SPECIAL SPECIFICATION

SECTION 13870S

HPM MONITORING AND CONTROL SYSTEM

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. The contractor shall furnish, program, install, adjust, calibrate, and make ready for use all sensors, switches, relays, controllers, SCADA hardware, wiring, and accessories indicated on the drawings and required for a complete and totally functioning HPM Monitoring and Control System. Work includes the installation, termination, and testing of the following systems:

1. Flammable, Silane, and toxic gas detection.
2. Liquid leak detection.
3. HPM shutdown control system.
4. HPM alarm annunciation system.
5. UV/IR flame detection.
6. Manual stations for Toxic Gas Alert and Emergency Gas-Off functions.
7. Miscellaneous instrumentation as described on the plans.

1.02 REFERENCES/PROJECT REQUIREMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Requirements of the following Project Specification Sections apply to this section:

1. Section 13085S – Seismic Protection
2. Section 13871S – Hazardous Gas Detection
3. Section 13872S – Liquid Leak Detection System
4. Section 16120 - Controls Cabling and Wireways.

C. References :

1. Appendices:

    a. Appendix A – Instrument Datasheets

    b. Appendix B – Instrument Point List

    c. Appendix C – Functional Matrix

1.03 DEFINITIONS

A. Not Used

1.04 SYSTEM DESCRIPTION

A. General

1. The control system for the Hazardous Materials Monitoring and Notification System (HPM Monitoring and Control System) shall be an Allen-Bradley PLC-based redundant system with hot backup capabilities allowing development and upgrade work to be performed on one CPU while the other maintains the continuous operation of the system.

2. Normal operation will be the fully automatic mode. Manual override from the operator's pulpit, from local Man-Machine-Interfaces and individual actuators/motor controllers is required.

3. Two (2) PLCs will have a man machine interface (MMI) to the local SCADA monitoring and control system. The MMI will enable output forcing, changing of set points, acknowledging of alarms, and generating reports. In the future trending capability will be added. Logic changes however will not be authorized at this level.

4. All analogue measurements may be archived for the purpose of retroactive investigation and for trend analysis at a later date.

5. Any and all PID control loops will be continuously self-tuning. They will be configured for "soft start" and 'bumpless' control.

B. Programmable Logic Controller

1. The PLCs will consist of a basic unit to which the I/O modules are to be connected and the redundant or duplicate unit for hot backup. Terminal blocks will be used to allow the change of I/O modules without any change of the wiring. Only a field proven system (hardware and software) may be used. The PLC equipment will enable monitoring, open-loop control, closed loop control plus logic functions. It is to consist

of two programmable logic units. The individual PLC software will be generated by combining standard software function modules which are specially adapted to the technical requirements of building service and process automation. All parameters and data will be installed in separate software related data areas.

2. These data areas will be available on a data communication interface installed in the PLC unit for external processing (for example for printing of protocols or for system operation).

3. Only a field proven system (hardware and software) may be used. The control system will be designed with autonomous controllers (PLC) and remote I/O cabinets at the lowest possible hierarchic level. The main controller of the HPM Monitoring and Control System will be backed up by a stand-by Unit (hot back up). Data will be collected by remote I/O cabinets for processing by the PLCs. All events and analogue values may be archived.

4. Real-time indication will be provided at the PLCs. Continuous data will be collected and logged in for monitoring purposes. Set point adjustment for non-safety systems shall also be possible.

5. A total of two programmable logic controllers will be installed.

6. The PLCs will be accommodated in a cabinet at the northeast corner of the MERC. Remote I/O racks are located as shown on the plans.

7. This main PLC will be duplicated, with the second in hot backup.

8. In the event of any failure of the network connection of the PLCs, the non-faulted unit will continue to operate as an independent unit, using the latest information received.

9. Interfacing between the PLCs/SCADA and the sensors/sub-systems will be by means of a fault tolerant DH+ network or direct-wired connections.

10. The DH+ network must be routed entirely in conduit, no exceptions.

C. SCADA system

1. The SCADA system will be a computer-based real-time system designed to provide advance warning and alarm indication. This may either be by means of direct monitoring such as with the specialty gases, chemical system and utilities or it may mean taking over an alarm indication from a package unit.

2. Faults and operating conditions have to be displayed by means of color changing/blinking. The process values have to be updated within approx. 2 - 6 sec. The respond time for critical circuits and for safety requirements must be below 1 sec. All safety circuits are "closed circuit current" to be able to detect cable faults or lose contacts. The respond time for non-critical situations is not to exceed 2 - 3 seconds.

3. Provide software packages such as tag group display, alarm management, history, system diagnostic report, operator action request, color graphic displays, graphic/bar diagrams, maintenance schedule (option), energy reports (option), word processing and spreadsheets.

4. Enable change of set points.

5. Activate emergency shut-off functions.

6. Provide manual override.

7. The system will be multi-user and multi-tasking.

8. Each SCADA system will consist of:

   a. One (1) color graphic workstations (with HMI software) with operator keyboard and pointing device ("mouse").

   b. Data storage and exchange

   c. One color graphic printer

   d. One (1) b/w alarm strip printer

D. Alarm Sequence of Operations: Sequence of operation shall be in accordance with HPM monitoring and control system functional matrix. Actuation of low and high level alarm inputs from gas detection equipment causes system to enter ALARM. High level alarm activates, but is not limited to the following operations:

   1. Audible and visual annunciation near the location of the gas leak.

   2. Transmit signal to system monitors and printers.

   3. Transmit shutdown signal to the gas cabinets, VMB, or other gas equipment associated with the gas leak.

E. Warning Sequence of Operations: Sequence of operation shall be in accordance with HPM monitoring and control system functional matrix in Appendix C. Activation of low-level alarms from gas detection equipment shall cause system to transmit a signal to system monitors and printers.

F. Alarm Reset: The HPM monitoring and control system shall latch in the alarm state and must be manually acknowledged and reset. RESET function resets alarm system out of ALARM only if alarm initiating conditions have been cleared.

G. Trouble Sequence of Operations: Sequence of operation shall be in accordance with HPM monitoring and control system functional matrix. Actuation of a malfunction or maintenance signal from the gas detection equipment causes system to enter TROUBLE.

H. Instruments

1. Refer Appendix B for the instrument point list.

1.05 SUBMITTALS

A. Provide Submittals in accordance with Conditions of Contract and Section 01300S:

B. Provide calibration data and procedures for all sensors, switches, and controllers as part of submittals.

C. Provide control diagrams in the form of shop drawings for each system or sub-system. Use the control diagrams included in the contract drawings for this purpose. Each diagram shall be altered to show all proposed controls and controlled devices, together with name, catalog number, set point, and actions performed.

D. The contractor will be furnished reproducible copies of all contract drawings for use in preparing his shop drawings.

E. The contractor shall provide preliminary submittals detailing the software functions that will be performed by the various components within the system. The submittal shall include a repetition of all functions required by the drawings and specifications as well as details on the implementation of each required measurement or control action. Descriptions of the SCADA interface and alarming systems and hierarchies shall also be included. This document shall be revised by the contractor during the course of the project and shall serve as the system functional testing procedure at the completion of the project. Owner review and approval of this submittal will be required prior to procurement of equipment, at the start of programming and for the functional testing submission.

F. Provide operation and maintenance manuals for all equipment under provisions of Section 01700.

1.06 QUALITY ASSURANCE

A. Drawings, documentation, software, programming, and configuration are for exclusive use by the owner, and may be reused as deemed necessary by the owner.

B. Conform to control system manufacturer's hardware and software installation, operations and programming documents.

1.07 SCHEDULING

A. Coordinate and limit down time for control systems once started. Obtain approval for system shutdowns from Owner.

1.08 WARRANTY

A. All contractor furnished products and labor shall have a two-year warranty.

B. During warranty, all defective products shall be repaired or replaced, and all readjustments necessary to accomplish the specified sequences of operation shall be at no cost to SNL.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials and components used shall be standard components, regularly manufactured for this type application and not custom designed especially for this project.

B. All products shall be as specified on the drawings and in these specifications or approved equals.

2.02 PROGRAMMABLE LOGIC CONTROLLERS

A. The programmable controller system shall be Allen-Bradley ControLogix 1756 series. The PLCs shall be configured as “primary” and “Hot Backup”. Each PLC shall read the real inputs from the backplane connection in the rack but only the primary shall write to the real output devices. In the event of a primary processor failure, the backup shall assume the role of the primary PLC. Configuration of the system shall allow for restoration of the original primary PLC to operation following a processor failure without requiring a total system shutdown.

B. Power supplies for the PLC system shall be redundant and external to the rack system. Inputs shall be provided from the power supplies to indicate operating status of each power supply.

C. PLC system design shall provide for safe operation of the HPM monitoring system in the event of a single PLC processor or power supply failure.

D. The PLC racks shall be capable of having one or more modules to provide serial communications interfaces to third-party devices.

E. Use latest release of PLC hardware and firmware as of purchase date. Supply list of hardware with associated part numbers, serial numbers, release dates, and dipswitch settings to Owner for approval prior to the start of commissioning.

F. Quote software and hardware interfaces required to program PLCs.

2.03 GENERAL I/O SYSTEM REQUIREMENTS

A. Field wiring terminal blocks shall be able to be disconnected from I/O modules for removal/replacement without disruption of field wiring terminations using swing-arm or removable style connectors.

B. The PLC system shall support local I/O and remote I/O configurations. Vendor shall specify available communication methods for the remote I/O interface.

C. Provide required hardware and interfaces for PLC programming.

D. Provide the ability to monitor and override I/O from the field.

E. Instrument and Control Devices: Manufacturer's latest design.

1. Process I/O devices shall provide data acquisition of a wide variety of points including analog signals and discrete input/output signals. Availability shall be provided by having a variety of input cards available, each supporting multiple inputs of a similar type. Analog and discrete inputs shall be scanned at a minimum of one-tenth second intervals.

2. Programmable logic controller hardware shall be capable of supporting process signals from process sensors and contact closure devices, preferably without requiring external or auxiliary signal conditioning devices including:

a. 4-20 mA inputs.

b. Discrete inputs (DC or dry contacts).

c. 4-20 mA outputs.

d. Discrete outputs (DC) sustained or momentary.

3. Discrete outputs: Relay type, except outputs going to the PLC scan monitoring devices. The cabinet mounted local indicators and piezoelectric buzzers can be powered by either dry contact or 24VDC modules.

4. Provide PLC related hardware and interconnecting cabling.

5. Provide PLC equipment with EMI/RFI/ESD protection.

6. Equip PLC modules with front access wiring terminations.

7. Analog and discrete output modules to be configured to freeze output signals upon failure of loss of communications to associated I/O base.

2.04 DISCRETE I/O MODULES

A. Discrete inputs and outputs shall be 24 Vdc. Base the number of modules required on 110 percent of the P&ID point count.

B. Source discrete outputs at 24 Vdc at a minimum of 500 mA each, continuous service. Each output point shall be capable of current limit protection. State the maximum module ratings for I/O modules.

C. Modules shall provide individual status lights for each input and output, and be constructed such that the I/O wiring does not have to be removed from the terminals while replacing the module. Each digital module shall have a light indicating its status (OK or Fault).

2.05 ANALOG I/O MODULES

A. Base the actual number of analog modules on 110 percent of the P&ID point count.

B. Analog input modules shall be channel configurable to accept 4- to 20-mAdc, 0- to 5-Vdc, 0- to 10-Vdc, and 1- to 5-Vdc signals. Isolated and non-isolated versions must be available. 4- to 20-mAdc signals shall experience an input impedance of 250 ohms.

C. Analog output modules shall be capable of driving a 4- to 20-mAdc signal into a 0 to 600-ohm load.

D. Analog to Digital conversion of input signals shall meet the following specification:

1. Resolution: 12 bits.

2. Accuracy: ±0.1 percent.

3. Linearity: 0.05 percent.

4. Temperature Effect: <±0.5 percent for a 28 degrees C change within the limits of 5 to 60 degrees C.

5. Common Mode Rejection: >120dB at 250V for 50/60 Hz.

6. Supply Voltage Effect: ±0.2 percent for a ±5 percent shift of supply.

7. Surge Withstand Capability: Input components shall meet IEEE Standard 472-1974 regarding the withstanding of an electrical surge such that no permanent damage occurs nor are any damaging transients passed to other parts.

E. Analog outputs from controller shall meet the following specifications:

1. Resolution: 12 bits.

2. Accuracy: ±0.1 percent.

3. Linearity: 0.05 percent.

2.06 PROGRAMMING EQUIPMENT

A. Provide one portable computer (manufacturer selected by owner), to the Owner prior to PLC systems training. Equip each computer with:

1. Connection cables.

2. Carrying case.

3. Extra battery.

4. 1.2 GHz Pentium IV microprocessor

5. 512 MB RAM memory (minimum).

6. 4 GB hard drive (minimum).

7. 1.44 MB 3.5" floppy drive.

8. Latest release of MS Windows XP.

9. Latest release of Word for Windows software.

10. Latest release of Excel for Windows software.

11. Latest release of Allen-Bradley ControlLogix programming software.

12. Latest release of SCADA development software.

13. Integral pointing device.

2.07 SCADA SYSTEM

A. The SCADA system shall employ standard industrial control software and hardware approved for use with the specified programmable controller system. Minimum fuctional requirements are for display of all measurements in a graphical format using the facility layout as backgrounds, specialized alarm screens, HPM Monitoring system status displays, Trend screens for all analog measurement points, and system navigation displays. Peripheral devices shall include printers (alarm and graphic), modems for interface with remote HMI terminals, and Hub(s) for connection to the PLC system.

B. The contractor shall include a detailed system block diagram showing all proposed components of the HPM monitoring system with his bid. Supporting catalog literature shall also be included with the bid for evaluation.

C. Failure of the SCADA system hardware shall not cause an interuption in the HPM monitoring system safety functions. Failure of the SCADA system shall be annunciated through a digital contact monitored by the callout alarm system.

D. All HMI desktop computers shall be the latest version capable of supporting the SCADA software. The computers shall have either a shared SCADA software license or shall have individual licenses.

2.08 CALLOUT ALARM SYSTEM

A. The contractor shall provide and configure a RACO "Verbatim" system for callout of critical alarms. The system shall be provided with a remote printer for callout logging. A list of callout alarms shall be proposed by the contractor as a part of the software submittal described in this specification.

2.09 COMPONENTS

A. See Appendix A for instrument data sheets.

B. Refer to Section 13871S, Flammable Gas Detection Systems for additional information and requirements regarding hydrogen gas leak detectors and controller.

C. Refer to Section 13872S, Liquid Leak Detection System for requirements regarding coaxial cable type liquid detection systems and components.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with "Allen-Bradley" installation, operations and programming documents.

B. Locate PLC's in MERC.

C. Locate I/O cabinets throughout facility as described on the plans.

D. Install and test I/O communications cabling as described in Section 16120.

E. Install and support panels per Section 13085S, Seismic Protection.

3.02 APPLICATION

A. Process Logic:

1. Engineering units: U.S. Standard.

2. Device tagname convention: ISA Standard. Refer to HPM Monitoring and Control System Legend drawing FJ0002858EF.

3. Program system controller(s). Coordinate through one individual to promote consistency in all application strategies.

4. Program controller(s) using latest release of Allen-Bradley. Turn all software over to Owner after release of control system.

5. Custom program processes that require control logic. Do not base quotations on packaged programming packages.

6. Develop and submit specific control logic descriptions to Owner prior to start of controller programming.

7. Activate device resets by:

    a. From the SCADA monitor.

8. Provide logic necessary to properly control each process, including:

    a. Process reset logic.

    b. Equipment failure logic.

    c. Normal and emergency power startup logic.

    d. Alarm acknowledge, reset, and silence logic.

    e. Sensor out of range logic.

    f. Signal selection logic for redundant process sensors.

    g. Device reset logic.

    h. PID loop state change logic.

    i. Failure mode logic.

9. Use retentive logic relays, or their equivalent, for processes that may be upset due to disturbances caused by loading in new programs.

10. Test final release of software for each process, witnessed by Owner. Prior to this test, submit list of proposed sequential tests.

11. Alarm limiting:

    a. Add alarm limiting logic to limit number of alarms, including:

        (1) Alarm defeat when equipment is not operational.

        (2) Logical timers to reduce impulse alarms.

        (3) Analog signal averaging logic.

b. Evaluate each configured alarm point for logic so as not to compromise operation of the facility. Provide alarm logic deemed acceptable and required by Owner.

12. Organize SCADA related data to optimize communications throughput.

a. Scale analog values in controller. Transmit analog data in engineering units between controller and SCADA.

b. Place data in contiguous blocks so as to minimize the number of SCADA poll records.

c. Partition data blocks into multiple sections, based on data type and update time requirements. Submit SCADA data organization plan to Owner prior to start of programming.

13. Controls Contractor shall provide additional logic as required to prevent process interruptions during a forced compile downloads. Submit proposed "forced compile download " logic and procedures prior to start of programming.

14. Maximum fill of 75 percent for all forms of memory.

15. Configure alarms to be monitored by the SCADA system that are necessary for troubleshooting of PLC system failures and inoperable PLC system components.

B. Safety system logic:

1. Refer to the Functional Matrix on the plans. Make minor changes to matrix as required. An Excel file of the safety matrix will be made available for this purpose.

C. Hardwired control logic:

1. Design and install hard-wired relay logic to fail-safe. In alarm state, de-energize associated relays and require manual reset.

D. Software logic:

1. Latch all alarms, warnings, and malfunction conditions in the PLC logic with manual resets.

2. Provide dry (potential free) contacts for PLC output modules that command shutdowns or evacuation annunciations.

3. Use software for logic associated with the safety systems, where possible. Relays will only be allowed with written approval from the Owner.

4. Open all discrete input points in alarm state.

5. Open all discrete output contacts if power is lost.

6. Provide dry (potential free) contacts for interfaces to the following locations. Close contacts in alarm state. Install end-of-line terminating resistor per alarm monitoring system requirements.

   a. Fire Alarm Control System

   b. KAFB Fire Department

   c. Building 802/SCC

   d. Building 858L

7. Place data in contiguous blocks so as to minimize the number of SCADA poll records.

8. Partition data blocks into multiple sections, based on data type and update time requirements. Submit SCADA data organization plan to Owner prior to start of programming.

9. Provide delay timers for interlock logic associated with analog input and discrete input points which have the capability of causing process upsets based on momentary impulse signals. The owner will determine the timer settings.

3.03 ADJUSTING

A. Make minor modifications to PLC logic based on Owner inputs. Include a total of 80 man-hours to cover this work.

B. Modifications must be approved by Owner prior to the start of related work. Payment will not be made for unapproved modifications.

C. Prior to performing any modifications, submit a form to the Owner for signed approval. Include the following information in the form:

   1. Explanation of modifications.

2. Estimated number of hours to complete modification.

3. Date form was filled out.

END OF SECTION