**SECTION 230900 BUILDING AUTOMATION SYSTEM (BAS)**

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| **This section is a partial spec noting a Special Product Requirement for MAA. Designer shall complete the specification with information applicable to the project.**  |

1. **GENERAL**
	* + 1. BAS SYSTEM SUPPLIER REQUIREMENTS
				1. The Contractor, through the use of an Automatic Temperature Control (ATC) System Supplier, shall furnish, install, and place into service the complete heating, ventilating, and air conditioning (HVAC) monitoring and control system, all in accordance with the requirements of the Contract Documents. The HVAC monitoring and control system shall communicate with the existing Baltimore/Washington International Thurgood Marshall Airport (BWI Marshall) Facility Management System (FMS)/Building Automation Systems (BAS).
				2. The System Supplier shall assume and execute full responsibility to select, furnish, install and connect, test and calibrate, place into operation all specified components, assemblies, and accessories needed for a complete and functional system of HVAC monitoring and control in full compliance with the requirements of the specification.
				3. The system supplier shall be a single firm, or corporation subcontracted by the Contractor to assume full responsibility to perform all engineering, to select, furnish, and place into operation, a complete and functional system of HVAC monitoring and control. Acceptable System Supplier shall be “Factory Branch Office” of the following:

**Johnson Controls, Inc., 60 Loveton Circle, Sparks, Maryland – (Eric Badders at: telephone 410-527-2607).**

Other bids by wholesalers, contractors, and franchised dealers are not acceptable.

* + - 1. BAS SYSTEM DESCRIPTION:
				1. The existing Baltimore/Washington International Thurgood Marshall Airport (BWI Marshall) Building Automation System is a Johnson Controls Metasys System.
				2. The BAS System shall be Metasys system consisting of BACnet MS/TP direct digital controls as manufactured by Johnson Controls, utilizing electric actuation. A minimum of one (1) Network Automation Engine (NAE) shall be installed as a web-based extension to the existing Metasys ADX server network. A “Facility Explorer”, FX controller, or NCM-based system is unacceptable.
				3. Communications: The Building Automation Contractor shall be responsible for full communications to the existing BWI Marshall Metasys network. Full communications means, the BWI Marshall facility operators will be able, from the existing Metasys operator workstations, to fully utilize the Metasys network manager software. The FMS operator will be able to receive alarms, logs, and reports; monitor operating conditions; change control setpoints and operating schedules; and, operate equipment as desired at all existing Metasys operator workstation locations.
			2. LIGHTING CONTROL SOFTWARE DESCRIPTION
				1. Provide lighting control software/programming at Metasys and at each lighting control panel. Prior to start of programming work, request a lighting control schedule from the MAA. This schedule will dictate default on and off control of lights on a per day basis. Do not proceed until the approved schedule is obtained from the MAA. Provide a menu driven selection screen that will allow the following:

Monitoring of the corridor and holdroom lighting zone on/off status.

Individual control of each lighting zone.

* + - 1. SUBMITTALS
				1. General: Submit each item in this Article according to the Conditions of the Contract and General Specification Sections.
				2. Product Data for each type of product specified. Include manufacturer's technical Product Data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials, installation instructions, and startup instructions.
				3. Shop Drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection. Submit damper leakage and flow characteristics, plus size schedule for controlled dampers.
				4. Provide the following information for each control system:

Schematic flow diagram showing pumps, fans, coils, dampers, valves, air flow
measurement devices, and control devices.

Each control device labeled with setting or adjustable range of control.

Diagrams for all required electrical wiring. Clearly differentiate between factory‑installed! and field-installed wiring.

Details of control panel faces, including controls, instruments, and labeling.

Written description of sequence of operation.

Trunk cable schematic showing programmable control unit locations and trunk data conductors.

Listing of connected data points, including connected control unit and input device.

System graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.

Software description and sequence of operation.

System configuration showing peripheral devices, diagrams, and interconnections.

* + - * 1. Wiring diagrams detailing wiring for power, signal, and control systems and differentiating clearly between manufacturer-installed and field-installed wiring.
				2. Maintenance data for control systems equipment to include in the operation and maintenance manual. Include the following:

Maintenance instructions and spare parts lists for each type of control device.

Interconnection wiring diagrams with identified and numbered system components and devices.

Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.

Calibration records and list of set points.

* + - * 1. Field Test Reports: Procedure and certification of pneumatic control piping system.
				2. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors. Revise Shop Drawings to reflect actual installation and operating sequences.
			1. QUALITY ASSURANCE
				1. Startup Personnel Qualifications: Engage specially trained personnel in direct employ of manufacturer of primary temperature control system.
				2. Comply with NFPA 90A.
				3. Comply with NFPA 70.
				4. Comply with ASHRAE 135 for DDC Components.
			2. DELIVERY, STIORAGE, AND HANDLING
				1. Store equipment and materials inside and protected from weather.
				2. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping control devices to unit manufacturer.
			3. WARRANTY
				1. Standard Material and Labor Warranty:

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

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.

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.

Maintain an on-site record of all work done, all items removed from site, all items returned to site, all new replacement items installed and all remedial programming and database entry work undertaken including software revisions installed. Maintain a record of all calibrations required as a result of Warranty service.

1. **PRODUCTS**
	* + 1. MANUFACTURERS
				1. Johnson Controls, Inc., Loveton Circle, Sparks, Maryland (telephone: 410-527-2607). Contact Person: Erik Badders.
			2. GENERAL PRODUCT DESCRIPTION
				1. The Building Automation System shall be capable of integrating multiple building functions including equipment supervision and control, alarm management, energy management, information management, and historical data collection and archiving.
				2. The Building Automation System shall consist of the following:

Standalone DDC panels.

Local Display Devices.

The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, standalone DDC panels, and operator devices.

* + - * 1. System architectural design shall eliminate dependence upon any single device for alarm reporting and Control execution. Each DDC panel shall operate independently by performing its own specified control, alarm management, operator I/O, and historical data collection. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.
				2. Standalone DDC panels shall be able to access any data from, or send control commands and alarm reports directly to any other DDC panel or combination of panels on the network without dependence upon a central processing device, including a Central File Server. Standalone DDC panels shall also be able to send alarm reports to multiple operator workstations, terminals, and printers without dependence upon a central processing device or File Server.
			1. CONTROLS SYSTEM ARCHITECTURE
				1. General:

The Controls Systems shall consist of multiple Nodes and associated equipment connected by industry standard digital and communication network arrangements.

The Operator 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.

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

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

Operator Workstations: Fixed and portable as required by the Specifications.

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

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

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

Addressable elements, sensors, transducers and end devices.

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

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

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 Authority Having Jurisdiction (AHJ) at the site, and to meet all requirements of the Contract Documents.

* + - * 1. Network:

The Controls Systems shall incorporate primary Tier 1 network(s) and also incorporate multiple and integrated secondary Tier 2 and tertiary Tier 3 networks.

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.

Dial-up Communications: Auto-dial/auto-answer communications shall be provided to allow standalone DDC panels to communicate with remote operator devices on an intermittent basis via telephone lines.

* + - 1. OPERATOR INTERFACES
				1. General:

The Controls Systems Operator Interfaces shall be user friendly, readily understood and shall make maximum use of colors, graphics, icons, embedded images, animation, text-based information and data visualization techniques to enhance and simplify the use and understanding of all displays by authorized users at the OWS.

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

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

User access for selective information retrieval and control command execution.

Monitoring and reporting.

Alarm and non-normal condition annunciation.

Selective operator override and other control actions.

Information archiving, manipulation, formatting, display and reporting.

Controls Systems internal performance supervision and diagnostics.

On-line access to user HELP menus.

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 MAA personnel.

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.

Means to archive all Controls Systems Contract Project specific configuration databases, software programs and other pertinent operational data such that any component of the software and project specific operational databases may be reloaded on-site from archived data.

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. Submit proposed naming arrangements for approval prior to data entry.

* + - * 1. All devices, including Servers and Application Nodes, required to support and drive the Operator Interfaces shall support multiple independent user terminals through a theoretical unlimited number of Browsers. Support shall be configured for a minimum of 25 users for all Applications and features provided.
			1. CONTROLS SYSTEMS APPLICATIONS – GENERAL
				1. General:

The Controls Systems Application Nodes (AN) shall include all monitoring, control and data handling Nodes including programmable field panels and controllers.

AN shall be programmable and governed by the requirements of their applicable codes, approvals and regulations for their Application.

The AN shall be designed, packaged, installed, programmed and commissioned in consideration of their specific service and prevailing operating conditions.

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

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

AN shall comply with FCC Part 15 subpart J Class A emission requirements.

AN shall maintain all programming in non-volatile or battery backed memory and shall automatically resume normal monitoring and control following the restoration of stable electrical power after a power outage.

* + - 1. NETWORK AUTOMATION ENGINE (NAE)
				1. Description:

The NAE is an automation engine that manages facilities using information and Internet technology.

The NAE uses the communication technologies of the building automation industry, including BACnet® protocol; LONWORKS® network and the N2 Busto monitor; and supervise Heating, Ventilating, and Air Conditioning (HVAC) equipment; and lighting, security, fire, and access control. The NAE55 supports a comprehensive set of supervisory features and functions for large facilities and technically advanced buildings and complexes. The NAE35 and NAE45 extend the power of the NAE to smaller buildings and enable the wider distribution of supervisory functions in larger facilities. The NAE85 is a high-capacity NAE. This device allows the integration of large BACnet Internet Protocol (IP) systems and can take the place of multiple NAEs.

A single NAE or a network of multiple NAE devices within a building provide monitoring and control, alarm and event management, data exchange, trending, energy management, scheduling, and data storage.

The NAE has an embedded user interface and supports concurrently connected Web browsers with password access control and the security protection technology of the Information Technology (IT) industry.

Features::

Communication using commonly accepted IT standards at the automation and enterprise level.

Web-based user interface.

Site Director function.

Support for Web services at the automation network level.

User interface and online system configuration software embedded in NAE.

Supervision of field controller networks including N2 Bus, LonWorks network, BACnet MS/TP, and BACnet IP devices.

Multiple connection options for data access.

* + - 1. APPLICATION AND DATA SERVER (ADS)
				1. Description:

The Application and Data Server (ADS) is a component of the Metasys system that manages the collection and presentation of large amounts trend data, event messages, operator transactions, and system configuration data. As Site Director, the ADS provides secure communication to a network of Network Automation Engines (NAEs), Network Control Engines (NCEs), and Network Integration Engines (NIEs).

The User Interface (UI) of the ADS provides flexible system navigation, user graphics, comprehensive alarm management, trend analysis, and summary reporting capabilities. Via a Web browser, occupant comfort and energy usage can be efficiently managed and quickly responded to during critical events., Multiple users can gain access to information from the Building Automation System! (HAS) that uses Internet protocols and Information Technology (IT) standards, and is compatible with enterprise level communication networks.

Features:

Support of IT Standards and Internet Technologies.

Standard Web Browser User Interface.

Secure User Access.

Flexible System Navigation and Dynamic User Graphics.

Alarm and Event Management.

Site Director Function.

Long-Term Trend Data Storage.

Optional Storage of Historical Data on a Separate Computer.

Optional Metasys Advanced Reporting System.

* + - 1. NETWORK INTEGRATION ENGINE (NIE)
				1. Description:

The Metasys® Network Integration Engine (NIE) integrates existing Metasys N1-based Building Automation Systems (BASs) into the new generation of technology that includes the Internet, Information Technology (IT), and enterprise level global communication. Metasys system extended architecture NI Integration is based on the NIE, a Web-enabled network controller that speaks IT and Internet language to the expanding world of Web browsers and remote operations centers. At the same time, it uses Internet Protocol (IP) Ethernet network technology to communicate with Metasys N1 networks that are installed in many facilities including BWl Marshall Airport.

The NIE transfers point data from one or more Network Control Module (NCM) devices in a Metasys NI network, providing alarm and event management, trending, energy management, scheduling, and data sharing capabilities in a manner consistent with the new technology of Metasys system extended.

Features:

Communication with NI Networks using commonly accepted IT standards at the automation and enterprise levels.

Web-based user interface.

User interface and online system configuration software embedded in NIE.

Site Director function in one NIE or one NAE or in an Application and Data Server (ADS) for large installations.

Scalable system integration solution for integrating and migrating Metasys N1 networks.

Mapping capability of N1 data 'types including analog, binary, multistate and control system objects, and access to scheduling feature.

Trending, totalization, and alarming functions automatically regenerated in the METASYS system extended architecture.

* + - 1. SYSTEM SOFTWARE FEATURES
				1. General

All necessary software to form a complete operating system as described in this specification shall be provided.

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

* + - * 1. Graphics Display: Color graphic floor plan displays and system schematic for each piece of mechanical equipment shown on plans shall be provided. Provide a color graphic floor plan for all floors to show the on/off status of lighting zones.
				2. Alarm Management: Alarm management shall be provided to monitor, buffer, and direct alarm reports to operator devices and memory files. Each DDC panel 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 DDC panel's ability to report alarms be affected by either operator activity at a PC Workstation or local I/O device, or communications with other panels on the network.

Point Change Report Description: All alarm or point change reports shall include the point's description in English language, and the time and date of occurrence.

Prioritization: The user shall be able to define the specific system reaction for each point. Alarms shall be prioritized to minimize nuisance reporting and to speed operator response to critical alarms. A minimum of three priority levels shall be provided. Each DDC panel 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. The user shall also be able to define under which conditions point changes need to be acknowledged by an operator, and/or sent to follow-up files for retrieval and analysis at a later date.

Report Routing: Alarm reports, messages, and files will be directed to a user-defined list of operator devices or PC disk files used for archiving alarm information. Alarms shall also be automatically directed to a default device in the event a primary device is found to be off-line.

Alarm Messages: In addition to the point's descriptor and the time and date, the user shall be ,able to print, display or store a 65-character alarm message to more fully describe the alarm condition or direct operator response. Each standalone DDC panel shall be capable of storing a library of at least 250 Alarm Messages. Each message may be assignable to any number of points in the panel.

Auto-Dial Alarm Management: In Dial-up' applications, only critical alarms shall initiate a call to a remote operator device. In all other cases, call activity shall be minimized by time-stamping and saving reports until an operator scheduled time, a manual request, or until the buffer space is full. The alarm buffer must store a minimum of 50 alarms.

Transaction Logging: Operator commands and system events shall be automatically logged to disk in Personal Computer industry standard database format. Operator commands initiated from Direct-connected workstations, dial-up workstations, and local DDC panel Network Terminal devices shall all be logged to this transaction file. This data shall be available at the Operator Workstation. Facility shall be provided to allow the user to search the transaction file using standard database query techniques, including searching by dates, operator name, data point name, etc. In addition, this transaction file shall be accessible with standard third party database and spreadsheet packages.

* + - * 1. Historical Data and Trend Analysis: A variety of Historical data collection utilities shall be provided to automatically sample, store, and display system data in all of the following ways:

Continuous Point Histories: Standalone DDC panels shall store Point History Files for all analog and binary inputs and outputs. The Point History routine shall continuously and automatically sample the value of all analog inputs at half hour intervals. Samples for all points shall be stored for the past 24 hours to allow the user to immediately analyze equipment performance and all problem-related events for the past day. Point History Files for binary input or output points and analog output points shall include a continuous record of the last ten status changes or commands for each point.

Control Loop Performance Trends: Standalone DDC panels shall also provide high resolution sampling capability in one-second increments for verification of control loop performance.

Extended Sample Period Trends: Measured and calculated analog and binary data shall also be assignable to user-definable trends for the purpose of collecting operator-specified performance data over extended periods of time. Sample intervals of 1 minute to 2 hours shall be provided. Each standalone DDC panel shall have a dedicated buffer for trend data, and shall be capable of storing a minimum of 5000 data samples.

Data Storage and Archiving: Trend data shall be stored at the Standalone DDC panels, and uploaded to hard disk storage when archival is desired. Uploads shall occur based upon either user-defined interval, manual command, or when the trend buffers become full. All trend data shall be available in disk file format compatible with Third Party personal computer applications.

* + - * 1. Runtime Totalization: Standalone DDC panels shall automatically accumulate and store runtime hours for binary 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 Runtime Totalization.

Unique, user-specified messages shall be generated when the limit is reached.

* + - * 1. Analog/Pulse Totalization: Standalone DDC panels shall automatically sample, calculate and store consumption totals on a daily, weekly, on monthly basis for user-selected analog and binary pulse input-type points.

Totalization shall provide calculation and storage of accumulations of up to 99,999.9 units (e.g., KWH, gallons, KBTU, 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.

* + - * 1. Event Totalization: Standalone DDC panels shall have the ability to count events such as the number of times a pump or fan system is cycled on and off. Event totalization shall be performed on a daily, weekly, or monthly basis.

The Event Totalization feature shall be able to store the records associated with a minimum of 9,999,999 events before reset.

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

* + - 1. CONTROL SYSTEMS FIELD DEVICES
				1. Input Devices: Provide controls systems devices as required for each specific project. The following is a list of major devices. Provide additional devices and instrumentation as required.

Air Low Differential Pressure Switch.

Air Low Differential Pressure Sensor.

Air High Differential Pressure Switch.

Water Differential Pressure Switch.

Temperature Sensors.

Humidity Sensors.

Air Flow Switch.

Water Flow Switch.

Current Switch.

Current Transducer.

Static Pressure Transmitter/Transducer.

Differential Pressure Transmitters/Transducer.

Water Pressure Transducers.

Water Differential-Pressure Transducers.

Differential-Pressure Switch (Air or Water).

Room Sensor Covers.

Room Sensor Accessories.

* + - * 1. Output Devices:

Electric/Pneumatic Transducers.

Controls Relays.

* + - * 1. Controlled Devices:

Ball Valve.

Butterfly Valve.

Globe Valve.

Control Damper.

Electric Damper Actuators.

Electric Valve Actuators.

Pneumatic Valve Actuators.

Pneumatic Damper Actuators.

Combination Fire/Smoke Dampers w/Actuator.

Smoke Dampers.

Status Sensors:

Status Inputs for Fans.

Status Inputs for Pumps.

Status Inputs for Electric Motors.

Voltage Transmitter (100- to 600-V ac).

Power Monitor.

Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

Gas Detection Equipment:

Carbon Monoxide Detectors.

Carbon Dioxide Sensor and Transmitter.

Occupancy Sensor.

Other Control Devices:

Electric Thermostats.

Humidistats.

Pressure Controller.