

SECTION 230900

DDC EMS GENERAL REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. DDC EMS System Requirements.
- B. General Procedures.

1.2 RELATED SECTIONS

- A. The completion of the work described in this Section requires work in or coordination with other Sections of these specifications. The Contractor and the subcontractor shall be responsible for identifying and including all related work in other Sections of these specifications and/or drawings necessary for a complete installation of the work described in this Section. These related Sections include but are not limited to the following:
 - 1. Section 01352 - LEED Requirements.
 - 2. Section 019100 - Commissioning.
 - 3. Section 15012 - Commissioning of HVAC.
 - 4. Section 230519 - Meters and Gages for HVAC Piping.
 - 5. Section 230913 - Instruments and Control Elements.
 - 6. Section 230904 - EMCS - Control And Automation
 - 7. Section 230973 - Facility Management System Integration, which provides additional definition of the technical work scope for the EMCS provided Portable Operator Terminal (POT), the existing remote Central Host System (CHS) and the FMSI provided local Operator Work Station (OWS)
 - 8. Other Division 23 - Mechanical.
 - 9. Division 26 - Electrical.
 - 10. Architectural, Mechanical, Plumbing, F, PF and Electrical series drawings
 - 11. Requirements of Security and Fire Alarm Systems
 - 12. EMCS Contractor to pay specific attention to:
 - a. Requirement to provide Portable Operator Terminals (POT)
 - b. Lonworks Binding requirements for all inputs and outputs in the LNS Lonworks Server utilizing Lonmaker for Windows.
 - c. Commssioning and coordination requirements between the EMCS and FMSI contractors
 - d. Requirement to provide Lon bus protocol analyzer software on the POT

1.3 REFERENCES

- A. NFPA 70 - National Electrical Code; National Fire Protection Association; 2005.
- B. Systems must be made up of LonMark certified devices and LNS Based tools.
- C. All controllers must be based on ANSI/CEA 709.1 LonTalk Protocol
- D. All routing must be via ANSI/CEA 852 LonWorks to IP Routing.

1.4 1.04 DEFINITIONS

- A. Alarm: Notification of an abnormal condition.
- B. Algorithm: A logical procedure for solving a recurrent mathematical problem.
- C. Analog: A continuously varying signal value (temperature current, velocity, etc.)

- D. Application Generic Controller (AGC): A networked device or node that contains a complete, configurable application that is generic in nature and suited for various control tasks. The device manufacturer produces this application. The manufacturer exposes a high number of network variables and configuration properties on the device to allow the specific use of the device to be configured with network tools.
- E. Application Specific Controller (ASC): A networked device or node that contains a complete, configurable application that is specific to a particular task. This application is normally produced by the device manufacturer and contains a number of configuration parameters that may be adjusted by network tools.
- F. Binary: A two-state system where an "on" condition is represented by a high signal level and an "off" condition is represented by a low signal level.
- G. Bridge: A device that routes messages or isolates message traffic to a particular segment sub-net or domain of the same physical communication media.
- H. Building Automation System (BAS): The complete facility control system comprised of all mechanical system automation, and automatic temperature control, etc., as defined in the contract documents. The BAS is built upon a single network infrastructure based upon LonWorks Network Services. This infrastructure may include field wiring, LON wiring, routers, bridges, raceways, and gateways as required connecting non-interoperable subsystems and devices.
- I. Channel: A physical media serving a number of nodes. All nodes on any given channel 'hear' messages produced by other nodes on the channel. The network configuration and node application program determines whether or not a device responds to the messages.
- J. Control Unit: A LonWorks control product that handles multiple inputs and outputs and more than one control loop. May utilize a supplemental general-purpose microprocessor in addition to the Neuron chip to perform additional functions or software applications.
- K. Control Wiring: Includes conduit, wire and wiring devices to install complete control systems including motor control circuits, interlocks, thermostats, EP and PE switches and like devices. Includes all wiring from Intelligent Devices and Controllers to all sensors and points defined in the input/output summary shown on the drawings or specified herein and required to execute the sequence of operation.
- L. Custom Application Controller (CAC): Programmable control product that incorporates solid-state components based upon the ANSI/CEA 709.1 protocol to perform control loops or functions. The application in the controller is custom software produced by the Control System Contractor specifically for the project. These applications shall conform to the LonWorks functional profiles and interoperability standards. Complete documentation including object diagrams, Device Resource Files (DRF), and External Interface Files (XIF) must be submitted EOR (Engineer of Record) when such devices/controllers are used.
- M. Deadband: A temperature range over which no heating or cooling energy is supplied, such as 72EF -78EF, i.e. as opposed to single point changeover or overlap.
- N. Device Resource File: External Interface files and Lon plug-ins that are required to display manufacturer's defined network variables or configuration parameters correctly.
- O. Distributed Control: A system whereby all control processing is decentralized and independent of a central computer.
- P. Diagnostic Program: A machine-executable program with instructions used to detect and isolate

- system and component malfunctions.
- Q. Domain: A domain is logical collection of nodes on one or more channels. Communications can only take place among nodes configured in a common domain; therefore, a domain forms a virtual network. Multiple domains can occupy the same channels, so domains may be used.
 - R. Gateway: A device that contains an I/O software driver to translate data from other protocols to the conforming LonWorks standard.
 - S. Graphical User Interface (GUI): A graphical subset of operator interfaces.
 - T. HVAC Control Systems: The complete LonWorks Control System comprising User Interface, routers, gateways, repeaters, Control Units (CU), software, Portable Operators Terminals (POT), network communications wiring and raceways and required field hardware, etc.
 - U. Intelligent Devices: A LonWorks product that is configured to provide control over a single control loop or to monitor a single or multiple control variable(s); incorporates solid-state components based upon the LonTalk protocol to perform dedicated functions (ex: actuators, sensors, and switches).
 - V. LonWorks: General purpose direct digital control technology platform originally developed by Echelon Corporation and now controlled by ANSI and LonMark. The technology employs routers, gateways, bridges, and multimedia transceivers to permit topology and media independent control solutions comprised of multiple interoperable devices.
 - W. LonMark International (LMI)/LonMark Americas (LMA): An international member based, non-profit organization with committees of numerous independent product developers, systems integrators, engineers, and end users dedicated to determine and maintain the interoperability guidelines for the LonWorks industry. LMI tests and certifies devices for interoperable compliance.
 - X. Man-Machine Interface (MMI): A graphical, object-oriented method by which an operator is capable of communicating with the system. The Man-Machine interface allows the operator to manage, control, monitor, and configure the system.
 - Y. Network: A system of distributed control devices that are linked together on a communication bus. A network allows sharing of point information between all control devices. Additionally, a network may provide central monitoring and control of the entire system from an MMI/GUI.
 - Z. Node: An intelligent device attached to the network. Usually falls into one of the following categories - sensor, actuator, ASC, AGC, CAC.
 - AA. Operator Interface: A device with combination of hardware and software, (PC, laptop or display terminal) which provides client access to the control system, primarily used for network management, configuration, and diagnostics.
 - AB. Operating System (OS): Software which controls the execution of computer programs.
 - AC. Peripheral: External devices used to communicate to and from a computer. Peripherals include CRT, printer, hard drives, disk drives, modems, etc.
 - AD. Point: Group of data, which corresponds to a hardware input, output, or calculated value.
 - AE. Portable Operator's Terminal (POT): Laptop/tablet device that allows local and remote access to the local control network.
 - AF. Router: A device that routes or forwards messages destined for a node on another subnet or domain of the control network. The device controls message traffic based on node address and priority. Routers may also serve as communication interfaces between different channel media.

(i.e., powerline, twisted pair, Ethernet, and RF).

- AG. Segment: A set of channels connected by bridges or repeaters. A node sees every packet from every other node on its segment.
- AH. Sensor: Device capable of measuring the condition or value of a variable.
- AI. Software: Programs and routines used to extend the capabilities of computers hardware.
- AJ. Subnet: A subnet is a logical collection of up to 127 nodes within a domain. Up to 255 subnets can be defined within a single domain. All nodes in a subnet must be on the same segment. Subnets cannot cross-intelligent routers.
- AK. Supervisory Control Panel: A microprocessor-based standalone DDC panel, multi-tasking, multi-user, real time, digital control processors. Each SCP shall consist of modular hardware with plug-in enclosed processors, communication controllers, power supplies, and input/output modules.
- AL. Terminal Unit Controller: Programmable Terminal Unit controller that incorporates solid state components based upon the ANSI/CEA 709.1 protocol to perform control loops or functions. The application in the controller is custom software produced by the Control System Contractor specifically for the project. These applications shall conform to the LonWorks functional profiles and interoperability standards.
- AM. MM.XIF Files: The external interface files created in Neuron C defining the LonMark product's network variables, message tags, and hardware-related parameters.

1.5 ABBREVIATIONS

- AGC - Application Generic Controller
- ASC - Application Specific Controller
- BAS - Building Automation System
- BMS - Building Management System
- CAC - Custom Application Controller
- CCC - City of San José Communication Center
- CHS - Central Host System
- COS - Change of State
- CPU - Central Processing Unit
- DDC - Direct Digital Controller
- DPU - Digital Point Unit
- DRF - Device Resource File
- DWGS - Drawings
- EMCS - Energy Monitoring Control System
- EP - Electric-Pneumatic
- FAS - Facility Automation System
- FACP - Fire Alarm Control Panel

FCC - Fire Command Center
FMSI - Facility Master System Integrator
FMS - Fire Management System
GUI - Graphical User Interface
HVAC - Heating, Ventilating and Air Conditioning
ITC- Intermediate Telecommunications Closet
I/O - Input/Output
LON- Local Operating Network
LNS - LonWorks Network Services
NSS - Network Services Server
NSI - Network Services Interface
NFFPA - National Fire Protection Association
OI - Operator interface
OS - Operating System
OWS - Operator Work Station
PE - Pneumatic-Electric
PID - Proportional Integral Derivative
POT - Portable Operator Terminal
RAM - Random Access Memory
SCADA - Supervisory Control and Data Acquisition System
SCP - Supervisory Control Panel
TCS - Temperature Control System
TUC - Terminal Unit Controller
TCC - Temperature Control Contractor
UL - Underwriters' Laboratory
VAV - Variable Air Volume
VCS - Voice Communication System
XIF - External Interface File

1.6 PROJECT SCOPE

- A. Work of this Division comprises of the Design, Engineering, furnishing, installing, testing and commissioning of the completely operational Energy Monitoring Control System (EMCS) for the new City of San José Environmental Innovation Center and other auxiliary support areas including the interface with the City of San José Communication Center (CCC).
- B. All items specified in this division, indicated on the Drawings or reasonably inferred as

necessary for safe and proper operation; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified.

- C. Elements of the work include, but are not limited to, materials, labor (design, detailing, programming, customizing, testing, calibrating, etc.), supervision, supplies, equipment, transportation, storage, utilities and all required permits and licenses. All work performed under this Division shall be in accordance with the Drawings and Specifications and subject to the terms and conditions of the Contract.
- D. Work Included: The Work includes, but is not limited to the following systems, equipment, and services. Services provided shall include procurement, installation, connection, programming, testing, adjusting and commissioning.
- E. The local Operator Work Station (OWS) will be provided and installed by the FMSI contractor. The Wonderware based system will operate on a Windows XP platform and will interface to the San Jose Communication Center's Historian Server and the EMCS provided Lonworks Server via the WAN and/or LAN. The EMCS Contractor will provide and install an Echelon iLon 100 for all scheduling activities and provide all required bindings using Lonmaker for Windows. The FMSI provided OWS will interface to the iLon 100 to allow the operator to make scheduling adjustments or changes. This will ensure that all required control functions or sequence of operations are not dependent on the OWS for operation.
- F. The EMCS contractor shall perform all Lon control bindings to allow all points to be monitored, scheduled, adjusted, alarmed or modified from LNS Server by the FMSI provided Wonderware based OWS.

1.7 SYSTEM DESCRIPTION

- A. The Energy Management and Control System (EMCS) contractor shall be hired by the General Contractor and shall be responsible for all LonWorks® nodes, instrumentation, control devices, control panels, controller programming, controller programming software, setpoints, alarms, controller input/output and power wiring, controller network wiring to Energy Management Control system (EMCS), database generation, and associated control devices. The EMCS contractor may not be hired to serve as Facility Master System Integrator (FMSI).
- B. General: Provide Energy Monitoring and Control System (EMCS) consisting of Direct Digital Control (DDC) based temperature control system, Microprocessor-based controllers, Lonworks server, Wide Area Networks, Local Networks, Other miscellaneous control systems, Echelon iLon 100 as a network connected scheduler, Fire Alarm (FA) interface, Building Smoke Control System, and associated peripherals, software, programming, systems integration for a fully operational system for the City of San Jose Environmental Innovation Center project and commissioning in accordance with Contract Documents.
- C. City of San José Communication Center Interface: Provide EMCS peripherals, operator workstations, operating system and applications software, networks, graphics package, system integration devices, required for the monitoring, controlling and archiving of building and system information from the City of San Jose communication center (CCC) control room located at the City of San Jose Department of Public Works, 200 E. Santa Clara Street, San Jose, CA.
- D. Systems and Network Integration: Provide necessary network engineering, systems integration, preparation of customized software, programming, for each equipment and for each zone of the buildings. The scope of Work shall also include integration between the dissimilar processor platforms such as the Intel based processors of building control systems with the other control system provided by the equipment manufacturers. See "Controls Network Conceptual Diagram" on the drawings.

- E. Commissioning of the Building Systems: The project requires complete commissioning of the mechanical, electrical, plumbing and EMCS systems, by an independent commissioning agent, in accordance with the requirement of Section 01810 - Commissioning and Section 15012 Commissioning of HVAC. Energy Management and Control System contractor shall include in the bid price for providing all necessary support including technical manpower, programming, troubleshooting, testing measurement, calibrating, verifying etc. as required by the commissioning agent. The commissioning will be required for all MEP and EMCS systems in the two buildings. Included in the commissioning is the commissioning of the VAV boxes, FSDs, fan coils, all fan systems, CO and NO2 systems, refrigerant monitoring systems, fuel-oil leak detection and monitoring system, packaged Air Conditioning Units, Computer Room A/C units, boiler, cooling tower and chiller units and pumps. EMCS system contractor shall also be completely responsible for commissioning of these HVAC systems.
- F. Miscellaneous System Monitoring: EMCS system shall be responsible for coordinating and interfacing with the respective equipment supplier and provide all necessary hardware, network interface cards, network connection etc. to integrate system control and alarms points, verify performance, monitor status, alarms, etc. anywhere in the system network node points. All remote control and monitoring shall be available at the Central Control center (CCC) located at City of San Jose Department of Public Works, 200 E. Santa Clara Street, San Jose, CA. The miscellaneous systems shall include but not limited to the following:
1. Controlling and status Monitoring of all the combination fire-smoke dampers (FSD) and automatic smoke dampers (ASD).
 2. Refrigeration leak detection and monitoring system.
 3. Monitoring of Building Power Usage: EMCS shall monitor normal power status, emergency power status and power usage on a continuous basis.
 4. Monitoring of Building Water Usage: EMCS shall monitor the water flow and usage on a continuous basis.
 5. Monitoring of Building Natural Gas Usage: EMCS system shall monitor natural gas flow and usage on a continuous basis.
 6. Controlling and status Monitoring of all the combination fire-smoke dampers (FSD) and automatic smoke dampers (ASD).
- G. Provide all necessary control devices, controllers, computer hardware, power supply, data and communication wiring, conduits and installation for a fully functioning EMCS system. Provide a complete operating system fully calibrated, programmed and debugged to perform the sequences and programs outlined herein, including, but not limited to:
1. Provide DDC controls for all equipment and systems shown on the Division 23 and Division 26 drawings, to provide the specified Sequence of Controls, and as specified hereinafter, including DDC controllers, thermostats, sensors, relays, end switches, actuators and conduits.
 2. Provide electric/electronic actuators and end position monitoring for all control dampers and control valves, even for those furnished by other trades (ex: AHU dampers, VAV, etc.).
 3. Furnish all sensors, control valves, flow devices, etc. to the respective trade contractors for field installation. Provide VAV terminal unit actuator and controller for factory installation by the terminal unit manufacturer.
 4. Provide DDC Control panels and fire alarm interface panels as required and/or as specified hereinafter and/or as shown on the Drawings.
 5. For all electrical power distribution work that are provided as part of EMCS work, prepare and submit electrical power distribution plans, riser diagrams, power distribution panel schedules, conduit routing, etc. in accordance with Division 26, NEC and applicable codes for all the EMCS equipments, devices, control panels and other panels such as CO2 system, building pressure control system, etc.. The drawings shall be prepared and signed by a registered electrical engineer in the State of California and submitted for review by the

project electrical engineer of record.

- H. Communication Protocol: The DDC control system shall use non-proprietary "open" LON protocol. The network communication between supervisory control panels (SCPs) and the application controllers (ACs) and terminal Unit controllers (TUCs) shall also be non-proprietary "open" protocol and UL listed.
- I. Control Matrix: Energy Management and Control System contractor shall prepare and submit a coordinated EMCS control matrix identifying all the input and output points for all the equipment and system that are controlled and monitored by the EMCS system. The Event Matrix shall list all the controlled equipment, control points type, positions of equipment under normal modes and emergency modes, etc. and shall provide a comprehensive global view of the events throughout the buildings on a system-by-system and on life safety zone basis. It shall also provide the required functions and status of fans and dampers during emergency and normal modes.
- J. Energy Management and Control System contractor shall be responsible for reviewing and coordinating the Control Event Matrix with the fire alarm and security system contractors and reflect the control sequence under emergency mode of operation.
- K. Energy Management and Control System contractor shall provide all necessary programming, interfacing devices, communication networking, power distribution, wiring and conduit, relays, control panels and field devices to properly implement and execute the control sequence stipulated in the approved Control Event Matrix.
- L. Provide LonWorks based products that communicate on multiple channels to meet the functional specifications as indicated on the Drawings and the dedicated product functional specifications and profiles specified in other Sections.
- M. Provide FTT-10A LonTalk routers and repeaters as required to combine different communication channels onto a central field bus or as required to segment groups of Intelligent Devices and/or Control Units.
- N. Provide Intelligent Control Devices, Programmable Controllers, and Application Specific Controllers as herein specified, as needed to perform functions indicated in the input/output summaries and sequences of operation, and/or indicated on the HVAC drawings.
- O. Provide wire, raceway systems, 24 VDC and/or 24 VAC power supplies and final connections to nodes provided by this contract. Must comply with Division 26 requirements.
- P. The contractor shall provide all controls and sequence of operations as required by these specifications and by the drawings. Provide all required devices, sensors, hardware, software, wiring, controllers, etc. Provide all required devices, sensors, hardware, software, wiring, controllers, etc. including any required and not specifically addressed in this specification but required for system functionality. It shall be the responsibility of the contractor to provide a complete and functional system.
- Q. The system shall allow for future integration of other systems (Card Access, Lighting, Intrusion Monitoring etc.) on the network proposed in this document, and also share a common infrastructure for network communications, time scheduling, alarm handling, history logging, monitoring and system control.

1.8 COORDINATION OF WORK WITH OTHER TRADES

- A. Energy Management and Control System contractor shall be responsible for coordinating the Work of this Division with the Work of other Divisions, and providing all materials and labor

- required for installation of the Energy Monitoring and Control System, which is not specified to be provided under another Division.
- B. During the course of construction, the Energy Management and Control System contractor shall be responsible for coordinating EMCS provisions by other Divisions and shall be responsible for the proper installation of all provisions used by EMCS. Where provisions are not properly coordinated, it shall be the responsibility of the Energy Management and Control System contractor to correct the provisions at the expense of this Contractor.
 - C. The Contractor shall be responsible for reviewing the Division 23, 25, 26, 27 & 28 Drawings and Specifications to determine the EMCS provisions and interface points provided under those Divisions and coordinating the work of this Division as required for proper interface. Energy Management and Control System contractor shall familiarize himself with scope and content of Division 23, 26 & 27 specifications and must co-ordinate and fill in all gaps, if any.
 - D. The Contractor shall be responsible for reviewing Drawings and Specifications of Security and Fire Alarm System to determine the EMCS requirements, interface points and their locations, routing of conduits and terminations and control sequences, and coordinating the work of this Division as required for proper interface.
 - E. Contractor shall be responsible for coordinating the delivery and installation of EMCS components such as unit controllers, actuators, AHU controllers, etc. for installation by the mechanical equipment suppliers as required.
 - F. Contractor shall be responsible for coordinating locations of exposed devices in areas accessible to the general public. Contractor shall coordinate locations of devices with architectural requirements, provide detailed and dimensioned shop drawing showing locations and catalogue cuts for all devices. Contractor shall make allowances for field relocation of devices up to ten feet laterally and vertically.
 - G. Contractor shall coordinate the mounting of DDC control panels on unitary equipment for proper accessibility and service clearance.
 - H. Contractor shall coordinate the EMCS work with the Facility Management System Integrator (FMSI) to properly interface and integrate the new building system controls with the Citywide Central Control (CCC) room, which is remotely located. See Section 230973 - Facility Management System Integration.

1.9 SUBMITTALS

- A. See Section 013300 - Submittal Procedures.
- B. Project Planning:
 - 1. Scope Reconfirmation: A written statement regarding the scope of work and an overview of systems, equipments, components used including system architecture.
 - 2. Project Planning: Provide overview of the project design and construction planning and project coordination plan.
 - 3. Testing and Quality Control Planning: A written plan for implementing testing, debugging and commissioning.
 - 4. Training Plan: Written plan of City Instructions.
- C. Product Data: Preprinted manufacturers specification sheets showing performance data, dimensions, rating, listing, model number, charts, graphs, etc. for all control elements but not limited to:
 - 1. Field Devices, Actuators, valves, enclosures, switches, sensors, third party equipment.
 - 2. DDC panels, controllers, interfacing panels, network transceivers, resource files, LNS plug-ins, XIF documentation, configuration parameter options, and third party control systems.

3. Computer hardware and software, PC operating system, information regarding third party software, proprietary software, protocol information, and source code information.
- D. Diagrams and Schedules: Provide all necessary diagrams, charts, schedules that are specially prepared for the project but not limited to the following:
1. EMCS riser diagrams.
 2. Network interface diagrams.
 3. EMCS and Fire Alarm interface diagrams.
 4. Temperature control diagrams.
 5. Third party control system interfacing diagrams.
 6. Control panel wiring diagrams.
 7. Interconnection wiring diagrams.
 8. Point-to-Point wiring diagrams.
 9. I/O points list and address for all the systems.
 10. Control Matrix interface list.
 11. Valve schedule.
 12. Damper schedule.
 13. Control panel schedule.
- E. Shop Drawings: Provide all necessary detailed, fully dimensioned shop drawings specially prepared for the project showing equipment location and arrangement including, but not limited to, the following:
1. Floor plans showing Room No., Room name, locations of active components, space sensors, EMCS panel locations, Fire and Smoke Damper locations, motors, VFDs, AVDs, ASDs, third party control panels and sensors, etc.
 2. Seismic bracing and anchoring calculations and drawings for equipments, panels, conduits, pipes, etc.
 3. Shop drawings for one-of-a-kind fabricated equipment, device, support element or system.
 4. Sequence of Operation: Provide sequence of operation after reconciling with the approved Control Event Matrix. The sequence shall further include operations during normal mode, during the Smoke Control Modes of operation - during and after power interruptions.
 5. Indicate trunk cable schematic showing programmable control unit locations, and trunk data conductors.
 6. List connected data points, including connected control unit and input device.
 7. Indicate system graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations. Provide demonstration diskette containing graphics.
 8. Show system configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
 9. Indicate and tag each input/output served by each Control Unit or Intelligent Device.
- F. Provide functional descriptions and programming specifications for all software and database entries provided by the Contractor.
- G. Provide instructions for making the programming changes listed above.
- H. Provide documentation on all point naming conventions to the Architect/Engineer of Record for incorporation into the Graphical User Interface (GUI).
- I. Prepare and submit Test Plans, Test Procedures and Test Reports for Factory Acceptance Tests, Operational Testing and Integration Testing.
- J. Product samples for all the devices that will be visible to public view but not limited to Temperature Sensors, Thermostats, Carbon dioxide Sensors, etc. Samples shall include intended locations and manufacturers' options available in product material, finish, shape, size

and features for City selection and approval.

- K. Fan and Damper Control Matrix: Contractor shall prepare and submit fan and damper control matrix consisting of a logically arranged tubular data coordinated with Fire Alarm (FA) Signals, showing the relationship and functional status of each damper and fan and other smoke control related equipment during various modes of operation. The matrix shall be prepared using coordinated device address for each zone. Submit control matrix for review and approval prior to implementation, configuration and programming. Each of the automatic control dampers and fire smoke damper shall be assigned a unique damper address in collaboration with other trade work and indicated in the EMCS plans and control matrix.
- L. Manufacturer's Instructions: Indicate manufacturer's installation instructions for all manufactured components.
- M. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors.
 - 1. Revise shop drawings to reflect actual installation and operating sequences.
 - 2. Include submittals data in final "Record Documents" form.
 - 3. Provide CD backup of LNS database including all changes and updates.
- N. Operation and Maintenance Data: Provide documentation with complete Operating and Maintenance manuals.
 - 1. Include interconnection wiring diagrams complete field installed systems with identified and numbered, system components and devices.
 - 2. Include keyboard illustrations and step-by-step procedures indexed for each operator function.
 - 3. Include inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
- O. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.10 QUALITY ASSURANCE

A. GENERAL

- 1. Design of system and system software under direct supervision of a Professional Engineer experienced in design of this Work and licensed in the State of California. Controls shop drawings shall be stamped and signed by the licensed Professional Engineer.
- 2. The BAS shall be furnished, engineered and installed by Licensed Trade Technicians. The contractor shall have on staff trained LonWorks Network Integrators. Training shall include a minimum of 40 hours of LonWorks Network Design and LonWorks Network Management tool training. Contractor must have at least two fully trained staff members at all times. Contractor shall provide training class certifications of staff members. Contractor shall have a direct line of technical support from suppliers. The contractor shall employ technicians who have completed factory-authorized training. The contractor shall employ technicians to provide instruction, routine maintenance, and emergency service within 24 hours upon receipt of request.
- 3. All devices, interfaces, wiring, control panels, software, network controllers and programs and completed system shall meet the requirements of NFPA 92A, and must be UL listed.
- 4. All work of this Division shall comply with applicable standards and codes.
- 5. Provide Firewalls on the EMCS system access points to prevent unauthorized access into the systems. Provide latest and proven versions to protect the entire EMCS system.
- 6. The EMCS system shall be provided by a local qualified system integrator. The work shall be performed by skilled mechanics and electricians under the direction of experienced engineers, all of whom shall be properly trained and certified to be qualified for this work.

The manufacturer shall demonstrate financial and organizational capability to handle such a project by having installed a minimum of at least one 3,000 point system - all in one phase - within last three years.

7. Single source responsibility of the Contractor shall be the complete installation and proper operation of the EMCS system, and shall include debugging and proper calibration and commissioning of each component in the entire system.
 8. All materials and equipment used shall be standard components, regularly manufactured for this and/or other systems, and not custom designed for this project. All systems and components shall have been thoroughly tested and proven in actual use for period of at least two years on a project with minimum of 3,000 control points or more.
 9. Supplier shall have an in-place support facility within 50 miles of the site with technical staff, spare parts inventory, and all necessary test and diagnostic equipment to provide maintenance and repair at the project site within 24 hours of notification. The control systems shall be furnished, installed and commissioned by the local qualified system integrator.
 10. All electronic equipment shall conform to the requirements of FCC regulation Part 15, Section 15 governing radio frequency electromagnetic interference and be so labeled. It is the contractor's responsibility to protect the systems specified here from causing interference of other systems, and through compliance with the FCC as indicated above to prevent interference with other systems.
 11. The EMCS software shall be designed, implemented, maintained and supported by the Contractor who can demonstrate the ability to fully support the software over the life of the system. The Contractor shall provide all documentation, configuration, and sources as required to maintain the software over the life of the system. Third-party software packages that are not fully supported by the Contractor will not be acceptable. Contractor to notify City of any revisions to software that improves software performance or that corrects problems found during use of software.
 12. Control System Protocol: City's open system protocol shall be ANSI/CEA 709 LonWorks.
 13. The network infrastructure shall conform to the published guidelines for wire type, length, number of nodes per channel, termination, and other relevant wiring and infrastructure criteria as published (reference: Junction Box and Wiring Guidelines for Twisted Pair LonWorks Networks).
- B. Manufacturer Qualifications:
1. The manufacturer(s) of the hardware and software components must be primarily engaged in the manufacture of LonWorks based systems as specified herein, and must have been so for a minimum of five (5) years.
 2. The manufacturer(s) of the hardware and software components as well as its subsidiaries must be a member in good standing of LonMark International and/or LonMark Americas.
 3. The manufacturer(s) of the hardware and software components shall have an authorized representative capable of providing service and support as referenced in section B above, and must have done so for a minimum of five (5) years.
 4. The manufacturer(s) of the hardware and software components shall have a technical support group accessible via a phone/fax/email that is staffed with qualified personnel, capable of providing instruction and technical support service for networked control systems.
 5. The manufacturer(s) of the hardware and software components must have no less than five (5) similar projects, which have LonWorks based Facility Automation Systems as specified herein installed by the authorized representative referenced above. These projects must be on-line and functional such that the Owners/Users representative can observe the system in full operation.
- C. Installer Qualifications:

1. The Contractor must be regularly engaged in the service and installation of LonWorks based systems as specified herein, and must have been so for a minimum of five (5) years.
 2. The Contractor must be an authorized representative in good standing of the manufacturer of the proposed hardware and software components.
 3. The Contractor shall have an office that is staffed with designers trained in integrating interoperable systems and technicians fully capable of providing LonWorks instruction and routine emergency maintenance service on all system components.
 4. The Contractor shall have in house capabilities to provide control strategies for whole building control. This includes HVAC, lighting, access, and security applications etc.
 5. The Contractor shall have a service facility, staffed with qualified service personnel, capable of providing instructions and routine emergency maintenance service for networked control systems.
 6. The Contractor shall submit a list of no less than three (3) similar projects, which have LonWorks based BAS as specified herein installed by the Contractor. These projects must be on-line and functional such that they can be observed the system in full operation.
 7. The Contractor must employ at least two LonMark Certified Professional integrators and shall submit their LonMark Credentials with the proposal.
- D. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.11 PRE-INSTALLATION MEETING

- A. Convene one week before starting work of this Section.
- B. Require attendance of parties directly affecting the work of this Section.

1.12 WARRANTY AND GUARANTEE

- A. General: Contractor is required to provide Warranties in accordance with Division 1 and Closeout Procedures in accordance with Section 017700. - Warranties. Contractor shall warranty all material, equipment and software provided by him against all type of defects for 36 months. Contractor shall warranty service for all work provided by the contractor against defects in workmanship and material for a period of 12 months after final acceptance of the work by the City and he shall repair or replace any materials or equipment developing such defects within that time, promptly on due notice given him by the City and at Contractor's sole cost and expense.
- B. After completion of the installation, control manufacturer shall completely adjust all control equipment provided under this Contract; place the system in operation, subject to the City's Representative approval, and instruct the operating personnel in the operation of the control system.
- C. Service shall be accomplished and guarantee fulfilled by qualified employees of the Energy Management and Control System contractor. The contractor shall have a quality history of at least 5 years in the project area.
- D. Indirect temperature control service by independent contractors, distributors and franchised installers will not be acceptable.
- E. Warranty servicing shall include, but not be limited to, the following:
 1. Replacing defective parts and components as required.
 2. Servicing by factory-trained and locally employed service representative of system contractor.
 3. Maintaining of system programming.

- F. The Energy Management and Control System contractor shall have an in-place service facility within 50 miles of project site with technical staff, complete spare parts inventory, and all necessary test and diagnostic equipment to keep system operating.
- G. Tie-Ins: During the warranty period, additional EMCS circuits and devices shall be connected and programmed to be controlled and monitored by the EMCS system. New devices shall be connected in the same manner as shown on the drawings for this contract and the existence of the new connections shall not void this guarantee.

1.13 MAINTENANCE SERVICE

- A. Provide service and maintenance of energy management and control systems for one year from date of acceptance of work by the City.

1.14 RECORD DRAWINGS

- A. See Section 017839 - Project Record Documents

1.15 PROTECTION OF SOFTWARE RIGHTS

- A. Patent: Should patented articles, methods, materials, apparatus, etc., be used in this work, the contractor shall acquire the right to use the same. The Contractor shall hold the City and his agents harmless for any delay, action, suit, or cost growing out of the patent rights for any device on this project.
- B. Copyrights: Should copyrighted software be used in this work, the Contractor shall acquire the right to use same. The Contractor shall hold the City and his agents harmless for any delay, action, suit, or cost growing out of the copyrights for any software on this project.
- C. License to Use: All software required for the complete operation of the system as specified herein shall be delivered with either full ownership transferred to the City or a non-time-limited License to use on each machine it is installed on, including the right to make back up copies.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Products and installation by the following manufacturers of BAS controllers are acceptable contingent upon compliance with the Specifications.
 - 1. TAC (Invensys)
 - 2. Honeywell
 - 3. Distech
 - 4. Circon
 - 5. Trane Controls
 - 6. or approved equal.
- B. Substitutions: See Section 012513 - Product Substitutions Procedures

2.2 EMCS SYSTEM REQUIREMENTS

- A. This section defines the Basic Materials and Methods provided by the Controls Contractor and used in the installation of LonWorks Control products to provide the functions necessary for control of the mechanical systems on this project. Please be advised that the requirements of this specification will be strictly enforced. Systems that do not meet the requirements of the specification as outlined below (section 1.1 in particular) will not be accepted.
- B. Provide an Energy Management and Control System incorporating LonWorks, Direct Digital Control (DDC), equipment monitoring, and control consisting of microprocessor based plant control processors interfacing directly with sensors, actuators, and environmental delivery

- systems (ie. HVAC units); electric controls and mechanical devices for all items indicated on drawings described herein including dampers, valves, panels, sensing devices; a primary communications network to allow data exchange between microprocessor based devices.
- C. The system will consist of a flat, open architecture that utilizes the ANSI/CEA 709.1 (LonTalk™) Protocol as the common communication protocol between all controlled and controlling devices. Where necessary or desired, LonTalk packets may be encapsulated into TCP/IP using IP-852 routing messages to take advantage of existing infrastructure or to increase network bandwidth. Hierarchical systems consisting of master or global controllers that poll and/or control less intelligent unitary controllers on a secondary bus will not be considered.
 - D. The entire system network shall be a Local Operating Network (LON). All nodes shall communicate with each other utilizing ANSI/CEA 709. There will be no consideration given to any network which does not use LonWorks as the primary communications network. Controllers shall be capable of sharing standard network variable data with other LON-based devices.
 - E. Controllers shall implement the full ANSI/CEA 709.1 "LonTalk" protocol. Controllers must meet all of the requirements of this standard and must adhere to all of the protocol definition set forth by ANSI. All controllers shall be able to co-exist and interoperate on the LonWorks network without interfering or limiting other controller's functionality. Controllers shall be able to be installed by any standard LonWorks Network Services (LNS) based network management tool. This project requires the use of LonMaker for Windows as the primary installation tool.
 - F. The system installed shall seamlessly connect devices other than HVAC throughout the building regardless of subsystem type, i.e. HVAC, lighting, and security devices should easily coexist on the same network channel without the need for gateways. Use of ANSI/CEA-852 (IP-852) layer 3 transparent routers is the only acceptable method spanning multiple channels and is the recommended method for system scalability. These components shall share common software for network communications, configuration, time scheduling, alarm handling, history logging, and custom programming. Any routers required by the system shall be supplied and commissioned as part of this specification.
 - G. Gateways shall not be used unless specifically authorized in writing. Use of a gateway requires submittal of the documentation as required by the City or City's Representative. It is the intent of this specification that gateways be limited to integrating legacy systems where applicable. Acceptance of gateways is at the sole discretion of the owner.
 - H. System Monitoring shall be provided through the installation of FMSI provided Wonderware based OWS software applications that support a direct driver to the LonWorks database or through web browser based devices (see specification section 230973). The FMSI provided Wonderware based OWS shall provide complete access to any point in the system at any time. A complete and fully commissioned LNS database must be delivered for use with the FMSI provided Wonderware based OWS as a specific deliverable as defined on the project schedule. This EMCS provided database must include ALL node definitions, ALL channel and subnet definitions, all router and repeater definitions, and all bindings etc.
 - I. The control system shall be designed such that mechanical equipment will be able to operate under stand-alone control. Functional methodology such as scheduling, trending, and alarming shall be outlined fully in your submittal documentation. Methodology must follow pertinent and applicable LonMark guidelines. Controllers that require a master computer or controller to perform basic functions are not acceptable. In the event of a network communication failure, or the loss of any other controller on the LON network, the control system shall continue to independently operate under control of the resident program stored in nonvolatile memory as detailed herein.

- J. The documentation contained in this section and other contract documents pertaining to HVAC Controls is schematic in nature. The contractor shall provide all required hardware and software necessary to implement the functions shown or as implied in the contract documents.
- K. System configuration and monitoring will be performed via a PC-type computer. Under no circumstances shall the PC be used as a control device for the network. It can be used for storage of data, network management, and as a GUI. If the PC is taken off line, the control system shall continue to operate fully.
- L. All LonWorks devices (controllers, sensors, actuators, etc) shall be integrated into one common network infrastructure utilizing a common network management tool and creating a single LNS network database. LonMaker for Windows is required to perform these functions.
- M. All system controllers shall utilize a peer-to-peer communications scheme to communicate with each other and with the PC-type monitoring computer(s). All controllers shall utilize Standard Network Variable Types (SNVTs) as defined by LonMark International. Controllers shall implement LonMark device profiles as appropriate. All devices shall be provided with an LNS plug-in configuration utility. If an LNS plug-in is not available for a device, all device resource files, XIF files, and points list shall be provided.
- N. Controllers shall contain non-volatile memory for storage of control programs, configuration, and setpoints. All such data shall be retained in the event of a power failure. At least one controller shall have an on-board (battery or "super cap"-backed) real-time clock to ensure correct time-of-day operation following a power failure. Controllers that are not backed-up in the event of a power failure and that require time based operation (VAV's, heat pumps, etc..) shall be peers on the network and be able to obtain time synchronization from a power fail protected controller and/or controllers upon network power restore.
- O. Historical data logging, alarm monitoring and management, and scheduling interface to the EMCS provided i.Lon 100 Scheduler shall be accessible and managed via the OWS provided by the Facility Management Systems Integrator (FMSI).
- P. Controllers shall use a software mechanism for network addressing and identification. It shall not be required to set physical network address switches on each controller.
- Q. System shall utilize LonMark defined standard network and command messaging for all system data.
- R. In general, only LonMark certified devices will be accepted on this control network. Each device must be LonMark certified version [3.2] or higher. In those instances in which LonMark devices are not available, provide LonWorks devices with application source code, device resource files, and external interface definitions. Any controller that does not meet this spec must be stated and submitted with specific reason why it is not LonMark certified. LonMark compatible, LonMark compliant, LonMark "ish" controllers are not acceptable. Exceptions may be granted for programmable controllers utilizing a custom programming software tools. These programmable controllers must meet all LonMark requirements for interoperability and shall utilize standard variable and configuration properties (SNVTs, SCPTs) as defined by LonMark. Any custom software required for controller programming shall be included as a leave-behind tool with license capability built into the bid to support the installation.
- S. If a dedicated configuration tool is provided it is must be launched as a plug-in from within LonMaker for Windows. If not, any software required for controller configuration shall be included as a leave-behind tool with full license capability to support the installation.
- T. The network infrastructure shall conform to the LonMark published guidelines for network wiring

- and system architecture. Wire type, distance, termination, and use of routers shall strictly conform to the LonMark wiring standards. The number of nodes per channel shall be no more than 80% of the defined segment (logical or physical) limit in order to provide future system enhancement with minimal infrastructure modifications. See reference to the Junction Box and Wiring Guidelines.
- U. Upon job completion provide all drawings, product information, complete and functional LNS databases, resource files, configuration files, etc on standard recordable media (CD, DVD).
 - V. The contractor shall provide 2 legal copies of all software tools, configuration tools, management tools, and utilities used during system programming, commissioning, and installation. All software shall be provided on original optical media with full usage licenses. All software licenses shall be user installable with product keys, passwords, dongles, etc. provided at project close. All tools shall be generally available in the market. No closed and/or unavailable tools will be permitted. Contractor shall convey all software tools and their legal licenses at project close out.
 - W. If Internet or IP connectivity is specified, all devices connecting to the LAN shall use the TCP/IP protocol stack. Any LAN to LonWorks routers shall use the ANSI/CEA-852 standard layer 3 transparent routing protocol. Specific IP interconnectivity shall follow IT standards for security, firewalls, address, etc. published in separate documents (if appropriate).
 - X. The control system shall be installed using the best available products from the currently available suppliers that meet the system specification. Controllers from multiple manufactures are acceptable.
 - Y. The system integrator shall provide a protocol analyzer log summary for each channel for a minimum of 24 hours showing system performance. The statistical summary shall show that all bandwidth utilization and error limits are within acceptable ranges and that there are no network traffic problems, node communication problems, or system sizing problems. The EMCS shall provide licensed Lon protocol analyzer software on the POT.

END OF SECTION

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