

For Reference Only - This is a sample SOW based on a project currently in process

Install Monitors for Indoor Environmental Quality

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1. Introduction and Background

The Buildings Technology Services (BTS) Division in PB-ITS was established as a response to the IT security concerns related to Building Management Control (BMC) systems, as well as to develop and implement a program that established cross-functional standards, guidance, and resources for the PBS Regions. These industry-tested standards and federally regulated program requirements would enable the Regions to address their business requirements while leveraging the use of GSA’s enterprise network to acquire capital and operational cost efficiencies. The BTS program, in partnership with GSA IT Security, the Office of Federal High Performance Buildings and the PBS Office of Facilities Management (OFM), is at the forefront of assessing and managing the risk posed by BMC systems (hardware and software) components. The BTS Division has taken the cross-functional lead in working with all GSA IT groups, Facilities Management, Design & Construction, Contracting & Procurement, and the Regions to develop standards and processes and to allocate resources for the integration, operation, and support of BMC systems.

The Office of Federal High-Performance Buildings conducts research to improve knowledge of how indoor environments influence the health and performance of the occupant's of GSA's portfolio. IEQMS are used to gather the objective data necessary for this research. This data consists of minute by minute recordings of environmental conditions for the interior spaces and the immediate exterior of buildings as described in tasks issued under the BPA. Generally these include thermal comfort parameters Temperature (T) and Relative Humidity (RH); environmental quality parameters vertical illuminance (VI), horizontal illuminance (HI), sound levels (dBA), and pressure; and, the air quality parameters particulate matter (PM1.0, PM2.5, and PM10) and Total Volatile Organic Compounds (TVOC). All air quality monitoring components shall meet requirements outlined in the most recent version of the RESET™ Air Accredited Monitor Standard for High Performance Indoor Air Quality.

In line with these program objectives, GSA requests a quote for installation by a qualified contractor *for monitoring indoor environmental quality* using a new sensor network system aligned with the Buildings Automation System in use at the XXX Federal Building.

2. Scope of Work

2.1 System Description

- A. The contractor shall install an Indoor Environmental Quality Monitoring System (IEQMS) including the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned in these Division documents which are required for a complete, fully functional and commissioned IEQMS meeting the specified sequence of operation. The system shall provide IEQ data to the building automation system through the end of the current Operations and Maintenance Contract and include costs of any required maintenance or calibration to meet operating standards defined in paragraph B.
- B. Provide networking to new IEQMS equipment using one of the following “Fully Open BAS” communication standards and protocols listed within this section.
 - The IEQMS shall use native BACnet MS/TP, BACnet TCP/IP architecture and be in strict accordance with ANSI/ASHRAE Standard 135-2010. All controllers shall be BACnet Testing Labs (BTL) Certified. All BACnet points shall only use native BACnet BTL Certified standardized PICS (Protocol Implementation Conformance Statement) and BIBBS (BACNET

Interoperability Building Blocks). 100% of the physical and virtual points shall be programmed as BACnet Objects and Events without any exceptions.

- For repairs and/or upgrades of existing LON systems: The IEQMS shall have a fully compliant LonMark® Certified LNS LonWorks architecture that utilizes the ANSI/CEA 709.1. The entire system network shall be a Local Operating Network (LON) and installed by LonMark® Certified Technicians during Installation. All nodes shall communicate with each other utilizing ANSI/CEA 709.1 Controllers shall be capable of sharing SNVT (standard network variable type) data with other LON-based devices. The system will consist of a flat, open architecture that utilizes the ANSI/CEA 709.1 (LonTalk™) Protocol as the common communication protocol between all controlled and controlling devices. Where necessary or desired, LonTalk packets may be encapsulated into TCP/IP messages to take advantage of existing infrastructure or to increase network bandwidth. Hierarchical systems consisting of master or global controllers that poll and/or control less intelligent unitary controllers on a secondary bus will not be considered. Any new devices and their protocol shall be the same as the overall system installed currently in the building, unless otherwise directed by task order requirements. For example, lon devices for lon BAS systems, BACnet devices for BACnet BAS etc. New devices and software versions shall be backwards-compatible with the previously installed BAS devices.
 - Sensor devices, and applicable network components, shall meet minimum requirements as set forth by the most recent version of the RESET™ Air Accredited Monitor Standard. The contractor will deploy sensors providing monitoring of Temperature (T), Relative Humidity (RH), CO2, counts of fine Particulate Matter 2.5 microns or less (PM2.5), Vertical Illuminance (VI) and sound level (dBA) as indicated below. Sensors shall be laid out as described below and as depicted on the IEQ Monitoring Plan:
 - Sensor monitoring T, RH, CO2, and Sound Level in:
 - Every 2,000SF of open office space
 - Every conference or other meeting room
 - 20% sample of Private Offices (at direction of local leadership)
 - Sensor monitoring PM 10 and PM 2.5 in:
 - One open office location on each floor of the three wings of the Federal Building (can be combined with open office sensor above)
 - Every print/copy, kitchen, and break room
- C. System shall be programmed for interoperability with smart equipment and program applications such as National Computerized Maintenance Management System (NCMMS), GSA Smart Building Application - GSALink, and GSA integration

applications. The system shall conform to the reference GSA Data Normalization for Building Automation Systems and the GSA National BAS Object Naming and Tagging Standard.

- D. The system and sensor installer shall be responsible for all electrical work associated with the IEQMS. This includes but is not limited to government furnished equipment (GFE) such as switches, routers, GSA BAS consoles, or other specific equipment as defined by task order requirements. Controls installer shall use the Telecommunications Distribution Design Guide V8, Building Technologies Technical Reference Guide v 1.2, and standard low voltage wiring standards as they apply to BAS and other controls systems.
- E. System requirements may require an extension of an existing control system. Specific task order requirements shall define and allow for such extensions where permissible.
- F. All deliverables, including materials, equipment, software, and hardware, associated with this BPA shall be fully turned over to the government for ownership, management, and control. This includes administration tools and/or passwords.

2.2 Work Included

- A. The installation of the IEQMS shall be performed under the direct supervision of the sensor manufacturer or manufacturer authorized representative with the shop drawings, flow diagrams (including all proposed shared variables between controllers), bill of materials, component designation, or identification number and sequence of operation all bearing the name of the manufacturer. Installation by a consultant who is a professional engineer or RESET Accredited Professional may be substituted on certain task orders where identified initially in the contractor's proposal and approved by the contracting officer.
- B. Furnish a complete distributed IEQMS in accordance with this specification section. This includes all system controllers, logic controllers, and all input/output devices.

2.3 Submittals

- A. Provide a complete submittal with all controls system information for approval before installation starts. The "Authorization Boundary Diagram," the "Data Flow Diagram," and the "Network Architecture Diagram" described below can be condensed into a single diagram provided all requirements are shown on the document. Include the following:

- a. Monitoring Installation Plan which shows the location and type of device to be installed on the floorplans for the second and third floors of Federal Building. The monitoring installation plan will be reviewed with GSA and tenant leadership for approval prior to installation and the monitoring plan updated and maintained with device identification numbers after installation.
- b. Points list for each sensor and other devices including but not limited to gateways, hubs, and other local network communications devices. List will include both inputs and outputs (I/O), point numbers, controlled device associated with each I/O point, device operating range, device setpoint (if applicable), and device location.
- c. Network Diagrams (as required by Telecommunications Design and Distribution Guide - TDDG) showing IP connected devices and GSA Network switch connections. At a minimum the Network Diagram shall document:
 - a. Number of IP addresses required and if public or private IP addresses are needed for devices on premise
 - b. List communication ports to be used
 - c. List communication protocols to be used
 - d. List IP addresses of any cloud servers
- d. An Authorization Boundary Diagram providing detailed and explicit definition of the system authorization boundaries.
- e. A Data Flow Diagram which documents the flow of data, describes protections implemented at all entry and exit points, and identifies any internal controls between administrator and end users. The data flow diagram shall outline the format (csv files) and organization (sensor naming conventions) used to store data.
- f. A Network Architecture Diagram which allows third parties to easily identify hardware, software, and network inventories for the project.
- g. Protocols and Services document which lists all ports, protocols, and services used by the system in table format.
- h. Building Recovery (BR) Documentation (in support of local access to the BAS Supervisory or Field Controller system in case of loss of communications to the GSA Network for continued control of the site.

Loss of communication can result from many causes, including disruption to the virtual server communications).

- B. Once the system is deployed, an 'as-built' network diagram must be provided.
- C. Submit a sample of each physical sensing or communication device intended to be connected to the GSA Network directly for a risk assessment by GSA's Device BMC Lab. The assessment process will require 60 days or as specified in each individual task order. The contractor will remediate any "findings" presenting greater than "low" risk prior to any connection to GSA's network and submit for reassessment. Contractors shall complete remediations identified in the initial and subsequent assessments within 120 days. The process steps and all detailed submission requirements for the risk assessment are documented in the [IT Security Procedural Guide: Building Automation Systems Security Assessment Process](#). Note: all devices meeting protocol for direct connection to an existing GSA BAS (2-wire, BACnet/MSTP enabled devices) do not require a security scan.

2.4 Warranty

- A. Conform to the warranty requirements of the Contract Documents, General Requirements and this section or a minimum of 12 months. Provide the strictest Warranty that shall cover all costs for parts, labor, associated travel, and expenses for a period of one year from completion of system demonstration.
- B. All warranty documentation shall be provided to the Government for review and approval prior to contract or task order award(s). The Government reserves the right to review warranty conditions prior to acceptance.
- C. Warranty period commencement shall be defined within task order requirements. Therefore, material purchase date(s) shall be closely coordinated with government CO/COR for approval prior to purchase.
- D. Requirements for Service Maintenance Agreements (SMAs) for software subscriptions shall be defined within task orders. Specific requirements shall define minimum acceptable time frames for labor and warranty periods allowable by the government.

2.5 Training

- A. Training support for personnel, supplies, manuals, documentation, lesson plans, recordings, and/or other supporting materials shall be provided.

- B. Training may be provided for GSA representatives, as well as GSA contractors, such as O&M contract staff.
- C. All training schedules shall be coordinated with the GSA. Attendance sheets of the trainees shall be recorded for each session and approved by attending GSA representative.
- D. Training requirements shall be defined by task orders. Specific requirements may include, but is not limited to, operational training on system and sensor function, data collection and evaluation, recording of training, and submittal requirements for hard copy and/or digital training materials.
- E. Training curriculum shall be defined by task order requirements.

2.6 Travel

All travel costs associated with the performance of this BPA shall be reimbursed in accordance with the Federal Travel Regulations (FTR).

- A. Contract support to execute work must be within driving distance of the work site. Acceptable driving distance shall be defined within individual task orders by the Government.
- B. Government shall review for approval to travel outside of driving distance in advance of travel. Costs incurred for transportation and per diem (lodging, meals and incidental expenses) will be billed in accordance with the regulatory implementation of Public Law 99-234, FAR 31.205-46 Travel Costs, and the contractor's cost accounting system. Unless approved by the Government, the Contractor shall be responsible for additional incurred travel costs for contract support outside of driving distance.

3. Products

Devices installed under this contract become U.S. Government property.

3.1 Acceptable Systems

- A. As applicable, IEQ sensors shall meet RESETTM Air Accredited Monitor requirements at a minimum. Sound level meters shall meet ANSI Standard S1.4 or meet the following minimum requirements or better: sensing range of 30 to 120 dBA, accuracy of +/- 5%, and record data in at 1 min intervals or less.

3.2 IEQMS Network

- A. All networked control products provided for this project shall be comprised of an industry standard open protocol network. Communication involving control components (i.e. all types of controllers and operator interfaces) shall conform to task order requirements for standards. Networks and protocols proprietary to one company or distributed by one company are prohibited.
- B. For BACnet devices: Coordination and implementation of all UDP ports, Instance numbers MSTP Instance numbers and network numbers are to be defined by specific task order requirements. Any device whether BACnet/IP or BACnet/MSTP that does not have changeable udp ports, instance or network numbers (hard coded) will not be acceptable.
- C. Access to system data shall not be restricted by the hardware configuration of the building management system. The hardware configuration of the BMS network shall be totally transparent to the user when accessing data or developing control programs.
- D. The network architecture shall consist of three levels of networks:
 - 1 The Management level shall utilize BACnet/IP over Ethernet along with other standardized protocol, such as web services, html, JAVA, SOAP, XML, etc., to transmit data to non-IEQMS software and databases.
 - 2 The Automation level network shall be BACnet/IP over Ethernet. It shall network the Automation Server, Operator workstations, and BAS components.
 - 3 The Floor level network shall be BACnet over MS/TP. It shall network to all BAS equipment on a floor or in a system and network to a router that connects to the Automaton level BAS backbone.
- E. The Building Level Controllers shall be able to support subnetwork protocols that may be needed depending on the type of equipment or application. The system installed shall seamlessly connect devices other than HVAC throughout the building regardless of subsystem type, i.e. HVAC, lighting, renewable, and Metering devices should easily coexist on the same network channel without the need for gateways.
- F. Task order requirements shall outline minimum sensor device count and spare capacity on each subnetwork for the addition of future sensors.

3.3 Building Automation Server and Workstation Hardware

- A. All IEQMS components shall reside on the GSA Building Systems Network (BSN)
- B. All network managed switches shall be provided by GSA.
- C. There shall be NO vendor provided switch, hub, or router allowed in any part and in any connection configuration to the IEQMS.

- D. The IEQMS server shall be Government Furnished Equipment (GFE) provided by GSA as a virtual server. NO physical servers or non-GFE will be provided nor allowed.
- E. IEQMS workstation, known as a IEQ console, shall be provided by GSA and will likely be the same as the BSN console for the local BAS. The BSN console shall be the only on-site physical access (via GSA Supplied BSN Console laptop) to the system unless otherwise approved by GSA. System shall be accessible for virtual (remote) access via the GSA network with approved system access.
- F. Contractor is responsible for mounting all network equipment per GSA specification. Contractor is responsible for providing all mounting hardware and peripherals.
- G. Contractor shall not connect company or personnel laptop or hand held device to the GSA network in any fashion.
- H. Contractor shall design and install a system to operate as ‘stand-alone’ with graphics and control software tools on the IEQMS server as well as local workstation. Stand-Alone is defined as retaining all logic at the sensor level so network outages do not impact the operation of the respective controller. Process for operation and system setup shall be documented in Building Recovery (BR) submittal and shall be included in system operation training.

3.4 Building Network Controllers

- A. The Network Controller/Network Engine shall act as the point of convergence for all building sub-system controls.
 - 1. IP network architectures must be explicitly designed and coordinated per requirements of the Buildings Technologies Technical Reference Guide (BTTRG). Approval is required by PB-ITS and Regional Smart Building Point of Contact (POC).
 - 2. No IP infrastructure should be installed without prior approval of the design by GSA IT.
 - 3. Systems shall not directly be connected to the GSA’s enterprise network. They will be logically segregated as part of the Building Systems Network (BSN) design. This entails logical separation of network controllers and sensors utilizing network security controls.
- B. The Network Controller shall communicate BACnet/IP and be compliant with the latest version of ASHRAE 135. Network controllers shall be tested and certified by BACnet Testing Labs (BTL). Alternatively, as it applies to pre-existing LonWorks systems, all nodes shall communicate with each other utilizing ANSI/CEA 709.1 and fully comply with LonMark® Certified LNS LonWorks architecture.

- C. Network Controllers shall be capable of storing schedules, trending, alarms, and system graphics. A sufficient number of Network Controllers shall be supplied to fully meet the requirements of the project specifications.
- D. The Network Controller shall be capable of executing application control programs to provide
 - 1. Calendar Functions
 - 2. Scheduling
 - 3. Trending
 - 4. Alarm Monitoring and Routing, via GSA approved notification method.
 - 5. Time Synchronization
 - 6. Native integration of BACnet controller, Modbus controller, and LonWorks controller data.
- E. Hardware Specifications shall be defined within task order requirements.
- F. The Network Controller shall employ a modular I/O design to allow expansion. Input and Output capacity is to be provided through plug-in modules of various types.

3.5 Field Bus Controllers

- A. Field Controllers shall communicate to the Network Controller via BACnet MS/TP or fully compliant with ANSI/CEA 709.1 (LonTalk™) Protocol. For LonWorks systems, where necessary, TCP/IP may be used with government approval.
- B. Field Controllers shall have LED indication indicating that they are powered
- C. Field Controller shall be locally powered. Link power devices (power is furnished from a central source over the field bus cable) are not acceptable.
- D. Application programs shall be stored in a manner such that a loss of power does not result in a loss of the application program or configuration parameters settings
- E. Controllers shall store their application programming and configuration data in flash memory. If using a battery to retain memory, a ‘low battery’ notification alarm both visually on the controller and logically to the building automation server is mandatory.
- F. Field controllers must be configurable with “free programming” and not completely pre-configured with block programming functions
- G. Field Controllers must be completely open and all points must be 100% exposed for any other vendor to use.
- H. Task orders shall define all logic requirements that are crucial to troubleshooting the system.
- I. All setpoints are to be exposed to the building automation server.

- J. All control loops shall be fully tuned to maintain steady state of the controlled system. Task order may require system service tool software to be installed.
- K. Specific use or need for override switches shall be defined within task order requirements.

3.6 Sensing and Other Peripheral Devices

All sensor devices meet the minimum standards set by the most recent version of RESET™ Air Accredited Monitor Standard where applicable or other task order requirements if more stringent. Specific requirements for occupancy sensors including motion sensors, sound level sensors and other devices will be discussed in individual task orders. All peripheral devices become GSA property after installation.

Peripheral devices must reside on controls network and must have WiFi capability locked out except where approved by GSA IT. In order to avoid the necessity of remediating the device for security purposes by GSA IT. Individual task orders may allow for peripheral devices to undergo hardening to address cybersecurity policies for specific projects, including WiFi capabilities. GSA's preference is for WiFi connected devices to report data directly to local BAS using a hub or gateway device hardwired to an on-premises network server as described in section 3.3. Where it is deemed acceptable, alternative processes for cloud devices will use one of the following approaches:

- L. For all environmental sensing applications using a cloud solution that are not classified as 'low impact', the vendor or consultant must have their application reviewed and approved through the Federal Risk and Authorization Management Program (FedRAMP) prior to installing any devices. Details on FedRAMP compliance can be found at: <https://www.fedramp.gov/>
- M. Under certain circumstances, environmental sensing applications may use FedRAMP Tailored for Low-Impact Software-as-a-Service (LI-SaaS) processes and protocols. The intent to make use of LI-SaaS must be stated in the proposal, all data collected and stored must be classified as "low-impact" by the Government, and it may only be used for a period not to exceed one year while in transition to full FedRAMP certification.

4.0 Execution

4.1 Contractor Responsibilities

- A. General

1. Installation of the building automation system shall be performed by the Contractor or a subcontractor. However, all installation shall be under the personal supervision of the Contractor. The Contractor shall certify all work as proper and complete. Under no circumstances shall the design, scheduling, coordination, programming, training, and warranty requirements for the project be delegated to a subcontractor. !

B. Demolition

1. Remove controls which do not remain as part of the building automation system, all associated abandoned wiring and conduit, and all associated pneumatic tubing. The Owner will inform the Contractor of any equipment which is to be removed that will remain the property of the Owner. All other equipment which is removed will be disposed of by the Contractor.
2. Regional task orders shall specify additional requirements that allow for the region to retain demolition items, as needed, per task order.

C. Site Access

1. Unless notified otherwise, entrance to the building is restricted. No one will be permitted to enter the building unless their names have been included on project 'Requesting Official Contractor Approval List' (ROCOL) and all necessary HSPD-12 clearance has been obtained.
2. Contractor shall not rely on the local O&M or local security officers to provide escorted service to the building during the time of obtaining HSPD-12 clearance. Exceptions for limited or short term access shall be coordinated with the government for appropriate approval.

D. Code Compliance

1. All wiring shall be installed in accordance with all applicable electrical codes and will comply with equipment manufacturer's recommendations. Should any discrepancy be found between wiring specifications in Division 17 and Division 16, wiring requirements of Division 17 will prevail for work specified in Division 17.

E. Clean Up

1. At the completion of the work, all equipment pertinent to this contract shall be checked and thoroughly cleaned, and all other areas shall be cleaned around equipment provided under this contract.
2. GSA IT equipment (BAS old consoles, switches etc) and old BAS controllers shall be returned to the GSA Building Manager for proper, secure disposal and/or possible re-use.

4.2 Wiring, Conduit, and Cable

- A. All wire will be copper and meet the minimum wire size and insulation class listed below:

Wire Class	Wire Size	Isolation Class
Power 1	2 Gauge	600 Volt
Class One	14 Gauge Std.	600 Volt
Class Two	18 Gauge Std.	300 Volt
Class Three	18 Gauge Std.	300 Volt
Communications	Per Mfr.	Per Mfr.

- B. Power and Class One wiring may be run in the same conduit. Class Two and Three wiring and communications wiring may be run in the same conduit.
- C. Where different wiring classes terminate within the same enclosure, maintain clearances and install barriers per the National Electric Code
- D. Where wiring is required to be installed in conduit, EMT shall be used. Conduit shall be minimum 1/2 inch galvanized EMT. Set screw fittings are acceptable for dry interior locations. Watertight compression fittings shall be used for exterior locations and interior locations subject to moisture. Provide conduit seal-off fitting where exterior conduits enter the building or between areas of high temperature/moisture differential.
- E. Flexible metallic conduit (max. 3 feet) shall be used for connections to motors, actuators, controllers, and sensors mounted on vibration producing equipment. Liquid-tight flexible conduit shall be used in exterior locations and interior locations subject to moisture.
- F. Junction boxes shall be provided at all cable splices, equipment termination, and transitions from EMT to flexible conduit. Interior dry location J-boxes shall be galvanized pressed steel, nominal four-inch square with blank cover. Exterior and damp location JH-boxes shall be cast alloy FS boxes with threaded hubs and gasketed covers.
- G. Where the space above the ceiling is a supply or return air plenum, the wiring shall be plenum rated. Teflon wiring can be run without conduit above suspended ceilings. EXCEPTION: Any wire run in suspended ceilings that is used to control outside air dampers or to connect the system to the fire management system shall be in conduit.
- H. Fiber optic cable requirements shall follow the Telecommunications Design and Distribution Guide (TDDG).

- I. Only glass fiber is acceptable, no plastic.
- J. Fiber optic cable shall only be installed and terminated by an experienced contractor. The BAS contractor shall submit to the Engineer the name of the intended contractor of the fiber optic cable with his submittal documents.
- K. No media converters, physical repeaters, or software repeaters are permitted.

4.3 Hardware Installation

- A. Installation Practices for Wiring
- B. All controllers are to be mounted vertically and per the manufacturer's installation documentation.
- C. The 120VAC power wiring to each Ethernet or Remote Site controller shall be a dedicated run, with a separate breaker. Each run will include a separate hot, neutral and ground wire. The ground wire will terminate at the breaker panel ground. This circuit will not feed any other circuit or device.
- D. A true earth ground must be available in the building. Do not use a corroded or galvanized pipe, or structural steel.
- E. Wires are to be attached to the building proper at regular intervals such that wiring does not droop. Wires are not to be affixed to or supported by pipes, conduit, etc.
- F. Conduit in finished areas will be concealed in ceiling cavity spaces, plenums, furred spaces and wall construction. Exception; metallic surface raceway may be used in finished areas on masonry walls. All surface raceway in finished areas must be color matched to the existing finish within the limitations of standard manufactured colors.
- G. Conduit, in non-finished areas where possible, will be concealed in ceiling cavity spaces, plenums, furred spaces, and wall construction. Exposed conduit will run parallel to or at right angles to the building structure
- H. Wires are to be kept a minimum of three (3) inches from hot water, steam, or condensate piping.
- I. Where sensor wires leave the conduit system, they are to be protected by a plastic insert.
- J. Wire will not be allowed to run across telephone equipment areas.
- K. All new BAS IP-addressable controllers and new/upgraded BAS software must be installed according to the finished GSA OCIO Security Assessment Report (SAR) for each device/software that is installed. Non-compliant installations will be removed off the GSA network for security reasons. The SAR(s) can be provided on request by the GSA POC to the awarded contractor. Also, a listing of current

remediated devices and software can be provided to the Contractor during the Design phase.

4.4 Installation Practices for Field Devices

Installation for IEQ sensors shall follow the most recent RESET™ Air Accredited Monitor Standard for installation of devices and all other requirements set forth in individual task orders. Additional requirements include:

- A. Well-mounted sensors will include thermal conducting compound within the well to ensure good heat transfer to the sensor.
- B. Actuators will be firmly mounted to give positive movement and linkage will be adjusted to give smooth continuous movement throughout 100 percent of the stroke.
- C. Relay outputs will include transient suppression across all coils. Suppression devices shall limit transients to 150% of the rated coil voltage.
- D. Water line mounted sensors shall be removable without shutting down the system in which they are installed.
- E. For duct static pressure sensors, the high pressure port shall be connected to a metal static pressure probe inserted into the duct pointing upstream. The low pressure port shall be left open to the plenum area at the point that the high pressure port is tapped into the ductwork.
- F. For building static pressure sensors, the high pressure port shall be inserted into the space via a metal tube. Pipe the low pressure port to the outside of the building.
- G. All field cables will be uniquely and clearly labeled both in the field and in their control panel(s) in accordance with the as-built BAS control prints. Terminations will be neatly installed with terminal blocks and not wire nuts.

4.5 Enclosures

- A. For all I/O requiring field interface devices, these devices where practical will be mounted in a field interface panel (FIP). The Contractor shall provide an enclosure which protects the device(s) from dust, moisture, conceals integral wiring and moving parts.
- B. FIPs shall contain power supplies for sensors, interface relays and contactors, and safety circuits

- C. The FIP enclosure shall be of steel construction with baked enamel finish; NEMA 1 rated with a hinged door and keyed lock. The enclosure will be sized for twenty percent spare mounting space. All locks will be keyed identically.
- D. All wiring to and from the FIP will be to screw type terminals. Analog or communications wiring may use the FIP as a raceway without terminating. The use of wire nuts within the FIP is prohibited.
- E. All outside mounted enclosures shall meet the NEMA-4 rating.
- F. The wiring within all enclosures shall be run in plastic track. Wiring within controllers shall be wrapped and secured.

4.6 Identification

- A. Identify all control wires with labeling tape or sleeves using words, letters, or numbers that can be exactly cross-referenced with as-built drawings. A laminated copy of as-built drawing shall also be provided within each respective panel.
- B. All field enclosures, other than controllers, shall be identified with a Bakelite nameplate. The lettering shall be in white against a black or blue background.
- C. Junction box covers will be marked to indicate that they are a part of the BAS system.
- D. All I/O field devices (except space sensors) that are not mounted within FIP's shall be identified with name plates.
- E. All I/O field devices inside FIP's shall be labeled.

4.7 Existing Controls

- A. Existing controls which are to be reused must each be tested and calibrated for proper operation. Existing controls which are to be reused and are found to be defective requiring replacement, will be noted to the Owner. The Owner will be responsible for all material and labor costs associated with their repair

4.8 Control System Switch-over

- A. Demolition of the existing control system will occur after the new temperature control system is in place, including new sensors and new field interface devices.
- B. Switch-over from the existing control system to the new system will be fully coordinated with the Owner. A representative of the Owner will be on site during switch-over.

- C. The Contractor shall minimize control system downtime during switch-over. Experienced installation mechanics will be on site so that the entire switch-over can be accomplished in a reasonable time frame.
- D. Control system switch over scheduling shall be coordinated in advance and approved by the government.

4.9 Location

Location of IEQ sensors and other required devices will be as set forth in the IEQ Monitoring plan under this contract. The contractor shall meet minimum requirements as set under the most recent version of the RESET™ Air Accredited Monitor Standard and the following:

- A. Space humidity, temperature and sound level sensors will be mounted away from machinery generating heat, direct light, and diffuser air streams as well as significant amounts of noise.
- B. Outdoor air sensors will be mounted under an integrated cover on the north building face directly in the outside air and / or where outdoor air intakes are located. Install these sensors such that the effects of heat radiated from the building or sunlight is minimized.
- C. Field enclosures shall be located immediately adjacent to the controller panel(s) to which it is being interfaced.

4.10 Software Installation & Maintenance Services

- D. The Contractor shall provide all labor necessary to install, initialize, start-up and debug all system software as described in this section. This includes any operating system software or other third party software necessary for successful operation of the system. All software shall be licensed to GSA.
- E. GSA servers, physical and/or virtual, require 'admin access' prior to software installation. Access shall be coordinated with GSA IT and local GSA staff.
- F. Following installation, contractor shall notify and document for GSA IT (server team) the BAS applications and Windows-based services that require ongoing monitoring by GSA IT.
- G. The Contractor will provide all labor to configure those portions of the database that are required by the points list and sequence of operation.
- H. Unless otherwise directed by the owner, the Contractor will provide color graphic displays as depicted in the mechanical drawings for each system and floor plan. For each system or floor plan, the display shall contain the associated points

identified in the point list and allow for setpoint changes as required by the owner. Point naming convention shall follow the latest version of GSA Data Normalization for Building Automation Systems.

- I. BPA shall allow for Maintenance Services in support of BAS specific software patches or BAS software updates. All updates performed under maintenance services shall be conducted in accordance with Buildings Technologies Technical Reference Guide (BTTRG) and coordinated with the Government. Specific task order requirements shall define time period and system requirements for on-going or periodic maintenance services. Maintenance services are specific to BAS software requirements and do not replace O&M contractual obligations on contract support.

4.11 Reports

- A. The Contractor will configure a minimum of five (5) reports for the owner. These reports shall, at a minimum, be able to provide:
 - A. Pre-alteration functionality report (for system upgrades)
 - B. Trend comparison data
 - C. Alarm status and prevalence information
 - D. Energy Consumption data
 - E. System user data

4.12 Documentation

- A. As built software documentation, may include, but is not limited to the following documentation. Specific requirements shall be defined within task orders.
 - 1. Descriptive point lists, corresponding to GSA Data Normalization for Building Automation System guidance
 - 2. Application program listing
 - 3. Application programs with comments.
 - 4. Printouts of all reports.
 - 5. Alarm list
 - 6. Printouts of all graphics
 - 7. Commissioning and System Startup
 - 8. User BAS login list
 - 9. Admin passwords to All IP-addressable hardware and BAS software
 - 10. Training manuals and video files
 - 11. Technical user software and controller hardware manuals
 - 12. UDP port & instance numbers listings
 - 13. GSA Building Recovery Plan

- 14. GSA Server Monitor Form
- 15. As-built BAS system control drawings

4.13 Point to Point checkout

- A. Each I/O device (both field mounted as well as those located in FIPs) shall be inspected and verified for proper installation and functionality. A checkout sheet itemizing each device shall be filled out, dated and approved by the Project Manager for submission to the owner or owner's representative.

4.14 Controller and Workstation Checkout

- A. A field checkout of all controllers and front end shall be conducted to verify proper operation of both hardware and software. A checkout sheet itemizing each device and a description of the associated tests shall be prepared and submitted to the owner or owner's representative by the completion of the project.

4.15 System Acceptance Testing

- A. All application software will be verified and compared against the sequences of operation for the following but not limited to:
 - 1. Chiller control
 - 2. Boiler Control
 - 3. Single Zone Air Handlers
 - 4. Multi Zone Air Handlers
 - 5. VAV Air Handlers
 - 6. Packaged Roof Top Control
 - 7. Cooling Only VAV
 - 8. Fan Powered VAV
 - 9. Fan Coil Control
 - 10. Heat Pump Control
 - 11. Unit Ventilator Control
 - 12. Optimum Start/Stop Scheduling Details
- B. Control loops will be exercised by inducing a setpoint shift of at least 10% and observing whether the system successfully returns the process variable to steady-state operation at the new setpoint within minutes without oscillating modulation. Record all test results and attach to the Test Results Sheet.
- C. Test each alarm in the system and validate that the system generates the appropriate alarm message, that the message appears at all prescribed destinations

(workstations or printers and/or emails), and that any other related actions occur as defined (i.e. graphic panels are invoked, reports are generated, etc.). Submit a Test Results Sheet to the owner.

- D. Verify that normal occupancy and yearly holiday schedules are programmed for HVAC equipment as defined in the sequences.
- E. If applicable, for new controls involving daily start/stop of HVAC equipment, verify that optimum start and warmup-mode programming is implemented for energy-efficient operation.
- F. Perform an operational test of each unique graphic display and report to verify that the item exists, that the appearance and content are correct, and that any special features work as intended. Submit a Test Results Sheet to the owner.
- G. Perform an operational test of each third party interface that has been included as part of the automation system. Verify that all points are properly polled, that alarms have been configured, and that any associated graphics and reports have been completed. If the interface involves a file transfer over Ethernet, test any logic that controls the transmission of the file, and verify the content of the specified information.
- H. Perform a Building Recovery (BR) Test, if applicable.
- I. Specifics of acceptance testing shall be defined in task order requirements.

4.16 GSA Documentation

- A. The following mentioned documents shall be incorporated into this scope of work. These documents are provided by GSA upon request.
 - BAS IT Implementation guide
 - Telecommunications Design and Distribution Guide (TDDG)
 - Buildings Technologies Technical Reference Guide (BTTRG)
 - Building Monitoring and Control Device Security Assessment Process
 - GSA Data Normalization for Building Automation Systems
 - P-100 that shall be strictly followed
 - IT Security Procedural Guide: Security and Privacy Requirements for IT Acquisition Efforts CIO-IT Security-09-48
 - IT Security Procedural Guide: Building Automation System (BAS) Security Assessment Process CIO-IT Security-16-76
 - GSA Order - GSA IT Security Policy - CIO 2100
 - Guidance for drafting a BMC Configuration Management and Hardening Plan
 - GSA Regional BAS Requirements document (as is necessary)

- B. Document versions shall be provided by the Government per task order to ensure the latest version appropriate for the subject work is implemented for specific requirements.

5.0 Data Trending, Retention, and Accessibility

The contractor shall trend and retain all data from the new IEQ sensors and other data points in this section for a period of 5 years or to the end of their current contract and remaining option periods. The data requirement is only related to services provided to the second and third floors of the building. GSA employees approved by the COR shall be granted access to pull the data by remote entry to the BAS. The contractor shall be responsible for monitoring device connectivity and will report and correct interruption of service within 1 week of any interruption.

BAS points to trend and retain include the following:

- SpaceTemp
- SpaceRH
- OAFlow
- OccClgSetPt/OccCoolSP
- OccHtgSetPt/OccHeatSP
- MinOAFlowSpt
- OA Damper position
- Ventilation rate
- UnoccCoolSP
- UnoccHeatSP
- OccStatus
- ReturnAirTemp
- ReturnAirRH
- SupplyAirTemp
- SupplyAirRH
- OAT

“Sparks” or system status data to trend and retain if available. The contractor will identify any of the following system data that is currently captured, propose alternates if the data is not directly addressed, or identify any points that are not available:

Highest “eCost” – System data identified with higher energy use and cost.

- AHU Heating Failure
- AHU Cooling Failure

- AHU Cooling & Heating Simultaneously

- AHU Cooling Valve Leaking
- AHU Heating Valve Leaking
- AHU Heating Valve Unstable
- AHU Cooling Valve Unstable

- AHU Discharge Temperature Setpoint Unreachable
- Chilled Water Pressure Setpoint Unreachable

- AHU Damper Unstable
- AHU Outside Damper Stuck Closed
- AHU Outside Damper Stuck Open
- AHU Excessive Outside Air During Unoccupied Status
- AHU Economizing & Heating Simultaneously
- AHU Economizing & Cooling Simultaneously

- AHU Excessive Discharge Fan Speed
- AHU Excessive Return Fan Speed
- AHU Discharge Fan Failure
- AHU Discharge Pressure Setpoint Unreachable
- Terminal Unit Airflow Setpoint Unreachable

Highest “sCost” – System data identified with to occupant satisfaction

Most Significant Sparks tracking Too Hot in Summer

- Chilled Water Pressure Setpoint Unreachable
- AHU Cooling Valve Leaking
- AHU Cooling Failure
- AHU Cooling Valve Unstable

Most Significant Sparks tracking Too Cold in Winter

- AHU Discharge Temperature Unreachable
- AHU Heating Valve
- AHU Heating Failure
- Heat Exchanger Temperature Setpoint Unreachable

Most Significant Sparks tracking to Too Cold in Summer

- Occupied Cooling Setpoint Out of Range (below 71F)

- Occupied Zone Temperature Out of Range (below 69F summer/winter or greater than 76F summer)

Most Significant Sparks tracking Inadequate Fresh Air, Compromised Fresh Air

- AHU Discharge pressure unreachable (compromised filters or duct path)
- AHU discharge fan failure
- Terminal Unit Airflow Setpoint Unreachable
- AHU OA air damper stuck closed
- AHU Excessive Return Fan Speed = negative pressure and pollution intake?
- AHU Damper Unstable

Most Significant Sparks tracking Humidity Control (to avoid too high or too low humidity)

- AHU Outside Air Damper Stuck Open
- AHU Economizing & Cooling Simultaneously
- AHU Economizing & Heating Simultaneously (good for air quality but too dry?)

END OF SCOPE OF WORK