LSC-V 200
VARIABLE SPEED
PUMP CONTROL
SPECIFICATION
for

STANDARD SPECIFICATION

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1. GENERAL

1.1 Scope

This document examines the specifications for a Pump Control System used to control and monitor the performance of variable speed pumps that will be used to control the wetwell level at a Pump Station Facility in the USA.

The purpose of this section is to specify a complete Pump Control System as follows:

The control system shall be comprised of a standard off the shelf microprocessor with user friendly developed standard PLC and Graphical software. The controller shall have a bright color display with active text and active graphics, and operate with any type of compatable analog level transmitter. The controller shall be 100% digital. Control adjustments shall be accomplished through color soft touch screen graphical entry points (potentiometers or other analog adjustments shall not be acceptable). The controller shall allow for setpoint changes from the color soft touch screen graphical interface. All of the above shall be accomplished from the microprocessor display without special codes. An integral float backup program, shall be initiated in case of a primary level transmitter failure. Pump alternation sequencing, shall operate in both primary and float back up operation. Pump run times shall be displayed. Station inflow, in gallons per minute, shall be calculated and displayed. All operator adjustable setpoints and feature selections shall be accessable through user friendly color soft touch screen graphical displays. All digital outputs from the controller shall be normally open relay contacts rated for 120 vac. The unit shall meet all the requirements described in the section of this specification labeled " Components "- Pump Controller.

The manufacturer of the control system shall take complete responsibility for the proper operation and sequencing of the total pump control system.

The manufacture of the control system shall supply the variable speed drives to insure system uniformity and compatability.

The manufacturer of the system shall take single source, unit responsibility for every component contained within the manufacturer's pump control system.

The system shall be the LSC - V 200 variable speed control system as manufactured by EG Controls, Jacksonville, FL or pre-approved equal.

1.2 Codes And Standards

Electrical equipment, materials and workmanship shall comply with all applicable codes, safety and fire law regulations at the location of the work and shall conform to applicable codes and standards of the organizations listed below.

A. Institute of Electrical and Electronic Engineers. (IEEE)

B. National Electric Code. (NEC)

C. National Electrical Manufactures Association (NEMA)

D. American National Standards Institute. (ANSI)

E. Underwriters Laboratories 508. (UL-508)

2. OPERATIONAL CHARACTERISTICS

Operation of the Pump Station Controller shall be as described in the following paragraphs.

2.1 Design Data

The pump control system shall be capable of operating X, XX HP, XX full load amp (FLA), XXXX RPM Pumps in a variable speed mode in order to convey sewage to the next Pump Station without causing a sewage over-flow, regardless of system demands.

The available input power is XXX VAC, 3 phase, X wire, 60 HZ and is supplied from a __ KVA, __ % impedance transformer with a {Delta} {Wye} {Wye grounded} {Other} secondary winding configuration.

The pumping system shall be capable of operating in the duplex or triplex mode.

The system controller shall supervise all sequencing, pump combinations, non critical annunciation, system testing, system monitoring and back-up systems, and overall system status and control.

The complete system shall be equal to the LSC - V 200 variable speed control system as manufactured by EG Controls, Jacksonville, Florida.

A. Sequence Of Operation

The control system shall alternate the selected pumps for each operation. Upon a call to run signal from the controller the the lead pump shall be started and run up to it's maximum speed and then adjust it's speed as necessary to maintain an adjustable wet well level. Further increase in wet well level will cause the lead pump to ramp up to it's maximum speed. If the wet well level continues to increase after the lead pump has reached it's maximum speed, the lag pump shall be started at it's minimum speed and both pumps shall adjust to the same speed and operate in parallel to maintain the wet well level. Further increase in the wet well shall cause the lead pump and the lag pump to ramp up to the maximum speed of the lag pump. Further increase in wetwell level shall cause a high level alarm condition.

On decreasing wet well level, lag pump shall be removed from operation when the wet well level has reached the stop pump level of the lag pump. The lead pump shall then adjust it's speed to maintain the level in the wet well. A further decrease in the wetwell level shall cause

the lead pump to slow to it's minimum speed and run flat at it's minimum speed untill the stop lead pump level has been reached and stopped. A further decrease in the wetwell level shall cause a low level alarm to activate.

2.2 Primary System Operation

The system shall be designed to produce an outflow from the wet well, in an efficient manner, to prevent the wetwell from overflowing.

2.3 Back-Up System and Redundancy:

a) Float Backup System

Failure of the pump controller transducer will cause the wet well level to rise to the Standby-Float-System on level. The standby float system will lock out all other control and start the pumps as required based on four float switches (1) for high level float, (1) for start lag float pump, (1) for start lead float pump and (1) for stop pumps.

- The pumps shall sequence on in a selected time delay manner.
- The pumps will sequence off only when the wet-well level reaches the "stop" pump float level and the pumps shall then alternate.

b) Hand Off Automatic (HOA) Switch for each pump

3. EQUIPMENT DESCRIPTION

3.1 Circuit Breakers

Circuit breakers shall have a quick make and break operator mechanism.

The handle position shall indicate on, off, or tripped.

A padlock provisions shall be provided to lock the circuit breaker in the Off position.

All motor three phase short circuit protection shall have a minimum rating of 14KAIC .

Breakers shall be as manufactured by EATON.

3.2 Motor Control (Starters, Contactors)

Motor control components shall meet the following criteria:

All contactors shall be NEMA, HP rated and bear a UL listed label.

IEC control will not be accepted due to reduced life expectancy.

Mechanical and electrical interlocks will be provided whenever two contactors are connected to any electrical component or motor and the possibility exists for equipment damage or personnel injury.

A minimum of 1N.O. and 1N.C. auxiliary contacts shall be provided for each starter or contactor.

Overload heaters must be of the bimetallic type and shall be ambient compensated.

Unit shall be manufactured by EATON Corporation.

3.3 Alarm Horn & Beacon

The panel shall have a red/amber alarm beacon and audible horn. The beacon shall be mounted on top of the panel. The alarm beacon shall be rated 120 VAC, 40/60W, and shall illuminate/flash and the audible alarm shall sound to indicate an alarm condition exists.

3.4 Relays

Relays shall be of the plug-in design and have a transparent, polycarbonate dust cover to protect the contact surfaces from airborn dust and other contaminats. All relays shall have q minimum of 2PDT contacts and a molded nylon coil rated for continuous duty operation on 24 and 120VAC. Relay contacts shall be rated for 10A at 300VAC with .187 quick connect terminals.

Relay sockets shall be of the (.187) eleven (11) blade design and have screw terminals with self-lifting clamps. Terminal identification numbers shall be visible on the sockets

3.5 Intrinsic Safe Relay (ISR) for Float Back Up System

The ISR shall be UL and FM approved and designed to interface devices in hazardous locations with equipment in non-hazardous locations. The ISR shall operate from 120VAC and accept a minimum of four (4) inputs from a hazardous area.

3.6 Seal Failure Relays

Seals Failure relays providing adjustable resistance sensing circuitry from 0 to 250,000 ohms for each pump shall be supplied. Upon activation, the seal failure relay shall not shut down the pump but shall activate an alarm that shall be displayed on the graphical screen display. The moisture sensing probes shall be supplied and installed in the pumps by the pump manufacturer.

3.7 Over Temperature Sensing Relays

Pump over temperature (manual reset) sensors located in the pump motor shall be supplied for each pump. When activated, the alarm shall be displayed on the graphical screen display.

3.8 Dry Contacts

Form “C” Dry contacts shall be supplied for power failure, high level alarm, VFD failure and float backup enabled conditions.

3.9 Phase Monitor Relay

A three phase monitoring relay shall be connected to the incoming side of the power input terminals. The unit shall have six LED indicators that annunciate the status of incoming power and monitor loss of phase, phase reversal, under voltage, high voltage and phase imbalance. It shall also include a memory that remembers the last 10 types of faults and the order in which they occurred. A special user-friendly adjustment panel allows the operator to make adjustments to phase imbalance, low and high voltage trip points, individually adjustable trip and restart delays and offers a selectable restart setting.

3.10 Convenience Receptacle

A GFI convience receptical shall be provided. The unit shall have polarized blades for two (2) or three (3) wire receptacles. The unit shall require a reset after any ground fault interruption.

3.11 Heater with Thermostat

The control panel shall be equipped with a panel heater to minimize the effects of humidity and condensation. The heater shall include a thermostat.

3.12 Control Circuit Transformer

Nominal control voltage not to exceed 120V.

Control power transformers (CPT) shall be mounted inside the enclosure.

Overcurrent protection shall be supplied on both the line and load sides. Line protection for all step-down transformers shall be provided.

Transformers to be sized for a minimum of 25% extra capacity under full load conditions.

One secondary line shall be grounded for operator safety.

Transformers shall be manufactured by Eaton.

3.13 Surge Protection

Line-to-line and line-to-ground protection shall be provided. This protection shall exceed the requirements of ANSI / IEEE standard C62.1-1984 section 8.6.1. and 8.7.3 by a factor of at least 300%.

Voltage clamping time shall be less than 5 nanoseconds with a maximum surge current of 30,000A RMS at a clamping voltage 552VAC.

Clamping voltage levels shall be specifically sized for the applied system voltage as well as the winding and grounding configuration of the supply transformer. These voltage levels will be chosen to assure minimizing system voltage excursion.

One surge arrestor shall be supplied at the incoming service to the control panel.

3.14 Pump Controller

1. The pump controller shall utilize a microprocessor with a graphical screen display to program and alternate up to two (2) pumps in a variable speed mode with high level alarm. All operator adjustable setpoints and features shall be accessable from the face of the microprocessor through the use of user friendly graphical screen displays.

2. Accurate measurement of the liquid level in the sump shall be made by a compatable analog level transmitter. The transmitter range shall be entered through the graphical screen display.

3. The controller shall automatically alternate up to two (2) pumps in the automatic operation mode. The alternation scheme shall include the capability of selecting either pump 1 or 2 in the lead position without alternation.

4. A lag pump start time delay shall be provided to prevent simultanious pump starts on power up or the restoring of power after a power outage. The lag pump time delay shall be adjustable from a graphical screen display.

5. The controller shall be capable of calculating inflows and shall dynamically display the flows in gallons per minute(GPM). Inflow shall be calculated at 15 second intervals.

6. The controller shall measure and display the run time hours for both pumps 1 & 2. The timers shall be re-settable, if desired, from the graphical display screen.

7. The following standard alarm conditions shall be provided on the graphical screen display covered more fully in section: 3.15 of this specification.

    1) Main Screen Text Alarm Alert
    2) Pump 1 VFD Fail
    3) Pump 2 VFD Fail
    4) Pump 1 Seal Fail
    5) Pump 2 Seal Fail
    6) Pump 1 Overtemp
    7) Pump 2 Overtemp
    8) High Level Alarm
    9) Float Backup Enabled

The controller shall be the LSC - V 200 variable speed controller as manufactured by EG Controls of Jacksonville Florida.

3.15 Graphical Operational Screens

The controller, color soft touch Graphical Interface (GUI), shall contain the following screens:

3.15.1 Menu Screen:

The Menu Screen shall be comprised of informational and operating screens and Set Up and data entry screens. The menu buttons on the screen shall be clearly defined an easy to locate. Touching the selected buttons shall call up the screen selected for display.

3.15.2 Main Screen:

The Main Screen shall provide an overview of the pump control systems operational status by graphically depecting the wetwell level with wetwell transmitter range, lead and lag pump status and configuration, lead and lag pump start and stop set points, pump 1 and pump 2 percent speed bargraphs, alarms present indication and other digital readouts and display buttons as required to present a clear view of the pump stations operational status.

3.15.3 Pump Status Screens:

The Pump Status Screen shall be designed to give you an up-to-date status of each pump in your pump control system. Each pump status screen shall use icons, vertical and horizontal bargraphs, digital readouts and display buttons to provide wet well level, wet well transmitter range, pump speed, HOA status, pump configuration, pump run status, pump status, fail reset button, pump lock out button, alarm text, pump run hours, total pump starts, pump starts per hour, pump hours reset pushbutton, pump starts reset pushbutton and station outflow in GPM. In an alarmed condition the pump status screen shall depict, through the use of pop up windows, five alarm conditions, start fail alarm, seal fail alarm, overtemp alarm, overload alarm and excessive pump starts per hour alarm.

3.15.4 Pump Alternation Set Up Screen:

The Pump Alternation Set Up Screen shall allow for automatic alternation selection or manual line up selection. If manual line up selection is selected lead pump selection shall be available and shall be selectable from the alternation screen. Selection for Last On First Off (LOFO) or First On First Off (FOFO) shall be provided and shall be selectable from the screen. If automatic alternation is selected alternate at pumps off, alternate at specific time of day ,allow for a minimum of two times, alternate every X number of hours shall all be selectable from the alternation screen.

3.15.5 Help Screen

Help Screens shall be selectively provided through out the graphical interface to assist the operators in properly utilizing a particular operational screen.

3.15.6 Test Screen

A system test screen that provides wetwell level simulation for the testing of the pumps and system alarms shall be provided. The system test screen shall display and update the simulated wetwell level, the actual wetwell level, pump line up, pump run status, pump configuration, pump speed and all alarm conditions.

3.15.7 Alarm History Screens

An Alarm History Screen shall be provided. The alarm history screen shall record and display the alarm entry number, the alarm idenification number, alarm message and alarm confirmation. The screen shall display the last eight (8) recorded alarms.

3.15.8 Seal Fail Enable Screen

A Seal Fail Enable Screen shall be provided. The seal fail enable screen shall allow for the enabling or the disabling of the seal fail alarm for the station pumps. The enable selection shall cause an alarm to occur and the pumps to be stopped when a seal fail occurs. The disable selection shall cause an alarm to occur, but the pumps shall continue to run.

3.15.9 Trend Screen's

A Trend Screen shall be provided. The trend screen shall be comprised of two (2) real time trend screens. Each trend screen shall shall represent a 60 minute time segement. The screens shall be as follows:

1. Pump Performance Trend Screen
   The pump performance trend screen shall provide for the comparision and evaluation of a station pump's individual performance. When the trend is iniated it shall display the calculated pump discharge flow for the pump that is currently running. Only one pump shall be allowed to trend at any given time. Individual pump performance trends shall be retreivable up too a 30 day period.

2. Wet Well Trend Screen
   The wet well trend screen shall provide for the comparsion and evaluation of a stations over all performance. The wet well trend screen shall trend the wet well inflow and the wet well outflow. The timing and operation of the screen shall be the same as the pump performance screen.

3.15.10 Pump Set Up Screens

A Pump Set Up Screen shall be provided. The pump Set Up screen shall allow for the establishment of operator set points for the pumps start level, stop level and

maximum starts per hour that each pump may have before an alarm is activated. The set points entry shall be accomplished directly from the pump Set Up screen.

3.15.11 Flow Set Up Screen

A Flow Set Up Screen shall be provided. The Flow Set Up screen shall allow the operator to select the configuration of the wet well and specify the demensions of the wet well appropriate for the chosen configuration. The information shall be utlized as a part of the flow algorythem used to calculate the stations flow.

A flow bargraph tend minimum set point and a flow bargraph maximum set point, shall be provided on the screen These set points shall establish the minimum and maximum flow values that shall be displayed.

3.15.12 Timer Set Up Screen

A Timer Set Up Screen shall be provided. The Timer Set Up screen shall at a minimum provide for the following timer adjustments from the Set Up screen:

1. Pump #1 time to wait for run feedback in seconds
2. Pump #2 time to wait for run feedback in seconds
3. Lead pump start delay after lead start level is reached in seconds
4. Lag pump start delay after lag start level is reached in seconds
5. Delay between lead and lag pumps called to run in seconds
6. High level alarm delay in seconds
7. High level alarm reset delay in seconds
8. Low level alarm delay in seconds
9. Low level alarm reset delay in seconds
10. Level transmitter failure delay in seconds
11. Level transmitter failure reset delay in seconds
12. Pump #1 seal fail alarm delay in seconds
13. Pump #2 seal fail alarm delay in seconds
14. Pump #1 overtemp alarm delay in seconds
15. Pump #2 overtemp alarm delay in seconds
16. Phase fail alarm delay in seconds
17. Simulation auto cancel time duration in seconds

3.15.13 PLC Time Set Up Screen’s

A PLC Time Set Up Screen shall be provided. The PLC Time Set Up Screen shall allow the operator to specify the the time and date and communicate the information to the PLC. The time shall be provided in hours, minutes and seconds and shall be entered through appropriate box’s that shall be provided on the screen. All three values shall be required to be entered into the PLC. The date shall be provide in year, month and day of the month and shall be entered through appropriate boxes provided on the screen. All three values shall be required to be entered into the PLC.

3.15.14 Alarm Set Up Screen

An Alarm Set Up Screen shall be provided. The alarm Set Up screen shall provide for the setting of the level setpoints for the following conditions:

1. High level alarm in feet
2. Low level alarm in feet
3. Level transmitter failure in feet

Entry box's shall be provided on the screen for the alarm setpoint and for the alarm re-set point.

3.15.15 Engineer Set Up Screen

An Engineering Set Up Screen shall be provided. The Engineering Set Up screen shall provide for the scaling in engineering units of the level transmitter. Entry box's shall be provided on the screen for the level transmitter's low and high range perameters.

3.15.16 Screen Set Up Screen

An Screen Set Up Screen shall be provided. The screen Set Up screen shall allow for the contrast adjustment of the graphical interface screen to insure maximum viewability.

3.15.17 Power Fail And Restore Screen

A Power fail and Restore Screen shall be provided. The power fail and restore screen shall display the time power failed and the time power was restored during a power outage.

3.16 Data Logging

The control system shall perform two (2) data logging functions.

1. wet well inflow inflow shall be data logged at one minute intervals. Each value shall be time /date stamped and be in delimited format for direct import into Microsoft Excel, Microsoft NotePad, WordPad and Word. Storage duration shall be for a minimum of 226 days.

2. All alarm logging shall be to an alarm file. Each alarm shall have plain text descriptors, time/date stamps, and be in delimited format for direct import into Microsoft Excel, Microsoft NotePad, WordPad and Word. Storage duration shall be for a minimum of 226 days.

Data shall be stored on a 128 MB flash driveThe flash drive shall be removable for direct transfer to a PC via a USB port.

3.17 Primary Level Sensor

The Submersible Pressure Transducer shall be specifically designed to meet rigorous environments encountered in level measurement applications. It shall provide repeatable, precision depth measurements under the most adverse conditions.

This transducer shall incorporate an isolated diaphragm sensor which is specifically designed for use with hostile fluids and gasses. The sensor will utilize a silicon pressure cell that has been fitted into a stainless steel housing with an integral, compliant stainless steel barrier diaphragm. The sensor assembly shall be housed in a rugged 316 SS case that provides for a variety of pressure inputs as well as electrical output connections.

It shall have a static accuracy of +/- 1% FSO BFSL:

Construction shall be welded 316 SS construction.

It shall be Datalogger compatible.

The transducer will be fully temperature compensated.

The Submersible Pressure Transducer shall be manufactured by Keller PSI.

3.18 Back Up Level Sensor

A. Float Sensor

The backup float sensor shall have the following physical characteristics:

- All time delays and other components inherent in this system shall be incorporated within the pump controller.
- The system shall require 4 floats (to be supplied and installed by the Contractor at wet-well levels as determined by the Consulting Engineer).
- The float system shall be powered by 24 VDC.
- Manual reset from float to analog transmitter shall be accomplished through the graphical screen display.

3.19 Enclosure

The graphical screen display and HOA switches shall be mounted on the inner door of the enclosure.

The (maximum) size of the enclosure shall be (XXH x XXW x XXD). The enclosure shall be NEMA type 12 with drip shield which is designed to house electrical and electronic equipment. The enclosure shall be of the type for use outdoors to protect the enclosed equipment against falling rain and the formation of ice on the enclosure.

The material used for construction shall be cold roll steel, with a minimum thickness of 14 gage. All seams shall be continuously welded and the welds will be ground to present an attractive appearance. Body stiffeners shall be welded into the enclosure to further insure a

rigid construction. The integrity of the door seal shall be assured by using an oil-resistant gasket, bonded to the inside of the doors with an oil-resistant adhesive, and held in place by steel retaining strips. The door seal shall be made complete by using a three point latching mechanism, operated by an oil-tight, key-locking handle.

The Enclosure shall be supplied with a painted cold rolled steel floor stand kit.

Enclosure shall be as manufactured by Hoffman Enclosures or approved equal.

4. QUALITY ASSURANCE

4.1 Manufacturer's Experience

The manufacturer of the control system shall be certified by Underwriters Laboratories (UL) as being a UL 508 listed systems panel manufacture certified to install a serialized label for quality control and insurance liability considerations.

The manufacturer of the control system must submit documentation verifying at least 10 years of experience in manufacturing constant speed control systems of a similar size and scope.

The manufacturer of the control system must submit to the Consulting Engineer documentation proving experience in successfully designing and manufacturing at least 10 similar systems of a similar scope.

The manufacturer of the control system must carry blanket liability insurance of at least $2 million.

4.2 Manufacturer's Quality Control

The complete control system, shall be functionally tested at the manufacturers facility and certified as a complete system to assure proper operation per specification in order to minimize costly field changes.

All components must be mounted with stainless steel hardware.

4.3 Manufacturer's Approval

Manufacturers listed in this specification do not constitute approval. All controls must have the capabilities and functions as outlined in the following paragraphs.

4.4 UL Approvals

All components that make up the system shall meet UL (Underwritters Labatories) standards and bear a UL label. The system enclosure shall also bear the UL label certifying that the system meets all UL requirements.

5. SUBMITTAL REQUIREMENTS

NOTE: Non adherence to the request for information below, shall be cause for the submittals to be disapproved.

5.1 Base-Bid Approval

The base bid control system shall be the **LSC- V 200** system as manufactured by EG Controls, Jacksonville, Florida. All bidding contractors shall base their bids on the base bid control system. Alternative deductive systems will be considered only after contract award and must be specified with any applicable deducts at bid time in order to receive consideration. Bidder must submit along with his bid package appropriate cut sheets, circuit drawings, display screen print-outs, and detailed bill of materials for any alternative control systems. Acceptance of an alternative system is subject to approval of its quality and conformance with established standards. The contractor shall reimburse the engineer for any additional expenses to review the system and pay additional costs associated with use of the alternative system.

5.2 Substitutions

The Engineer will consider proposals for substitution of materials, equipment, methods, and services only when such proposals are accompanied by full and complete technical data and all other information required by the Engineer for the proposed substitution.

Substitution of materials, equipment, methods, and/or services is not allowed unless such substitution has been specifically approved by the Engineer.

Where the phrase "Or Equal", "Pre-approved", or "Pre-approved equal" occurs in the specification, do not assume that any materials, equipment, methods, or services will be approved as equal unless the item has been specifically pre-approved by the Engineer.

5.3 Shop Drawings

All drawings are to be of "computer generated" class, $8\frac{1}{2}$" X 11"in size, and bound.

All equipment and materials shall be new and shall be specifically designed for the function herein.

Approval for fabrication and installation will be made only after submittal and review of all shop Contract Documents. The minimum information required for approval shall include eight (8) sets of the following.

Computer generated, 3-line electrical diagram of the power and control system.

Complete electrical schematics detailing every wire and connection within the system as well as all field connections.

Bill of material and product data sheets on all high voltage components (>120VAC), drives, switches, and other critical/important components.

Detailed drawings of the enclosure (size, construction, entry/ exit, and mounting).

Exploded detail of every face plate, light, switch or meter mounted on the exterior of the enclosure.

5.4 Record Documents

The following documents shall be provided:

"AS-BUILT" DRAWINGS: 8 sets of "Shop Drawings" are to be supplied and marked in colored ink as depicting "As-built" conditions. These are to include any field modifications made by the authorized start-up personnel during installation, start-up, or testing.

Original copy of the final Q.C. report.

Operation and Maintenance Manuals: the control system manufacturer shall supply a complete and detailed operation and maintenance manual prepared for this system.

6. WARRANTIES

NOTE: All guarantees implied or stated by the control system manufacturer shall be passed in full force to the owner. The manufacturer of the control system shall warrant all components in the system for unit responsibility purposes.

6.1 Components

As a minimum, all components in the specified control system shall carry a comprehensive, parts only, twelve (12) month guarantee against defects in workmanship and material from the date of final inspection and acceptance, not to exceed 18 months from the date of shipment from the manufacturer's facility.

7. EQUIPMENT IDENTIFICATION

All electrical equipment shall be identified in accordance with these specifications.

All identification labels, both within the enclosure and external, shall be laser-screened laminated mylar.

All control wiring shall be numbered on each termination.

Screw-in type, engraved nameplates or laser-screened laminated mylar shall be provided to identify all individually mounted push buttons, rocker switches, lights, meters, disconnect switches, circuit breakers, motor starters, transformers, relays, fuses, phase monitors, surge arrestors, and any other equipment for which identification is required for eventual service or replacement. This includes the appropriate equipment within the cabinet. Embossed tape is not acceptable.

8. EXECUTION

8.1 Field Installation And Start Up

8.1.1 THE CONTRACTOR

The Contractor shall include in his bid the services of a trained representative for whatever period of time, assuming 1 trip, is required to inspect, start-up, test the control system, and instruct plant personnel in the proper maintenance and operation of such equipment.

8.1.2 THE OWNER

The owner of this equipment shall supply any personnel to assist the start up crew which are required to oversee or perform actual work if so required by labor/credit contracts. This cost shall be born by the Contractor.

8.1.3 THE MANUFACTURER

Prior to final approval, the manufacturer shall submit a letter certifying that the installation has been tested, and functions as per the plans and specifications.