Part 1 General

1.1 General Scope And Related Work

.1 All Work required by these Controls Specifications, Schedules, Point Lists and Drawings shall be coordinated and provided by the single Contractor referenced in these Specifications as the Controls Contractor.

.2 If the Controls Contractor believes there are conflicts or missing information in the Contract Documents then the Contractor shall promptly request clarification and instruction from the Consultant before proceeding.

.3 The Controls Contractor shall have visited the Project site and obtained information as necessary prior to submittal of the bid to ensure that prevailing physical conditions and Project arrangements that may be material to the performance of the Work have been ascertained and accommodated in the bid. No claims for additional payments will be accepted due to the Contractor's failure to complete this survey.

.4 If, in order to complete the Work of the Controls Contract, private and/or public telephone lines and connections, including ISDN lines and/or LAN/WAN support and connections, are required then these shall be provided by the Owner to the Controls Contractor, at the Owner's direct cost, in a timely manner.

.5 The owner has an existing central monitoring system in place. Where DDC points are identified as centrally monitored points, the controls contractor shall provide and install required hardware and software to interface to the owner's Johnson Controls Metasys EA servers and workstations. These are located at the Central Control Offices, 510 Main Street, Winnipeg, Manitoba.

.6 The facility has existing Johnson Controls DDC systems using N2 open communication bus technology. Where required, and identified in this specification, the controls contractor is to provide web sever (NAE) with N2 open bus(s) to interface existing systems to allow monitoring of these systems, per paragraph .5 above.

1.2 Controls Systems Description

.1 The Controls Contractor's work shall consist of the provision of all labor, materials, special tools, equipment, enclosures, power supplies, software, software licenses, project specific software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, submittals, testing, verification, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, warranty, specified services and items required by the Contract that are required for the functional turn-key operation of the complete and fully functional Controls Systems.

.2 Provide a complete, neat and workmanlike installation. Use only employees who are qualified, skilled, experienced, manufacturer trained and familiar with the specific equipment, software and configurations to be provided for this Project.

.3 The Controls Contractor shall employ qualified and experienced Controls Systems, Software, Application Design, Installation and Project Supervision personnel to provide the specific solutions required to meet the Project requirements and who are available to undertake this work as scheduled.

.4 Manage and coordinate the Controls Systems work in a timely manner in consideration of the Project master schedules. Coordinate cooperatively with the associated work of the other trades so as to assist the progress and not impede or delay the work of associated trades.

.5 Controls Systems as provided shall incorporate, at minimum, the following integral features, functions and services:

.1 All automated monitoring, supervision, control, information storage and presentation as required by these Specifications.

.2 Operator information on all supervised building arrangements including but not limited to current status and value, historical archived information, summaries, analysis, displays, reports and operator control and management functions as required by the Specifications.

.3 The detection, annunciation and management of all alarm and unexpected conditions as required by the Specifications.

.4 The diagnostic monitoring and reporting of system functions, Nodes and communication networks.

.5 Interfaces between individual elements and the systems and networks provided by other trades as required by the Contract Documents.

.6 All other Controls Systems functions as required by the Contract Documents.

.6 The Controls System as provided shall comprise, at a minimum, the following primary elements:

.1 Operator Workstation(s) (quantities and locations as specified in Section 3 of this specification)

.2 NAE Web Server

.3 Network and Application Nodes.

.4 Field Devices.

.5 Control wiring.

1.3 Quality Assurance

.1 General Requirements:

.1 The following companies are approved Controls Contractors

.1 Johnson Controls Branch Office

.2 All devices shall be CSA certified and UL or FM listed and labeled for the specific use, application and environment to which they are applied.

.3 All electronic equipment shall conform to the requirements of FCC regulations, part 15, section 15, governing radio frequency electromagnetic interference, and be so labeled.

.2 Workplace Safety And Materials Management

.1 Provide a safety program in compliance with the Contract Documents.

.2 The Controls Contractor shall have a comprehensive Safety Manual and a designated Safety Supervisor for the Project.

.3 The Contractor and its employees and sub trades shall comply with Federal, Provincial and local safety regulations.

.4 The Contractor shall ensure that all subcontractors and employees have written safety programs in place that cover their scope of work.

.5 Hazards created by the Contractor or its subcontractors shall be eliminated before any further work proceeds.

.6 Hazards observed but not created by the Contractor or its subcontractors shall be reported to either the General Contractor or the Owner within the same day. The Contractor shall be required to avoid the hazard area until the hazard has been eliminated.

1.4 Submittals

.1 Shop Drawings, Product Data and Samples:

.1 The Controls Contractor shall submit shop drawings for review and acceptance by the Architect or Owner.

.2 Provide at minimum the following basic submittals:

.1 Individual System Schematics including sequences of operation.

.2 Complete Bill of Materials.

.3 Valve and Damper Schedules.

.4 Descriptions and/or product data sheets for all equipment, materials, software, firmware components and items to be furnished and provided. Information shall be Project specific and not general advertising.

.5 Samples of system graphic, zone control graphic and overall system Navigation Scheme.

.6 Details of telephone line, ISP and associated requirements to be provided by the Owner, at its cost, in order for the Contractor to complete the work.

.2 Operation and Maintenance Manuals

.1 At the completion of the project the Controls Contractor shall submit three sets of as-built documentation for the Owners Operation and Maintenance Manuals which shall include the following as a minimum:

.1 Name and address of installing contractor along with 24-hour emergency service telephone number.

.2 As-built version of Shop Drawings.

.3 Licenses, Guarantees and warranty documents for all equipment and systems.

.4 Include sections dedicated to software that includes a system overview and a detailed description of each software feature. The manual shall instruct the user on programming or re-programming any portion of the Controls Systems. Include complete documentation on all control programs, algorithms, setpoints, alarms, etc.

1.5 Warranty

.1 Standard Material and Labor Warranty:

.1 Provide a one-year labor and material Warranty on Controls Contract work provided under this Contract.

.2 If within twelve (12) months from the date of acceptance of the Controls Contract work and following receipt of written notice from the Owner the product is found to be defective in operation, workmanship or materials, then the product shall be promptly replaced, repaired or adjusted at the option of the Controls Contractor at the cost of the Controls Contractor.

.3 Maintain an adequate supply of materials available directly to the Project site such that replacement of key parts, including programming, may be promptly carried out. Warranty work shall be done during the Controls Contractor's normal business hours.

Part 2 2.0 Products

2.1 Controls System Architecture

.1 General

.1 The Controls Systems shall consist of Operator Workstations, Web Servers, Network and Application Nodes and their associated equipment connected by an industry standard communication network.

.2 The Interfaces provided shall incorporate complete tool sets, operational information displays, multi-Window displays and other interactive aids to assist interpretation and ease of use.

.3 The Workstations, Servers and principal network computer equipment shall be standard products of recognized major manufacturers available through normal

PC and computer vendor channels – not "Clones" assembled by a third-party subcontractor.

.4 Provide licenses for all software residing on and used by the Controls Systems and transfer these licenses to the Owner prior to completion.

.5 The networks shall, at minimum, comprise, as necessary, the following:

.1 Workstations – fixed and portable as required by the Specifications.

.2 Network computer processing, data storage and communication equipment including Servers and digital data processors.

.3 Routers, bridges, switches, hubs, modems, interfaces and the like communication equipment.

.4 Active processing Network and Application Nodes including programmable field panels and controllers together with their power supplies and associated equipment.

.5 Addressable elements, sensors, transducers and end devices.

.6 Third-party equipment interfaces as required by the Contract Documents.

.7 Other components required for a complete and working Control Systems as specified.

.6 The system shall be modular in nature, and shall permit easy expansion through the addition of software applications, workstation hardware, network and application nodes sensors and actuators. The system architecture shall support 300% expansion capacity of all types of nodes and point types included in the initial installation.

.7 The Specifications for the individual elements and component subsystems shall be minimum requirements and shall be augmented as necessary by the Contractor to achieve both compliance with all applicable codes, standards, the requirements of the AHJ (Authority having jurisdiction) at the site and to meet all requirements of the Contract Documents.

.2 Network

.1 The Controls Systems shall incorporate a primary Tier 1 network(s) utilizing standard Ethernet communications operating at a minimum speed of 10 Mb/sec. All Network Nodes, Web Servers, Configuration and Operator Workstations as a minimum shall reside on the primary Tier 1 network. At the Controls Contractor's option, they may also incorporate multiple and integrated secondary Tier 2 and tertiary Tier 3 networks

.2 The communication Network shall be based upon the following open architecture(s); BACnet in accordance with ANSI/ASHRAE Standard 135-2001.

.3 The networks shall utilize only copper and optical fiber communication media as appropriate and to comply with the applicable codes, ordinances and regulations and the AHJ. They may also utilize digital wireless technologies if required by the Project and approved by the Architect or Owner and the AHJ.

.4 The Owner shall provide all private and public telephones lines, ISDN lines and Internet Service Provider services and connections as necessary for the Controls Contractor to complete the work as contracted at the Owner's direct cost. The Controls Contractor shall identify the specific requirements in their shop drawing submittal.

2.2 Operator Workstations

.1 The Operator Workstations (OWS) shall provide the primary means of operator communication with the Controls Systems and shall be used for monitoring, operations, management, audit, reporting and other related functions. The OWS shall comprise PC and related facilities that have as their primary function the Operator Interface functionality. Refer to Part 3 herein for details of OWS quantities and locations.

.2 Each fixed OWS shall, at a minimum, consist of:

.1 Personal Computer c/w XP Professional

.2 Intel Pentium 4, 2.8 GHz, 1024 MB SDRAM

.3 120 GB, 7200 RPM Hard Drive

.4 24X DVD/CD-RW Combo Drive

.5 Full ASCII keyboard and optical Mouse.

.6 Full color, 19 inch flat screen display LCD native, minimum 1280 x 1024 resolution.

.7 Ink Jet Printer, 19 ppm monochrome, 14 ppm color

.3 The OWS shall be provided with all required and installed operating system, Application specific software and database support facilities, including the associated original manufacturer software licenses, as part of the base work and price of the Controls Contract. All software shall be to the original manufacturer's latest revision level at the time of delivery to Project site.

.4 Transfer all Controls Systems software licenses to the Owner, at no additional cost to the Owner, before the time of acceptance for the Work.

.5 The Controls Contractor will use the OWS and associated equipment as necessary for the purposes of setting up, calibrating and verifying the Work. This equipment and facilities shall be delivered to site and installed by the Contractor as late as is feasible in the scheduling of the Work and shall comprise the latest versions of these products available at the time of delivery.

2.3 Operator Interfaces

.1 General

.1 The Controls Systems Operator Interfaces shall be user friendly, readily understood and shall make maximum use of colors, graphics (floor plans,

individual system schematics), icons, embedded images, animation, text based information and data visualization techniques to enhance and simplify the use and understanding of the displays by authorized users at the OWS.

.2 User access shall be protected by a flexible and Owner redefinable software-based password access protection. Password protection shall be multi-level and partitionable to accommodate the varied access requirements of the different user groups to which individual users may be assigned. Provide the means to define unique access privileges for each individual authorized user. Provide the means to on-line manage password access control under the control of a project specific Master Password.

.3 The Operator Interface shall incorporate comprehensive support for functions including, but not necessarily limited to, the following:

.1 User access for selective information retrieval and control command execution.

.2 Monitoring and reporting.

.3 Alarm and non-normal condition annunciation.

.4 Selective operator override and other control actions.

.5 Information manipulation, formatting, display and reporting.

.6 Controls Systems internal performance supervision and diagnostics.

.7 On-line access to user HELP menus.

.8 On-line access to current as-built records and documentation. At minimum, one (1) copy of all record documentation shall be stored on a designated OWS or Server and be accessible to the Owner.

.9 Means for the controlled re-programming, re-configuration of systems operation and for the manipulation of database information in compliance with the prevailing codes, approvals and regulations for the component applications and elements.

.4 Provide an audit trail of all user activity on the Controls Systems including all actions and changes.

.5 Provide on-line reports and displays making maximized use of simple English language descriptions and readily understood acronyms, abbreviations, icons and the like to assist user understanding and interpretation. All text naming conventions shall be consistent in their use and application throughout the Controls Systems.

.2 Operator Interface

.1 The Operator Interface provided shall include the functionality to selectively combine data and information from any system element or component in the Controls Systems Application on a single window display panel at the Operator's option. This shall include both current information and historical data.

.2 Navigation Trees:

.1 Provide the capability to display multiple navigation trees that aid the operator in navigating throughout all systems and points connected. At minimum provide a tree that identifies all systems on the Controls Systems networks.

.2 Provide the capability for the Operator to add custom trees. The Operator shall be able to define any logical grouping of systems or points and arrange them on the tree in any selected order. Provide the capability to nest groups within other groups.

.3 Divisible Display Windows:

.1 Provide for the operator to divide the display area within a single window into multiple display panels. The content of each display panel can be any of the standard summaries and graphics provided in the Controls Systems Application.

.2 Provide each display panel with minimize, maximize and close icons.

.4 Alarms:

.1 Alarms shall be routed directly from primary Controls Systems Application Nodes to OWS and Server(s). Provide for specific alarms from specific points to be routed to selectable OWS and Server(s). The alarm management portion of the Controls Systems Operator Interface software shall, at minimum, provide the following functions:

.1 Log date and time of alarm occurrence.

.2 Generate a “Pop-Up” window on the display panel, with audible alarm, informing the Operator that an alarm has been received.

.3 Allow an Operator, with the appropriate password, to acknowledge, temporarily silence or cancel an alarm.

.4 Provide an audit trail for alarms by recording user acknowledgement, deletion or canceling of an alarm. The audit trail shall include the ID of the user, the alarm, the action taken on the alarm and a time/date stamp.

.5 Provide the ability to direct alarms to an e-mail address or alphanumeric pager. This must be provided in addition to the pop-up window described herein. Controls Systems that use e-mail and pagers as the exclusive means of annunciating alarms are not acceptable.

.6 Provide for any attribute of any object in the Controls Systems to be designated to report as an alarm.

.7 Provide the ability to add, delete or modify alarms.

.2 The Controls Systems Application shall annunciate systems diagnostic alarms indicating system failures and non-normal operating conditions.

.3 Provide the on-line means to display alarms by date/time of occurrence, priority class, point designation, value or other defined text keywords.

.5 Operator Transactions:

.1 Provide the means to automatically record all Operator activities on the Controls Systems Application for the recall of same for reporting.

.2 Provide the means to sort and report activities by Operator, date/time, activity type and system area.

.3 Provide access protection to preclude the unauthorized removal or tampering with records.

.6 Reports:

.1 Reports shall be generated and directed to the user interface display or printer. As a minimum, the Controls Systems Application shall provide the following reports:

.1 All points in the Controls Systems Application.

.2 All points in a user-defined group of points.

.3 All points currently in alarm.

.4 All points locked out.

.5 All Controls Systems Application schedules.

.6 All user defined and adjustable variables, schedules, interlocks, diagnostics, systems status reports and the like.

.2 Provide all applicable original manufacturers standard reports for the Controls Systems.

.7 Dynamic Color Graphics:

.1 Provide for any number of real-time color graphic displays shall be able to be generated and displayed in the Controls Systems Application limited only by memory data storage capacity.

.2 Values of real-time attributes displayed on the graphics shall be dynamic and updated on the displays.

.3 The graphic displays shall be able to display and provide animation based on real-time data that is acquired, derived or entered into the operating Controls Systems.

.4 Provide for the Owner to be able to change values (setpoints) and states in system controlled equipment directly from the graphic display.

.5 Provide a graphic editing tool that allows for the creation and editing of graphic files. It shall be possible to edit the graphics directly while they are on line, or at an off line location for later downloading to the Controls Systems.

.8 Schedules:

.1 Provide multiple schedule input forms for automatic time-of-day scheduling and override scheduling of operations. At a minimum, the following schedule types shall be accommodated:

.1 Weekly schedules.

.2 Temporary override schedules.

.3 Special "Only Active If Today Is A Holiday" schedules.

.4 Monthly schedules.

.2 Schedules shall be provided for each group, system and sub-system in the Controls Systems Application. It shall be possible to include all or any commandable points residing within the Controls Systems in any custom schedule. Each point shall have a unique schedule of operation relative to the system use schedule, allowing for sequential starting and control of equipment within the system. Scheduling and rescheduling of points shall be accomplished easily via the system schedule spreadsheets.

.3 Multiple monthly calendars for a 12-month period shall be provided that allow for simplified scheduling of holidays and special days in advance. Holidays and special days shall be user-selected with the pointing device or keyboard, and shall automatically reschedule equipment operation as previously defined on the weekly schedules.

.9 Trending And Data Collection:

.1 Trend and store point data for all actual and virtual (software) points and values as required by the Owner.

.2 At a minimum, provide the capability to:

.1 Add / Modify and Delete Trends

.2 Display trend data in textural and / or graphical format

.3 Display multiple points in a single trend study.

.10 Operator Access Security (Combined Password and User ID):

.1 Provide for Operator access into the Controls Systems via the use of on-line Owner defined software Password and User Identification (ID) pairs, unique for each Operator and unique throughout the Controls Systems Application, to supplement standard OWS password access control.

.2 Stored password/user ID definitions shall be stored in encrypted formats.

.3 Password logins shall not be echoed on any screen or printer except during Master Password definition processes. An Operator defining a password shall be required to re-enter to confirm authenticity.

.4 Operator access privileges shall be definable in terms of functions and Project areas.

.5 As part of the access privileges definition for each user the Owner shall be able to define at minimum the following:

.1 Access times by day.

.2 Permanent or temporary, with expiry date, password.

.3 Number of incorrect access attempts allowed before the password is disabled.

.4 Whether or not the Operator is able to redefine their own password.

.5 A field for the Operator's e-mail address.

.6 A field for the Operator's contact phone number.

.7 Definition of the Operator's access privilege functionalities including viewing only, full control, selected functions, etc.

2.4 Web Server

.1 General

.1 The Controls Systems shall support multiple remote Web based User Interfaces through a Web Server.

.2 The Web Server shall support an unlimited number (non simultaneous) of remote Web based User Interface(s) utilizing a mix of local Intranet, the Internet, telephone and cable modem connections.

.2 Web Server

.1 The Web Server shall be provided with all required and installed operating system, Browser, management, end user, and application specific software and database support facilities, including the associated original manufacturer software licenses. All software shall be to the original manufacturer's latest revision level at the time of delivery to Project site.

.2 The Web Server hardware and software configuration shall be selected to support the number of installed Network and Application Nodes.

.3 The Web Server shall include either a software or hardware firewall.

.3 Web Based User Interface

.1 The Web Interface(s) shall be provided to operate through an IT industry standard Web Browser such as Internet Explorer or Netscape.

.2 The Web Interface(s) provided shall incorporate complete tool sets, operational information displays, multi-Window displays and other interactive aids to assist interpretation and ease of use.

.3 The Web Interface(s) provided shall not require the procurement or licensing of any special or proprietary software from the Controls Contractor or its suppliers. In the event that specialized proprietary software is required, the Controls Contractor shall provide to the owner under this contract 10 licensed copies of the proprietary software.

.4 The Web Interface(s) shall support the following functions at a minimum:

.1 User Name and Password restricted access.

.2 Easy to use "tree" diagram access to the following functions

.1 Display of Graphical System representations with dynamic real-time data.

.2 Trend Data Display

.3 Addition and Deletion of Trend Studies

.4 Scheduling display and adjustment

.5 Alarm Summary Display and Alarm Management Functions.

.6 Adjustment and Override of Operating Parameters

2.5 Network and Application Nodes

.1 General

.1 The Controls Systems shall be composed of a mixture of Network and Application Nodes as required to meet the project requirements.

.2 The Nodes shall be designed, packaged, installed, programmed and commissioned in consideration of their specific service and prevailing operating conditions. They shall be proven standard product of their original manufacturer.

.3 A failure at a Node shall not cause failures or non-normal operation at any other system Node other than the possible loss of active real-time information from the failed Node.

.4 Ancillary equipment, including interfaces and power supplies, shall not be operated at more than 80% of their rated service capacity.

.2 Network Nodes

.1 The Controls Systems Tier 1 Network Nodes shall be designed and implemented entirely for use and operation on an Ethernet TCP/IP network such as the Internet or the Owner's Intranet. This functionality for operational access shall extend down to the field panel and field point level.

.2 The Tier 1 Network Nodes shall be fully IT compatible operating over industry standard IT infrastructure. The Controls Contractor shall coordinate with the IT infrastructure support staff or trade contractors to ensure compatibility and performance of the operation of the Controls Systems over the LAN/WAN made available for its shared use.

.3 The Tier 1 network shall be configured on IT industry standard off-the-shelf technologies

.4 Network Nodes may act as Application Nodes.

.3 Application Nodes:

.1 Application Nodes (AN) shall provide both standalone and networked direct digital control of mechanical and electrical building systems as required by the Specifications.

.2 Each AN shall retain program, control algorithms, and setpoint information for at least 72 hours in the event of a power failure and shall return to normal operation upon stable restoration of normal line power.

.3 Each AN shall monitor its communication status and provide a system advisory upon communication failure and restoration.

.4 The AN shall provide the functionality to download and upload configuration data

.5 The AN shall perform the functional monitoring of all Controls Application variables, both from real hardware points, software variables, and controller parameters such as setpoints.

.6 The AN shall be designed, packaged, installed, programmed and commissioned in consideration of their specific service and prevailing operating conditions. They shall be proven standard product of their original manufacturer and not a custom product for this project.

.7 HVAC Systems

.1 Central HVAC Systems

.1 Standalone AN(s) shall be provided and programmed to control the Central Air Handlers, Heating and Cooling Plants as described in the sequence of operation

.2 Terminal HVAC Systems

.1 A dedicated AN shall be provided and configured for each Terminal HVAC Unit (CV and VAV Boxes, Dual Duct Boxes, Fan Coil Unit, Heat Pump, Unit Ventilator, packaged RTU, etc.)

.2 The Zone Temperature sensor associated with each AN controlling a CV, VAV or Dual Duct Box shall provide the ability (password protected access) to setup the box operating parameters (min/max flows, flow pickup Area, flow pickup K factor, etc.) or shall support the plug-in (at the sensor) of a portable service tool to do the same,

.3 Standalone AN(s) shall be provided and configured to control heating and cooling elements such as Wall Fin Radiation, Ceiling Radiant Heating and or Cooling, In-floor radiant Heating, Unit Heaters and Force Flows as called for in the sequences of operation.

.3 Mechanical Equipment with Microprocessor based Controls

.1 Controls Contractor shall integrate real-time data from building systems supplied by other trades and databases originating from other trades as called for in the sequences of operation.

.2 The Controls Systems shall include necessary hardware, equipment and software to allow data communications between the Controls Systems and building systems supplied by other trades.

.3 The trade contractors supplying other associated systems and equipment shall provide their necessary hardware and software at their cost and shall cooperate fully with the Controls Contractor in a timely manner and at their cost to ensure complete functional integration.

.4 Software:

.1 The Application and/or Network Nodes shall support the following standard programming capabilities as required to achieve the specified sequences of operation.

.1 Execute custom, job-specific processes defined by the user to automatically perform calculations and special control routines using:

.1 System measured point data

.2 Calculated data

.3 The results from other processes

.4 User defined constants

.5 Arithmetic functions

.6 Boolean Logic Operators

.7 Proportional plus Integral plus Derivative Control Algorithms as required.

.2 The Application and/or Network Nodes shall support the following software features:

.1 Event Messaging: Provide for the automatic execution of user-defined messages on the occurrence of each predefined real-time event including equipment/point status change, approaching limit or alarm, time of day and the like.

.2 Optimum Start/Stop: Provide software to start equipment on a sliding schedule based upon indoor and outdoor conditions. Determine the minimum time of HVAC system operation needed to satisfy the space environmental requirements. The program shall also determine the earliest possible time to stop the mechanical systems. The optimum start/stop program shall operate in conjunction with, and be coordinated with, the scheduled start/stop and night setback programs.

.3 Auto Alarm Lockout: Provide for scheduled and automatic lockout of alarm annunciation from equipment during non-normal operating conditions including shutdown, emergency power operation, filter alarm and the like.

.4 Energy Metering: Provide software to monitor and totalize consumption as measured by the defined pulse meters.

.5 Event Initiated Programs and Custom Logic: Provide software to define custom logic sequences that reside in the Application and/or Network Nodes.

.6 Heavy Load Delays: Provide software to achieve protection against excessive demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical or other defined loads.

.7 Runtime Totalization: Automatically sample, calculate and store runtime hours for binary input and output points as listed in the point schedule of this specification.

.8 Analog/Pulse Totalization: Sample, calculate and store consumption totals on a daily, weekly or monthly basis for user-selected analog and 2 binary pulse input-type points.

.9 Binary Totalization: Provide totalization for binary event counters.

2.6 Controls Systems Field Devices

.1 Input Devices:

.1 Temperature Sensors

.1 Outdoor Air Temperature Transmitter shall contain an RTD sensing element mounting in an enclosure rated for outdoor use. The output shall be compatible with the panel it serves. Transmitter shall be factory calibrated to an accuracy of + 1% over the full range.

.2 Pipe Temperature Transmitter shall contain an RTD sensing element to monitor water temperature. The Contractor shall provide brass wells of sufficient size for the pipe to be installed. The output shall be compatible with the panel it serves. Transmitter shall be factory calibrated to an accuracy of + 1% over the full range.

.3 Duct Type Temperature Transmitter shall be a general purpose RTD sensing element, moisture resistant transmitter for mounting into a duct. The operating range shall be as indicated with an accuracy of + 1% over the full range. The output shall be compatible with the panel it serves.

.4 Duct Averaging Type Temperature Transmitter shall be a general purpose RTD sensing element, moisture resistant transmitter for mounting into a duct. The operating range shall be as indicated with an accuracy of + 1% over the full range. The output shall be compatible with the panel it serves. The sensing element shall be of sufficient length to provide a minimum of one (1) foot of element for every two (2) square feet of coil area.

.5 Space Temperature Transmitter shall contain an RTD sensing element to monitor room air temperatures in the range of 30 degrees F to 90 degrees F, unless indicated otherwise. The transmitter shall be factory calibrated to an accuracy of + 1%. The output shall be compatible with the panel it serves. Transmitter shall be factory calibrated to an accuracy of + 1% over the full range.

.2 Humidity Sensors

.1 Humidity Transmitter Outside Air shall be capable of providing continuous measurement of percent relative humidity with an accuracy of + 2% over the range 20 to 90% RH. The output shall be a proportional 4

– 20 mA or VDC signal. Transmitter shall have outside weather enclosure. Transmitter shall be General Eastern RH-1 or equal.

.2 Humidity Transmitter Duct shall be capable of providing continuous measurement of percent relative humidity with an accuracy of + 4% over the range of 10 to 80% RH. The output shall be a proportional 4 – 20 mA or VDC signal.

.3 Humidity Transmitter Space shall be capable of providing continuous measurement of percent relative humidity with an accuracy of + 3% over the range of 20 to 60% RH. The output shall be a proportional 4 – 20 mA or VDC signal.

.3 Pressure Sensors

.1 Pressure Transducers for steam service shall utilize a stainless steel sensor. The device shall output a 4-20 mA or VDC signal which is linear in relation to the sensed pressure. Accuracy shall be + 0.5% of the full scale. Power shall be from the controller and range from 22-26 volts DC. The unit shall have temperature compensation so that thermal effects are no more than + .05% of the full scale from 0-175 DEGF. The unit shall be suitable for the media and pressure measured.

.2 Differential Pressure Transducer shall be for air or water service. The device shall output a 4-20 mA or VDC signal which is linear in relation to the sensed pressure. Accuracy shall be + 0.5% of full scale. The power shall be from the controller and shall be in the range of 22-26 volts DC. The unit shall have temperature compensation so that thermal effects are no more than + .05% of the full scale from 32-100 DEGF. The transducer shall be suitable for the media and pressure measured.

.4 Safeties and Alarms

.1 Low Limit Thermostats shall be of manual reset type, with setpoint adjustment. The sensing element shall be of sufficient length to provide a minimum of one (1) foot of element for every two (2) square feet of coil area. The element shall run fully across the coil on each pass. When any one foot of the element senses a temperature as low as the setpoint, the thermostat contacts shall open. These shall contain double pole switches for simultaneous remote alarms or as desired.

.2 Differential Pressure Switch for water shall have a single-pole, single-throw (SPST) contact, adjustable setpoint, UL rated 6 amperes at 120 volts, 100 psig design.

.3 Differential Pressure Switch for air shall have a single-pole, single-throw (SPST) contact, adjustable setpoint, UL rated 9.8 amperes at 120 volts

.4 Current Sensing Transducers shall be self-powered, solid state with adjustable trip current. Each transducer shall be selected to match the current and voltage of the application. The output shall be compatible with the panel it serves. Each transducer shall include an LED to indicate output status.

.5 Specialty Sensors

.1 Carbon Dioxide Transmitter shall be capable of providing continuous measurement of Carbon Dioxide levels with an accuracy of + 50 ppm over the normal operating range of 400 – 1000 ppm. Transmitter shall utilize microprocessor based temperature compensated infrared sensing technology.

.2 Output Devices:

.1 Control Dampers:

.1 Dampers required in the temperature and smoke control functions of the automatic control system shall be sized as shown on drawings or as specified.

.2 All damper frames shall be constructed of 13 gauge galvanized sheet metal or extruded aluminum of 12 gauge thickness, and shall have a flange or duct mounting. The blades shall be parallel or opposed, as required, and suitable for the air velocities to be encountered in the system. Replaceable Butyl rubber seals are to be provided on damper blades and installed along with the top and bottom of the frame. Stainless steel damper blades and seals shall be installed inside the frame sides. Seals and bearings shall be able to withstand temperatures ranging from - 40°C to 93°C (- 40°F to 200°F).

.3 Dampers shall be leak rated for 15.2 lps/m^2 (3 cfm/$ft.^2$) at 250 kPa (1" WC) and 20 CFM/foot. squared at 1000 kPa (4" WC) or less in full closed position at 1000 kPa (4" WC) pressure differential across damper.

.4 Damper blades shall not exceed 150 mm (6") in width. All blades are to be corrugated type construction, fabricated from two sheets of #22 gauge galvanized sheet steel, spot welded together. Blades are to be suitable for high velocity performance.

.5 Dampers shall be Ruskin CD-60 or equivalent.

.6 All smoke control dampers must conform to UL5555 and be Ruskin SD-60 or equivalent.

.2 Control Valves:

.1 Valves shall be sized by the control manufacturer to produce the required capacity at a pressure loss not exceeding the allowable pressure drop indicated on the drawing.

.2 Nominal body rating shall be not less than 860 kPa (125 PSI). However, the valve body and packing selected shall be sized to withstand the system static head plus the maximum pump head and the maximum temperature of the control medium, chilled water, steam, and/or hot water.

.3 Two-way modulating valves shall have close-off ratings exceeding the maximum pressure difference, at any load condition, between the outlet

and inlet. Each valve shall be equipped with proper packing to assure there will be no leakage at the valve stem.

.4 Terminal unit two-way control valves shall have equal percentage characteristics. Terminal unit three-way control valves shall have linear flow characteristics.

.5 Valve sizes 12 mm to 50 mm (½" to 2") shall have screwed connections. Valve sizes 63 mm (2-1/2") and larger shall have flanged connections.

.3 Damper and Valve Operators:

.1 Damper and valve operator shall be electric and be provided for each automatic damper or valve and shall be of sufficient capacity to operate the damper or valve under all conditions and to guarantee tight close-off of valves, as specified, against system pressure encountered.

.2 Damper operators shall be direct drive and equal to those manufactured by Belimo. Provide sufficient quantity of damper operators to provide a minimum of 5.9 Nm/m^2 (5 $in\text{-}lbs/ft^2$) of damper area.

.3 Each central system damper or valve operator shall be provided with spring-return for normally closed or normally open position for fail safe operation to account for fire, low temperatures, or power interruption as indicated or as appropriate.

.4 Electric to Pressure Transducers:

.1 Electric to pressure transducers shall be used to interface to pneumatically actuated field devices.

.2 Transducers shall produce a high volume pneumatic output.

.3 Transducers shall include both zero and span adjustment capabilities.

Part 3 3.0 Execution

3.1 Installation Practices:

.1 Controls Systems Wiring

.1 All conduit raceways, wiring, accessories and wiring connections required for the installation of the Controls Systems shall be provided by the Controls Contractor except as shown on the Electrical Trade documents. All wiring shall comply with the requirements of applicable portions of the Electrical Trade work and all local and national electric codes and the requirements of the AHJ.

.2 All Controls Systems wiring materials and installation methods shall comply with the original equipment manufacturer recommendations and standards.

.3 The sizing type and provision of cable, conduit, cable trays and raceways shall be the design responsibility of the Controls Contractor.

.4 Class 2 Wiring

.1 All Class 2 (30VAC or less) wiring shall be installed in conduit unless otherwise specified.

.2 Conduit is not required for Class 2 wiring in concealed accessible locations. Class 2 wiring not installed in conduit shall be supported every 5 ft. from the building structure. Wiring shall be installed parallel to the building structural lines.

.5 Class 2 signal wiring and 24VAC power may be run in the same conduit. Power wiring 120VAC and greater shall not share the same conduit with Class 2 signal wiring.

.2 Line Voltage Power Sources

.1 120-volt AC circuits for the Controls Systems shall be taken by the Controls Contractor from electrical trade panelboards and circuit breakers as designated on the electrical drawings.

.2 Circuits used for the Controls Systems shall be dedicated to these Controls systems and shall not be used for any other services.

.3 Controllers for powered terminal units may use 120-volt AC power from motor power circuits.

.3 Controls Systems Raceways

.1 All wiring shall be installed in conduit or raceway except as noted elsewhere in the Specification.

.2 Where it is not possible to conceal raceways in finished locations, surface raceway (Wiremold) may be used as approved by the Architect.

.3 All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the supporting surface.

.4 UL/ULC Listed Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment. Flexible Metal Conduit may be used within partition walls and for final connection to equipment.

.4 Field Panel Installation and Location

.1 The Controls Systems panels, enclosures and cabinets shall be located as coordinated with the Architect at an elevation of not less than 2 feet from the bottom edge of the panel to the finished floor. Each cabinet shall be anchored per the manufacturer's recommendations.

.2 All field devices shall be installed per the manufacturer recommendation and in accessible locations as coordinated with the Architect.

.3 Panels to be located in damp areas or areas subject to condensation shall be mounted with wall standoffs.

.4 Conduit configurations entering or leaving panels and devices shall be such as to preclude condensation traps.

.5 Identification

.1 All control components and services shall be identified with appropriately sized lamecoid labels with a unique name/number referencing item back to the shop drawings and or maintenance manuals.

.2 All control wiring conduits shall be color-coded and identified so as to be distinguishable from standard electric conduiting.

.3 Clearly identify all controls LAN hubs and racks.

.4 All control wiring terminations shall be taqgged and referenced.

3.2 Verification:

.1 Fully test and verify all aspects of the Controls Systems Contract work on a point/system/integrated operational basis for all points, features and functions specified.

.1 Test each digital output for proper results from the Operator Workstation.

.2 Test each analog output by sending commands from the Operators Workstation to stroke an actuator throughout its range.

.3 Test each digital input for proper verification at the Operators Workstation. Jumper digital alarm inputs as required.

.4 Calibrate all temperature, humidity and pressure sensors with a hand held digital meter with equal or better accuracy.

.5 All software programs shall be fully tested to eliminate any glitches and to ensure conformance with the specifications. A system shall be considered commissioned when all alarms and system values are appropriate for the control sequence defined. Submit history logs for approval.

.2 Provide all necessary specialist labor, materials and tools to demonstrate to the Architect that the Controls Systems have been verified and are operating in compliance with the Controls Systems Contract.

.3 Promptly rectify all deficiencies and submit in writing to the Architect a signed report that this has been done.

.4 The Architect will retest the deficiencies in conjunction with the Controls Contractor at the Architect's option.

3.3 Training:

.1 The Controls Contactor shall provide the following training services for up to three (3) Owner's Representatives at common sessions:

.1 Provide two (2) full days of on-site training by a Field Technician who is fully knowledgeable of the specific installation details of the Project. This training shall, at a minimum, consist the following:

.1 Review of project documentation control system software layout and naming conventions

.2 Basic Controls System operation.

.3 System reporting and alarm management.

.4 Scheduling and point trending.

.5 Setup of Paging feature.

.2 Should the Web based user interface differ from the Operator Interface provide an additional two (2) full days of on-site training consisting of the following:

.1 Basic User Interface operation.

.2 System reporting and alarm management.

.3 Scheduling and point trending.

3.4 Schedule of Workstations and Web Servers.

.1 Provide a new OWS in the basement Engineer's office.

.2 Provide a new CWS in the basement Engineer's office.

.3 The Controls Contractor shall utilize their own CWS to setup and verify the complete installation.

.4 Provide a new Web Server located as suitable for this installation. The Owner shall supply Personal Computers to be used for remote access to the Controls Systems through the Web Server.

3.5 System Graphics

.1 Provide Home Navigation graphics complete with links to each central system graphic and one or more floor plan graphics

.2 Provide individual Color Graphics for each central Air Handler, Heating and Cooling System

.3 Provide one or more floor plan graphics with indication of each measured space temperature.

.1 Include a link on the floor plan graphic from each space temperature indicator to its associated terminal unit control graphic.

3.6 Sequences of Operation

.1 The following sequences of operation shall be read in conjunction with the Points List associated with this section.

.2 In the event of a discrepancy, the contents of the Points List shall be taken over the contents of the Sequences of Operation.

.3 Air Handling Units (AH-4 and AH-9)

.1 During occupied mode, the supply fan shall run continuously and the outdoor damper shall open to minimum position.

.1 The minimum position for AH-4 shall be 40% outdoor air.

.2 The minimum position for AH-9 shall be 25% outdoor air.

.3 The outdoor air damper shall modulate to maintain a space CO_2 concentration of 800 ppm.

.2 The gas-fired heating section shall modulate as required to maintain a discharge air temperature of 13°C (55°F).

.1 If the space temperature falls below the heating setpoint, the existing space heaters shall be energized.

.2 If the space temperature remains below the setpoint, the gas-fired heating section shall be energized to full heat until the heating setpoint is satisfied.

.3 If the space temperature rises above the cooling setpoint, the outdoor air damper shall open to maintain a discharge air temperature of 13°C (55°F).

.1 If the space temperature rises above the cooling setpoint at 100% outdoor air, the outdoor air damper shall return to minimum position and the cooling section shall be energized.

.4 Zone temperature control shall be provided by VAV-9.1.

.5 During unoccupied mode, the supply air fan shall stop and the outdoor economizer dampers shall fully close.

.1 If the space temperature falls below the heating setpoint, the existing space heaters shall be energized.

.2 If the space temperature remains below the setpoint, the gas-fired heating section shall be energized to full heat until the heating setpoint is satisfied.

.3 If the space temperature rises above the cooling setpoint, the supply fan and the cooling section shall be energized.

.4 Air Handling Units (AH-6 and AH-8)

.1 During occupied mode, the supply fan shall run continuously and the outdoor damper shall open to minimum position.

.1 The minimum position for AH-6 shall be 50% outdoor air.

.2 The minimum position for AH-8 shall be 50% outdoor air.

.3 The outdoor air damper shall modulate to maintain a space CO_2 concentration of 800 ppm.

.1 The CO_2 sensor for AH-6 shall be mounted in the return air duct.

.2 The heating coil valve shall modulate as required to maintain a discharge air temperature of 13°C (55°F).

.1 If any space temperature falls below the heating setpoint, the existing space heaters shall be energized.

.2 If the space temperature remains below the setpoint, the heating coil valve shall fully open until the heating setpoint is satisfied.

.3 If any space temperature rises above the cooling setpoint, the outdoor air damper shall open to maintain a discharge air temperature of 13°C (55°F).

.1 If any space temperature rises above the cooling setpoint at 100% outdoor air, the outdoor air damper shall return to minimum position and the cooling section (CU-6 or CU-8) shall be energized.

.4 During unoccupied mode, the supply air fan shall stop and the outdoor economizer dampers shall fully close.

.1 If the space temperature falls below the heating setpoint, the existing space heaters shall be energized.

.2 If the space temperature remains below the setpoint, the heating coil valve shall fully open until the heating setpoint is satisfied.

.3 If the space temperature rises above the cooling setpoint, the supply fan and the cooling section (CU-6 or CU-8) shall be energized.

.5 Air Handling Units (AH-7)

.1 During occupied mode, the supply fan shall run continuously and the outdoor damper shall open to minimum position.

.1 The minimum position for AH-7 shall be 50% outdoor air.

.2 The heating coil valve shall modulate as required to maintain a discharge air temperature of 13°C (55°F).

.1 If the space temperature falls below the heating setpoint, the existing space heaters shall be energized.

.2 If the space temperature remains below the setpoint, the heating coil valve shall fully open until the heating setpoint is satisfied.

.3 If the space temperature rises above the cooling setpoint, the outdoor air damper shall open to maintain a discharge air temperature of 13°C (55°F).

.1 If the space temperature rises above the cooling setpoint at 100% outdoor air, the outdoor air damper shall return to minimum position and the cooling section shall be energized.

.4 Zone temperature control shall be provided by VAV-7.1 to VAV-7.5.

.5 During unoccupied mode, the supply air fan shall stop and the outdoor economizer dampers shall fully close.

.1 If the space temperature falls below the heating setpoint, the existing space heaters shall be energized.

.2 If the space temperature remains below the setpoint, the heating coil valve shall fully open until the heating setpoint is satisfied.

.3 If the space temperature rises above the cooling setpoint, the supply fan and the cooling section shall be energized.

.6 Air Handling Units (AH-10 and AH-11)

.1 During occupied mode, the supply fan shall run continuously and the outdoor damper shall open to minimum position.

.1 The minimum position for AH-10 shall be 20% outdoor air.

.2 The minimum position for AH-11 shall be 20% outdoor air.

.3 The outdoor air damper shall modulate to maintain a space CO_2 concentration of 800 ppm.

.2 The gas-fired heating section shall modulate as required to maintain a discharge air temperature of 13°C (55°F).

.1 During a heating demand, the gas-fired heating section shall be energized to full heat until the heating setpoint is satisfied.

.3 If the space temperature rises above the cooling setpoint, the outdoor air damper shall open to maintain a discharge air temperature of 13°C (55°F).

.1 If a cooling demand exists at 100% outdoor air, the outdoor air damper shall return to minimum position and the cooling section shall be energized.

.4 Zone temperature control shall be provided by VAV-10.1 to VAV-10.4, VAV-11.1 to VAV-11.6) and FPB-11.1.

.5 During unoccupied mode, the supply air fan shall stop and the outdoor economizer dampers shall fully close.

.1 If the space temperature falls below the heating setpoint, the existing space heaters shall be energized.

.2 If the space temperature remains below the setpoint, the gas-fired heating section shall be energized to full heat until the heating setpoint is satisfied.

.3 If the space temperature rises above the cooling setpoint, the supply fan and the cooling section shall be energized.

.7 Air Handling Unit (AH-12)

.1 During occupied mode, the supply fan shall run continuously and the outdoor damper shall open to minimum position.

.1 The minimum position for AH-12 shall be 10% outdoor air.

.2 The outdoor air damper shall modulate to maintain a space CO_2 concentration of 800 ppm.

.2 The gas-fired heating section shall modulate as required to maintain a discharge air temperature of 13°C (55°F).

.1 If any space temperature falls below the heating setpoint, the space heating valves shall fully open.

.2 If the space temperature remains below the setpoint, the gas-fired heating section shall be energized to full heat until the heating setpoint is satisfied.

.3 If the space temperature rises above the cooling setpoint, the outdoor air damper shall open to maintain a discharge air temperature of 13°C (55°F).

.1 If a cooling demand exists at 100% outdoor air, the outdoor air damper shall return to minimum position and the cooling section shall be energized.

.4 During unoccupied mode, the supply air fan shall stop and the outdoor economizer dampers shall fully close.

.1 If the space temperature falls below the heating setpoint, the existing space heaters shall be energized.

.2 If the space temperature remains below the setpoint, the gas-fired heating section shall be energized to full heat until the heating setpoint is satisfied.

.3 If the space temperature rises above the cooling setpoint, the supply fan and the cooling section shall be energized.

.8 Variable Air Volume Boxes (VAV-7.1 to VAV-7.5, VAV-9.1, VAV-10.1 to VAV-10.4, VAV-11.1 to VAV-11.6)

.1 When the space temperature is above the cooling setpoint:

.1 If the supply air temperature is below the space temperature, the damper actuator shall modulate to increase the supply air volume.

.1 If the damper actuator is fully open and the setpoint is not satisfied, the system initiates cooling mode.

.2 If the supply air temperature exceeds the space temperature, the damper actuator shall modulate to decrease the supply air volume.

.1 If the damper actuator is at minimum position and the setpoint is not satisfied, the system initiates cooling mode.

.2 When the space temperature is below the heating setpoint:

.1 The associated two-position perimeter heating valve shall fully open (VAV-10.2 and VAV-11.3 only).

.2 If the supply air temperature is above the space temperature, the damper actuator shall modulate to increase the supply air volume.

.1 If the damper actuator is fully open and the setpoint is not satisfied, the system initiates heating mode.

.3 If the supply air temperature is below the space temperature, the damper actuator shall modulate to decrease the supply air volume.

.1 If the damper actuator is at minimum position and the setpoint is not satisfied, the system initiates heating mode.

.9 Fan Powered Box (FPB-11.1)

.1 When the space temperature is above the cooling setpoint:

.1 If the supply air temperature is below the space temperature, the damper actuator shall modulate to increase the supply air volume.

.1 If the damper actuator is fully open and the setpoint is not satisfied, the system initiates cooling mode.

.2 If the supply air temperature exceeds the space temperature, the damper actuator shall modulate to decrease the supply air volume.

.1 If the damper actuator is at minimum position and the setpoint is not satisfied, the system initiates cooling mode.

.2 When the space temperature is below the heating setpoint:

.1 If the supply air temperature is above the space temperature, the damper actuator shall modulate to increase the supply air volume.

.1 If the damper actuator is fully open and the setpoint is not satisfied, the unit shall revert to heating mode.

.2 If the supply air temperature is below the space temperature, the damper actuator shall modulate to decrease the supply air volume.

.1 If the damper actuator is at minimum position and the setpoint is not satisfied, the unit shall revert to heating mode.

.3 When the unit reverts to heating mode, the damper modulates fully closed, the supply fan is energized and the two-position heating valve fully opens.

.10 Boilers (B-1 and B-2 / P-1 and P-2 / PB-1 and PB-2)

.1 When the outdoor air temperature is below 10°C (50°F), circulating pump P-1 or P-2 shall be energized.

.1 P-1 and P-2 shall operate in a lead-lag configuration, with the lead pump changing weekly.

.2 B-1 and B-2 shall fire as required to maintain a heating water supply temperature based on a reset schedule.

.1 Each boiler will have factory supplied control package kit.

.2 PB-1 and PB-2 will be energized to operate when B-1 and B-2 are energized.

.3 The alarm and status for each boiler shall be displayed on the control user terminal.

.11 Boilers (B-3 to B-6 / P-3 and P-4 / PB-3 to PB-6)

.1 When the outdoor air temperature is below 10°C (50°F), circulating pump P-3 or P-4 shall be energized.

.1 P-3 and P-4 shall operate in a lead-lag configuration, with the lead pump changing weekly.

.2 B-3 to B-6 shall fire as required to maintain a heating water supply temperature based on a reset schedule.

.1 Each boiler will have factory supplied control package kit.

.2 PB-3 to PB-6 will be energized to operate when B-3 to B-6 are energized.

.3 The alarm and status for each boiler shall be displayed on the control user terminal.

.12 Fans (F-1 to F-7)

.1 F-1 and F-2 shall be energized to operate on a programmed time schedule.

.2 F-3 shall be energized when the space temperature rises above the setpoint.

.3 F-4 shall be energized when the relative humidity in the roof void exceeds the setpoint.

.1 Two motorized relief dampers shall fully open when F-4 operates.

.4 F-5 shall be energized when the relative humidity in the crawlspace exceeds the setpoint.

.1 A motorized relief damper shall fully open when F-5 operates.

.5 F-6 shall be energized when the space temperature in the penthouse mechanical room exceeds the setpoint.

.1 Motorized relief air and intake air dampers shall fully open when F-6 operates.

.6 F-7 shall be energized when the space temperature in the elevator machine room exceeds the setpoint.

.1 Motorized relief air and intake air dampers shall fully open when F-7 operates.

3.7 Points List

.1 Provide the points listed on the following Points List.

DESCRIPTION		I/O SPECIFICATION				
SERVICE	FUNCTION	UNITS	SCALE	POINT TYPE	NUMBER	DEVICE
AH-4, AH-9	Supply Fan Start/Stop			DO	2	
AH-4, AH-9	Supply Fan Status			AI	2	
AH-4, AH-9	Freeze Stat			DI	2	
AH-4, AH-9	Faulty Alarm			DI	2	
AH-4, AH-9	High Current Alarm			DI	2	
AH-4, AH-9	Filter Status			DI	2	

DESCRIPTION		I/O SPECIFICATION				
SERVICE	FUNCTION	UNITS	SCALE	POINT TYPE	NUMBER	DEVICE
AH-4, AH-9	Supply Air Temperature	°C	-40 to 60	AI	2	
AH-4, AH-9	Mixed Air Temperature	°C	-10 to 40	AI	2	
AH-4, AH-9	Mixed Air Low Limit Status			DI	2	
AH-4, AH-9	Economizer Dampers	%	0 to 100	AO	2	
AH-4, AH-9	Heating			AO	2	
AH-4, AH-9	Cooling			DO	2	
AH-4, AH-9	Space Temperature	°C	-10 to 40	AI	2	
AH-4, AH-9	CO_2 Sensor	PPM	0 to 2000	AI	2	
AH-6, AH-7, AH-8	Supply Fan Start/Stop			DO	3	
AH-6, AH-7, AH-8	Supply Fan Status			AI	3	
AH-6, AH-7, AH-8	Freeze Stat			DI	3	
AH-6, AH-7, AH-8	Faulty Alarm			DI	3	
AH-6, AH-7, AH-8	High Current Alarm			DI	3	
AH-6, AH-7, AH-8	Filter Status			DI	3	
AH-6, AH-7, AH-8	Supply Air Temperature	°C	-40 to 60	AI	3	
AH-6, AH-7, AH-8	Mixed Air Temperature	°C	-10 to 40	AI	3	
AH-6, AH-7, AH-8	Mixed Air Low Limit Status			DI	2	
AH-6, AH-7, AH-8	Economizer Dampers	%	0 to 100	AO	3	
AH-6, AH-7, AH-8	Heating Valve			AO	3	3-way
AH-6, AH-7, AH-8	Cooling (CU-6, CU-7, CU-8)			DO	3	
AH-6, AH-7, AH-8	CO_2 Sensor	PPM	0 to 2000	AI	3	
AH-6	Room Temp Sensor			AI	5	
AH-7	Relief Air	%	0 to 100	AO	1	
AH-8	Room Temp Sensor			AI	4	
AH-10, AH-11, AH-12	Supply Fan Start/Stop			DO	3	
AH-10, AH-11, AH-12	Supply Fan Status			AI	3	
AH-10, AH-11, AH-12	Freeze Stat			DI	3	
AH-10, AH-11, AH-12	Faulty Alarm			DI	3	
AH-10, AH-11, AH-12	High Current Alarm			DI	3	
AH-10, AH-11, AH-12	Filter Status			DI	3	

DESCRIPTION		I/O SPECIFICATION				
SERVICE	FUNCTION	UNITS	SCALE	POINT TYPE	NUMBER	DEVICE
AH-10, AH-11, AH-12	Supply Air Temperature	°C	-40 to 60	AI	3	
AH-10, AH-11, AH-12	Mixed Air Temperature	°C	-10 to 40	AI	3	
AH-10, AH-11, AH-12	Mixed Air Low Limit Status			DI	2	
AH-10, AH-11, AH-12	Economizer Dampers	%	0 to 100	AO	3	
AH-10, AH-11, AH-12	Heating			AO	3	
AH-10, AH-11, AH-12	CO_2 Sensor	PPM	0 to 2000	AI	3	
AH-10, AH-11	Cooling			DO	2	
AH-10	Perimeter Heating Valve			DO	7	2-way
AH-11	Perimeter Heating Valve			DO	3	2-way
AH-12	Perimeter Heating Valve			DO	9	2-way
AH-12	Cooling			DO	2	
AH-12	Relief Air	%	0 to 100	AO	2	
F-1 to F-7	Fan Start/Stop			DO	7	
F-1 to F-7	Fan Status			AI	7	
F-1 to F-7	Intake/Exhaust Dampers			DO	8	
F-3, F-6, F-7	Room Temp Sensor			AI	3	
F-4, F-5	Humidity Sensor			AI	3	
VAV-7.1 to VAV-11.6	Position Transmitter	%	0-100	AI	17	
VAV-7.1 to VAV-11.6	Position Control	%	0-100	AO	17	
VAV-7.1 to VAV-11.6	Differential Pressure	Pa	??	AI	17	
VAV-7.1 to VAV-11.6	Room Temperature	°C	0 to 100	AO	17	
FPB-11.1	Position Transmitter	%	0-100	AI	1	
FPB-11.1	Position Control	%	0-100	AO	1	
FPB-11.1	Differential Pressure	Pa	??	AI	1	
FPB-11.1	Fan Start/Stop			DO	1	
FPB-11.1	Heating Valve	%	0-100	AO	1	3-way
FPB-11.1	Room Temperature	°C	0 to 100	AO	1	
B-1, B-2	Start/stop			DO	2	
B-1, B-2	Status			DI	2	
B-1, B-2	System Flow Switch			DI	1	
B-1, B-2	Heating Water Supply	°C	0 to 100	AI	1	

DESCRIPTION		I/O SPECIFICATION				
SERVICE	FUNCTION	UNITS	SCALE	POINT TYPE	NUMBER	DEVICE
B-1, B-2	Heating Water Return	°C	0 to 100	AI	1	
PB-1, PB-2	Start/stop			DO	2	
P-1, P-2	Start/stop			DO	2	
P-1, P-2	Pump Status			AI	3	
B-3 to B-6	Start/stop			DO	4	
B-3 to B-6	Status			DI	4	
B-3 to B-6	System Flow Switch			DI	1	
B-3 to B-6	Heating Water Supply	°C	0 to 100	AI	1	
B-3 to B-6	Heating Water Return	°C	0 to 100	AI	1	
PB-3 to PB-6	Start/stop			DO	3	
P-3, P-4	Start/stop			DO	2	
P-3, P-4	Pump Status			AI	3	
Existing Floor Heating	Heating Water Supply	°C	0 to 100	AI	1	
Existing Floor Heating	Heating Control Valve	%	0-100	AO	1	3-way

END OF SECTION