

SECTION 23 09 00

FACILITY MANAGEMENT AND CONTROL SYSTEM (FMCS)

PART 1 GENERAL

1.01 SUMMARY

- A. The requirements of this specification will be strictly enforced. Systems that do not meet the requirements of the specification as outlined below, specifically section 1.2 of this specification, shall not be accepted. No exceptions.
- B. All labor, material, equipment and software not specifically referred to herein that is required to meet the functional intent of this specification, shall be provided without additional cost to the County.
- C. It is the County's goal to implement an open system that will allow products from various suppliers to be integrated into a unified system in order to provide flexibility for expansion, maintenance, and service of the system. The County shall be the named license holder of all software associated with any and all incremental work on the project(s).

1.02 SYSTEM DESCRIPTION

- A. It is the intent of this specification is to provide Los Angeles County Hall of Justice with a completely integrated building management system with the ability to interface with multiple protocol systems of multiple disciplines within the building installed under this contract.
- B. The System Integrator (SI) shall provide all hardware, software, programming, and interface modules required to integrate to other building systems as shown in the specifications. The SI shall have demonstrated capability, with references, that show their capability to integrate to foreign hardware and protocols. Under this contract, the SI shall provide digital protocol integration to the following systems:
 - 1. Electrical meters at each feeder in the main switchboard.
 - 2. Fire Alarm Systems (EST3)
 - 3. ATS Alarm and Control Panel, including Emergency Generator and Day Tanks (brand as specified elsewhere)
 - 4. Chiller Room Refrigerant Monitor Alarm
 - 5. Plumbing Equipment as follows:
 - a. Domestic hot and cold water booster pump – status, alarm.
 - b. Sewage ejector – status, alarm.
 - c. Sump pump – status, alarm.
 - d. Domestic hot water heater heat exchangers – high temperature alarm, leaving hot water temperature 120 degrees patient and 140 degrees kitchen system.
 - e. Circulating pumps – status, alarm.
 - f. Water softener – status, alarm.
 - g. Instrument air compressor - status, alarm.
 - h. Fire pump system and jockey pump – status, alarm.
 - i. Grease interceptor – level alarm.
 - j. Fuel oil – day tanks status, level alarm.
 - k. Fuel oil – storage tanks, level alarm.
 - l. Fuel oil – transfer pumps, status.
- C. The SI shall also provide integration to the following sub-system protocols but not limited to:
 - 1. BACnet/IP
 - 2. BACnet over Ethernet

3. XML (Extensible Markup Language)
4. OPC (Open Connectivity)
5. MODBUS
6. Legacy Systems (Including existing TMMC Solidyne Building Automation System)
7. LONworks
8. NEXSYS
9. OBIX

D. The Facility Management and Control System (FMCS) shall be comprised of Network Area Controllers (NAC) within each facility. The NAC shall connect to the County's local or wide area network, depending on configuration. Access to the system, either locally in each building, or remotely from a central site or sites, shall be accomplished through standard Web browsers, via the Internet and/or local area network. Each NAC shall communicate BACnet (IBC) and other open and legacy protocol systems/devices provided under Division 23, 26, or Division 27.

1.03 DEFINITIONS

A. Definitions of the acronyms used in this specification are as follows:

| | |
|-------|---|
| DDC | Direct Digital Controls |
| FMCS | Facility Management and Control System |
| GUI | Graphical User Interface |
| IBC | Interoperable BACnet Controller |
| LAN | Local Area Network |
| NAC | Network Area Controller |
| MS/TP | Master Slave / Token Passing BACnet ASC Network |
| NICS | Compatibility Statement |
| OOT | Object Oriented Technology |
| PICS | Product Interoperability Compliance Statement |
| PMI | Power Measurement Interface |
| POT | Portable Operator's Terminal |
| TCS | Temperature Control System |
| WAN | Wide Area Network |
| WBI | Web Browser Interface |
| XML | Extensible Mark Up Language |

1.04 ACCEPTABLE CONTRACTORS

- A. Climatec Building Technologies Group
- B. Automated Logic
- C. Johnson

1.05 SUBMITTAL

- A. Eight (8) copies of shop drawings of the entire FMCS shall be submitted and shall consist of a complete list of equipment and materials, including manufacturers catalog data sheets and installation instructions. Shop drawings shall also contain complete wiring and schematic diagrams, software descriptions, calculations, and any other details required to demonstrate that the system has been coordinated and will properly function as a system. Terminal identification for all control wiring shall be shown on the shop drawings. A complete written Sequence of Operation shall also be included with the submittal package. Division 23, 26, and 27 contractor supplying products and systems, as part of their packages shall provide catalog data sheets, wiring diagrams and point lists to the Division 27 contractor for proper coordination of work.
- B. Submittal shall also include a complete point list of all points to be connected FMCS by the Systems Integrator. Division 23 and 26 contractors shall provide necessary point lists, protocol documentation, and factory support information for systems provided in their respective divisions but integrated into the FMCS.

- C. Submittal shall also include a copy of each of the graphics developed for the Graphic User Interface including a flowchart (site map) indicating how the graphics are to be linked to one another for system navigation. The graphics are intended to be 80% - 90% complete at this stage with the only remaining changes to be based on review comments from the A/E design team and/or County.
- D. Upon completion of the work, provide a complete set of 'as-built' drawings and application software on compact disk. Drawings shall be provided as AutoCAD™ or Visio™ compatible files. Eight copies of the 'as-built' drawings shall be provided in addition to the documents on compact disk. Division 23 and 26 contractors shall provide as-builts for their portions of work. The Division 27 contractor shall be responsible for as-builts pertaining to overall FMCS architecture and network diagrams. All as built drawings shall also be installed into the FMCS server in a dedicated directory.

1.06 DIVISION OF WORK

- A. FMCS contractors shall be responsible for all controllers (IDC, IBC and INC), control devices, control panels, controller programming, controller programming software, controller input/output and power wiring and controller network wiring.
- B. FMCS contractor shall be responsible for the Network Area Controller(s) (NAC), software and programming of the NAC, graphical user interface software (GUI), development of all graphical screens, Web browser pages, set-up of schedules, logs and alarms, and connection of the NAC to the local or wide area network.

1.07 RELATED WORK SPECIFIED ELSEWHERE

- A. Division 23 Direct Digital Control System:
 - 1. Providing control devices and systems including but not limited to:
 - a. Interoperable BACnet Controllers and programming
 - b. Control panels, devices and wiring
 - c. Local controller and control device networks
- B. Division 26, Electrical:
 - 1. Providing motor starters and disconnect switches (unless otherwise noted).
 - 2. Power wiring and conduit (unless otherwise noted).
 - 3. Provision, installation and wiring of smoke detectors (unless otherwise noted).
 - 4. Other controllers, equipment and wiring as specified in Division 26.

1.08 AGENCY AND CODE APPROVALS

- A. The latest edition of the following standards and codes in effect and amended as of supplier's proposal date, and any applicable subsections thereof, shall govern design and selection of equipment and material supplied. Verification that the applicable approvals exist for all submitted products shall be provided with the submittal package. Systems or products not currently offering the following approvals are not acceptable:
 - 1. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
 - 2. ANSI/ASHRAE Standard 135-2001, BACnet.
 - 3. Uniform Building Code (UBC), including local amendments.
 - 4. UL 916 Underwriters Laboratories Standard for Energy Management Equipment.
 - 5. National Electrical Code (NEC).
 - 6. FCC Part 15, Subpart J, Class A
 - 7. EMC Directive 89/336/EEC (European CE Mark)
- B. City, county, state, and federal regulations and codes in effect as of contract date.

- C. Except as otherwise indicated the system supplier shall secure and pay for all permits, inspections, and certifications required for his work and arrange for necessary approvals by the governing authorities.

1.09 SOFTWARE LICENSE AGREEMENT

- A. The County shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to County as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets contained within such software.
- B. It is the County's express goal to implement an open system that will allow products from various suppliers to be integrated into a unified system in order to provide flexibility for expansion, maintenance, and service of the system. The County shall be the named license holder of all software associated with any and all incremental work on the project(s). In addition, the County shall receive ownership of all job specific configuration documentation, data files, and application-level software developed for the project. This shall include all custom, job specific software code and documentation for all configuration and programming that is generated for a given project and/or configured for use with the NAC, FMCS Server(s), and any related LAN / WAN / Intranet and Internet connected routers and devices. Any and all required IDs and passwords for access to any component or software program shall be provided to the County.

1.10 DELIVERY, STORAGE AND HANDLING

- A. Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons through shipping, storage, and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.

1.11 JOB CONDITIONS

- A. Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to ensure that the Work will be carried out in an orderly fashion. It shall be this Contractor's responsibility to check the Contract Documents for possible conflicts between his Work and that of other crafts in equipment location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers, and structural and architectural features.

PART 2 MATERIALS

2.01 GENERAL

- A. The Facility Management Control System (FMCS) shall be comprised of a network of interoperable, stand-alone digital controllers, a computer system, graphical user interface software, printers, network devices and other devices as specified herein.
- B. The installed system shall provide secure password access to all features, functions and data contained in the overall FMCS.

2.02 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURES

- A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate ANSI/ASHRAE Standard 135-2001 BACnet technology, MODBUS, OPC, and other open and proprietary communication protocols in one open, interoperable system.
- B. The supplied system must incorporate the ability to access all data using standard Web browsers without requiring proprietary operator interface and configuration programs. An Open DataBase Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on a supplier-installed server for all database access. Systems requiring proprietary database and user interface programs shall not be acceptable.

- C. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable.
 - 1. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.
 - 2. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

2.03 NETWORKS

- A. The Local Area Network (LAN) shall be a 100 Megabits/sec (Minimum) Ethernet network supporting BACnet and XML for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Network Area Controllers (NACs), user workstations and, if specified, a local server.
- B. Local area network minimum physical and media access requirements:
 - 1. Ethernet; IEEE standard 802.3
 - 2. Cable; 100 Base-T, UTP-8 wire, Category 5
 - 3. Minimum throughput; 100 Mbps.

2.04 NETWORK ACCESS

- A. Remote Access. For Local Area Network installations, provide access to the LAN from a remote location, via the Internet. The County shall provide a connection to the Internet to enable this access via high speed cable modem, asynchronous digital subscriber line (ADSL) modem, ISDN line, T1 Line or via the customer's Intranet to a corporate server providing access to an Internet Service Provider (ISP). Customer agrees to pay monthly access charges for connection and ISP.

2.05 NETWORK AREA CONTROLLER (NAC)

- A. The Division 27 contractor shall supply one or more Network Area Controllers (NAC) as part of this contract to integrate the existing Terminals. Number of area controllers required is dependent on the type and quantity of devices provided under Divisions 23, 26, and 27.
- B. The Network Area Controller (NAC) shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the NAC. It shall be capable of executing application control programs to provide:
 - 1. Calendar functions
 - 2. Scheduling
 - 3. Trending
 - 4. Alarm monitoring and routing
 - 5. Time synchronization
 - 6. Network Management functions for all controllers
- C. The Network Area Controller must provide the following hardware features as a minimum:
 - 1. One Ethernet Port – 10/100 Mbps
 - 2. One RS-232 port
 - 3. One RS-485 port
 - 4. Battery Backup
 - 5. Flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity)
 - 6. The NAC must be capable of operation over a temperature range of 32 to 122°F

7. The NAC must be capable of withstanding storage temperatures of between 0 and 158°F
 8. The NAC must be capable of operation over a humidity range of 5 to 95% RH, non-condensing
- D. The NAC shall provide multiple user access to the system and support for ODBC or SQL. A database resident on the NAC shall be an ODBC-compliant database or must provide an ODBC data access mechanism to read and write data stored within it.
- E. The NAC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 32 simultaneous users.
- F. Event Alarm Notification and actions
1. The NAC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
 2. The NAC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up telephone connection, or wide-area network.
 3. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but limited to:
 - a. To alarm
 - b. Return to normal
 - c. To fault
 4. Provide for the creation of a minimum of eight of alarm classes for the purpose of routing types and or classes of alarms, i.e.: security, HVAC, Fire, etc.
 5. Provide timed (schedule) routing of alarms by class, object, group, or node.
 6. Provide alarm generation from binary object "runtime" and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.
- G. Control equipment and network failures shall be treated as alarms and annunciated.
- H. Alarms shall be annunciated in any of the following manners as defined by the user:
1. Screen message text
 2. Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:
 - a. Day of week
 - b. Time of day
 - c. Recipient
 3. Pagers via paging services that initiate a page on receipt of email message
 4. Graphic with flashing alarm object(s)
 5. Printed message, routed directly to a dedicated alarm printer
- I. The following shall be recorded by the NAC for each alarm (at a minimum):
1. Time and date
 2. Location (building, floor, zone, office number, etc.)
 3. Equipment (air handler #, accessway, etc.)
 4. Acknowledge time, date, and user who issued acknowledgement.
 5. Number of occurrences since last acknowledgement.
- J. Alarm actions may be initiated by user defined programmable objects created for that purpose.

- K. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.
- L. A log of all alarms shall be maintained by the NAC and/or a server (if configured in the system) and shall be available for review by the user.
- M. Provide a "query" feature to allow review of specific alarms by user defined parameters.
- N. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.
- O. An Error Log to record invalid property changes or commands shall be provided and available for review by the user.

2.06 DATA COLLECTION AND STORAGE

- A. The NAC shall have the ability to collect data for any property of any object and store this data for future use.
- B. The data collection shall be performed by log objects, resident in the NAC that shall have, at a minimum, the following configurable properties:
 1. Designating the log as interval or deviation.
 2. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
 3. For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
 4. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.
 5. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.
- C. All log data shall be stored in a relational database in the NAC and the data shall be accessed from a server (if the system is so configured) or a standard Web browser.
- D. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.
- E. All log data shall be available to the user in the following data formats:
 1. HTML
 2. XML
 3. Plain Text
 4. Comma or tab separated values
- F. Systems that do not provide log data in HTML and XML formats at a minimum shall not be acceptable.
- G. The NAC shall have the ability to archive its log data either locally (to itself), or remotely to a server or other NAC on the network. Provide the ability to configure the following archiving properties, at a minimum:
 1. Archive on time of day
 2. Archive on user-defined number of data stores in the log (buffer size)
 3. Archive when log has reached it's user-defined capacity of data stores
 4. Provide ability to clear logs once archived

2.07 AUDIT LOG

- A. Provide and maintain an Audit Log that tracks all activities performed on the NAC. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached its user-defined buffer size. Provide the ability to archive the log locally (to the NAC), to another NAC on the network, or to a server. For each log entry, provide the following data:
1. Time and date
 2. User ID
 3. Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.

2.08 DATABASE BACKUP AND STORAGE

- A. The NAC shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval.
- B. Copies of the current database and, at the most recently saved database shall be stored in the NAC. The age of the most recently saved database is dependent on the user-defined database save interval.
- C. The NAC database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

2.09 GRAPHICAL USER INTERFACE SOFTWARE

- A. Operating System: The GUI shall run on Microsoft Windows XP Professional.
- B. The GUI shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu-pull downs, and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with a minimum knowledge of the HVAC Control System and basic computing skills. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line), that displays the location and the selected object identification.
- C. Real-Time Displays. The GUI, shall at a minimum, support the following graphical features and functions:
1. Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of a graphic background, the GUI shall support the use of scanned pictures.
 2. Graphic screens shall have the capability to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL's, and links to other graphic screens.
 3. Graphics shall support layering and each graphic object shall be configurable for assignment to a layer. A minimum of six layers shall be supported.
 4. Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.
 - a. Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
 - b. Holidays shall be set by using a graphical calendar without requiring any keyboard entry from the operator.
 5. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
 6. Adjustments to analog objects, such as set points, shall be done by right-clicking the selected object and using a graphical slider to adjust the value. No entry of text shall be required.

- D. System Configuration. At a minimum, the GUI shall permit the operator to perform the following tasks, with proper password access:
 - a. Create, delete or modify control strategies.
 - b. Add/delete objects to the system.
 - c. Tune control loops through the adjustment of control loop parameters.
 - d. Enable or disable control strategies.
 - e. Generate hard copy records or control strategies on a printer.
 - f. Select points to be alarmable and define the alarm state.
 - g. Select points to be trended over a period of time and initiate the recording of values automatically.

- E. On-Line Help. Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext. All system documentation and help files shall be in HTML format.

- F. Security. Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.

- G. System Diagnostics. The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.

- H. Alarm Console
 - 1. The system will be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and acknowledge the alarm. The use of the Alarm Console can be enabled or disabled by the system administrator.
 - 2. When the Alarm Console is enabled, a separate alarm notification window will supercede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and un-acknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator shall not be acceptable.

2.10 WEB BROWSER CLIENTS

- A. The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer™, Mozilla FireFox™ or Netscape Navigator™. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacture-specific browsers shall not be acceptable.

- B. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., in order to allow the Web browser to function with the FMCS, shall not be acceptable.

- C. The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.

- D. The Web browser client shall support at a minimum, the following functions:
1. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.
 2. Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.
 3. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.
 4. Storage of the graphical screens shall be in the Network Area Controller (NAC), without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
 5. Real-time values displayed on a Web page shall update automatically without requiring a manual "refresh" of the Web page.
 6. Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:
 - a. Modify common application objects, such as schedules, calendars, and set points in a graphical manner.
 - 1) Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
 - 2) Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
 - b. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
 - c. View logs and charts
 - d. View and acknowledge alarms
 - e. Setup and execute SQL queries on log and archive information
 7. The system shall provide the capability to specify a user's (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to just their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.
 8. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

2.11 SERVER FUNCTIONS AND HARDWARE

- A. A central server, located in, CUP, shall be provided. The server shall support all Network Area Controllers (NAC) connected to the customer's network whether local or remote.
- B. Local connections shall be via Fiber Optic Network. Remote connections can be via ISDN, ADSL, T1 or dial-up connection.
- C. It shall be possible to provide access to all Network Area Controllers via a single connection to the server. In this configuration, each Network Area Controller can be accessed from a remote Graphical User Interface (GUI) or from a standard Web browser (WBI) by connecting to the server.
- D. The server shall provide the following functions, at a minimum:
 1. Global Data Access: The server shall provide complete access to distributed data defined anywhere in the system.

2. Distributed Control: The server shall provide the ability to execute global control strategies based on control and data objects in any NAC in the network, local or remote.
3. The server shall include a master clock service for its subsystems and provide time synchronization for all Network Area Controllers (NAC).
4. The server shall accept time synchronization messages from trusted precision Atomic Clock Internet sites and update its master clock based on this data.
5. The server shall provide scheduling for all Network Area Controllers and their underlying field control devices.
6. The server shall provide demand limiting that operates across all Network Area Controllers. The server must be capable of multiple demand programs for sites with multiple meters and or multiple sources of energy. Each demand program shall be capable of supporting separate demand shed lists for effective demand control.
7. The server shall implement the BACnet Command Prioritization scheme (16 levels) for safe and effective contention resolution of all commands issued to Network Area Controllers. Systems not employing this prioritization shall not be accepted.
8. Each Network Area Controller supported by the server shall have the ability to archive its log data, alarm data and database to the server, automatically. Archiving options shall be user-defined including archive time and archive frequency.
9. The server shall provide central alarm management for all Network Area Controllers supported by the server. Alarm management shall include:
 - a. Routing of alarms to display, printer, email and pagers
 - b. View and acknowledge alarms
 - c. Query alarm logs based on user-defined parameters
10. The server shall provide central management of log data for all Network Area Controllers supported by the server. Log data shall include process logs, runtime and event counter logs, audit logs and error logs. Log data management shall include:
 - a. Viewing and printing log data
 - b. Exporting log data to other software applications
 - c. Query log data based on user-defined parameters

E. Server Hardware Requirements: The server hardware platform shall have the following requirements:

1. The computer shall be an Intel Pentium M based computer (minimum processing speed of 2.4 GHz with 1 GB RAM and a 100-gigabyte minimum hard drive). It shall include a DVD-ROM/CD-RW Combination Drive, 2-parallel ports, 2-asynchronous serial ports and 2-USB ports. A minimum 22" flat panel color monitor, 1280 x 1024 optimal preset resolution, 25 ms response time shall also be included.
2. The server operating system shall be Microsoft Windows XP Professional. Include Microsoft Internet Explorer 6.0 or later.
3. Connection to the FMCS network shall be via an Ethernet network interface card, 100 Mbps.
4. A system printer shall be provided. Printer shall be laser type with a minimum 600 x 600-dpi resolution and rated for 60-PPM print speed minimum.
5. For dedicated alarm printing, provide a dot matrix printer, either 80 or 132 column width. The printer shall have a parallel port interface.

2.12 SYSTEM PROGRAMMING

- A. The Graphical User Interface software (GUI) shall provide the ability to perform system programming and graphic display engineering as part of a complete software package. Access to the programming functions and features of the GUI shall be through password access as assigned by the system administrator.
- B. A library of control, application, and graphic objects shall be provided to enable the creation of all applications and user interface screens. Applications are to be created by selecting the desired control objects from the library, dragging or pasting them on the screen, and linking them together using a built in graphical connection tool. Completed applications may be stored in the library for future use. Graphical

User Interface screens shall be created in the same fashion. Data for the user displays is obtained by graphically linking the user display objects to the application objects to provide "real-time" data updates. Any real-time data value or object property may be connected to display its current value on a user display. Systems requiring separate software tools or processes to create applications and user interface displays shall not be acceptable.

C. Programming Methods

1. Provide the capability to copy objects from the supplied libraries, or from a user-defined library to the user's application. Objects shall be linked by a graphical linking scheme by dragging a link from one object to another. Object links will support one-to-one, many-to-one, or one-to-many relationships. Linked objects shall maintain their connections to other objects regardless of where they are positioned on the page and shall show link identification for links to objects on other pages for easy identification. Links will vary in color depending on the type of link; i.e., internal, external, hardware, etc.
2. Configuration of each object will be done through the object's property sheet using fill-in the blank fields, list boxes, and selection buttons. Use of custom programming, scripting language, or a manufacturer-specific procedural language for configuration will not be accepted.
3. The software shall provide the ability to view the logic in a monitor mode. When on-line, the monitor mode shall provide the ability to view the logic in real time for easy diagnosis of the logic execution. When off-line (debug), the monitor mode shall allow the user to set values to inputs and monitor the logic for diagnosing execution before it is applied to the system.
4. All programming shall be done in real-time. Systems requiring the uploading, editing, and downloading of database objects shall not be allowed.
5. The system shall support object duplication within a customer's database. An application, once configured, can be copied and pasted for easy re-use and duplication. All links, other than to the hardware, shall be maintained during duplication.

2.13 OBJECT LIBRARIES

- A. A standard library of objects shall be included for development and setup of application logic, user interface displays, system services, and communication networks.
- B. The objects in this library shall be capable of being copied and pasted into the user's database and shall be organized according to their function. In addition, the user shall have the capability to group objects created in their application and store the new instances of these objects in a user-defined library.
- C. In addition to the standard libraries specified here, the supplier of the system shall maintain an on-line accessible (over the Internet) library, available to all registered users to provide new or updated objects and applications as they are developed.
- D. All control objects shall conform to the control objects specified in the BACnet specification.
- E. The library shall include applications or objects for the following functions, at a minimum:
 1. Scheduling Object. The schedule must conform to the schedule object as defined in the BACnet specification, providing 7-day plus holiday & temporary scheduling features and a minimum of 10 on/off events per day. Data entry to be by graphical sliders to speed creation and selection of on-off events.
 2. Calendar Object. . The calendar must conform to the calendar object as defined in the BACnet specification, providing 12-month calendar features to allow for holiday or special event data entry. Data entry to be by graphical "point-and-click" selection. This object must be "linkable" to any or all scheduling objects for effective event control.
 3. Duty Cycling Object. Provide a universal duty cycle object to allow repetitive on/off time control of equipment as an energy conserving measure. Any number of these objects may be created to control equipment at varying intervals

4. Temperature Override Object. Provide a temperature override object that is capable of overriding equipment turned off by other energy saving programs (scheduling, duty cycling etc.) to maintain occupant comfort or for equipment freeze protection.
5. Start-Stop Time Optimization Object. Provide a start-stop time optimization object to provide the capability of starting equipment just early enough to bring space conditions to desired conditions by the scheduled occupancy time. Also, allow equipment to be stopped before the scheduled un-occupancy time just far enough ahead to take advantage of the building's "flywheel" effect for energy savings. Provide automatic tuning of all start / stop time object properties based on the previous day's performance.
6. Demand Limiting Object. Provide a comprehensive demand-limiting object that is capable of controlling demand for any selected energy utility (electric, oil, and gas). The object shall provide the capability of monitoring a demand value and predicting (by use of a sliding window prediction algorithm) the demand at the end of the user defined interval period (1-60 minutes). This object shall also accommodate a utility meter time sync pulse for fixed interval demand control. Upon a prediction that will exceed the user defined demand limit (supply a minimum of 6 per day), the demand limiting object shall issue shed commands to either turn off user specified loads or modify equipment set points to effect the desired energy reduction. If the list of sheddable equipment is not enough to reduce the demand to below the set point, a message shall be displayed on the users screen (as an alarm) instructing the user to take manual actions to maintain the desired demand. The shed lists are specified by the user and shall be selectable to be shed in either a fixed or rotating order to control which equipment is shed the most often. Upon suitable reductions in demand, the demand-limiting object shall restore the equipment that was shed in the reverse order in which it was shed. Each sheddable object shall have a minimum and maximum shed time property to effect both equipment protection and occupant comfort.

F. The library shall include control objects for the following functions. All control objects shall conform to the objects as specified in the BACnet specification.

1. Analog Input Object - Minimum requirement is to comply with the BACnet standard for data sharing. Allow high, low and failure limits to be assigned for alarming. Also, provide a time delay filter property to prevent nuisance alarms caused by temporary excursions above or below the user defined alarm limits.
2. Analog Output Object - Minimum requirement is to comply with the BACnet standard for data sharing.
3. Binary Input Object - Minimum requirement is to comply with the BACnet standard for data sharing. The user must be able to specify either input condition for alarming. This object must also include the capability to record equipment run-time by counting the amount of time the hardware input is in an "on" condition. The user must be able to specify either input condition as the "on" condition.
4. Binary Output Object - Minimum requirement is to comply with the BACnet standard for data sharing. Properties to enable minimum on and off times for equipment protection as well as interstart delay must be provided. The BACnet Command Prioritization priority scheme shall be incorporated to allow multiple control applications to execute commands on this object with the highest priority command being invoked. Provide sixteen levels of priority as a minimum. Systems not employing the BACnet method of contention resolution shall not be acceptable.
5. PID Control Loop Object - Minimum requirement is to comply with the BACnet standard for data sharing. Each individual property must be adjustable as well as to be disabled to allow proportional control only, or proportional with integral control, as well as proportional, integral and derivative control.
6. Comparison Object - Allow a minimum of two analog objects to be compared to select either the highest, lowest, or equality between the two linked inputs. Also, allow limits to be applied to the output value for alarm generation.
7. Math Object - Allow a minimum of four analog objects to be tested for the minimum or maximum, or the sum, difference, or average of linked objects. Also, allow limits to be applied to the output value for alarm generation.

8. Custom Programming Objects - Provide a blank object template for the creation of new custom objects to meet specific user application requirements. This object must provide a simple BASIC-like programming language that is used to define object behavior. Provide a library of functions including math and logic functions, string manipulation, and e-mail as a minimum. Also, provide a comprehensive on-line debug tool to allow complete testing of the new object. Allow new objects to be stored in the library for re-use.
 9. Interlock Object - Provide an interlock object that provides a means of coordination of objects within a piece of equipment such as an Air Handler or other similar types of equipment. An example is to link the return fan to the supply fan such that when the supply fan is started, the return fan object is also started automatically without the user having to issue separate commands or to link each object to a schedule object. In addition, the control loops, damper objects, and alarm monitoring (such as return air, supply air, and mixed air temperature objects) will be inhibited from alarming during a user-defined period after startup to allow for stabilization. When the air handler is stopped, the interlocked return fan is also stopped, the outside air damper is closed, and other related objects within the air handler unit are inhibited from alarming thereby eliminating nuisance alarms during the off period.
 10. Temperature Override Object - Provide an object whose purpose is to provide the capability of overriding a binary output to an "On" state in the event a user specified high or low limit value is exceeded. This object is to be linked to the desired binary output object as well as to an analog object for temperature monitoring, to cause the override to be enabled. This object will execute a Start command at the Temperature Override level of start/stop command priority unless changed by the user.
 11. Composite Object - Provide a container object that allows a collection of objects representing an application to be encapsulated to protect the application from tampering, or to more easily represent large applications. This object must have the ability to allow the user to select the appropriate parameters of the "contained" application that are represented on the graphical shell of this container.
- G. The object library shall include objects to support the integration of devices connected to the Network Area Controller (NAC). At a minimum, provide the following as part of the standard library included with the programming software:
1. For BACnet devices, provide the following objects at a minimum:
 - a. Analog In
 - b. Analog Out
 - c. Analog Value
 - d. Binary
 - e. Binary In
 - f. Binary Out
 - g. Binary Value
 - h. Multi-State In
 - i. Multi-State Out
 - j. Multi-State Value
 - k. Schedule Export
 - l. Calendar Export
 - m. Trend Export
 - n. Device
 2. For each BACnet object, provide the ability to assign the object a BACnet device and object instance number.
 3. For BACnet devices, provide the following support at a minimum
 - a. Segmentation
 - b. Segmented Request
 - c. Segmented Response
 - d. Application Services
 - e. Read Property

- f. Read Property Multiple
- g. Write Property
- h. Write Property Multiple
- i. Confirmed Event Notification
- j. Unconfirmed Event Notification
- k. Acknowledge Alarm
- l. Get Alarm Summary
- m. Who-has
- n. I-have
- o. Who-is
- p. I-am
- q. Subscribe COV
- r. Confirmed COV notification
- s. Unconfirmed COV notification
- t. Media Types
- u. Ethernet
- v. BACnet IP Annex J
- w. MSTP
- x. BACnet Broadcast Management Device (BBMD) function
- y. Routing

2.14 OPEN BUILDING INFORMATION EXCHANGE (OBIX) DEVICE INTEGRATION

- A. Specification Compatibility: The oBIX driver shall be compatible with Committee approved specification. The document identifier is obix-0.12.2. The specification can found by visiting: <http://www.obix.org>
- B. oBIX: The Open Building Information eXchange is a web services protocol designed to enable communications between building mechanical and electrical systems, and enterprise applications.
- C. URI: A Universal Resource Identifier is the location of an internet resource (e.g. web-page, ftp-service, ...). This term is a more general term for the commonly used Uniform Resource Location or URL.
- D. Lobby: The oBIX lobby is the root of a server's oBIX object tree. The lobby has certain semantics associated with it such as how to create watches and batch operations.
- E. Watches: oBIX watches are subscriptions. Watches allow a client to maintain a real-time cache for the current state of one or more objects. They are also used to access an event stream from a feed such as alarms.
- F. The Network Area Controller shall support the integration of device data via Open Building Information Exchange (oBIX), over the Ethernet Network. The Network Area Controller shall act as an oBIX client or server to another software application that supports oBIX.
- G. Provide the required objects in the library, included with the Graphical User Interface programming software, to support the integration of these devices into the FMCS. Objects provided shall include at a minimum:
 - 1. oBIX Generic AI Object
 - 2. oBIX Generic AO Object
 - 3. oBIX Generic BO Object
 - 4. oBIX Generic BI Object

2.15 MODBUS SYSTEM INTEGRATION

- A. The Network Area Controller shall support the integration of device data from Modbus RTU, Ascii, or TCP control system devices. The connection to the Modbus system shall be via an RS-232, RS485, or Ethernet IP as required by the device.

- B. Provide the required objects in the library, included with the Graphical User Interface programming software, to support the integration of the Modbus system data into the FPMS. Objects provided shall include at a minimum:
 1. Read/Write Modbus AI Registers
 2. Read/Write Modbus AO Registers
 3. Read/Write Modbus BI Registers
 4. Read/Write Modbus BO Registers
- C. All scheduling, alarming, logging and global supervisory control functions, of the Modbus system devices, shall be performed by the Network Area Controller.
- D. The FMCS supplier shall provide a Modbus system communications driver. The equipment system vendor that provided the equipment utilizing Modbus shall provide documentation of the system's Modbus interface and shall provide factory support at no charge during system commissioning.

2.16 LEGACY SYSTEM INTEGRATION

- A. The Network Area Controller shall support the integration of device data from the existing control system. The connection to the existing system shall be via an RS-232 connection between the Network Area Controller and the existing control system.
- B. Provide the required objects in the library, included with the Graphical User Interface programming software, to support the integration of the existing system data into the FMCS. Objects provided shall include at a minimum:
 1. LEGACY SYSTEM Generic AI Object
 2. LEGACY SYSTEM Generic AO Object
 3. LEGACY SYSTEM Generic BO Object
 4. LEGACY SYSTEM Generic BI Object
- C. All scheduling, alarming, logging and global supervisory control functions (demand limiting, etc.), of the existing system devices, shall be performed by the Network Area Controller. Integration of the existing system's schedules, alarms, logs, etc. is neither required nor desired.
- D. The FMCS supplier shall provide a legacy system communications driver. The County shall provide documentation of the existing system's protocol to facilitate the development of this driver. Costs for the development of the driver are to be arranged between the County and the FMCS supplier and are not included as part of this contract.

2.17 GRAPHICAL USER INTERFACE COMPUTER HARDWARE (DESKTOP)

- A. The browser workstation shall be an Intel Pentium based computer (minimum processing speed of 2.4 Ghz with 1.0 GB RAM and a 100-gigabyte minimum hard drive). It shall include a DVD-ROM/CD-RW Combination Drive, 2-parallel ports, 2-asynchronous serial ports and 2-USB ports. A minimum 22"flat panel color monitor, 1280 x 1024 optimal preset resolution, 25 ms response time, shall also be included.
- B. Connection to the FMCS network shall be via an Ethernet network interface card, 10 Mbps.
- C. A system printer shall be provided. Printer shall be laser type with a minimum 600 x 600-dpi resolution and rated for 8 PPM print speed minimum.

2.18 GRAPHICAL USER INTERFACE COMPUTER HARDWARE (LAPTOP COMPUTER)

- A. The laptop computer shall consist of an Intel Pentium based laptop computer (minimum processing speed of 2 Ghz with 1 GB RAM and a 80-gigabyte minimum hard drive). It shall include a CD-ROM drive, a 3.5" floppy drive.

- B. Connection to the FMCS network shall be via an Ethernet network interface card, 10/100 Mbps.
- C. A system printer shall be provided. Printer shall be laser type with a minimum 600 x 600-dpi resolution and rated for 60 PPM print speed minimum.

PART 3 EXECUTION

3.01 INSTALLATION

- A. All work described in this section shall be performed by system integrators or contractors that have a successful history in the design and installation of integrated control systems. The installing office shall have a minimum of five years of integration experience and shall provide documentation in the submittal package verifying the company's experience.
- B. Install system and materials in accordance with manufacturer's instructions, and as indicated.
- C. FMCS network are diagrammatic only and any apparatus not shown, but required to make the system operative to the complete satisfaction of the County's Representative shall be furnished and installed without additional cost.
- D. Line and low voltage electrical connections to control equipment shown specified or shown on the control diagrams shall be furnished and installed by the Temperature Control sub-contractor in accordance with the specifications in Divisions 23, 26, and 27.

3.02 WIRING

- A. The electrical contractor (Division 26) shall furnish all power wiring to NAC, computer and any networking equipment (routers, hubs, switches, etc.).
- B. All wiring shall be in accordance with the Project Electrical Specifications (Division 26).
- C. All wiring to be installed in conduit.

3.03 WARRANTY

- A. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance.
- B. Within this period, upon notice by the County, any defects in the work provided under this section due to faulty materials, methods of installation or workmanship shall be promptly (within 48 hours after receipt of notice) repaired or replaced by the FMCS contractor at no expense to the County

3.04 SOFTWARE LICENSE

- A. The County shall be the named license holder of all software associated with any and all incremental work on the project(s). The County, or his appointed agent, shall determine the NICS of all software licenses.
- B. The County, or his appointed agent, shall be free to direct the modification of the NICS software license, regardless of supplier.
- C. The County, or his appointed agent, shall receive ownership of all job specific software configuration documentation, data files, and application-level software developed for the project. This shall include all custom, job specific software code and documentation for all configuration and programming that is generated for a given project and /or configured for use within BACnet based controllers and/or servers and any related LAN / WAN / Intranet and Internet connected routers and devices. Any and all required ids and passwords for access to any component or software program shall be provided to the County.

3.05 ACCEPTANCE TESTING

- A. Upon completion of the installation, the FMCS contractor shall load all system software and start-up the system. The FMCS contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to insure that the system is functioning in full accordance with these specifications. The FMCS contractors are to coordinate the checkout of the system such that each Division has a representative present during system checkout.
- B. The FMCS contractor shall perform tests to verify proper performance of components, routines, and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the DDC system operation. The Division 27 contractor shall have a representative present during system checkout.
- C. Upon completion of the performance tests described above, repeat these tests, point by point as described in the validation log above in presence of County's Representative, as required. Properly schedule these tests so testing is complete at a time directed by the County's Representative. Do not delay tests so as to prevent delay of occupancy permits or building occupancy.
- D. System Acceptance: Satisfactory completion is when the Division 23, 26 and 27 contractors have performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the County's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

END OF SECTION