SECTION 23 09 00 AUTOMATIC TEMPERATURE CONTROLS SYSTEM (ATCS)

PART 1 GENERAL REQUIREMENTS

WORK INCLUDED

General Requirements:

Section 23 09 00 shall be bid direct to the Mechanical Contractor.

The existing campus wide Automatic Temperature Controls System (ATCS) is controlled by three (3) existing central computers. These systems are the Honeywell "SymmetrE" front end, the Johnson Controls "Metasys" front end a TAC/ Invensys front end. **All DDC controls for this contract shall communicate to one of the 3 systems.** Communication to the Central Computer shall be via the campus-wide Ethernet communication backbone.

Approved suppliers must have permanent representation located in Mobile or Baldwin County, have been in business a minimum of five years and have at least three, factory trained local employees. No exceptions will be allowed. The three approved suppliers for this project are **Honeywell International, TAC/ Invensys** and **Johnson Controls Inc**.

The drawings and specifications are complementary to one another, meaning that what is called for on one is to be considered called for in both. Where conflicts exist between the specifications and/or drawings, the more stringent requirement shall apply.

The BAS Contractor shall be responsible for field verification of site conditions and for gathering all necessary field data for all items to be provided under this contract prior to submitting his bid.

Where work specified under other sections of these specifications connects to equipment or systems which are a part of this section. Provide proper connection(s) to such equipment including trade coordination.

DEFINITIONS

Algorithm: A software procedure for solving a recurrent mathematical or logical problem.

Analog: A continuously varying signal or value (temperature, current, velocity, etc.).

Binary: A two-state system where an "ON" condition is represented by a high signal level and an "OFF" condition is represented by a low signal level.

Building Automation System (BAS): The entire system of hardware and software specifically designed to centrally manage building HVAC and related utilities. The BAS includes the DDC subsystem, open system ports, open protocol bus or integrators and network routers for connection to information networks.

BAS Contractor: The Building Automation System Contractor responsible for the installation of the Building Automation System specified herein. **The BAS contractor for this project shall be a local Honeywell International Authorized Controls Integrator (ACI), a local TAC/ Invensys authorized contractor or the local Johnson Controls branch office.**

Control Process: The software required to perform a complete control loop from input signal to interlock logic, process calculation to final output signal control.

Control Wiring: Includes conduit, wire and wiring devices to install a complete Control System including motor control circuits, interlocks, thermostats, PE and EP switches and like devices. Include all wiring from a DDC cabinet to all sensors and points defined in the points list summary or specified herein and required to execute the sequence of operation. Include necessary power wiring to all BAS devices, digital controllers including terminal units and actuators.

Interoperability: The ability of control system components from different manufacturers to connect together and

provide coordinated control via real-time data exchange through a common communications data exchange protocol. Interoperability shall extend to the operator workstation software which shall support user interaction with all control system components. Methods of interoperability for this project include integrator interfaces between cooperating manufacturer's systems.

Link: A link is a graphical display element that allows the operator to "click" the item and automatically display the associated screen or service. Any screen may have links to or be linked from any other screen. Links shall be configured on each display screen to provide a logical user navigation system using a ladder tree hierarchy.

Network: A system of distributed control units that are linked together on a communication highway. A network allows sharing of point information between all control units. Additionally, a network provides central monitoring and control of the entire system from any distributed control unit location. First tier networks shall provide "Peer-to-Peer" communications. Second tier networks shall provide either "Peer-to-Peer", Master-Slave or Supervised Token Passing communications.

The term "provide" means "provide complete in place", that is, furnished and installed and ready for operation and use.

QUALITY ASSURANCE

General

The Building Automation System herein specified shall be fully integrated and installed as a complete package by the Building Automation System Contractor. The System shall include all wiring, piping, installation supervision, calibration, adjustments, and checkout necessary for a complete and fully operational system.

The Building Automation System Contractor for this project shall be a **Honeywell International Authorized Controls Integrator, TAC/ Invensys authorized dealer or Johnson Controls branch office located in Mobile or Baldwin Counties.**

The BAS Contractor shall be responsible for all work fitting into place in a satisfactory and neat workmanlike manner acceptable to the Owner/Architect/Engineer.

The BAS Contractor will coordinate with other trade contractors regarding the location and size of pipes, equipment, fixtures, conduit, ducts, openings, switches, outlets, etc.; in order eliminate any delays in the progress of the job.

Products

The Building Automation System architecture shall be the standard product of **Honeywell International, TAC/ Invensys or Johnson Controls.**

.

Electrical Wiring

All wiring shall comply with the requirements of all local and national electric codes.

All DDC Controllers shall be UL listed.

Where not provided by the division 16 contractor, provide power wiring from the circuit breaker to the following equipment.

DDC controllers - Use a dedicated circuit for each controller. Terminal controllers may share a common circuit. Terminal controllers may be powered by the terminal device providing that this is accepted by the controller manufacturer.

Local interface panels - Use a dedicated circuit for control power at each local control panel.

Provide utility outlet for operator's terminal within all controller enclosures (excluding terminal units) or within associated adjacent local control panel.

INSTALLATION PRACTICES

Control System Wiring

All conduit, wiring, accessories and wiring connections required for the installation of the Building Automation System, as herein specified, shall be provided by the BAS contractor unless specifically shown on the electrical drawings under Division 16 Electrical.

All wiring shall comply with the requirements of applicable portions of Division 16 and all local and national electrical codes.

All system input wiring shall be twisted pair, minimum 18-gauge wire, shielded where required by BAS equipment mfr.

All system analog output wiring shall be twisted pair, minimum 18-gauge wire.

All internal panel device wiring for binary outputs and pilot relay shall be minimum 18-gauge wire.

Control System Wiring Installation

All wiring shall comply with the installation requirements of applicable portions of Division 16 and all local and national electric codes.

All wiring shall be installed in conduit.

Minimum control wiring conduit size shall be 1/2" **including** flex connections.

Low voltage control wiring and 24VAC can be run in the same conduit. Power wiring 120VAC and greater must be in separate conduits.

Local Control Panel Enclosures

Each enclosure shall be furnished with a key lock for the door.

Devices mounted within a panel shall be arranged in a neat and orderly fashion. The bottom edge of each device shall be level with the bottom of the panel.

Field wiring shall be connected to terminal strips located within the local control panel. Direct connection of field wiring to panel devices shall not be accepted unless the panel device is equipped with removable modular plug-in terminal blocks.

Identification Standards

Controller Identification: All controllers shall be identified by a nameplate fastened within the enclosure.

Panel Identification: All local control panels shall be identified by a plastic engraved nameplate securely fastened to the outside of the controller enclosure.

Raceway Identification: Identification labels stating "Control System Wiring" shall be affixed to the covers of all junction and pull boxes of the control system raceways.

SUBMITTALS

Shop Drawings, Product Data and Samples

BAS Contractor shall submit installation drawings and control strategies for review in an electronic format on CD.

Each submittal shall have a cover sheet with the following information provided: Submittal ID number and date. Project name, address and title, name, address and phone number of BAS Contractor.

Include the following information.

BAS riser diagram showing all DDC controllers, operator workstations, network repeaters, and network wiring.

Points list for each DDC controller: Include; point type, user address, hardware address, engineering units, controller type, cable terminations, module type, panel, and module number.

Vendor's own written description for each sequence of operation: Sequences shall reference Input/Output and

software parameters by name and description.

The sequences of operation provided in the submittal by the BAS Contractor shall represent the detailed analysis needed to create actual programming code from the design documents.

Points shall be referenced by name, including all software points such as programmable setpoints, range limits, time delays, etc.

The sequence of operation shall cover normal operation and operation under the various alarm conditions applicable to that system.

User interface functional outline. Include at each Honeywell, TAC/ Invensys or Johnson Metasys operator workstation, data to be displayed, and links to other screens. Outline level hierarchy shall be:

Site
Building
Floor
System

Detailed bill of material list identifying quantity, part number, description, associated options.

Hardware data sheets for all operator workstations, local access panels and portable operator terminals.

Software manuals for all applications programs to be provided as a part of the operator workstations, portable operator terminals, programming devices, etc. for evaluation for compliance with the performance requirements of this specification.

As-Built Drawings: Integrate with flow diagrams, show outline of HVAC equipment with control devices, schematic one-line control piping and wiring, and reduced floor plan drawings showing installation routing of all DDC system network LANs. Equipment numbers shall correspond to those shown on the contract drawings. Provide as-built drawings as follows:

One complete set of CD's.

One set of applicable prints mounted in each local control panel of each mechanical room.

Operation and Maintenance Manuals

Maintenance Instructions: Document all maintenance and repair/replacement procedures.

Include the following documentation in the DDC Software Manual:

Sequence of Operations

Program Listing of Software Source Code OR Flow Chart Diagrams of Programming Objects.

Printed listing of controller and operator workstation database files.

Software Point Name List. Include User Address, Controller Where Located, Point Type and Hardware Address.

I/O Point List. Include User Address, Controller Where Located, Point Type and Hardware Address.

Provide three copies of all manufacturers manuals covering the installed system. This shall include, as a minimum:

System Engineering Manual

System Installation Manual

Programming Manual

Engineering and Troubleshooting Bulletins

Operator Workstation Software Manual

All manuals shall be provided in Acrobat format on CD or as part of an on-line documentation system through the operator workstation.

INSTRUCTION

Operator Training

Provide three (4) hour on-site operators training upon completion of the installation and prior to final sign-off for start of the warranty.

GUARANTEE

Material: The Control System shall be free from defects in material and workmanship under normal use and service. If within twelve (12) months from the date of completion any of the equipment herein described is defective in operation, workmanship or materials, it will be replaced, repaired or adjusted at the option of the BAS Contractor during normal working hours, free of charge.

PART 2 - PRODUCTS

ACCEPTABLE MANUFACTURERS

The following is a list of Building Automation System manufacturers that have been pre-approved for this project.

Honeywell International
TAC/ Invensys Controls
Johnson Controls Inc.

BASE NETWORK

First Tier Network
The first tier BAS is existing (Honeywell, Invensys and Johnson PC'S) and shall be reused or provided as new
Second Tier Network

Second tier networks shall provide either "Peer-to-Peer", Mater-Slave or Supervised Token Passing communications and shall operate at a minimum communication speed of 9600 baud. If a new system is furnished, it shall be an open, Lonmark compliant network operate at a minimum communication speed of 78,600 baud.

Application Specific Controllers using the existing network reside on the second tier. All Lonmark controllers shall reside on the same tier.

DDC HARDWARE

Network and System Controllers (Johnson Controls)

Communications Network: Controller shall reside on a single tier network. Each controller shall support a network of a minimum of 100 controllers on the network.

Processor: Controllers shall be microprocessor-based with a minimum word size of 16 bits and a maximum program scan rate of 1 second. They shall be multi-tasking, multi-user, real-time digital control processors consisting of modular hardware with plug-in enclosed processors, communication controllers and power supplies. Controller size and capability shall be sufficient to fully meet the requirements of this specification.

Memory: Each controller shall have sufficient memory to conform to the performance requirements, as specified below to support its own operating system, databases, control programs and to provide supervisory control for all second tier controllers.

Hardware Real Time Clock: The controller shall have an integrated hardware based real time clock.

Communications Ports: Controller shall provide at least two RS-232 serial data communication ports for operation of operator I/O devices such as industry standard printers, operator terminals, modems and portable operator's

terminals. Controllers shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems, printers or terminals.

Diagnostics: Controller shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all panel components. The network controller shall provide both local and remote annunciation of any detected component failures, low battery conditions or repeated failure to establish communication.

Power Failure: In the event of the loss of normal power, there shall be an orderly shutdown of all controllers to prevent the loss of database or operating system software. Nonvolatile memory shall be incorporated for all critical controller configuration data, and batter backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours.

During a loss of normal power, the control sequences shall go to the normal system shutdown conditions.

Upon restoration of normal power, after a minimum off time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.

Should a controller memory be lost for any reason, the operator :

Workstation shall automatically reload the program transparent and

without any intervention by the system operators.

Certification: All controllers shall be listed by Underwriters Laboratories (UL).

Unitary and Extended Digital Controller (Application Specific):

Communications Network

The application specific controller shall reside on the second network tier and shall communicate using a minimum of 9600 baud.

Capabilities

Application specific controllers shall include all points, inputs and outputs, necessary to perform the specified control sequence.

Each controller shall support its own real-time operating system. Provide a time clock with battery backup to allow for stand-alone operation in the event communication with its System Controller is lost and to insure protection during power outages.

Provide each application specific controller with sufficient memory to accommodate point database, operating programs, local alarming and local trending. All databases and programs shall be stored in non-volatile EEPROM.

Programming of application specific controllers shall utilize the manufacturer’s configuration tool with a library of proven software programs.

Each controller shall have connection provisions for a portable operator’s terminal. This tool shall allow the user to display, generate or modify all point databases and operating programs. All new values and programs may then be restored to EEPROM or other non-volatile memory via the programming tool.

All application specific controllers shall be listed by Underwriters Laboratories (UL).

The system shall contain self-diagnostics that continuously monitor the integrity of the system. Any malfunction of the system will be reported to the operator’s terminal to inform the operator of the nature of the malfunction and the unitary controllers affected.

Inputs: Monitoring of the following types of inputs, without the addition of equipment outside the application specific controller cabinet:

Analog inputs shall monitor the following analog signals:

4-20 mA Sensors
0-10 VDC Sensors
1000ohm RTD's

Binary inputs shall monitor dry contact closures. Input shall provide filtering to eliminate false signals resulting from input "bouncing".

Counter inputs shall monitor dry contact pulses with an input resolution of one HZ minimum.

Outputs

Analog outputs shall provide the following control outputs:

4.20 mA - Sink or Source
0-10 VDC

Binary outputs shall provide SPDT output contacts rated for 2 amps at 24 VAC. Provide surge and noise suppression on all pilot relays. Inductive loads, i.e. solenoids, shall be controlled by pilot relays.

Tristate outputs shall be paired binary outputs for use as Power Close/Power Open control output contacts rated for 2 amps at 24 VAC. Provide surge and noise suppression on all pilot relays.

DDC SOFTWARE (Johnson system)

General Requirements

The software control language(s) used in all digital controllers shall provide point identifications .
Network , System, and Application Specific Controllers

All necessary software to form a complete operating system as described in this specification shall be provided and shall reside solely within the individual controller and/ or its remote I/O boards.

The software programs specified in this section shall be provided as an integral part of controllers and shall not be dependent upon any higher level computer or controller for execution.

Each controller shall be fully independent from other controllers with the following exceptions:

Common outside air temperature and humidity, fire alarm status, and other common points as designated.

Shared data points shall be available to any peer level controller and shall be updated regularly.
Programming Environment

The Network and System controllers shall use the same programming language and software development tools (i.e. graphical or text-based).

Pre-Programmed Processes: Application Specific Controllers, which utilize pre-programmed processes, are acceptable provided that they also meet the sequences of operation as specified herein.

Custom Processes: Network and System controllers shall execute custom, job-specific processes defined by the user, to automatically perform calculations and special control routines. Control programs shall be Text Based or graphical language orientated and I/O points, program variables and constants shall be accessed by a 12 character point name.

The programming language must be simple and concise in use

Any process shall incorporate measured or calculated data from any and all other system controllers on the network as may be required to execute the specified sequence of operations.

Processes shall generate operator messages and advisories to operator I/O devices. A process shall directly send a message to a specified device or cause the execution of a dial-up connection to a remote device such as a printer or pager.

The custom control programming feature shall be documented via text-based descriptors or graphical diagrams.

The programming language must support the creation of custom “Library Routines” to handle common control applications for the facility. It shall be possible to create a “Template” for a specific program sequence with all associated blocks defined for ease of use.

Schedules

Controllers shall provide user definable schedules as follows:

Weekly schedules with multiple Start/Stop times for each day of the week.
Temporary weekly override schedules.

Special override schedules for specific user selectable calendar dates.

Holiday scheduling, including floating holidays.

Weekly schedules shall be provided for each piece of equipment with a specific time use schedule. Each schedule shall include start and stop times for each day of the week. Multiple weekly schedules may be grouped together to control a single piece of equipment or equipment group.

It shall be possible to define one or more master holiday schedule to allow the operator to define in one location the holidays for all associated schedules. Systems requiring the operator to change holiday definitions on a schedule by schedule basis shall not be accepted.

Standard weekly schedules shall be inactive on a holiday. The system shall allow the user to include in a schedule group a schedule which will only be active if today is a holiday.

Temporary weekly overrides schedules may be inserted into schedule groups for modified operating schedules. After overrides have been executed, the original schedule will automatically be restored.

Schedules shall be provided for each system, or sub-system in the facility. Each schedule shall include all commandable points residing within the system. Each point may have a unique schedule of operation relative to the system. Each point may have a unique schedule of operation relative to the system use schedule, allowing for sequential starting and control of equipment within the system.

Special days shall automatically reschedule equipment operation as previously defined on the weekly schedules on a specific calendar date.

Historical Data Collection: Historical data collection utilities shall be provided to manually or automatically sample, store and display system data for points as specified.

Each controller shall store point history data for all analog and digital inputs and outputs as follows:

Any point, physical or calculated may be designated for trending. Three methods of collection shall be allowed: defined time interval upon a change of value whenever a value is out of range.

Each digital system controller shall have a dedicated RAM-based buffer for trend data and shall store 96 samples for each physical point and software variable, including and individual sample time/date stamp. Points may be assigned to multiple history trends with different collection parameters.

Trend and change of value data shall be stored within the controller and uploaded to the workstation when retrieval is desired. Uploads shall occur based upon either user-defined interval, manual command or when the trend buffers are full. All trend data shall be available for use in 3rd party personal computer applications such as Excel via a single command data export utility.

Each controller shall also provide high resolution sampling for verification of control loop performance.

Provide formatted trend report displays for each point. Include all trend data and associated parameters.

Provide preformatted commands to view and print trend and tuning reports.

Alarms: Alarm management shall be provided to monitor and direct alarm information to operator devices. Each controller shall perform distributed, independent alarm analysis and filtering to minimize operator interruptions due to non-critical alarms, minimize network traffic and prevent alarms from being lost. At no time shall the controller ability to report alarms be affected by either operator activity at a workstation, local I/O device or communications with other panels on the network.

All alarm or point change reports shall include the point's English language description and the time and date of occurrence.

The user shall be able to define the specific system reaction for each point. Each alarm shall have user definable destination categories (i.e. PC, printer, system controller, pager, etc.) to provide full flexibility in defining the handling of system alarms. Each system controller shall automatically inhibit the reporting of selected alarms during system shutdown and start-up. Users shall have the ability to manually inhibit alarm reporting for each point.

Alarm reports and messages will be directed to a user-defined list of operator devices and/or workstations.

In addition to the point's descriptor and the time and date, each system controller shall store a library of at least 50 custom alarm messages. Each message may be assignable to any number of points in the controller. The alarm message shall be a minimum of 60 characters.

Operator-selected alarms shall initiate a call to a remote operator device, such as a remote alarm printer or digital pager.

Local Alarms

The controller shall provide alarm monitoring for all analog input values that are outside of user definable ranges, for all binary alarm status points and for all binary output points that do not prove status based on a paired binary input status point.

The user shall be able, from the operator workstation, to configure the alarm limit ranges, limit dead bands and to enable/disable the alarm.

The user shall be able to configure any controller alarm as a conditional alarm that will only occur when a selected binary point is ON of OFF. This shall be used to prevent nuisance alarms during non-operating and/or system startup modes.

Temperature alarms shall be operator configured to alarm base on:
An operator adjustable alarm deadband which shall generate a warning or alarm whenever the temperature is above the current active setpoint plus the alarm deadband or below the current active setpoint minus the alarm deadband.

High and Low alarm limit setpoints and return to normal values or dead bands.

Remote Communications: Network Controllers shall provide at least one RS-232 serial data communication port for operation of a PC industry standard modem for access by a remote portable operator's terminal or workstation.

Controllers shall automatically accumulate and store run-time hours for all digital input and output points.

The totalization routine shall have a sampling resolution of one minute or less.

The user shall have the ability to define a warning limit for run-time totalization for each point. Unique, user-specified messages shall be generated when the limit is reached.

Provide a formatted report display for each point showing all calculated data and associated parameters.

Controllers shall automatically sample, calculate and store consumption totals on a daily, weekly and monthly basis for all analog and digital pulse type inputs monitoring flow, kW, kWh, etc.

Totalization shall provide calculation and storage of accumulations of up to 9,999.9 units (e.g. kWh, gallons, BTU, tons, etc.)

The totalization routine shall have a sampling resolution of one minute or less.

The user shall have the ability to define a warning limit. Unique, user-specified messages shall be generated when the limit is reached.

Provide a formatted report display for each point showing all calculated data and associated parameters.

Network Controllers shall support an Open Protocol Bus (OPB) or equal for interface with other manufacturer's open communication protocols.

Network Controllers shall support an Open Systems Port (OSP) or equal for the interface to external devices.

COLOR GRAPHIC SOFTWARE (Johnson system)

General Requirements

The BAS contractor is required to create and bind color graphics on each of the operator workstations as described. Provide individual graphics for each system including hot water system, chilled water system, air handling unit, each reheat, and each VAV box.

Software Data Exchange. The color graphic software shall support at least one of the following PC industry standard data exchange protocols:

DDE
OLE
SQL

Dynamic Graphical Displays

Color graphic floor plan displays and system schematics for each mechanical system.

Each mechanical system shall display all associated program parameters on a tabular or graphical screen linked directly to the system schematic diagram display. Provide multiple screens as required to display all information in an easy to read and well-organized format. Logical function association shall group parameters.

Each mechanical system shall display associated schedule information on the specified formatted display which shall be linked to the system schematic diagram display.

Each history trend display for a mechanical system shall be linked to the systems schematic or parameter display screens.

The operator interface shall allow users to access the various system schematics and floor plans via a graphical penetration scheme, menu selection or text-based commands.

Dynamic temperature values, humidity values, pressure values, flow values and status indication shall be shown in their actual respective locations and shall automatically update to represent current conditions without operator intervention.

Link each graphic system display to its respective control drawing in PDF format.

Historical Data Graphical Displays

Provide a historical data display for each specified history trend that allow the user to view the trended data on a graphical display. Displays shall be actual plots of both static and real-time dynamic point data.

A minimum of 4 points may be viewed simultaneously on a single graph, with color selection and line type for each point being user-definable.

Displays shall include an 'X' axis indicating elapsed time and a 'Y' axis indicating a range scale in engineering units for each point. The 'Y' axis shall have the ability to be manually or automatically scaled at the user's option. Dynamic graphs shall represent real-time point data. Any point or group of points may be graphed, regardless of whether they have been pre-defined for trending. The graphs shall continuously update point values.

The user shall be able to print any graph on the system printer for use as a building management and diagnostics tool in both a tabular text format and as a graphical screen print.

BTU Calculations

Where flow sensors are required by the plans and specifications, provide a calculation of the BTU usage for the hot water system and for the chilled water system and provide the information on the new Operator Workstation.

DDC & BAS Software (Honeywell and TAC/ Invensys systems)

General

The Server software shall be a complete package of industry standard software and custom building automation and control software designed, tested and certified by the HVAC BAS manufacturer to perform as a complete system in compliance with the References and Standards of this specification.

The Operating System shall be Microsoft Windows XP or newer with TCP/IP networking software, Microsoft Office 2003 suite, and Internet Explorer 5.1 or later.

Real Time Database Management software shall store information about the system configuration, scan controllers for current data, generate event logs and alarms, process data for graphical display on operator Workstations, write values to controllers for control, store a minimum of 100, 000 events to be analyzed later, and monitor the quality of communications between different system components.

Controller scanning software shall provide the database with the current analog, status, accumulator, and access point data utilizing the appropriate protocol for the controller being scanned. Scanning shall be accomplished by exception and periodic techniques to minimize communications system loading and maintain the specified throughput. Operators, reports, and applications shall also be able to demand a scan at any time.

Database Point data shall include name, area, alarm assignment, history collection assignment, algorithm assignments, display assignments, and :

for analog points shall include present value, set point value, output variable control value, mode, and four auxiliary parameters;
for status points shall include present value, output variable control value, and a mode parameter;
for accumulator points shall include present value;

Group Control software shall permit the user configuration of point lists, which shall then be controlled simultaneously as a group. Provide capability to group both changes of state and analog point control.

Alarm and Event Processing Software

Alarm points shall be assigned one of the following four priority levels: Urgent, High, Low, or Journal. All system changes, including alarm changes, operator changes, security level changes, etc., shall be logged as events in the event log. Urgent, High, and Low priority events shall generate alarm conditions. Journal priority events shall only be logged in the event log. Points in alarm shall remain in alarm until the condition returns to normal or is acknowledged by an operator. Alarms shall be automatically displayed on assigned Workstations and printed on alarm printers. The display shall not be presented in a window covering other operator displays or require acknowledgement to return to normal operator tasks. Workstations shall continuously display the most recent or oldest and highest priority unacknowledged alarms in an alarm information area, with icons, and via wave file initiation or local indication via status point output change of state.

Points in alarm shall provide the operator with detailed point and user definable alarm information. Display shall include as a minimum time and date of occurrence, indication of alarm condition, analog, value or status, user

address, and alarm message. The user shall be able to assign alarm points to un-acknowledged alarm priority escalation to ensure critical alarms are not ignored.

Point Control Scheduler software shall permit one shot, daily, workday, weekend, day of week, predefined shift, and holiday scheduling of database points by authorized operators and administrators.

User Security software shall provide for password protected access to the entire data base, selected areas of the database, and individual points within the database. Access shall be configurable by Workstation and by individual operators. Operator and administrator based security shall provide six hierarchical levels: Level 1, Level 2, Operator, Engineer, and Manager.

Graphic Display storage shall be provided for a minimum of 400 standard operator displays plus all custom graphic operator displays specified.

Provide the following standard pre-formatted reports which shall be selected from a report summary display:

Standard Reports
Alarm-Event - list of points currently in alarm or event conditions;
Alarm Duration - list of selected points with calculated alarm duration;
All Point - sorted list of all points by attribute or value and details of current point conditions;
Point Attribute - list of all points with specified attributes or in specified states;
Point Change - list of points specified with calculated change of state frequencies;
After Hours Alarm - list of all alarms that occurred outside operational hours;

Custom reports– Open Report (Generic Crystal) format capability shall be provided utilizing Crystal Reports 3rd party software provided by others. Training shall be provided for the end user in development of custom reports. The BAS contractor shall develop the custom reports only where described in the sequence of operations.

Field Controller Interface software shall be provided to configure controller channels, controllers, and points and monitor communications between the Field Controllers and the data base. Each Controller Channel shall be individually configured with an adjustable Diagnostic Scan Period, Marginal Alarm Limit, and Failure Alarm Limit. Each Controller shall be individually configured with an adjustable Marginal Alarm Limit and Failure Alarm Limit. Communication errors or response failures shall be monitored, incremented and decremented. Marginal alarms shall be reported with a High priority and Failure alarms reported with an Urgent Priority.

LAN/WAN software shall provide Client/Server communications utilizing TCP/IP networking protocol between local and remote Server data bases and Clients as required by these specifications.

Open Database [ODBC] driver software shall be provided to permit the use of an ODBC compliant tool for user custom reports development.

ASCII Import Export software shall be provided to permit the import and export of Comma Separated Variable [CSV] file data to and from the Server Database. It shall be possible to add, delete, and modify the imported data for use in other LAN/WAN connected Databases. The software shall support standard reports and be executable as a command line function.

Terminal Server Interface software shall be provided as required to expand Server serial port capabilities.

Provide Microsoft Excel Data Exchange [MEDE] software to permit user incorporation of current point data and static or dynamic historical data from the HAVC BAS Server Database into Microsoft spreadsheets, utilizing the MEDE Wizard.

If any equipment in related sections requires Advanced Dynamic Data Exchange [ADDE] interfaces, provide ADDE software to set-up, configure, and test communications between the HVAC BAS Server and field controllers connected by other servers. Provide support for any device or DDE server capable of standard or advanced Windows DDE protocol, including Wonderware Fast DDE servers using standard Windows DDE protocol.

Archival Software

Server based archival storage shall include Fast, Standard, and Extended History storage. Fast History shall provide five second snapshots of a point parameter. Standard History shall provide one-minute snapshots of point data and, six-minute, one hour, eight hour, and twenty four-hour averages of the one minute snapshots. Extended History shall provide one hour, eight hour, and twenty four-hour snapshots of point data.

Operator Interface Software

Provide a hierarchically linked dynamic graphic operator interface for accessing and displaying system data and commanding and modifying equipment operation. The interface shall provide configurable pull-down menus and tool bars, standard tool bars, dialog boxes, zoom, pan, scroll boxes, coloration and animation to facilitate operator understanding of the system. Multiple levels of graphic penetration shall be provided. Descriptors for graphics, points, alarms, etc., shall be modified through the operator station under password control. All operator-accessed data shall be displayed on the color monitor. The operator shall select further penetration via a user input device, e. g. a keyboard entry or mouse click on an area, building, floor, fan, etc.

Standard system, summary, status and configuration displays shall provide current values of alarms, points, cards, controllers, channels, access levels, and zones. Configuration displays shall also provide on-line configuration of select functions. Operator display shall be refreshed at a user selected rate up to once per second.
System displays shall include menu, configuration, and status displays:
System menu display shall provide access to general monitoring and control functions, building management functions , and setup and maintenance functions;
System configuration displays shall provide access to general server functions, system hardware functions, alarm and event management functions, system security and area functions, point and point scheduling functions, operating display and report functions, application functions, and engineering tool functions.
System summary displays shall provide access to channel, controller, workstation, printer, redundant server, and distributed server functions.

Summary displays shall provide access to and information on alarms, events, system components:
Alarm summary displays shall provide date, time, area, point ID, condition, priority, description, and value of all alarms in the summary. It shall be possible to select filters to sort alarm summaries by priority and areas.
Event summaries shall provide date time point ID, event type, level, description, value and field time of all events in the log.

Status displays shall provide information on specific channels, controllers, workstations, printers, redundant servers, distributed servers, and input and output points.

Configuration displays shall be provided for:

- alarms and point processing, alarm paging, advanced alarm management, and extended event archiving;
- point and point scheduling, point collections, history collection, holidays, and shifts;
- operators, areas, and area profiles;
- reports and history archiving, trends, groups, dead-man timers, guard tours, group control;
- workstations, connections, channels, controllers, printers, redundant servers, distributed servers, channel maintenance;
- server wide settings, and server licenses;
- Applications;

Display and point building engineering tools.

Standard scanning statistic displays shall provide current performance and load information of all controller channels.

Standard operating group displays shall provide the data of all logically related points on the same display so that all aspects of a system can be viewed simultaneously on a single display.

Standard trend set displays shall be provided to view historical point data for analysis. Provide the capability to assign displays to standard, fast or extended historical trending. Provide the following pre-formatted displays:
Single - Displays a bar graph of historical data for a single point;
Dual - Displays a bar graph of historical data for two points, or the same point with different time scales;
Triple - Displays a bar graph of historical data for three points;
Multiplot - Displays a line graph of historical data for up to eight points;
X-Y - Displays an X-Y plot of the historical data for two analog points, with one points data plotted against the other;
Numeric - Displays a list of the historical data for up to eight points in numerical format;

Multirange - Displays a line graph of historical data for up to eight points, allowing the display range of the points to be individually configured.

Custom operator displays with dynamic data points shall be provided as follows:

Site layout [showing buildings, streets, etc.];
Individual building detailed floor plans of each floor showing all sensors, major equipment, etc.;
Individual building elevations or isometric drawings;
Any other graphics necessary for logical penetration;
Schematic system diagrams of all major mechanical and electrical systems;
Sequences of operations with dynamic adjustments;
Flow charts of critical DDC systems;
System configuration of Section 15900, and all integrated systems showing all controllers;
Supervisor graphics.

Alarm software shall provide a graphical alarm display, and generate an audible alarm when abnormal conditions occur. Alarms shall be assigned an Urgent, High, Low, or Journal priority. Urgent, High, and Low priority alarms shall be displayed in the alarm summary. The alarm will remain until acknowledged by the operator. Alarms may be assigned to Priority Escalation to ensure critical, high level alarms are acknowledged. A dedicated status zone at the bottom of the display shall continuously indicate the most recent [or oldest] and highest priority alarm that has not been acknowledged. All alarms and response actions shall be recorded in an event file for analysis and reporting. The operator shall be able to print an alarm summary to an alarm/event printer.

Scheduling software shall be provided to permit the operator to schedule any point in the Server database, Global scheduling of GPC's for the entire facility or sections of the facility on a Global basis, and Directly access a controller for scheduling within that controller.

General Purpose Controller (GPC), Controller Global Scheduling shall allow the operator to create, modify, delete and download a set of user defined schedules to multiple controllers logically grouped together [floor, wing, building]. Provide a (GPC) Global Scheduling Display that displays a lists of available control locations, assigned control locations, download status of each control location, graphically shows the enable, standby, and disabled period of every schedule, and permits schedule name definition, weekend, weekday, and all week schedules, three special schedules, and reports download errors.

Direct GPC Controller Scheduling shall allow the operator to directly access and control the native controller time program functions, including daily and weekly schedules, and making temporary point and date overrides. Provide a Direct Access Display that permits the operator to add, delete, rename, view, and/or edit the daily and weekly schedules, create and delete temporary point overrides, and add and remove date overrides.

Building HVAC Tuning capabilities shall be provided to permit the operator to directly access Section 15900 General Purpose and Unitary Direct Digital Controllers and points within those controllers. Provide standard system displays to view and modify write-able point parameters and controller parameters. Provide custom displays that directly activate individual unitary DDC point parameter displays for points requiring frequent tuning where shown on the drawings or specified in the Custom Display summary.

Reports shall be provided to permit the operator to request reports for immediate printout or display or to schedule the reports for future predetermined times. The report capabilities shall include pre-configured standard reports, custom reports, and integrated spreadsheet reports.

Operator Security for the workstation shall be provided to limit each operator and workstation's access to database areas and codes; point control by point level, segregation, areas, and sign-on levels; command control access. Each operator shall be assigned an individual ID and Password.

Workstation based security shall not require a user ID or password for system log-on, but shall require both to change to higher security levels for configuration and administration.

Operator based security shall provide six levels of security, each with different privileges. Operator based security shall allow control of database points, database areas, day and time access, workstation access.

Point control security shall prevent overriding or viewing of point information by assigning point access levels, area access levels, and/or command segregation levels.

Duress log on passwords shall be available to Operators to activate silent alarms upon sign-on.

Client Application Development

Provide a configuration and modification tool to allow rapid database development of new controller channels, controllers, points, workstations, and printers, and also allows user modification of the existing database. The configuration tool shall create projects for download to the server and permit upload of existing database information for modification, organizing the information in pages. The configuration tool shall provide dialog boxes featuring default values and selection lists, and provides arrangement, sorting, filtering, and selection features for prompt viewing of any aspect of project information. It shall be possible to quickly configure multiple objects [points, controllers, workstations, etc.], view common properties of selected objects, cut and paste objects, use filters to limit the types of objects, and import configuration information from spreadsheet applications. [Point Builder]

Provide a custom display building tool to supplement the standard graphic displays to provide site plans, floor plans, and custom process displays, etc. The custom displays shall allow creation of user friendly animated displays linked to the database for real-time event display. The display builder shall be provided with a shape library of useful industry-standard and commonly used shapes, a shape gallery of dynamic and animated shapes, but shall also allow script creation using Visual Basic Script, and inclusion of web, intranet, and video objects in the display that can run on the Workstation.

Internet Browser Software shall be provided to enable navigation to and from corporate Intranet and other web sites directly from the Workstation without interference with alarm monitoring capability. Internet access shall be configurable to restrict access to specific web pages or sites. Provide the ability to:
add Hyper-links on the BAS pages and web pages to provide direct linking;
embed Active Documents such as MS Word and Excel documents into Workstation displays;
attach Visual Basic Scripts to display elements to perform animation and input **string validation, etc.;**
permit the Workstation to function as an OLE Server.

INPUT DEVICES

Differential Pressure Transmitters

General Air and Water Pressure Transmitter Requirements:

Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage and to hold calibrated accuracy when subject to a momentary 40% over-range input.

Pressure transmitters shall transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal.

Differential pressure transmitters used for flow measurement shall be sized to the flow sensing device and shall be supplied with Tee fittings and shut-off valves in the high and low sensing pick-up lines to allow the balancing contractor and Owner permanent easy-to-use connection.

Flow Monitoring

Water Flow Monitoring

Water flow meters shall be electromagnetic type with integral microprocessor based electronics. Meter shall have an accuracy of 1% and shall be manufactured by Onicon or equal.

Humidity Sensors

The sensor shall be a solid state, type relative humidity sensor of the bulk polymer design. The sensor element shall resist service contaminations.

Humidity transmitter shall be equipped with non-interactive span and zero adjustments, a 2 wire isolated loop powered, 4-20 mA or 0-10v, 0-100% linear proportional output.

The humidity transmitter shall provide 3% overall accuracy including lead loss and analog to digital conversion.

Outside air relative humidity sensors shall be installed with a rain proof, perforated cover. The transmitter shall be installed in a NEMA 3R enclosure with sealtite fittings and stainless steel bushings.

Transmitters shall be shipped factory pre-calibrated.

Duct type sensing probes shall be constructed of 304 stainless steel and be equipped with a neoprene grommet, bushings and a mounting bracket.

Acceptable Manufacturers: Vaisala, Mamac, Veris Alta Labs, Honeywell, General Eastern and Johnson Controls.

Power Monitoring Devices

Current Measurement (Amps)

Current measurement shall be by a combination current transformer and a current transducer. The current transformer shall be sized to reduce the full amperage of the monitored circuit to a maximum 5 amp signal which will be converted to a 4-20 mA or DDC compatible signal for use by the building automation system.

Current Transformer. Provide a split core current transformer to monitor motor amps.

Operating frequency - 50 - 400 Hz

Insulation - 0.6 kV class 10Kv BIL

UL recognized

Five amp secondary

Select current rating as appropriate for application.

Current Transducer. Provide a current to voltage or current to mA transducer. Current transducer shall include:

6X input over amp rating for AC inrushes of up to 120 amps. Manufactured to UL 1244.

Accuracy: $\pm$.5%, Ripple $\pm$1%.

Minimum load resistance 30kOhm.

Input 0-20 Amps.

Output 4-20 mA.

Status and Safety Switches

General Requirements

Switches shall be provided to monitor equipment status, safety conditions and generate alarms at the BAS when a failure or abnormal condition occurs. Safety switches shall be provided with two sets of contacts and interlock wired to shut down respective equipment.

Current Sensing Switches

Current sensing switch shall be self-powered with solid state circuitry and a dry contact output. Switches shall consist of a current transformer, a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over current up to twice its trip point range.

Current sensing switches shall be used for run status for fans, pumps, and other miscellaneous motor loads.

Freezestats:

Provide single or dual contact type as required to monitor status of each one at its associated controller through a binary input. Wire second contact through the associated air handling unit's safety circuit. Honeywell L480 type

Temperature Sensors

Provide sensors and transmitters as outlined in the input/output summary and sequence of operation. For space sensors associated with VAV box controllers, provide space sensors with local set point adjustment and override button.

FPDDC temperature sensors shall be of the resistance type and shall be either three-wire 100-ohm platinum RTD, or two-wire 1000-ohm platinum RTD. ASC temperature sensors shall be of the resistance type and shall be two-wire 20K-ohm thermistor.

The following accuracy's are required and include errors associated with the sensor, lead wire and A to D conversion:

Point Type	Accuracy
Chilled Water	± 5°F.
Room Temperature	± 1.0°F.
Duct Temperature	± .1.0°F.
All Others	± 1.0°F.

Thermowells shall be pressure rated and constructed in accordance with the system working pressure.

Thermowells and sensors shall be mounted in a threadolet or 1/2" NFT saddle and allow easy access to the sensor for repair or replacement.

Thermowells shall be constructed of 316 stainless steel.

Outside Air Sensors

Outside air sensors shall be designed to withstand the environmental conditions to which they will be exposed. They shall also be provided with a solar shield.

Temperature transmitters shall be of NEMA 3R construction and rated for ambient temperatures.

Acceptable Manufacturers

Johnson Controls, Mamac, Honeywell or Kele

OUTPUT DEVICES

Actuators

General Requirements

Electronic valve actuators shall be manufactured by the valve manufacturer or Belimo Air Controls. Each actuator shall have current limiting circuitry incorporated in its design to prevent damage to the actuator.

Provide modulating and two-position actuators as required by the sequence of operation. Actuators shall provide the minimum torque required for proper valve close-off against the system pressure for the required application. Size valve actuator based on valve manufacturer's recommendations for flow and pressure differential. All actuators shall fail in the last position unless specified with mechanical spring return in the sequence of operations. The spring return feature shall permit normally open or normally closed positions of the valves as required. All direct shaft mount rotational actuators shall have external adjustable stops to limit the travel in either direction.

Modulating Actuators shall accept 24 VAC power supply and be UL listed. Control signal shall be 2-10 VDC or 4-20 mA and actuator shall provide a clamp position feedback signal of 2-10 VDC if required.
Control Relays

Control Pilot Relays

Control pilot relays shall be of a modular plug-in design with retaining springs or clips.
Mounting bases shall be snap-mount.
Provide DPDT, 3PDT or 4PDT relays as appropriate for application.
Contacts shall be rated for 10 amps at 120VAC.

Control Valves
All automatic control valves shall be fully proportioning and provide near linear heat transfer control. The valves shall be quiet in operation and fail-safe open, closed or in their last position. All valves shall operate in sequence with another valve when required by the sequence of operation. All control valves shall be sized by the control manufacturer, and shall be guaranteed to meet the heating and cooling loads as specified. All control valves shall be suitable for the system flow conditions and close against the differential pressures involved. Body pressure rating and connection type (sweat, screwed or flanged) shall conform to pipe schedule elsewhere in this Specification.

Chilled water control valves shall be modulating plug, ball and/or butterfly as required by the specific application. Modulating water valves shall be sized per manufacturer's recommendations for the given application. In general, valves (2 or 3-way) serving variable flow air handling unit coils shall be sized for a pressure drop equal to the actual coil pressure drop, but no less than 5 PSI. Valves (3-way) serving constant flow air handling unit coils with secondary circuit pumps shall be sized for a pressure drop equal to 25% the actual coil pressure drop, but no less than 4 PSI. Mixing valves (3-way) serving secondary water circuits shall be sized for a pressure drop of no less than 5 PSI. Valves for terminal reheat coils shall be sized for a 3 PSIG pressure drop, but no more than a 5 PSI drop.

Modulating plug water valves of the single-seat type with equal percentage flow characteristics shall be used for all hot and chilled water applications except those described hereinafter. The valve discs shall be composition type. Valve stems shall be stainless steel.

Ball valves are not acceptable

Butterfly valves shall be acceptable for modulating chilled water or hot water system applications greater than modulating plug valves. In-line and/or three-way butterfly valves shall be heavy duty pattern with a body rating comparable to the pipe rating, replaceable lining suitable for temperature of system and a stainless steel vane. Valves for modulating service shall be sized and travel limited to 50 degrees of full open. Valves for isolation service shall be the same as the pipe. Valves in the closed position shall be bubble-tight.

PART 3- EXECUTION

SEQUENCE OF OPERATION:

Refer to mechanical sheets for control sequences and DDC I/O summaries

END OF SECTION 15950