

## Using the Specification Framework

This document provides the framework of a comprehensive specification for implementing the PLEXUS WEB SERVERS in conjunction with an Open LONWORKS building automation system. It has been prepared to assist the Building Construction Industry in designing and implementing open Building Automation Systems (BAS) using ANSI/EIA standard 709.1, also known as the LonTalk® protocol, with the Plexus products.

This system specification framework leverages the product interoperability standards defined by the LONMARK® Association as well as the industry standard LONWORKS Network Services (LNS) technologies. For additional information concerning the LONMARK association, refer to the LONMARK web site at [www.LonMark.org](http://www.LonMark.org)

### FRAMEWORK USAGE

The Institute of Electrical and Electronics Engineers (IEEE) has defined an 'open system' in the following way:

*"An open system provides capabilities that enable properly implemented applications to run on a variety of platforms from multiple vendors, interoperate with other applications, and present a consistent style of interaction with the user"*

Within this document, the term 'open system' refers to a control system that meets the above definition. An open system based on LONWORKS technology exhibits the following specific characteristics:

- 1) Uses de facto industry standard Network Services for design, installation, and commissioning;
- 2) Contains LONMARK compliant products from multiple manufacturers;
- 3) Uses gateways only for interaction with legacy systems or as required by codes; and
- 4) Stresses horizontal functionality over proprietary vertical subsystem implementation.

Systems that have the characteristics enumerated above provide the following benefits:

- 1) Empowers the end user to select best in class products;
- 2) Ensures competitive bidding of multiple phases or additions to a system;
- 3) Maximizes use of media infrastructure and minimize wiring needs; and
- 4) Leverages multi-service networking of control, data, and telecommunication information.

Thus, the combination of open products and standard services defined within this document enables multiple integrators to easily construct a complete open system solution with products from multiple manufacturers. An open LONWORKS system is one in which products may be competitively bid as can additions, moves, and changes to the system itself. In order to meet these goals, this specification framework calls for the incorporation of products manufactured to meet LONMARK guidelines wherever possible and network tools based upon LNS for design, installation, and commissioning. True interoperability and an open, holistic building control system can be obtained by following the recommendations within this framework.

*This specification framework is not meant to be a complete or comprehensive specification. Several of the sections are meant to serve as a 'menu' of items that may or may not be used on any given project. The owner, specifier, or consultant should freely edit the materials within this framework in order to tailor it to meet project needs. The core of the framework is intended to define the minimal technical requirements for implementing a truly open system based upon LONWORKS technology with the Plexus NSX Range of Web Servers. Sequences of Operation, controller quantity and type, and physical hardware input/outputs are not provided in this document. It is preferable that these items as well as temperature control diagrams, wiring schematics, and logical diagrams be developed for each individual project. It is recommended that sequences of operation should reside with the corresponding system diagrams to clearly identify the performance and installation requirements.*

This specification framework encompasses those integration services required to install a complete system. The numbering scheme used is intentionally generic to allow ease of integration into standard specifications anywhere in the world. It should be noted, however, that the terms, units of measure, and codes mentioned herein are based upon North American standards. If AIA standards are used, the network integration content provided within this framework is applicable for use in Division 17. Portions of this material can also be used for the mechanical control system content normally found in Division 15, and the electrical control system content (Lighting, Access, Fire) normally found in Division 16.

## SECTION 15900 FACILITY MANAGEMENT AND CONTROL SYSTEM (FMCS)

*Note to Specifiers: This section provides a standard Temperature Control Specification based on the open interoperable LONWORKS™ standard.*

### PART 1 GENERAL

#### SUMMARY

Furnish all labor, materials, equipment, and service necessary for a complete and operating Facility Management and Control System (FMCS), utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are diagrammatic only. The FMCS shall be capable of total integration of the facility infrastructure systems with user access to all system data either locally over a secure Intranet within the building or by remote access by a standard Web Browser over the Internet. This shall include where deemed necessary HVAC control, electrical, gas and water metering, energy management, alarm monitoring, security and personnel access control, fire-life safety systems, and all trending, reporting and maintenance management functions related to normal building operations all as indicated on the drawings or elsewhere in this specification.

All labor, material, equipment and software not specifically referred to herein or on the plans, that is required to meet the functional intent of this specification, shall be provided without additional cost to the Owner.

- A. The entire Facility Management and Control System (FMCS) shall be comprised of a network of interoperable, stand-alone digital controllers communicating on an open LONWORKS™ communication network to dedicated Web Server(s) within the facility and communicating via the internet/intranet to a host computer in a remote location, running no more than a Web Browser (e.g. Internet Explorer).
- B. The FMCS will consist of a flat, open architecture that utilizes ANSI/EIA standard 709.1, the 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 messages to take advantage of existing infrastructure or to increase network bandwidth. Any such encapsulation of the LonTalk protocol into IP datagrams shall conform to existing LONMARK guidelines for such encapsulation.
- C. The BAS is intended to seamlessly connect devices throughout the building regardless of subsystem type, i.e. HVAC, lighting, and security devices should easily coexist on the same network channel. Gateways shall not be used unless specifically authorized by the project engineer. Use of a gateway requires submittal of the documentation detailed in herein. It is the intent of this specification that gateways be limited to integrating legacy systems. Gateways used to separate channels of open devices will not be allowed.
- D. The products used in constructing the BAS shall be LONMARK compliant. In those instances in which LONMARK devices are not available, the SI shall provide LONWORKS devices with application source code, device resource files, and external interface definitions as described herein. The software tools required to install and commission the device shall be provided for non-LONMARK devices.
- E. The SI Contractor shall furnish and install a Web based, LONWORKS-protocol, networked with Direct Digital Control (DDC) system for control and monitoring of

the building heating, ventilating and air conditioning systems as described in this specification and attached points list

- F. System shall consist of stand-alone Custom Application Controllers (CAC), sensors, automatic valves, actuators, dampers, operating software, approved submittal, operation and maintenance manuals, start-test-check documentation, as-built documents, operator training, installation labor, warranty and all other necessary material and labor to provide a complete and workable system.
- G. Network services for the BAS shall be provided by LNS. Proposed network service alternatives must demonstrate industry standardization by documenting an ability to support tools, applications, and products manufactured by no fewer than ten (10) distinct companies in the building control industry. Proposed alternatives will then be field tested with network management tools from at least five (5) distinct manufacturers.

System Monitoring and Supervisory Control shall be provided through the Web Servers, detailed in Section **XXXX** applications that must support a direct driver to the LNS database. Client access must be provided through standard Internet Browsers that require no software installing on the Client machine. Each Client shall provide complete access to any point in the system at any time. Remote Operator interfaces and configuration tools shall be supported by the LNS database in a client-server fashion.

## **SUBMITTAL**

Eight copies of shop drawings of the entire control system 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 as well as a hard copy graphical depiction of the application control programs shall also be included with the submittal package.

Submittal shall also include a trunk cable schematic diagram depicting the Web Servers, control panel locations and a description of the communication type, media and protocol.

Submittal shall also include a complete point list of all connected points to the DDC system.

Upon completion of the work, provide a complete set of 'as-built' drawings and application software on a 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.

## **RELATED WORK SPECIFIED ELSEWHERE**

Division 15, Mechanical:

Providing taps and installation of wells in piping for control system sensors and flow measurement devices.

Installation of any control system dampers.

Division 16, Electrical:

Providing motor starters and disconnect switches (unless otherwise noted).

Power wiring and conduit (unless otherwise noted).

Provision, installation and wiring of smoke detectors (unless otherwise noted).

**DELIVERY, STORAGE AND HANDLING**

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.

**JOB CONDITIONS**

Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to insure 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.

**SPECIFICATION NOMENCLATURE**

Acronyms used in this specification are as follows:

FMCS	Facility Management and Control System
IDC	Interoperable Digital Controller
WBI	Web Browser Interface
POT	Portable Operator's Terminal
PMI	Power Measurement Interface
DDC	Direct Digital Controls
LAN	Local Area Network
WAN	Wide Area Network
OOT	Object Oriented Technology

**INTEGRATOR QUALIFICATIONS**

- A. The SI shall have an office that is staffed with engineers trained in Integrating Interoperable Systems and technicians fully capable of providing LONWORKS instruction and routine emergency maintenance service on all system components.
- B. The SI shall have certified and trained staff to provide the Web Serving element of this project.
- C. SI shall have in house capabilities to provide control strategies for whole building control, as relevant to this project. This may include HVAC, lighting, access, and security applications.
- D. SI shall be a company willing and able to supply product from a variety of manufacturers. Companies owned by product manufacturers will be considered only if they submit a letter of intent with their bid stating their intention to provide an open system as defined herein that is comprised of products from multiple vendors.

**3.1 ACCEPTABLE INTEGRATORS**

**\*\*\*LIST ACCEPTABLE CONTRACTORS HERE.**

- A. Acceptable Integrators qualified to furnish and install the FMCS work as specified herein are as follows:

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

## **PART 2 MATERIALS**

### **GENERAL**

The Facility Management Control System (FMCS) shall be comprised of a network of LONWORKS™ interoperable, stand-alone digital controllers, Web Servers (providing graphics and data services), portable operator terminals, printers, network devices and other devices as specified herein. All controllers and software within FMCS shall be Year 2000 compliant and shall be supported by compliance documentation from the manufacturer.

The installed system shall provide secure password access to all features, functions and data contained in the overall FMCS.

### **OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURES**

The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system.

The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. In addition, adherence to industry standards including LONMARK™ to assure interoperability between all system components is required. For each LONWORKS™ device that does not have LONMARK™ certification, the device supplier must provide an XIF file for the device.

All components and controllers supplied under this contract shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.

The supplied system must incorporate the ability to access all data using Java enabled 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, or on one of the Web Servers. Systems requiring proprietary database and user interface programs shall not be acceptable.

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.

*Note to specifiers: There are many possible network configurations. For common Local Area Networks (LAN), use paragraph A. For Wide Area Networks (WAN), specific information about the customer's network configuration will be needed to properly specify equipment and connections required.*

## **NETWORKS**

The Local Area Network (LAN) shall be either a 10 or 100 Megabits/sec Ethernet network supporting Java, XML, FTP and HTTP for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Web Servers and Web Browser Connections.

Local area network minimum physical and media access requirements:

Ethernet; IEEE standard 802.3

Cable; 10 Base-T, UTP-8 wire, category 5

Minimum throughput; 10 Mbps, with ability to increase to 100 Mbps

## **NETWORK ACCESS**

### **Remote Access.**

For Local Area Network installations, provide access to the LAN from a remote location, via the Internet. The owner 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). Owner agrees to pay monthly access charges for connection and ISP.

Where no Local Area Network exists, FMCS supplier shall provide the following:

8 Port Ethernet hub (3Com, or equal)

Ethernet router (Cisco or equal)

The owner shall provide a connection to the Internet to enable this access via high-speed cable modem, asynchronous digital subscriber line (ADSL) modem, ISDN line or T1 Line. Owner agrees to pay monthly access charges for connection and ISP

## **Web Servers**

The Web Servers 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 Web Servers. It shall be capable of executing application control programs to provide:

Hosting of the LNS™ Database

Calendar functions

Scheduling

Trending

Alarm monitoring and routing

Time synchronization

Network Management functions for all LONWORKS™ controllers utilizing the industry standard binding tool LONMAKER for Windows.

Each Web Server must provide the following hardware features as a minimum:

One Ethernet Port -10 / 100 Mbps

One Serial RS-232 port

One Printer Port

Two USB Ports

20GB Hard Drive

1.1GHz Processor

256MB Ram

LONWORKS™ Interface Port – VNI/RNI or 78KB FTT-10A (Option TP1250)

Support for a up to 256 LONWORKS™ Controllers

Battery Backup

Active and Enabled Keyboard and Mouse Ports

Active and Enabled VGA Monitor Port

It must be capable of operation over a temperature range of 0 to 50°C and humidity range of 5 to 95% RH, non-condensing

The Web Servers must be able to monitor and display/alarm/email alert based on hardware parameters included but not limited to; system temperature, CPU temperature, CPU fan speed, system fan speed and system voltages.

The Operating System must be either Windows 2000 or Windows XP (95, 98 or NT are not acceptable).

The Web Servers must support both a VNI (Virtual Network Interface) and RNI (Remote Network Interface) to ensure that an open solution is being provided. This also ensures that the owner has flexibility and choice for future network upgrades and additions.

The Web Server shall provide multiple user access to the system and support for open databases. A database resident on the Web Server shall be an ODBC-compliant database (e.g. SQL Server, Oracle and Microsoft Access) and a mechanism to read and write data stored within it.

Web Servers that do not use ODBC compliant Databases are not acceptable.

The Web Server shall support standard Web browser access via the Intranet/Internet. It shall provide the support for up to 20 simultaneous users.

## Software License

The Software License for the Web Server(s) must be open and enable any Systems Integrator to engineer, change or modify the application once the project is complete. Restrictive engineering access to the Web will not be an acceptable.

## Event Alarm Notification and actions

The Web Server shall provide alarm recognition, storage, routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.

The Web Server 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.

Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but limited to:

Alarm Not Acknowledged

Alarm Acknowledged

Alarm Return to Normal Not Acknowledged

Alarm Return to Normal Acknowledged

Provide for the creation of an unlimited number of alarm classes for the purpose of routing types and or classes of alarms, i.e.: security, HVAC, Fire, etc.

Provide alarm generation from runtime data and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.

Control equipment and network failures shall be treated as alarms and annunciated.

Multiple alarm list boxes will be required; it must be possible to display these on a single web page and/or over multiple web pages. The fields displayed in the list box must be configurable for each list box generated to allow the specific information that the user requires to be displayed, and no more.

Action Pages will be generated in standard HTML code and activated by clicking on a button next to the alarm itself within the Alarm List Box.

In the same way that Action Pages can be referenced from the Alarm List Box it must be possible to do the same with a Web/Graphic Page. Upon receipt of the Alarm, it will be required to link to a particular Web/Graphic page directly.

Upon Alarm Acknowledgement it must be possible to configure whether or not an Alarm Acknowledgement Comment is required. This should be free form text and no less than 255 characters.

The alarm text color and background color will be configurable for each condition of the alarm e.g. Alarm Not Acknowledged, Alarm Acknowledged, Alarm Return to Normal Not Acknowledged, Alarm Return to Normal Acknowledged.

Historical Alarm Logs will be accessible from the Browser. The presentation of logs must not be restrictive. The style and format will be specified and the Systems Integrator must be able to develop a Style Sheet to the Clients requirements without interaction / reliance on the product manufacturer.

Alarms shall be annunciated in any of the following manners as defined by the user:

- Screen message text
- Pagers via paging services that initiate a page on receipt of email message
- Graphic with flashing alarm object(s)
- Printed message, routed directly to a dedicated alarm printer

The following shall be recorded by the Web Server for each alarm (at a minimum):

- Time and date
- Location (building, floor, zone, office number, etc.)
- Equipment (air handler #, accessway, etc.)
- Acknowledge time, date, and user who issued acknowledgement.

Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.

A log of all alarms shall be maintained by the Web Server and/or a Site Server (if configured in the system) and shall be available for review by the user.

Provide a "query" feature to allow review of specific alarms by user defined parameters.

An Activity Log to record all events and action of the system shall be provided and available for review by the user. This is to identify and record the User that was logged on to the system against the action or command instigated, within the Log.

### **Data Logging and Storage**

The Web Server shall have the ability to collect data for any object and store this data for future use.

The data collection shall be performed through the Data Logging Service, resident in the Web Server that shall have, at a minimum, the following configurable properties:

Designating the log as interval or deviation.

For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.

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.

Each log shall have the ability to have its data cleared by the user.

All log data shall be stored in an ODBC compliant database such as SQL, Oracle or Access in the Web Server or remote Host Server. It will be necessary for the Remote Server to Query to the Data Logging Database (regardless of location) using standard 'Open' software technologies and at a minimum must support XML and ODBC. The data must be presented in a standard Web Browser, the logged data will be configurable between tabular and graphical formats. Standard Style Sheet formatting of the User Data must be possible.

A minimum of 12 data logs will be required on the same chart / tabular report. It shall also be possible to 'zoom in' on logged data through selection of the data using the mouse.

All log data, shall be capable of being manipulated using standard SQL statements.

All log data shall be available to the user in the following data formats:

HTML

XML

Plain Text

Comma or tab separated values

Systems that do not provide log data in HTML and XML formats at a minimum shall not be acceptable, nor will closed or proprietary database formats.

### **Audit Log**

Provide and maintain an Audit Log that tracks all activities performed on the Web Server. 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 it's user-defined buffer size. Provide the ability to archive the log locally (to the Web Server), to another Web Server on the network, or to a Site Server. For each user actions, for all client connections provide log entries as follows:

Time and date

User ID

User Log on.

Failed user authentication connections

Screens that have been displayed, when they were displayed and by which user

Network variable values that have been changed, when they were changed and by which user

In addition to the above Query of the log based on individual users must be available as well as the Entire audit log.

### **Security / User Administration**

Communications between the Web Server and Web Browser are to adopt proven 'Secure User Authentication' employing 128-bit industry standard MD5 digital signatures. All transactions to/from the Web Server are to adopt the MD5 security procedures as a minimum to ensure the data on the system is protected from unauthorized access.

It is necessary to set data to Read Only, Read/Write (full access) or no access. This is to enable the security administrator to permit different users to access different features of the system. For example a user with no access rights to fire system related information would see no graphics or data on pages containing this information whereas a user with full access rights would be able to view this information and make changes to it.

Security is levels are to adopt two levels; namely users and groups; each user is to be allocated an individual profile (user name, logon id, password etc.) and may belong to one or more groups.

Access is to be granted at any level on the data hierarchy, at an individual data item level or node level (or pre-defined group of data items).

## Interoperable Digital Controller (IDC)

Controls shall be microprocessor based Interoperable LONMARK™ or LONWORKS™ Controllers (IDC). Where possible, all Interoperable Digital Controllers shall bear the applicable LONMARK™ interoperability logo on each product delivered.

All control logic will reside in the IRC's. It will not be acceptable for Control Logic to reside in the Web Servers.

HVAC control shall be accomplished using LONMARK™ based devices where the application has a LONMARK™ profile defined. Where LONMARK™ devices are not available for a particular application, devices based on LONWORKS™ shall be acceptable. For each LONWORKS™ device that does not have LONMARK™ certification, the device supplier must provide an XIF file for the device. LNS™ Plug-ins must be provided when available and used to commission / set-up the Controller. It must be possible to run the LNS™ Plug-in through the Web Server. All programming, documentation and programming tools necessary to set up and configure the supplied devices per the specified sequences of operation shall be provided.

The LONWORKS™ Network must be installed in accordance with the Open System Guidelines. It must be possible for all LONWORKS™ devices to communicate and pass data without restriction between each other regardless of whether the Web Serving Software is running or not.

All LONWORKS™ and LONMARK™ devices must be supplied using FTT-10A LONWORKS™ communications transceivers.

The Web Server will provide all scheduling, alarming, trending, and network management for the LONMARK™/ LONWORKS™ based devices.

The IDC's shall communicate with the Web Server(s) at a baud rate of not less than 78.8K baud. The IDC shall provide LED indication of communication and controller performance to the technician, without cover removal.

All IDC's shall be fully application programmable and shall at all times maintain their LONMARK™ certification. Controllers offering application selection only (non-programmable), require a 10% spare point capacity to be provided for all applications. All control sequences within or programmed into the IDC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained.

The supplier of any programmable IDC shall provide one copy of the manufacturer's programming tool, with documentation, to the owner.

## Web Server Graphics

The Web Server should provide a 'Server Manager' application that controls all applications, communications, user rights, etc and an application to simply, create web pages for the Web Server to serve to a Browser. No HTML or Java Scripting will be required to generate the Web Pages.

Real-Time Displays. The Web Server Graphics, shall at a minimum, support the following graphical features and functions:

Graphic screens shall be developed using any drawing package capable of generating a GIF 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.

Graphic screens shall have the capability to contain objects for text, real-time values, animation, sliders, color spectrum objects, logs, graphs, HTML or XML document links, hyperlinks to other URL's, and links to other graphic screens.

Graphics shall support layering and each graphic object shall be configurable for assignment to a layer. A minimum of 15 layers shall be supported.

Modifying common application objects, such as set points shall be accomplished in a graphical manner using either pre-constructed components or sliders. Selecting a number / text from a list box is not acceptable.

Commands to start and stop binary objects shall be done by clicking on active buttons. It will not be acceptable to make more than one click to achieve a simple on/off control (e.g. Right-clicking the selected object and selecting the appropriate command from the pop-up menu is not acceptable). No entry of text shall be required.

Adjustments to analog objects, such as set points, shall be done by sliding a bar or clicking on an increase / decrease buttons. It will not be acceptable to make more than one click to achieve a simple function (e.g. Right-clicking the selected object and selecting the appropriate command from the pop-up menu is not acceptable). No entry of text shall be required.

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.

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 down to point level. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. All system security data shall be stored in an encrypted format.

### **Web Browser Clients**

The system shall be capable of supporting a minimum of 20 simultaneous client connections using a standard Web browser such as Internet Explorer™ 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.

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.

The Web browser shall provide a view of the system, in terms of graphics, schedules, calendars, logs, etc. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.

The Web browser client shall support as a minimum, the following functions:

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.

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.

Storage of the graphical screens shall be in the Web Server, without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.

Real-time values displayed on a Web page shall update automatically without requiring a manual "refresh" of the Web page.

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.

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.

## **PART 3 EXECUTION**

### **INSTALLATION**

All work described in this section shall be installed, wired, circuit tested and calibrated by factory certified technicians qualified for this work and in the regular employment of the temperature control system manufacturer or its exclusive factory authorized installing contracting field office (representative). The installing office shall have a minimum of five years of installation experience with the manufacturer and shall provide documentation in submittal package verifying longevity of the installing company's relationship with the manufacturer. Supervision, calibration and checkout of the system shall be by the employees of the local exclusive factory authorized temperature control contracting field office (branch or representative).

Install system and materials in accordance with manufacturer's instructions, and as detailed on the project drawing set.

Drawings of temperature control systems are diagrammatic only and any apparatus not shown, such as relays, accessories, etc., but required to make the system operative to the complete satisfaction of the Architect shall be furnished and installed without additional cost.

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 these specifications.

Equipment furnished by the HVAC Contractor that is normally wired before installation shall be furnished completely wired. Control wiring normally performed in the field will be furnished and installed by the Temperature Control sub-contractor.

All control devices mounted on the face of control panels shall be clearly identified as to function and system served with permanently engraved phenolic labels.

## **WIRING**

All electrical control wiring and power wiring to the control panels shall be the responsibility of the FMCS contractor.

The electrical contractor (Div. 16) shall furnish all power wiring to electrical starters and motors.

All wiring shall be in accordance with the Project Electrical Specifications (Division 16), the National Electrical Code and any applicable local codes. All FMCS wiring shall be installed in the conduit types specified in the Project Electrical Specifications (Division 16) unless otherwise allowed by the National Electrical Code or applicable local codes. Where FMCS plenum rated cable wiring is allowed it shall be run parallel to or at right angles to the structure, properly supported and installed in a neat and workmanlike manner.

## **WARRANTY**

Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance.

Within this period, upon notice by the Owner, any defects in the FMCS due to faulty materials, methods of installation or workmanship shall be promptly (within 48 hours after receipt of notice) repaired or replaced by the Temperature Control sub-contractor at no expense to the Owner

## **WARRANTY ACCESS**

The Owner shall grant to the Temperature Control sub-contractor, reasonable access to the FMCS during the warranty period. The owner shall allow the contractor to access the FMCS from a remote location for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period.

## **ACCEPTANCE TESTING**

Upon completion of the installation, the Temperature Control sub-contractor shall load all system software and start-up the system. The Temperature Control sub-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 Temperature Control sub-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.

Upon completion of the performance tests described above, repeat these tests, point by point as described in the validation log above in presence of Owner's Representative, as required. Properly schedule these tests so testing is complete at a time directed by the Owner's Representative. Do not delay tests so as to prevent delay of occupancy permits or building occupancy.

System Acceptance: Satisfactory completion is when the Temperature Control sub-contractor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of

the Owner's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

## **OPERATOR INSTRUCTION, TRAINING**

During system commissioning and at such time acceptable performance of the FMCS hardware and software has been established the Temperature Control sub-contractor shall provide on-site operator instruction to the owner's operating personnel. Operator instruction shall be done during normal working hours and shall be performed by a competent representative familiar with the system hardware, software and accessories.

The Temperature Control sub-contractor shall provide 40 hours of instruction to the owner's designated personnel on the operation of the FMCS and describe its intended use with respect to the programmed functions specified. Operator orientation of the FMCS shall include, but not be limited to; the overall operation program, equipment functions (both individually and as part of the total integrated system), commands, systems generation, advisories, and appropriate operator intervention required in responding to the System's operation.

The training shall be in three sessions as follows:

Initial Training: One day session (8 hours) after system is started up and at least one week before first acceptance test. Manual shall have been submitted at least two weeks prior to training so that the owners' personnel can start to familiarize themselves with the system before classroom instruction begins.

First Follow-Up Training: Two days (16 hours total) approximately two weeks after initial training, and before Formal Acceptance. These sessions will deal with more advanced topics and answer questions.

Warranty Follow Up: Two days (16 hours total) in no less than 4 hour increments, to be scheduled at the request of the owner during the one year warranty period. These sessions shall cover topics as requested by the owner such as; how to add additional points, create and gather data for trends, graphic screen generation or modification of control routines.

***Note to specifiers: Put the required sequences of operation in this part.***

## **PART 4 SEQUENCES OF OPERATION**

### **4.1 SUMMARY**

For each system listed, provide the sequence of operation as stated in this section.

