13810 ENERGY MANAGEMENT SYSTEM (EMS)

PART 1 GENERAL

1.1 BASICS:

A. The District’s Energy Management System (EMS) physical integration and functional design shall focus on the sustainable fulfillment of its purpose, reducing its costs and minimizing the need for its operation, servicing and repair to be performed by Maintenance & Operation personnel; or service contractors.

B. The EMS Triad is a computer / microprocessor based operational command signals network, comprised of solid state printed circuits components, subsystems, accessories and devices, electronically integrated for the quantification, control and reduction of energy consumption in M-DCPS facilities.

C. The EMS design shall comply with Florida Statutes 255.257.

D. Any conflict between any term, condition, provision and requirements herein stated shall be promptly brought in writing to the attention of the A/E and M-DCPS Office of Energy Management personnel for clarification.

1.2 Related Sections:

1. 15240 - Vibration Isolation
2. 15510 - Piping (HVAC)
3. 15515 - Valves, Hangers, and Specialties
4. 15890 - Ductwork
5. 15910 - Duct Accessories
6. 15960 - Variable Frequency Drives
7. 15990 - Test (HVAC)
8. 16155 - Motor Power and Control Wiring
9. 16721 - Fire Detection Alarm System

1.3 DEFINITIONS

A. The provider of the EMS, hereinafter referred to as the EMS Contractor, is the business entity responsible for equipment, installation, materials, labor and accessories necessary for delivering a complete integrated fully operational EMS Triad.

B. RMC: M-DCPS Regional Maintenance Center.

C. SBAB: School Board Administration Building, 1450 N.E. 2nd Avenue, Miami, FL.

D. Triad: Complementary interaction of 1) District School Facilities, 2) Regional Maintenance Centers, and 3) M-DCPS Office of Energy Management, to attain a cost effective physical
plant operation, utilizing an EMS-LAN communication network. See M-DCPS Design Criteria – Appendix for additional EMS information.

E. BACnet: is a Data Communications Protocol for Building Automation and Control Networks. It is an ASHRAE, ANSI and ISO standard protocol.

F. Enhanced Hurricane Protection Area (EHPA): As defined in FBC 423.25.

G. Energy Management: M-DCPS operational function dedicated to reduce energy consumption in schools and support facilities. Presently, it is a section of M-DCPS District Inspection, Operations and Emergency Management.

H. AHU: Air Handling Unit.

I. VAV: Variable Air Volume Boxes.

J. AI: Analog Input.

K. AO: Analog Output.

L. DI: Digital Input.

M. DO: Digital Output.

1.4 SUBMITTALS

A. Submit to the A/E and M-DCPS Office of Energy Management, all EMS manufacturers’ literature for proposed equipment, material and software showing performance specifications, schematics, dimensions and installation instructions, for their review and acceptance.

B. Submit to the A/E and M-DCPS Office of Energy Management, all detailed shop drawings showing proposed EMS equipment locations, control sequences, raceway routing, grounding requirements, interconnections, and special instructions, for their review and acceptance. Wiring shall be clearly shown with terminations occurring on labeled terminal strips.

C. Submit a list of EMS components for which spare parts shall be provided as specified in this document.

D. Furnish to electrical contractor wiring diagrams and wire runs specified in Division 16.

E. Substantial Completion Submittal Requirements: Upon substantial completion, provide M-DCPS Office of Energy Management with the following:

1. Record drawing: 6 sets.
2. AutoCAD compatible disk.
3. Manufacturer’s maintenance and repair instructions (6 sets) including troubleshooting instructions and schematic diagrams depicting EMS’s components integration.
4. A copy on a CD or USB Flash Drive of the EMS backup database.
F. Any EMS components manufacturer that considers any of the requirements established in this Specification to be proprietary shall not be acceptable to M-DCPS.

G. All the necessary technical, operational, instructional, procedural and calibration manuals addressing the overall EMS composition, integration and functions, shall be provided at Substantial Completion.

1.5 QUALITY ASSURANCE

A. Submit proof of having a local office within a 50-mile radius of the job site. The EMS Contractor office shall be staffed with factory-trained personnel fully capable of providing effective training, instruction and routine/emergency maintenance service on EMS components to M-DCPS personnel.

B. Submit proof of having a minimum of five (5) years successful history in design, installation and overall support of EMS similar in performance and scope as specified herein.

C. Furnish copies to M-DCPS of required warranty for equipment and materials as specified in the Instructions to Bidders, General Conditions and these Specifications.

1.6 WARRANTY

A. Components, parts, and assemblies furnished and installed by the EMS Contractor, product manufacturer representative or distributor, shall be warranted - in writing - against defects in material and labor, for two (2) year after Substantial Completion.

B. The EMS Contractor shall respond to routine warranty service requests by completing repairs within 24 hours from notification by M-DCPS.

C. The EMS Contractor shall respond to emergency warranty service requests with the arrival of service technician at affected site within four (4) hours of notification of the emergency. Repairs shall be expedited to bring the EMS online as soon as possible. Emergencies include, but are not limited to, failures of controls components or any other fault attributed to an EMS failure.

D. If the problem is not correctable within the specified time frame, the EMS Contractor shall provide in writing an expected completion date to M-DCPS.

E. Inspections at End of Warranty: Forty-five (45) days prior to the end of the two (2) year warranty period, the EMS Contractor shall meet on-site with M-DCPS Office of Energy Management designated staff and representatives from the corresponding RMC to address all unresolved warranty items to the satisfaction of M-DCPS.

1.7 EQUIPMENT UPKEEP

A. During the warranty period, the EMS Contractor shall perform at least three (3) EMS condition maintenance inspections six (6) months apart in order to ensure that the EMS is performing as contractually required. The first of these inspections shall be conducted six (6) months from the substantial completion date of the EMS. The date of the other inspections shall be coordinated with M-DCPS designated representative. After each inspection, the EMS Contractor shall provide M-DCPS Office of Energy Management a report documenting their findings and what corrective actions were taken to resolve the
deficiencies that were noted. Each inspection shall be carried out together with M-DCPS Office of Energy Management and RMC’s representatives in order to facilitate the transition to full M-DCPS servicing. During this period, the EMS Contractor shall abide by M-DCPS Maintenance staff observations, Manufacturer’s operation guidelines and current Industry’s standards. The EMS maintenance inspection shall address, as a minimum, the following items:

1. Check all wiring connections and make all necessary repairs.
2. Check communication between the Controller and Network, and make the necessary repairs.
3. Check communications with the field Network devices and make the necessary repairs.
4. Verify operation of all sensors, valves and damper actuators and make necessary adjustment and repairs.

1.8 PREVENTIVE MAINTENANCE AND REPAIR SERVICE PROPOSAL

A. The EMS Contractor is to provide M-DCPS Office of Energy Management a proposal for a two (2) year, with the option for two annual extensions thereafter, overall EMS Preventive Maintenance and Repair Service contract, to begin at the end of the two (2) year warranty period. The Preventive Maintenance and Repair Service contract shall cover the servicing, up-keep and repair of the EMS and shall include at a minimum the following items:

1. Periodic EMS inspections at six (6) months intervals, the first of which will take place six (6) months from the end of two (2) year warranty period. The remaining inspections shall be coordinated with M-DCPS designated personnel.
2. Check all wiring connections, and make necessary repairs.
3. Check communication between the Controllers and Network, and make necessary repairs.
4. Check communication with the field Network devices and make necessary repairs.
5. Check all batteries and replace them once per year.
6. Verify operation of all sensors, valves and damper actuators and make necessary adjustment and repairs.

PART 2 PRODUCT

2.1 EMS CONFIGURATION

A. The EMS shall have a Triad in tandem configuration, comprised of separate but, if needed, concurrently interacting control loops:

1. On-site EMS Control Subsystem Loop: It shall be the functional core of the School EMS Center. It shall be dedicated to local mode activation and control of diverse equipment confined within the school campus. It shall act independently and be exclusive from any pre-set EMS automation program established by others, to regulate the levels of ambient comfort in occupied spaces. Area temperature to prevail shall be established with the consent of the Principal and discretionarily adjusted by authorized on-site staff, as needed. It shall be achieved by means of a centralized console having a “touch screen” monitor depicting a descriptive digital display identifying the actual status of the physical plant performance parameters. The School EMS Center infrastructure shall contain built-in temperature range limiting
features. On-site operational control programming shall make the School EMS Center to be self-standing and able to be connected to work simultaneously in conjunction and parallel with the corresponding RMC’s EMS Station and/or the SBAB EMS Terminal, when needed.

2. Off-site EMS Control Subsystem Loop: It serves to concurrently access each active School EMS Center microprocessor from its corresponding RMC. It shall be able to establish operational dialogues by interconnecting in tandem with assigned schools via electronic communication means. It shall act mainly as a “partner”, dedicated to assist by remote mode in the activation and proper performance of the physical plant machinery, buildings controllers programming and network general conditions monitoring. It shall be capable of remote graphic displays and depicting individual EMS components working status in real time.

3. The SBAB’s EMS Terminal represents the third operational element of the District’s EMS Triad. It shall perform diverse supplementary tasks, in particular physical plant equipment start/stop and on/off power activation scheduling, personnel training, and emergency communications response.

B. The equipment and software provided by the EMS Contractor shall be the latest model available at the time of bidding. No customized products shall be accepted, unless approved by M-DCPS in writing. All EMS component spares shall be readily available from their original source during at least seven (7) years. All EMS components shall be ‘backward compatible’ with its manufacturer’s installed infrastructure.

C. The EMS shall follow the latest BACnet standard available at the time of bidding, ensuring both hardware and software interoperability among sub-systems located in the schools and RMCs.

1. Compliance level: Provide PICS documents showing at least a Level 3 ability to support data read-and-write functionality for each BACnet device.

2. Physical connection of BACnet devices: BACnet network using the ISO 8802-3 (Ethernet) Data Link/Physical layer protocol.

Note to Specifier: The following Manual Override function shall be provided at all Facilities identified by M-DCPS as an Enhanced Hurricane Protection Area (EHPA).

D. EHPA Manual Override Panel: At Facilities designated by M-DCPS as an EHPA, provide one manual override panel for use by authorized Staff to activate manual override of cooling, ventilation and lighting systems serving the designated EHPA zones. Override-panel shall have the following features:

1. Install EHPA override-panel in the EHPA Emergency Shelter Director’s office. Locate override-panel within a lockable wall mounted cabinet. The cabinet shall be labeled with a sign indicating: “EMERGENCY SHELTER - MANUAL OVERRIDE PANEL LOCATED INSIDE”.

2. Override-panel shall be operated with a single push button switch and shall have a status light labeled “EMERGENCY SHELTER MANUAL OVERRIDE”, to signal activation.

3. Upon activation, the EMS shall convert its operating mode to “SHELTER ACTIVE MODE”, providing 24/7 mechanical cooling and ventilation, including lighting, to the designated EHPA zones.
4. In the “SHELTER ACTIVE MODE”, the system shall override any EMS “time-schedules”, demand-limiting, or energy-saving programs that may compromise the use of the Facility as an EHPA.

5. Each chiller shall be connected to separate power circuits.
   
   a. As long as normal FPL power in being provided to the Facility, the HVAC system shall provide 100% of cooling to the EHPA.
   
   b. If normal power fails, the emergency ventilators and other life-safety systems serving the EHPA shall continue running on emergency power.

2.2 EMS INTEGRATION

A. Provide a fully integrated EMS with a high-speed, peer-to-peer network of Direct Digital Controller (DDC) controllers and operator workstations, part of communicating on a BACnet network. Components or controllers that require “polling” by a host to pass data shall not be utilized.

B. The overall EMS composition shall be as uncomplicated and user friendly as possible to facilitate pertinent personnel to quickly learn by hands-on training; which shall include: EMS’s fundamentals, industry standards, and components integration and operation details.

C. The EMS shall be microprocessor based and consist of a School EMS standalone Center console, field/unitary control processors and all other necessary components (software and hardware) for a fully integrated functional and operational entity.

D. Provide equipment, software, and instructions necessary for M-DCPS Staff reprogramming of any performance parameter resident in non-volatile memory (eg. EPROM, EEPROM, magnetic media, etc.). For those EMS using “custom” software programming, detailed instructions and documentation shall be provided, and approved by M-DCPS.

E. Provide a backup power source for the EMS Center Console, all Building Controllers and controllers serving all major electro/mechanical equipment. During power interruptions, the backup power source shall be capable of maintaining the contents of the EMS functional parameters that are stored in volatile memory (e.g., RAM memory) for a minimum of seventy-two (72) hours.

2.3 MANUFACTURERS

A. EMS Components Manufacturers:
   
   1. I/A by Schneider Electric
   2. Delta
   3. Metasys by Johnson Controls
   4. Trane

2.4 EMS OPERATION INTERFACE:

A. Software Package: The EMS software shall be a complete Web enabled package including interactive graphics that shall support a minimum of ten (10) simultaneous users utilizing Internet Explorer as the Web browser.
1. Provide equipment, software, wiring interfaces, and instructions necessary for M-DCPS personnel to reprogram any of the diverse performance parameters resident in controllers provided as part of the EMS.

2. Web server software shall operate on standard industry PC server. Web-server/controllers by manufacturer are acceptable.

3. Web browser software: As provided by the EMS Contractor, with the same looks and feel as the operating system. Third-party Web software is prohibited.

4. The time clocks in all controllers shall be automatically synchronized daily. An operator change to the time clock in any controller shall be automatically broadcast to all controllers on the network.

5. The Software package provisions shall allow the responsible on-site staff to set a subjective level of comfort within occupied spaces, such as adjusting temperature set points or changing school operation schedules.

6. Software Operating System shall be Microsoft Windows Professional.

7. Software Licenses: All software supplied to the M-DCPS shall have its correspondent licenses from the computer and operating components designer. The Software licenses shall not be in the form of a hardware device e.g. UBS flash drive, or any other physical device.

8. User Access level: The software provided by the EMS contractor shall provide to M-DCPS personnel full access to all EMS capabilities and allow M-DCPS to set up different access levels to operate the EMS. The software shall have the capability to upload, download, create, delete and support the following BACnet Objects:

   a. Analog input, analog output and analog value
   b. Binary input, binary output and binary value
   c. Calendar
   d. Device
   e. Event enrolment
   f. File
   g. Graphics
   h. Notification class
   i. Programs
   j. Schedule
   k. Trend log

9. Accessories and software shall accomplish, but not limited to the following:

   a. Full color graphics monitoring and command of remote EMS.
   b. Digital and analog data monitoring and command.
   c. Time and event programming.
   d. Duty cycle programming.
   e. Chiller optimization.
   f. Optimum start/stop programming.
   g. Chilled Water Temperature Reset.
   h. Thermostats Night Temperature (Auto) Setback.

B. Power Utility Interfaces: For new facilities, provide a dedicated KW meter to measure and record energy usage. This meter shall be a BACnet interface device ISO 8802-3 (Ethernet) Data Link/ Physical layer protocol, that transmits and plots in real time, the physical plant electricity consumption data for its quantification, monitoring, tracking, and load shedding programs. The KW meter readings shall have a comparison of: KW hours
vs. baseline, KW month vs. Baseline, Carbon Equivalent, Total Energy Consumption, and have a WEB access minimum of 50 simultaneous users.

C. Exterior lighting circuits shall be interlocked with the EMS. The interlock shall provide for lighting circuits to remain energized (fail-safe) in case of total EMS failure. Full illumination shall be effected only during periods of scheduled evening occupancy. Where applicable, a “spot” illumination shall be provided for security purposes. Exterior perimeter illumination and artificial lighting of parking lots, and other open areas shall be activated by means of sunlight-exposed photocells and time-of-day controls wired in-series. All EMS outputs for lighting controls shall originate from EMS controllers that are located within wall enclosures mounted 54” AFF and located at electrical/mechanical rooms.

D. The on/off switching of buildings’ interior lights shall not be affected by pre-set EMS automatic timing.

E. Exhaust and ventilation fans shall be interlocked with corresponding air handling units.

2.5 SCHOOL EMS CENTER

The EMS Company shall provide a “shortcut” to access the School’s EMS Center Portal, to the following on-site desktop computers: School’s Principal, School’s Zone Mechanic, and one additional computer located in the main Administration area, as designated by the School’s Principal.

2.6 REMOTE EMS OPERATION INTERFACE AND CONNECTION

A. The EMS interaction grid/network shall incorporate state of the art up-to-date advanced developments in electronic communication technology. It shall maximize Web links and Internet server resources in seeking the latest technical information on programming software products and industry off-the-shelf devices. Once integrated, the EMS shall be capable to process and transmit all required and formatted data via secure communication methods.

B. The EMS shall allow the operator to access any site/location using the M-DCPS’ Intranet network. No Telephone / Modem connection shall be allowed. The connection shall be either direct connect using the source software or via Web browser. Third party software shall not be acceptable.

C. IP Addresses: To aid in communications, M-DCPS Network Services has reserved a group of IP addresses in the first segment at each school for EMS’ users interconnectivity.

1. All communication from the EMS shall be done via M-DCPS Intranet.
2. The first 3 numbers are unique from the site location numerical identity. The last number at each IP address make the reserved IP addresses for the site EMS, as follows:

   XXX.XXX.XXX.78   School main EMS Address/Web-Server
   XXX.XXX.XXX.79   Spare
   XXX.XXX.XXX.80   Chiller 1
   XXX.XXX.XXX.81   Chiller 2
   XXX.XXX.XXX.82   Chiller 3
   XXX.XXX.XXX.83   Spare
   XXX.XXX.XXX.83   Spare
3. The above listed IP addresses are available for connection to the Web server for monitoring and control of designated end users. Additional IP addresses of Web-based analog devices for measuring utilities consumption, shall be provided by M-DCPS Network Services and the local M-DCPS' Information Technology technician, upon request.

4. It is the responsibility of the EMS Contractor to program the IP in the various EMS' and to establish the connection between the school campus building and other required EMS locations.

5. The JAVA platform shall not interfere with remote connection to a Building Controller from any computer in District.

2.7 BUILDING CONTROLLER

A. Provide a digital Building Controller with direct support of Ethernet, MS/TP or a communications card to local terminals. Connect to the BACnet network using the ISO 8802-3 (Ethernet) Data Link/ Physical layer protocol.

B. School EMS Center and Building Controller: Top-level 10/100bT Ethernet network, using the BACnet/IP protocol.

1. Provide a Sub-network using the BACnet MS/TP protocol, with at least 38.4 kb speed that connects the local, standalone controllers with Ethernet-level controller/routers.
2. Sub-networks can also be installed with manufacturer RS485 or communications protocol.
3. EMS communication/control connections shall not utilize building power service wiring.

C. Communication: Building Controllers shall be connected to EMS Center Console, Application and Application Specific Controllers using BACnet routing.

D. The EMS shall dispatch automatic E-mail warning messages for emergency prompting of “CHILLER DOWN”, “POWER RESTORED” or “EHPA IN OPERATION” to the respective RMC’s EMS Station, to the designated on-site Administrator and to the SBAB EMS Terminal.

E. Environment: Building Controller shall be appropriately located within the Main Telecom room at 4'-0" AFF or other area designated by MDCPS. The PC portion of the EMS Center Console equipment shall also be located within the same space.

F. Building Controllers shall be fully peer-to-peer and support up to a minimum of 99 Application Specific Controllers. Building Controllers shall have a real time clock built into it.

G. Serviceability: Locate equipment in a manner that will permit easy access for performing routine maintenance.

1. The Building Controller shall have diagnostic LEDs for power, communication, and processor.
2. Each controller shall have a Service Port for a laptop computer or a portable operator's tool. Its function shall be, but not limited to:
a. Log On and Off
b. Adjust and change EMS performance parameters set points and schedules.
c. Access data from DDC controllers.
d. Modify point/object trend logs, graphic displays and printing
e. Perform DDC controller unit operation and maintenance procedures

H. Memory: The Building Controller shall have, as a minimum, SRAM of 256 KB, standard DRAM of 1MB and standard non-volatile 1 MB of flash memory in lieu of EPROM. Memory shall be user extendible through RAM chip sockets and SIMMs and have seventy-two (72) hours program memory protection.

I. Power loss and noise: Controller shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m [3 ft] and shall shutdown automatically below 80 % nominal voltage.

2.8 SUBSYSTEMS CONTROLLERS

A. Subsystem Control Units are stand-alone microprocessor based control units that include, but are not limited to, the following:
   1. No need to communicate with any other device to execute EMS programs and other control functions.
   2. Fully user-programmable, and not restricted to any one type of equipment.
   3. Support direct Ethernet or by using a communications card included with the subsystem controller. Connect SCU to the BACnet network using the ISO 8802-3 (Ethernet) Data Link/Physical layer protocol.
   4. Primary communication network shall support BACnet MS/TP
   5. Alarm Reporting. Subsystem Controllers shall be able to route critical alarms to designated RMC’s EMS Stations.
   6. A Master Controller shall be provided when multiple Subsystem Controllers are installed.

B. Subsystem Controllers with a communications card shall perform BACnet routing if connected to a network of Custom Application and Application Specific Controllers, and shall:
   1. Contain software, programs, and parameters resident in the EMS control processor in non-volatile memory random-access memory and shall allow local operator access, and backup power supply.
   2. Monitor or control each Input/Output (I/O) point, process information and download from or upload to operator workstation, or diagnostic terminal unit.
   3. Have 25% expandability in analog input and output points by the addition of expansion modules.
   4. Have 25% expandability in digital input and output points by the addition of expansion modules.
   5. Work in stand-alone mode control functions and operate regardless of network status.

C. Environment: Controller hardware shall be suitable for the designed ambient conditions.
1. Controllers used outdoors, inside weather exposed equipment and/or in wet ambient conditions shall be mounted within waterproof enclosures, and shall be rated for operation at 0°C to 40°C [32°F to 100°F] and 10 to 90% RH.

2. Controllers used in conditioned space shall be mounted in dust-proof enclosures and shall be rated for operation at 0°C to 50°C [32°F to 120°F].

D. Serviceability:

1. The Subsystem Controllers shall have diagnostic LEDs for power, communication, and processing.

2. Each controller shall have Service Port for a laptop computer or a portable operator's tool. Its function shall be, but not limited to:
   a. Log On and Off.
   b. Adjust; change, upload, and download EMS programmed performance parameters set points and schedules.
   c. Access data from DDC controllers.
   d. Modify point/object trend logs, and graph/print these.
   e. Perform DDC controller unit operation and maintenance procedures.

E. Communications Requirements: For communications between the EMS controllers and associated components:

1. All hardware and software shall conform to BACnet standard, ISO 8802-3 (Ethernet) Data Link/Physical layer protocol, to promote interoperability between the different buildings subsystems.

2. The Subsystem Controller shall reside on a BACnet network using the MS/TP Data Link/Physical layer protocol.

F. Power loss and noise: Controllers shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m [3 ft] and shall shut below 80% nominal voltage.

G. Electrical Transient Protection (ETP) shall be provided for equipment according Division 16 of M-DCPS Master Specifications and with the following:

1. Power Lines:
   a. Three line surge protection
      1) Hot and neutral wires
      2) Hot and ground wires
      3) Neutral and ground wires
   b. Northern Technology, Inc., Spokane WA, Model No. TCS-20HW, or approved equal.
   c. Device shall be installed at equipment to be protected inside a sheet metal enclosure and connected to earth ground with one #6 AWG (minimum) wire in an isolated conduit.
   d. Clamping voltage shall be UL Rating 1449 330V, Joule Rate 1000, Electrical Rating 20A, 120/277 VAC.
2. Coaxial lines: (if applicable) General Semiconductor Industries, Inc., No. CX12 at each end of the coaxial lines over 20 feet in length.
3. CAT5 network lines: PWCAT5 NTP, by Eaton or approved equal shall be used for data transient protection.
4. EMS control lines (at each end of the cable):
   a. For DC lines below 13 VDC provide Northern Technologies, Inc., Model DLP-41 or approved equal.
   b. For DC lines from 13 VDC to 25 VDC, and for AC lines below 16VAC, provide Northern Technologies, Inc., Model No. DLP-42 or approved equal.
   c. For higher voltages, contact Northern Technologies, Inc., for model numbers.

2.9 APPLICATION CONTROLLER

A. Application Controllers shall be standalone microprocessor based control units that include, but are not limited to, the following:

1. No need to communicate with other devices to execute EMS programs and associated control functions.
2. Pre-programmed application such as, VAV, VVT, HVAC unit’s algorithms are allowed. All pre-set algorithms shall allow the user to modify performance parameters, as applications may change in the field.
3. Connect to the BACnet network using the ISO 8802-3 (Ethernet) Data Link/Physical layer protocol.
4. Primary communication network shall support BACnet MS/TP.
5. Alarm Reporting. Application Controllers shall be able to route critical alarms to designated RMC’s EMS Station.

B. Application Controllers with a communications card shall perform BACnet routing if connected to a network of Custom Application and Application Specific Controllers, and also shall:

1. Contain software, programs, and functional parameters resident in the EMS control processor in non-volatile memory random-access memory. It shall allow local operator access, and backup power supply.
2. Monitor and control each I/O point, process information, and download from or upload to operator workstation, or diagnostic terminal unit.
3. Work in stand-alone mode control function operations, regardless of network status.

C. Environment: Controller hardware shall be suitable for the designed ambient conditions.

1. Controllers used outdoors, inside rooftop equipment and/or in wet ambient conditions shall be mounted within waterproof enclosures, and shall be rated for operation at 0°C to 40°C [32°F to 100°F] and 10 to 90% RH.
2. Controllers used in conditioned space shall be mounted in dust-proof enclosures, and shall be rated for operation at 0°C to 50°C [32°F to 120°F].

D. Serviceability:

1. The Application Controllers shall have diagnostic LEDs for power, communication, and processing.
2. Each controller shall have Service Port for a laptop computer or a portable operator's tool. Its functions shall be, but not limited to:
   
a. Log On and Off.
b. Adjust, change, upload, and download subsystem performance parameters set points and schedules.
c. Access data from DDC controllers.
d. Modify point/object trend logs, and graph/print these.
e. Perform DDC controller unit operation and maintenance procedures.

E. Communications Requirements: For communications between the Application Controller and all other associated components:
   
1. All hardware and software shall conform to BACnet standard, ISO 8802-3 (Ethernet) Data Link/ Physical layer protocol, to promote interoperability between building subsystems.
2. The controller shall reside on a BACnet network using the MS/TP Data Link/ Physical layer protocol.

2.10 EMS ACCESSORIES AND DEVICES

A. Temperature sensors:
   
1. Duct sensors shall be rigid or averaging. Averaging sensors shall be a minimum of 1.5 m [5 feet] in length.
2. Immersion sensors shall be provided with a separable brass well. Pressure rating of well is to be consistent with the fluid pressure in which it is to be installed.
3. Provide matched temperature sensors for differential temperature measurement.

B. Relative Humidity (RH) sensors:
   
1. Duct and room sensors shall have a sensing range of 20% to 80%.
2. Duct sensors shall be provided with a sampling chamber.
3. Outdoor air humidity sensors shall have a sensing range of 20% to 95%. They shall be suitable for ambient conditions of -40°C to 75°C [-40°F to 170°F].
4. Humidity sensor's drift shall not exceed 3% of full scale per year.

C. Flow switches:
   
1. Flow-proving switches shall be either paddle or differential pressure type, as shown.
2. Paddle type switches (water service only) shall be UL Listed, SPDT snap-acting with pilot duty rating (125 VA minimum) with adjustable sensitivity with NEMA 1 enclosure unless otherwise required by Code.
3. Differential pressure type switches (air or water service) shall be UL Listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 enclosure, with scale range and differential suitable for the intended application.

D. Relays:
   
1. Control relays shall be UL Listed plug-in type with dust cover. Contact rating, configuration, and coil voltage suitable for application.
2. Time delay relays shall be UL Listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable 200% (minimum) from established set points. Contact rating, configuration, and coil voltage suitable for application. Provide NEMA 1 enclosure when not installed in local control panel.

E. Current transmitters:

1. AC current transmitters shall be self-powered combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 0 to 5 VDC two-wire output. Unit ranges shall be 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A full scale, internal zero and span adjustment, and 1% full scale accuracy at 500 ohm maximum burden.
2. Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA listed.
3. Unit shall be split-core type for clamp-on installation.

F. Current transformers:

1. AC current transformers shall be UL/CSA listed and completely encased (except for terminals) in approved plastic material.
2. Transformers shall be available in various current ratios and shall be selected for 1% accuracy at 5 A full-scale output.
3. Transformers shall be split-core type for installation on new or existing wiring.

G. Voltage transmitters:

1. AC voltage transmitters shall be self-powered single loop (two-wire) type, 4 to 20 mA output with zero and span adjustment.
2. Ranges shall include 100 to 130 VAC, 200 to 250 VAC, 250 to 330 VAC, and 400 to 600 VAC full-scale, adjustable, with 1% full-scale accuracy at 500 ohm maximum burden.
3. Transmitters shall be UL/CSA listed at 600 VAC rating and meet or exceed ANSI/ISA S50.1 requirements.

H. Voltage transformers:

1. AC voltage transformers shall be UL/CSA listed, 600 VAC rated, complete with built-in fuse protection.
2. Transformers shall be suitable for ambient temperatures of 4 to 55°C [40 to 130°F] and shall provide 0.5% accuracy at 24 VAC and a 5 VA load.
3. Windings (except for terminals) shall be completely enclosed in a Nema 1 enclosure unless otherwise required by Code.

I. Current switches:

1. Current-operated switches shall be self-powered, solid-state with adjustable trip current. The switches shall be selected to match the current of the application and output requirements of the DDC system.

J. Pressure transducers:

1. Transducer shall have linear output signal. Zero and span shall be field-adjustable.
2. Transducer sensing elements shall withstand continuous operating conditions of positive or negative pressure 50% greater than calibrated span without damage.

3. Water pressure transducer shall have stainless steel diaphragm construction of 150-psi minimum. Transducer shall be complete with 1 to 5 VDC or 4 to 20 mA output, required mounting brackets, and block and bleed valves.

4. Water differential pressure transducer shall have stainless steel diaphragm construction of 150-psi minimum. Over-range limit (differential pressure) and maximum static pressure shall be 300-psi. Transducer shall be complete with 1 to 5 VDC or 4 to 20 mA output, required mounting brackets, and enclosed five-valve manifold.

5. Differential pressure type switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum), with scale range and differential suitable for the intended application in a NEMA 1 enclosure unless otherwise required by Code.

K. Panel construction:

1. EMS Panel Enclosures: Constructed of 20-gauge steel. Equip panel doors with locks and transparent windows for viewing displays, if such displays are located within the panel. All control cabinets shall be fully enclosed NEMA 1 construction unless otherwise required by Code, with hinged door, key-lock latch, and removable sub-panels. A single key shall be common to all field panels and sub-panels.

L. Actuating Dampers:

1. Actuated control dampers shall be a minimum of 13 gauge, channel shaped galvanized steel, low leakage dampers with nylon or eolith bearings, as scheduled on the mechanical drawings. Leakage rating at shutoff shall be less than 1/2 percent of flow rate at 1500 FPM face velocity, with 5 inches wg differential across damper.

M. Actuating Valves:

1. Two-ways and three-ways actuated control valves shall be as herein specified or as indicated on the mechanical drawings.
2. All valves shall conform with the requirements of Division 15 of M-DCPS Master Specifications.

N. Electric damper/valve actuators:

1. All these actuators shall be UL and CSA rated and have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator.
2. All rotary spring-return actuators shall be capable of both clockwise and counter-clockwise spring-return operation. Linear actuators shall spring-return to the retracted position. Spring-return actuators with more than 7 Nm [60 in-lb] torque capacity shall have a manual crank.
3. Proportional actuators shall accept a 0 to 10 VDC or 2 to 10 VDC operating range.
4. All 24 VAC/VDC actuators shall operate on Class 2 wiring.
5. All non-spring-return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered.
O. Outdoor Air Flow Measuring Station shall be a sensor type GTA116Pc Gold Series flow sensor from EBTRON or approved equal (size sensor for duct area).

P. The EMS Contractor shall secure a written guarantee confirming the EMS components manufacturer's assurances not to discontinue the production and supply of any of the various different EMS models' spare parts and core replacements, for at least seven (7) years after the date of Substantial Completion.

2.11 EMS GRAPHICS INTERFACE

A. The EMS Triad shall exhibit common sets of tandem graphical displays. These displays shall include but not be limited to the following:

1. Password protected “log-on” screen.
2. “School Energy Management Center Portal” screen showing the following graphics:
   a. Picture of the School.
   b. Principal's name and picture.
   c. School general information.
   d. “Energy Usage” plotted trend curve (KW/month) shall display total consumption for the month and established targets.
   e. Visual Data Points showing the following conditions:
      1) Outdoor Temperature (°F)
      2) Indoor Temperature at Administration Area (°F)
      3) “Year to Date” Consumption (KWh)
      4) Demand Budget (KW/Month)
      5) Actual Demand (KW/Month)
      6) To-Date Projection (%)
      7) HVAC Mode - activated by chiller failure to run
      8) 24/7 Warning - activated if any mechanical equipment controlled by the EMS is set on “Manual” mode.
   f. “Hot Buttons” providing direct links to the following screens:
      1) **Occupancy Schedule** - Provides a single page screen to change time occupancy schedules per building. Graphic interface requiring to program individual time schedules for AHU are not acceptable.
      2) **Energy Usage** - Provides a display of KW Demand vs. Time, Fiscal YTD consumption, Demand Budget for the Month, Actual Demand, To-Date Projection, and School energy usage status.
      3) **Occupancy Temporary Override** - Every time the override is activated, the School EMS Center will provide 3 hours extension for the selected building / zone. This screen shall display each zone and the Building Occupied status (Green ON = System ON). The graphic shall display a counter of the elapsed time for each zone.
      4) **Plant Operation** - This screen shall identify each building, each AHU/chiller name and location, occupancy status, unit control relay status, unit status, supply temperature and functional performance parameters for each. All locations shall be identified using Florida Inventory of School House (FISH) numbers. In addition, this screen shall contain “hot buttons” to provide direct links to the following screens:
a) Floor Plan(s) - showing the temperature at each “zone” with the FISH numbers indication; each VAV box shall be identified with the FISH number of the area it serves; and one link for VAV and air handling units.

b) Chiller Plant Equipment - Provides status and values for all chiller plant controls and monitoring points included but not limited to; chilled water supply and return per chiller to the building, condenser water leaving and entering the chiller, pump status, variable speed control and speed, differential pressure sensors and set-point.

c) Mechanical Equipment (AHU-VAV) - Provides visual indication for all controls and monitoring points for each mechanical device installed and controlled by the EMS.

d) Occupancy Temporary Override.

e) Energy Usage.

f) Occupancy Schedule.

g. All screens shall be provided with a “hot button” to go back to the main “School Energy Management Center Portal” screen.

h. Graphics shall comply with the latest requirements established by M-DCPS District Inspections, Operations and Emergency Management (DIOEM). Contractor shall contact DIOEM at (305)995-1550 to obtain a copy of these requirements prior to bidding.

i. The JAVA platform shall not be used to create graphics.

2.12 WORK COORDINATION

A. Test and Balance: The EMS Contractor shall facilitate the T&B contractor all software and cables necessary to interface with the EMS during the test and balance process.

B. The following represents the scope of work of participating Trades Contractors, which the EMS contractor shall coordinate with:

1. All EMS control valves, auto temperature control dampers and sensor wells shall be provided by the EMS contractor for installation by others.

2. The Piping Contractor shall:

   a. Install automatic valves and separate wells as specified to be supplied by the EMS Contractor.

   b. Furnish and install all necessary pressure taps for steam, water, drain and overflow connections piping.

   c. Furnish and install all necessary piping connections required for flow devices.

3. The HVAC Sheet Metal Contractor shall:

   a. Install all automatic temperature control dampers provided by the EMS Contractor, and provide and install all necessary blank-off plates, or transitions required to install dampers that are smaller than duct size.

   b. Assemble multiple section dampers provided by the EMS Contractor with required interconnecting linkages and extend required number of shafts through duct for external mounting of damper actuators.
c. Provide access doors or other approved means of access through ducts for service to EMS equipment.

4. Electrical Contractor shall:
   
a. Furnish 120-volt power wiring to all DDC controllers including terminal box controllers and control valves as noted on drawings.
   
b. Provide a minimum of one (1) 120V duplex outlet adjacent to each EMS AHU controller.

2.13 EMS WIRING

A. All EMS wiring shall be installed in strict compliance with FBC, the EMS components manufacturer's instructions, and applicable M-DCPS’ Division 16 requirements. Where these requirements differ, the more stringent shall be followed.

B. All EMS wiring shall be installed in dedicated conduits. Conduit shall be minimum 3/4 inch galvanized EMT or rigid conduit in accordance with Division 16 of M-DCPS Design Standards. Where the requirements of this section differ with those in Division 16, the requirements of this section shall take precedence.

C. Wiring:
   
1. All wiring necessary for the installation of the EMS and associated controls shall be provided by the EMS Contractor under this Section. This shall include but not be limited to all wires, conduits, miscellaneous materials and labor as required for mounting and connecting of EMS and control devices, unless otherwise specifically noted herein.
   
2. Direct Burial cables shall be listed by a Nationally Recognized Testing Laboratory (NRTL) approved by OSHA.
   
3. When Cat-5 communication cable is use, the maximum wire length shall not exceed 300 feet. When the length of any communication cable exceeds 300 feet, fiber optic cable shall be use.
   
4. The EMS Contractor shall provide all Network wiring between controllers and Ethernet Data connections required for the remote access to the system.
   
5. The EMS Contractor shall be responsible for calibration and proper functioning of EMS and electronic devices furnished under this section.
   
6. The EMS Contractor shall coordinate with all the necessary associated trades in order to perform all EMS wiring work.

2.14 APPLICABLE CODES AND STANDARDS

A. All work, materials, and equipment associated with this specification shall comply with all the applicable Rules and Regulations, Codes and Ordinances established by local, state, and federal authorities. The EMS installation workmanship shall comply with all mandatory industry standards, as established by:
   
2. Florida Building Code (FBC).
4. FCC Regulation, Part 15 - Governing Frequency Electromagnetic Interference
5. Underwriters Laboratories UL916, or other OSHA approved Nationally Recognized Testing Laboratory (NRTL).

2.15 EMS COMPONENTS SELECTION

A. The EMS Contractor shall be responsible for the proper selection of control devices.

2.16 EMS DELIVERY

A. The EMS Contractor shall deliver, install and connect all required EMS components, and be responsible for the initial set-up of the EMS Triad, as a whole.

B. On existing sites, the overall security access to the work place shall be coordinated with pertinent on-site staff.

C. The school occupancy time schedule for the Physical Plant equipment EMS commanded automatic start/stop and On/Off circuits timing base-line shall be programmed in agreement with the school Principal, or leading administrator of the facility, at Substantial Completion.

1. The School EMS Center console display shall be installed visible from the Principal’s office. Installation shall be flush mounted, so that the bottom edge of the status display window appears at 4'-0" above finish floor, unless otherwise required by applicable accessibility Codes.

2. Sets of keys for access to the respective School EMS Center Console and RMC’s EMS Station shall be delivered to M-DCPS Office of Energy Management staff for distribution.

PART 3 WORK EXECUTION

3.1 INSPECTION:

A. At completion of the EMS work, a thorough inspection of the entire EMS Triad shall be conducted. The inspection shall be performed by the EMS Contractor, the A/E, the M-DCPS Project Manager, representatives from the corresponding RMC’s, and personnel from M-DCPS Office of Energy Management. The Project Manager shall coordinate with the EMS Contractor and M-DCPS relevant staff the conduct of the inspection. A minimum of two (2) weeks’ notice shall be given to all involved parties prior to the performance of this inspection.

3.2 TRAINING:

A. The EMS Contractor shall provide two levels of hands-on training to M-DCPS Staff. All training shall be conducted by certified EMS components manufacturer’s representatives.

1. The EMS Contractor shall provide 4 hours of hands-on training to M-DCPS Office of Energy Management personnel, Central Maintenance Training Administrator, the corresponding RMC’s technician and on-site zone mechanic on the function, operation, software programming, maintenance and emergency repair of the EMS components.
2. The EMS Contractor shall provide a minimum of two (2) 4-hour training sessions (total of 8 hours) to M-DCPS Office of Energy Management personnel and on-site staff addressing the operation of the School’s EMS Center console as well as details on the functional interaction of the RMC’s EMS Station and SBAB’s EMS Terminal.

3. All training shall be scheduled at M-DCPS’ discretion within thirty (30) days after Substantial Completion.

3.3 DEMONSTRATION:

A. Prior to Substantial Completion, the EMS Triad shall undergo a series of performance tests to verify operation and compliance with this specification. The required tests shall be scheduled after the EMS Contractor has completed the overall installation, activate the entire EMS, and performed its own tests.

B. Demonstrate compliance with Sequences of Operation through all modes of operation.

C. Final connections and operational tests of EMS equipment shall be performed by certified factory trained technicians or under the direct supervision of manufacturers’ representatives of the equipment being tested.

D. The EMS Triad concluding checkout and testing procedures shall include tests for short circuits, ground faults, and continuity of wiring and components.

E. For Facilities considered to be EHPA, the Contractor shall test the EMS override switch in the presence of the A/E, M-DCPS Project Manager, M-DCPS Energy Management personnel, Central Maintenance Training Administrator, the corresponding RMC’s technician and the on-site zone mechanic. The test sequence shall be as follows:

   1. Shut off normal power to school.
   2. Start Emergency Generator.
   3. Turn off EMS/ EHPA override switch.
   4. Confirm that all EHPA Systems, including but not limited to AHU’s, exhaust/supply fans, cooling equipment, VAV’s, EMS emergency controls, etc., and are properly operating on power provided by the emergency generator.

3.4 CLEANING:

A. The EMS Contractor shall clean up all debris resulting from its activities daily, removing all cartons, containers, crates, etc., under his responsibility as soon as their contents have been removed. Waste shall be collected and placed in a designated location.

3.5 FINAL COMPLETION:

A. Upon the completion of all the EMS Triad work, including the correction of all deficiencies identified in the Test and Balance Report, and all items identified by the A/E and M-DCPS during the Substantial Completion inspection, the EMS Contractor shall request a Final Completion Inspection of the work. Prior to requesting Final Inspection, the EMS Contractor shall ensure that all the requirements of the specifications have been completed including but not limited to the following:

   1. Completion of all punch list items.
   2. Performance of all sequence of operation tests.
   3. Submittal of all closeout documents including Operations and Maintenance Manuals.
4. Performance of all training sessions.
5. Submittal of all spare parts.

END OF SECTION