sexual orientation or gender identity) and Chapter 13 (Licenses and Regulations) of the Lexington-Fayette Urban County Government Code of Ordinances, and Resolution No. 484-17 (Minority, Women, and Veteran-Owned Businesses)) and the regulations of all authorities having jurisdiction over the project shall apply to the contract, and shall be deemed to be incorporated herein by reference.

2. Failure to submit ALL forms and information required by LFUCG may be grounds for disqualification.

3. Addenda: All addenda and IonWave Q&A, if any, must be considered by the bidder in making its response, and such addenda shall be made a part of the requirements of the bid contract. Before submitting a bid response, it is incumbent upon bidder to be informed as to whether any addenda have been issued, and the failure of the bidder to cover any such addenda may result in disqualification of that response.

4. Bid Reservations: LFUCG reserves the right to reject any or all bid responses, to award in whole or part, and to waive minor immaterial defects in proposals. LFUCG may consider any alternative proposal that meets its basic needs.

5. Liability: LFUCG is not responsible for any cost incurred by bidder in the preparation of its response.

6. Changes/Alterations: Bidder may change or withdraw a proposal at any time prior to the opening; however, no oral modifications will be allowed. Only letters, or other formal written requests for modifications or corrections of a previously submitted proposal which is addressed in the same manner as the bid response, and received by LFUCG prior to the scheduled closing time for receipt of bids, will be accepted. The bid response when opened, will then be corrected in accordance with such written request(s), provided that the written request is contained in a sealed envelope which is plainly marked "modifications of bid response".

7. Clarification of Submittal: LFUCG reserves the right to obtain clarification of any point in a bid or to obtain additional information from any bidder.

8. Bribery Clause: By his/her signature on its response, bidder certifies that no employee of his/hers, any affiliate or subcontractor, has bribed or attempted to bribe an officer or employee of the LFUCG.

9. Additional Information: While not necessary, the bidder may include any product brochures, software documentation, sample reports, or other documentation that may assist LFUCG in better understanding and evaluating the bid response. Additional documentation shall not serve as a substitute for other documentation which is required by the LFUCG to be submitted with the bid response.

10. Ambiguity, Conflict or other Errors: If a bidder discovers any ambiguity, conflict, discrepancy, omission or other error in the bid request of LFUCG, it shall immediately notify LFUCG of such error in writing and request modification or clarification of the document if allowable by the LFUCG.

11. Agreement to Bid Terms: In submitting its bid response, the bidder agrees that it has carefully examined the specifications and all provisions relating to LFUCG's bid request, including but not limited to the bid contract. By submission of its bid response, bidder states that it understands the meaning, intent and requirements of LFUCG's bid request and agrees to the same. The successful bidder shall warrant that it is familiar with and understands all provisions herein and shall warrant that it can comply with them. No additional compensation to bidder shall be authorized for services, expenses, or goods reasonably covered under these provisions that the bidder omits from its bid response.

12. Cancellation: LFUCG may unilaterally terminate the bid contract with the selected bidder(s) at any time, with or without cause, by providing at least thirty (30) days advance written notice unless a different advance written notice

period is negotiated prior to contract approval. Payment for services or goods received prior to termination shall be made by the LFUCG provided these goods or services were provided in a manner acceptable to the LFUCG. Payment for those goods and services shall not be unreasonably withheld.

13. Assignment of Contract: The selected bidder(s) shall not assign or subcontract any portion of the bid contract with LFUCG without the express written consent of LFUCG. Any purported assignment or subcontract in violation hereof shall be void. It is expressly acknowledged that LFUCG shall never be required or obligated to consent to any request for assignment or subcontract; and further that such refusal to consent can be for any or no reason, fully within the sole discretion of LFUCG.

14. No Waiver: No failure or delay by LFUCG in exercising any right, remedy, power or privilege hereunder, nor any single or partial exercise thereof, nor the exercise of any other right, remedy, power or privilege shall operate as a waiver hereof or thereof. No failure or delay by LFUCG in exercising any right, remedy, power or privilege under or in respect of this bid proposal or bid contract shall affect the rights, remedies, powers or privileges of LFUCG hereunder or shall operate as a waiver thereof.

15. Authority to do Business: Each bidder must be authorized to do business under the laws of the Commonwealth of Kentucky and must be in good standing and have full legal capacity to provide the goods or services specified in the bid proposal. Each bidder must have all necessary right and lawful authority to submit the bid response and enter into the bid contract for the full term hereof including any necessary corporate or other action authorizing the bidder to submit the bid response and enter into this bid contract. If requested, the bidder will provide LFUCG with a copy of a corporate resolution authorizing this action and/or a letter from an attorney confirming that the proposer is authorized to do business in the Commonwealth of Kentucky. All bid responses must be signed by a duly authorized officer, agent or employee of the bidder.

16. Governing Law: This bid request and bid contract shall be governed by and construed in accordance with the laws of the Commonwealth of Kentucky. In the event of any proceedings regarding this matter, the bidder agrees that the venue shall be the Fayette County Circuit Court or the U.S. District Court for the Eastern District of Kentucky, Lexington Division and that the bidder expressly consents to personal jurisdiction and venue in such Court for the limited and sole purpose of proceedings relating to these matters or any rights or obligations arising thereunder.

17. Ability to Meet Obligations: Bidder affirmatively states that there are no actions, suits or proceedings of any kind pending against bidder or, to the knowledge of the bidder, threatened against the bidder before or by any court, governmental body or agency or other tribunal or authority which would, if adversely determined, have a materially adverse effect on the authority or ability of bidder to perform its obligations under this bid response or bid contract, or which question the legality, validity or enforceability hereof or thereof.

18. Price Discrepancy: When applicable, in case of price discrepancy, unit bid price written in words will prevail followed by unit price written in numbers then total amount bid per line item.

19. Bidder understands and agrees that its employees, agents, or subcontractors are not employees of LFUCG for any purpose whatsoever. Bidder is an independent contractor at all times related to the bid response or bid contract.

20. Contractor [or Vendor or Vendor's Employees] will not appropriate or make use of the Lexington-Fayette Urban County Government (LFUCG) name or any of its trade or service marks or property (including but not limited to any logo or seal), in any promotion, endorsement, advertisement, testimonial or similar use without the prior written consent of the government. If such consent is granted LFUCG reserves the unilateral right, in its sole discretion, to immediately terminate and revoke such use for any reason whatsoever. Contractor agrees that it shall cease and desist from any unauthorized use immediately upon being notified by LFUCG.

21. If any term or provision of this bid contract shall be found to be illegal or unenforceable, the remainder of the contract shall remain in full force and such term or provision shall be deemed stricken.

Signature

3/21/2025

Date

WORKFORCE ANALYSIS FORM

Name of Organization: P&C Prime, LLC.

Categories	**Total**	White (Not Hispanic or Latino)		Hispanic or Latino		Black or African-American (Not Hispanic or Latino		Native Hawaiian and Other Pacific Islander (Not Hispanic or Latino		Asian (Not Hispanic or Latino		American Indian or Alaskan Native (not Hispanic or Latino		Two or more races (Not Hispanic or Latino		**Total**	
		M	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Administrators	2	1	1														
Professionals	2	2															
Superintendents																	
Supervisors	3	3															
Foremen	2																
Technicians	8																
Protective Service																	
Para-Professionals																	
Office/Clerical	1		1														
Skilled Craft																	
Service/Maintenance																	
Total:	18																

Prepared by: Amanda Board, Office Manager **Date:** 03 / 20 / 2025

(Name and Title)

Revised 2015-Dec-15

DIRECTOR, DIVISION OF PROCUREMENT
LEXINGTON-FAYETTE URBAN COUNTY GOVERNMENT
200 EAST MAIN STREET
LEXINGTON, KENTUCKY 40507

NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION TO ENSURE EQUAL EMPLOYMENT OPPORTUNITIES AND DBE CONTRACT PARTICIPATION

The Lexington-Fayette Urban County Government has a Certified Minority and Women Business Enterprise seventeen percent (17%) minimum goal including minimum subgoals of five percent (5%) for Minority Business Enterprises (MBE) and a subgoal of twelve percent (12%) for Women Business Enterprises (WBE); a three (3%) minimum goal for Certified Veteran-Owned Small Businesses and/or Certified Service- Disabled Veteran Owned Businesses; and a goal of utilizing Disadvantaged Business Enterprises (DBE), where applicable, for government contracts.

For assistance in locating certified DBEs, MBEs, WBEs, VOSBs and/or VOSBs, contact Sherita Miller at 859/258-3320 or by writing the address listed below:

Sherita Miller, MPA, CPSD
Minority Business Enterprise Liaison
Division of Procurement
Lexington-Fayette Urban County Government
200 East Main Street
Lexington, Kentucky 40507
smiller@lexingtonky.gov
859-258-3323

LEXINGTON

MINORITY BUSINESS ENTERPRISE PROGRAM

Sherita Miller, MPA, CPSD
Minority Business Enterprise Liaison
Division of Procurement
Lexington-Fayette Urban County Government
200 East Main Street
Lexington, KY 40507
smiller@lexingtonky.gov
859-258-3323

OUR MISSION: The mission of the Minority Business Enterprise Program (MBEP) is to facilitate the full participation of minority and women owned businesses in the procurement process and to promote economic inclusion as a business imperative essential to the long- term economic viability of Lexington-Fayette Urban County Government.

To that end the urban county council adopted and implemented Resolution 272-2024 – a Certified Minority and Women Business Enterprise seventeen percent (17%) minimum goal including minimum subgoals of five percent (5%) for Minority Business Enterprises (MBE) and a subgoal of twelve percent (12%) for Women Business Enterprises (WBE); a three (3%) minimum goal for Certified Veteran-Owned Small Businesses and/or Certified Service- Disabled Veteran Owned Businesses; and a goal of utilizing Disadvantaged Business Enterprises (DBE), where applicable, for government contracts.

The resolution states the following definitions shall be used for the purposes of reaching these goals:

Certified Disadvantaged Business Enterprise (DBE) *– a business in which at least fifty-one percent (51%) is owned, managed and controlled by a person(s) who is socially and economically disadvantaged as define by 49 CFR subpart 26.*

Certified Minority Business Enterprise (MBE) *– a business in which at least fifty-one percent (51%) is owned, managed and controlled by an ethnic minority (i.e. Black American, Asian American, Hispanic American, Native American)*

Certified Women Business Enterprise (WBE) *– a business in which at least fifty-one percent (51%) is owned, managed and controlled by a woman.*

Certified Veteran-Owned Small Business (VOSB) *– a business in which at least fifty-one percent (51%) is owned, managed and controlled by a veteran who served on active duty with the U.S. Army, Air Force, Navy, Marines or Coast Guard.*

Certified Service -Disabled Veteran Owned Small Business (SDVOSB) *– a business in which at least fifty-one percent (51%) is owned, managed and controlled by a disabled veteran who served on active duty with the U.S. Army, Air Force, Navy, Marines or Coast Guard.*

The term "Certified" shall mean the business is appropriately certified, licensed, verified, or validated by an organization or entity recognized by the Division of Procurement as having the appropriate credentials to make a determination as to the status of the business.

The following certifications are recognized and accepted by the MBEP:

Kentucky Transportation Cabinet (KYTC), Disadvantaged Business Enterprise (DBE)
Kentucky Minority and Women Business Enterprise (MWBE)
Women's Business Enterprise National Council (WBENC)
National Women Business Owners Corporation (NWBOC)
National Minority Supplier Development Council (NMSDC)
Tri-State Minority Supplier Development Council (TSMSDC)
U.S. Small Business Administration Veteran Small Business Certification (VetCert)
Kentucky Service- Disabled Veteran Owned Small Business (SDVOSB)

To comply with Resolution 272-2024, prime contractors, minority and women business enterprises, veteran owned small businesses, and service-disabled veteran owned small businesses must complete monthly contract compliance audits in the Diverse Business Management Compliance system, https://lexingtonky.diversitycompliance.com/

A list of organizations that certify and/or maintain lists of certified businesses (i.e. DBE, MBE, WBE, VOSB and/or SDVOSB) is available upon request by emailing, Sherita Miller, smiller@lexingtonky.gov.

LEXINGTON

LFUCG MWDBE PARTICIPATION FORM
Bid/RFP/Quote Reference #_____

The MWDBE and/or veteran subcontractors listed have agreed to participate on this Bid/RFP/Quote. If any substitution is made or the total value of the work is changed prior to or after the job is in progress, it is understood that those substitutions must be submitted to the Division of Procurement for approval immediately. **Failure to submit a completed form may cause rejection of the bid.**

MWBE Company, Name, Address, Phone, Email	DBE/MBE WBE/VOSB/SDVOSB	Work to be Performed	Total Dollar Value of the Work	% Value of Total Contract
1. Type text here				
2.				
3.				
4.				

The undersigned company representative submits the above list of MDWBE and veteran firms to be used in accomplishing the work contained in this Bid/RFP/Quote. Any misrepresentation may result in the termination of the contract and/or be subject to applicable Federal and State laws concerning false statements and false claims.

_____ _____

Company **Company Representative**

_____ _____

Date **Title**

LEXINGTON

LFUCG MWDBE SUBSTITUTION FORM

Bid/RFP/Quote Reference #_____

The substituted MWDBE and/or veteran subcontractors listed below have agreed to participate on this Bid/RFP/Quote. These substitutions were made prior to or after the job was in progress. These substitutions were made for reasons stated below and are now being submitted to the Division of Procurement for approval. By the authorized signature of a representative of our company, we understand that this information will be entered into our file for this project. **Note: Form required if a subcontractor is being substituted on a contract.**

SUBSTITUTED DBE/MBE/WBE/VOSB Company Name, Address, Phone, Email	DBE/MBE/WBE/VOSB/SDVOSB Formally Contracted/ Name, Address, Phone, Email	Work to Be Performed	Reason for the Substitution	Total Dollar Value of the Work	% Value of Total Contract
1.					
2.					
3.					
4.					

The undersigned acknowledges that any misrepresentation may result in termination of the contract and/or be subject to applicable Federal and State laws concerning false statements and false claims.

_____ _____

Company **Company Representative**

_____ _____

Date **Title**

LEXINGTON

DOCUMENTATION REQUIRED FOR GOOD FAITH EFFORTS AND OUTREACH PLANS

As affirmed in Resolution Number 272-2024, the Urban County Council has adopted an annual aspirational goal of utilizing at least seventeen percent (17%) of public funds spend from certain discretionary agreements with certified Minority Business Enterprises (MBEs) and certified Woman Business Enterprises (WBEs); utilizing at least three percent (3%) of public funds from certain discretionary agreements with Certified Veteran-Owned Small Business and Certified Service-Disabled Veteran-Owned Small Businesses (VOSBs); and utilizing Disadvantaged Business Enterprises (DBEs) where applicable. Bidders should make every effort to achieve these goals.

Therefore, as an element of the responsiveness of the bid, all Bidders are required to submit documentation of their good faith and outreach efforts to ensure all businesses, including small and disadvantaged businesses such as minority-, woman-, and veteran-owned businesses, have an equal opportunity to compete for and participate in the performance of any subcontracts resulting from this procurement. Examples of good faith and outreach efforts that satisfy this requirement to encourage the participation of, DBEs, MBEs, WBEs, VOSBs and/or SDVOSBs include:

1. Advertised opportunities to participate in the contract in at least two (2) publications of general circulation media; trade and professional association publications; small and minority business or trade publications; and publications or trades targeting minority, women, and disadvantaged businesses not less than fifteen (15) days prior to the deadline for submission of bids to allow, DBEs, MBEs, WBEs, VOSBs and/or SDVOSBs to participate.

2. Attended LFUCG Procurement Economic Inclusion Outreach event(s) within the past year to meet new small businesses, DBEs, MBEs, WBEs, VOSBs and/or SDVOSBs to partner with on LFUCG contracts and procurements.

3. Attended pre-bid/pre-proposal meetings that were scheduled by LFUCG to inform small businesses, DBEs, MBEs, WBEs, VOSBs and/or SDVOSBs of subcontracting opportunities.

4. Sponsored Economic Inclusion event to provide networking opportunities for prime contractors and small businesses, DBEs, MBEs, WBEs, VOSBs and/or SDVOSBs.

5. Requested a list of certified small, DBE, MBE, WBE, VOSB and/or SDVOSB subcontractors or suppliers from LFUCG and showed evidence of contacting the companies on the list(s).

6. Contacted organizations that work with small, DBE, MBE, WBE, and VOSB companies for assistance in finding certified DBEs, MBEs, WBEs, VOSB and/or SDVOSBs to work on this project. Those contacted and their responses must be a part of the bidder's outreach efforts documentation.

7. Sent written notices, by certified mail, email, or facsimile, to qualified, certified small businesses, DBEs, MBEs, WBEs, VOSBs and/or SDVOSBs soliciting their participation in the contract not less than seven (7) days prior to the deadline for submission of bids to allow them to participate effectively.

8. Followed up initial solicitations by contacting small businesses, DBEs, MBEs, WBEs, VOSBs and/or SDVOSBs via tailored communications to determine their level of interest.

9. Provided the interested small businesses, DBEs, MBEs, WBEs, VOSBs and/or SDVOSBs with adequate and timely information about the plans, specifications, and requirements of the contract.

10. Selected portions of the work to be performed by small businesses, DBEs, MBEs, WBEs, VOSBs and/or SDVOSBs in order to increase the likelihood of subcontracting participation. This includes, where appropriate, breaking out contract work items into economically feasible units to facilitate small, DBE, MBE, WBE, VOSB and/or SDVOSB participation, even when the prime contractor may otherwise perform these work items with its own workforce.

11. Negotiated in good faith with interested small businesses, DBEs, MBEs, WBEs, VOSBs and/or SDVOSBs, not rejecting them as unqualified without sound reasons based on a thorough investigation of their capabilities. Any rejection must be so noted in writing with a description as to why an agreement could not be reached.

12. Included documentation of quotations received from interested small businesses, DBEs, MBEs, WBEs, VOSBs and/or SDVOSBs that were not used due to uncompetitive pricing or were rejected as unacceptable and/or copies of responses from firms indicating that they would not be submitting a bid.

    a. Bidder has to submit sound reasons why the quotations were considered unacceptable. The fact that the bidder has the ability and/or desire to perform the contract work with its own forces will not be considered a sound reason for rejecting a small business', DBE's MBE's, WBE's, VOSB's and/or SDVOSB's quote. Nothing in this provision shall be construed to require the bidder to accept unreasonable quotes in order to satisfy the participation goals.

13. Made an effort to offer assistance to or refer interested small businesses, DBEs, MBEs, WBEs, VOSBs and/or SDVOSBs to obtain the necessary equipment, supplies, materials, insurance and/or bonding to satisfy the work requirements of the bid proposal.

14. Made efforts to expand the search for small businesses, DBEs, MBEs, WBEs, VOSBs and/or SDVOSBs beyond the usual geographic boundaries.

15. Other – any other evidence that the bidder submits that may demonstrate that the bidder has made reasonable efforts to include small, DBE, MBE, WBE, VOSB and/or SDVOSB participation.

Bidder must document, with specificity, each of the efforts it made to include small businesses, DBEs, MBEs, WBEs, VOSBs and/or SDVOSBs as subcontractors in the procurement, including the date on which each effort was made, the medium through which each effort was made, and the outcome of each effort.

<u>Note</u>: Failure to submit the documentation requested in this section may be cause for rejection of bid. Bidders may include any other documentation deemed relevant to this requirement which is subject to review by the MBE Liaison. Documentation of Good Faith and Outreach Efforts must be submitted with the Bid, regardless of the proposed level of small, DBE, MBE, WBE, VOSB and/or SDVOSB participation in the procurement. If the Good Faith and Outreach Effort documentation is not submitted with the bid response, the bid may be rejected.

OUTREACH EFFORTS EVALUATION

Outreach efforts demonstrated by the bidder or respondent will be evaluated on a pass/fail basis.

ATTACHMENT A – SMALL AND DISADVANTAGED, MINORITY-, WOMEN-, AND VETERAN-OWNED BUSINESS OUTREACH PLAN

Proposer Name:		**Date:**	
Project Name:		**Project Number:**	
Contact Name:		**Telephone:**	
Email:			

The mission of the Minority Business Enterprise Program is to facilitate the full participation of disadvantaged businesses, minority-, women-, veteran-, and service-disabled veteran-owned businesses in the procurement process and to promote economic inclusion as a business imperative essential to the long -term economic viability of Lexington-Fayette Urban County Government.

To that end, small and disadvantaged businesses, including minority-, woman-, veteran-, and service-disabled veteran-owned businesses, must have an equal opportunity to be utilized in the performance of contracts with public funds spent from certain discretionary agreements. By submitting its offer, Bidder/Proposer certifies that it has taken, and if there are further opportunities will take, reasonable steps to ensure that small and disadvantaged businesses, including minority-, woman-, veteran-, and service-disabled veteran-owned businesses, are provided an equal opportunity to compete for and participate in the performance of any subcontracts resulting from this procurement.

The information submitted in response to this clause will not be considered in any scored evaluation. Failure to submit this form may cause the bid or proposal to be rejected.

Is the Bidder/ Proposer a certified firm? Yes ☑ No ☐

If yes, indicate all certification type(s):

DBE ☐ MBE ☐ WBE ☐ SBE ☐ VOSB/SDVOSB ☑

and supply a copy of the certificate and/or certification letter if not currently listed on the city's Minority Business Enterprise Program's (MBEP) certified list.

1. Include a list of firms that Bidder/ Proposer has had a contractual relationship with within the last two years that are minority-owned, woman-owned, veteran-owned or small businesses, regardless of their certification status.

Click or tap here to enter text.

2. Does Bidder/Proposer foresee any subcontracting opportunities for this procurement?

Yes ☐ No ☐

If no, please explain why in the field below. Do not complete the rest of this form and submit this first page with your bid and/or proposal. Click or tap here to enter text.

If yes, please complete the following pages and submit all pages with your bid and/or proposal.

Describe the steps Bidder/Proposer took to solicit small and disadvantaged businesses, including MBEs, WBEs, VOSBs, and SDVOSBs, for subcontracting opportunities for this procurement.

3. Check the good faith and outreach efforts the Bidder/Proposer used to encourage the participation of small and disadvantaged businesses including, MBEs, WBEs, VOSBs and SDVOSBs:

☐ Bidder placed advertisements in search of prospective small businesses, DBEs, MBEs, WBEs, VOSBs and/or SDVOSBs for the solicitation.

☐ Bidder attended LFUCG Procurement Economic Inclusion Outreach event(s) within the past year.

☐ Bidder attended pre-bid and/or pre-proposal meetings for this solicitation.

☐ Bidder sponsored an Economic Inclusion Outreach event.

☐ Bidder requested a list of certified small, DBE, MBE, WBE, VOSB and/or SDVOSB subcontractors or suppliers from LFUCG.

☐ Bidder contacted organizations that work with small, DBE, MBE, WBE, VOSB and/or SDVOSB companies.

☐ Bidder sent written notices to certified small, DBE, MBE, WBE, VOSB and SDVOSB businesses.

☐ Bidder followed up to initial solicitations with interested small, DBE, MBE, WBE, VOSB and/or SDVOSB.

☐ Bidder provided small, DBE, MBE, WBE, VOSB and/or SDVOSB businesses interested in performing the solicited work with prompt access to the plans, specifications, scope of work, and requirements of the solicitation.

☐ Bidder made efforts to segment portions of the work to be performed by small businesses, DBEs, MBEs, WBEs, VOSBs and/or SDVOSBs, including dividing sub-bid/partnership opportunities into economically feasible units/parcels, to facilitate participation.

☐ Bidder negotiated in good faith with interested small, DBE, MBE, WBE, VOSB and/or SDVOSB businesses.

☐ Bidder provided adequate rationale for rejecting any small business', DBEs, MBEs, WBEs, VOSBs or SDVOSBs for lack of qualifications.

☐ Bidder offered assistance in obtaining bonding, insurance, financial, equipment, or other resources to small businesses, DBEs, MBEs, WBEs, VOSBs and/or SDVOSBs, in an effort to assist them in meeting project requirements.

☐ Bidder made efforts to expand the search for small businesses, DBEs MBEs, WBEs, VOSBs and/or SDVOSBs beyond the usual geographic boundaries.

☐ Bidder made other reasonable efforts to include small businesses, DBEs, MBEs, WBEs, VOSBs and/or SDVOSBs participation.

4. Bidder/Proposer must include documentation, including the date each effort was made, the medium through which each effort was made, and the outcome of each effort with this form, regardless of the level of small, DBE, MBE, WBE, VOSB and/or SDVOSB participation. Examples of required documentation include copies of email communications, copies of newspaper advertisements, or copies of quotations received from interested small businesses, DBEs, MBEs, WBEs, VOSBs or SDVOSBs.

Click or tap here to enter text.

For detailed information regarding outreach efforts that satisfy the MBE Program's requirements, please see "Documentation Required for Good Faith Efforts and Outreach Plans" page.

Note: The Bidder/Proposer must be willing to report the identity of each subcontractor and the value of each subcontract to MBEP if awarded a contract from this procurement.

Failure to submit the documentation requested may be cause for rejection of the bid. Bidders may include any other documentation deemed relevant to this requirement, which is subject to review by the MBE Liaison. Documentation of Good Faith and Outreach Efforts must be submitted with the bid, regardless of the proposed level of SBEs, DBEs, MBEs, WBEs, VOSBs and/or SDVOSBs participation in the procurement. If the Good Faith and Outreach Effort Form and associated documentation is not submitted with the bid response, the bid may be rejected.

The undersigned acknowledges that all information is accurate. Any misrepresentations may result in termination of the contract and/or be subject to applicable Federal and State laws concerning false statements and claims.

P&C Prime	Jim Johnson
Company	**Company Representative**
3-23-2025	Sr Technical Advisor
Date	**Title**

4870-1925-6809, v. 1

AMENDMENT 1 —
CERTIFICATION OF COMPLIANCE FOR EXPENDITURES USING FEDERAL FUNDS, INCLUDING THE AMERICAN RESCUE PLAN ACT

The Lexington-Fayette Urban County Government ("LFUCG") may use Federal funding to pay for the goods and/or services that are the subject matter of this bid. That Federal funding may include funds received by LFUCG under the American Rescue Plan Act of 2021. Expenditures using Federal funds require evidence of the contractor's compliance with Federal law. Therefore, by the signature below of an authorized company representative, you certify that the information below is understood, agreed, and correct. Any misrepresentations may result in the termination of the contract and/or prosecution under applicable Federal and State laws concerning false statements and false claims.

The bidder (hereafter "bidder," or "contractor") agrees and understands that in addition to all conditions stated within the attached bid documents, the following conditions will also apply to any Agreement entered between bidder and LFUCG, if LFUCG uses Federal funds, including but not limited to funding received by LFUCG under the American Rescue Plan Act ("ARPA"), toward payment of goods and/or services referenced in this bid. The bidder also agrees and understands that if there is a conflict between the terms included elsewhere in this Request for Proposal and the terms of this Amendment 1, then the terms of Amendment 1 shall control. The bidder further certifies that it can and will comply with these conditions, if this bid is accepted and an Agreement is executed:

1. Any Agreement executed as a result of acceptance of this bid may be governed in accordance with 2 CFR Part 200 and all other applicable Federal law and regulations and guidance issued by the U.S. Department of the Treasury.

2. Pursuant to 24 CFR § 85.43, any Agreement executed as a result of acceptance of this bid can be terminated if the contractor fails to comply with any term of the award. This Agreement may be terminated for convenience in accordance with 24 CFR § 85.44 upon written notice by LFUCG. Either party may terminate this Agreement with thirty (30) days written notice to the other party, in which case the Agreement shall terminate on the thirtieth day. In the event of termination, the contractor shall be entitled to that portion of total compensation due under this Agreement as the services rendered bears to the services required. However, if LFUCG suspects a breach of the terms of the Agreement and/or that the contractor is violating the terms of any applicable law governing the use of Federal funds, LFUCG may suspend the contractor's ability to receive payment by giving thirty (30) days' advance written notice. Further, either party may terminate this Agreement for cause shown with thirty (30) days written notice, which shall explain the party's cause for the termination. If the parties do not reach a settlement before the end of the 30 days, then the Agreement shall terminate on the thirtieth day. In the event of a breach, LFUCG reserves the right to pursue any and all applicable legal, equitable, and/or administrative remedies against the contractor.

3. The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, sexual orientation, gender identity, or national origin. The contractor will take affirmative action to ensure that applicants are employed and that employees are treated during employment without regard to their race, color, religion, sex, sexual orientation, gender identity, or national origin. Such action shall include, but not be limited to the following:

(1) Employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause.

(2) The contractor will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, or national origin.

(3) The contractor will not discharge or in any other manner discriminate against any employee or applicant for employment because such employee or applicant has inquired about, discussed, or disclosed the

compensation of the employee or applicant or another employee or applicant. This provision shall not apply to instances in which an employee who has access to the compensation information of other employees or applicants as a part of such employee's essential job functions discloses the compensation of such other employees or applicants to individuals who do not otherwise have access to such information, unless such disclosure is in response to a formal complaint or charge, in furtherance of an investigation, proceeding, hearing, or action, including an investigation conducted by the employer, or is consistent with the contractor's legal duty to furnish information.

(4) The contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding a notice to be provided advising the said labor union or workers' representatives of the contractor's commitments under this section and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

(5) The contractor will comply with all provisions of Executive Order 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.

(6) The contractor will furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the administering agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

(7) In the event of the contractor's noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations, or orders, this contract may be canceled, terminated, or suspended in whole or in part, and the contractor may be declared ineligible for further government contracts or federally assisted construction contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

(8) The contractor will include the portion of the sentence immediately preceding paragraph (1) and the provisions of paragraphs (1) through (8) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The contractor will take such action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provisions, including sanctions for noncompliance.

Provided, however, that in the event a contractor becomes involved in or is threatened with litigation with a subcontractor or vendor as a result of such direction by the administering agency, the contractor may request the United States to enter into such litigation to protect the interests of the United States.

4. If fulfillment of the contract requires the contractor to employ mechanic’s or laborers, the contractor further agrees that it can and will comply with the following:

(1) Overtime requirements: No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such a workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such a workweek.

(2) Violation: liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in paragraph (1) of this section, the contractor and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory) for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (1) of this section, in the sum of $10 for each calendar day on which such individual was required

or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (1) of this section.

(3) Withholding for unpaid wages and liquidated damages. LFUCG shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (2) of this section.

(4) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (1) through (4) of this section and also a clause requiring the subcontractors to include these clauses in any lower-tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower-tier subcontractor with the clauses set forth in paragraphs (1) through (4) of this section.

5. The contractor shall comply with all applicable standards, orders, or regulations issued pursuant to the Clean Air Act, as amended, 42 U.S.C. § 7401 et seq.

6. The contractor shall report each violation to LFUCG and understands and agrees that LFUCG will, in turn, report each violation as required to assure notification to the Treasury Department and the appropriate Environmental Protection Agency Regional Office.

7. The contractor shall include these requirements in numerical paragraphs 5 and 6 in each subcontract exceeding $100,000 financed in whole or in part with Federal funding.

8. The contractor shall comply with all applicable standards, orders, or regulations issued pursuant to the Federal Water Pollution Control Act, as amended, 33 U.S.C. § 1251 et seq.

9. The contractor shall report each violation to LFUCG and understands and agrees that LFUCG will, in turn, report each violation as required to assure notification to the Treasury Department and the appropriate Environmental Protection Agency Regional Office.

10. The contractor shall include these requirements in numerical paragraphs 8 and 9 in each subcontract exceeding $100,000 financed in whole or in part with Federal funds.

11. The contractor shall comply with all applicable standards, orders, or regulations issued pursuant to the Federal Water Pollution Control Act, as amended, 33 U.S.C. § 1251 et seq.

12. The contractor shall report each violation to LFUCG and understands and agrees that LFUCG will, in turn, report each violation as required to assure notification to the Treasury Department and the appropriate Environmental Protection Agency regional office.

13. The contractor shall include these requirements in numerical paragraphs 11 and 12 in each subcontract exceeding $100,000 financed in whole or in part with American Rescue Plan Act funds.

14. The contractor shall include this language in any subcontract it executes to fulfill the terms of this bid: “the sub-grantee, contractor, subcontractor, successor, transferee, and assignee shall comply with Title VI of the Civil Rights Act of 1964, which prohibits recipients of federal financial assistance from excluding from a program or activity, denying benefits of, or otherwise discriminating against a person on the basis of race, color, or national origin (42 U.S.C. § 2000d et seq.), as implemented by the Department of the Treasury’s Title VI regulations, 31 CFR Part 22, which are herein incorporated by reference and made a part of this contract (or agreement). Title VI also includes protection to persons with ‘Limited English Proficiency’ in any program or activity receiving federal financial

assistance, 42 U.S.C. § 2000d et seq., as implemented by the Department of the Treasury's Title VI regulations, 31 CFR Part 22, and herein incorporated by reference and made a part of this contract or agreement."

15. Contractors who apply or bid for an award of $100,000 or more shall file the required certification that it will not and has not used federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency. Each tier certifies to the tier above that it will not and has not used federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a member of Congress, officer or employee of Congress, or an employee of a member of Congress in connection with obtaining any federal contract, grant, or any other award covered by 31 U.S.C. § 1352. Each tier shall also disclose any lobbying with non-federal funds that takes place in connection with obtaining any federal award. Such disclosures are forwarded from tier to tier, up to the recipient. The required certification is included here:

a. The undersigned certifies, to the best of his or her knowledge and belief, that:

   (1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

   (2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

   (3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

b. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

16. The contractor acknowledges and certifies that it has not been debarred or suspended and further acknowledges and agrees that it must comply with regulations regarding debarred or suspended entities in accordance with 24 CFR § 570.489(l). Funds may not be provided to excluded or disqualified persons.

17. The contractor agrees and certifies that to the greatest extent practicable, it will prefer the purchase, acquisition, and use of all applicable goods, products or materials produced in the United States, in conformity with 2 CFR 200.322 and/or section 70914 of Public Law No. 117-58, §§ 70901-52, also known as the Infrastructure Investment and Jobs Act, whichever is applicable.

18. The contractor agrees and certifies that all activities performed pursuant to any Agreement entered as a result of the contractor's bid, and all goods and services procured under that Agreement, shall comply with 2 C.F.R. § 200.216 (Prohibition on certain telecommunications and video surveillance services and equipment) and 2 C.F.R. 200 § 200..323 (Procurement of recovered materials), to the extent either section is applicable.

19. If this bid involves construction work for a project totaling $10 million or more, then the contractor further agrees that all laborers and mechanics, etc., employed in the construction of the public facility project assisted with funds provided under this Agreement, whether employed by contractor, or contractor's contractors, or subcontractors, shall be paid wages complying with the Davis-Bacon Act (40 U.S.C. 3141-3144). Contractor agrees that all of contractor's contractors and subcontractors will pay laborers and mechanics the prevailing wage as determined by the Secretary of Labor and that said laborers and mechanics will be paid not less than once a week. The contractor agrees to comply with the Copeland Anti- Kick Back Act (18 U.S.C. § 874) and its implementing regulations of the U.S. Department of Labor at 29 CFR part 3 and part 5. The contractor further agrees to comply with the applicable provisions of the Contract Work Hours and Safety Standards Act (40 U.S.C. Section 327-333), and the applicable provisions of the Fair Labor Standards Act of 1938, as amended (29 U.S.C. et seq.). Contractor further agrees that it will report all suspected or reported violations of any of the laws identified in this paragraph to LFUCG.

Signature

3-23-2025

Date

LOW VOLTAGE
ELECTRICAL MAINTENANCE AND REPAIR
SCOPE OF SERVICES

The Lexington-Fayette Urban County Government – Division of Water Quality (LFUCG-DWQ) desires to procure the indefinite services of qualified electrical contractors to assist LFUCG-DWQ maintenance staff with low voltage electrical maintenance and installation services. For the purposes of this scope low voltage is defined as less than 600 volts. Appendix A contains Standard Electrical Specifications that will be followed as needed for each project quoted. LFUCG-DWQ already employs a staff of electricians and technicians qualified for low voltage systems; LFUCG-DWQ desires to augment current staff with on-call/as needed outsourced electrical contracting services.

Electrical contractors issued a Purchase Order under the terms and conditions of this scope and the associated contract documents must be available to work the two different capacities listed below.

1. On-Call Capacity – Prepared to perform urgent electrical maintenance work at the rates stated in Exhibit A on the Unit Price Quotation Form. Unless otherwise authorized, urgent electrical low voltage service work requires a maximum 24-hour response.

2. As-Needed Capacity – Prepared to perform repair work at the rates stated in Exhibit A on the Unit Price Quotation Form. When a project is requested in an As-Needed Capacity a description of the work will be sent to all preapproved/accepted contractors. A time will be scheduled so all contractors can come inspect the site and ask questions. Written quotes will be received from all interested and a final price will be negotiated. The lowest responsible bid will be accepted.

Multiple qualified electrical contractors will be preapproved/accepted for this contract. The contract will be issued for one (1) year with three (3) one (1) year renewals. A single project, awarded through this contract will not exceed $250,000.00 with a $500,000.00 aggregate for the calendar year. Exceptions to the expense limit will be considered in the event of an emergency but cannot proceed without a certificate of emergency signed by the mayor.

The selected electrical contractors are expected to perform electrical maintenance tasks including but not limited to the following tasks:

- Assemble, install, test, and maintain electrical or electronic wiring, equipment, appliances, apparatus, and fixtures, using hand and/or power tools. Work from ladders, scaffolds, and roofs to install, maintain or repair electrical wiring, equipment and fixtures. Perform physically demanding tasks, such as digging trenches to lay conduit and moving and lifting or heavy objects. Diagnose malfunctioning systems, apparatus, and components, using test equipment and hand tools, locate the cause of electrical breakdowns and correct the problem. Inspect electrical systems, equipment, and components to identify hazards, defects, and the need for adjustment or repair, and to ensure compliance with all applicable electrical codes. Connect wires to motors, drives, circuit breakers, transformers, or other components. Place conduit

(pipes or tubing) inside designated partitions, walls, or other concealed areas, and pull insulated wires or cables through the conduit to complete circuits between boxes. Test electrical systems and continuity of circuits in electrical wiring, equipment, and fixtures, using testing devices such as ohmmeters, voltmeters, and oscilloscopes, to ensure compatibility and safety of system.

- Plan layout and installation of electrical wiring, equipment and fixtures, based on job specifications and local codes. Prepare sketches or follow blueprints to determine the location of wiring and equipment to ensure conformance to all electrical codes. Perform administrative duties such as pulling appropriate permits, maintaining records and files, preparing reports and ordering supplies and/or equipment as delegated.

- Ability to run and bend rigid conduit up to 6 inch. Proficient use of electrical meters in the troubleshooting and repair of electrical items which includes mega-ohm meter, multi meter and ground resistance meter.

- Electrical service will be available as-needed on an on-call basis. Emergency work may include troubleshooting and repairing equipment failures, laying temporary cabling and/or wiring, installing service poles, replacement of electrical equipment and/or components and assisting other contractors as necessary to remedy an emergency situation.

Specific projects that are expected to surpass $250,000.00 will be competitively bid unless the emergency exception is approved by LFUCG. The purpose of this preapproval/selection is to support the daily electrical maintenance activities of the maintenance department and provide emergency maintenance as necessary for LFUCG-DWQ facilities to run effectively on a 24-hour basis.

SAFETY AND TRAINING REQUIREMENTS

All workers will adhere to NFPA 70E

All installations must meet NEC and local codes.

Contractor is required to submit any electrical safety training that has been completed.

REFERENCES

Provide up to 3 references with your bid. Provide name, phone number, and address. Indicate type of work provided; references for other high voltage service contracts are preferred.

EXHIBIT A

PAYMENT RATES – UNIT PRICE QUOTATION FORM

Electrical Maintenance and Installation Services

COMPANY NAME: _____ DATE:_____

COMPANY ADDRESS: _____

Be sure to fill out this form completely, it will become "Exhibit A – Payment Rates" of the Contract Agreement. Use the Conditions for Payment Rate column to describe, in detail, the schedules and conditions which may merit and variance from the Standard Time Payment Rate. Examples of alternative rates may include Weekend Rates, Holiday Rates, Double-Time, work over certain threshold of hours, different classifications or electricians related to experience or certifications, etc.

TIME & LABOR RATES

TYPE OF PAY	TITLE	CONDITIONS FOR PAYMENT RATE	HOURLY RATE
Standard Time (*Required)	Master Electrician	(example: "Up to X hours per day, up to Y days per week")	$ 140 /hour
Standard Time (*Required)	Journeyman Electrician	(example: "Up to X hours per day, up to Y days per week")	$ 140 /hour
Standard Time (*Required)	Lineman	(example: "Up to X hours per day, up to Y days per week")	$ 135 /hour
Standard Time (*Required)	Laborer	(example: "Up to X hours per day, up to Y days per week")	$ 130 /hour
Alternative Rate #A, B, or C, if applicable			$ /hour
Overtime Rates, if applicable			$ /hour
Provide and other Alternate Rate information on a separate sheet containing the contracting firm's letterhead.			

NON-LABOR RATES

Minimum Service Call Duration (in hours)	= 4 hours
Mileage Reimbursement Rate (in $ per mile), standard vehicle	= $ per mile
Anticipated Average Round Trip to/from WWTP	= $100 miles
Rental Equipment Markup	= Cost + 10 %
All other rates	As needed from Standard rental rates

COMPANY REPRESENTATIVE

SIGNATURE: Jim Johnson DATE: 3-23-2025

NAME: Jim Johnson TITLE: SR Technical Advisor

PHONE: 502-750-4551 EMAIL: jjohnson@pandctesting

REFERENCES

Reference 1:	Sterling Industrial (Agency)	Andrew Weis, Engineer (Contact Name, Title)	(812) 455-0575 (Contact Phone #)
Reference 2:	Kentucky Utilities (Agency)	Chad Mitchell (Contact Name, Title)	(502) 443-5230 (Contact Phone #)
Reference 3:	Big Rivers Electric Corp. (Agency)	Howie McCormick (Contact Name, Title)	(270) 724-2000 (Contact Phone #)

EXHIBIT B
INSURANCE REQUIREMENTS

Minimum Scope or Insurance

Coverage shall be at least as listed below:

CGL (Including Products/Completed Operations)	$1m per occurrence, $2m agg
Auto Liability	$1m per occurrence
Workers Compensation	Statutory Limits
Employers Liability	$100k
Excess/Umbrella Liability	$2m per occurrence

APPENDIX A

Division of Water Quality
Standard Electrical Specifications
Low Voltage Contract

Division of Water Quality
Standard Electrical Specifications
Low Voltage Contract

January 2025

TABLE OF CONTENTS

SECTION 16050 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 REQUIREMENT

A. Contractors bidding work under the low voltage services contract shall read and understand these specifications. Work under other contracts must be completed in conformance with the specifications included as part of the bid document package for that project.

B. The Contractor shall bid as outlined in the above-mentioned Specifications and shall be governed by any alternates or unit prices called for in the form of proposal.

C. Each Contractor bidding on the work included in these Specifications shall view the building site and carefully examine any and all Drawings and Specifications provided to them, so that he/she may fully understand what is to be done, and to document existing conditions.

1.02 SCOPE OF WORK

A. Work included in this section of the Specifications shall include the furnishing of all labor, material, tools, approvals, utility connection fees, excavation, backfill, and other equipment necessary to install the electrical system as described in the Scope of Work and as specified herein.

B. It also includes installation and connection of all electrical utilization equipment included in this scope but furnished by other contractors or suppliers.

C. It is the general intent that all motors shall be furnished with the particular object of equipment it drives.

D. The Contractor shall furnish and install all conduit, wire, disconnect switches and miscellaneous material to make all electrical connections to all items of utilization equipment or wiring devices except as otherwise specified.

E. The electrical design depicted in the Scope of Work, is conceptual. As the Contractor and Subcontractors layout the job in the field and submit Shop Drawings, it is likely that minor changes will need to be made to the layout, field control wiring, or branch circuits/feeders, from what is existing and in service. These changes will be indicated by the LFUCG Project Manager’s review comments on Shop Drawings or issuance of field orders. It is the Contractors job to coordinate these changes among any and all Subcontractors and equipment vendors, to assure a complete and fully operational electrical system at completion of construction. The Contractor shall not layout the job from the Scope of Work, but rather from accepted Shop Drawings. Electrical rough-in shall be done based on templates provided from the electrical switchboard and MCC manufacturers showing allowable conduit entry locations. Do not submit electrical panelboard Shop Drawings, Motor Control Center Shop Drawings, or Switchboard Shop Drawings until all utilization equipment submittals have been made and accepted. Short Circuit, Coordination, and Arc Flash studies must be accepted prior to submittal of Shop Drawings for panelboards, MCC’s, or switchboards.

F. The Contractor shall perform the work of this contract in a “neat and workmanlike manner” as required by NEC Article 110.12, and further delineated in ANSI/NECA 1, latest edition, “Standard for Good Workmanship in Electrical Construction”.

G. Equipment connections shall be made with flexible or rigid conduit as required. Controllers for motors, disconnect switches, and all control, protective and signal devices for motor circuits, except where such apparatus is furnished mounted and connected integrally with the motor driven equipment, shall be installed, connected and left in operating condition. The number and size of conductors between motors and control or protective apparatus shall be as

required to obtain the operation described in these Specifications, and/or as shown in manufacturer furnished, LFUCG Project Manager approved Shop Drawings.

H. All devices and items of electrical equipment, including those found in service but not specifically mentioned in the Scope of Work and/or approved shop drawings are to be furnished under this section of the specifications. Any such device or item of equipment, if not defined in quality, shall be equal to similar Equipment and/or devices specified herein and compatible with Equipment current in service at the work site.

I. All devices and items of equipment mentioned in this section of the Specifications whether electrical or not or whether furnished under this or other Division of the Specifications, shall be installed under this Division of the Specifications, unless specifically indicated otherwise.

J. Where wiring diagrams are not already provided, they are to be provided by the supplier of the equipment served and such diagrams shall be adhered to except as herein modified.

K. The following is a list of items that may not be defined clearly on the Scope of Services or in other parts of these Specifications. The list is meant to be an aid to the Contractor and is not necessarily a complete list of all work to be performed under an approved Low Voltage Contract Task Order:

1. Connect all motors and accessories furnished by equipment suppliers.

2. Furnish, install, and connect all motor controls.

3. Furnish, install, and connect lighting, indoor and outdoor.

4. Furnish, install, and connect power and signal lines to all instrumentation equipment, and accessories.

5. Furnish, install, and connect all electrical conduit, duct, and cables.

6. Furnish, install, and connect all communications boxes, outlets, etc.

7. Furnish, install, and connect all power distribution equipment.

8. Furnish and install standby power equipment.

1.03 SHOP DRAWINGS, DESCRIPTIVE LITERATURE, INSTALLATION, OPERATION, AND MAINTENANCE INFORMATION

A. Shop Drawings including descriptive literature and/or installation, operation and maintenance instructions shall be submitted to the LFUCG Project Manager for review and approval.

B. Shop Drawings shall be submitted on the following materials specified in this Division:

1. Conduit - all types and sizes, including liquid-tight flexible.

2. Boxes - all types and sizes.

3. Coal tar epoxy paint.

4. Wiring devices.

5. Device plates.

6. Metal framing system (Strut type channel).

7. Conduit fittings, expansion joints, support hardware.

8. Motor control equipment - including individually mounted items.

9. Power distribution equipment - including individually mounted items.

10. Adjustable speed equipment and accessories.

11. Miscellaneous spare parts and hardware.

12. Wire - all types and sizes.

13. Light fixtures - all types.

14. Wire markers, signs, and labels.

15. Lightning/transient suppressors.

16. Motors.

17. Transformers.

18. Standby power equipment and accessories.

C. The LFUCG Project Manager reserves the right to make modifications to motor control and power distribution equipment ratings after Shop Drawing review, if the Shop Drawings are submitted prematurely (prematurely meaning submitted before all utilization equipment has been reviewed and accepted). Cost of modifications shall be the Contractor's responsibility.

1.04 SYMBOLS AND ABBREVIATIONS

A. The symbols and abbreviations contained on drawings related to this work generally follow standard electrical and architectural practice.

1.05 COORDINATION WITH OTHER TRADES

A. The Contractor shall coordinate the electrical work with that of other trades, as directed by the LFUCG Project Manager to ensure proper final location of all electrical equipment and/or connections. The Contractor shall verify door swings to see that light switches are located properly.

1.06 CODES

A. The minimum standard for all work shall be the latest revision of the Kentucky Building Code (KBC), and the National Electrical Code (NEC). Whenever and wherever state and/or local laws or ordinances and/or regulations require a higher standard that the current NEC or KBC, then these laws and/or regulations and/or the design shall be followed.

B. Following is a list of other applicable Standards or Codes:

1.	Kentucky Building Code	KBC
2.	National Electrical Code	NEC
3.	National Electrical Safety Code	NESC
4.	Underwriters Laboratories, Inc.	UL
5.	Factory Mutual System	FM
6.	National Fire Protection Association	NFPA
7.	National Electrical Manufacturers Association	NEMA
8.	Occupational Safety and Health Administration	OSHA
9.	Insulated Cable Engineers Association, Inc.	ICEA
10.	Illuminating Engineering Society of North America	IES
11.	Institute of Electrical and Electronic Engineers, Inc.	IEEE
12.	International Society of Automation	ISA
13.	Certified Ballast Manufacturers Association	CBM
14.	American National Standards Institute, Inc.	ANSI
15.	Anti-Friction Bearing Manufacturers Association, Inc.	AFBMA
16.	Joint Industry Council	JIC
17.	American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.	ASHRAE
18.	Federal Communications Commission	FCC
19.	American Society for Testing and Materials	ASTM
20.	American Wood Preservers Association	AWPA
21.	Rural Electrification Association	REA

1.07 INSPECTIONS AND PERMITS

A. Inspection of the electrical system on all construction projects is required. If the local government has appointed a state licensed inspector, the Contractor shall be required to use that person to perform the inspections. If a locally mandated inspector does not exist, the Contractor shall select and hire a state licensed inspector, who has jurisdiction before any work is concealed. The Contractor shall notify the electrical inspector in writing, immediately upon notice to proceed, and a copy of the notice shall be submitted to the LFUCG Project Manager.

B. At the time of completion of the project, there shall be furnished to the Owner a certificate of compliance, from the agency having jurisdiction pursuant to all electrical work performed. The LFUCG Project Manager shall also receive a photostatic copy.

C. All costs incurred by the Contractor to execute the above mentioned requirements shall be paid by the Contractor at no extra cost to the Owner.

D. All permits necessary for the complete electrical system shall be obtained by the Contractor from the authorities governing such work. For further information, see Division 1.

1.08 STORAGE

A. All work, equipment, and materials shall be protected against dirt, water, or other injury during the period of construction.

B. Sensitive electrical equipment such as light fixtures, motor starters, controls, and panelboards, delivered to the job site, shall be protected against injury or corrosion due to atmospheric conditions or physical damage by other means. Protection is interpreted to mean that equipment shall be stored under roof, in a structure properly heated in cold weather and ventilated in hot weather. Provision shall be made to control the humidity in the storage area to 50 percent relative. The stored equipment shall be inspected periodically, and if it is found that the protection is inadequate, further protective measures shall be employed. Electrical equipment other than boxes and conduit shall not be installed until the structure is under roof with doors and windows installed.

C. No light fixtures or device plates shall be hung or installed until after painting is completed; however, temporary lighting shall be provided by the Contractor.

D. The Contractor shall not store submersible pump units in any wet well. If it is absolutely necessary to do so, the open power cable ends are to be suspended above the maximum flood elevation or maximum expected water level. If not stored in this manner, the Contractor may be called upon to replace the pump motors and cables with new units to ensure that water has not penetrated the cable and entered the motor housing.

1.09 MATERIALS

A. All materials used shall be new and at least meet the minimum standards as established by the NEC and/or National Electrical Manufacturers Association (NEMA). All materials shall be UL listed for the application, where a listing exists. Additional requirements are found in Division 1. All equipment shall meet applicable FCC requirements and restrictions.

B. The material and equipment described herein has been specified according to a particular trade name or make to set quality standards. However, each Contractor has the right to substitute other material and equipment in lieu of that specified, other than those specifically mentioned at matching or for standardization, providing such material and equipment meets all of the requirements of those specified and is accepted, in writing by the LFUCG Project Manager.

C. The reuse of salvaged electrical equipment and/or wiring will not be permitted unless directed, in writing, by the LFUCG Project Manager.

D. All salvaged or abandoned electrical materials shall become the property of the LFUCG and shall not be removed from the job site upon completion of the project.

1.10 ERRORS, CORRECTIONS, AND/OR OMISSIONS

A. Should a piece of utilization equipment be supplied of a different size or horsepower than what is currently installed, the Contractor shall be responsible for installing the proper size wiring, conduit, starters, circuit breakers, etc., for proper operation of that unit and the complete electrical system at no extra cost to the Owner.

B. It is the intent of these Specifications to provide for an electrical system installation complete in every respect, to operate in the manner and under conditions as shown in these Specifications and described in the Scope of Work provided by the LFUCG Project Manager (PM). The Contractor shall notify the PM, in writing, of any omission or error at least 10 days prior to ordering equipment and/or materials. In the event of the Contractor's failure to give such notice, he/she may be required to correct work and/or furnish items omitted without additional cost.

C. Necessary changes or revisions in electrical work to meet any code or power company requirement shall be made by the Contractor without additional charge.

1.11 GUARANTEES AND WARRANTIES

A. The Contractor shall guarantee all work including equipment, materials, and workmanship. This guarantee shall be against all defects of any of the above and shall run for a period of 1 year from the date of acceptance of the work, concurrent with the one year guarantee period designated for the general construction contract under which electrical work is performed. Date of acceptance shall be considered to be the date on which all "punch list" items are completed ("punch list" is defined to be the written listing of work that is incomplete or deficient that must be finished or replaced/repaired before the Contractor receives final payment).

B. Repair and maintenance for the guarantee period is the responsibility of the Contractor and shall include all repairs and maintenance other than that which is considered as routine. (That is oiling, greasing, etc.) The LFUCG Project Manager shall be the judge of what shall be considered as routine maintenance.

1.12 TESTING

A. After the wiring system is complete, and at such time as the LFUCG Project Manager may direct, the Contractor shall conduct an operating test for acceptance. The equipment shall be demonstrated to operate in accordance with the requirements of these Specifications and the Scope of Services. The test shall be performed in the presence of the LFUCG Project Manager or his authorized representative. The Contractor shall furnish all instruments and personnel required for the tests, as well as the necessary electrical power.

B. Before energizing the system, the Contractor shall check all connections and set all relays and instruments for proper operation. He shall obtain all necessary clearances, approvals, and instructions from the serving utility company and/or equipment manufacturers prior to placing power on the equipment.

C. Tests may be performed by the LFUCG Project Manager to determine integrity of insulation on wiring circuits selected by the LFUCG Project Manager at random.

D. Cost of utilities for testing done prior to beneficial occupancy by the Owner shall be borne by the Contractor.

1.13 CLEANUP

A. Cleanup shall be completed as soon as possible after the electrical installation is complete. All light fixtures, outlets, switches, starters, motor control centers, disconnect switches and other electrical equipment shall be free of shipping tags, stickers, etc. All painted equipment shall be left free of scratches or other blemishes, such as splattered or blistered paint, etc. All light fixture diffusers shall be clean and the interior of all motor controls, etc., shall be free of

dust, dirt, wire strippings, etc. Surplus material, rubbish, and equipment resulting from the work shall be removed from the job site by the Contractor upon completion of the work.

B. During construction, cover all Owner equipment and furnishings subject to mechanical damage or contamination in any way.

1.14 CUTTING AND PATCHING

A. Cutting and patching shall be held to an absolute minimum and such work shall be done only under the direction of the LFUCG Project Manager or Owner. The Contractor shall be responsible for and shall pay for all openings that may be required in the floors or walls, and he shall be responsible for putting said surfaces back in their original condition. Every attempt shall be made to avoid cutting reinforcing steel bars when an opening is required in a reinforced concrete wall or floor slab.

1.15 EXCAVATION AND BACKFILL

A. Excavation

1. Excavation for conduits shall be of sufficient width to allow for proper jointing and alignment of the type conduit used. Conduit shall be laid in straight lines between pull boxes and/or structures unless otherwise notes on the Scope of Services. The cost of solid rock excavation shall be included in the lump sum bid with no extra pay allowed (unclassified).

B. Encasement/Backfill

1. All buried conduits shall be concrete encased. Backfill over the duct bank may contain rocks but must be mixed with sufficient earth to fill all voids.

1.16 SLEEVES, CHASES, AND OPENINGS

A. Sleeves shall be required at all points where exposed conduits pass through new concrete walls, slabs, or masonry walls. Sleeves that must be installed below grade or where subject to high water conditions must be installed watertight.

B. Wiring chases shall be provided where shown on the Scope of Services. The Contractor shall have the option of installing chases below surface mounted panelboards provided all structural requirements are met.

C. It is the Contractor's responsibility to leave openings to allow installation of the complete, operational electrical system. Openings required but not left shall be cut as outlined under cutting and patching. The Contractor shall coordinate all holes and other openings with necessary diameters for proper firestopping.

1.17 POWER COMPANY COORDINATION

A. The Contractor is responsible for coordinating all activities onsite by the power company.

B. All power company metering equipment shall be electrically located "upstream" of any manual/automatic transfer equipment on projects requiring onsite emergency power generation equipment.

C. Any special provisions required by the serving electrical utility shall be as outlined on the Scope of Services or as advised by the utility at the time of construction, and work required by these special provisions shall be executed with no extra cost to the Owner.

1.18 TEMPORARY ELECTRICAL POWER

A. The Contractor shall be responsible for providing temporary electrical power as required during the course of construction and shall remove the temporary service equipment when no longer required. Temporary power is also addressed in Division 1.

1.19 OVERCURRENT PROTECTION

A. Circuit breakers or fused switches shall be the size and type as written herein and shown on the Scope of Services. Any additional overcurrent protection required to maintain an equipment listing by an authority having jurisdiction shall be installed by the Contractor at no extra cost to the Owner.

B. The Contractor shall submit to the LFUCG Project Manager actual nameplate data from motors shipped to the site, stating motor identification as well as characteristics. Overload relay thermal unit selection tables shall accompany the motor data. The LFUCG Project Manager will select thermal unit sizes from this data for use by the Contractor in ordering proper thermal units.

1.20 TRAINING

A. All manufacturers supplying equipment for this division shall provide the Owner's operations staff with training in the operation and maintenance on the equipment being furnished. The training shall be conducted at the project site by a qualified representative of the manufacturer.

B. The cost of this training shall be included in the bid price.

C. The required training shall consist of both classroom and hands-on situation. Classroom training shall include instruction on how the equipment works, its relationship to all accessories and other related units, detailed review of shop drawings, detailed presentation of written O & M instructions, troubleshooting and record-keeping recommendations. Hands-on-training shall include a review of the manufacturer's O & M instructions, check out of each operator to identifying key elements of the equipment, tear down as appropriate, calibration, adjustment, greasing and oiling points, and operating manipulations of all electrical and mechanical controls.

D. The training shall be scheduled through the Contractor with the Owner. The timing of the training shall closely coincide with startup of the equipment, but no training shall be conducted until the equipment is operational.

E. The minimum number of hours to be provided by manufacturers supplying equipment on this project shall be in accordance with the following table:

	Training Hours	
Item	Classroom	Hands-on
Standby Power System & Accessories	2	2
Variable Speed Systems	2	2

F. At least 60 days prior to the training the manufacturer shall submit through the Contractor to the LFUCG Project Manager an outline of the training proposed for the LFUCG Project Manager's review and concurrence.

G. The Owner reserves the right to record all training sessions.

1.21 MAINTAINING CONTINUOUS ELECTRICAL SYSTEM AND SERVICE

A. Existing service(s) continuity shall be maintained at all times. In no way shall the installation and/or alteration of the electrical work interfere with or stop the normal operation of the existing facilities, except where prior arrangements have been made

B. When additions and taps to existing service(s) require electrical outages of duration in excess of a few minutes, arrangements shall be made in advance for such outages. All outages shall be held to an acceptable minimum with none exceeding 8 hours continuous duration. If necessary, cuts shall be performed on premium time. If performed at night, requiring a general outage, the Contractor shall furnish an auxiliary source of light and power as required. Under no circumstances shall an electrical outage of any duration be initiated until the Owner and LFUCG Project Manager have concurred, and as far as possible in advance.

1.22 GROUNDING AND BONDING

A. All metallic conduit, cabinets, equipment, and service shall be grounded in accordance with the latest issue of the National Electrical Code. All supporting framework and other metal or metal clad equipment or materials which are in contact with electrical conduit, cable and/or enclosures, shall be properly grounded to meet the code requirements.

1.23 RELATED SPECIFICATION DIVISIONS

A. The following divisions contain Specifications on utilization equipment, equipment accessories, and procedures related to execution of the electrical work, and are included here for the Contractor's information. Bids shall still be based on complete Contract Documents.

Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract
Division 1 - General Requirements
Division 11 - Equipment
Division 13 - Special Construction
Division 15 – Mechanical
Division 17 - Instrumentation

1.24 SERVICE ENTRANCE

A. Conductors and terminations for service entrances shall be furnished and installed by the Contractor. Voltage, phase, and number of wires shall be as shown on the Drawings. Clearances for overhead entrance wires shall be per power company, NEC, and NESC requirements.

B. Any details not shown on the Drawings or written in the Specifications pertaining to the service entrance shall be per power company requirements. It is the Contractor's responsibility to contact the utility prior to bidding and obtain any special requirements or costs they will be imposing. Those costs shall be included in the bid.

C. On underground service entrances from pad mounted transformers, the Contractor shall be responsible for furnishing and installing all primary, secondary, and metering conduits, ct cabinet, as well as secondary service/metering conductors. The Contractor shall be

responsible for furnishing pull wires in primary conduits for use by the power company. The Contractor shall be responsible for fabricating the required concrete pad that the transformer will be mounted on. The Contractor shall also mount the meter base furnished by the electrical contractor.

1.25 CONTRACTOR LICENSING

A. The Contractor performing the electrical work on this project shall be locally licensed, if required by local law or ordinance. If the Contractor has passed the State test, it may not be necessary to meet local testing requirements. It shall be the Contractor's responsibility to investigate these requirements and comply with same.

1.26 ANCHORING/MOUNTING

A. Electrical conduits and/or equipment shall be rigidly supported. Anchors used shall be metallic expansion type, or if appropriate to prevent spalling concrete, epoxy set type. Plastic or explosive type anchors are prohibited.

B. All supports shall be consistent with the latest edition of the KBC and ASCE 7.

1.27 ELECTRICAL COMPONENT MOUNTING HEIGHTS

A. Unless otherwise indicated, mounting height for components shall be as defined herein. In cases of conflicts with architectural or structural aspects, the components may be relocated. If an indicated height conflicts with a code requirement, the code shall govern.

B. Mounting heights are given from finished floor elevation to the centerline of the component, unless otherwise noted.

	Component	Height	Comments
1.	Wall type light switch	4'-0"	To top of box
2.	Low wall outlet	16"	To bottom
3.	Medium height wall outlet	4'-0"	
4.	Medium height telephone outlet	4'-0"	
5.	High wall outlet or fixture	7'-0"	
6.	Wall type buzzers, horns, etc.	8'-0" Max.	Top 2" below ceiling
7.	Push-button or control stations	4'-0"	
8.	Top of panelboards or control panels	6'-6"	Maximum (except for handicapped areas)
9.	Top of telephone back boards	6'-6"	Maximum
10.	Top of switch handle on motor control center	6'-6"	Maximum
11.	Top of local motor controller	6'-0"	Maximum
12.	Top of local disconnect switch	6'-0"	Maximum
13.	Wall mount exterior light fixtures	8'-0"	or as shown
14.	Wall mount emergency light fixtures	6'-6"	Maximum to test button
15.	Wall thermostats	4'-0"	To top of thermostat

In situations where there appears to be a conflict with Americans with Disabilities Act (ADA) legislation, utilize the ADA requirements.

1.28 HAZARDOUS AREA CLASSIFICATIONS

The following table identifies the applicable hazardous areas for this project, and the classifications for each. All equipment used in these areas shall be UL listed for the application,

and all wiring methods shall be in accordance with Chapter 5 of the National Electrical Code. All conduits to these spaces from non-hazardous areas shall be properly sealed.

Location	Area Classification	Extent of Hazardous Area
Wet well	Class I, Division 1, Group D	Entire Wet well
Valve Vault	Class I, Division 1, Group D	Entire Vault
Odor Control Room	Class I, Division 2, Group D	Entire Room
Control Building	Unclassified	Entire Building except Odor Control Room

Note: These ratings are based on no continuous ventilation and some may be rerated if continuous ventilation is provided (per NFPA 820).

Refer to NEMA Designation sheets in the Electrical Drawings for more information.

1.29 RECEIPTS

A. Some sections of the Specifications call for equipment, materials, accessories, etc. to be provided and "turned over to the Owner" or like requirements. The Contractor shall obtain a receipt for each item turned over, signed by the Owner or his representative. A copy of this receipt shall be transmitted to the LFUCG Project Manager.

B. When a question arises concerning whether items have been turned over to the Owner, and there is no signed receipt, it may be assumed that the items were not provided.

1.30 POWER SYSTEM STUDIES

A. General

1. The Contractor shall provide Short Circuit Studies, Protective Device Evaluation Studies, Protective Device Coordination Studies, and Arc Flash Studies performed by a professional registered electrical LFUCG Project Manager currently registered in the State of Kentucky for the entire electrical system. The studies shall be performed in accordance with 399- 1997, IEEE Recommended Practice for Industrial and Commercial System Power Analysis (IEEE Brown Book). The studies shall be submitted to the LFUCG Project Manager prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment for manufacture. If formal completion of the studies may cause delay in equipment manufacture, approval from the LFUCG Project Manager may be obtained for a preliminary submittal of sufficient study data to insure that the selection of device ratings and characteristics will be satisfactory.

2. The studies shall include all portions of the electrical distribution system from the utility company protective devices, the normal and standby power sources down to and including the 480 volt feeder protective devices for each feeder. The study shall include all low and medium voltage switchgear, MCCs, and panelboards. System connections and those which result in maximum fault conditions shall be adequately covered in the study.

3. In the event that the short circuit study requires a higher interrupting and/or withstand rating of equipment than that which is indicated in the Contract Documents, the Contractor shall furnish and install the equipment as required based on the study with no extra cost to the Owner.

4. In the event that the protective device coordination study indicates that different settings or equipment is required than that which is specified, the Contractor shall furnish and install the equipment based on the study with no extra cost to the Owner.

B. Data Collection for the Studies

1. The Contractor shall provide the required data for preparation of the studies. The preparer of the studies shall furnish the Contractor with a listing of the required data immediately after award of the Contract.

2. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to release of the equipment for manufacture.

C. Short Circuit Study and Protective Device Evaluation Study

1. The short circuit study shall be performed with the aid of a digital computer program and shall be in accordance with the latest editions of IEEE Std. 399 and IEEE Std. 141.

2. The study input data shall include the utility company's short circuit contribution, resistance and reactance components of the branch impedances, the X/R ratios, base quantities selected, and other source impedances.

3. Short circuit close and latch duty values and interrupting duty values shall be calculated on the basis of assumed three-phase bolted short circuits at each bus, switchgear, medium and low-voltage motor control center, distribution panelboard, pertinent branch circuit panel and other significant locations through the system. The short circuit tabulations shall include symmetrical fault currents, and X/R ratios. For each fault location, the total duty on the bus, as well as the individual contribution from each connected branch, shall be listed with its respective X/R ratio.

4. A protective device evaluation study shall be performed to determine the adequacy of circuit breakers, molded case switches, automatic transfer switches, and fuses by tabulating and comparing the short circuit ratings of these devices with the calculated fault currents. Appropriate multiplying factors based on system X/R ratios and protective device rating standards shall be applied. Any problem areas or inadequacies in the equipment due to short circuit currents shall be promptly brought to the attention of the LFUCG Project Manager.

5. All equipment furnished shall meet the requirements of this study, with no extra cost to the Owner.

D. Protective Device Coordination Study

1. A protective device coordination study shall be performed to provide the necessary calculations and logic decisions required to select or to check the selection of power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated current transformers, and low voltage circuit breaker trip characteristics and settings.

2. The coordination study shall include all low voltage classes of equipment from the utility company service protective devices down to and including the main circuit breakers of motor control centers. The phase and ground overcurrent protection shall be included as well as settings of all other adjustable protective devices.

3. The time-current characteristics of the specified protective devices shall be drawn on log-log paper. The plots shall include complete titles, representative one-line diagram and legends, significant motor starting characteristics, complete parameters of transformers, complete operating bands of low voltage circuit breaker trip curves and fuses. The

coordination plots shall indicate the types of protective devices selected, proposed relay taps, time dial and instantaneous trip settings, transformer magnetizing inrush and ANSI transformer withstand parameters, cable thermal overcurrent withstand limits and significant symmetrical and asymmetrical fault currents. All restrictions of the National Electrical Code shall be adhered to and proper coordination intervals and separation of characteristic curves shall be maintained. The coordination plots for phase and ground protective devices shall be provided on a system basis. A sufficient number of separate curves shall be used to clearly indicate the coordination achieved.

4. The selection and settings of the protective devices shall be provided separately in a tabulated form listing circuit identification, IEEE device number, current transformer ratios and connections, manufacturer and type, range of adjustment and recommended settings. A tabulation of the recommended power fuse selection shall be provided for the medium voltage fuses where applied in the system. Any discrepancies, problem areas, or inadequacies shall be promptly brought to the attention of the LFUCG Project Manager.

E. Arc Flash Hazard Analysis

1. An Arc Flash Hazard Analysis shall be performed with the aid of a digital computer program in accordance with IEEE Std. 1584, “IEEE Guide For Performing Arc Flash Hazard Calculations”, NFPA 70E, and OSHA 29-CFR, Part 1910 Subpart S.

2. Arc Flash Warning Labels and Bus Detail Sheets shall be produced for each bus. Labels shall be printed in color on adhesive backed labels. Labels shall be attached to the doors of the equipment. Each label and detail sheet shall list the following:

   a. Bus name

   b. System operating voltage

   c. Date of issue

   d. Flash hazard protection boundary

   e. Limited approach boundary

   f. Restricted boundary

   g. Prohibited boundary

   h. Incident energy level

   i. Required personal protective equipment class

      In addition, each Bus Detail Sheet shall list the following:

      1) Upstream Protective Devices Names, Type and Settings

3. Arc Flash Evaluation Summary Sheets shall be produced. Summary sheets shall list the following:

   a. Bus name

   b. Upstream protective device name, type, and settings

   c. Bus line-to-line voltage

   d. Bus bolted fault

e. Protective device bolted fault current

f. Arcing fault current

g. Protective device trip / delay time

h. Breaker opening time

i. Solidly grounded column

j. Equipment type

k. Gap

l. Arc flash boundary

m. Working distance

n. Incident energy

o. Required personal protective equipment class

4. Analyze the short circuit, protective device coordination, and arc flash calculations and highlight any equipment that is determined to be underrated or causes an abnormally high incident energy calculation. Propose approaches to reduce the energy levels. Proposed major corrective modifications will be taken under advisement by the LFUCG Project Manager and the Contractor will be given further instructions.

F. Study Report

1. The results of the power system studies shall be summarized in a report. The report shall be submitted to the LFUCG Project Manager. The report shall be submitted for review and acceptance prior to submittals for medium voltage switchgear, medium voltage motor control equipment, low voltage switchgear and switchboards, motor control centers, variable frequency drives, panelboards, and similar electrical equipment.

2. The report shall include the following sections:

   a. Description, purpose, basis and scope of the study and a detailed single line diagram with "nodes" cross-referenced to the calculated values tabulated in the study report of that portion of the power system which is included within the scope of the study.

   b. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short circuit duties and commentary regarding same.

   c. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.

   d. Fault current calculations including a definition of terms and guide for interpretation of computer printout.

3. Prior to commencing the work, the preparer the studies shall meet with the testing firm that will do the relay field testing and the Owner's representative at the site for a walk through of the facility to insure that existing conditions are taken into account.

4. The study shall include a detailed explanation of all software programs and procedures used to arrive at the calculated values, settings, and drawings (e.g. single line diagrams) showing fault valves at all busses.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 16060 - SECONDARY GROUNDING

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Grounding shall be done in accordance with the NEC, as described in these Specifications, and as shown on the Contract Documents.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Grounding equipment shall be Cadweld, T&B Blackburn, ITT Weaver, Copperweld Bimetallics Group, or equal.

PART 3 - EXECUTION

3.01 INSTALLATION/APPLICATION/ERECTION

A. Grounding shall utilize a supplemental driven ground rod system in a bed to achieve the design ground resistance.

B. The ground system shall be continuous with all structures on a common ground. This can be accomplished by bonding all conduits together and bonding to the ground bus at each motor control center. Bonding jumpers shall be required at all pull boxes, and at all motor casings. A separate grounding conductor shall be pulled in all conduits in addition to wire counts shown on Drawings.

C. Ground rods shall be 3/4" x 10'-0" copper clad type. Where multiple rods are driven, they shall be separated by at least 10 feet to assure maximum effect.

D. Ground resistance between ground and absolute earth shall not exceed 5 ohms.

E. All grounding and grounding electrode systems shall be as required by the NEC as for types of electrodes utilized and sizing of grounding conductor to service equipment from the electrode system. These shall include footer rebar, buried metal water pipe, buried bare copper conductor, etc.

F. All grounding electrode system connections shall be made using exothermic welds, Cadweld, or equal. No splices are allowed in the grounding electrode conductor.

G. Should ground rods be impractical for use due to rocky conditions, then grounding electrode plates may be used after acceptance by the LFUCG Project Manager on a case by case basis.

3.02 FIELD QUALITY CONTROL

A. Testing

1. The Contractor shall be required to provide all labor, tools, instruments, and materials as

necessary to perform testing of the grounding electrode system. Results shall be submitted in writing to the LFUCG Project Manager. The testing shall be done to determine the effectiveness of the selected grounding scheme and to see that it conforms with resistance specified (5 ohms maximum).

2. The testing should be done using a fall-of-potential method test at the point of grounding electrode conductor connection to main power distribution equipment and at each separately derived system or MCC. The test shall be performed no sooner than 48 hours after a rainfall event.

3. The written report should contain the following information:

    a. Type of ground scheme used, i.e., building steel, driven rod, mat, etc.

    b. Type of instrument used.

        1) Manufacturer

        2) Model Number

        3) Confirm fall-of-potential test

        4)* Serial Number

        5)* Where instrument was obtained

        * These 2 items are required so that the same instrument may be utilized should reproduction of the test be necessary due to unsatisfactory readings/instrument miscalibration.

    c. Ground resistance readings obtained at various test distances.

    d. Ground resistance/distance curve.

    e. Value of Grounding Electrode Resistance at knee of curve.

    f. Sketch showing setup of instrumentation and location of grounding electrode and test probes.

    g. Proposed method to achieve the specified resistance, should an unacceptable reading be obtained.

    h. Ground resistance readings obtained (if applicable) after modifications incorporated.

END OF SECTION

SECTION 16070 - SUPPORTING DEVICES

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. All electric equipment shall be rigidly mounted and installed using supporting devices as indicated on the Scope of Services, as required by the work, and described herein.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. “Kindorf,” “Unistrut,” or equal.

2.02 MATERIALS

A. All mounting brackets and strut shall be aluminum. Fasteners used to mount equipment shall be 316 stainless steel.

B. Aluminum support members shall not be installed in direct contact with concrete. Stainless steel or non-metallic "spacers" shall be used to prevent contact of aluminum with concrete.

C. Utilize Fiberglass-reinforced Plastic (FRP) strut and accessories in the Chemical Feed Room.

PART 3 - EXECUTION

3.01 ANCHORING CABINETRY

A. All free standing equipment shall be anchored to its foundation using expansion bolts of the size and number recommended by the equipment manufacturer.

3.02 SEISMIC CONSIDERATIONS

A. Where indicated, seismic restraints shall be provided for electrical equipment.

END OF SECTION

SECTION 16075 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.01 EQUIPMENT LABELING

A. All starters, feeder units in panelboards, switchboards, disconnects, instruments, etc. shall be marked to indicate the motor, outlet, circuit they control, or variable monitored. Marking is to be done with engraved laminated nameplates and shall bear the designation shown on the Scope of Services where this information is given. Nameplates shall be fastened to equipment with stainless steel screws, minimum of one each side. In no way shall the installation of mounting screws void the NEMA enclosure rating of the equipment in which they are installed. If there are more than one identical unit, they shall be given consecutive numbers or other descriptions as designated by the LFUCG Project Manager. Nameplate background color shall be white, with black engraved letters, unless otherwise noted.

B. Branch circuits in lighting panels shall be typed on a card suitable for the card frame furnished with the panel. The card shall bear the panel designation listed on the Scope of Services where this information is given, as well as indicate what each circuit controls.

C. Motor control centers, individual wall mounted starters, panelboards, and disconnect switch shall be labeled with vinyl self-adhesive signs that warn of “High Voltage” (state the specific voltage). Main service entrance conduits to a building, where exposed, shall be labeled with the voltage of the service they carry. Other major equipment such as transformers, transfer switches, generator sets, pump control panels, etc., shall be labeled as such. The type of labels to be used shall have orange as the basic color to conform with OSHA requirements, letters shall be black. The labels shall be of proper size to fit flatly on the surface of the enclosure to make for a neat appearance and not interfere with the operating function of the device it is attached to. These labels shall be as manufactured by the Brady Identification Systems Division, Safety Sign Company, or equal.

D. Furnish and install “Authorized Personnel Only” signs by doors into all power distribution equipment rooms/buildings. Furnish and install other signs as indicated on the Scope of Services.

1.02 LOCATING UNDERGROUND UTILITIES

A. Plastic tape bearing the general notation of “buried electric service” or “buried high voltage cable” shall be placed in trenches with backfill about 12 inches below finished grade on all medium voltage underground conduit runs, and on others as indicated on the Scope of Services.

PART 2 - PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 16120 - CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. All wire and cable shall conform to the latest requirements of the NEC and shall meet all ASTM/UL specifications. Wire and cable shall be new; shall have size, grade of insulation, voltage rating and manufacturer's name permanently marked on the outer covering at regular intervals. Complete descriptive literature shall be submitted to the LFUCG Project Manager for review and acceptance prior to installation.

B. Building wire #12 - #1 shall be applied based on a 60 degree Celsius temperature rise. Building wire larger than #1 may be applied at its 75 degree Celsius temperature rise.

1.02 DELIVERY, STORAGE, AND HANDLING

A. Wire and cable shall be suitably protected from weather and damage during storage and handling and shall be in first class condition when installed.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Building Wire (types "THWN" and "THW"-cu.) – "Southwire," "Collyer," "American," "Carol," or equal.

B. Control Cables (Shielded or unshielded) 600V max. – "Belden," "Eaton-Dekoron," "Okonite," or equal.

C. Instrumentation Cables (Shielded) 600V mx. – "Eaton-Dekoron," "Manhatton," "American," "Belden," "Okonite," or equal.

D. VFD cable for motor branch circuits from VFD's: "Belden", "Draka", "Service Wire Co", or equal.

2.02 MATERIALS

A. General

1. In general, all conductors shall be 98 percent conductive, annealed copper unless otherwise noted on the Scope of Services.

2. Conductors shall be type THW or THWN insulation. Conductor size shall be AWG (American Wire Gauge) Standard. Minimum conductor size shall be AWG number 12 except branch circuits in excess of 75 feet from panel to first outlet not smaller than no. 10 AWG. Minimum voltage rating shall be 600 volts. Conductors for small power may be solid (i.e. lighting, receptacles), but conductors for control work shall be stranded.

3. Conductors with high temperature rated insulations and special construction shall be used where required in connecting to light fixtures or appliances that have special requirements.

4. Conductors shall be rated THHN, THWN, and MTW.

B. VFD Cable

1. The cable shall be 600V/1000V rated, with stranded tinned copper conductors, shielded, suitable for use with Variable Frequency Drives.

2. The insulation shall be rated for 90 degrees Celsius Wet/Dry operating temperature.

3. Accessories (terminations) shall have ratings that are at least equal to those of the cable and comply with cable manufacturer recommendations.

4. All cables shall be round.

5. Cable shall be suitable for use in wet/dry locations, indoors and outdoors, in cable trays, in conduits, trenches, and in underground ducts and direct burial.

6. The conductor shall be annealed stranded tinned copper per ASTM B3, B8, and B33.

7. The insulation thickness shall have a minimum average wall thickness of 30 mils. The insulation material must be XLPE with an XHHW-2 listing per UL 44. Each insulated conductor shall be identified in accordance with ICEA Method 4 color coding.

8. The insulated conductors are to be cabled together with a minimum of one ground wire. The ground wire(s) are to have a minimum circular mil area equivalent to one circuit conductor. Fillers shall be included as necessary to make the cable round.

9. The cabled assembly shall be shielded using one of two methods:

    a. Applying helically two 2-mil copper tapes. The shield shall provide 100% coverage over the assembly.

    b. Applying an 80% minimum coverage tinned copper braid shield used in conjunction with an Aluminum Foil shield tape.

10. All cables shall have a continuous overall outer sheath of Polyvinyl Chloride (PVC), suitable for 90 degree Celsius use.

11. The jacket shall be resistant to abrasion, rated for direct burial, sunlight resistant, and flame resistant in accordance with UL 1277.

12. The following permanent legend shall be clearly embossed or printed at approximately 2 foot intervals on the outer jacket for the entire length of the cable:

    a. Manufacturer’s name and or Trade Mark.

    b. Number of conductors and size (-- AWG).

    c. Type of insulation (XLPE) or NEC Listed Conductor Type (XHHW-2).

    d. Voltage rating.

    e. TC-ER rating.

    f. 1000V Flexible Motor Supply Cable rating.

    g. Sequential footing marking at 2 foot intervals.

13. Only one continuous (without splices) length of cable shall be shipped on a reel. Both ends shall be waterproof sealed, secured, protected from damage, and both ends shall be available for testing.

C. Instrument Cable

1. General

   a. All signal lines should be constructed of individually twisted pairs (6 to 10 twists per foot), including thermocouple extension leads. Cables should be made of twisted pairs, with all lays and pairs twisted in the same direction for maximum flexibility.

   b. Wire size is #16 AWG minimum.

   c. Stranded tinned copper conductor shall be used for all wiring other than thermocouple extension leads.

   d. Insulation resistance at 68 degrees Fahrenheit between conductors and between conductors and ground should be at least 500 megohms per 1,000 feet.

   e. Multi-pair cable should be jacketed with poly-vinyl-chloride, polyethylene or Teflon at least 0.045" thick. Voltage rating shall be 600 volts.

2. Signal Wiring

   a. Low level analog (less than 500 millivolt d-c). Use twisted pairs which may be cabled with other pairs carrying similar voltage levels. Foil wraps or equivalent shielding is required for each cable with the shield insulated from ground.

   b. High level analog (greater than 500 millivolts d-c). Use twisted pairs which may be cabled with other pairs carrying similar voltage levels and current levels less than 100 ma. Shielding is required.

   c. Analog outputs (normally 0-4 d-c or 4-20 ma). Same as b.

   d. Contact inputs - use twisted pairs and run in separate conduit.

   e. Contact outputs - same as d.

   f. Pulse inputs - same as d.

3. Signal and Shield Grounding

   a. All shields must be grounded at one point only as close as possible to the signal source.

   b. Thermocouples may be grounded or ungrounded.

   c. Analog signals, if grounded, should be grounded as near the signal source as possible.

   d. Resistance bulbs should not be grounded.

4. Signal and Wiring Separation

   a. Analog signals shall be run in a separate conduit from contact or pulse signals.

   b. A minimum separation of 12 inches between analog signal leads and a-c power leads should be maintained. For a-c power leads carrying 100 amps or greater, a 24 inch separation should be maintained. Parallel runs should be limited to less than 500 feet. Perpendicular runs may be as close as 6 inches.

D. Submersible pump Power Cable

1. Power cables for submersible pumps shall be of the extra hard usage type suitable for submerged duty and able to withstand common corrosive agents found in water and wastewater. They shall be provided with high grade non-magnetic stainless steel relief cable grips installed at the pump end and high grade non-magnetic stainless steel support cable grips anchored to the wet well structure where they enter the wet well. The strain relief and support cable grips shall be as manufactured by Kellems, Slater/Flexcor, or equal. Non-metallic corrosion resistant grips may be used in lieu of stainless steel if available for the cable size.

E. Ethernet and Devicenet Cables

1. Ethernet cables shall be Category 6 rated.

2. Ethernet cables inside VFD cabinets shall be Category 6 rated and shielded.

3. Devicenet trunk, drop cables, and accessories shall be as recommended by the PLC manufacturer.

PART 3 - EXECUTION

3.01 INSTALLATION/APPLICATION/ERECTION

A. General

1. Conductors shall be continuous from outlet to outlet and no splices shall be made except accessible in junction or outlet boxes. Wire connectors of insulating material or solderless pressure connectors, properly taped, shall be used for all splices in wiring, wherever possible.

2. Conductors shall be color coded in accordance with the following schedule:

	480/277V 3 Phase	208/240V 3 Phase	120/240, Single Phase
Phase A	Brown	Black	Black
Phase B	Orange	Red	Red
Phase C	Yellow	Blue	
Neutral (Grounded)	White or Light Gray	White or Light Gray	White or Light Gray
3-Way Tracers			Blue
Grounding	Green	Green	Green
Remote Energized Conductors (Control)			Yellow
Control	Std. Code	Std. Code	

3. Conductors shall be pulled into raceways in strict accordance with manufacturer's recommendations.

4. Ample slack conductors shall be allowed at each terminal point, and pull or junction box, to permit installation with ease and without crowding.

5. All conductors terminating at terminal blocks shall be identified with numbers and/or letters identical to circuit or control identification.

6. No conductors shall be drawn into conduits until all work which may cause wire or cable damage is completed. Wire pulling shall be accomplished utilizing machinery and accessories intended for the purpose.

7. All connections and splices shall be made in accordance with conductor manufacturer's recommendations, and as written herein.

8. In general, feeder sizes shown are based on no more than three current carrying conductors in a conduit. Multiple small branch circuit feeders may be combined in a common conduit, provided conductors are derated in accordance with NEC article 310-15.

9. Unless otherwise specifically indicated, neutrals may not be shared.

B. Feeders

1. All feeders are of the secondary type, below 600 volts, unless otherwise noted. Secondary feeder voltage shall be 480 volt, as noted in the Scope of Services. Three phase, 4 wire for power and 208/120 volt, 3 phase, 4 wire for general lighting, unless otherwise noted. The Contractor shall furnish and install all feeders from the distribution center(s) to each of the other structures/subpanels as shown on the Scope of Services.

2. Wire shall be factory color coded for each phase and neutral, with green used for the ground conductor. As far as practical, all feeders shall be continuous from origin to panel termination without running splices in intermediate pull boxes.

3.02 FIELD QUALITY CONTROL

A. Testing

1. All testing shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

a. Witness Shop Tests

1) Not required.

b. Shop Test

1) Cable and wiring shall be tested in accordance with the applicable ICEA Standards. Wire and cable shall be physically and electrically tested in accordance with the manufacturer's standards.

c. Field Tests

1) Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and NETA acceptance testing specifications.

2) After installation, all wires and cables shall be tested for continuity. Testing for continuity shall be "test light" or "buzzer" style.

3) After installation, all wires and cables shall be tested for insulation levels. Insulation resistance between conductors of the same circuit and between conductor and ground shall be tested. Testing for insulation levels shall be as follows:

- For 600V power and control cable, apply 1,000 VDC from a Megohmeter for one (1) minute for all 600V wires and cables installed in lighting, control, power, indication, alarm and motor feeder circuits. Resistance shall be no less than 100 Megohms.

- 600V instrumentation signal cable shall be tested from conductor to conductor, conductor to shield, and conductor to ground using a Simpson No. 260 volt-ohmmeter, or approved equal. The resistance value shall be 200 Megohms or greater.

2. Low voltage wires and cables shall be tested before being connected to motors, devices or terminal blocks.

3. Voltage tests shall be made successively between each conductor of a circuit and all other conductors of the circuit grounded.

4. If tests reveal defects or deficiencies, the Contractor shall make the necessary repairs or shall replace the cable as directed by the LFUCG Project Manager, without additional cost to the Owner.

5. All tests shall be made by and at the expense of the Contractor who shall supply all testing equipment. Test reports shall be submitted to the LFUCG Project Manager.

END OF SECTION

SECTION 16130 - RACEWAYS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This section of the Technical Specifications includes all raceways for accommodation of electrical conductors, communications conductors, sleeves for underground electrical installations, conduit stubs for future installations, fittings therefore and accessories.

B. All raceways shall be marked with the manufacturer's name or trademark as well as type of raceway and size. This marking shall appear at least once every 10 feet and shall be of sufficient durability to withstand the environment involved. All raceways shall be furnished and installed as outlined under Part 3 of this Specification.

C. All raceways and fittings shall be painted to match existing or surrounding surfaces except in mechanical spaces.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Tubular Raceways

1. Steel, Galvanized, Rigid, Heavy-Wall, Threaded – "Wheatland Tube Co.," "Triangle," "Allied Tube & Conduit Corp.," or equal.

2. Plastic (PVC); Type A (Thin Wall); Type 40 (or Schedule 40); Type 80 (or Schedule 80) (Heavy -Wall) – "Carlon," "Cantex," or equal.

3. Flexible Metal Conduit – "AFC," "Southwire," or equal.

4. Liquidtight Flexible Metal Conduit – "Carol Cable Co., Inc.," "Superflex," "OZ Gedney," or equal.

5. Liquid-Tight Flexible Non-Metallic Conduit - Type "LNM-P" as manufactured by Electri-Flex, Type "Ultralite" as manufactured by Southwire, Type "CNP" as manufactured by Anaconda, or equal.

6. Aluminum Conduit - "Wheatland Tube Co.", "Allied Tube & Conduit Corp.", or equal.

7. PVC Coated Metallic Conduit (PCMC) - "Plasti-Bond Red" as manufactured by Robroy Industries, "OCAL-Blue" as manufactured by Ocal, Inc., Perma-Cote Supreme by Perma-Cote Industries, or equal.

B. Raceway Fittings

1. Conduit fittings – "Crouse-Hinds," "Appleton," "OZ Gedney," or equal.

2. Non-metallic conduit fittings –"Carlon," "Cantex," or equal.

3. Flexible conduit fittings – "Raco," "T & B," "OZ Gedney," or equal.

4. PVC Coated Metallic Conduit fittings - "Plasti-Bond Red" as manufactured by Robroy Industries, "OCAL-Blue" as manufactured by Ocal, Inc., Perma-Cote Supreme by Perma-Cote Industries, or equal.

2.02 MATERIALS

A. Rigid Steel Conduit

1. Rigid steel conduit and fittings shall be of mild steel piping, galvanized inside and out, and shall conform to UL standards. The conduit and fittings hall be listed and labeled by UL as well. The galvanized coating of zinc shall be of uniform thickness applied by the hot-dipped process, and shall be applied also to the threads. It shall be further dipped in a chromic acid bath so as to chemically form a corrosion resistant protective coating of zinc chromate which has a characteristic yellow-green color. Each piece of conduit shall be straight, free from blisters and other defects, cut square, and taper reamed. It shall be delivered with plastic protectors on the threads.

B. Polyvinylchloride (PVC) Conduit

1. PVC conduit and fittings shall be Schedule 40, 80 heavy wall, or thin wall, as indicated in these Specifications manufactured to conform to UL standards. It shall be listed and labeled by UL. It shall have at least the same temperature rating as the conductor insulation. Expansion joints shall be used as recommended by the manufacturer in published literature. PVC systems shall be 90 degrees Celsius minimum UL rated, have a tensile strength of 7,000 psi @ 73.4 degrees Fahrenheit, flexural strength of 11,000 psi and compressive strength of 8,000 psi.

C. Flexible Conduit

1. Flexible metallic conduit shall be constructed from flexibly or spirally wound elecro-galvanized steel. Connections shall be by means of galvanized malleable iron squeeze type fittings, or tomic twist-in type in sizes not exceeding 3/4 inch. Liquidtight conduit shall be light gray in color and have sealtight fittings, type UA.

2. In hazardous locations where flexible connections are required, flexible couplings UL listed for the application shall be used. The couplings shall consist of stainless steel tubing and outer braid, with insulating liner. Female end fittings shall also be stainless steel, with removable steel close nipples. Couplings shall be O-Z/Gedney, or equal.

D. Liquid-Tight Flexible Metal Conduit

1. Liquid-tight flexible conduit (LFMC) shall be galvanized steel, single strip, with a copper strip interwoven and suitable as a grounding means. LFMC shall be UL listed. LFMC shall have an extruded moisture and oil-proof PVC jacket.

2. PVC coated or stainless steel watertight connectors shall be used with liquid-tight flexible metal conduit on both ends.

E. Liquid-Tight Flexible Non-Metallic Conduit

1. Liquid-tight flexible non-metallic conduit (LFNC) shall be constructed of PVC. LFNC shall be UL listed. LFNC shall have an extruded moisture and oil-proof PVC jacket.

2. Watertight connectors shall be used with liquid-tight flexible non-metallic conduit on both ends. LFNC shall be used to connect all vibrating equipment installed in sodium hypochlorite storage and transfer areas as specified herein, and other applications as directed by the LFUCG Project Manager or as indicated on the drawings.

F. Aluminum Conduit

1. Aluminum conduit shall be extruded from alloy 6063 and shall be the rigid type, non-toxic, corrosion resistant, and non-staining. It shall be manufactured per UL standards as well as listed/labeled by same.

2. Fittings, boxes, and accessories used in conjunction with aluminum conduit shall be die cast, copper free type. They shall be resistant to both chemical and galvanic corrosion. All covers shall have neoprene gaskets.

3. All aluminum conduit used for this project shall be UL listed for the purpose.

G. PVC Coated Metallic Conduit

1. PVC coated rigid steel conduit (PCMC) shall be rigid galvanized steel conduit covered with a bonded 40 mil (minimum) thickness PVC jacket and coated inside with urethane. The conduit shall comply with NEMA RN-1.

H. Conduit Fittings

1. Rigid Steel Conduit Fittings

a. Standard threaded couplings, locknuts, bushings, and elbows made only of steel or malleable iron are acceptable. Integral retractable type IMC couplings are acceptable also.

b. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.

c. Bushings: Metallic insulating type, consisting of an insulating insert molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.

d. Erickson (union-type) and set screw type couplings: Approved for use in concrete are permitted or use to complete a conduit run where conduit is installed in concrete. Use set screws of case hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.

e. Sealing fittings: Threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water vapor. In concealed work, installed fittings in flush steel boxes with blank coverplates having the same finishes as that of other electrical plates in the room.

f. Fittings for PVC coated rigid conduit shall be manufactured by the maker of the conduit.

2. Rigid Aluminum Conduit Fittings

a. Standard threaded couplings, locknuts, bushings, and elbows: Malleable iron, steel, or aluminum alloy materials. Zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are prohibited.

b. Locknuts and bushings: As specified for rigid steel and IMC conduit.

c. Set screw fittings: Not permitted for use with aluminum conduit.

3. Expansion and Deflection Couplings

a. Accommodate 1.9 cm (0.75 inch) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.

b. Include internal flexible metal braid sized to guarantee conduit ground continuity and fault currents in accordance with UL, and the NEC code tables for ground conductors.

c. Watertight, seismically qualified, corrosion-resistant, threaded for and compatible with rigid or intermediate metal conduit.

d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material and stainless steel jacket clamps.

PART 3 - EXECUTION

3.01 PREPARATION

A. Exterior underground metallic conduits shall be degreased, pretreated, and coated with 2 coats of Carboline 888 epoxy, or equal. Other finishes may be acceptable upon the LFUCG Project Manager's review.

3.02 INSTALLATION

A. Conduit

1. All conduit shall be installed in a first class workmanship manner. It shall be installed in horizontal and vertical runs in such a manner as to ensure against trouble from the collection of trapped condensation and shall be arranged so as to be devoid of traps wherever possible. Special care shall be used in assuring that exposed conduit runs are parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings. No open wiring is allowed.

2. Fittings or symmetrical bends shall be required wherever right angle turns are made in exposed work. Bends and offsets shall be avoided wherever possible, but where necessary, they shall be made with an approved conduit bending machine. All conduit joints shall be cut square, reamed smooth and drawn up tight, using couplings intended for the purpose.

3. Conduits shall be securely fastened to all sheet metal outlets, junction and pull boxes with double galvanized locknuts and insulating-grounding bushings as required by the NEC. Conduit crossings in insulating roof fill will require both conduits to be secured to the roof deck, and these crossings can only be made where the insulating fill is a minimum of 3 inches deep. Runs of exposed conduit shall be supported in accordance with the NEC using cast aluminum or malleable iron one hole pipe straps with spacers to provide an air space behind the conduit. Stainless steel minerallac, one piece conduit clamps shall be acceptable where located such that building occupants are not in danger of inadvertent contact, since this type fitting has several sharp edges. In general terms, they may be considered in areas such as on or above ceilings, or high on walls. All conduit in walls and slabs shall be securely braced, capped (wooden plugs are prohibited), and fastened to the forms to prevent dislodgement during vibration and pouring of concrete.

4. During construction, all conduit work shall be protected to prevent lodgement of dirt, plaster or trash in conduits, fittings or boxes. Conduits which have been plugged shall be entirely freed of accumulations or be replaced. All conduits in floors or below grade shall

be swabbed free of debris and moisture before wires are pulled. Crushed or deformed conduit shall not be permitted.

5. Where GRS conduit penetrates a floor slab the conduit shall be painted with 2 coats of Koppers Bitumastic 300-M or equal to a point 6 inches above the penetration.

6. The final section of conduit connecting each motor or piece of utilization equipment subject to vibration shall be of the flexible type. Type “UA” shall be used in all process areas and in outdoor or wet locations. Flexible conduit to space heaters shall be long enough to allow swivel action.

7. All underground conduits entering a building shall be sealed against water/condensate entering around the conductors. Sealant may be silicone rubber based caulk.

8. In certain situations, conduit expansion joints shall be required to ensure against conduit and/or cable damage due to settling or thermal expansion and contraction. These expansion joints shall be required where required by the manufacturer or the Scope of Services and shall be installed per manufacturer’s instructions.

9. Aluminum conduits shall not be in contact with concrete surfaces. Where aluminum conduits are routed along concrete surfaces, they shall be installed with one hole cast straps with clamp-backs to space the conduit ¼” away from concrete surface. Where aluminum conduit passes through concrete, CMU or brick walls, the penetration shall be made such that the aluminum conduit does not come in contact with concrete, CMU, brick or mortar. All penetrations shall meet or exceed the UL design standards. Aluminum conduit shall transition to PVC coated steel conduit where entering a concrete encasement, floor or duct bank.

10. Unless specifically identified on the Drawings as "Direct Buried," all conduits in the earth, including conduits below slabs-on-grade, shall be concrete encased. Joints in conduit shall be staggered so as not to occur side by side. Rigid non-metallic (PVC) conduit shall be connected to PVC coated rigid steel conduit at the point where it leaves the ground, with the transition to metal conduit occurring inside the concrete encasement. PVC coated rigid steel conduit may transition to non-coated conduit after exiting the encasement. The transition coupling between PVC coated conduit and non-coated conduit shall be PVC coated.

11. It is the general intent that boxes for light fixtures, switches, receptacles, etc. in or on the building be flush mounted with concealed conduit to the device, except in areas designated to have all conduit installed exposed.

12. All metal raceway systems shall be grounding conductive, solidly bonded throughout and grounded in accordance with NEC requirements and/or as noted on the Scope of Services. In addition, all raceway systems shall be provided with separate grounding conductors.

13. **Minimum conduit size shall be 3/4 inch.** The following table shows the minimum burial depth required for all exterior conduit or cable:

Schedule 40 PVC, Concrete Encased	18"
Schedule 40 PVC, Concrete Encased (for medium voltage service entrance)	42"

14. Wire pulling shall be facilitated by the use of a UL approved pulling compound in pulls over 30 feet in length or where there are 2 or more 90 degree bends. Only polypropylene,

nylon, or manila pulling ropes will be permitted. **Standard industry recognized wire pulling equipment shall be used.**

15. All conduits entering and leaving instrument enclosures shall be sealed around the wires with silicone caulk.

16. All conduits for emergency lighting systems shall be separate from other building power conduits.

17. Areas of use for each type of conduit:

Location	Schedule 40 PVC	Schedule 80 PVC	Aluminum	PCMC
Electrical Room – Exposed			X	X
Pump Station and Wet well			X	X
Electrical Room – Concealed in Wall		X	X	X
Odor Control Room – Exposed			X	X
Odor Control Room – Concealed in Wall		X	X	X
Chemical Storage Areas		X		
Restroom – Concealed Only		X	X	X
Valve Vault – Exposed Only			X	X
Attic Space			X	X
Exterior Exposed			X	X
Exterior Underground, Underslab, or In Slab	X	X		X
Exterior Underground Service Entrance (Primary and Sec.)	X	X		X

18. All conduit shall have an insulated ground wire pulled to all equipment and receptacles.

19. All raceway runs are shown diagrammatically to outline the general routing of the raceway. The installation shall be made to avoid interference with pipes, ducts, structural members or other equipment. Should structural or other interference prevent the installation of the raceways, or setting of boxes, cabinets, or the electrical equipment, as indicated in the Drawings, deviations must be approved by the Owner, and after approval, shall be made without additional charges and shown on the Record Drawings.

20. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.

21. No conduit shall be run exposed across roofs without first obtaining permission from the LFUCG Project Manager.

22. Conduit may be run inside concrete slabs as long as the slab is at least 6-inches thick and conduit will have at least 1 2-inches of cover on both sides.

23. Runs of flexible conduit above accessible ceilings shall be limited to 10 ft. Runs of exposed flexible conduit shall be limited to 5 ft. All runs of flexible conduit shall be supported in accordance with NEC requirements.

24. All PVC coated conduit shall be installed in accordance with manufacturer's instructions. The Contractor shall use tools that are specifically suited for coated conduit systems. The use of pipe wrenches and other such tools on PVC coated RGS conduit is prohibited. The LFUCG Project Manager and Owner reserve the right to reject any installation of coated conduit that does not meet the requirements of the Section or the manufacturer's instructions. The LFUCG Project Manager and Owner also reserve the right to reject any installation that exhibits damage due to the improper use of tools. All rejected installations shall be replaced by the Contractor at no additional cost to the Owner. The use of PVC coated conduit repair compounds to repair damages or improper installation is prohibited.

25. All Contractor personnel that install PVC coated RGS conduit shall be trained by the PVC coated RGS conduit manufacturer. Training shall include proper conduit system assembly techniques, use of tools appropriate for coated conduit systems, and field bending/cutting/threading of coated conduit. The Contractor shall furnish evidence of such training as specified herein. Training shall have been completed within the past 24 months prior to the Notice to Proceed on this Contract for all coated conduit installation personnel. Contractor personnel not trained within this timeframe shall not be allowed to install coated conduit, or shall be trained/re-trained as required prior to commencement of conduit installation.

26. Sealing fittings shall be installed where conduits pass from non-hazardous locations to hazardous locations and as required by Chapter 5 of the NEC. See section 16050 for hazardous area classifications.

END OF SECTION

SECTION 16131 - BOXES

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Outlet and junction boxes shall be furnished and installed where indicated on the Scope of Services, and\or as required by the work in accordance with the NEC.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Boxes – “Wiegmann,” “Appleton,” “Raco,” “Crouse-Hinds,” “Hoffman,” “Robroy Industries,” “Carlon,” or equal.

2.02 GENERAL

A. All junction and/or pull boxes for dry (non-corrosive) areas shall be of code gauge sheet metal construction, of the inside dimensions as required by code, with covers.

B. Outlet boxes for wet or damp locations shall be cast metal, rust and corrosion resistant (NEMA 4X), with at least 5-1/2 full threads for each (bossed) conduit opening, and shall be suitable for flush or surface mounting as required with drilled external, cast mounting extensions (bossed to provide at least 1/8" between back of box and mounting surface for drainage). Box covers shall be hinged or cap screw retained as required, of the same material as the box and provided with stainless steel (rustproof) hardware.

C. Junction and/or pull boxes for out-of-doors use or indoor process areas, not mounted in concrete may be sheet metal (NEMA 4X), waterproof, rustproof, rain and sleetproof, with hinged covers and latches and provided means of locking by means of keyed locks, tamper-resistant screws or padlocking as required and with clamping cap-screws top and bottom door edges to provide firm contact with gasketing. All gaskets shall be molded (unbroken) neoprene or butyl rubber.

D. NEMA 4X junction and/or pull boxes shall be stainless steel.

E. Junction boxes for use in wet-wells and other hazardous areas shall be watertight, rustproof and corrosion resistant, and explosionproof with threaded conduit openings (5-1/2 full threads - minimum) and provided with rustproof hardware.

F. Explosionproof sealing fittings shall be furnished and installed in accordance with NEC requirements.

G. Junction and/or pull boxes for chemical storage and transfer areas shall be Schedule 80 PVC where Schedule 80 PVC conduit is specified in 16130.

PART 3 - EXECUTION

3.01 INSTALLATION, APPLICATION, AND ERECTION

A. General

1. Outlets shall be installed in the locations shown on the Scope of Services. The Contractor shall study the general building plans in relation to the space surrounding each outlet, in order that his work may fit the other work required by these Specifications. When necessary, the Contractor shall relocate outlets so that when fixtures or other fittings are installed, they will be symmetrically located according to room layout and will not interfere with other work or equipment.

2. All supports for outlet boxes shall be furnished and installed by the electrical trades.

B. Concealed Work

1. All outlet boxes shall be standard galvanized steel type at least 2 inches deep, single or gang type of size to accommodate devices shown. Exceptions shall be noted on the Scope of Services.

2. Standard deep type outlet boxes (concrete rings with appropriate covers) shall be used in floor slab construction so concealed conduits entering sides of boxes can clear reinforcing rods.

3. Outlet boxes for concealed telephone and signaling systems shall be the 4-inch square type, unless otherwise noted or required by the telephone company.

4. Boxes for use in masonry construction shall be 2-1/2 inches deep for 4-inch block and 3-1/2 inches deep for 6- and 8-inch block. Through wall boxes are prohibited for outlets opposite each other.

C. Exposed Work

1. Outlet or junction boxes for use with exposed aluminum conduit shall be copper free, cast aluminum type.

2. Outlet or junction boxes for use with exposed PVC conduit shall be PVC.

D. Pull Boxes

1. Pull boxes for exterior underground work are shown on the Scope of Services and are the minimum number required. Others may be added at the Contractor's option, but no extra pay shall be allowed. Interior pull boxes are not shown but shall be used as needed. Pull box types are as follows:

   Exterior - Per detail on the Scope of Services.

   Interior - Interior pull boxes in dry areas shall be of code gauge steel of not less than the minimum required by the NEC and shall be provided with hinged covers. In wet areas or pipe galleries, they shall be rated watertight, of stainless steel, cast aluminum, PVC, fiberglass, or equal. Hardware shall be stainless steel.

E. Openings in Electrical Boxes

1. All openings in electrical equipment, enclosures, cabinets, outlet and junction boxes shall be by means of welded bosses, standard knockouts, or shall be sawed, drilled, or punched with tools specially made for the purpose. The use of a cutting torch is prohibited. Unused openings shall be plugged per the NEC.

END OF SECTION

SECTION 16140 - WIRING DEVICES

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Wiring devices shall be installed where indicated on the Scope of Services.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. “Hubbell,” “Eagle,” “General Electric,” “Wiremold,” “P&S,” “Leviton,” “Daniel Woodhead,” “Killark”, or equal.

2.02 EQUIPMENT

A. Receptacles

1. Twin-convenience - outlet (interior) – “Hubbell” cat. no. 5362, or equal.

2. Twin-convenience - outlet (exterior) – “Hubbell” cat. no. 5362 with Taymac Corporation or Intermatic, Inc. safety outlet enclosure.

3. Special purpose outlet - Per equipment requirements.

4. Ground fault interrupting receptacles shall be required where shown on the Scope of Services, and shall be indicated by the abbreviation “GFI” beside the circuit symbol on the Scope of Services. They shall be rated 20 amps (125 volts) and shall be of the duplex, feed through type, capable of protecting all downstream receptacles on the same circuit. They shall be UL listed and interrupt the current between 4-6 milliamps of ground fault leakage. Appropriate plates shall be furnished and installed. The 20 ampere rating shall apply not only to device internals but to the faceplate as well.

5. Explosionproof receptacles shall be Killark series KRS rated for Class I, Division 1 and 2, Group C & D atmospheres, or equal. Provide a matching plug and install on the Davit Crane winch power cable.

B. Plates and Covers

1. Furnish and install plates of the appropriate type and size for all wiring and control devices, signal and telephone outlets.

2. All plates on flush and surface mounted boxes shall be of 302 stainless steel (nonmagnetic) with rounded or beveled edges, except where weatherproof covers are shown. All device plate screws shall be nylon or stainless steel with countersunk heads. Plates shall be installed vertically and with an alignment tolerance of 1/16 inch. Device plates shall be of the one-piece type, of suitable shape for the devices to be covered. Plates shall have a smooth finish with no crevices to collect dirt. Oversize plates are not acceptable.

3. Covers for boxes serving equipment where flexible conduit is to be tapped into cover plates shall be sheet metal drilled for conduit. Gaskets shall be required as well as all special adapters for mounting.

C. Wall Switches (Tumbler Type)

1. Single pole (interior) – “Hubbell” cat. no. 1221, or equal.

2. Single pole (exterior) – “Hubbell” cat. no. 1222, or equal, and Hubbell 1795 or equal plate.

3. 3-way switches (interior) – “Hubbell” cat. no. 1223, or equal.

4. 4-way switches (interior) – “Hubbell” cat. no. 1224, or equal.

5. Outside receptacles shall be labeled for the purpose.

PART 3 - EXECUTION

3.01 INSTALLATION/APPLICATION/ERECTION

A. Wall Switches

1. Wall switches shall be mounted at a height as indicated in Section 16050, unless otherwise noted on the Scope of Services.

B. Receptacles

1. Outlets shall be located as shown on the Scope of Services. Where located in special interior finishes, they shall be properly centered. Boxes shall be of the type noted and accepted for the specific installation.

2. Furnish and install receptacle circuits where called for on the Scope of Services and/or by these Specifications. Circuits shall be installed in conduit from panel to receptacle, with flush mounted boxes except as noted on the Scope of Services.

3. Receptacles and lighting circuits shall not be combined on the same overcurrent device. For runs over 75 feet or for 30 amp receptacles, minimum wire size shall be AWG No. 10.

4. Receptacles for specific devices (i.e., air conditioner), shall be rated at the correct voltage and amperage for that unit.

5. The minimum free length of conductor at each box for the connection of a fixture, switch or receptacle shall be 8 inches. All connections shall be made mechanically and electrically secure.

6. Receptacles shall be duplex type, rated at 20 amps, 125 volts, brown colored, unless otherwise noted. Mounting height shall be as specified for low outlets in Section 16050. All receptacles shall be of the grounding type.

7. Receptacles over workbenches or countertops or at medium or high mountings shall be mounted so that the grounding slot is below the neutral and hot. All other receptacles shall be mounted with the grounding slot above the neutral and hot.

8. Exterior weatherproof receptacles, shall be weatherproof while in use. This requirement shall apply on all outdoor units and on others as indicated on the Drawings. To meet this requirement, appropriate safety outlet covers as manufactured by Taymac Corporation, Intermatic Guardian Series, or equal shall be utilized in these areas.

END OF SECTION

SECTION 16150 - WIRE CONNECTIONS AND CONNECTING DEVICES

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Wire connection and connecting devices shall be as herein specified and as recommended by equipment manufacturers.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Connectors, Lugs, etc. – “T & B”, “Anderson”, “Burndy”, or equal.

B. Termination and splice connectors – “3M Scotchlok”, “Anderson”, “T & B”, “Burndy”, or equal.

2.02 MATERIALS

A. Wire Splicing and Terminations (600 Volts and Below)

1. Electrical Terminal and Splice Connectors (#22 - #4 AWG)

a. Terminals and splice connectors from #22 - #4 AWG shall be compression types with barrels to provide maximum conductor contact and tensile strength. Performance, construction, and materials shall be in conformance with UL standards for wire connectors and rated for 600 volts and 105 degrees Celsius.

b. Connectors shall be manufactured from high conductivity copper and entirely tin plated. Terminal barrels shall be serrated on the inside surface and have a chamfered conductor entry. Terminals shall have funnel entry construction to prevent strand fold-back. All barrels shall be brazed seam or seamless construction.

c. Spade type terminals shall be sized for the appropriate stud and shall be locking type that snap firmly onto studs with a close fit for maximum retention. Spade type terminals shall be insulated with an insulation suitable for maintaining a high dielectric strength when crimped and be made from nylon, PVC, or equal.

2. Electrical Lugs and Connectors (#6 AWG - 1000 Kcmil)

a. Lugs and splice connectors from #6 AWG - 1000 Kcmil shall be compression types with barrels to provide maximum conductor contact and tensile strength. They shall be manufactured from high conductivity copper and entirely tin plated. They shall be crimped with standard industry tooling. The lugs and connectors must have a current carrying capacity equal to the conductors for which they are rated and must also meet all UL requirements. All lugs above 4/0 AWG shall be 2-hole lugs with NEMA spacing. The lugs shall be rated for operation through 35 KV. The lugs shall be of closed end construction to exclude moisture migration into the cable conductor.

3. Twist-on Wire Connectors (#22 AWG - #10 AWG)

a. All twist-on wire connectors must have a corrosion resistant spring that is free to expand within a steel jacket. The steel jacket must be insulated with a flexible vinyl jacket capable of withstanding 105 degrees Celsius ambient temperatures and of sufficient length to cover wires that are inadvertently overstripped.

b. Each connector size must be listed by UL for the intended purpose and color coded to assure that the proper size is used on the wire combinations to be spliced. The connectors must be compatible with all common rubber and thermoplastic wire insulations.

4. Solderless/re-usable lugs shall be used only when furnished with equipment such as control panels, furnished by others, where specification of compression type lugs is beyond the Contractor's control. In the event their use is necessary, the Contractor shall be responsible for assuring that they are manufactured to NEMA standards, with proper number and spacing of holes and set screws.

PART 3 - EXECUTION

3.01 INSTALLATION, APPLICATION, & ERECTION

A. Insulation of Splices and Connections

1. Connections/splices with a smooth even contour shall be insulated with a conformable 7 mil thick vinyl plastic insulating tape which can be applied under all weather conditions and is designed to perform in a continuous temperature environment up to 105 degrees Celsius. The tape shall have excellent resistance to abrasion, moisture, alkalies, acids, corrosion, and varying weather conditions (including sunlight). The tape shall be equal to Scotch 33+ and shall be applied in conformance with manufacturer's recommendations. In addition, it shall be applied in successive half-lapped layers with sufficient tension to reduce its width to 5/8 of its original width. The last inch of the wrap shall not be stretched.

2. Connections/splices with irregular shapes or sharp edges protruding shall be first wrapped with 30 mil rubber tape to smooth the contour of the joint before being insulated with 33+ insulating tape specified in the previous paragraph. The rubber tape shall be high voltage (69 KV) corona-resistant based on self-fusing ethylene propylene rubber and be capable of operation at 130 degrees Celsius under emergency conditions. The tape must be capable of being applied in either the stretched or unstretched condition without any loss in either physical or electrical properties. The tape must not split, crack, slip, or flag when exposed to various environments. The tape must be compatible with all synthetic cable insulations. The tape must have a dissipation factor of less than 5 percent at 130 degrees Celsius, be non-vulcanizing, and have a shelf life of a least 5 years. The rubber tape shall be applied in successive, half-lapped wound layers and shall be highly elongated to eliminate voids. Other manufacturer's recommendations on installation shall be adhered to. The rubber tape shall be equal to Scotch 23 or 130C electrical splicing tape.

3. Splices made in wet or damp locations shall be made submersible and watertight with special kits made for the application and compatible with type of cables employed.

B. Connection Make-up

1. Connections of lugs to bus bars, etc., shall be made up with corrosion resistant steel bolts having non-magnetic properties with matching nuts, and shall utilize a Belleville spring washer (stainless steel) to maintain connection integrity. Connections shall be torqued to the proper limits. Prior to bolting up the connection, electrical joint compound shall be brushed on the contact faces of the electrical joint.

2. All motor lead connections shall be made up to match the type of lead furnished on the motor. If the lead is not lugged, then twist-on wire connectors may be used. To prevent possible vibration problems, twist-on connectors shall be taped after installation.

3. All lugged motor lead connections (excluding motors over 200 horse-power) shall be made up using ring tongue compression lugs with proper size stainless steel nuts and bolts. Belleville type spring shall be used to maintain tension on the connections. The connections shall then be insulated using the procedure described for irregular shapes, utilizing rubber tape in conjunction with vinyl electrical tape.

4. At the time of final inspection, the LFUCG Project Manager may request the Contractor to disassemble 3 randomly selected motor lead connections in the LFUCG Project Manager's presence, to assure conformance with these Specifications.

5. The Contractor shall include all necessary tools, materials, and labor in his bid for disassembly of the connections and for remaking them with new insulating materials after inspection.

END OF SECTION

SECTION 16170 – SAFETY SWITCHES

PART 1 – GENERAL

1.01 SCOPE OF WORK

A. Provide horsepower-rated, quick-make, quick-break, safety switches provided with the number of poles and fuses as required.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS/EQUIPMENT

A. Safety switches shall be as manufactured by General Electric, Schneider, Eaton, or equal.

B. Switches shall be NEMA Type HD, single-throw, externally operated, non-fused or fused with Class R fuse clips.

C. Switches shall have arc shields, shall be of enclosed construction and fusible or non-fusible as indicated. Switches shall be rated for either 250-volt AC or 600-volt AC service as required.

D. All switches shall be capable of interrupting locked rotor current of motor which it serves.

E. Enclosures shall be as indicated in the Drawings.

F. Provide dual-element Bussman type FRN (250 volt) or type FRS (600 volt) fuses for any fusible safety switch serving a motor circuit.

G. For non-motor loads, provide dual element Bussman type LPN (250 volt) or type LPS (600 volt).

H. All switches shall be capable of being padlocked in either the “On” or “Off” position.

I. Safety switches shall be provided with auxiliary contacts where indicated on Scope of Services.

J. Safety switches shall be UL listed and shall conform to NEMA Standards. NEMA 4X enclosed safety switches where called for shall be stainless steel.

K. NEMA 1 enclosed switches shall be phosphate coated as equivalent, code gauge steel with baked enamel finish.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Provide non-fusible switches at remote motor locations as indicated on drawings.

B. Provide fusible disconnects at package A/C units, fused as specified on unit nameplate.

C. Mount switches to walls or to equipment enclosures with a minimum of 4 bolts using toggle anchors for masonry construction, Phillips “Red Head” anchors for poured concrete construction and bolts, jumbo washers, lock washers and nuts for equipment enclosure mounting.

D. All safety switches to be identified with nameplates per Section 16075.

END OF SECTION

SECTION 16220 - MOTORS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Motors are to be furnished with driven equipment except where otherwise noted on the Scope of Services or elsewhere in this Division of the Specifications. All motors shall conform to the following Specifications and any special requirements of the driven equipment. Special requirements of the driven equipment shall take precedence over these Specifications should a discrepancy occur. Starting torque and slip ratings shall conform to the requirements of the driven equipment.

B. Polyphase motors shall be of the squirrel cage induction type and single phase of the capacitor start-induction run type except as otherwise noted. Conduit boxes shall be tapped for the size conduit shown on the Scope of Services.

C. All motors shall be manufactured and installed in accordance with applicable NEMA standards and NEC provisions, latest revisions.

1.02 DELIVERY, STORAGE, & HANDLING

A. All electrical motors shall be protected against the accumulation of moisture, dust and debris and physical damage during the course of installation of the job.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Motors – “General Electric”, “Westinghouse”, “U.S. Motors”, “Gould Century”, “Lincoln”, “Baldor”, “Marathon”, “Reliance”, “Magnatek”, “Siemens”, or equal.

2.02 EQUIPMENT

A. Motors 200 Horsepower and Under for Service Under 600 Volts

1. Ratings and Electrical Characteristics

a. Time: All motors shall be rated for continuous duty.

b. Temperature: Based on NEMA standards for a maximum ambient temperature of 40 degrees Celsius and an altitude of 3,300 feet or less, according to service factor and insulation class employed.

c. Voltage: All single phase motors shall be rated 115/208/230 volts and all polyphase motors 230/460 volts. Submersible polyphase motors to be operated at 460 volts may take exception to the dual voltage requirement. All motors shall be capable of normal operation at balanced voltages in the range of ±10 percent from rated winding voltage.

d. Frequency: All a-c motors shall be rated for 60 Hz. operation. All motors shall be capable of normal operation at frequencies 5 percent above or below the nominal rating of 60 Hz.

e. Horsepower: Horsepower of the motors shall be as given in the Specification Division on the driven equipment or as shown on the Scope of Services. Submersible motors shall be allowed to be furnished even though the horsepower rating may not be in accordance with standard NEMA assignments. In many cases, the horsepower specified is a minimum requirement and certain alternate manufacturers may require larger horsepower motors. The larger motor shall be furnished at no extra cost to the Owner.

f. Locked Rotor Current: Locked rotor current shall be in accordance with NEMA standards.

g. Efficiency and Power Factor: Efficiency and power factor shall be given consideration during Shop Drawing review. The ratings at full, 3/4, and 1/2 load shall be compared to similar motors manufactured by acceptable suppliers listed in these Specifications. Excessive variation shall be considered grounds for rejection.

h. Speed: Synchronous speed of motors shall correspond to standard NEMA ratings. Actual speed shall be as given in the Specification Division on the driven equipment. Slip shall not exceed 5 percent at full load.

i. Service Factor: The service factor shall be 1.15 unless requirements of the driven load necessitate a higher service factor. The service factor for inverter duty rated motors shall be 1.0.

j. Insulation Class: Insulation shall be NEMA Class F, except as otherwise noted. Submersible motors shall be Class F, and inverter duty motors to be operated at variable speed shall be Class F. Motors shall operate at a Class B rise at nameplate horsepower loading regardless of Insulation Class.

k. Design Level: Motors shall be NEMA design B, except as otherwise noted.

l. Enclosure: Motors for process equipment 2 HP and smaller shall be totally enclosed. All motors for process equipment larger than 2 HP shall be TEFC (totally enclosed fan cooled), suitable for use indoors or outdoors, except as otherwise noted. Totally enclosed non-ventilated (or air-over) motors may be used for ventilators and other auxiliary equipment that by virtue of the load are provided with more than adequate ventilation. ODP (open dripproof) motors may be used for ventilators where the motor is outside the air stream yet still protected from the weather. Division 15 of the Specifications and the HVAC Scope of Services will detail the type of enclosure required for ventilators. Submersible motors shall be air or oil filled and of watertight construction. Motors used in classified atmospheres shall be properly rated for that hazard.

m. Frame Size: Frame designations shall be in accordance with NEMA standards.

n. Winding Overtemperature Sensors: All motors 15 horsepower and over shall be provided with motor winding thermostats. The devices shall be hermetically sealed, snap-acting thermal switches, actuated by a thermally responsive bi-metallic disk. A minimum of 1 per phase is required, with switches wired into the control circuit of the starter to provide deenergization should overheating threaten. All submersible motors shall be equipped with motor winding thermostats.

o. All submersible pump/motor assemblies shall be equipped to detect presence of moisture and alarm at the controller.

p. Motors specified for operation with variable frequency drives shall be inverter duty and shall be designed to output 100 percent of nameplate horsepower under continuous duty service without exceeding the temperature rise specified herein

when controlled by the actual drives furnished. Inverter duty motors shall be designed to operate down to 10% of full load speed without the need for a line powered cooling fan.

2. Mechanical Characteristics

   a. Integral Horsepower Motor Construction

      1) Motor frames for horizontal motors shall be cast iron, heavy fabricated steel, or cast aluminum (alloy 356 or 360). A steel insert ring shall be set into the aluminum alloy endshield when cast to minimize wear of the bearing support. **Aluminum alloy motors shall not be used in areas where exposed to chlorine gas.**

      2) Motor frames for vertical motors shall be cast iron, heavy fabricated steel, or extruded aluminum (alloy 6063-T4 or 6063-T6). Endshields for vertical motors **must** be cast iron.

      3) If an aluminum frame is used, the endshields and/or all other steel hardware must be plated with zinc or cadmium and coated with grease before assembly to minimize the galvanic action between the steel and aluminum.

      4) Motor frames and endshields shall be of such design and proportions as to hold all motor components rigidly in proper position and provide adequate protection for the type enclosure employed. Lifting lugs of all motors shall conform to NEMA standards.

      5) Windings shall be random or form wound, adequately insulated and securely braced to resist failure due to electrical stresses and vibration. If the windings are aluminum, there shall be a cold welded aluminum-copper transition joint at the termination of the windings to permit the use of standard copper to copper connection techniques by the electrician and to prevent galvanic action between the copper power wires and the aluminum windings.

      6) The motor shaft shall be made of high grade machine steel or steel forging of size and design adequate to withstand the load stresses normally encountered in motors of that particular rating. Bearing journals shall be ground and polished.

      7) Rotors shall be made from high grade steel laminations adequately fastened together and to the shaft. Rotor cage windings may be cast aluminum of bar type construction with brazed end rings.

      8) Integral horsepower motors shall be equipped with cone, roller, or ball bearings made to AFBMA standards, Grade 1 and shall be of ample capacity for the motor ratings. The bearing housing shall be large enough to hold sufficient lubricant to minimize the need for frequent relubrication (ten years normal operation without lubrication), but facilities shall be provided for adding new lubricant and draining out old lubricant without motor disassembly. The bearing housing shall have long, tight running fits or rotating seals to protect against the entrance of foreign matter into the bearings or leakage of lubricant out of the bearing cavity.

      9) See the specification division relating to each piece of motor driven equipment for additional motor requirements to those listed above.

   b. Fractional Horsepower Motor Construction

      1) Motor and shell shall be rigid welded steel designed to maintain accurate alignment of motor components and provide adequate protection. End shields

shall be reinforced, lightweight, die cast aluminum. Windings shall be of varnish insulated wire with slot insulation of polyester film and baked on bonding treatment to make the stator winding strongly resistant to heat, aging, moisture, electrical stresses, and other hazards. Motor shafts shall be made from high grade, cold rolled, shaft steel with drive shaft extensions carefully machined to standard NEMA dimensions for shaft coupled drive connection. Bearings shall be carefully selected precision ball bearings with extra quality, long life grease and large reservoir providing 10 years normal operation without relubrication, AFBMA Grade 1.

c. Submersible Motor Construction

1) See Equipment Specifications.

3. Tests, Nameplates, and Shop Drawings

a. Tests

1) Tests shall be required on integral horsepower motors only. A factory certified test report of “electrically duplicate motors previously tested” shall be supplied on all motors under 200 horsepower. The test shall be certified by the factory and shall contain a statement to the effect that complete tests affirm the guaranteed characteristics published in the manufacturer’s catalogs or descriptive literature.

2) Tests will be in accordance with IEEE test procedures.

b. Nameplates

1) Each motor shall have a permanently affixed nameplate of brass, stainless steel, or other metal of durability and corrosion resistance. The data contained on the nameplate shall be in accordance with NEMA standards.

c. Shop Drawings

1) Shop Drawings shall consist of motor dimensions, nameplate data from each motor and tests as outlined above. Also included shall be efficiency and power factor at 100, 75, and 50 percent load. Operation, maintenance, and lubrication information (including bearing catalog numbers) shall be submitted with Shop Drawings for review.

4. Efficiency Requirements

a. The following motor full load efficiency requirements shall be met as a minimum for totally enclosed 3 phase integral horsepower motors, per NEMA test methods:

Horsepower	Nominal 3600 RPM (Minimum %)	Nominal 1800 RPM (Minimum %)	Nominal 1200 RPM (Minimum %)
1	75.5	82.5	80.0
1.5	82.5	84.0	85.5
2	84.0	84.0	86.5
3	85.5	87.5	87.5
5	87.5	87.5	87.5
7.5	88.5	89.5	89.5
10	89.5	89.5	89.5

Horsepower	Nominal 3600 RPM (Minimum %)	Nominal 1800 RPM (Minimum %)	Nominal 1200 RPM (Minimum %)
15	90.2	91.0	90.2
20	90.2	91.0	90.2
25	91.0	92.4	91.7
30	91.0	92.4	91.7
40	91.7	93.0	93.0
50	92.4	93.0	93.0
60	93.0	93.6	93.6
75	93.0	94.1	93.6
100	93.6	94.5	94.1
125	94.5	94.5	94.1
150	94.5	95.0	95.0
200	95.0	95.0	95.0

Open Motors where specified shall also comply with NEMA efficiency minimums.

b. Motors shall be energy efficient type to comply with requirements of the Energy Policy Act of 1992.

PART 3 - EXECUTION

3.01 INSTALLATION/APPLICATION/ERECTION

A. Installation of motors shall comply with motor manufacturer's instructions as well as applicable NEMA recommendations and requirements of the driven equipment OEM (original equipment manufacturer).

B. Motors shall be aligned to acceptable tolerances and shall not vibrate excessively.

C. Motors shall not be energized until they have been accepted by the OEM start up personnel.

END OF SECTION

SECTION 16225 - ELECTRIC VALVE AND GATE ACTUATORS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Provide valve and gate actuators as indicated on the Scope of Services and as specified herein.

B. Provisions of the valve actuator specifications in Division 11 shall overrule requirements herein. These requirements are supplemental to Division 11.

C. Actuators shall be sized in cooperation with valve/gate manufacturer to get proper torque/horsepower/speed ratings as well as dimensional compatibility.

1.02 RELATED WORK

A. Division 11

B. Division 15

C. Division 16

D. Division 17

1.03 SUBMITTALS

A. Shop drawing approval is required. Valve and gate submittals shall include their respective actuators in a single submittal. Include complete wiring diagrams and electrical information.

B. Operation and Maintenance Manuals shall be submitted.

1.04 QUALITY ASSURANCE

A. Actuators shall comply with AWWA C540.

1.05 WARRANTY AND SERVICE

A. Minimum one-year warranty is required on all actuators from the date of substantial completion. Provide extended warranty if necessary to meet this date requirement.

1.06 TRAINING

A. Provide one 4-hour training class on actuator operation, maintenance, and troubleshooting, for each type of actuator provided.

PART 2 - PRODUCT

2.01 MANUFACTURERS

A. Acceptable manufacturers for motorized actuators shall be Limitorque.

2.02 ACTUATOR CONSTRUCTION

A. Actuators shall consist of an electric motor, worm gear reduction, electronic torque sensor, mechanically and electrically interlocked reversing motor contactor, electronic control, protection, and monitoring package, manual override handwheel, valve interface bushing, LCD (Liquid Crystal Display), and local control switches. Actuator design life shall be at least one million drive sleeve turns.

B. Actuator Housing: Actuators installed above grade shall be NEMA 4X. Actuators proposed for hazardous areas (as indicated on the Drawings) shall be FM certified for the indicated hazardous area. An integral space heater and thermostat shall be provided for prevention of condensation.

C. Actuators indicated as two-position actuators shall have limit switches to indicate position status.

D. The power transmission shall be completely bearing-supported, and consist of a hardened alloy steel worm and bronze alloy worm gear; oil-bath lubricated using synthetic oil designed specifically for extreme pressure worm and worm gear transmission service.

E. The actuator voltage rating shall be as indicated on the Drawings. The motor shall have Class F insulation and a thermistor embedded within the motor windings to prevent damage due to overload. The motor shall be easily removed through the use of a plug-in connector and shaft coupling. Valve motors shall be listed for continuous duty operation.

F. Motors for open-close service shall be suitable for 100 starts per hour.

G. An electronic torque sensor shall be included. The torque limit may be adjusted from 40-100% of rating in 1% increments. The motor shall be deenergized if the torque limit is exceeded. A boost function shall be included to prevent torque trip during initial valve unseating and during extreme arctic temperature operation (-50°C), and a “Jammed Valve” protection feature, with automatic retry sequence, shall be incorporated to de-energize the motor if no movement occurs.

H. A Phase Correction circuit shall be included to correct motor rotation faults caused by incorrect site wiring. The phase correction circuit shall also detect the loss of a phase and disable operation to prevent motor damage. The monitor relay shall trip and an error message shall be displayed on the LCD screen when loss of phase occurs and indicate the fault for Remote operation.

I. A monitor relay shall be included and shall trip when the actuator is not available for remote operation. Both N/O and N/C contacts shall be included, rated 125VAC, 0.5A and 30VDC, 2 amps. The monitor relay shall be configurable for three additional fault indications; lost phase, valve jammed, and motor overtemp. The yellow LED shall blink when the monitor relay is active.

J. Four (4) programmable relays shall be provided to provide the following signals to the customer’s control system:

   1. #1 - Actuator full open.

2. #2 - Actuator full closed.

3. #3 - Actuator in “Remote” control.

4. #4 - Spare relay.

K. LCD display shall be provided with a lithium battery powered display back-up module to maintain display illumination during a power outage.

L. A padlockable LOCAL-STOP-REMOTE switch and an OPEN-CLOSE switch shall be included for local valve actuator control. The control switches shall not penetrate the controls cover and shall be designed to electrically isolate the actuator’s internal components from the external environment. The OPEN-CLOSE switch may be configured for maintained or push-to-run (inching) control.

M. Double sealed terminal compartment and Terminal block – All customer connections shall be located in a terminal chamber that is separately sealed from all other actuator components. Site wiring shall not expose actuator components to the environment.

N. Coatings – The actuator shall be coated with a polymer powder coat. The coating system shall be suitable for an ASTM B117 salt spray test of 1500 hours. External fasteners shall be stainless steel or high-strength carbon steel that has been chromate-hexavalent coated, and then top coated with a high-strength, high-endurance polymer. The fasteners shall be suitable for an ASTM B117 salt spray test of 500 hours.

O. A handwheel and declutch lever shall be provided for manual operation. The handwheel shall not rotate during electric operation nor can a seized motor prevent manual operation. Changing from motor to manual operation is accomplished by engaging the declutch lever. Energizing the motor shall return the actuator to motor operation. The lever to enable the declutch shall be padlockable to permit motor operation only.

P. The actuator shall include a removable torque or thrust bushing to mate with the valve shaft.

Q. Factory testing – Every actuator shall be factory tested to verify: rated output torque, output speed, handwheel operation, local control, control power supply, valve jammed function, all customer inputs and outputs, motor current, motor thermistor, LCD and LED operation, direction of rotation, microprocessor checks, and position-sensor checks. A report confirming successful completion of testing shall be included with the actuator.

R. Schedule:

Tag No.	Service	Modulating/ Open-Close	Voltage	Accessories
G-1	Wetwell Isolation	Open-Close	460,3	4
G-2	Wetwell Isolation	Open-Close	460,3	4
G-3	Wetwell Isolation	Open-Close	460,3	4
V-1	Pump No. 1 Discharge	Open-Close	460,3	4
V-2	Pump No. 2 Discharge	Open-Close	460,3	4
V-3	Pump No. 3 Discharge	Open-Close	460,3	4
V-4	Pump No. 4 Discharge	Open-Close	460,3	4
V-5	Pump Header Discharge	Open-close	460,3	4

Accessories:
1. Integral circuit breaker disconnect switch.
2. Communications: Modbus RTU.
3. Communications: Profibus.
4. Communications: DeviceNet.

5. Communications: Foundation Fieldbus.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install the valve and actuator per manufacturer's instructions.

B. Contractor shall furnish a factory certified field technician to check mechanical operation, configure programmable parameters, span input and output signals, test, and commission the actuator to ensure proper operation.

END OF SECTION

SECTION 16280 – SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.01 REQUIREMENTS

A. The Contractor shall furnish, install, and place in satisfactory operation, the surge protective devices (SPD) as specified herein.

B. Surge protective devices shall be provided as a stand-alone unit, separate from the enclosure of the equipment to which they are connected or as integrally mounted devices as noted on the Scope of Services.

1.02 CODES AND STANDARDS

A. The surge protective device shall be designed, manufactured, and listed to the following standards:

1. Underwriters Laboratories, Inc. (UL)

    a. UL1449 4th Edition: Surge Protective Devices

    b. UL1283 5th Edition: Electromagnetic Interference Filters

2. American National Standards Institute (ANSI)/Institute of Electrical & Electronic LFUCG Project Managers (IEEE)

    a. C62.41.1: 2002 Guide for Surge Voltages in Low-Voltage AC Power Circuits

    b. C62.41.2: 2002 Recommend Practice on Characterization of Surges in Low Voltage (100V and Less) AC Power Circuits.

    c. C62.45: 2002 IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000V and Less) AC Power Circuits

    d. C62.62: 2000 IEEE Standard Test Specifications for Surge Protective Devices for Low Voltage (1000V and Less) AC Power Circuits

3. National Electric Code (NEC), Latest Edition

1.03 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

1. Witnessed Shop Tests

    a. None required.

2. Certified Shop Tests and Reports

    a. Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of NEMA, ANSI, and UL standards.

b. All surge protective devices, subassemblies, and components shall be 100% tested and certified by the manufacturer to meet their published performance parameters.

3. Field Tests

a. None required.

1.04 SUBMITTALS

A. The Contractor shall obtain from the equipment manufacturer and submit to the LFUCG Project Manager.:

1. Shop Drawings

2. Operation and Maintenance Manuals

3. Spare Parts List

4. Special Tools List

5. Reports of Shop Tests

1.05 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for re-submittal.

C. Drawings submitted by the manufacturer shall be complete and documented to provide the Owner with operations and maintenance capabilities.

D. Shop drawings for each SPD shall include but not be limited to:

1. Product Data Sheets.

2. Detailed drawings showing weights and dimensions.

3. Wiring diagrams showing field connections.

4. Proof that all products provided under this Section are UL listed and labeled by Underwriters Laboratories to UL1449 4th Edition. This proof shall be a copy of the data listed under the UL File Number for the manufacturer, which may be obtained from the UL Online Certification Directory. No other means of proving compliance (such as manufacturer data sheets, marketing material, etc) will be considered acceptable.

5. Proof of Short Circuit Current Ratings (SCCR), Voltage Protection Ratings (VPRs) for all modes, Maximum Continuous Operating Voltage rating (MCOV), Nominal Discharge Current (In), and device listing Type shall be submitted using the same means as described in the paragraph above.

6. Proof that all products provided under this Section are UL listed and labeled by Underwriters Laboratories to UL 1283 5th Edition. This proof shall be a copy of the data listed under the UL File Number for the manufacturer, which may be obtained from the

UL Online Certification Directory. No other means of proving compliance (such as manufacturer data sheets, marketing material, etc) will be considered acceptable.

7. Warranty Information

E. The shop drawing information shall be complete and organized in such a way that the LFUCG Project Manager can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "Soft Cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are to provide are acceptable and shall be submitted.

1.06 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall submit operation and maintenance manuals.

1.07 TOOLS, SUPPLIES, AND SPARE PARTS

A. The SPDs and accessories shall be furnished with all special tools necessary to disassemble, service, repair, and adjust the equipment. All spare parts as recommended by the equipment manufacturer shall be furnished by the Contractor to the Owner.

B The Contractor shall furnish one (1) spare field replacement module of each rating provided under this Contract.

C. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.

D. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the Work, at which time they shall be delivered to the Owner.

E. Spare parts lists, included with the shop drawing submittal shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.

F. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same part number.

1.08 IDENTIFICATION

A. Each SPD shall be identified by equipment name. A nameplate shall be securely affixed in a conspicuous place on each SPD.

1.09 TRAINING

A. The Contractor shall provide training for Owner personnel. Training shall be conducted by the manufacturer's factory trained specialists who shall instruct Owner personnel in operation and maintenance of all equipment provided under this Section. The training shall also include an overview of current SPD standards, as well as basic SPD operation and maintenance.

B. Provide the services of an experienced, factory trained technician or service LFUCG Project Manager of the SPD manufacturer at the jobsite for minimum of 1/2 day for training of Owner personnel, beginning at a date mutually agreeable to the Contractor and the Owner.

1.10 WARRANTY

A. All SPDs, associated hardware, and supporting components shall be warranted to be free from defects in materials and workmanship, under normal use and in accordance with the instructions provided, for a period of five (5) years after acceptance of the equipment by the Owner.

B. Any component or subassembly contained within the surge protection system that shows evidence of failure or incorrect operation during the five (5) year warranty period, shall be replaced and reinstalled by the manufacturer at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 GENERAL

A. The SPD shall be UL 1449 4th Edition Listed and must bear the 4th Edition mark. Units that are “manufactured in accordance with” UL 1449 3rd Edition or tested by other testing agencies “in accordance with” UL 1449 3rd Edition are not acceptable and will be rejected.

B. The SPD shall be UL 1283 5th Edition Listed and must bear the UL mark. Units that are “manufactured in accordance with” UL 1283 5th Edition or tested by other testing agencies “in accordance with” UL 1283 5th Edition are not acceptable and will be rejected. Further, SPD units using UL 1283 capacitors but not tested to UL 1283 will be rejected.

C. SPDs shall be provided as a stand-alone unit, separate from the equipment to which they are connected.

D. All SPDs furnished and installed under this Contract shall be from the same manufacturer.

2.02 PRODUCTS

A. Type I surge protective devices (SPD) shall be furnished and installed. Type II SPDs are not acceptable.

B. Each SPD shall be rated for the voltage and configuration of the equipment to which it is connected.

C. Each SPD shall have UL 1283 5th Edition EMI/RFI filtering with minimum attenuation of -50dB at 100kHz.

D. The short circuit current rating of each SPD shall match or exceed the rating of the equipment to which it is connected. The Contractor shall reference the Pump Station Schedule for short circuit current rating of each piece of equipment.

E. Each SPD system shall provide surge protection in all possible modes. Surge protection shall be as follows:

SYSTEM CONFIGURATION	MODES OF PROTECTION	NUMBER OF MODES
3-Phase Wye	L-N, L-G, N-G	7
3-Phase Delta	L-L, L-G	6
3-Phase Impedence Grounded	L-L, L-G	6
Single-Phase	L-N, L-G, N-G	3

F. Each SPD shall have a Maximum Continuous Operating Voltage (MCOV) of at least 115% of the nominal voltage of the equipment to which it is connected.

G. The Nominal Discharge Current (I_n) of each SPD shall be 20kA. Peak surge current ratings shall not be used as a basis for applying the SPD to the system.

H. The Voltage Protection Rating (VPR) of each SPD shall not exceed the following:

SYSTEM VOLTAGE	L-N	L-G	L-L	N-G
208Y/120	700V	700V	1200V	700V
480Y/277	1200V	1200V	2000V	1200V
480 DELTA	N/A	1200V	2000V	N/A
240 DELTA	N/A	1200V	1200V	N/A
120/240	700V	700V	1200V	700V

I. The surge current rating for each SPD shall be as indicated on the Scope of Services. Surge current rating indicated is on a per phase basis.

J. Each SPD shall be provided in an enclosure to match or exceed the NEMA rating of the equipment enclosure that it is serving (i.e. NEMA1, NEMA 12, NEMA 4X, etc).

K. Each SPD shall be provided with the following accessories:

1. Each individual module shall feature an LED indicating the individual module has all surge protection devices active. If any single component is taken off-line, the LED shall turn off and another LED shall illuminate, providing individual module as well as total system status indication.

2. Surge counter and audible alarm with reset/silence switch.

3. One set of Form C (SPDT) dry contacts rated for at least 5A at 120VAC.

L. SPDs shall be as manufactured by Eaton Electrical, Thor Systems, Advanced Protection Technologies (APT), or LEA International.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The SPD units shall be furnished and installed in accordance with the manufacturer's installation instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

B. The SPD units shall be mounted such that the conductor lengths are as short as possible, but no greater than 36 inches. Any installation resulting in a conductor length of greater than 36 inches shall be reviewed with the LFUCG Project Manager as a special type of cable may need to be installed. For equipment such as panelboards, the Contractor shall relocate the circuit breaker that is to be connected to the SPD as needed to achieve the shortest conductor length possible.

C. The Contractor shall use a close nipple to enclose the conductors between the SPD and the equipment served. However, if due to field conditions a 90 degree conduit bend is required to connect the SPD to the equipment that it serves, the bend shall have a minimum radius of 36 inches to eliminate any potential for sharp bends in the conductors.

D. Conductors between the equipment served and the SPD shall be 600V power wire and cable as specified in Section 16120 – Conductors and Cables. The individual conductors shall be gently twisted.

E. Prior to energizing, the Contractor shall verify that the SPD unit voltage and configuration is suitable for the system to which it is connected.

F. Prior to energizing, the Contractor shall also verify that any Neutral to Ground bonding jumpers are installed as required.

G. Prior to energizing, the Contractor shall also verify that the impedence of the equipment grounding conductor between the SPD and the grounding electrode system is less than 1 ohm.

END OF SECTION

SECTION 16430 - LOW VOLTAGE SWITCHBOARDS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish and install all switchboards as specified herein and as shown on the Scope of Services. All switchboards shall be UL listed.

1.02 POWER SYSTEM STUDIES

A. Refer to specification Section 16050 for study requirements.

B. Refer to specification Section 16280 for surge protection requirements.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Schneider, ABB, or equal.

2.02 EQUIPMENT

A. Low Voltage Switchboard (Front Access Only)

1. General Construction

a. All low voltage power distribution equipment shall be by the same manufacturer as the motor control equipment. The power distribution switchgear shall be of the required number of vertical sections bolted together to form one rigid switchboard 91.5 inches high incorporating switching and protective devices of the number, ratings and type noted herein or as shown on the Scope of Services with all interconnections, instrumentation, and control wiring. Switchboard construction shall be of the universal frame type using die-formed members bolted and braced through the exclusive use of self-tapping bolts. The sides, top, and rear shall be covered with removable screw-on plates having formed edges all around. Front plates shall be sectionalized and removable. All front plates shall be fabricated from code gauge steel and shall have formed edges all around. Ventilation openings shall be provided where required. All covers shall be secured by self-tapping screws.

b. The bus shall be hard-drawn silver-plated copper of sufficient size to limit the temperature rise to 65 degrees Celsius based on UL tests and adequately braced to withstand mechanical forces exerted during short circuit conditions when directly connected to a power source having the indicated available short circuit current. All connections shall be tightly bolted.

c. Small wiring, necessary fuse blocks and terminal blocks within the switchboards shall be furnished when required. All groups of control wires leaving the switchboard shall be provided with terminal blocks with suitable numbering strips. All hardware used on conductors shall have a high tensile strength and anti-corrosive zinc plating.

d. A ground bus shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the switchboard. A ground lug shall be furnished, attached to the ground bus in a convenient location.

e. The switchboard shall be provided with adequate lifting means and shall be capable of being rolled or moved into installation position and bolted directly to the floor without the use of floor sills.

f. A-B-C-N type bus arrangement, left-to-right, top-to-bottom, and front-to-rear; as viewed from the front shall be used throughout.

g. Shop drawings shall be furnished providing the following information: switchboard voltage/current ratings, overall outline dimensions including available conduit space, switching and protective device amp ratings and frame size; bussing dimensions/ratings; and one line diagram. Adequate conduit space shall be provided to meet NEC requirements.

h. Service manuals shall be provided on all equipment and accessories.

i. Each switching and protective device shall be provided with visible means of on-off identification. All terminals shall be of the anti-turn solderless type suitable for Cu or Al cable of sizes shown on the Scope of Services.

j. All interior and exterior steel surfaces of the switchboard shall be properly cleaned and finished with enamel over a rust-inhibiting phosphatized coating. Finish color shall be manufacturer's standard gray.

k. The switchboard shall be 24 inches deep.

l. Construction shall allow maintenance of incoming line terminations, main device connections, and all bus bolted connections to be performed without rear access.

m. The main horizontal bus bars shall be mounted on glass polyester insulators with all 3 phases arranged in the same vertical plane. The main bus shall have a maximum ampacity as required and shall be braced for short circuits of up to 65,000 RMS amps.

n. Vertical sections shall be completely factory assembled, wired, and tested before delivery. Design shall meet NEC and NEMA standards as well as OSHA requirements. Individual vertical sections shall be designed for bolting together at the job site.

o. Switchboard shall be Service Entrance labeled.

2. Circuit Breakers

a. Main Breakers

1) The breakers shall be operated by a toggle type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip free from the handle so that the contacts cannot be held against short circuits or abnormal currents. Tripping due to overload or short circuit shall be clearly indicated by the handle automatically assuming a position midway between the manual on and off positions. All latch surfaces shall be ground and polished. All poles shall be so constructed that they open, close, and trip simultaneously.

2) Breakers must be completely enclosed in a molded case. Interchangeable trip units shall be sealed to prevent tampering. Ampere ratings shall be clearly visible. Contacts shall be of non-

welding silver alloy. Arc extinction must be by means of arc chutes, consisting of metal grids mounted in an insulating support.

3) The minimum interrupting ratings of the circuit breakers shall be at least equal to the available short circuit current at the line terminals. Circuit breaker ratings, and modifications, shall be as shown in the Scope of Services.

4) The breakers shall have solid state trip elements with associated current monitors and the transfer shunt trips completely factory assembled and tested, and a push-to-trip button to mechanically check the trip mechanism or for use under emergency trip conditions.

5) The breakers shall have adjustable rating plugs to permit adjustment of the selected continuous current rating from 70 percent to 100 percent of the plug nameplate rating to provide the closest possible level of overload protection. An interlock in the rating plug will trip if an attempt is made to remove the plug with the breaker in the “on” position. With the plug removed, the breaker cannot be closed.

6) The breakers shall be equipped with an adjustable magnetic trip for all three poles which simultaneously adjusts the short delay from instantaneous at low setting to maximum of 10 cycles at high setting. Trip times and ratings shall not be affected by temperature changes.

7) The breaker shall be equipped with integral, adjustable ground fault protection.

8) Where the highest continuous current trip setting for which the actual overcurrent device installed in a circuit breaker is rated or can be adjusted is 1200A provide Alternate Maintenance Setting (AMS) switch and Restraint Interface Module (RIM) to provide energy reducing maintenance switching in accordance with section 240.87 of the NEC. Provide local status indication. AMS switch shall set the circuit breaker trip to “no intentional delay” to reduce clearing time while worker is working within the arc-flash boundary.

PART 3 - EXECUTION

3.01 INSTALLATION / APPLICATION / ERECTION

A. Switchgear/Switchboards shall be firmly anchored to the concrete foundation as indicated on the Drawings.

B. Manufacturer instructions shall be followed, and gear shall be megger tested prior to energization.

C. Switchboards shall have 36-inch-wide rubber matting placed in front of them.

END SECTION

SECTION 16440 - MOTOR CONTROL

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Contractor shall furnish and install motor control equipment as specified herein and as shown on the Drawings.

1.02 SUBMITTALS

A. Motor control equipment shall be new and the equipment of one manufacturer. Each component is specified by a particular trade name; however, this does not relieve the Contractor of the responsibility of submitting descriptive literature and Shop Drawings for review of all components. Motor control shall be the same brand as power distribution equipment on projects with both.

B. Shop drawings, including layout drawings, complete schematic and composite wiring diagrams, control circuit wiring diagrams and descriptive literature shall be submitted to the LFUCG Project Manager for review. **Service manuals shall be submitted on all equipment and shall be bound in 3-ring looseleaf binders.** The manuals shall also include information on accessories such as timers, etc., built in the control center.

1.03 SERVICE OF MANUFACTURER'S REPRESENTATIVE

A. The Contractor shall provide the services of a qualified manufacturer's technical representative who shall adequately supervise the installation and testing of all equipment furnished under this Contract and instruct the Contractor's personnel and the Owner's operating personnel in its maintenance and operation as outlined elsewhere in Division 1. The services of the manufacturer's representative shall be provided for a period of not less than as follows:

1. One trip of one (1) working day during installation of the equipment for each motor control center.

2. One trip of one (1) working day after acceptance of the equipment.

3. One trip of one (1) working day during the warranty period.

B. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor. The manufacturer's representative shall sign in and out at the office of the LFUCG Project Manager's Field Representative on each day he is at the project.

1.04 TRAINING

A. The Contractor shall provide training for Owner personnel. Training shall be conducted by the manufacturer's factory trained specialists who shall instruct Owner personnel in operation and maintenance of all equipment provided under this Section.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Control Equipment

1. “Schneider”, “Allen Bradley”, or equal.

B. Timers

1. “Paragon”, “Tork”, “Intermatic”, or equal.

2.02 MOTOR CONTROL CENTERS (MCC)

A. General

1. Quality of built-in transformers, starters, lighting panelboards, timers, etc. shall be as written elsewhere in this Division unless otherwise noted.

2. Motor Control Center(s) shall consist of one or more enclosed vertical sections joined together to form a rigid, free standing assembly. The construction of the Motor Control Center shall meet the requirements set forth by Underwriters’ Laboratories publication UL-845, NEMA publication number ICS-2-322, the National Electrical Code, and color coded.

3. The structure shall be UL listed and labeled as service equipment if applicable. All sections shall bear UL labels.

4. Enclosures shall be NEMA 1 unless otherwise indicated, and each control center suitable for connection to an available fault current of 65,000 RMS symmetrical amperes unless otherwise indicated on the Drawings.

B. Construction

1. Vertical Sections

a. Vertical sections shall support the horizontal and vertical buses, combination starter units, covers and doors, and shall be designed to allow for easy rearrangement of units by the purchaser. Vertical sections shall have structural supporting members formed of a minimum of 13 gauge hot-rolled steel. All finished surfaces shall be blemish-free. Where needed, reinforcement structural parts shall be of 10-gauge steel to provide a strong rigid assembly. Each section shall be 90 inches high and shall have 7 gauge steel, 3 inch high removable lifting angle and two 1 1/2 inch high base channels. Complete control center line-ups shall be divided into shipping splits no wider than approximately 60 inches. The lifting angle shall be provided on the top of each shipping split and shall extend the entire width of the shipping split. Lifting angles shall be designed to support the entire weight of the MCC section. Base channels shall be provided with holes to permit bolting the Motor Control Center(s) to the floor. The entire assembly shall be constructed and packaged to withstand all stresses induced in transit and during installation.

b. Motor Control Centers shall be designed so that matching vertical sections of the same current rating and manufacture can be added later at either end of the line-up without use of transition sections and without difficulty or undue expense. Removable end closing plates shall be provided to close off openings on the end of the Motor Control Center line-up. A removable top plate shall be provided on each vertical section and shall be of one-piece construction for added convenience in cutting

conduit holes. The design shall allow use of the standard conduit entrance area without significant sag or deformation of the top plate.

c. Vertical sections shall be designed to accommodate plug-on units in front-of-board or back-to-back construction as shown on Scope of Services. Vertical sections housing plug-on units shall be 20 inches wide and shall be 20 inches deep. Wider sections will be permitted only for bolted connection type units not fitting the 20-inch wide sections. Unit mounting area shall be divided into 1/2 space factor divisions, each approximately 6 inches. NEMA Size 1 and 2 combination starter units shall use only 1 space factor, or 12 inches, of unit mounting space. Vertical sections shall allow for 7 space factors of unit mounting space. Removable blank plates shall cover all unused unit-mounting spaces. Blank plates shall be flanged on all 4 sides and shall be mounted with captive screws. Blank space shall be equipped for future use.

d. Vertical sections shall be provided with both horizontal and vertical wireways. Sufficient clearances shall be provided in the horizontal wireway so that no restriction is encountered in running wires from the vertical to horizontal wireway. Wireways shall be in accordance with the wireway sections contained in this document.

2. Horizontal Wireways

a. Horizontal wireways shall be provided in the top and bottom of each vertical section as indicated in the Scope of Services and shall be arranged to provide full-length continuity throughout the entire assembly. The top horizontal wireway shall have a cross sectional area of not less than 20 square inches with openings between sections of not less than 11/2 square inches. The bottom horizontal wireway shall extend through the length and depth of the vertical sections and shall also be provided with openings of not less than 11/2 square inches to allow for full length continuity throughout the entire assembly. The bottom horizontal wireway height shall be not less than 9 1/4 inches. Covers for all wireways shall be equipped with captive type screws to prevent loss of hardware during installation. All wireways shall be isolated from the bus bars.

3. Vertical Wireways

a. A vertical wire trough shall be located on the right -hand side of each vertical section and shall extend from the top horizontal wireway to the bottom of the available unit mounting space. Each vertical wire trough shall have a cross sectional area of not less than 19 square inches and shall be isolated from the bus bars to guard against accidental contact. A separately hinged door having captive type screws shall cover the vertical wire trough to provide easy access to control wiring without disturbing control units.

b. Reusable wire ties shall be furnished in each vertical wire trough for the purpose of grouping and securely holding wires in place for a neat and orderly installation.

4. Busbars

a. A continuous main three-conductor horizontal bus shall be provided over the full length of the control center. A fully rated horizontal neutral bus (1200 ampere maximum) shall also be supplied over the full length of the Motor Control Center. When necessary, the bus shall be split to allow for ease in moving and handling. Splice bars will be supplied to join the bus wherever a split has been made. All splice connections shall be made with at least two bolts and shall employ the use of Belleville washers in the connection. Horizontal bus bars shall be mounted edgewise and supported by insulated bus supports.

b. For distribution of power from the main horizontal bus to each unit compartment, a three-phase vertical bus shall be provided. The vertical bus shall be firmly bolted to the horizontal bus for permanent contact.

c. The main horizontal and vertical buses shall be made of copper and the entire length shall be electrolytically tin plated to provide maximum protection to the bus bars from normal or adverse atmospheric conditions.

d. Bus supports shall be formed of high strength glass reinforced alkyd material. Bus supports shall have generous surface clearances in the vertical plane to shed dust and maintain dielectric integrity. Bus supports and insulators shall be red to indicate proximity of energized bus parts.

e. Horizontal and vertical buses shall have continuous current ratings adequate to handle all loads as shown on the one line diagram in the Scope of Services. Continuous current ratings shall be in accordance with temperature rise specifications established by UL, ANSI, and NEMA standards.

f. A copper ground lug shall be provided in each incoming line vertical section capable of accepting a #8 to 250 MCM cable. A horizontal copper grounding bus shall be provided in each section of the Motor Control Center. Horizontal grounding bus shall run continuously throughout the control center except where splits are necessary for ease of shipment and handling in which case splice bars shall be provided. Grounding bus shall be tin plated copper and have a cross sectional area equal to 28% of the main horizontal bus cross sectional area. Horizontal ground bus shall be located at the bottom of the Motor Control Center.

5. Bus Barriers

a. Insulated horizontal and vertical bus barriers shall be furnished to reduce the hazard of accidental contact with the bus. Barriers shall have a red color to indicate proximity of energized buses. Vertical bus barriers shall have interlocking front and back pieces to give added protection on all sides and shall segregate the phases to reduce the possibility of accidental “flash over”. Small, separate openings in the vertical bus barriers shall permit unit plug-on contacts to pass through and engage the vertical bus bars. Bottom bus covers shall be provided below the vertical bus to protect the ends of the bus from accidental contact with fish tapes or other items entering from the bottom of the enclosure.

b. Isolation of unused stab openings shall be accomplished by use of a manual shutter to close off the stab opening. These shutters shall be attached to the structure so that when they are removed (to allow a stab connection) they are retained in the structure and are readily accessible for use should a plug-in unit be removed from the motor control center.

6. Main Incoming Lug Compartment

a. A front accessible main lug compartment shall be provided with suitable main lugs to accommodate the number of cables per phase as indicated on the Scope of Services. The compartment shall be located in the top most or bottom most unit space of the section to accommodate the user’s cables entering the Motor Control Center as indicated on the Scope of Services. The main incoming lug compartment shall be covered by a hinged door for maintenance access. This door shall be held closed with captive type screws to discourage unauthorized access. (A unit door padlock attachment shall also be provided to lock the door in the closed position with one 5/16 inch diameter shackle padlock. This attachment shall also accept a meter type seal.)

7. Units

   a. Combination starter units shall consist of Size 1 minimum full voltage magnetic starters, molded case magnetic-only circuit breakers, and auxiliary control devices, as required and/or shown on the one-line and elementary diagrams. Pilot light assemblies (push-to-test) shall be 30 mm LED. All auxiliary equipment, except that which is specified for mounting on the door, shall be mounted within the compartment. All units shall be provided with unit doors, unit support pans, unit saddles and unit disconnect operators as outlined in this Specification. Each unit compartment shall be enclosed and isolated from adjacent units, buses and wireways except for openings for conductor entrance into units. Units shall be designed and constructed so that any fault will be localized within the compartment. All units shall be UL listed for minimum of 65,000 amperes RMS symmetrical fault withstand ability unless otherwise indicated on the Drawings.

   b. Plug-on combination starter units of the same NEMA size and branch feeder units of the same trip size shall be readily interchangeable with each other. It shall be possible to withdraw each plug-on unit to a de-energized position with the unit still being supported by the structure. It shall be possible to lock the unit in this position with one padlock.

   c. Full voltage non-reversing combination starter units shall have the following minimum space factor requirements, shall be provided with plug-on connections and shall be provided with ample space for customer wiring room:

	Circuit Breaker Space Factor
Size 1	1
Size 2	1
Size 3	1 1/2
Size 4	2

8. Unit Plug-On

   a. For convenient unit connection to bus bars, unit plug-on contacts shall be provided on the following units:

      1) For circuit breaker type units; full voltage starters, size 4 and smaller; auto-transformer reduced voltage starters, size 4 and smaller; part winding reduced voltage starters, size 4PW and smaller; branch circuit units, 225 ampere and smaller.

   b. The plug-on connection for each phase shall be of a high quality two- point connection and shall be designed to tighten around the vertical bus bar during a heavy current surge. For trouble-free connections, the plug-on fingers shall be silver plated and coated with a compound to assure a low resistance connection. Contact fingers shall be of a floating and self-aligning design to allow solid seating onto the vertical bus bars.

   c. Starters NEMA size 4 and larger shall bolt directly to the vertical bus bars, circuit breakers rated higher than 225 amps shall also bolt directly to the bus bars.

9. Unit Doors

   a. Each unit shall have a door securely mounted with rugged concealed-type hinges which allow the door to swing open a minimum of 112° for unit maintenance and withdrawal. Doors shall be fastened to the structure so that they remain in place when a unit is withdrawn and may be closed to cover the unit space when the unit has been temporarily removed. Doors shall be held closed with captive type screws

which engage self-aligning cage nuts. These screws shall provide at least two threads of engagement to hold doors closed under fault conditions. Each unit door shall be interlocked with its disconnect mechanism to prevent the door from opening when the unit is energized. A defeater mechanism shall be provided for defeating this interlock by authorized personnel. Removable door panels held with captive type screws shall be provided on starter unit doors for mounting push buttons, selector switches or pilot lights. Blank door panels capable of accepting future pilot devices shall be furnished when pilot devices are not originally specified for starter units. Each starter unit door shall house an external low-profile overload reset button for resetting the overload relay in the event of tripping.

10. Unit Support Pan

    a. Each plug-on unit shall be supported and guided by a tilt and lift-out removable pan so that unit rearrangement can be easily accomplished. For easy unit installation and rearrangement, transfer of this unit support pan from one location to another shall be accomplished with ease after the control unit and door have been removed.

11. Unit Saddles

    a. Each plug-on unit shall have a saddle of 14 gauge hot rolled steel designed and constructed to physically isolate the unit from the bus compartment and adjacent units. Saddlers shall be equipped with captive, self-aligning mounting screws which shall hold the unit securely in place during shipment. Flanged edges shall be provided on each saddle to facilitate unit removal.

12. Disconnect Operators

    a. An external operator handle shall be supplied for each switch or breaker. This mechanism shall be engaged with the switch or breaker at all times regardless of unit door position to prevent false circuit indication. The operator handle shall be color coded to display red in the “ON” position and black in the “OFF” position. The operator handle shall have a conventional up-down motion and shall be designed so that the down position will indicate the unit is “OFF”. For added safety it shall be possible to lock this handle in the “OFF” position with up to three padlocks. The operator handle shall be interlocked with the unit door to prevent switching the unit to “ON” while the unit door is open. A defeater mechanism shall be provided for the purpose of defeating this interlock by a deliberate act of an electrician should he desire to observe the operation of the operator handle assembly or the unit components. Operators shall not be higher than 6'-6" above finished floor elevation, as installed.

13. Wiring

    a. The motor control center wiring shall be NEMA Class II, Type B.

    b. All wiring to the terminal strips from outside the MCC shall be made with spade type terminals of the proper size and rating for the wire used. Pull apart terminal blocks shall be provided in unit spaces of motor starters that contain field wiring energized from a remote source to comply with NEC Article 430-74.

    c. All control wiring shall be No. 14 AWG (minimum) labeled at each end in accordance with the wiring numbers shown on the accepted shop drawings. Power wiring shall be sized to suit the maximum horsepower rating of unit; No. 12 AWG (minimum). Wiring shall be type MTW rated for 105 C. Wire color coding shall be red for control and black for power. Wire numbers shall not be repeated in a motor control center.

14. Finish

    a. The finish shall be manufacturer's standard gray enamel applied over a rust inhibiting phosphate primer.

15. Optional Modifications and Accessories

    a. Additional modifications and accessories shall be as listed and specified on the Scope of Services.

16. Identification

    a. A control center identification nameplate describing section catalog numbers and characteristics shall be fastened on the vertical wire trough door of every section. Each control center unit shall have its own identification nameplate fastened to the unit saddle. These nameplates shall have suitable references to factory records for efficient communication with supplier. Each control center unit shall also have an engraved Bakelite nameplate fastened to the outside of each unit door inscribed as written on the Scope of Services for ease in identification and for making changes when regrouping units. An overall structure nameplate is also required.

17. Metering

    a. All voltmeters, ammeters, wattmeters, current transformers, potential transformers and phase selector switches shall be furnished as shown on the Scope of Services. Meter accuracy shall be $\pm$ 1 percent. Solid state metering shall be as specified this section.

18. Surge Protective Devices

    a. Specification Section 16280 – Surge Protective Devices for motor control center SPD requirements.

C. Starters and Overcurrent Protective Devices

1. Magnetic Starters

    a. Magnetic starters shall be furnished in all combination starter units unless otherwise indicated on Scope of Services. Starter Sizes 1 through 4 shall employ the use of a bell-crank lever design to transform vertical action of the armature into horizontal action of the contact carriers and thus minimize contact bounce and produce extra long contact life. Thermal overload relays on starters shall be ambient temperature compensated bimetallic type with selector for either auto or manual reset. Overload heater units shall be provided in each starter unit. Overload relay heater schedules shall be provided on each starter unit.

2. Circuit Breakers

    a. Type FA, KA, LA, MA and PA molded case circuit breakers shall be furnished in all starter and branch feeder units using circuit breakers as a disconnect means. All circuit breakers will have a push-to-trip test feature for testing and exercising the circuit breaker trip mechanism.

3. Starters shall conform to requirements listed under individually mounted Motor Control Devices, hereinafter.

D. Lighting Panelboards

1. Lighting panelboards shall be as specified in other section of this Division. Lighting panelboard unit doors shall be held closed with captive latches that may easily be operated without the use of tools, i.e., wing nuts, handle, etc.

E. Transformers

1. 480 volt primary, 120/240 volt or 120/208 volt secondary transformers shall be as specified in other sections of this Division.

2.03 INDIVIDUALLY MOUNTED MOTOR CONTROL DEVICES (480, 240, OR 120 VOLT)

A. General

1. All motor control equipment shall be new and the product of 1 manufacturer. All individually mounted disconnects, push-button stations, latchout stations, starters, etc., indoors shall be mounted on a 1 inch galvanized unistrut, 1 inch Kindorf channel, or equal to provide an air space at rear. Outside mounted equipment shall utilize 1-inch aluminum strut as required in 16070.

B. Starters

1. General

a. All starters shall be of the voltage rating, type, and sized for the motor size shown in these Specifications and/or on the Scope of Services. For enclosure type see the system operation description and/or the Scope of Services. All starters shall be of the magnetic type. Should a piece of electrically driven equipment be furnished with a larger motor than shown on the Scope of Services, the proper size combination starter shall be provided for the equipment supplied, at no extra cost to the Owner.

b. See the Scope of Services for the auxiliary equipment to be furnished and/or Section 16900 - Controls of this division. **Maximum control voltage shall be 120 volts, a-c.** Minimum starter size shall be NEMA Size 1.

2. Overloads

a. Each starter shall have a thermal overload device in each ungrounded leg. The overload shall be of the “Ambient compensated Bi-metallic”, thermal element type or solid state. All overloads shall be of the manual reset type and shall be reset without opening the starter enclosure. Heaters will be sized for the proper temperature rise of the motor that it is being used on. Heaters for general service shall be of the standard trip type. All integral horsepower motors, 15 horsepower and over, require thermal elements embedded in the windings. See Motor Specifications, this division.

3. Contactors

a. All contactors for motor starters shall be of the a-c magnetic type with “undervoltage” protection when used in conjunction with momentary contact push-button control and “undervoltage” release when used with maintained contact push-button control.

b. Contactor size shall be in accordance with NEMA Standards for the motor controlled and shall be horsepower rated. IEC rated equipment is not acceptable and shall be used as a basis for rejection of the equipment.

c. Contacts shall be of the heavy duty silver-to-silver type and shall be totally enclosed in individual arc quenching chambers. Contacts shall be easily accessible for replacement.

d. The contactor coil shall be of the vacuum impregnated or epoxy resin type, moisture resistant and corrosion proof.

C. Control Stations

1. General

a. Control stations shall be heavy duty, maintained or momentary contact type, as noted on the Scope of Services. Contacts shall be silver alloy, double break type. The number and marking of controls shall be as shown on the Scope of Services. Enclosures shall be NEMA 4X for indoor and outdoor mounting, unless otherwise noted on the Scope of Services. All control stations shall operate on 120 volt, a-c maximum, unless otherwise designated on the Scope of Services. “Latch-out” facilities shall be provided where called for in these Specifications and/or on the Scope of Services.

2. Maintained Contact

a. Maintained contact control switches shall be marked “On” and “Off”. The button pushed shall remain in and push the other button out until the other button is pushed. In general, they are to be used for hand control of motors which have to operate continuously and restart whenever power is off then resumed, without any manual operator. This is needed for motors which have to operate continuously in the absence of an operator.

3. Momentary Contact

a. Momentary contact control push-button switches shall be marked “start” and “stop”. Pushbuttons shall spring out whenever pushed. If the circuit is dropped for any reason, operation cannot be resumed until a “start” push-button is pushed. In general, they are to be used for hand control of motors which are desired to operate intermittently in the presence of the operator and stop and start independently from more than one parallel control location.

D. Circuit Breakers

1. Circuit breakers shall be molded case type. Trip elements of multi-pole breakers shall be effectively insulated from one another. Multi-pole breakers shall be designed so that an overload on any one pole shall open all poles simultaneously.

2. The breaker operating mechanism shall be the quick-make, quick-break type and shall be entirely trip free to prevent the contacts being held in a closed position against a short circuit.

3. Breakers not used with motor starters shall be of the thermal magnetic type with a thermal bimetallic element for time delayed overload protection and a magnetic element for short circuit protection.

4. The breaker shall be trip indicating with the trip position midway between the “On” and “Off” positions.

5. Breakers for combination starters shall be 100 amp frame or larger. All breakers for combination starters shall have an adjustable magnetic trip element of the motor circuit protector type.

6. Breakers for combination starters shall be F frame or larger. All breakers shall have adjustable magnetic trip elements. Circuit breakers K frame and larger shall have interchangeable thermal-magnetic trip elements.

E. Selector Switches

1. Hand-off-automatic type selector switches shall be of oil-tight construction and shall have 3 positions. The switch must not have a spring loaded return. It shall be of the “quick-make”, “quick-break” type.

F. Manual Motor Starting Switches

1. Manual motor starting switches for the control of fractional horsepower motors shall be single pole, and shall be provided with a thermal heater of the correct size for the load controlled. Each starting switch shall be mounted where shown on the Scope of Services. Where they are used for rotating equipment such as grinders, they shall be equipped with low voltage protection, and required manual reset after power failure. As an alternate to low voltage protection built-in, a “Safety Restart Plug” may be utilized, available from Mitchell Instrument Company.

G. Alarm Horns

1. Alarm horns, where called for on the Scope of Services, shall be weatherproof, suitable for surface mounting and shall be provided with a silence button. Alarm horn shall be Edwards 876 series with 103dB at 10 feet, Federal Signal, or equal.

H. Timing Relays

1. Time delay relays shall have an adjustable timing range as shown on the Scope of Services. The time delay shall be after energizing timer coil. Timing relays shall be Agastat, Square D, or equal.

2.04 TIMERS

A. Timers for various services required in the motor control equipment shall be Paragon, Tork or equal as indicated in control circuits shown on the Drawings.

B. Timers requiring tripping pins shall be supplied with enough pins to completely fill all locations on the dial face.

2.05 NETWORKABLE POWER METER

A. The metering unit shall contain self-powered status inputs capable of detecting dry contact closure.

B. The metering unit shall be capable of directly communicating via Ethernet without any modifications. Intermediate bridges or gateways are not acceptable.

C. The meter shall be supplied with a separate display unit. If a separate unit is supplied, the display shall be rated for NEMA 4 indoor use. The separate display unit shall be connected to the base unit utilizing an Ethernet switch and Category 6 cable. All metering data, logs, and harmonic information contained within the meter shall be accessible via the display unit.

D. The following logs shall be contained within the unit with a nominal date/time stamping resolution of 0.01 seconds. The unit shall maintain all logs and configuration parameters in the event of loss of control power.

1. Min/Max log capable of retaining and displaying the minimum- and maximum-recorded values for all real-time power system parameters.

2. Snapshot log – A user configurable time/event driven based log.

3. Event logs – Configurable to user defined measurable events. The unit shall be capable of retaining the most recent 100 events.

E. Setpoints. The metering unit shall have the ability to date/time stamp excursions beyond user-defined values for multiple parameters. These setpoint excursions shall be capable of triggering a log entry into the event log, triggering an oscillographic recording, and/or energizing one of the meter's onboard relays.

F. Oscillographic waveforms shall be available as (1) simultaneous, with all channels recorded for at least two cycles; and (2) user configurable with at least 75% cycles of pre-trigger data. Oscillographic recordings can be either manually triggered or internally triggered from a setpoint or event.

G The metering unit and all accessories shall be listed and/or certified by UL, CSA, and CE and built in accordance with ISO 9000.

H. The following power monitoring device is approved – no substitutions:

1. Allen-Bradley Powermonitor-5000 M5

PART 3 - EXECUTION

3.01 INSTALLATION/APPLICATION/ERECTION

A. Motor Control Centers

1. Ends of MCC(s) shall be closed with 1/4" mesh hardware cloth and galvanized or aluminized insect screen or sill covers to prevent the entrance of rodents and large insects into the MCC housing(s).

2. Each MCC shall be provided with a 4" high concrete pad.

3. Lifting-eyes in tops of MCC(s) section shall be removed (and retained) and the threaded openings closed with stainless cap screws and plastic washers or plastic seals provided for that purpose by the MCC(s) manufacturer.

4. In installations where conduit runs to electrical equipment emanate from the top of MCC(s) there shall be provided additional wiring space in the form of metal trough(s) of the same metal housing(s) dimensions and details. Trough(s) shall be provided by the manufacturer of the MCC(s).

B. Individually Mounted Motor Control Devices (480, 240, or 120 Volt)

1. Each motor disconnect shall be located as near as possible to its respective motor.

2. Remote control station at or near motor shall be mounted near its respective motor, adjacent to the motor disconnect.

3. All devices and equipment furnished under this section (electronic circuit monitors, power correction equipment, etc.) shall be programmed, configured, and calibrated by the manufacturer. Any settings required shall be as determined by the manufacturer. If coordination studies or power system analysis is required, it shall be performed by the manufacturer.

3.02 EXTRA STOCK/SPARE PARTS

A. Provide the following spare parts:

10 fuses of each type/amperage used

1 pilot light lamp for each pilot light socket assembly provided

1 control transformer for each size utilized

END OF SECTION

SECTION 16446 - VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.01 REFERENCES

A. The drive shall be designed to meet the following specifications:

1. NFPA 70 - US National Electrical Code
2. NEMA ICS 3.1 - Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems
3. NEMA 250 - Enclosures for Electrical Equipment
4. UL 508C – Underwriter's Laboratory
5. CAN/CSA-C22 No. 14-M91 - Canadian Standards Association
6. IEC 146 - International Electrical Code

1.02 REGULATORY REQUIREMENTS

A. The drive shall conform to the following requirements:

1. NFPA 70
2. IEC 146
3. EN Standard/CE marked for EMC directives

Emissions	Immunity
EN 50081-1	EN 50082-1
EN 50081-2	EN 50082-2
EN 55011 Class A	IEC 801-1,2,3,4,6,8
EN 55011 Class B	(per EN 50082-1,2)

4. EN Standard/CE marked for Low Voltage directives

   EN 60204-1
   PREN 50178

5. IEC 801
6. C-UL marking to provide an approved listing for both United States and Canadian users.

1.03 QUALIFICATIONS

A. Manufacturer: The drive manufacturer shall have been in the drive business continuously for a minimum of 15 years and specialize in the design and manufacturing of PWM Adjustable Frequency Drives.

B. Support: The drive manufacturer shall maintain factory trained and authorized service facilities for their drives within 100 miles of the project and have a demonstrated record of service for at least the previous three years. Full-time support personnel shall be employed by the drive manufacturer.

C. Certification: All drives must be assembled at locations that are certified to the ISO-9001 Series of Quality Standards. This insures all quality and corrective action procedures are documented and implemented with a goal of Total Customer Satisfaction.

D. The drives must not generate harmonics to the line exceeding IEEE 519 limits of 5% of fundamental for current and voltage.

E. Floor space is critical, so any product offered by the Contractor must fit in the allocated space as shown on the Drawings.

1.04 SUBMITTALS

A. In addition to normal documentation, shop drawings shall include a harmonics analysis calculated at full load in accordance with Section 8 of IEEE 519. The analysis shall show that sufficient filtering has been provided to limit the total harmonic distortion (THD) to 5% for current and voltage.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. “Schneider”, “Allen Bradley”, or approved equal.

2.02 RATINGS

A. Input Power: The drive is self-adjustable to accept an input voltage range between 200-240/380-480/500-600VAC, three phase +/-10%.

B. Displacement power factor shall range between 1.0 and 0.95, lagging, over the entire speed range (0.80 for 0.5-5hp/0.37-3.7kW, 200-480V drives). The efficiency of the drive shall be a minimum of 97% at full load and speed.

C. Environment: Storage ambient temperature range: -40 to 70 C (-40 to 158 F). Operating ambient temperature range: 0 to 40 C (0 to 109 F) without derating. The relative humidity range is 5% to 95% non-condensing.

D. Operating elevation: up to 1000 Meters (3,300ft) without derating.

E. Output Power: The output voltage is adjustable from 0 to rated input voltage. The output frequency range is adjustable from 0 to 400 Hz. The inverter section will produce a pulse width modulated (PWM) waveform using latest generation IGBTs.

2.03 DESIGN

A. Hardware: The drive hardware shall employ the following power components:

1. Diode or fully gated bridge on the input.

2. DC bus inductor on all ratings 5.5kW (7.5HP) or greater.

3. Switching logic power supply operating from the DC bus.

4. Phase to phase and phase to ground MOV protection.

5. Gold plated plug-in connections on printed circuit boards.

6. Microprocessor based inverter logic isolated from power circuits.

7. Latest generation IGBT inverter section.

8. Inverter section shall not require commutation capacitors.

9. Customer Interface common for all horsepower ratings. Interface shall include an LCD digital display, programming keypad and operator keys option.

10. Main Control Board common for 5.5kW (7.5HP) and up.

11. Common control connection for all ratings.

12. Optimized for 4kHz carrier frequency at 44kW (60HP) or less, and 2kHz at 55kW (75 HP) and larger.

13. Peripheral Interface to enable attaching common options.

B. Control Logic: The drive shall be programmable or self adjusting for operation under the following conditions:

1. Operate drive with motor disconnected.

2. Controlled shut down, when properly fused, with no component failure in the event of an output phase to phase or phase to ground short circuit and annunciation of the fault condition.

3. Adjustable PWM carrier frequency within a range of 2-8kHz.

4. Selectable Sensorless Vector or V/Hz mode.

5. Selectable for variable or constant torque loads. Selection of variable torque provides 115% of rated VT current for up to one minute. Selection of constant torque provides 150% of rated CT current for up to one minute.

6. Multiple programmable stop modes including - Ramp, Coast, DC-Brake, Ramp-to-Hold and S-curve.

7. Multiple acceleration and deceleration rates.

8. All adjustments to be made with the door closed.

9. Adjustable output frequency up to 400Hz.

C. The VFD manufacturer shall utilize Low Pass shunt type harmonic filters within each drive cabinet enclosure. The filters shall be a second order high pass design utilizing line reactors, capacitors, and bleed resistors. Filter capacitors shall be sequenced (applied/disconnected) using a contactor, which is controlled by the VFD. The VFD shall control the capacitor contactor as a function of drive loading. The VFD shall disconnect the filter capacitors during off conditions of the VFD. The compensation kVAR shall be matched to the kVAR demand such that the true power factor does not exceed 0.95 lagging. The capacitors shall not affect

steady state operation of the VFD while operating from either utility or generator power. The switch-in of the filter shall not create power source transient disturbances which cause shutdown of other VFD equipment already on-line. Capacitor voltage rating shall be 600 Volts for operation on a nominal 480 Volt system.

D. Power Conditioning: The drive shall be designed to operate on an AC line which may contain line notching and up to 10% harmonic distortion. An input isolation transformer shall not be required for protection from normal line transients. If line conditions dictate the use of a transformer, the K factor shall be 4.0 or less.

2.04 FEATURES

A. Interface: The drive shall provide a removable Human Interface Module with integral display to show drive operating conditions, adjustments and fault indications. The display shall be removable under power without causing a fault and is visible and operable without opening the enclosure door. The display shall consist of 2 lines of 16 character alphanumeric, backlit LCD with the display being configurable for simultaneously displaying two values using customized multi-lingual text and user scaled units. The module shall provide LED indication of drive direction and commanded direction. The display shall be capable of remote mounting by means of cable connection up to 10 meters (33ft) from the drive and is capable of being used as a hand-held terminal.

B. Control Mode: Programming shall provide the ability to select sensorless vector or v/hz mode. The sensorless vector mode shall use motor nameplate data plus motor operating data, such as IR drop, nominal flux current and flux up time. The volts per hertz mode shall be able to be programmed for squared, cubed, straight line, pre programmed or full custom patterns.

C. Current Limit: Programmable current limit shall be available from 20% to 160% of constant torque rating. Current limit shall be active for all drive states; accelerating, constant speed and decelerating. The drive shall employ PI regulation with an adjustable gain for smooth transition in and out of current limit.

D. Acceleration/Deceleration: Accel/Decel settings shall provide separate adjustments to allow either setting to be adjusted from 0 seconds to 3600 seconds. A second set of remotely selectable Accel/Decel settings shall be accessible with Control Interface option. An adaptive current limit circuit shall be able to be disabled in programming for fast acceleration of low inertia loads.

E. Speed Regulation: The programmable speed regulation modes shall include the following:

1. Open Loop
2. Slip Compensation with 0.5% speed regulation
3. Droop - Negative Slip Compensation with 0.5% speed regulation
4. Traverse Function
5. Closed loop encoder feedback with 0.1% speed regulation
6. Process PI control

F. Speed Profiles: Programming capability shall allow the user to produce speed profiles with linear acceleration/deceleration or "S-Curve" profiles that provide changing accel/decel rates. S-Curve profiles shall be selectable for fixed or adjustable values.

G. Adjustments: The digital interface shall be provided for all set-up, operation and adjustment settings. All adjustments are shall be stored in nonvolatile memory (EEPROM). Potentiometer adjustments are not acceptable. The drive shall provide EEPROM memory for factory default values.

H. Process PI Control: An internal process PI regulator shall have both proportional and integral gain adjustments as well as error inversion and output clamping functions. The feedback may be configured for normal or square root functions. If the feedback indicates that the process is moving away from the setpoint, the regulator will adjust the drive output until the feedback equals the reference. Process control shall be enabled or disabled with a hardwire input. Transitioning in and out of process control shall be able to be tuned for faster response by preloading the integrator. Protection shall be provided for a loss of feedback or reference signal.

I. Fault Reset/Run: The drive shall have the ability to conduct up to nine automatic fault reset and restarts following a fault condition before locking out and requiring manual restart. The automatic mode is not applicable to a ground fault, shorted output faults and other internal microprocessor faults. The time between restarts shall be adjustable from 0.5 seconds to 30 seconds.

J. Skip Frequencies: The drive shall contain three adjustable set points that lock out continuous operation at frequencies which may produce mechanical resonance. The set points shall have a bandwidth adjustable from 0Hz to 15Hz.

K. Run On Power Up: A user programmable restart function shall be provided to automatically restart the equipment after restoration of power after an outage. A maintained 2-wire start input is required for this function.

L. Line Loss Restart: This programmable function shall be provided to select the reconnect mode of the drive after recovery from a line loss condition. The reconnect modes shall be B Last Speed, Speed Search, Track Volts, or Use Encoder. Disabling this feature shall force the drive to start from zero hertz.

M. Fault Memory: The last four faults as well as operating frequency, drive status and power mode shall be stored at the time of fault. Information shall be maintained in the event of a power loss.

N. Overload Protection: The drive shall provide Class 20 motor overload protection investigated by UL to comply with N.E.C. Article 430. Overload protection shall be speed sensitive and adjustable for motors with speed ranges of 2:1, 4:1 and 10:1. A viewable parameter shall store the overload usage in percent. An alarm bit can be used to adjust a process to eliminate an overload trip.

O. Auto Economizer: This feature shall automatically reduce the output voltage when the drive is operating in an idle mode (drive output current less than programmed motor FLA). The voltage shall be reduced to minimize flux current in a lightly loaded motor thus reducing kW usage. If the load increases, the drive shall automatically return to normal operation.

P. Terminal Blocks: Separate terminal blocks shall be provided for control and power wiring.

Q. Flying Start: The drive is shall be capable of determining the speed and direction of a spinning motor and adjust its output to "pick-up" the motor at the rotating speed. The flying start feature shall be operable with or without encoder feedback.

R. Ride Through: The control logic shall be capable of "riding through" a power outage of up to 2 seconds in duration.

S. Analog Output: An output signal shall be provided and be jumper selectable for 0 - 10V DC or 0 - 20 mA which is user programmable such that it is proportional to one of 13 process parameters including output frequency, output current, encoder feedback, output power and others. A programmable offset shall be provided to allow modification of the analog output to obtain 2 - 10V DC or 4 - 20 mA. Programmable gain adjustments for both upper and lower settings shall allow for system calibration.

T. Reference Signals: The drive shall be capable of the following input reference signals:

Digital pulse input	Digital MOP
Remote potentiometer	Serial
10V DC	HIM (Program/Control panel)
4-20 mA	

U. Loss of Reference: In the event of loss of the 4 - 20 mA reference signal, the drive shall be user programmable to the following:

Fault and stop
Alarm and maintain last reference within 10%
Alarm and go to preset speed
Alarm and go to minimum speed
Alarm and go to maximum speed
Active for Process PI reference or feedback

V. Digital I/O: Contact output ratings shall be 115V AC/30V DC, 5.0 Amp resistive, 2.0 Amp inductive. All four contacts provided shall be programmable to 17 different conditions. Factory settings shall be as follows:

Form A Run contact
Form C Fault contact
Form C Alarm contact
Form A at Speed contact

W. Operator Devices, and Control Interface: Provide start and stop controls integrally with the drive. Also provide control interface cards as required to accommodate the external control deices shown in Control Circuits.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with manufacturer’s recommendations, except as modified herein.

B. Drives shall be adjusted such that maximum speed is motor nameplate RPM, and minimum speed is just high enough to provided motor driven equipment cooling.

3.02 START-UP, TRAINING, AND TESTING

A. The drive manufacturer shall provided factory authorized, trained service personnel for start-up and testing. Upon successful completion of installation and testing, training shall be provided in accordance with 16050.

3.03 TOOLS AND SPARE PARTS

A. Any special tools required for normal operation and maintenance shall be provided by the equipment manufacturer.

B. Furnish the following spare parts:

1. Ten fuses for each type used.

2. Ten lamps for each type used.

END OF SECTION

SECTION 16460 - SMALL POWER AND MISCELLANEOUS TRANSFORMERS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Transformer locations and size shall be as shown on the Scope of Services, as specified herein.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. “Schneider”, or approved equal.

2.02 FABRICATION

A. General Purpose Dry-Type Transformers

1. Single phase transformers shall be 480 volt primary and 120/240 volt secondary. Three phase transformers shall be 480 volts delta primary and 208 Y/120 or 240 volt delta secondary. Transformers 25 KVA and larger shall have a minimum of 4 (2 above, 2 below) 2 1/2 percent full capacity primary taps.

2. Transformers shall be 150 degrees Celsius temperature rise above a 40 degrees Celsius ambient. All insulating materials are to be in accordance with the latest NEMA Standards for a 220 degrees Celsius UL recognized insulation system.

3. Transformer coils shall be of the continuous wire wound construction and shall be impregnated with non-hygroscopic, thermo-setting varnish. The coils shall also have a final wrap of electrical insulating material to prevent mechanical injury to the wire as well as increasing the electrical breakdown strength.

4. All cores shall be constructed of high grade, non-aging silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below the saturation point. The core laminations shall be clamped together with steel angles. The completed core and coil shall then be bolted to the base of the enclosure but isolated from the base by means of rubber, vibration absorbing mounts. There shall be no metal-to-metal contact between the core and coil to the enclosure. On transformers 500 KVA and smaller, the vibration isolation system shall be designed to provide a permanent fastening of the core and coil to the enclosure. To further facilitate vibration and noise isolation, the final section of conduit to the transformer shall be flexible.

5. Transformers 25 KVA and larger shall be in heavy gauge, sheet steel, ventilated enclosures. The ventilating openings shall be designed to prevent accidental access to live parts in accordance with UL, NEMA, and National Electrical Code Standards for ventilated enclosures. Transformers 25 KVA through 75 KVA shall be designed so they can either be floor or wall mounted. Above 75 KVA they shall be of the floor mounted design.

6. The entire transformer enclosure shall be degreased, cleaned, phosphatized, primed, and finished in the same color as the motor control equipment. For more details see Division 9 of these Specifications.

7. The maximum temperature of the top of the enclosure shall not exceed 50 degrees Celsius rise above a 40 degrees Celsius ambient.

8. The core of the transformer shall be visibly grounded to the enclosure by means of a flexible grounding conductor sized in accordance with NEMA and NEC Standards.

9. The transformer shall be marked “DANGER HIGH VOLTAGE” with labels specified in the section on marking, this Division.

10. The transformers shall be manufactured to requirements of applicable standards, especially as they apply to noise level and surface temperatures.

PART 3 - EXECUTION

3.01 INSTALLATION / APPLICATION / ERECTION

A. Transformers shall be rigidly mounted to the structure or the foundation in the case of freestanding units.

B. Transformers shall be megger tested prior to energization.

C. Transformers with taps shall be adjusted to supply the nominal service voltage required on the secondary.

D. Transformers shall be installed in accordance with NEC requirements and manufacturer recommendations.

END OF SECTION

SECTION 16495 - SWITCHBOARD MATTING

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Switchboard matting shall be furnished by the Contractor and placed in front of all power distribution and control equipment.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Switchboard matting shall be W.H. Salisbury & Company, Wearwell, Erico, or equal.

2.02 MATERIALS

A. Switchboard matting shall be nonconductive with a minimum of 40,000 volts dielectric strength. The mat shall have a corrugated, non-slip surface and shall be a minimum of 1/4 inch thick. Width shall be 36 inches and length shall be as required at each location. The mat shall be black in color, ozone and oil resistant, and manufactured to meet all applicable ANSI/ASTM standards.

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 16496 - AUTOMATIC TRANSFER SWITCH

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, connect, test and place in satisfactory operation automatic transfer switches as specified herein and indicated in Drawings.

B. All devices and components of the automatic transfer switch shall be NEMA rated. IEC rated devices are unacceptable and shall be cause for rejection of the submittals/equipment.

1.02 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required include, but are not limited to:

1. Witnessed Shop Tests

    a. None required

2. Certified Shop Tests and Reports

    a. Automatic transfer switches shall be given routine factory tests. The factory tests shall demonstrate that the completed switches function correctly and that the required timing has been set. Certification of these settings shall be submitted to the LFUCG Project Manager upon request.

    b. Test procedures shall be in accordance with UL-1008. During the 30 cycle withstand tests, there shall be no contact welding or damage.

    c. The thirty cycle tests shall be performed without the use of current limiting fuses.

    d. Oscillograph traces across the main contacts shall verify that contact separation has not occurred and there is contact continuity across all phases after completion of the test.

    e. When conducting temperature rise tests in accordance with UL-1008, include post-endurance temperature rise tests to verify the ability of the transfer switch to carry full rated current after completing the overload and endurance tests.

    f. Manufacturer shall submit test reports upon request.

3. Field Tests

    a. Electrical contractor shall establish conductor phasing prior to testing.

    b. Prior to performance testing, transfer switch field technician shall:

        1) Program all time delays.

        2) Program all parameter threshold setpoints.

        3) Check all field power wiring.

        4) Coordinate with Electrical Contractor to verify correct termination points for all SCADA signals required by the Contract.

5) For those installations utilizing network communications, the field technician shall coordinate with system integrator to establish communication link is functional.

c. Transfer switch field technician shall execute unloaded test simulation by performing no-load test from transfer switch. Upon completion of simulated test, note generator cool down operation.

d. Transfer switch field technician shall execute loaded test from transfer switch to power the maximum facility load that can be exercised at the time of the test. The technician shall:

1) Confirm all metering data is displayed correctly.

2) Confirm switch position status and source status indicators display correctly.

3) Confirm all delay timing functions operated properly.

4) Coordinate with Electrical Contractor to verify transmission of SCADA signals.

e. During load test, Electrical Contractor shall perform infrared scanning of power wiring terminations and document results.

f. Failure of the transfer switch to operate properly during tests shall be corrected and the test repeated.

1.03 SUBMITTALS

A. In accordance with the procedures and requirements established by the LFUCG Project Manager, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings

2. Operation and Maintenance Manuals

3. Spare Parts Lists

4. Special Tools List

5. Reports of certified shop tests shall be submitted which indicates a closing and withstand ampere rating as required based on short circuit study requirements. Rating shall be symmetrical, 30 cycles at 480 VAC.

6. Report indicating transfer switch performance testing was completed satisfactorily including a data sheet with the values of all programmed parameters as left upon completion of testing.

7. Guarantee/Warranty Program

B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete or illegible submittals will be returned to the Contractor for resubmittal without review.

C. Shop drawings for each automatic transfer switch shall include but not be limited to:

1. Product data sheets.

2. Complete assembly, layout, and installation drawings with clearly marked dimensions and conduit entrance locations.

3. Example equipment nameplate data sheet.

4. Complete internal schematic and interconnecting wiring diagrams. Standard wiring diagrams that are not custom created by the manufacturer for the automatic transfer switch for this project are not acceptable.

5. Nameplate schedule.

6. Manufacturer's standard installation instructions.

7. Manufacturer's standard warranty.

D. The shop drawing information shall be complete and organized in such a way that the LFUCG Project Manager can determine if the requirements of these specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

E. Prior to completion and final acceptance of the project, the Contractor shall furnish and install "as-built" wiring diagrams for each automatic transfer switch. These final drawings shall be plastic laminated and securely placed inside each transfer switch and included in the O&M manuals.

1.05 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1.

1.06 TOOLS, SUPPLIES AND SPARE PARTS

A. The automatic transfer switches shall be furnished with all special tools necessary to disassemble, service, repair and adjust the equipment. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor.

B. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.

C. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the Owner.

D. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.

E. Parts shall be completely identified with a numerical system to facilitate parts inventory

control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

1.07 SERVICES OF MANUFACTURER'S REPRESENTATIVE

A. The Contractor shall provide the services of a qualified manufacturer's technical representative who shall adequately supervise the installation and testing of all equipment furnished under this Contract and instruct the Contractor's personnel and the Owner's operating personnel in its maintenance and operation. The services of the manufacturer's representative shall be provided for a period of not less than as follows:

1. One trip of one (1) working day during installation of the equipment.

2. On trip of one (1) working day to program parameters and test transfer switch in conjunction with standby generator as indicated under paragraph 1.02.A.3, Field Tests.

3. One trip of one (1) working day after acceptance of the equipment.

4. One trip of one (1) working day during the warranty period.

B. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor.

C. The manufacturer shall have an established network of service centers capable of servicing the specified equipment. The manufacturer shall have a service center within 200 miles of the project site which shall stock parts necessary to service the switch. The manufacturer shall include a toll-free telephone number for a field service contact affixed to each enclosure.

D. Service center personnel shall be on call 24 hours a day, 365 days a year. Personnel shall be factory trained and certified in the maintenance and repair of the specified equipment.

E. After warranty service contracts shall be made available to the Owner by the manufacturer, through the service centers, to provide periodic maintenance and/or repair of the specified equipment.

1.08 IDENTIFICATION

A. Each automatic transfer switch shall be identified with the identification number indicated on the Drawings (ATS-AMPS). A lamacoid nameplate with black lettering on white background shall be securely affixed in a conspicuous place on each switch.

1.09 TRAINING

A. The Contractor shall provide training for Owner personnel. Training shall be conducted by the manufacturer's factory trained specialists who shall instruct Owner personnel in operation and maintenance of all equipment provided under this Section.

B. Provide the services of an experienced, factory trained technician or service LFUCG Project Manager of the switch manufacturer at the jobsite for minimum of four (4) hours for training of Owner personnel, beginning at a date mutually agreeable to the Contractor and the Owner. The training shall include:

1. Description of the operating parts of the transfer switch.

2. Description of the various menus and parameters in the operator display and demonstration of how to navigate through the menus and parameters.

3. Demonstration of how change programmed parameters.

4. Description of metering data available (if applicable) and demonstration of how to display them.

5. Demonstration of how to display and reset alarms and faults.

6. Troubleshooting to remedy faults.

7. Other subjects as may be requested by Owner.

1.10 WARRANTY

A. The manufacturer shall warrant each automatic transfer switch for a minimum of five (5) years from date of shipment. In addition, the manufacturer shall repair or replace equipment found faulty under the terms of the warranty. The manufacturer shall submit data outlining the guarantee/warranty program.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

B. The equipment described herein, as a minimum, shall meet all of the requirements specified in this Section and shall be a product of a manufacturer who has produced automatic transfer switches for a period of at least five (5) years. The equipment shall be compatible with the loads to be served. Assembly of the switches by a fabricator is not acceptable.

C. The manufacturer of the automatic transfer switch shall verify that the switches are listed by Underwriters Laboratories, Inc., standard UL-1008, with 30-cycle withstand and close-in values as indicated on the Drawings or specified herein.

D. The automatic transfer switches shall be Model RTS-30 as manufactured by Russelectric, Inc., or equivalent. The basis of design is the Russelectric RTS-30.

2.02 AUTOMATIC TRANSFER SWITCH

A. General

1. Switches shall have ampere ratings and number of poles as indicated on the Drawings and shall be suitable for 480 VAC, three-phase, 60 Hertz operation.

2. For three phase, four-wire systems where a neutral is required (for ground fault switching), a true four-pole switch shall be supplied with all four electrically and mechanically identical poles mounted on a common shaft. The continuous current rating and the closing and withstand rating of the fourth pole shall be identical to the rating of the main poles.

3. The transfer switch shall have both top and bottom mounted cable access, and be front access only.

4. The switch shall be capable of switching all classes of load and rated for continuous duty when installed in a non-ventilated enclosure.

5. The 30-cycle closing and withstand current rating of the switch shall be 42,000 amperes RMS (minimum). This rating shall not be restricted by the use of a specific manufacturer's circuit breaker.

6. This switch shall be complete with all accessories and listed by UL under Standard UL-1008 for use on emergency systems.

7. All bolted bus connections shall have Belleville compression type washers. Switches for four-wire systems shall be furnished with a fully rated solid neutral bus.

8. The switch shall be equipped with 90°C rated copper/aluminum solderless mechanical type lugs of the proper quantity and size to accommodate the termination of field wiring.

9. Switches shall be capable of normal operation during and after seismic loading. Seismic loading shall not cause false operation.

B. Design Requirements

1. The switch shall utilize dual operators. Operators shall provide for an adjustable neutral off position in which the load is disconnected from both sources during transfer from utility to generator and re-transfer back the utility.

2. Switches shall be capable of transferring successfully in either direction with 70 percent of rated voltage applied to the terminals.

3. The time delay between the opening of the closed contacts and the closing of the open contacts shall allow for voltage decay before transfer, allowing the motor and transformer loads to be re-energized after transfer with normal in-rush current. Switches using in-phase monitors are not acceptable.

4. Normal and standby contacts shall be positively interlocked mechanically and electrically to prevent simultaneous closing. Main contacts to be of silver-tungsten alloy, mechanically locked in position in both the normal and standby positions without the use of hooks, latches, or magnets. Provide separate arcing contacts, with magnetic blowouts on each pole. Interlocked molded case circuit breaker switches or contactors are not acceptable.

5. Equip the transfer switch with a permanently attached, safe, manual operator designed to prevent injury to personnel in the event the electrical operator should become energized during manual transfer. The manual operator shall provide the same contact-to-contact transfer speed as the electrical operator to prevent a flashover from slowly switching the main contacts and shall be operable with the transfer switch enclosure door closed.

C. Sequence of Operation

1. Should the voltage on any phase of the normal source drop below 80 percent or increase to 120 percent, or frequency drops below 90 percent, or increase to 110 percent, or 20 percent voltage differential between phases occur, after a programmable time delay period of 0-9999 seconds factory set at three (3) seconds to allow for momentary dips, the engine starting contact(s) shall close to start the standby plant or connect to the standby source.

2. Transfer to the standby power source shall occur when 90 percent of rated voltage and frequency has been reached by the standby power source.

3. After restoration of normal power on all phases to a preset value of 90 percent to 110

percent of rated voltage, at least 95 percent to 105 percent of rated frequency, and voltage differential is below 20 percent between phases, an adjustable time delay period of 0-9999 seconds factory set at 300 seconds shall delay the transfer to allow stabilization of the normal source. Should the standby source fail during this time delay period, the switch shall automatically retransfer to the normal source.

4. After retransfer to the normal power source, the standby plant shall operate at no load for a programmable period of 0-9999 seconds factory set at 300 seconds. Should the normal power source fail during this time delay period, the transfer switch shall automatically return to the standby source.

D. Controls

1. The transfer switch shall be equipped with a microprocessor-based control system to provide all the operational functions of the automatic transfer switch. The controller shall have a real time clock with Nicad battery back-up.

2. The CPU shall be equipped with self-diagnostics which perform periodic checks of the memory, I/O, and communication circuits with a watchdog power fail circuit.

3. The controller shall include a Modbus TCP/IP Ethernet communication port for interfacing with the Owner's SCADA system.

4. The controller shall have password protection to limit access to authorized personnel.

5. The controller shall include a 20 character LCD display with a keypad, which allows access to the system.

6. The controller shall include three-phase over/under voltage, over/under frequency, phase sequence detection, and phase differential monitoring on both normal and standby sources.

7. The controller shall be capable of storing the following records in memory for access either locally or remotely:

   a. Number of hours the transfer switch is in the standby position (total since record reset).

   b. Number of hours standby power source is available (total since record reset).

   c. Total transfer in either direction (total since record reset).

   d. Date, time, and description of the last four source failures.

   e. Date of the last exercise period.

   f. Date of record reset.

8. Controller shall indicate:

   a. Switch is in normal position

   b. Switch is in standby position.

   c. Controller is running.

9. An LCD readout shall display both normal source and standby source availability.

10. The microprocessor controller shall meet the following requirements:

a. Storage conditions - 25°C to 85°C

b. Operation conditions - 20°C to 70°C ambient

c. Humidity 0 to 99% relative humidity, non-condensing

d. Capable of withstanding infinite power interruptions

e. Surge withstand per ANSI/IEEE C-37.90A-1978

11. All control wiring shall be 18 gauge (minimum), 600 VAC, SIS switchboard type. All control wiring shall be identified at each termination (both ends) using tubular, sleeve-type wire markers.

12. The automatic transfer switch controller shall be a Model RPTCS manufactured by Russelectric (Basis of Design), GE Zenith Controls equivalent, or ASCO equivalent. The controller shall be programmed by the manufacturer's field representative during start-up and testing in conjunction with the standby generator.

E. Accessories

1. Programmable three phase sensing of the normal source set to pickup at 90% and dropout at 80% of rated voltage and overvoltage to pickup at 120% and dropout out at 110% of rated voltage. Programmable frequency pickup at 95% and dropout at 90% and over frequency to pickup at 110% and dropout at 105% of rated frequency. Programmable voltage differential between phases, set at 20%, and phase sequence monitoring.

2. Programmable three phase sensing of the standby source set to pickup at 90% and dropout at 80% of rated voltage and overvoltage to pickup at 120% and dropout out at 110% of rated voltage. Programmable frequency pickup at 95% and dropout at 90% and over frequency to pickup at 110% and dropout at 105% of rated frequency. Programmable voltage differential between phases, set at 20%, and phase sequence monitoring.

3. Time delay for override of momentary normal source power outages (delays engine start signal and transfer switch operation). Programmable 0-9999 seconds. Factory set at 3 seconds.

4. Time delay on retransfer to normal, programmable 0-9999 seconds, factory set at 300 seconds, with overrun to provide programmable 0-9999 second time delay, factory set at 300 seconds, unloaded engine operation after retransfer to normal.

5. Time delay on transfer to standby, programmable 0-9999 seconds, factory set at 3 seconds.

6. A maintained type load test switch shall be included to simulate a normal power failure, keypad initiated.

7. A time delay bypass on retransfer to normal shall be included. Keypad initiated.

8. Contact, rated 10 A at 30VDC, to close on failure of normal source to initiate engine starting.

9. A plant exerciser shall be provided with (10) 7 day events, programmable for any day of the week and (24) calendar events, programmable for any month/day, to automatically exercise the standby plant programmable in one minute increments. Also include a control switch for selection of either "no load" (switch will not transfer) or "load" (switch

will transfer) during the exercise period. Keypad initiated.

10. Relay contacts which close when normal source fails wired to a terminal strip.

11. Relay contacts which open when normal source fails wired to a terminal strip.

12. Relay contacts which close when emergency source is available wired to a terminal strip.

13. Relay contacts which open when emergency source is available wired to terminal strip.

14. Two auxiliary contacts rated 15 A at 120 VAC on main shaft, closed on normal and wired to a terminal strip.

15. Two auxiliary contacts rated 15 A at 120 VAC on main shaft, closed on standby and wired to a terminal strip.

2.03 BYPASS/ISOLATION SWITCHES

A. Non-Essential Loads: 4-Pole/4-Wire, 1600 Amperes, 480/277 Volt-60Hz.

B. Description: Manual type, arranged to select and connect either source of power directly to load, isolating transfer switch from load and from both power sources. Include the following features for each combined automatic transfer switch and bypass/isolation switch:

1. Means to lock bypass/isolation switch in the position that isolates transfer switch with an arrangement that permits complete electrical testing of transfer switch while isolated. While isolated, interlocks prevent transfer-switch operation, except for testing or maintenance.

2. Drawout Arrangement for Transfer Switch: Provide physical separation from live parts and accessibility for testing and maintenance operations.

3. Bypass/Isolation Switch Current, Voltage, Closing, and Short-Circuit Withstand Ratings: Equal to or greater than those of associated automatic transfer switch, and with same phase arrangement and number of poles.

4. Contact temperatures of bypass/isolation switches shall not exceed those of automatic transfer-switch contacts when they are carrying rated load.

5. Operability: Constructed so load bypass and transfer-switch isolation can be performed by 1 person in no more than 2 operations in 15 seconds or less.

6. Legend: Manufacturer's standard legend for control labels and instruction signs shall describe operating instructions.

7. Maintainability: Fabricate to allow convenient removal of major components from front without removing other parts or main power conductors.

C. Interconnection of Bypass/Isolation Switches with Automatic Transfer Switches: Factory-installed copper bus bars; plated at connection points and braced for the indicated available short-circuit current.

2.04 ENCLOSURES

A. The transfer switches shown to be installed indoors shall be housed in a NEMA 1 (gasketed) enclosure fabricated from 12-gauge steel. The enclosure shall exceed the UL-1008 minimum wire bending space requirements. The enclosure shall be equipped with an internal, welded

steel, door-mounted print pocket.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Each automatic transfer switch shall be installed as shown on the Drawings and in accordance with the manufacturer's installation instructions.

B. The automatic transfer switch shall be provided with adequate lifting means for installation of wall or floor mounted enclosures.

C. The Contractor shall tighten all assembled bolted connections to the manufacturer's torque recommendations prior to energizing.

D. Install each switch to allow complete door swing required for component removal. This is specifically required where a switch is set next to a wall to the left of the switch enclosure.

END OF SECTION

SECTION 16500 - LIGHTING

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The specific characteristics of the light fixtures to be furnished and installed shall be as detailed in the light fixture schedule on the Scope of Services. Should a fixture of a different type or manufacturer than that specified be submitted for the LFUCG Project Manager's review, it will be compared to that specified on: construction, dimensions, and photometrics. Failure to compare equally to what was specified will be grounds for rejection.

PART 2 - PRODUCTS

2.02 LUMINAIRES

A. All fixtures shall be delivered complete with suspension and mounting accessories, ballasts, diffusers, reflectors, etc., all wired and assembled. All accessory wiring shall be furnished and installed as shown on the Scope of Services.

B. All steel supports required for luminaires in addition to that furnished under the general building construction shall be furnished and installed by the Contractor.

C. When fixtures are noted to be installed flush, they shall be complete with the proper accessories for installing in the particular ceiling involved. All flush mounted fixtures shall be supported from the structure and shall not be dependent on the hung ceilings for their support.

D. All outside luminaires shall be a type that will prevent insect accumulation inside the luminaire.

E. Exterior luminaires shall be weatherproof and rustproof.

F. Luminaires for vaults and pipe galleries shall be watertight and rustproof. Explosionproof where the atmosphere is classified.

G. Luminaire wire shall be fixture type of non-asbestos construction.

2.03 LAMPS

A. “Lamps” shall be LED source with appropriate drivers and heat removal.

2.04 CONTROLS

A. Exterior luminaires shall be controlled by manual switchl.

B. Interior luminaires shall be controlled by switches and/or occupancy sensor set to vacancy mode as indicated on the Drawings.

PART 3 - EXECUTION

3.01 INSTALLATION/APPLICATION/ERECTION

A. General

1. The Contractor shall furnish all light fixtures, lighting equipment, components, hangers,

etc., as shown on the Scope of Services and shall install them at the locations shown on the Scope of Services.

2. All fixture wiring shall be in conformance with the latest revision of the NEC and UL standards.

3. Locations of fixtures shall be coordinated with LFUCG Project Manager's reflected ceiling plans where they exist. Any conflicts between electrical plans and LFUCG Project Manager's reflected ceiling plans, the reflected plans shall override.

B. Luminaires

1. Fixtures shall be rigidly mounted against the surface of the ceiling unless otherwise noted on the Scope of Services. Conduit runs to and between fixtures shall be rigid metallic type. Use of flexible conduit for connection to fixtures is prohibited, except where concealed above a suspended ceiling.

2. All ferrous metal surfaces of fixtures and plaster frames shall be treated and given rust-inhibiting and finish coat adherence properties before final enamel coats are applied. Finish enamel coat shall be baked on at approximately 320 degrees Fahrenheit.

3. Similar fixtures in each room or area shall be installed with bottom of fixtures at same elevation, unless otherwise noted.

4. Minimum wire size shall be AWG No. 10 for runs over 75 feet.

5. Outlets shall be as specified herein and shall be suitable for the installation conditions encountered.

6. Flexible fixture hangers shall be used for all pendant mounted fixtures.

7. Conduit run in areas with hung ceilings shall be installed in the space above the hung ceiling as close to the structure as possible. Conduits and junction boxes shall be supported from the structure.

8. No light fixtures shall be hung or installed until after painting is completed, however, temporary lighting shall be provided by the Contractor. Fixtures in suspended ceilings shall be fastened to the main tees of the ceiling grid.

9. All fixtures shall be left in a clean condition, free of dirt and defects, before acceptance by the LFUCG Project Manager.

C. Lighting Standards

1. All primed area light poles shall be painted per Division 9 of the Specifications. Galvanized steel, weathering steel or aluminum light poles Are Not To Be Painted.

2. When standards (poles) arrive on the job site, the protective wrapping should be removed immediately, especially if stored outside. If not removed, rain or other sources of water moistening the wrapping may cause stains (barber pole effect) on the pole finish. Such stains shall be cause for rejection.

3. A concrete foundation shall be provided for each pole as detailed on the Contract Drawing. The poles will be mounted utilizing anchor bolts set in the concrete. The anchor bolts should have galvanized or plated threads and should be furnished with the pole by the manufacturer. This is particularly important since they are LFUCG Project Managered as part of the pole structural system.

4. When anchor bolts are positioned prior to pouring concrete, spacing and projection must be verified with pole manufacturer's recommendations. A plastic or plywood template should be fabricated from the manufacturer's instructions to use when setting the anchor bolts. Anchor bolts that are not installed plumb and in the correct locations shall be removed and replaced. The Contractor shall not be allowed to bend the anchor bolts back to plumb after concrete is set.

5. Leveling nuts shall be utilized for the mounting of poles to foundations. A nut should be screwed down on each bolt until it meets the concrete, and then the nuts must be adjusted until they are level.

6. The pole should be carefully lowered onto the anchor bolts and allowed to rest on the leveling nuts. Flat washers followed by lock washers should be placed on the anchor bolts and the top nut installed. Minor adjustments on the leveling nuts may be necessary to plumb the pole before the top nuts are tightened down. Special care should be taken to tighten the top nuts to the torque level recommended by the pole manufacturer. All nuts and washers shall be galvanized or plated.

7. Concrete grout of the nonshrink type must be installed between the base of the pole and the concrete foundation. The grout should be puddled around the edge of the pole base and firmly packed in the space between the pole and foundation. A short piece of small diameter pipe must be installed to make a drain hole through the grout to the pole interior.

8. Aluminum poles must have the bottom of the base painted with Koppers bitumastic No. 50 or equal substitute product before grouting so that the aluminum does not come in contact with the concrete.

9. Poles shall not be modified or drilled on the job site.

10. Under no circumstances should a ground wire be wrapped around an anchor bolt underneath an anchor bolt nut.

11. Do not set poles without light fixtures installed, as poles are more likely to vibrate and become damaged.

12. Manufacturer's installation instructions should be followed as well as those instructions contained herein. Should a discrepancy exist, promptly contact the LFUCG Project Manager for clarification.

13. Bases shall have 1" chamfer all around and rubbed smooth to a point below grade.

14. Anchor bolt covers shall also be provided and installed with tamperproof hardware.

15. Lighting standards 30 feet and longer shall be furnished with built-in Aeolian vibration dampener from the factory.

END OF SECTION

SECTION 16620 – PACKAGED ENGINE GENERATOR SYSTEMS

PART ONE - GENERAL

1.01 THE REQUIREMENT

A. The Equipment Supplier shall provide a standby power engine generator set complete with base-mounted fuel storage tank, leak detection systems, piping, exhaust silencer, batteries, charger, weather protective enclosure, and other appurtenances as may be required.

B. It is the intent under this Contract to require a complete package in every detail whether or not specified. Consequently, the Equipment Supplier is responsible for all details, devices, accessories, and special construction necessary to properly install, adjust, test, and place in successful operation the engine-generator set.

C. Use materials which are new, unused, and as specified, or, if not specifically indicated, the best and most suitable of their kinds for the purpose intended, and for the design and expected conditions of service, subject to the approval of the LFUCG Project Manager.

D. Provide workmanship that is first class in every respect. Employ workers thoroughly experienced in such work. A neat and workmanlike appearance in the finished work shall be required.

E. All materials used must bear the inspection labels of the Underwriter's Laboratories, if the material is of a class inspected by the Laboratory.

F. Unless otherwise indicated, the materials to be provided under this Specification shall be the products of manufacturers regularly engaged in the production of all such items and shall be the manufacturer's latest design. The products shall conform to the applicable standards of UL and NEMA, unless specified otherwise. International Electrotechnical Commission (IEC) standards are not recognized. Equipment designed, manufactured, and labeled in compliance with IEC standards is not acceptable.

G. The engine generator sets shall fully comply with all current Environmental Protection Agency (EPA) emission regulations for permanently-installed, diesel-fueled, emergency standby power. The engine generator set(s) must meet the EPA new source performance requirements required at the time the engine generator set(s) submittal is approved by the LFUCG Project Manager. Engines manufactured previous to the submittal approval date that do not meet the current regulated emissions levels are not acceptable.

1.02 CODES AND STANDARDS

A. The packaged engine-generator system shall comply with the following Codes and Standards as a minimum:

1. NEMA MG1, Motors and Generators.

2. NEMA MG2, Safety Standard for Construction and Guide for Selection, Installation, and Use of Motors and Generators.

3. ISO STD 8528, Reciprocating Internal Combustion Engines.

4. ISO STD 3046, Performance Standard for Reciprocating Internal Combustion Engines.

5. NFPA 30, Flammable and Combustible Liquids Code.

6. NFPA 70, National Electrical Code

7. NFPA 70E, Standard for Electrical Safety in the Workplace

8. NFPA 110, Standard for Emergency and Standby Power Systems.

9. UL 508, Industrial Control Equipment.

10. EGSA, Electrical Generating Systems Association.

11. UL 142, Steel Aboveground Tanks for Flammable and Combustible Liquids.

1.03 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions. The following tests are required:

1. Witnessed Shop Tests

    a. None required.

2. Certified Shop Tests and Reports

    a. Fully test the engine-generator set with all accessories in the manufacturer's plant before shipment; test at various loadings from full load to no load, and at such other conditions as to properly establish that all requirements have been met. Tests shall be conducted through the use of balanced, three-phase, dry-type, resistive load banks. Obtain LFUCG Project Manager's approval before shipment is made.

    b. Submit two (2) certified copies of all test reports.

3. Field Tests

    a. Startup and field testing shall take place at the site of the Project.

    b. In the presence of the Owner’s representative inspect, adjust and test the entire system and leave in good working order. Tests shall be conducted through the use of balanced, three-phase, dry-type, resistive load banks. Notify the Owner by letter approving the equipment as ready for test two (2) weeks prior to the running of the specified field test. Field tests shall be conducted after the entire system is completely installed. Field tests shall include, but are not limited to, the silencer, radiators, engine-generators, and all other equipment included in the complete system.

    c. Conduct a continuous test run of at least four (4) consecutive hours without shutdown for the set under the following conditions of load.

        2 hours, full load
        1/2 hour, 3/4 load
        1/2 hour, 1/2 load
        1/2 hour, 1/4 load
        1/2 hour, no load

        Record complete test data for frequency, amperes, volts, power factor, exhaust temperature, coolant temperature, and oil pressure every 15 minutes during the continuous run test. If any failures and/or shutdowns occur during this four (4) hour test, the problems shall be fixed and the test shall be restarted. The test shall not be considered complete until the generator has operated for four (4) consecutive hours without any shutdowns under the conditions listed above.

1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions the Equipment Supplier shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings
2. Spare Parts List
3. Special Tools List
4. Reports of Certified Shop and Field Tests
5. Operation and Maintenance Manuals

B. Each submittal shall be identified by the applicable Specification section.

1.05 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete or illegible submittals will be returned to the Equipment Supplier without review for resubmittal.

C. Shop drawings for each engine-generator set shall include but not be limited to:

1. A Compliance, Deviations, and Exceptions (CD&E) letter. If the shop drawings are submitted without this CD&E letter, the submittal will be rejected. The letter shall include all comments, deviations and exceptions taken to the Specifications by the Equipment Supplier AND Equipment Manufacturer. This letter shall include a copy of this specification section. In the left margin beside each and every paragraph/item, a letter “C”, “D”, or “E” shall be typed or written in. The letter “C” shall be for full compliance with the requirement. The letter “D” shall be for a deviation from the requirement. The letter “E” shall be for taking exception to a requirement. Any requirements with the letter “D” or “E” beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not acceptable.
2. Standard manufacturers printed specification sheet showing critical engine and generator set specifications including the following:
    a. Dimensions, and weights
    b. Guaranteed fuel consumption at 25%, 50%, 75% and 100% of full rated load
    c. Engine bhp available
    d. Engine jacket water heat rejection
    e. Exhaust flow rate and temperature at 100% of rated load
    f. Ventilation and combustion air requirements
    g. Exhaust backpressure limitation

h. Liquid refill capacities

i. Generator efficiency at 50%, 75%, and 100% load

j. Telephone Interference Factor (TIF)

k. Harmonic waveform distortion

l. Type of winding insulation and generator temperature rise

m. Voltage regulation characteristics

n. Guaranteed noise levels

o. Per unit subtransient impedance X'' and X/R ratios for positive, negative, and zero sequences

p. Transient reactance (Xd')

q. Synchronous reactance (Xd)

r. Sub transient time constant (Td'')

s. Transient time constant (Td)

t. DC time constant (Tdc)

u. Decrement curve

3. Engine and generator material composition and construction.

4. Manufacturer's printed warranty statement of the engine and generator set showing single source responsibility by the engine manufacturer.

5. Generator control panel equipment and features. Include a written explanation of the auto start/stop logic and operation.

6. Engine-generator set and accessory catalog data sheets including, but not limited to, the vibration isolators, flexible exhaust coupling, exhaust silencer, batteries, battery charger, main line circuit breaker and enclosure, circuit breaker trip units, fuel lines, fuel level devices, jacket coolant heater, generator strip heater, fuel tank(s) and pump(s).

7. Standard dealer preventative maintenance contract for review and possible adoption under a separate Contract. Dealer must have existing contracts and personnel and contractual detailed performance information available.

8. Normal operating ranges for systems temperature, pressure and speed.

9. Manufacturer's part number for the engine and generator operation guide, parts book, service manual, warranty policy, and installation guide.

10. Phone numbers of twenty-four (24) hour products support contacts and locations.

11. Drawing showing right hand, left hand, and top views of proposed assembly; battery rack, isolators, exhaust silencer, conduit stub up locations, and flexible fittings; wiring schematics, interconnection diagrams (point to point), and written description of engine generator controls and alarm circuits.

12. Control panel layout drawings and wiring diagrams.

13. Drawings and specifications for base-mounted fuel storage tank with accessories and leak detection system.

14. Detailed drawings showing plan, front, and side views as well as appropriate section views of the weatherproof, engine-generator enclosure. Include product data sheets for all appurtenances (e.g. exhaust fan, thermostat, lighting, switches, receptacles, combination power unit, etc.) to be furnished and installed in the enclosure.

D. The shop drawing information shall be complete and organized in such a way that the LFUCG Project Manager can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Equipment Supplier intends to provide are acceptable and shall be submitted.

1.06 OPERATION AND MAINTENANCE MANUALS

A. The Equipment Supplier shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions.

B. Furnish identical bound instruction manuals covering operating procedures, lubrication, and maintenance requirements of all equipment furnished under this Item. Include wiring diagrams, drawings, product data sheets, parts lists, and other necessary data. Number or otherwise clearly identify all parts to facilitate ordering of replacements. Exclude data not pertinent to this installation. Within manual, fill in serial number, model number, and nameplate data of engine and generator provided.

1.07 TOOLS, SUPPLIES, AND SPARE PARTS

A. The engine-generator systems shall be furnished with all special tools necessary to disassemble, service, repair and adjust the equipment as part of a regular maintenance program. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Equipment Supplier.

B. The Equipment Supplier shall furnish the following spare parts for each engine-generator set:

No. Required	Description
1	Set of Fuel Oil Filters
1	Set of Air Filters
1	Set of Lube Oil Filters
1	Set of Fuel Oil/Water Separator Filters

C. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.

D. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Equipment Supplier shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the Owner.

E. Spare parts list, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.

F. The dealer shall have sufficient parts inventory to maintain over-the-counter availability of at least 90% of any required part and 100% availability within 48 hours.

1.08 SERVICE OF MANUFACTURER'S REPRESENTATIVE

A. The Equipment Supplier shall provide the services of a qualified manufacturer's factory-trained technical representative to provide training as specified.

B. The engine-generator set manufacturer shall have an authorized dealer within 100 miles radius who can provide factory trained service, the required stock of replacement parts, technical assistance, and warranty administration for all components supplied by the dealer.

1.09 IDENTIFICATION

A. Each engine-generator set shall be identified with the identification number specified by the Owner. A nameplate shall be securely affixed in a conspicuous place on the generator.

1.10 TRAINING

A. The Equipment Supplier shall provide training for Owner personnel. Training shall be conducted by the manufacturer's factory trained specialists who shall instruct Owner personnel in operation and maintenance of all equipment provided under this Section.

B. Training for the generator shall be performed at the Project site.

C. Each generator shall be tested on pump station load for a minimum of 30 minutes during field training.

1.11 WARRANTY TERMS

A. The manufacturer's and dealer's standard warranty shall in no event be for a period of less than two (2) years or four hundred (400) hours of operation, whichever comes first, from date of initial start-up of the system and shall include repair labor, travel expense necessary for repairs at the jobsite, and expendables (lubricating oil, filters, antifreeze, and other service items made unusable by the defect) used during the course of repair. Submittals received without written warranties as specified shall be rejected in their entirety.

PART TWO - PRODUCTS

2.01 MANUFACTURERS

A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily.

B. Consideration will be given only to the equipment of those manufacturers who have furnished comparable size diesel engine-generator sets for at least two similar installations that have been in regular successful operation for not less than five (5) years.

C. The Equipment Supplier shall furnish evidence of this experience and data on the equipment's operation at these installations to the LFUCG Project Manager upon request.

D. The engine-generator set manufacturer shall be responsible for the entire engine-generator package including the engine-generator set with enclosure, fuel system, piping, accessories, electrical equipment, and other devices for a complete and operable system. The engine-generator set manufacturers shall be:

1. Kohler
2. Caterpillar
3. MTU/Detroit Diesel
4. Cummins/ONAN
5. LFUCG Project Manager-approved equal

2.02 GENERAL DESCRIPTION

A. The engine-generator set shall be rated 900 kw, 3136 skva, 480-volt, 3-phase, 4-wire, 0.8 P.F. emergency standby power. It shall have the capability to operate at its standby rating for the duration of any power outage with all accessories including engine running devices, silencer, radiator, cooling fans, fuel system, and all appurtenances installed. The kW capacity above is based on loads and sequencing defined in generator sizing software limiting the voltage drop and frequency drop to a maximum of 20% and 5% respectively. The engine-generator running kW and starting kVA capacity shall not be less than that stated above. Only manufacturer's standard ratings shall be acceptable. No dealer special ratings will be acceptable.

2.03 ENGINE

A. The engine shall be diesel, 4 cycle, radiator cooled, and shall be turbocharged having an operating speed of 1800 RPM. Engine shall operate on No. 2 diesel fuel. Engines requiring premium fuels are not acceptable.

B. The specified standby kW rating shall be for continuous electrical service during interruption of the normal utility source, per NEMA standards. Prime rating shall also be included in the submittal where available.

C. Engine speeds shall be governed by an electronic isochronous governor that will sense generator speed and provide accurate load transient correction capability at less than 0.5 percent regulation, from no load to full load generator output.

D. The engine shall have a 12 or 24 volt battery charging generator with an automatic charge rate regulator. Starting shall be by a 12 or 24 volt electric starter.

2.04 GENERATOR

A. The generator shall conform with NEMA and IEEE standards. The generator shall be brushless, salient pole, 2/3 pole pitch and synchronous.

B. Laminations and windings shall be designed for minimum reactance, low voltage waveform distortion and maximum efficiency.

C. Insulation shall be Class H, 125 degrees C rise according to NEMA standards. All windings and coils shall have an additional treatment of three (3) coats of varnish to prevent fungus growth.

D. Radio interference suppression (both directions) shall be provided in accordance with NEMA and IEEE Standards.

E. The alternator shall have a brushless, permanent magnet exciter. The exciter shall supply field excitation to maintain output with the alternator loaded to 300% of continuous rating for 10 seconds at rated power factor.

F. Waveform deviation shall not exceed 5% from true sine wave. The transient response from no load to full load in one step of the engine-generator set shall not exceed a voltage dip of 35%, a frequency dip of 20%, and shall recover to complete steady state performance within 12 seconds for both voltage and frequency. The transient response from full load to no load in one step shall not exceed a voltage overshoot of 7% and shall recover to steady state performance within 3 seconds.

G. The Telephone Influence Factor (TIF) shall be less than 50.

H. The voltage regulator shall be an adjustable, solid-state, three-phase RMS sensing, volts/hertz type. Voltage regulation shall be a minimum of +/-0.5% from no load to continuous rating. The voltage regulator shall provide +/-10% voltage adjustment. The voltage regulator shall be located within the engine control panel.

I. A 120VAC generator mounted strip heater shall be furnished and installed as part of the system. The strip heater shall be "ON" to prevent condensation when the engine generator set is not running.

2.05 CONTROLS

A. Engine-generator monitoring and controls shall be mounted in a single NEMA 1 dust-tight enclosure. A suitable accessible terminal strip having all wires properly identified shall be furnished. The panel shall include a local engine failure alarm, a dry contact for remote "Generator System Failure" alarm indication, and engine starting control wire. The panel shall be mounted between 5’-0” and 6’-0” measured from the center of the panel to ground level. Elevated platform and handrail may be required, as determined by Owner, for control panels exceeding 6’-0”.

B. The engine starting shall be automatic and shall include a starting motor, a cranking contactor, provisions for electrically operated fuel control, and protective devices for low oil pressure, high coolant temperature, low coolant level, and overspeed conditions.

C. The automatic engine starting control shall operate from a single pole contact which closes for engine run and opens for engine stop. When the engine starts, starting control shall automatically disconnect cranking controls.

D. The cranking disconnect means shall be electrically self-regulating to prevent recranking for a definite time after source voltage has been reduced to a low value. If the engine fails to fire, or any safety device should operate while the engine is running, the engine shall be stopped immediately and the starting controls locked out requiring manual resetting.

   Failure to start shall initiate an alarm signal that must be reset in order to have the alarm activated after normal power is restored. The "Failure to Start" signal shall be derived from a dry contact closure which is wired as part of a common "Generator System Failure" alarm.

E. Starting control circuits shall be arranged so that cranking will commence immediately after the single pole contact closes. Four cranking cycles of 10 seconds "ON", 10 seconds "OFF" shall be provided.

F. The automatic engine starting controls shall use industrial rated control type elements throughout, and controls shall have the capability to operate at 50% battery voltage.

Indicating lamps, pushbuttons, selector switches, and other pilot devices shall be accessible and mounted on the control enclosure.

G. A molded case generator/exciter field circuit breaker shall be furnished and installed as part of the engine generator set.

H. Molded case main line circuit breaker(s) as specified herein shall be installed as load circuit interrupting and protection devices in NEMA 1 (gasketed) dust-tight enclosures. They shall operate both manually for normal operation and automatically for protection against overload or short circuits. Generator/exciter field circuit breakers are not acceptable for this service.

The molded case circuit-breakers described above shall be manufactured and tested in accordance with U.L. and NEMA AB1 standards. Their interrupting rating shall be suitable for the available fault current. All electrical ratings shall be suitable for the application.

I. The devices necessary for automatic starting shall be on the engine and in the engine control panel.

J. Engine-generator monitoring and control shall be provided using a microprocessor based control panel (EMCP 3.3, Digital Control Panel, Power Command, or equal) complete with LCD displays. Engine-generator monitoring and control shall include, but not be limited to, the following:

1. Engine oil pressure indicator
2. Coolant temperature indicator
3. Voltmeter
4. Ammeter
5. Phase selector switch
6. Running time meter
7. Frequency meter
8. High coolant temperature shutdown, signal light
9. Low oil pressure shutdown, signal light
10. Engine overspeed shutdown, signal light
11. Engine overcranking protection with signal light (after a cranking cycle of one minute, engine cranking shall stop)
12. Engine tried to start but failed signal light
13. Low coolant level signal light
14. Engine "Run" (green) and "Fail"signal lights
15. Low coolant temperature signal light
16. Pre-high engine temperature indication
17. Pre-low fuel indication
18. Low fuel shutdown indication

19. Fuel leak indication
20. Low battery indication.
21. Battery charger fail indication
22. Engine control mode switch (Run-Off-Auto)
23. Tachometer and engine speed (RPM) indicator
24. Emergency stop pushbutton
25. Generator voltage adjust potentiometer
26. Generator frequency adjust potentiometer
27. Indicator/display test switch
28. Panel lights with On/Off switch
29. 120V dry contacts for indicating the following to Owner's SCADA system:
    a. Generator running.
    b. Generator Run-Off-Auto control switch in "Auto".
    c. Generator pre-shutdown alarm.
    d. Low fuel level.

2.06 ENGINE ACCESSORIES

A. Furnish and install the engine with all accessory equipment and appurtenances which may be required for proper operation, including the following:

1. Dry type air cleaner
2. Engine driven lubricating oil pump
3. Lubricating oil strainer
4. Lubricating oil filter, bypass type, with replaceable absorbent-type elements
5. Lubricating oil cooler, water cooled
6. Lubricating oil cooling circulator pump (may be integral with main oil pump)
7. Fuel oil transfer pump
8. Fuel oil strainer
9. Fuel oil filter, with replaceable absorbent-type elements
10. Fuel oil fuel/water separator
11. Electronic controlled fuel injection

12. Fuel oil injection valve assemblies
13. Electronic isochronous governor
14. Radiator and cooling fan
15. Jacket water circulating pump
16. Thermostats
17. Water expansion tank
18. Exhaust manifold
19. Automatic battery starting system
20. Cold starting aid engine block heaters with all controls (6000 watt, 480 volt, three phase)
21. Radiator mounted fuel cooler to cool recirculated fuel before it is re-deposited into the fuel tank as recommended by the manufacturer.

2.07 MOUNTING

A. Couple the engine and generator together through a flexible, non-backlash type, all metal coupling which overcomes all normal misalignment stresses and transmits full engine torque with ample safety factor. Also provide flexible connections for piping connections.

2.08 RADIATOR

A. Provide a radiator manufactured of a non-corrosive material mounted on the engine. The radiator core shall be coated with a corrosion resistant coating. Corrosion resistant coating shall be a corrosion resistant baked phenolic coating or similar.

B. Connect the radiator to the engine internal cooling system with flexible piping.

C. The engine shall be cooled through a radiator sized to continuously maintain safe operation at full load and at 105°F outside ambient air with 50% ethylene glycol coolant. A blower type fan and low noise fan drive and controls shall be furnished. The fan and all rotating members and drive belts shall be guarded and meet OSHA standards.

D. The unit shall be provided with 50% ethylene glycol. Nalcool treatment shall also be added to the system in the proper proportion.

E. Unit mounted thermal circulation type water heaters shall be furnished to maintain engine jacket water temperature as recommended by manufacturer in an ambient temperature of 10° F. The heaters shall be single phase, 60 hertz, 120 volt or 240 volt AC thermostatically controlled.

2.09 ENGINE STARTING SYSTEM

A. Provide an engine starting system complete with battery charger and batteries.

B. The charger shall be an automatic battery charger, 10 A max, current limited, ±2% voltage regulation, ±10% line voltage variation, equalizing timer, DC voltmeter, and DC ammeter. Provide a 0-24 hour equalize timer and a Form C Dry Contact to indicate a low battery alarm condition.

C. Starting batteries shall be sealed, lead-acid typerated 12 or 24 volts having adequate capacity for rolling the engine for five (5), ten (10) second cycles without starting and operating the control devices in the generator panel. The batteries shall be mounted on a suitable non-corrosive rack. Batteries shall have battery cables with lugs and shall be provided with lugs for connection to the battery charger.

2.10 EXHAUST SILENCER

A. Furnish and install an exhaust silencer mounted within the generator enclosure. The silencer system shall be designed, furnished, and installed to prevent moisture and condensation from corroding the silencer. Silencers shall be insulated using a calcium silicate material covered by a brushed aluminum skin. All exterior components of the exhaust silencer system shall be of 316 stainless steel. The work shall result in a long-term, aesthetically pleasing installation.

B. Silencers shall be of critical type and sized to produce a high degree of silencing. Reference the sound attenuation requirements specified herein.

C. Connect the silencer to the engine exhaust manifold with a high corrosion and temperature resistant stainless steel flexible convoluted exhaust pipe. Use flange-type connections. Provide a taper-cut tail pipe complete with rain cap to exhaust the gases to the atmosphere.

D. The exhaust manifold, exhaust piping, and expansion fittings including collector box, shall be completely covered with an insulation blanket in order to protect operating personnel and to reduce noise. Insulation shall be of composite fiberglass and stainless steel construction capable of withstanding 1,200°F continuously. The insulation blankets shall be tailored and custom fabricated to fit the contours of the manifolds.

2.11 BASE MOUNTED FUEL TANK

A. The generator set shall be supplied with a U.L.-142 listed, double-walled, base-mounted fuel tank of sufficient capacity to operate the engine-generator set at full load for a minimum of 24 hours at full load. The tank, painted in a color as selected by the LFUCG Project Manager, shall be fabricated from steel with a rupture basin and leak detector system. The alarm and indicator for the leak detection shall be mounted adjacent to the generator control panel.

B. A level device shall also be furnished and installed to provide a local (generator control panel) indication of pre-low fuel tank level and low fuel tank level. The low fuel tank level alarm shall shut down the engine to prevent the fuel level from dropping below the fuel pickup piping in the fuel tank. The pre-low fuel level alarm shall activate when only 6 hours of fuel for full load operation remains in the fuel tank. Low alarm shall be connected to the SCADA system for remote monitoring.

C. The tank shall be supplied with all necessary fuel supply, return, vent, and fill fittings and a fuel level gauge. The lockable fill port and level gauge shall be easily accessible from outside the enclosure. The vent line shall be piped to the outside and be equipped with a fill whistle.

D. The system shall be equipped with a radiator mounted fuel cooler, which shall remove all heat added to fuel in the recirculation process at a 105°F ambient.

2.12 WEATHERPROOF ENGINE - GENERATOR SOUND ENCLOSURE (SL2)

A. Furnish and install an outdoor, weather-protective housing. The housing shall be furnished complete with a full sub-base floor resulting in complete enclosure. The enclosure shall be factory-assembled to the engine-generator set base and radiator cowling. Housing shall provide ample airflow for generator set operation. The housing shall be constructed of 12

gauge (minimum) aluminum or 14 gauge (minimum) galvanized steel, reinforced to be vibration free in the operating mode. The housing shall have hinged side-access doors and rear control panel access door. Each door shall have at least two latch-bearing points. All doors shall be lockable. All steel sheet metal shall be primed for corrosion protection and finish painted in the manufacturer's standard color. Roof shall be peaked to allow drainage of rain water. Unit shall have sufficient guards to prevent entrance by small animals. Batteries shall fit inside enclosure and alongside the engine (batteries under the generator are not acceptable). Unit shall have engine coolant and oil drains outside the unit to facilitate maintenance. Each drain line shall have a high quality valve located near the fluid source.

B. A "Skin-tight" housing shall be provided. No walk-around access is required within the enclosure.

C. All acoustical insulation shall be fixed to the mounting surface with pressure sensitive adhesive or mechanically fastened. In addition, all acoustical insulation mounted on a horizontal plane shall be mechanically fastened. The acoustical insulation shall be flame retardant.

D. The fully assembled housing and engine generator skid shall be rodent proof.

2.13 CATWALKS WITH STAIR ASSEMBLY (2 REQUIRED)

A. Catwalks are constructed in accordance with OSHA requirements.

1. 1910.24 – Fixed Industrial Stairs
2. 3124 – Stairways and Ladders

B. Frames are to be manufactured of 1/4 inch formed steel or 3/8-inch structural angle as required.

C. Walkway is to be manufactured from 1/8-inch aluminum tread.

D. Steps are to be manufactured from 7-gauge diamond plate minimum, A569 prime steel.

E. Handrails to be 1 1/4-inch aluminum pipe.

F. Catwalk is to be primed with a two-part polyurethane primer.

G. Catwalk is to be finish-coated with two-part polyurethane enamel.

H. Catwalks shall be manufactured by a company certified under ISO 9001:2008 quality standards.

PART 3 – EXECUTION

3.01 INSTALLATION

A. The Contractor shall apply for aboveground fuel tank permit and air permit.

B. After successful completion of all field testing and immediately prior to final inspection, the Equipment Supplier shall fill the fuel tank(s) and all other fluid levels to their capacity for the standby power system.

C. The Equipment Supplier shall be responsible for delivering the generator sets to the Owner after all testing and engine startup.

END OF SECTION

SECTION 16670 - LIGHTNING PROTECTION SYSTEMS (AIR TERMINALS)

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The lightning protection system shall be furnished, installed, and connected as detailed on the Scope of Services to provide a complete and functional system. Installation and equipment construction shall comply with Lightning Protection Institute Installation Code LPI-175, UL Master Label Code 96A, and NFPA 780.

B. The Contractor shall provide shop drawings indicating location and installation of equipment for review of the LFUCG Project Manager before beginning installation.

C. All equipment shall be of the same manufacturer, insofar as possible.

D. Equipment specified herein supplements actual suppression devices specified in Section 16280.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. “Thompson Lightning Protection, Inc.,” “Independent Protection Co., Inc.,” or equal.

2.02 EQUIPMENT

A. All equipment used in this installation shall be UL approved and labeled in accordance with UL procedures, with each air terminal bearing an “A” label and all main conductors bearing a “B” label at 10'-0" intervals.

B. All equipment shall be new, and of design and construction to suit the application where it is used in accordance with accepted industry standards and LPI and UL code requirements and as per manufacturers recommendations.

C. Downlead conductors from roof to ground shall be copper, of 28 strands, 17 gauge minimum. All main roof conductors shall be aluminum, of 24 strands, 14 gauge minimum.

D. Air terminals shall be solid, round aluminum bar of 1/2” minimum diameter, and shall project 10" minimum above the object to be protected.

E. Air terminal bases shall be of cast aluminum with bolted pressure cable connections and shall be securely mounted with stainless steel screws or bolts. Bases on built-up tar and gravel roofs shall be secured with a proper adhesive and shall have a minimum surface contact area of 18.5 square inches.

F. Ground rods shall be a minimum of 3/4" in diameter and 10'-0" long. They shall be connected to the system using exothermic welds, Cadweld, or equal.

G. Cable fasteners shall be substantial in construction, electrolytically compatible with the conductor and mounting surface and shall be spaced according to LPI and UL code requirements.

H. Bonding devices, cable splicers and miscellaneous connectors shall be of cast aluminum with bolted pressure connections to cable. Cast or stamped crip fittings are not acceptable.

I. Equipment on stacks and chimneys shall be protected from corrosion and sized in accordance with LPI and UL requirements.

J. All miscellaneous bolts, nuts, and screws shall be stainless steel.

K. An approved bimetal transition fitting shall be used at the roof level to change from aluminum roof conductor to copper downlead cable.

PART 3 - EXECUTION

3.01 INSTALLATION/APPLICATION/ERECTION

A. The installation shall be accomplished by an experienced installer listed with Underwriters' Laboratories as qualified and who is also a Certified Master Installer of the LPI or working under the direct supervision of an LPI manufacturer as listed above or his authorized LPI Certified Master Installer representative.

B. All equipment shall be installed in a neat workmanlike manner in the most inconspicuous manner possible. The system shall consist of a complete cable network on the roof including all air terminals, splices, and bonds with cable downleads routed concealed either directly in the building construction for a new structure or in conduit to ground for an existing structure.

C. The copper downlead cables shall not be brought directly through the roof. Through roof connectors with solid rods or conduits though pitch pockets shall be utilized for this purpose.

D. The limitations on areas of usage for aluminum cables and for copper and aluminum materials together as outlined in UL 96A and LPI 175 shall be observed. The lightning protection installer will work with other trades to ensure a correct, neat, and unobtrusive installation.

E. It shall be the responsibility of the lightning protection installer to assure a sound bond to the metallic main water service and to assure interconnection with other building ground systems, including both telephone and electrical and also to ensure that proper arresters have been installed on the power service.

F. Downlead conductors from roof to ground shall be protected from mechanical damage from a point 8 feet above to 1 foot below grade by conduit or other means.

G. The lightning protection installer shall secure and deliver a UL Master Label and LPI System Certification to the LFUCG Project Manager for the Owner upon completion of the installation.

H. The Contractor shall also submit 2 copies of as built shop drawings, 1 with the UL Master Label Application Form and another with LPI forms 175A and B.

I. A letter indicating its UL approval shall be submitted at project completion.

END OF SECTION

SECTION 16710 - COMMUNICATION SYSTEMS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This Section of the specifications addresses Contractor's requirements for communication systems. The work includes raceways, cables, runways, entrance facilities, cabling, labor and equipment to execute communication systems as detailed on the Drawings.

B. The Contractor is responsible for furnishing and installing all raceway and cables with 14 feet of slack at terminals and cabinets.

C. The structured telecommunications cable and pathway distribution and wiring system shall include permanently installed horizontal cabling, horizontal pathways, telecommunications outlet assemblies, conduit, raceway, and hardware for splicing, terminating, and interconnecting. The horizontal system includes the cabling and pathway between the PLC cabinets and vendor panels. Hardware and terminating equipment shall consist of UL approved, 110 RJ-45 connectors. Horizontal cable shall consist of Category 6 (1,000 MPBS) 100 ohm four (4) pair cable, unshielded twisted pair (UTP).

D. Use shielded cables inside VFD cabinets.

E. DeviceNet networks shall utilize Allen Bradley round trunk and drop cables as required with terminating resistors on either end of the main trunk. Furnish and install all the correct connectors and fittings for connecting drops to the trunk cable and the trunk cable to the PLC. At the contractors discretion, flat ribbon style cable may be used.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Drawings and General Provisions of this Contract including General and Supplementary Conditions and Division 1 Specifications Sections, apply to work of this Section.

B. Related Work in Other Technical Sections

1. Section 16050 - Basic Electrical Materials and Methods

2. Section 16120 – Conductors and Cables

3. Section 16130 - Raceways

4. Section 16131 - Boxes

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Telephone and Data Cables: AT&T, General Cable, Okonite, Belden, Alpha, Houston, American, Anixter, or equal.

2.02 MATERIALS

A. Components

1. Cabling passages shall be accessible via junction boxes and equipment cabinets. All cable installation will be facilitated with pull wires. Fixed cables and pathway systems for telecommunications systems shall be UL listed or third party independent testing laboratory certified, and shall comply with NFPA 70.

B. Pathways (Horizontal)

1. EIA/TIA-569 Pathway shall be conduit. Provide grounding and bonding as required by EIA/TIA-607.

C. Telecommunications Cabling

1. Cabling shall be UL listed for the application and shall comply with TIA-568 and ANSI/TIA/EIA-568-B.2-1 and NFPA 70. Cabling shall consist of Category 6 (1,000 MBPS) UTP cable. Provide a labeling system for cabling as required by EIA/TIA 606 and UL 969. Cabling manufactured more than 12 months prior to date of installation shall not be used.

D. Telecommunications Outlet/Connector Assemblies

1. Jacks shall comply with FCC Part 68.5, and TIA/EIA-568. Jacks shall accommodate UTP. UTP jacks shall be RJ-45 designation T568A type, UL 1863 listed, eight position, constructed of high impact rated thermoplastic housing rated for Category 6 (1,000 MBPS) service. UTP jacks for data shall be Category 6 (1,000 MBPS) hardware and shall comply with the attenuation requirements contained in ANSI/TIA-568-B.2-1. Telecommunications cover plates shall comply with UL 514C, and TIA/EIA-568.

PART 3 - EXECUTION

3.01 INSTALLATION/APPLICATION

A. Telecommunications cabling and pathway systems, including the horizontal cabling and pathway systems, telecommunications outlet/connector assemblies, and associated hardware shall be installed in raceway in accordance with TIA/EIA-568, EIA/TIA-569, NFPA 70, and UL standards as applicable.

B. Cabling

1. Install Category 6 (1,000 MBPS) UTP, telecommunications cabling and pathway system as detailed in TIA/EIA-568. Each RJ-45 connector shall have run to it one dedicating cable containing four pairs. Cabling installation shall comply with EIA TSB4O and EIA TSB-36. Screw terminals shall not be used except where specifically indicated on drawings. Use an approved insulation displacement connection (IDC) tool kit for copper cable terminations. Do not untwist Category 6 (1,000 MBPS) UTP cables more than 12 mm (one half inch) from the point of termination. Provide service loop on each end of the cable (one meter) for future additions. Do not exceed manufacturers' cable pull tensions for copper cables. Provide a device to monitor cable pull tensions. Do not exceed 110 N(25 pounds) pull tension for four pair copper cables. Do not chafe or damage outer jacket materials. Use only lubricants approved by cable manufacturer. Do not over cinch cables, or crush cables with staples.

2. Terminate all cables in cabinets such that final device connections utilize factory manufactured patch cords.

C. Pathway Installations

1. Comply with EIA/TIA-569. Keep conduit minimum 150 mm (6-inches) away from parallel runs of electrical power equipment, flues, steam, and hot water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located

above accessible ceilings and where conduit is visible after completion of project. Install no more than two 1.57 rad (90 degree) bends for a single horizontal cable run.

2. All wiring shall be installed in conduit or a metal raceway. 3/4-inch minimum conduit size.

3. To facilitate future cable installations, a new pull string shall be pulled in conduit simultaneously with cables being installed.

4. All communication junction boxes shall be marked “DATA” or painted green.

3.02 TESTING

A. Telecommunications Cabling Field Testing

1. Perform telecommunications cabling inspection, verification, and performance tests in accordance with TIA/EIA-568.

B. Inspection

1. Visually inspect cabling jacket materials for UL or third party certification markings. Visually inspect UTP jacket materials for UL or other certification markings. Inspect cabling terminations in telecommunications rooms and at workstations to confirm color code for tip and ring pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568. Visually confirm Category 6 (1,000 MBPS) marking of outlets, wallplates and jacks.

C. UTP Verification Tests

1. UTP copper cabling shall be tested for DC loop resistance, shorts, opens, intermittent faults, near-end cross talk, proper pinning and termination and polarity between conductors. Test operation of shorting bars in connection blocks. Perform 250 MHz near-end cross talk (NEXT), far-end cross talk (FEXT) return loss, propagation delay, delay skew requirements, and attenuation tests for Category 6 (1,000 MBPS) 100 ohm 4-pair systems installations.

END OF SECTION

SECTION 16900 - CONTROLS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Equipment controls shall be as specified herein and shown on the Scope of Services. Legends for starter nameplates shall be taken from the one line diagram in the Scope of Services.

B. Certain equipment starters contain nonresettable elapsed time meters as shown in the Scope of Services. Also, certain motor starters have remote control devices and require connections to operate these control devices as shown on starter schematics (control circuits).

C. All starters contain red “on” lights, control transformers, and auxiliary contacts to operate as defined on the control circuits of the Scope of Services. Reset pushbuttons shall also be provided for overloads built into the starters.

1.02 CUSTOM CONTROL PANELS

A. All control panels furnished under this Contract shall be manufactured in accordance with industry standards and as herein specified. Some control panels are specified to be furnished with the equipment controlled and others are to be furnished by the Contractor, as written elsewhere.

B. Panel construction shall comply with OSHA and other code requirements as applicable, and may be attested to by UL listing the panels as an assembly. Otherwise, panel modifications as required by the Electrical Inspector shall be performed by the supplier at no extra cost to the Owner.

C. Control panels to be furnished on this project shall be wired to function according to schematics shown on the Scope of Services. In addition to the requirements shown on the Scope of Services, the panels shall adhere to additional requirements as written herein, and in the utilization equipment specifications. Supply a copy of approved drawings to Owner before construction occurs.

D. Enclosures shall be dead front with all operators’ devices accessible without opening the enclosure door. All relays, timers, terminal strips, etc., shall be mounted to a subpanel inside the enclosure. All wiring must be stranded and sized to be protected by a 20 A circuit breaker. Supplemental overcurrent protection may be used in lieu of oversized wiring. <u>All panels mounted outside shall have operators devices mounted on an inner door with an outdoor door that is blank.</u>

E. All terminal strips and lugs shall be of a type UL listed to terminate the size and quantity of wires encountered. Myers hubs shall be installed to maintain the enclosure rating where conduits enter NEMA 4X rated enclosures. The exterior of stainless steel NEMA 4X enclosures shall be unpainted. The exterior of NEMA 12 panels shall be painted ANSI 49 light gray, lacquer or enamel.

F. Enclosures shall be provided with a locking hasp and any exterior hardware shall be stainless steel or other corrosion resistant material. Enclosures for use in process or outdoor areas shall be NEMA 4X and enclosures for interior use in dry areas shall be NEMA 12, unless otherwise indicated.

G. Elementary control schematics and connection diagrams showing the spatial relationship of

components and wiring shall be submitted for review. Also, a bill of materials, drawing of device arrangement on front, and enclosure fabrication drawings shall be submitted. Further, descriptive literature is required on all components. A copy of the shop drawings shall be furnished and stored in a pocket inside the enclosure.

H. Sleeve type wire markers or other “permanent” type marker shall be installed on all wires, keynoted back to the elementary schematic or the connection diagram, and all terminals identified.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED

END OF SECTION

SECTION 17311 - PLC HARDWARE AND SOFTWARE

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This Section includes Programmable logic controllers for control of process equipment, process oriented machinery, and process systems.

1.02 RELATED WORK

A. Refer to Section 17410.

B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.03 SUBMITTALS

A. Refer to other applicable sections regarding LFUCG Project Manager submittals and approvals.

B. Product Data: For each type of PLC include dimensions, mounting arrangements, and weights. Also, include manufacturer's technical data on features, performance, electrical ratings, characteristics, and terminal connections.

C. Operation and Maintenance Data: Provide literature detailing routine maintenance requirements (if any) for each PLC component including:

1. System specifications
2. Electrical power requirements
3. Application considerations
4. Assembly and installation procedures
5. Power-up procedures
6. Programming procedures
7. Explanation of internal fault diagnostics
8. Shut down procedures
9. Recommended spare parts list

1.04 REFERENCE STANDARDS

A. ASTM D999-91: Vibration

B. (CFR) Title 47, Part 18 (European EN 55011 (formerly C1SPR 11))

C. CSA Certification Class I, Division 2, Group A, B, C, D Hazardous or non-hazardous locations

D. IEC 60068-2.1 Environmental testing — Part 2-1: Tests - Test A: Cold, 2.2 Environmental testing - Part 2: Tests. Tests B: Dry heat, 2.3, 2.6 Environmental testing - Part 2: Tests - Test Fe: Vibration (sinusoidal) and 2.27 Environmental testing. Part 2: Tests. Test Ea and guidance: Shock

E. IEC 61000 Electromagnetic compatibility (EMC) - Testing and measurement techniques

1. Part 4-2: Electrostatic discharge immunity test

2. Part 4-3: Radiated, radio-frequency, electromagnetic field immunity test

3. Part 4-4: Electrical fast transient/burst immunity test

4. Part 4-5: Surge immunity test

5. Part 4-6: Immunity to conducted disturbances, induced by radio-frequency fields

F. IEC 61131-3: Programmable controllers - Part 3: Programming languages

G. IEC 801-3: RFI Immunity

H. IEC 801-5: Ground Continuity

I. IEC 801-2: Electrostatic Discharge

J. IEEE 472-1974/ANSI C37.90/90A-1974 (Surge Withstand) IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus

K. MIL STD 461B CS02: RFI/EMI Susceptibility

L. NEMA Pub No ICS2-230.42: Showering Arc Test

M. NSTA Project 1 A

N. UL 508 and CSA Standard C22.2 No. 142 (Isolation Voltages)

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer shall be capable of providing training, parts, and coordination of emergency maintenance and repairs.

B. The programmable controller and all of the corresponding components within the family of controller products shall be manufactured by a company that regularly manufactures and services this type of equipment.

C. The manufacturer shall comply with IS09001 standards for "Quality Systems- Model for Quality Assurance in Design/Development, Production, Installation, and Servicing".

D. The manufacturer shall provide complete technical support for all of the products. This shall include factory or on-site training, regional application centers, local or factory technical assistance, and a 24/7/365 technical support phone service.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver PLC components in packaging designed to prevent damage from static electricity and physical damage.

B. Store PLC equipment according to manufacturer requirements. At a minimum, store indoors in clean, dry space with uniform temperature to prevent condensation. Protect PLCs from exposure to dirt, fumes, water, corrosive substances, and physical damage. Also, protect the PLC from all forms of electrical and magnetic energy that could reasonably cause damage.

1.07 NOMENCLATURE AND IDENTIFICATION DEFINITIONS

A. AI: Analog Input

B. AO: Analog Output

C. Fixed I/O: A PLC style consisting of a fixed number of I/0, a processor, and a power supply all in one enclosure. Some fixed PLCs have limited expansion ability.

D. CPU: Central Processing Unit

E. DI: Discrete Input

F. Distributed I/O: Hardware specially designed to function as Remote I/O.

G. DO: Discrete Output

H. HMI: Human-Machine Interface

I. I/O Input and/or Output

J. Modular: A PLC style consisting of cards that are assembled to comprise a complete unit. All I/O, CPU, and Power Supply are dedicated cards. Typically, these cards are inserted into a chassis.

K. Master/Slave: Communication between devices in which one device, the master, controls all communications. The other devices, the slaves, respond only when queried by the master. Typically used in a Remote I/O application.

L. Peer to Peer: Communication between two or more devices, typically PLC's, in which each device can control the communication exchange.

M. PID: Control action, proportional plus integral plus derivative.

N. PLC: Programmable Logic Controller

O. Remote I/O: I/O that is located remotely from the processor. Remote I/O can communicate over a variety of communication protocols and can use standard rack based I/O, or special Remote I/O hardware referred to as Distributed I/O.

P. SCADA: Supervisory Control and Data Acquisition

1.08 SPARE I/O

A. Each I/O drop and I/O location shall include at least 20 percent (minimum of four) points of each type (AI, AO, DI, and DO) for future use, regardless of whether any of those point types are used in that drop or location or not. The spares shall be the same type of I/O modules supplied.

B. Spare output points that require the use of an external relay shall be supplied with the external relay.

C. Regardless of the spare requirement, all installed unused points on all I/O modules shall be wired to terminal blocks in the order that they occur on the I/O modules. Unwired spares shall not be acceptable.

1.09 SPARE PARTS

A. General requirements for spare parts are determined by the LFUCG Project Manager..

B. The following PLC spare parts shall be furnished:

1. Processors: Provide spare processor unit(s) for each unique processor installed.

2. Memory Cards: Provide spares for each type of card installed.

3. I/O Cards: Provide spares for each unique I/O module type installed. Provide two or 10 percent of installed quantity, whichever is greater.

4. Network interface, remote I/O, and communication modules: Provide one spare communication module for each unique communication module installed.

5. Specialty Modules: Provide as a minimum a spare of each type of module identified. Provide an additional spare for every ten modules of a specific type installed.

6. PLC Power supplies: Provide spare power supplies for each unique power supply installed.

7. Chassis: Provide spare chassis for each unique chassis installed.

8. Fixed PLCs: Provide spares for each unique type of PLC installed.

9. Miscellaneous components (including cables): Provide spares for each unique component installed.

1.10 MANUFACTURER SUPPORT

A. Provide a written proposal for a manufacturer support agreement for PLC hardware and software for a minimum of 12 months starting at final completion of the project. The cost of this manufacturer support agreement shall not be included in the Contract Price. The support agreement shall be executed in the name of, and for the benefit of, the OWNER. At a minimum, this agreement shall provide the OWNER with:

1. Twenty-four hour, 7 day per week manufacturer telephone support

2. Access to the manufacturer's technical support web site

3. Software and firmware updates.

PART 2 - PRODUCTS

1.03 GENERAL

A. Provide Programmable Logic Controller equipment with the required memory and functional capacity to perform the specified sequence of operation with the scheduled input and output points.

B. Processor Systems shall include processor, power supply, input/output modules, communication modules, redundancy modules, and remote interface modules as required to meet system requirements.

C. Furnish products listed and classified by Underwriters Laboratories (UL), CSA, or FM approval as suitable for purpose specified and indicated.

D. All equipment and devices furnished hereunder shall be designed for continuous industrial service. The system shall contain products of a single manufacturer, insofar as possible, and shall consist of equipment models that are currently in production.

E. All equipment furnished shall be designed and constructed so that in the event of power interruption the systems shall go through an orderly shutdown with no loss of memory, and resume normal operation without manually resetting when power is restored.

F. The PLCs shall communicate between the operator workstation and field-mounted transducers, switches, controllers, and process actuators. Communications protocol shall be completely transparent to process operators at the Human Machine Interface (HMI).

G. The PLC shall be capable of stand-alone operation in the event of failure of the communication link to the HMI subsystem.

H. Backup Processor Systems, if indicated on the drawings, shall consist of two chassis with power supplies, each containing a processor, redundancy module and communications module(s). Remote chassis shall be provided with communication modules to meet I/O and communication requirements.

I. Remote Input/Output Units shall include input/output modules, interface modules, communication modules, and power supply to meet system input and output requirements.

J. Agency and environmental specifications:

1. Electrical supply voltage to the PLC shall be 120 Vac, plus or minus 15 percent, 48-63Hz. PLC system power supplies shall be fused for overload protection.

2. Vibration: 3.5 mm Peak-to-Peak, 5-9 Hz: 1.0G, 9-1501Hz. The method of testing is to be based upon IEC 68-2-6 and JIS C 0911 standards for vibration. The system is to be operational during and after testing. Vibration Rating of 2.0G maximum peak acceleration for 10 to 500Hz. in accordance with at least one of the following:

   a. Installed rating: DIN rail mounted PLC: 10-57 Hz, amplitude 0.075 mm, acceleration 25-100 Hz, and

   b. Panel or plate mounted PLC: 2-25 Hz, amplitude 1.6mm, acceleration 25-200 Hz.

   c. In compliance with IEC 60068 and IEC 61131.

3. Shock: 15G, 11 msec. The method of testing is to be based upon IEC 68-2-27 and JIS C 0912 standards for shock. The system is to be operational during and after testing.

4. Temperature: All PLC hardware shall operate at an ambient temperature of 0 to +55 degrees C (+32 to +140 degrees F), with an storage ambient temperature rating of -25 to +70 degrees C (-40 to +185 degrees F).

5. Relative Humidity: The Programmable Controller hardware shall function continuously in the relative humidity range of 30 percent to 95 percent non-condensing.

6. Noise Immunity: The Programmable Controller system shall be designed and tested to operate in the high electrical noise environment of an industrial plant as governed by the

following regulations: IEEE 472, IEC 801, MILSTD 461B, IEC 255-4, NEMA ICS 2-230.40, and ANSI/IEEE C-37.90A-1978.

7. Altitude:

    a. Operation: 0-6,500 feet

    b. Storage: 0-9,800 feet

8. Degree of protection: NEMA 1 (IP20)

9. All products shall have corrosion protection.

K. All major assemblies and sub-assemblies, circuit boards, and devices shall be identified using permanent labels or markings indicating:

1. Modules product type such as analog or digital

2. Modules catalog number

3. Modules major revision number

4. Modules minor revision number

5. Module manufacturer vendor

6. Module serial number

L. All necessary cables shall be included. All cables and connectors shall be as specified by the manufacturer. Cables shall be assembled and installed per the manufacturer recommendations.

M. Manufacturers

1. Provide all PLCs from a single manufacturer. If the PLC manufacturer has authorized third party vendors to provide modules that are compatible with their platforms, then products manufactured by these authorized third party vendors will be acceptable.

2. Provide the PLC system by one of the following:

    a. Rockwell Automation Allen-Bradley

        1) 1756-L73 ControlLogix (8 MB)

    b. Or LFUCG Project Manager approved equal

N. Central Processing Unit (CPU)

1. The CPU shall be, at a minimum, a 16-bit microprocessor that provides system timing and is responsible for scheduling I/O updates, with no user programming required to ensure discrete or analog update. It shall execute user relay ladder logic programs, communicate with intelligent I/O modules, and perform on-line diagnostics. The CPU shall consist of a single module which solves application logic, stores the application program, stores numerical values related to the application processes and logic, and interfaces to the I/O.

2. The CPU shall sample all the discrete and analog inputs and outputs including internal coils and registers, and service special function modules every scan. The CPU shall

process the I/O with user program(s) stored in memory, then control the outputs based on the results of the logic operation.

3. Supply the CPU with a battery-backed time of day clock and calendar.

4. The CPU family shall allow for user program transportability from one CPU model to another.

O. Diagnostics

1. The CPU shall perform on-line diagnostics that monitor the internal operation of the PLC. If a failure is detected, the CPU shall initiate system shutdown and fail-over. The following, at a minimum, shall be monitored: Memory failure, memory battery low, and general fault, communications port failure, scan time over run, I/0 failure, and analog or special function I/O module failure.

2. All diagnostic information shall be accessible to the host communications interfaces and to the PLC program.

3. The PLC shall have indicators and on board status area to indicate the following conditions:

a. CPU run

b. CPU error or fault

c. I/O failure or configuration fault.

d. Battery good

e. Communications indicator

P. Memory

1. The user program and data shall be contained in non-volatile battery backed memory, of type CMOS RAM program memory.

2. Memory Backup System: provide lithium battery backup capable of retaining all memory for a minimum of three months and a Flash memory system capable of reloading program in the event of memory loss.

a. Backup Battery: The backup battery shall be capable of being replaced without disrupting memory integrity. Provide a visual indication of low battery voltage and a low battery alarm contact.

b. Flash Memory Card: Memory card storage capacity shall be a minimum of processor memory capacity. Memory cards shall be installed in processors for factory testing.

3. The operating system shall be contained in non-volatile firmware. The memory containing the operating system shall be field updateable via a separate update tool.

Q. Programming Environment

1. Programming port: The PLC shall utilize a serial USB or Ethernet port for programming.

2. On-Line programming: Application programs may be modified or stored while the CPU is running, with minimal impact on the scan time.

3. Online programming including runtime editing

4. IEC 61131-3 programming languages supported: Ladder logic, function block, sequential function chart, and structure text.

5. Supply all hardware and software necessary to program the CPU in these languages.

R. Communication Ports

1. The CPU shall be expandable and supplied with additional modules to support the required communication interfaces.

S. Remote I/O Communications

1. The CPU shall be capable of communicating with up to 12 remote base locations at a combined distance of 2500 feet. The CPU shall automatically sample and update all local and remote I/O modules each scan cycle of the CPU.

2. The communication link between the CPU and any RIO chassis shall be as recommended by the PLC manufacturer. For racks located on a link of less than 2500 cable feet, the speed of the communications link shall be greater than 230K baud with RIO scan rate of less than 5 millisecond per RIO.

3. Diagnostic and equipment status information shall be available from each RIO.

4. It shall be possible to communicate with remote I/O racks or other PLCs via fiber optic cable.

5. The remote I/O system shall have available a remote input/output arrangement capable of operation at locations physically separated from the PLC CPU by up to 5,000 feet as detailed on the drawings.

6. Communication with the remote I/O arrangement shall be through cable as recommended by the PLC manufacturer and provided by the PLC system supplier under this specification section.

2.02 REDUNDANCY

A. The PLC shall be supplied with all hardware and software required to produce a completely operational redundant system if shown in the Drawings. Redundancy shall be implemented using a minimum amount of user programming. Warm backup, which is not a standard offering from the PLC manufacturer, is not acceptable.

B. The backup system shall consist of redundant controllers located in separate chassis.

C. The back-up system shall provide bumpless switchover for system outputs. All remote I/O shall maintain their last position until either communications is re-established or the remote I/O watchdog timer expires.

D. Switch-over between the on-line PLC and the back-up PLC shall occur within 100 milliseconds if any of the following conditions occurs in the on-line unit: Power failure, CPU fault, communications module fault, or change in the on-line unit's mode from RUN to PROGRAM.

E. The switchover shall be transparent to any devices networked to the redundant controller chassis.

F. The system shall automatically cross-load the primary controller's program to the secondary controller.

G. System diagnostics and debugging tools shall be provided to assist in troubleshooting all redundancy equipment.

2.03 POWER SUPPLIES

A. The PLC shall have chassis mounted power supplies to power the chassis backplane, and provide power for the processor and applicable modules.

B. Power supplies shall have a clearly visible LED to indicate that the incoming power is acceptable and the output voltage is present.

C. Power supplies shall feature over-current and over-voltage protection and should be designed to operate in most industrial environments without the need for isolation transformers.

D. Power supplies shall be sized to accommodate the anticipated load plus 30%.

E. DC power supplies shall be capable of handling ripple up to 2.4V peak to peak.

F. AC Line Voltage rating of 85 to 265Vac, 47-63Hz

G. The power supplies shall allow for brown outs of at least 1/2 of a cycle, a harmonic rate of 10%, and will sustain continuous operation through momentary interruptions of AC line voltage of 10ms or less.

H. Automatically shut down the Programmable Controller system whenever its output power is detected as exceeding 125% of its rated power

I. Provide surge protection, isolation, and outage carry-over up to 2 cycles of the AC line.

J. Redundant power supplies will comply with all the requirements of non-redundant power supplies in addition to the features stated below.

1. The redundant power supplies shall be designed to share the current required by the chassis. In the event of a failure of one redundant power supply, the remaining supply will accommodate the entire load of the chassis without disruption to the chassis activity.

2. Provide a failsafe fuse that is not accessible by the customer.

3. Provide a solid state relay connection to allow for failure annunciation when wired to an input module.

4. Diagnostic LED status indicators for Power and redundancy.

2.04 CHASSIS

A. Medium and large PLC models shall be chassis based.

B. All system and signal power to the CPU and support modules shall be distributed on the backplane. No interconnecting wiring between these modules via plug-terminated jumpers shall be acceptable.

C. All system modules, main and expansion chassis shall be designed to provide for free air flow convection cooling. No internal fans or other means of cooling, except heat sinks, shall be permitted.

D. All system modules including the processor shall be removable from the chassis or inserted in to the chassis while power is being supplied to the chassis without faulting the processor or damaging the modules.

E. Modules shall be designed to plug into a chassis and to be keyed to allow installation in only one direction. The design must prohibit upside down insertion of the modules as well as safeguard against the insertion of a module into the wrong slot or chassis via an electronic method for identifying a module. Electronic keying shall perform an electronic check to insure that the physical module is consistent with what was configured.

2.05 DISCRETE INPUT AND OUTPUT MODULES

A. General

1. Digital input and output modules shall provide ON/OFF detection and actuation.

2. The I/O count and type shall be as required to implement the functions specified plus an allowance for active spares, as noted below.

3. Modules shall be designed to be installed or removed while chassis power is applied.

4. Modules shall have indicators to display the status of communication, module health and input / output devices.

5. Each module shall have the following status indicators.

   a. The On/Off state of the field device.

   b. The module's communication status.

6. I/O modules shall contain a maximum of 16 points per module.

B. Module Specifications (120Vac Isolated Input Module)

1. Nominal Input Voltage of 120V ac

2. On-State Current of 15inA @132V ac, 47-63Hz maximum

3. Maximum Off-State Voltage of 20V

4. Maximum Off-State Current of 2.5mA

C. Module Specifications (24Vdc Input Module)

1. Where 24 Vdc modules are called out on the Drawings, utilize 1756-IB16 sinking.

D. Module Specification (120Vac Isolated Output Module)

1. Each triac type discrete output shall have an associated interposing relay located in the same control panel. 120 VAC power for relay outputs shall be provided from the associated motor starter control circuit (when used with motor starters) or other 120 VAC source (when I/O is not associated with a particular motor starter).

2. Output Voltage Range of 74-265V ac, 47-63Hz.

3. Output Current Rating:

a. Per Point - 2A maximum @ 30 degrees C; 1.0A maximum @ 60 degrees C; Linear Derating

b. Per Module - 5A maximum @ 30 degrees C; 4A maximum @ 60 degrees C; Linear Derating

4. Surge Current Per Point of 20A for 43ms each, repeatable every 2s @ 60 degrees C

5. Minimum Load Current of 10mA per point

6. Maximum On-State Voltage Drop of 1.5V peak @2.0A and 6V peak @load less than 50mA

7. Maximum Off-State Leakage of 3mA per point

E. Module Specifications (Contact Output Module)

1. Output Voltage Range of 10-265V ac, 47-63Hz

2. Output Current Rating:

a. Resistive - 2A @ 125V ac

b. Inductive - 2A Steady State, 15A make @125V ac

3. Power Rating (Steady State) of 250VA maximum for 125V ac inductive output

4. Maximum Off-State Leakage of 0 mA per point

5. Configurable States

a. Fault Per Point - Hold Last State, ON or OFF

b. Program Mode Per Point - Hold Last State, ON or OFF

2.06 ANALOG INPUT AND OUTPUT MODULES

A. General

1. Analog input modules shall convert an analog signal that is connected to the module's screw terminals into a digital value. The digital value representing the magnitude of the analog signal shall be transmitted on the backplane. Analog output modules shall convert a digital value that is delivered to the module via the backplane into an analog signal on the module's screw terminals.

2. Modules shall be designed to be installed or removed while chassis power is applied.

3. Modules shall have indicators to display the status of communication, module health and input / output devices.

4. Each analog module shall provide both hardware and software indication when a module fault has occurred. Each module shall have an LED fault indicator and the programming software shall display the fault information.

5. Analog modules shall be software configurable through the I/O configuration portion of the programming software.

6. The following status shall be capable of being examined in ladder logic

a. Module Fault Word — Provides fault summary reporting.

b. Channel Fault Word — Provides under-range, over-range and communications fault reporting.

c. Channel Status Words — Provides individual channel under-range and over-range fault reporting for process alarm, rate alarms and calibration faults.

7. The 24 VDC power for analog instrument loops shall be provided as a part of the system. The 24 VDC power supply shall be derived from the 120 VAC input power circuit to the PLC. The field side of the 24 VDC power sources(s) shall have individual or grouped (of logically associated circuits) fusing and be provided with a readily visible, labeled blown fuse indicator.

B. Isolated Analog Input Module

1. Input Range of 4-20 mA

2. Resolution of approximately 16 bits across range

3. Input Impedance of Greater than 249 Ohms

4. Overvoltage Protection: 8V ac/dc with on-board current resistor

5. Normal Mode Rejection of 60dB at 60Hz

6. Common Mode Noise Rejection of 120dB at 60Hz, 100dB at 50Hz

7. Isolation Voltage

a. Channel to Channel - 100% tested at 1700V dc for ls based on 250V ac

b. User to System - 100% tested at 1700V de for is based on 250V ac

C. Isolated Analog Output Current Module

1. Output Current Range of 4 to 20 mA

2. Current Resolution of 12 bits across 20 mA

3. Open Circuit Detection — None

4. Output Overvoltage Protection - 24V ac/dc maximum

5. Output Short Circuit Protection — 20 mA or less (electronically limited)

6. Calibration Accuracy - Better than 0.1% of range from 4mA to 20 mA

7. Calibration Interval - 12 months typical

2.07 COMMUNICATION INTERFACES

A. The PLC will be capable of the following communication protocols as shown on the drawings:

1. 10BASE-T/100BASE-TX Ethernet communication.

2. Modbus (RTU and ASCII) for up to 247 slaves

3. Rockwell Automation's RIO Protocol

4. DeviceNet

5. Asynchronous serial link capable of communicating up to 19.2Kbps

B. When required provide a Communications Interface Module mounted in the chassis or the equivalent port directly on the CPU.

2.08 PLC SOFTWARE

A. Provide a PLC configuration and application development software package complete with documentation and disks to the Owner. The PLC software package and associated licensing and/or activation shall be installed on the computers shown on the drawings.

B. The software package shall allow on-line/off-line program development, annotation, monitoring, debugging, uploading, and downloading of programs to the PLCs.

C. All required hardware (including cables, cable adapters, etc.) for connection to PLCs shall be furnished.

D. All software licenses required to achieve the functionality described in the Specifications shall be provided.

E. The software package shall include a software license agreement allowing the Owner the right to use the software as required for any current or future modification, documentation, or development of the PLCs furnished for this project.

F. The software provided shall be capable of the following IEC 61131-3 functions:

1. Ladder logic.

2. Function block.

3. Sequential function chart.

4. Structure text.

G. In addition to the above editors, an add-on instruction editor shall work with any of the above-mentioned editors to create custom reusable function blocks. This software shall allow any of the derived function blocks to be modified on-line.

H. The software shall be Microsoft Windows-based and run on the supplied computers.

I. The software shall include a security feature to prevent unauthorized personnel from modifying and downloading the programs.

J. Provide an I/O simulator which allows the PLC application load program to be tested on a PC with simulated analog and digital inputs and outputs, allowing I/O testing and debugging to be performed in a safe, isolated environment without the need for running the PLC CPU and process I/O boards.

2.09 OPERATOR INTERFACE TERMINALS (OIT)

A. OITs shall be mounted on control panels and shall run interface software separate from the existing SCADA HMI software.

B. Manufacturers

1. Provide operator interface terminals (OIT) from one of the following:

   a. Allen-Bradley Panel View Plus 6 series

   b. Or equal

C. Software

1. The Operator Interface Terminal shall be pre-packaged with all configuration and programming software necessary to perform functions as shown on drawings and within the specifications.

2. The integrated OIT software shall have the following features

   a. Trending

   b. Data Logging

   c. Alarms

   d. Graphic Symbols

   e. Animations

D. I/O Ports and Devices

1. The OIT shall have a minimum of one Ethernet 10/100 Mbps for connectivity or programming

2. The OIT shall have a minimum of one Serial RS232 port.

3. Include the following communication expansion modules in the selected OIT: a. ControlNet, DeviceNet, RIO, DH+, DH485, Modbus Plus and PROFIBUS

4. Compact flash ports shall be Type 2.

5. The OIT shall have a minimum of one USB port.

E. Display

1. The OIT display size shall be 12.1"

2. The type of display for the OIT shall be Color Active Matrix TFT.

3. The display resolution shall be a minimum of 800 x 600.

4. Display shall support touch screen input.

F. Environmental

1. Rating: OIT shall be rated to maintain the rating of the control panel it will be mounted in.

2. Operating Temperature: 0-50 degrees C.

G. Manufacturers:

1. Rockwell Automation Allen-Bradley Panel View Plus 6

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION

A. Maintain area free of dirt and dust during and after installation of programmable controller products.

B. Anchor PLCs within enclosures as recommended by the PLC manufacturer.

C. Ventilation slots shall not be blocked, or obstructed by any means.

D. Examine areas, surfaces, and substrates to receive PLCs for compliance with requirements, installation tolerances, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

E. Install in accordance with manufacturer's instructions.

F. Unload, unpack and transport equipment to prevent damage or loss.

G. Replace damaged components as directed by LFUCG Project Manager.

3.02 PANEL LAYOUT

A. Coordinate size and configuration of enclosure to meet project requirements. Drawings indicate maximum dimensions for PLCs, minimum clearances between PLCs, and adjacent surfaces and other items.

B. Comply with indicated maximum dimensions and clearances, or with PLC vendors required distances if they are greater than the distances indicated.

1. Provide spacing around PLC as required by the PLC manufacturer to insure adequate cooling. Insure that the air surrounding the PLC has been conditioned to maintain the required temperature and humidity range.

2. Wires entering and exiting PLC components shall be sized to comply with the PLC manufacturers requirements. Doors on all components shall be able to be fully closed when all the wires are installed.

3. For chassis mounted PLCs, no wiring, wire ducts, or other devices shall obstruct the removal of cards from the rack.

4. PLC lights, keys, communication ports, and memory card slots shall be accessible at all times. Lights shall be visible at all times when enclosure door is opened.

C. Control panel designer shall provide independent line fuses or circuit breakers, per the PLC manufacturer recommendation, for each power supply, input module, output module, and other modules with separately derived power requirements.

D. Control panel designer shall insure that communication signals, 4-20mA signals (including those with embedded HART), are properly conditioned for the PLC and protected from all sources of radiated energy or harmonics.

E. Each PLC (including all I/O) shall be powered from a UPS power conditioning system.

F. Where multiple mechanical components are provided for process redundancy, their field connections to I/O modules shall be arranged such that the failure of a single module will not disable all mechanical components associated with the process redundancy (e.g., inputs and outputs for redundancy device 1 shall reside on different modules than the inputs and outputs for redundancy device 2, etc.), irrespective of the number of used points resulting from this configuration.

G. Provide all required cables, cords, and connective devices for interface with other control system components.

END OF SECTION

SECTION 17312 – RADIO TELEMETRY SYSTEM

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This section describes the requirements for furnishing, installing, and starting up a radio system for polling SCADA communications using Ethernet protocol.

1.02 SYSTEM DESCRIPTION

A. The successful communication of the new RTU panel back to the designated LFUCG WWTP (Town Branch or West Hickman) is the sole responsibility of the Contractor. The new radio shall be fully compatible with the existing system.

B. The radio systems shall be comprised of, but not limited to, the following (refer to the Drawings):

1. For radio all communications:

a. The radios will be connected to a new PLC at each site. Antennas, transmission cable, connectors, enclosure and mounting hardware shall be provided as required and as shown on the Drawings.

b. A central repeater will be utilized for all communications from all sites back to the designated LFUCG WWTP (Town Branch or West Hickman) where the data will be utilized for monitoring and control from SCADA.

c. Provide directional (Yagi) antennas, coaxial cable, connectors, in-line coaxial cable surge protectors, and antenna mounting supports as required. Each antenna shall be mounted on a support structure which meets the requirements for that site as shown on the drawings. The Contractor shall be responsible for obtaining any and all required Construction Permits for the installation of equipment at the sites and shall meet all applicable codes and regulations.

d. Coordination with Owner to meet all applicable federal communications commission (FCC), state and local regulations.

C. All equipment furnished under this Section of the Specifications shall be the responsibility of the ISS. The ISS shall assume responsibility for the complete radio telemetry including radios, antennas, and radio supervisory and control system. This shall include system testing and installation. The ISS shall furnish and install any additional equipment (e.g. repeaters, towers, etc.) necessary to provide a functional system. A functional system shall be defined as a system where the received signal at any location is not less than 25 dB fade margin based on radio manufacturer's published receive sensitivity for 10-6 bit error rate for unfaded signal.

D. The existing SCADA system shall clearly identify the station being polled, the number of consecutive fails at each station, and the current poll timer, maximum poll time, and minimum poll time.

1.03 SUBMITTALS

A. Include the following information for each product specified in this section in the submittal for this section.

1. Data sheets and catalog literature for hardware (radios and accessories), and for the poll/response SCADA communications software that will be used.

2. Physical dimension drawings.

3. A complete set of installation and service manuals for the equipment specified in this section.

4. Installation and interconnection/wiring diagrams depicting the proposed installation of the equipment, in conformance to the requirements specified on the Plans. These drawings shall be detailed to the extent that they may be modified after installation to serve as the "AS-BUILT" drawings.

5. After installation is complete at each site, provide printout of radio/communication performance data (i.e. forward and reverse power, etc.).

1.04 SPARE PARTS

A. A total of two complete radios shall be furnished as unit-swappable spares. Radios and firmware for all system radios and spare radios must be identical to minimize spare parts stocking.

PART 2 - PRODUCTS

2.01 RADIOS

A. The following general requirements shall be met by the radio:

1. Frequency Band: 451.3 / 456.3 MHz.

2. Data Rate: 1 Mbps/512 kbps, user configured.

3. Environmental: Full performance -30□ to +60□C

4. Power Requirements: 10-30 VDC.

5. RTU/PLC Interface: 10/100-base T, RJ45 connector.

6. System Gain: 139dB @ 512kbps; 134dB@1Mbps

7. Receiver Sensitivity: -97dBm @ 512kbps with 10-6 BER; -92dBm @ 1Mbps with 10-6 BER

8. Protocols: Wireless Ethernet IP.

9. Encryption: AES-128 with automatic key rotation.

10. Management: HTTPS.

B. Radios shall be Schneider Trio QR450, Simrex Datamover TR or LFUCG Project Manager approved equal

2.02 ANTENNAS

A. Antennas (omni-directional and Yagi types) shall be furnished at pump station site.

B. Antenna characteristics:

1.	Frequency Range:	Per radio specifications
2.	Gain:	as required
3.	Input Power:	50 watts minimum
4.	VSWR:	Less than 1.5
5.	Lightning Protection:	Direct ground
6.	Connector:	18 inch flexible extension (RG-393/U), type N male with neoprene housing or equivalent
7.	Mounting Hardware:	Clamps, standoff hardware as recommended by the antenna manufacturer
8.	Manufacturer:	Radio Frequency Systems (Celwave), or approved equal

C. Each antenna shall be mounted on a support structure which meets the requirements for that location.

2.03 TRANSMISSION CABLE AND ACCESSORIES

A. The transmission cable connecting the radio antenna port with the antenna shall be the low-loss foam-dielectric coaxial type. A single continuous piece of coaxial cable shall be furnished for each radio. This cable shall be ½ inch diameter (Andrew LDF4-50A, or equal). For coax runs exceeding 100 feet in length, furnish 7/8" diameter cable (Andrew LDF5-50A, or equal).

B. Provide one 3-foot section of "superflexible" transmission cable for coax interconnection at the radio antenna port. Provide standard Type N connectors at each end which will mate with the SS radio and the transmission cable.

C. Furnish two N-type connectors for terminating both ends of each transmission cable.

D. Furnish two coaxial cable grounding kits per radio. Furnish Andrew, or equal.

E. Provide Andrew coaxial cable hanger kits and clamping hardware, in 316 stainless steel. Adequate kits shall be installed to anchor the cables at three-foot intervals on the vertical antenna mast/tower.

F. All outdoor coaxial connectors shall be wrapped with two layers of Scotch Super 88 UV resistant tape, and then coated with two layers of Scotch-Kote.

2.04 LIGHTNING/SURGE PROTECTION

A. Furnish one in-line coaxial cable surge protector for each cable. Furnish Polyphaser, or equal with N-connector mating.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION

A. Instrumentation and accessory equipment shall be installed in accordance with the Manufacturer's instructions. Obtain in the field all information relevant to the placing of

process control work and in case of any interference with other work, coordinate with the LFUCG Project Manager/Owner and furnish all labor and materials necessary to complete the work in an acceptable manner.

B. All work shall be executed in full accordance with codes and local rulings. Should any work be performed contrary to said rulings, ordinances and regulations, the ISS shall bear full responsibility for such violations and assume all costs arising therefrom.

END OF SECTION

SECTION 17410 - BASIC MEASUREMENT AND CONTROL INSTRUMENTATION MATERIALS AND METHODS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The Contractor shall furnish all materials, labor, tools, equipment, supplies and services necessary to install all process control and instrumentation equipment complete as specified herein and shown on the Drawings. The Contractor shall be responsible for the expense of changing Drawings or structures, or any other expense necessitated by reason of installing alternative equipment. The Contractor will assume the responsibility for the satisfactory operation of any and all equipment offered.

B. The following equipment specification is included to establish the quality of equipment to be obtained. It is the intent of these Specifications to obtain industrial quality instrumentation and control equipment. Equipment furnished shall be accepted by the LFUCG Project Manager, prior to purchase by the Contractor.

C. Auxiliary and accessory devices necessary for system operation or performance, such as transducers or relays to interface with equipment provided under other Sections of this Specification, shall be included whether specified or not, at no extra cost.

D. In order to ensure proper integration and compatibility of the instrumentation and control systems, the systems must be supplied by a single provider of instrumentation and control equipment. This is not to say that all equipment being supplied shall be manufactured by a single manufacturer, but rather that a single provider of instrumentation and control equipment shall be responsible for supplying the complete system. To facilitate the Owner's future operation and maintenance, products performing the same function shall all be of the same manufacturer, type, and model number.

E. Substitutions on functions or equipment specified will not be acceptable. In order to ensure the interchangeability of parts, the maintenance of quality, the ease of interfacing between the various subsystems, and the establishment of minimums with regard to ranges and accuracy, strict compliance with the above requirements shall be maintained. In order to ensure compatibility between all equipment, it shall be the responsibility of the system supplier hereunder to coordinate all interface requirements with mechanical and electrical system suppliers and furnish any signal isolation devices that might be required.

F. Equipment shall be fabricated, assembled, installed, and placed in proper operating condition in full conformity with detail drawings, specifications, LFUCG Project Manager provided data, instructions, and recommendations of the equipment manufacturer as accepted by the LFUCG Project Manager.

G. The instrument supplier for this Contract shall be responsible for making the modifications shown on the Drawings and for calibrating all instruments and placing them in proper working order.

H. The Contractor shall be responsible for subcontracting out and managing the System Integration (programming) services and including this cost in the bid, to be paid for under an allowance. Refer to specification section 01210 on allowances.

1.02 RELATED WORK

A. The following Sections of this Specification Division contain requirements on instrumentation and control equipment and software which are considered to be covered by applicable requirements of this section (and shall be included in the bid by a single Instrumentation Supplier for this Project):

Section 17311 – Plc Hardware and Software
Section 17420 - Instruments
Section 17430 - Boxes, Panels, and Control Centers
Section 17480 - Instrument Lists and Reports
Section 17490 - Measurement and Control Commissioning

B. The following Divisions of these Specifications contain requirements on equipment furnished by other suppliers that must interface with the instrument system, or on methods and materials to be performed/used in the installation and/or wiring of the instrumentation system.

Division 1 - General Requirements
Division 11 - Equipment
Division 16 - Electrical

1.03 QUALITY ASSURANCE

A. The system supplier shall be required to demonstrate a minimum of 4 years recent, past experience in the design, manufacture, and commissioning of instrumentation and control systems of comparable size, type, and complexity to the proposed project. Further, the manufacturer must have at least 10 similar systems in operation currently. The system supplier shall be required to have his own in-house capability to handle complete system layout, fabrication, and testing.

B. The system supplier shall have in his employ the capable personnel for detailed coordination, drafting, procurement and expediting, scheduling construction, testing inspection, installation, start-up service for calibration and commissioning, and warranty compliance for the period specified.

1.04 REFERENCES

A. The Contractor is referred to Standards and Practices for Instrumentation published by the International Society of Automation (latest edition), for terminology, symbols, methods, and practices used or described herein or on the Drawings.

1.05 SUBMITTALS

A. General

1. Complete detail Drawings of the instrumentation and control systems and all components shall be submitted to the LFUCG Project Manager for review. They shall include installation instructions, operation and maintenance instructions, descriptive literature, connection drawings, and parts list for each item as well as individual control schematic drawings for each item.

2. The Contractor shall make any corrections or changes required by the LFUCG Project Manager, within the scope of the Drawings and Specifications, and return for final review and distribution. Number of copies shall be as specified in Special conditions and as agreed at the pre- construction conference.

3. Should any system submitted in the shop drawings not meet with the LFUCG Project Manager's acceptance as to conformity with requirements of the Drawings and Specifications, it shall be the responsibility of the successful Contractor to make whatever changes are necessary for acceptance at no extra cost to the Owner.

B. Detailed Requirements - Instruments/Hardware

1. Detailed information for each instrument or control device shall be submitted, including manufacturer's descriptive literature and a specific data sheet for each device which shall include as a minimum:

    a. Tag number assigned by the Contract Documents.

    b. Product (item) name used herein and on the Scope of Services.

    c. Manufacturer's complete model number.

    d. Location of the device.

    e. Input - output characteristics.

    f. Electrical characteristics.

    g. Range, size, and graduations.

    h. Physical size with dimensions, enclosure NEMA classification, and mounting details.

    i. Materials of construction of all components.

    j. Instrument or control device sizing calculations where applicable.

    k. Certified calibration data on all flow metering devices.

2. Submit a detailed loop diagram, for each monitoring or control loop, each on a single 8 ½ in. x 11 in. sheet. The format shall be the Instrument Society of America, Standard for Instrument Loop Diagrams, ISA-S5.4.

3. The data sheets shall be provided with an index and proper identification and cross-referencing. Partial submittals will be rejected.

4. Submit detailed drawings concerning control panels and/or enclosures including:

    a. Cabinet assembly and layout drawings to scale.

    b. Fabrication and painting specifications.

    c. I/O layout.

    d. Elementary panel wiring diagrams

    e. Point to point wiring diagrams depicting wiring within the panel as well as connections to external devices.

    f. Color samples for paint selection by the LFUCG Project Manager and/or Owner.

    g. Panel submittal drawings shall be on 11 in x 17 in. sheets.

5. Exceptions to the Specifications or Drawings shall be clearly indicated in the submittal by the system supplier. Data shall contain sufficient details so a proper evaluation may be made by the LFUCG Project Manager.

6. Prior to final acceptance, the final shop drawing submittal, which is to include Installation, Operation, and Maintenance instructions, shall be updated to reflect "As Constructed" status, and shall provide at least the following as a minimum:

    a. A comprehensive index.

b. A complete “As Constructed” set of accepted shop drawings.

c. A complete list of the equipment supplied, including serial numbers, ranges, and pertinent data.

d. Full specifications on each item.

e. System schematic drawings “As Constructed”, illustrating all components, piping and electrical connections of the systems supplied under this Section.

f. Detailed service, maintenance, and operation instructions for each item supplied.

g. Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.

h. The operating instructions shall also incorporate a functional description of the entire system, with reference to the systems schematic drawings and instructions.

i. Complete parts lists with stock numbers and name, address, and telephone number of the local supplier.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Shipping Precautions:

1. After completion of shop assembly, factory test, and acceptance, all equipment, cabinets, panels, and consoles shall be packed in protective crates and enclosed in heavy duty polyethylene envelopes or secured sheeting to provide complete protection from damage, dust, and moisture. Dehumidifiers shall be placed inside the polyethylene coverings. The equipment shall then be skid-mounted for final transport. Lifting rings shall be provided for moving without removing protective covering. Boxed weights shall be shown on shipping tags together with instructions for unloading, transporting, storing, and handling at the job site.

2. Special instructions for proper field handling, storage and installation required by manufacturer for proper protection, shall be securely attached to each piece of equipment proper to packaging and shipment.

B. Identification:

1. Each component shall be tagged to identify its location, tag number and function in the system. Identification shall be prominently displayed on the outside of the package.

2. A permanent stainless steel or other non-corrosive material tag firmly attached and permanently and indelibly marked with the instrument tag number, as given in the tabulation, shall be provided on each piece of equipment supplied under this Section.

C. Storage:

1. Equipment shall not be stored out-of-doors. Equipment shall be stored in dry permanent shelters including in-line equipment,and shall be adequately protected against mechanical injury. If any apparatus has been damaged, such damage shall be repaired by the Contractor at his own cost and expense. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through such tests as directed by the LFUCG Project Manager. This shall be at the cost and expense of the Contractor, or the apparatus shall be replaced by the Contractor at his own expense.

1.07 WARRANTY (MAINTENANCE CONTRACT)

A. A written total instrument maintenance contract shall be provided to the Owner, executed by the system supplier as a part of the work under this Section. The maintenance contract shall include all labor, parts, and emergency calls providing on-site response within 48 hours, to provide complete instrument system maintenance for a period of one year after the date of final acceptance of the system. The maintenance contract shall also include a minimum of 2 semi-annual preventive maintenance visits by a qualified serviceman of the supplier who is familiar with the type of equipment provided for this project. Each preventive maintenance visit shall include routine adjustment, calibration, cleaning, and lubrication of all system equipment and verification of correct operations. Emergency maintenance procedures or plant visits may coincide with a scheduled preventive maintenance visit, however, they shall not replace the work intended to be performed during a preventive maintenance visit. The system supplier shall have full responsibility for the preventive and corrective maintenance including replacing of defective components, maintaining sufficient spare parts on-site, and complete calibration of all components under this section, all at no cost to the Owner. The maintenance contract shall not begin until both the instrumentation training course and the system acceptance test have been successfully completed, at which time the Owner shall be capable of performing necessary preventive maintenance, and all instruments shall be functional.

B. During the one-year maintenance period, observation of maintenance operations by designated Owner personnel, and the instruction of said personnel in the details of the maintenance work being performed shall be provided.

C. A complete written report shall be furnished the LFUCG Project Manager and Owner after each scheduled and unscheduled visit, giving problems corrected, systems needing recalibration, and recommendations to prevent recurrence, if applicable.

D. The costs for the one-year maintenance service contract shall be included in the Contract price.

1.08 TRAINING

A. A training program shall be set up and conducted by the major equipment manufacturer furnishing the instrumentation package. The training session shall be for a minimum period of 1 day uninterrupted and shall be conducted at the pump station.

B. A course outline showing the material to be covered shall be submitted to the LFUCG Project Manager for review. The training program shall include both classroom and “hands-on” instruction for each instrument supplied under this group of the Specifications and shall furthermore include operational training, maintenance training, and training on use of calibration equipment.

C. As the equipment installed at the plant shall be used for the “hands-on” training, the training program shall not be conducted until all of the systems are operational, and operational related “punch list” items are corrected.

D. Training on equipment supplied by a manufacturer other than the major equipment manufacturer shall be by the original equipment manufacturer, and shall be scheduled in the training programs by the major equipment manufacturer. Exceptions may be granted if the instructor demonstrates adequate knowledge on the care and operation of the other manufacturers’ equipment.

E. The training programs shall be conducted at a time mutually agreeable to the LFUCG Project Manager, Owner, Contractor, and Supplier. The Owner shall decide how many of his personnel shall attend the training. A representative of the LFUCG Project Manager may observe the training in progress. The Owner shall have the right to record all training as it is conducted.

F. The supplier shall make use of audio-visual aids in the training courses and shall provide the OWNERS staff his undivided attention (i.e., shall not conduct his company business during training hours) for the full 1 day. The supplier shall furnish training participants with written handouts, preferably copies of the shop drawing submittal books, up to a maximum of 6 copies, for purposes of familiarization with the shop drawings, and to assist in explanations.

PART 2 - PRODUCTS

2.01 GENERAL

A. All instrumentation supplied shall be of the manufacturer's latest design and shall produce or be activated by signals which are established standards for the water industry.

B. All electronic instrumentation shall be of the solid-state type and shall utilize linear transmission signals of 4 to 20 mAdc (milliampere direct current), however, signals between instruments within the same panel or cabinet may be 0-10 V.d-c (volts direct current), or other manufacturer standard.

C. Outputs of equipment that are not of the standard signals as outlined, shall have the output immediately raised and/or converted to compatible standard signals for remote transmission. No zero based signals will be allowed for remote transmission.

D. All instruments shall be provided with mounting hardware and floor stands, wall brackets, or instrument racks as shown on the Drawings or as required.

E. All indicators and LED readouts shall be linear, direct reading in process units, unless otherwise noted. Percentage scales and indicators are prohibited.

F. All transmitters shall be provided with either integral indicators or conduit mounted indicators in process units, accurate to two percent, unless otherwise noted.

G. Electronic equipment shall be of the manufacturer's latest design, utilizing printed circuitry and suitably coated to prevent contamination by dust, moisture, and fungus. Solid state components shall be conservatively rated for their purpose, to assure optimum long term performance and dependability over ambient atmosphere fluctuations and 0 to 95 percent relative humidity. The field mounted equipment and system components shall be designed for installation in dusty, humid, and slightly corrosive service conditions.

H. All equipment, cabinets, and devices furnished hereunder shall be heavy-duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer, in-so-far as possible, and shall consist of equipment models which are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion.

I. All equipment shall be designed to operate on a 60 Hertz alternating current power source at a nominal 115 volts, plus or minus 10 percent, except where specifically noted. All regulators and power supplies required for compliance with the above shall be provided between power supply and interconnected instrument loop. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.

J. All analog transmitter and controller outputs shall be 4-20 milliamperes into a load of 0-750 ohms, unless higher load capacity is required.

K. All switches shall have double-pole double-throw contacts rated at a minimum of 600 VA, unless specifically noted otherwise.

L. Materials and equipment used shall be UL listed (or other independent lab listed) wherever such listed equipment and materials are available.

M. 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 manual resetting when power is restored.

N. All circuit boards in instruments mounted in damp locations or mounted outdoors shall be fungus proofed. All field transmitters mounted outside shall be equipped with sunshields and shall be capable of operation to -20^{o} Fahrenheit.

O. Equipment installed in a hazardous area shall meet Class, Group, and Division as shown on the Scope of Services, to comply with the National Electrical Code. All power supply and signals coming from and going to hazardous areas shall have intrinsic safety barriers provided.

2.02 INSTRUMENTS AND ACCESSORY EQUIPMENT

A. Refer to other Division 17 Instrumentation Specification Sections for equipment requirements for field mounted primary devices, transmitters, and secondary instruments, receivers and central control equipment.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 17420 - INSTRUMENTS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The CONTRACTOR shall furnish and install all primary devices, transmitters, primary and secondary receivers, analyzers and accessory items as shown on the Scope of Services and as specified herein.

1.02 RELATED WORK

A. The following Sections of this Specification Division contain requirements on instrumentation and control equipment and software which are considered to be covered by applicable requirements of this section (and shall be included in the bid by a single Instrumentation Supplier for this Project):

Section 17311 - Plc Hardware and Software
Section 17312 - Radio Telemetry System
Section 17410 - Basic Measurement and Control Instrumentation Materials and Methods
Section 17430 - Boxes, Panels and Control Centers
Section 17480 - Instrument Lists and Reports
Section 17490 - Measurement and Control Commissioning

B. The following Divisions of these Specifications contain requirements on equipment furnished by other suppliers that must interface with the instrument system, or on methods and materials to be performed/used in the installation and/or wiring of the instrumentation system.

Division 1 - General Requirements
Division 11 - Equipment
Division 16 - Electrical

PART 2 - PRODUCTS

2.01 INSTRUMENTS AND ACCESSORY EQUIPMENT

A. Product Descriptions

1. Loop Isolator/Signal Converter/Intrinsic Safety Barriers

a. Loop isolators, intrinsic barriers, or signal converters shall be furnished and installed where indicated, to isolate signals or to increase the load capacity of a system required to have many devices in the loop, or to limit energy to safe levels. Isolators shall provide 3-way isolation and shall have a power supply voltage of 115 VAC unless otherwise indicated. 2 wire style isolators are not acceptable. Isolators shall be Moore SCT, AGM, RIS, or equal, enclosed as appropriate for the application, or as indicated.

2. Computing Relays/Integrators

a. Computing relays or integrators for such purposes as batching, summing, totalization, etc., shall be Moore Industries, AGM, RIS, or equal.

3. Transient/Lightning Suppressors

a. Device Locations: As a minimum, provide surge protection devices at the following

locations:

1) At any connections between ac power and electrical and electronic equipment, including panels, assemblies, and field mounted analog transmitters.

2) At both ends of all analog signal circuits that have any portion of the circuit extending outside of a protecting building.

3) At both ends of all copper-based communications cables which extend outside of a building, including at field instruments and the field side of analog valve position signals.

4) On all external telephone communications lines.

b. Surge protection device assemblies for connections to AC power supply circuits shall:

1) Be provided with two 3-terminal barrier terminal strips capable of accepting No. 12 AWG solids or stranded copper wire. One terminal strip shall be located on each end of the unit.

2) Have a nonflammable enclosure that meets or exceeds UL 94 V0 flammability requirements. The surge protection device shall be provided with provisions for mounting to interior of equipment racks, cabinets, or to the exterior of freestanding equipment.

3) Be constructed as multistage devices consisting of gas tube arrestors, high energy metal oxide varistors, or silicon avalanche suppression diodes. Assemblies shall automatically recover from surge events, and shall have status indication lights.

4) Comply with all requirements of UL 1449, second edition.

5) Be able to withstand a peak surge current of 10,000 amps based on a test surge waveform with an 8-microsecond rise time and a 20-microsecond exponential decay time, as defined in UL 1449.

6) Have the following characteristics:

a) Maximum Continuous Operating Voltage: 150VAC

b) Maximum Operating Current: 20 amps

c) Ambient Temperature Range: -20 degrees C to +65 degrees C

d) Response Time: 5 nanoseconds

c. Surge protection device assemblies for analog signal circuits shall:

1) Have four lead devices with a threaded mounting/grounding stud or DIN Rail mounting.

2) Have a nonflammable enclosure that meets or exceeds UL 94 V0 flammability requirements.

3) Be constructed as multistage devices consisting of gas tube arrestors and silicon avalanche suppression diodes. Gas tube arrestors and diodes shall be separated by a series impedance of no more than 20 ohms. Assemblies shall automatically recover from surge events.

4) Comply with all requirements of UL 497B.

5) Be able to withstand a peak surge current of 10,000 amps based on a test surge waveform with an 8-microsecond rise time and a 20-microsecond exponential decay time, as defined in UL 1449.

6) Limit line-to-line voltage to 40 volts on 24VDC circuits.

7) Have the following characteristics:

a) Maximum Continuous Operating Voltage: 28VDC

b) Ambient Temperature Range: -20 degrees C to +65 degrees C

c) Response Time (Line-to-Line): 5 ns

d. Acceptable manufacturers shall be Phoenix Contact, Weidmuller, Transtector, or equal.

4. Altitude and Pressure Gauges

a. All indicating gauges are pipe mounted with male and brass threaded pipe connections. Gauges shall be 4 1/2 inch liquid filled for maximum vibration and corrosion protection. Gauges shall have phosphor bronze Bourdon tubes, white laminated phenol dials. Gauges shall have micrometer adjustment of pointers and black phenol, black cast iron, brass, or aluminum case and ring, original rotary gear design, corrosion resistant, stainless steel movement, blowout protection, and bronze socket with wrench flats. Accuracy shall be within 1/2 of 1 percent of the scale range. They shall be as manufactured by Helicoid Gage Division, “410"; Ashcroft; U.S. Gauge; Wika; or equal.

b. All gauges shall be piped with 316 Stainless Steel piping and provisions for venting pressure to allow calibration (zero) checks. Valves for gauge shutoff and zeroing shall be 1/4 turn ball valves with lever handle, 316 Stainless Steel.

c. Liquid filled diaphragm seals shall be installed on all gauges as indicated in the Gauge Schedule in Section 17480 of the Specifications. Diaphragm seals shall be of the continuous duty type, 3 piece construction with 1/4 inch flushing connection, 1/4 inch fill connection, 316 stainless steel lower housing and diaphragm material 1/4 inch gauge connection and 1/2 inch lower connection. Housing bolts shall also be stainless steel. Acceptable models are Marsh 42-01, Helicoid 100H, Ashcroft, or equal. Viton diaphragms are required on low range pressure applications (less than 15 psig). To prevent accidental loss of fluid, diaphragm seals shall be permanently attached to gauges by installation of a lead sealed wire connecting the two. Fill fluid shall be factory installed silicone. All gauges shall be precalibrated, as an assembly, with the seal.

5. Magnetic Flowmeter

a. Meter sizes larger than 4 inch shall be obstructionless, short form, characterized coil design, and the output signal produced shall be directly proportional to the liquid flow rate. The metering tube shall be steel with 150 pound ANSI flanged end connections. Liner shall be polyurethane or rubber. The electrodes shall be bullet nosed 316 stainless steel or Hastelloy C, and shall be field replaceable. The coils which generate the field shall be inside the pipe wall and shall be encapsulated in epoxy plastic and encased within the flow meter lining material. Laying length shall not exceed 1 ½ times the meter size. The meter shall have complete zero stability.

b. The temperature of the process will not exceed 135 degrees Fahrenheit. The meter

primary shall be suitable for submersion in 33 ft. of water for 48 hours.

c. The signal converter (transmitter) shall be designed for use in connection with the magnetic flowmeter primary devices supplied and shall receive its signal from the primary device and convert it to a corresponding pulse and current signal. A linear output meter and 8 digit non-reset register shall be provided on the converter. Indication, totalization and output signal shall be for either forward or reverse flow, with flow direction indicated by contact closure. Signal converter shall be powered by 120 VAC, single phase.

d. The meter shall provide a constant zero output during conditions of false flow signals are possible. An empty pipe detection feature shall drive the output signals to zero or 130% of range when electrodes become uncovered.

e. The signal converter shall have a NEMA 4X enclosure. The enclosure shall have a gasketed cover with window for reading the horizontal output meter and 8 digit non-reset flow register. The converter shall have solid state, printed circuit construction with a continuously adjustable range from 0-3 to 0-30 ft./sec., requiring no zero adjustment. The transmitter shall utilize a pulsed DC technique to drive the flux producing coils of the primary, converting the low level, high impedance pulsed DC signal to a 4-20 mADC current output directly proportional to flow rate. Where indicated, provide RS-232 or RS-484 serial interface connection. The output shall be provided with HART™ digital communications, with provides a digital process variable superimposed on the 4-20 mADC signal, with protocol based on Bell 202 FSK standard.

f. Liner voltage and frequency variations of ±10% shall have no effect on instrument calibration.

g. The scaled pulse output signal shall be inhibited when the flow rate is 2 percent or less of the maximum flow setting.

h. The accuracy, including the primary, shall be <0.25% or rate or <5% of full scale for a span setting of 0.53-30 ft/sec.

i. All magnetic flow meters shall be provided with type 316 stainless steel grounding rings. All interconnecting signal cable between the magnetic flowmeter and signal converter shall be provided by the meter manufacturer and be of sufficient length as required for the installation shown on the Drawings. Provide all special cable terminations/fittings to replace the meter body should removal be necessary.

j. The flowtube shall be suitable for use in Class I, Division 1, Group D hazardous locations, unless otherwise noted on drawings.

k. The flowmeter shall be 3000 or 3000G, COPA-X series as manufactured by ABB, or equal.

6. Submersible Pressure Transducer

a. The submersible pressure transducer shall be a continuous level measuring device that converts the measured pressure to a level reading and provides a continuous 4-20 mADC output.

b. The sensor shall be constructed of titanium and shall be suitable for installation in a well, tank, pipe, etc. Wetted materials shall be suitable for installation in nearly all fluids, including wastewater. The sensor cable shall contain a vent tube to reference the measured pressure to atmosphere.

c. The cable shall be constructed of tefzel, and shall be integrally connected at the

sensor with internal potting to prevent ingress of fluid back into the transmitter. Length of the cable shall be as required for the installation shown.

d. The sensor shall contain an internal lightning arrestor and voltage spike protection.

e. Operating temperature range shall be -4 to 140° F. The sensor shall be furnished and calibrated for the operating pressures encountered for the application, and the sensor shall be capable of four times the rated pressure without damage to the sensor.

f. The sensor/cable assembly shall be rated NEMA 4X, NEMA 6P, and NEMA 7 for Class I, Division 1 hazardous locations.

g. The submersible pressure transmitter shall be Druck PTX 1835 series, or equal.

7. Eccentric Weight Float Type Level Sensors

a. The level monitor shall be the integral eccentric weight non-mercury float switch type, Flygt Model ENM-10, or approved equal.

8. Combustible Gas Detection

a. The combustible gas monitor shall be a combination sensor/transmitter with LED display, and shall operate on an infrared sensing technology. The unit shall utilize an infrared light source which is directed through two wavelength filters, providing a dual-beam concept with a reference beam and a target gas beams which are directed back to the corresponding detector. The difference in IR intensity shall be proportional to the gas concentration.

b. The sensor shall provide a 4-20 mADC output which is proportional to the measured gas concentration.

c. Input voltage shall be 24VDC. Provide optional power supply with 115VAC input.

d. Two alarm relays shall be provided, with N.O. dry contact outputs rated 115VAC, 5A minimum.

e. The sensor/transmitter shall be UL listed for Class I, Division 1, Group D hazardous locations. Enclosure shall also have a NEMA 4X rating.

f. The combustible gas detection system shall be Sierra Monitor Model 5100-28-IT, or equal.

g. The toxic gas detector shall be of the same “IT” series by Sierra Monitor to match the combustible gas detector specified above. Provide Model 5100-03-IT for detecting low oxygen levels. Provide Model 5100-05-IT for detecting hydrogen sulfide.

h. Provide a Sierra Monitor Sentry IT Controller for 16 points, NEMA 1enclosed, suitable for 115 VAC power supply. Provide local HMI in controller and an Ehternet/IP communications port for connection of the system to the WWTP SCADA system.

i. Provide all necessary fittings, accessories, and calibration gases for maintenance and setup.

9. Single Station Smoke Detectors

a. The detector shall be photo-electric type with 2.5% normal sensitivity.

b. The alarm shall utilize an infrared LED sensing circuit which pulses in 4 to 5

second intervals; when subjected to smoke the pulse rate shall increase 8 times. After 2 consecutive pulses in smoke, the detector will alarm.

c. The alarm shall provide minimum 5-to-1 signal-to-noise ratio in the optics frame to assure stability of operation in environments of high RF and transient conditions.

d. The sensing chamber shall be fully protected to prevent entrance of small insects, thus reducing the probability of false alarms.

e. A solid state piezo alarm rated at 90dBA at 10ft.

f. A visual LED monitor (condition indicator) will pulse in normal operation and will remain solid in alarm.

g. An easily accessible test knob shall be provided. The test knob in the TEST position will simulate an actual smoke condition of approximately 3.4% causing the detector to alarm within 20-36 seconds. It will also have the capability of testing to 0.85% as a required minimum. A magnetic switch closure or other switch closure, or smoke generating equipment which does not scatter the light beam or test sensitivity is not sufficient.

h. The alarm shall have a tandem interconnect capability of up to 12 units or 6 units with relay.

i. The manufacturer shall provide other compatible alarm models with the following optional features: 1) auxiliary Form A/Form C relay contacts for the initiating remote functions and annunciation; 2) relay option that is capable of activation by tandem interconnect wire. Thermal sensor shall be self-restoring.

j. Unit must be UL 217 listed for both wall and ceiling mount.

k. All equipment shall be completely factory assembled, wired and tested, and the contractor shall be prepared to submit a certified letter testifying to this condition.

l. The Photoelectric Smoke Alarm shall be a Gentex Model 7100F, or equal.

10. Temperature Switch

    a. Provide a temperature switch for monitoring high temperature in the Electrical Building.

    b. Switch shall be United Electric 100 Series, 0-225 degrees Fahrenheit (or approved equal), set at 120 degrees.

11. Magnetic Door Contacts

    a. Door Intrusion Limit Switches shall be normally open with circuit closed when magnet is engaged, as manufactured by EDWARDS Catalog No. 60 or equal.

    b. Contacts for overhead doors shall be Winn Security products BSD-3011 or equal.

12. Sump Level Monitors

    a. The level monitors shall be of the tank float switch type. The instrument shall have a pipe size threaded nipple for mounting on a 6 inch by 6 inch by 1/4 inch (4 inches long) aluminum angle provided by the Contractor.

    b. The float material shall be stainless steel and shall be spherical in shape, having a 4 inch approximate diameter.

c. The enclosure shall be watertight NEMA 4X or explosion-proof rated for Class 1, Division 1, Group D atmospheres as shown on the Drawings. Power supply shall be 115 volts ac.

d. Float switches shall be equal to Model T20-4 as manufactured by Magnetrol International, or Series 301 as manufactured by Mercoid Control Corporation.

PART 3 – EXECUTION

3.03 GENERAL

A. All equipment shall be installed in accordance with manufacturer's instructions, commissioned and calibrated by factory-trained technicians.

END OF SECTION

SECTION 17430 - BOXES, PANELS, AND CONTROL CENTERS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The Contractor shall furnish and install all boxes, panels and control centers and accessory items as shown on the Scope of Services and as specified herein.

1.02 RELATED WORK

A. The following Sections of this Specification Division contain requirements on instrumentation and control equipment and software which are considered to be covered by applicable requirements of this section (and shall be included in the bid by a single Instrumentation Supplier for this Project):

Section 17311 – Plc Hardware and Software
Section 17312 – Radio Telemetry System
Section 17410 – Basic Measurement and Control Instrumentation Materials and Methods
Section 17420 – Instruments
Section 17480 – Instrument Lists and Reports
Section 17490 – Measurement and Control Commissioning
Section 16900 – Controls

B. The following Divisions of these Specifications contain requirements on equipment furnished by other suppliers that must interface with the instrument system, or on methods and materials to be performed/used in the installation and/or wiring of the instrumentation system.

Division 1 - General Requirements
Division 11 - Equipment
Division 16 - Electrical

PART 2 - PRODUCTS

2.01 FABRICATION

A. Instrument Panels

1. Furnish and install the following instrument panels:

   a. PLC-AMPS

   b. Safety Stop Relay Box

   The instrument panels shall be similar in design to that shown on the Drawings or as specified herein. The panels shall be of all-welded Type 316 stainless steel construction, shall be rated NEMA 12. Panels shall be suitable for surface wall mounting, unless indicated as freestanding.

2. The panel shall have double doors. Doors shall have a triple latch with continuous hinge with chrome plated handle and lock. The top of the panel shall be covered. The panel shall mount on the floor and be anchored down, similar to the way Motor Control Centers are anchored.

3. Panels shall contain an interior light with switch by the door inside, and an interior GFCI

duplex receptacle. The duplex receptacle shall be powered upstream of the UPS.

4. The panels shall be sized to provide heat dissipation such that the maximum operating temperature for the lowest rated component is not exceeded with an ambient temperature of 100 deg F.

5. Provide thermostatically-controlled panel heater to maintain an interior panel temperature of not less than 50 degrees F with an ambient temperature of -20 deg F. Panel heater shall not be powered from the UPS.

6. All conductors running from the field to the panels shall be a single, continuous length, without splices, except at accepted junction boxes. Junction boxes shall have terminal blocks with 20 percent spares in addition to terminals for all wires including spare wires. Special care shall be exercised to carry grounding lines through such junction boxes with the least possible resistance.

7. All panel equipment shall be mounted and wired on or within the cabinet. Wiring shall comply with the latest National Electrical Code. All wiring within the panel shall be grouped together with harnesses or ducts and secured to the structure. All wiring shall be numbered in accordance with the numbering system used on the wiring/connection diagrams. Power wiring shall be routed in separate wireways from low voltage DC signal wiring. Where crossing power and low voltage DC wiring is necessary, crossing shall be at right angles. Parallel troughs for different voltages shall be separated by a minimum of 12 inches. Power wire shall be 12 AWG type THWN stranded, insulated for not less than 600 volts, unless specified otherwise. Signal wire shall be 16 AWG, THW stranded, insulated for not less than 600 volts.

8. Wire color shall be as follows:

    a. Line Power – Black

    b. Neutral or common – White

    c. AC Control – Red

    d. DC Control – Blue

    e. Equipment or Chassis Ground – Green

    f. Externally powered circuits - Yellow

9. Wiring and connection diagrams shall conform to ISA S5.4 Instrument Loop Diagrams and shall be submitted by the manufacturer as part of the shop drawings for review by the LFUCG PROJECT MANAGER.

10. All wiring in the panels shall terminate in a terminal blocks. Terminal blocks shall have a minimum of 25 percent spares of each type. Terminal blocks shall be arranged in vertical rows and separated into groups (Power, AC control, DC signal, alarm). Terminal blocks shall be barrier type with the appropriate voltage rating (600 volts minimum). They shall be the raised channel mounted type. Wiring trough for supporting internal wiring shall be plastic type with snap-on covers. The sidewalls shall be open top type to permit wire changing without disconnecting. Wire connectors shall be the hook fork type with non-insulated barrel for crimp type compression connection to the wire. Wire and tube markers shall be the sleeve type with heat impressed letters and numbers. Terminal strips shall be provided for the purpose of connecting all control and signal wiring. Direct interlock wiring between equipment will not be allowed. Only one side of a terminal block row shall be used for internal wiring. The field wiring side of the terminal shall not be within 6 inches of the side panel or adjacent terminal. Wiring troughs shall not be filled to

more than 60 percent visible fill. Wiring trough covers shall be match marked to identify placement. If component identification is shown on covers for visibility, the ID shall also appear on the mounting sub-panel.

11. All wiring to hand switches and devices which are live circuits independent of the panel's normal circuit breaker protection shall be clearly identified as such.

12. Nameplates shall be provided for all flush mounted equipment. The nameplates shall be approximately 1 inch by 3 inch constructed of black and white laminated, phenolic material having engraved letters approximately 1/4 inch high, extending through the white face into the black layer. Nameplates may be omitted if a nameplate of approximately the same dimension is more conveniently and suitably located on the instrument door or face. Nameplates shall be attached to panels by self-tapping screws.

13. Print storage pockets shall be provided on the inside of each panel. Its size shall be sufficient to hold all of the prints required to service the equipment.

14. The instrument panel shall be factory-tested prior to shipment. Field installation by the Subcontractor shall consist only of setting the panel in place and making necessary electrical connections.

15. All components shall be mounted in a manner that shall permit servicing adjustment, testing and removal without disconnecting, moving or removing any other component. All gages, meters, receivers, switches, pushbuttons and accessories shall be flush mounted.

16. Components mounted on the inside of panels shall be mounted on removable plates and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required otherwise by the manufacturer to protect equipment from vibration. Component mounting shall be oriented in accordance with the component manufacturer's and industries' standard practices. All internal components shall be identified with suitable plastic or metal engraved tags attached with drive pins adjacent to (not on) each component identifying the component in accordance with Drawings, Specifications, and Supplier's data.

17. Pushbuttons shall be heavy-duty, oil tight, 30.5 mm, with momentary contacts. Switches shall be supplied with the number of poles required for the application, an escutcheon plate, and contacts rated for 10 amperes at 120 volts AC.

18. Relays shall be double pole, double throw, octal plug-in type with a transparent dust cover. The relay shall be equipped with an indicating light to indicate when its coil is energized. The relays shall have contacts rated for 10 amperes at 120-volts AC. The mechanical life of the relay shall be 10,000,000 operations minimum (ampere rating shall be increased as necessary for load handling capacity where needed.)

19. Timing relays shall be solid-state plug-in type with a dust and moisture resistant case. The timers shall be of the multi-range/analog or digital type with selectable ranges, between 1 second and 10 hours full scale. The output contacts shall be rated at 2.5 amperes minimum at 120 volts AC. The timing relay shall have a "timing in progress" indication. The mechanical life shall be 10,000,000 operations minimum.

20. Selector switches shall be heavy-duty 30.5 mm, oil tight. Switches shall be supplied with the number of poles required for the application, an escutcheon plate, and contacts rated for 10 amperes at 120 volts AC.

21. General layout of instruments and controls are shown on the Drawings. Minor deviations from the layout may be allowed after review by the LFUCG PROJECT MANAGER.

22. The instrument panels shall be furnished by the instrumentation and control system

supplier. Complete shop drawings, including wiring diagrams and panel structural drawings, shall be required for review prior to shipment.

23. Furnish Eaton Oxidation Inhibitors and install one in each panel at time of start-up.

24. Instrument panel power supply shall wire to a cord end inside the panel. A properly sized UPS system as specified elsewhere shall sit inside the enclosure and be plugged into the receptacle. UPS output shall power the instrument panel.

25. Loop isolators called out or intrinsic safety barriers shall mount inside the instrument panels.

26. An uninterruptible power supply, Liebert GXT4, or equal shall be provided for power to all PLC equipment for a minimum of 5 minutes, as well as field instruments. Provide alarm relay card.

27. Provide a Devicenet bridge/scanner module for interface with valve and gate actuators. Provide all configuration software and the software development kit.

28. The main Ethernet switch in PLC-AMPS shall be an Moxa EDS-516A or equal, Layer 2 managed switch. Provide the base switch with ten copper ports and one additional 8-port copper expansion module, for a total of 18 copper ports. Provide redundancy module and redundant 24-volt power supplies.

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 17480 - INSTRUMENT LISTS AND REPORTS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The CONTRACTOR shall furnish and install all instrumentation equipment and accessory items as shown on the Scope of Services and as specified herein.

B. Final program settings and functionality shall be as agreed by LFUCG staff during meetings with the System Integrator at an appropriate time to affect their input to the process. This specification is a starting point for those discussions.

1.02 RELATED WORK

A. The following Sections of this Specification Division contain requirements on instrumentation and control equipment and software which are considered to be covered by applicable requirements of this section (and shall be included in the bid by a single Instrumentation Supplier for this Project):

Section 17311 – PLC Hardware and Software
Section 17312 – Radio Telemetry System
Section 17410 - Basic Measurement and Control Instrumentation Materials and Methods
Section 17420 - Instruments
Section 17430 - Boxes, Panels and Control Centers
Section 17490 - Measurement and Control Commissioning

B. The following Divisions of these Specifications contain requirements on equipment furnished by other suppliers that must interface with the instrument system, or on methods and materials to be performed/used in the installation and/or wiring of the instrumentation system.

Division 1 - General Requirements
Division 11 - Equipment
Division 16 - Electrical

1.03 LOOP DESCRIPTIONS

A. General

1. Refer to ISA format P & ID’s in the Drawings for additional information on required monitoring.

2. Refer to point list in Instrument Drawings for PLC I/O requirements at new PLC-AMPS.

B. General Functionality

1. Runtimes for all equipment with run status feedback to the SCADA system shall be monitored. The runtimes shall be stored in non-volatile PLC registers so that they are available for display by any workstation and information will not be lost upon workstation database re-initialization or restart of the PLC. Runtimes shall be recorded in hours and shall be incremented at least every 0.1 hour.

2. Failure of the PLC shall result in a safe shutdown of the equipment.

3. Analog values shall be scaled in LFUCG Project Managering units and checked to see if the process signal from the field devices is within acceptable range (4-20 mA ± 0.5 mA). Signals outside of this range shall be alarmed. All analog variables shall be set up for trending.

4. Whenever called to operate, the equipment must provide a run status signal back to the Plant SCADA system. If a run status has not been detected after 30 seconds (adjustable), a failure alarm shall be generated in the Plant HMI.

5. All alarm elevations, flow setpoints, and level setpoints shall be adjustable in the PLC and SCADA system by the operator.

C. Miscellaneous Monitoring – P&ID 100 (Alarms and Status)

1. The MCC shall be equipped with a power meter that shall connect to the PLC and energy and demand data shall be uploaded to the SCADA system for display on the local HMI at the PLC as well as in the plant work stations in the main control room. The Contractor shall setup and program the meter and calibrate it locally. The System Integrator shall configure and program the local PLC HMI device. The System Integrator shall address the communications to the upstream plant SCADA system.

2. The local HMI for the PLC shall have a page created that displays all the data monitored.

3. The generator and automatic transfer switch shall be monitored as indicated in the drawings.

4. The PLC shall have the surge protection devices monitored as well as the power coming from the UPS system.

5. Smoke and heat detectors specified as part of this Division of the specifications and mounted in the Control Building shall be monitored. Magnetic door contacts on the Control Building doors shall also be monitored.

6. Valve Vaults shall have high sump levels alarmed.

7. The System Integrator shall be responsible for implementing all monitoring and control at the SCADA Workstation level in the Administration Building.

D. Loop 200 – Pump Station Discharge Flow

1. The primary force main for the station is 14”. The force main shall include a 12” size magnetic flowmeter to monitor flow. Measured flow shall be displayed at the transmitter, and a 4-20 mADC output sent to PLC-AMPS, where the flow shall be recorded and totalized in SCADA.

E. Loop 300 – Wetwell Level

1. Each wetwell level shall be measured submersible pressure transducer. A 4-20 mADC output from each pressure transducer shall be sent to the PLC-AMPS for pump control.

2. Common (Combined) Tank Mode: When the slide gates between Wetwell A and Wetwell B is open, the two tanks will combine to form one common liquid level. The operation of the pumps when in Common Mode shall be as follows:

   a. All pumps shall be set to alternate. Whichever pump has the lead position will start running when the liquid level in either tank has reached the lead “ON” start point for the common well. If the lead pump cannot maintain the desired liquid level in the tank, then the first lag pump will start once on the “ON” set point is reached for lag pump #1. When two or more pumps are running, VFD speed equalization shall occur and the pumps shall run at the same speed while maintaining the desired liquid level

in the tank. If the lead pump and lag pump #1 cannot maintain the desired liquid level in the tank, then lag pump #2 shall start once on the "ON" set point is reached for lag pump #2. If the lead pump, lag pump #1 and lag pump #2 cannot maintain the desired liquid level in the tank, then lag pump #3 shall start once the "ON" set point is reached for lag pump #3. When an energized "running" pump reaches the liquid level "OFF" set point in the lead/lag sequence, the pump shall be turned "OFF" until it is called for again based on the level in the common tank.

b. All pumps shall be able to be grouped into different operational sequences if required.

c. Rising Water Level: As the level in the wetwell rises, the lead pump stop level is reached. As the wetwell continues to rise, the lead pump start level is reached, and the lead pump starts. The 4-20 mADC speed reference output from the controller to the VFD shall be adjusted based on the measured level, to try to match incoming flow. If level continues to rise, the speed output shall continue to increase until the pump is operating at full speed. If the level continues to rise, the lag pump start level is reached, and the lag pump shall start. The lead and lag pump speed outputs shall be adjusted based on the measured level, to try to match incoming flow. If the level continues to rise, the speed output shall continue to increase until the pumps are operating at full speed. If the level continues to rise, the lag-lag pump start level is reached, and the lag-lag pump shall start. Speed outputs shall be adjusted based on the measured level, to try to match incoming flow. If the level continues to rise, the speed output shall continue to increase until all pumps are operating at full speed. The station is not designed for simultaneous operation of all four pumps; therefore, the backup pump is not part of the sequence.

d. Falling Water Level: If all pumps are operating at full speed, and the wetwell level begins to fall, all pumps shall continue to operate at full speed until the lead pump stop level is reached. If one or more pumps is operating at reduced speed, and the wetwell level begins to fall, the pump which is operating at reduced speed shall stop when its respective stop level has been reached. Any remaining pumps operating at full speed shall continue to operate at full speed until the lead pump stop level is reached.

3. Isolated (Individual) Tank Mode: When the slide gate between Wetwell A and Wetwell B is closed, the two tanks will be isolated from each other, and each tank will function with a separate set of pumps and controls. The operation of the pumps when the tanks are in isolated tank mode shall be as follows:

   a. All pumps for each individual well shall be set to alternate. Whichever pump has the lead position will start running when the liquid level in the tank has reached the lead "ON" start point for the individual well. If the lead pump cannot maintain the desired liquid level in the tank, then the first lag pump will start once the "ON" set point is reached for lag pump #1. When two or more pumps are running, VFD speed equalization shall occur, and the pumps shall run at the same speed while maintaining the desired liquid level in the tank. If the lead pump and lag pump #1 cannot maintain the desired liquid level in the tank, then lag pump #2 shall start once the "ON" set point is reached for lag pump #2. When an energized "running" pump reaches the liquid level "OFF" set point in the lead/lag sequence, the pump shall be turned "OFF" until it is called for again based on the level in the individual tank.

   b. All pumps in each individual well shall be able to be grouped into different operational sequences if required.

4. Disabled Tank Mode: If Tank A or Tank B should need to be out of operation, a selector switch shall be used to select the desired tank to be disabled and thereby shutdown the associated Triplex Pump Controller until needed. The pump controls shall automatically adjust to control the remaining active tank as determined by the position of the software

selector switch.

5. Failsafe Operation: The pump controls shall be able to be configured for failsafe operation if liquid level is not detected in the wet well (low level fault). Each set of pump controls for Tank A and Tank B shall be protected against a low-level condition, such that the pumps will not be permitted to run while a low liquid level condition exists.

E. Loop 400 – Submersible Pump Control

1. The local HMI for the PLC shall have pages created that display a graphic of the Pump Station, including a symbol for each of the four fill pumps and their respective tag. The run status of each pump shall be indicated by either a virtual indicator lamp or by a change in color of the pump symbol (or as mutually agreed with LFUCG staff). Alarm conditions shall also be indicated for seal leak, motor overtemperature, and VFD fault. This screen shall also display the discharge flow rate and shall totalize the gallons pumped.

2. The pumps shall be controlled via adjustable frequency drives (VFD's). All four pumps shall be monitored and controlled at the supervisory level by the PLC in the Control Building. The PLC shall include an Ethernet Switch, which shall be cabled in to each VFD. The VFD manufacturer shall be responsible for programming the VFD's themselves and the System Integrator shall be responsible for implementing communications with the PLC and Plant SCADA system.

3. The VFD's shall be set up with local HMI for local control and display of status and alarm conditions and shall connect to the Ethernet network through a communication module. The VFD's shall include Hand-Off-Automatic selector switches in the HMI. In Hand, control of the pump shall be from start/stop pushbuttons in the HMI of the VFD with speed adjustment locally by virtual potentiometer in the VFD HMI. The plant SCADA system shall be signaled when the VFD is in Hand mode. In Automatic, the pump shall be started and controlled remotely through the PLC. When the switch is placed in Automatic, the PLC shall be signaled that it is in control. The PLC shall provide manual starting and stopping of each pump. The PLC shall also allow for remote resetting of the VFD, in case of a controller fault. A virtual potentiometer in the PLC shall allow for remote speed adjustment when in manual control from the PLC.

4. The PLC shall also include outputs for on/off control for each pump, as well as 4-20 mADC speed output. On/off and speed control shall be as described in Loop 400 above. A status output is provided from each VFD to the PLC. A fail output is also provided from each VFD to the PLC.

5. The PLC shall allow operators to set lead-lag pump arrangements manually or automatically and shall indicate the pump operating speed based on an analog signal from the VFD.

6. The System Integrator shall be responsible for implementing monitoring and control at the SCADA Workstation level in the Administration Building at Town Branch WWTP or West Hickman WWTP.

7. Upon transfer from utility power to generator power, the pumps shall stagger start back on based on timer settings in the PLC to avoid block loading the generator.

F. Valve and Gate Monitoring and Control – P&ID 500

1. The local HMI for the PLC shall have a page created that displays a graphic of each Pump Station and valve vault. Valve and gate position shall be indicated on the HMI as well as whether the valve actuator is in local or remote-control mode. Each valve and/or gate shall be capable of being manually or automatically positioned by the PLC at the pump station and upstream plant SCADA system if in remote.

2. Communications to each actuator shall be via Devicenet Serial Network.

3. Sequences shall be programmed to automatically cycle all the actuators periodically as agreed in project meetings.

H. Gas Detection System – P&ID 900

1. A gas detection system shall be provided to monitor hazardous conditions in all the major structures, with a controller in the Control Building at the pump station. For reliability, each sensor shall have its own transmitter and be hardwired to the controller as individual analog signals. Combustibles and Hydrogen Sulfide shall be monitored in each structure and Oxygen shall also be monitored in the valve vault. Ethernet IP communications shall be provided to the plant SCADA system allowing full access to all data that is available at the controller.

2. The local HMI for the PLC shall have pages created that display a graphic of the various structures with sensors, showing the status and current analog values for each one, as well as monitoring, alarm and fault conditions shall show up at all levels in the SCADA system.

3. The equipment manufacturer shall be responsible for calibrating and programming the controller and all sensors. The System Integrator shall be responsible for programming the communications to this device and upstream monitoring in PLC-AMPS and monitoring at the plant SCADA workstations. The vendor shall cooperate and coordinate with the System Integrator to accomplish all monitoring and control.

1.04 GAUGE SCHEDULE

Quantity	Location Required	Range					Accessories
		Combination			Compound		
		Size	PSI	Feet	Vacuum (ft)	Altitude (ft)	
4	Pump Discharge	4-1/2"	0-200	0-460			A, B, C
1	Main Discharge Header	4-1/2”	0-200	0-460			A, B, C

Pressure Gauge Accessory Code:

A - Gauge Liquid Filled
B - Diaphragm Seal, Liquid Filled
C - Ball Valves for Shutoff and Vent
* - Viton Diaphragm

PART 2 - PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 17490 - MEASUREMENT AND CONTROL COMMISSIONING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The Contractor shall furnish and install all instrumentation equipment and accessory items as shown on the Scope of Services and as specified herein.

1.02 RELATED WORK

A. The following Sections of this Specification Division contain requirements on instrumentation and control equipment and software which are considered to be covered by applicable requirements of this section (and shall be included in the bid by a single Instrumentation Supplier for this Project):

Section 17311 - Plc Hardware and Software
Section 17312 - Radio Telemetry System
Section 17410 - Basic Measurement and Control Instrumentation Materials and Methods
Section 17420 - Instruments
Section 17430 - Boxes, Panels and Control Centers
Section 17480 - Instrument Lists and Reports

B. The following Divisions of these Specifications contain requirements on equipment furnished by other suppliers that must interface with the instrument system, or on methods and materials to be performed/used in the installation and/or wiring of the instrumentation system.

Division 1 - General Requirements
Division 11 - Equipment
Division 16 - Electrical

PART 2 – PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 SEQUENCE OF CONSTRUCTION

A. Installation and startup of the new pump station PLC shall be coordinated with the Owner, as the equipment will communicate over an existing trunked radio system.

B. Delivery, startup, and programming of new equipment furnished under this Division shall be coordinated with process equipment installation. A qualified technician shall be present on site during pump startup.

3.02 INSTALLATION/APPLICATION/ERECTION

A. Instrumentation and accessory equipment shall be installed in accordance with the manufacturer’s instructions. The locations of equipment, transmitters, alarms and similar devices shown on the Drawings are approximate only. Exact locations shall be as accepted by the LFUCG Project Manager during construction. Obtain in the field all information relevant to the placing of process control work, proceed as directed by the manufacturer and furnish all labor and materials necessary to complete the work in an acceptable manner.

B. The instrumentation installation details on the Drawings indicate the designed installation for the instruments specified. Where specific installation details are not specified or shown on the

Drawings, the manufacturer's recommended practice shall be followed.

C. All work shall be executed in full accordance with codes. Should any work be performed contrary to said codes and/or regulations, the Contractor shall bear full responsibility for such violations and assume all costs arising therefrom. All equipment used in areas designated as hazardous shall be designed for the Class, Division, and Group as required on the Drawings for the locations.

D. Unless specifically shown in the Contract Documents, direct reading or electrical transmitting instrumentation shall not be mounted on process piping. Instrumentation shall be mounted on instrument racks or stands. All instrumentation connections shall be provided with shutoff and drain valves.

E. All piping to and from field instrumentation shall be provided with necessary unions, test tees, couplings, adaptors, and shut-off valves.

F. Field instruments requiring power supplies shall be provided with local electrical shut-offs and fuses as required.

G. Brackets and hangers required for mounting of equipment shall be provided. They shall be installed in a workmanlike manner and not interfere with any other equipment.

H. The system supplier shall investigate each space in the building through which equipment must pass to reach its final location. If necessary, the system supplier shall be required to ship his material in sections sized to permit passing through restricted areas in the building. The system supplier shall also investigate, and make any field modifications to the allocated space for each cabinet, enclosure and panel to assure proper space and access (front, rear, side).

I. The shield on each process instrumentation cable shall be continuous from source to destination and be grounded as directed by the manufacturer of the instrumentation equipment but in no case shall more than one ground point be employed for each shield.

J. Lifting rings shall be removed from cabinets/assemblies. Hole plugs shall be provided for the holes of the same color as the cabinet.

K. The system supplier, acting through the Contractor, shall coordinate the installation, the placing and location of system components, their connections to the process equipment panels, cabinets and devices, subject to the LFUCG Project Manager's acceptance. He shall be responsible to ensure that all field wiring for power and signal circuits are correctly done in accordance with best industry practice and provide for all necessary system grounding to ensure a satisfactory functioning installation. The Contractor hereunder shall schedule and coordinate his work under this Section with that of the electrical work specified under applicable Sections of Division 16.

3.03 FIELD QUALITY CONTROL

A. After equipment and materials have been shipped to the job site, the Supplier shall furnish the services of a factory-trained service technician or LFUCG Project Manager to assist and advise the Contractor during installation and to provide programming/calibration/ adjustment at initial startup. A minimum period of 2 calendar days on the job site is required, and expenses associated with additional days necessary shall be at no cost to the Owner.

B. Following installation, checkout, and final adjustment of all panels, instruments, meters, monitoring, and control devices, the Contractor shall schedule a performance test in the presence of the LFUCG Project Manager on all equipment. The Contractor shall furnish the services of the system supplier's servicemen, all special tools, calibration equipment, and labor to perform the tests.

C. Meters shall be tested at 0 percent, 25 percent, 50 percent, 75 percent, and 100 percent of scale, if possible. All status and alarm switches as well as all monitoring and control functions shall also be checked, including logging at printers and change of state on graphics. Testing shall be done from the signal source to the final element or device including all field wiring. Results of all testing shall be submitted to the LFUCG Project Manager in writing.

D. As much as possible, points shall be checked “end-to-end”. For example, valve status inputs shall be checked by stroking the valve, and a pump start output shall be checked by using it to start to start the pump. Simulated testing shall be allowed only when no practical alternative exists. Workstation displays shall be verified for correctness at the same time. An I/O checklist shall be used to record test results and a copy provided to the LFUCG Project Manager upon completion. During system testing, the Contractor shall have a representative onsite continuously who is capable of troubleshooting and modifying system configuration programming.

E. If, during running of the tests, one or more points appear to be out by more than the system accuracy statement, or fails to perform in accordance with agreed strategies, the system supplier’s servicemen shall make such adjustment or alterations as are necessary to bring equipment/programming up to specification performance. Following such adjustment, the tests shall be repeated for all specified points to ensure compliance.

3.04 PERFORMANCE TEST

A. Subsequent to the full system implementation, the Contractor shall conduct a successful 30 day final acceptance test for the system furnished and installed under this Contract. In this test, the entire system must operate continuously for 24 hours per day, 7 days per week during the test period, with zero downtime resulting from system failures. If a system failure occurs, the 30-day test period will be repeated, starting over at time zero, from the time that the system failure is repaired. The Contractor shall repeat the test until it is satisfactorily completed. The system will only be acceptable to the Owner after all equipment and software has satisfied the performance test requirements.

B. The Contractor shall submit a final acceptance test completion report which shall state that all Contract requirements have been met and which shall include a summary of maintenance/repair efforts that were required during the test period. Final acceptance of the system by the Owner until this has occurred.

3.05 ADJUSTING AND CLEANING

A. All equipment furnished under this Section of the Specifications shall be adjusted/calibrated as defined elsewhere this Section/Division.

B. All instruments and equipment shall be left free from shipping stickers, paint splatter, dirt, grease, etc., and shall be clean and in like new condition at final acceptance. Touch-up paint shall be furnished as needed to repair blemishes and scratches in finish paint on panels and enclosures, which shall be corrected by the Contractor.

3.06 EXTRA STOCK/SPARE PARTS

A. The following supplies and spare parts shall be furnished:

1. Ten fuses for each type/size in the system.

2. Four Eaton C799L2 oxidation inhibitors; install one in each cabinet.

3. One relay of every size and type provided in the project

B. Other spare parts are listed in specific instrument technical specifications in the appropriate Division 17 Specification Section herein. All spare parts shall be packaged in an acceptable manner for long-term storage and adequately protected against corrosion, humidity and temperature extremes. All items shall be tagged externally with what they are; both a written description and a manufacturer brand/part number.

END OF SECTION

P&C Prime, LLC
Phone: 231-420-3650
Email: info@pandctesting.com

Power System Protection and Control Specialists

2025 P&C Prime, LLC Hourly Labor Rates

	Straight Time Hourly Rate	Overtime Hourly Rate
Level IV Field Engineer / Senior Technician	$140.00	$194.00
Level III Service Technician	$140.00	$194.00
Level II Technician / Wireman	$135.00	$189.00
Level I Wireman / Assistant	$130.00	$182.00
All Travel	$135.00	$135.00

- Perdiem will be charged at the GSA lodging and incidentals rate based on zip code
- Standard time applies to the first 8 normal working hours Monday through Friday
- Overtime will be applied after the first 8 hours M-F, and any time on Saturday and Sunday
- Materials and other travel expenses will be billed at cost plus 10%
- Test equipment rentals will be billed at cost plus 10%
- Mileage and vehicle expenses are covered in the hourly travel rates
- Owned test equipment will be charged a daily rate. See equipment rates.

P&C Prime 2025 Equipment Rates

Name	Description	Daily Rate	Monthly Rate
Relay test set 3 phase	Doble F6150E	125	2625
relay test set 1 phase	Doble F2500	25	525
Power Factor	Omicron CPC100	175	3675
CT Test set	Vanguard ezct200A	55	1155
TTR	AEMC / Megger	25	525
Battery Bank Trailer		160	3360
load bank tester	Megger torkel	55	1155
digital hydrometer	SVS	30	630
battery resistance meter	hioki	30	630
DLRO/100A	Megger	25	525
5KV Insulation Resistance Meter	Megger	25	525

Other equipmennt Rental rate plus 10%. Plue shipping cost,