

## **SECTION 15002 MECHANICAL SYSTEMS BASIC REQUIREMENTS**

### **PART 1 – GENERAL**

#### 1.1 SCOPE:

- A. The fundamental objective of these guidelines is to document standards for the design of mechanical systems for Montgomery County Public Schools (MCPS) educational facilities.
- B. This Section provides A/E submittal and coordination directions and guidelines.

#### 1.2 DESIGN SUBMISSION REQUIREMENTS AND EXPECTATIONS:

##### A. Schematic Design Phase:

- 1. Begin integrated delivery process (IDP) – Develop Performance Metrics
- 2. Review education specifications
- 3. Review and provide input on delivery schedule
- 4. Review MCPS standards and Energy Efficiency and Environmental Design requirements
- 5. Discuss and set re-occurring design team meetings
- 6. Survey and report the conditions of existing systems, if not performed during feasibility process. Reference Existing Condition Survey Requirements in separate document.
- 7. Finalize and submit Schematic design submittal
- 8. Submit the following for discussion at Pre-DD Meeting:
  - a. Life-Cycle Cost Analysis (LCCA) Parameters for each proposed system
  - b. Project specific performance metrics (i.e. proposed mechanical space requirements)
  - c. Potential energy and water conservation parameters/techniques (i.e. envelope recommendations, grey water systems, etc.)
  - d. Detailed description of existing building systems (if applicable) and associated performance evaluation.
  - e. List and description of scheduled PLAR work and if applicable, the next modernization date.

##### B. Design Development – LCCA Results

- 1. Submit completed LCCA with associated system recommendations.

##### C. Design Development Phase – (submission and discussion must reflect completion of the following items)

- 1. Complete coordination with Architect regarding envelope requirements and fire/smoke ratings
- 2. Complete coordination with Electrical Engineering regarding lighting densities
- 3. Block and room thermal load calculations
- 4. Ventilation calculations
- 5. Preliminary energy calculations and simulations (Energy Study – Section 15001)
- 6. Schematic layout of major systems
- 7. Single line distribution to indicate intent
- 8. Coordination with EMS designer and Commissioning agent
- 9. Initial evaluation of LEED scorecard with selected systems
- 10. Energy Compliance Statement

11. Provide State Submittal energy conservation analysis data
  - D. Construction Documents – 65% (submission must reflect completion of the following items)
    1. Finalized layout of major systems
    2. Completed schedules for major equipment
    3. Coordination with Electrical Engineering regarding power requirements of major equipment
    4. Layout and sizing of distribution systems (i.e. double line duct,
    5. Coordination with Architect regarding diffuser layout and RCP
    6. Completed specifications and control sequence
    7. Points list for control system
    8. Control diagrams for major equipment
    9. LEED documentation for specified credits
    10. Evaluation of MCPS design checklist
    11. Review of EMS design and Commissioning plan
    12. Complete MCPS Energy Conservation Analysis
    13. Provide State Submittal load and equipment sizing calculations
  - E. Construction Documents – 99% (submission must reflect completion of the following items)
    1. Completed schedules for all equipment
    2. Code evaluation of systems (including fire code)
    3. Completed points list and control diagrams for all equipment
    4. Evaluation of building pressurization (verify balanced as intended)
    5. Final LEED submittals for design submission
- 1.3 CONSTRUCTION ADMINISTRATION – MECHANICAL ENGINEER
- A. This Preliminary Scope of Work is provided as only a guideline.
  - B. The Mechanical Consultant shall perform construction administration services during the period of construction. These services will encompass serving as a MCPS representative with regard to activities at the construction site, interpretation of the requirements of the construction contract documents, assessing the acceptability of the contractor's work, and evaluating contractor's questions and/or claims. The Mechanical Consultant is expected to perform and complete, at minimum, the following activities:
    1. Attend progress meetings on a monthly basis or as additionally requested by MCPS and/or the Construction contractor.
    2. Process and issue clarifications and interpretations of the contract documents related to requests for information. The Consultant shall also issue necessary clarifications and interpretations of the contract documents in response to requests by the contractor.
    3. Review submittals, including but not limited to, shop drawings, product data, product samples, and "as-built" documents.
    4. Evaluate discipline related contract modifications, contract change orders, and claims. Included shall be a review for merit, an independent estimate and associated recommendation to MCPS for consideration. If approved, the Consultant will complete all required construction documentation modifications.
    5. Walk the project on a monthly basis to review the work of the contractor for project plan and specification compliance. Prepare a report and associated punch list following each visit.
    6. When the project is deemed substantially complete, the Project Engineer will attend a scheduled walk through with MCPS representatives and prepare a punch list of incomplete or

unsatisfactory items and submit the list to the contractor. Once all work is satisfactorily complete, the Consultant will deliver a statement to MCPS indicating that to the best of their knowledge and belief, after diligent investigation, the Project has been completed in accordance with the construction contract documents and recommends acceptance or as indicated in design contract with Architecture Firm.

7. Establish and maintain a Project file for delivery to MCPS after the construction is complete. Project file shall contain documentation as related to all above information.

#### 1.4 DESIGN TEAM COLLABORATION:

- A. Team Structure: It is fully expected for the team to form and operate in an integrated and optimized manner. The integrated project team will be composed of all life-cycle stakeholders and will be formed early in the design process. A primary goal during this process is to clearly define metrics that represent performance objectives of the various stakeholders. These metrics may include but are not limited to: space requirements, construction costs, life-cycle economics, energy-efficiency, environmental impact, occupant health, comfort and student performance, and building functionality and adaptability.
- B. Team Communications: The design team shall utilize open communication and collaboration between all project team members. This open communication protocol is critical for project success and will be stressed throughout each project stage.
- C. Independent Consultants: MCPS routinely utilizes independent consultants to perform Energy Management/Control Systems design and Systems Commissioning. It is fully expected that each member of the design team will facilitate a streamlined approach to transferring project data between participants.

#### 1.5 GENERAL REQUIREMENTS – CONSTRUCTION SPECIFICATIONS

##### A. Submittals

1. Require contractor to submit a minimum of eight (8) copies of appropriate shop drawings and catalog cuts of all equipment and materials within 30 days of General Contract being awarded.
2. Ozone Depleting Potential (ODP) and direct Global Warming Potential (GWP) ratings shall be provided for all of refrigeration equipment on projects pursuing LEED certification.

- ##### B. Coordination Drawings: Require mechanical contractor to prepare and submit for A/E review and approval coordinated shop drawings for ductwork, mechanical piping, sprinkler piping, structure, light fixtures, etc. prior to any ductwork installation.

##### C. Record Drawings:

1. Require contractor to keep accurate records of all deviations in work as actually installed from work indicated, paying particular attention to dimensioning outside underground utility lines, their offsets and valves. A record set of drawings is to be kept on site for specific purpose of recording as-built conditions and updated weekly.
2. Two (2) complete sets of "As-Built" marked-up prints are to be submitted to A/E for review and approval for subsequent delivery to MCPS prior to final acceptance.

##### D. Operating and Maintenance Manuals, Training:

1. O&M Manuals are to be prepared by contractor and approved by the A/E prior to any contractor's mechanical systems instructions and training of Owner's operating and maintenance personnel. The A/E approved O&M Manuals are to be available and used during training. Delivery of final O&M Manuals to Owner shall not occur until Owner's instructions and training have been completed and any amendments to manuals requested by Owner have been made.
2. Contractor is to provide all instructions and training of Owner's personnel; the training agenda, detailed presentation, and instructor resume. is to be submitted and approved. Contractor shall have all sessions professionally video recorded.

3. Upon completion of instructions and training, three (3) copies of O&M Manuals and three (3) copies of the videos in DVD format shall be provided to Owner.
  4. Contractor is to provide a detailed list of all filters and belts for equipment installed on the project, identifying the equipment, location, filter size/type, and belt size/type.
- E. Warranties (warranty period begins at substantial completion):
1. Two year full warranty on all HVAC systems and equipment
  2. Two year full warranty on plumbing, fire protection.
  3. Contractor shall provide warranty on all parts, labor, gases, recalibration, etc. and provide response to service calls within 24 hours during the warranty period.
  4. Certain equipment shall be provided with manufacturers' warranties extending beyond the contractor's warranty period; i.e. 5-year warranty on refrigeration compressors, 10-year warranty on gas fired furnace heat exchangers, etc. Contractor shall furnish Owner with all manufacturers' guarantees or warranties.
- F. Spare Parts: Spare parts requirements are detailed in subsequent sections of this guide. Assure delivery and acceptance of spare parts by Owner is documented per general conditions to contract.
- G. Identification: Labeling/Tagging/Painting
1. Labeling:
    - a. All equipment such as pumps, fans, terminal units, etc. shall be marked to clearly identify equipment and space or duty served. All control devices (i.e. panels, switches, starters, push button stations, temperature control, etc.) shall be identified as to their function and equipment controlled. Identity plates shall be engraved laminated phenolic legend plates with minimum  $\frac{3}{4}$ " high white letters on surrounding black; plates shall be screwed to equipment.
    - b. Piping shall be identified with colored, pre-rolled, semi-rigid plastic labels as manufactured by Seton, Marking Services, Inc. or approved equal. Labels shall be set around the pipes with field installed high strength cement around pipes. Labels shall be placed around the piping or insulation every 40 feet and with one label on each pipe in rooms with a dimension smaller than 15 feet. A label shall be placed at every major valve and at least six feet from exit or entrance to any item of equipment.
    - c. Ductwork shall be identified by stenciling. Stenciled lettering shall be minimum 3" high with adjacent direction of airflow arrows. Stenciled lettering shall be provided on all mains and principle duct branches. Mark each type of service every 30 feet with a marking of each shaft.
  2. Tagging:
    - a. Ceilings are to be marked with permanent tags on ceiling grid to show location of valves and equipment above ceiling. Ceiling tags shall be color coded for equipment, valves, etc. and bear embossed identity; i.e. equipment number or valve number.
    - b. All valves shall be tagged and numbered with a 1-1/4" brass disc. A list showing the number, location, service and remarks concerning operation of each valve shall be provided for framing and mounting under glass in the Main Pump Room.
  3. Painting:
    - a. All structural supports for equipment shall be painted with two (2) coats of rust inhibiting paint.
    - b. All ductwork exposed to weather shall be covered with two (2) coats of asphaltum paint.
    - c. All exposed piping in mechanical rooms shall be painted.
  4. Painting colors and labels are as follows:

Heat Pump Water Supply/Return (Closed building loop)	White	HPWS / HPWR
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Condenser Water Supply/Return (from/to cooling tower)	Gray	CTS / CTR
Heating Water Return (from condenser loop to boilers)	Orange	HWR
Heating Water Supply (from boilers to condenser loop)	Orange	HWS
Chilled Water Supply/Return	Dark Blue	CHWS / CHWR
Domestic Cold Water	Green	DWC
Domestic Hot Water, Hot Water Recirculating	Red	DWH / DWHR
Gas	Yellow	GAS
Fire Protection Sprinkler	Black	Sprinkler
Condensate	White	COND
Refrigerant	Black	REF

1.6 PERMITS: All required permits are contractors' responsibilities.

**PART 2 – PRODUCTS**

2.1 Equipment and products utilized in systems design shall be compliant with these guidelines where standards have been established. Contract documents shall be appropriately coordinated such that project specifications gel with equipment scheduled on drawings.

2.2 In the event any equipment contained in these guidelines has become obsolete or superseded; the A/E shall apprise MCPS of the occurrence and receive MCPS approval for substitutions.

**PART 3 – EXECUTION**

3.1 Mechanical/Electrical Requirements, Coordination:

- A. Piping and ductwork shall not be run above electrical panels, switchboards, motor control centers, etc. Piping shall not be run thru electrical rooms/closets or telecommunication, computer equipment rooms.
- B. All variable frequency drives shall be of the same manufacturer. Drives shall be installed close to the controlled motor. Drives for outdoor mounted equipment shall be independently mounted inside a NEMA 4x enclosure or factory installed within the manufacturer's equipment housing, but not in fan sections.
- C. All motor starters shall be provided with panel mounted Hand-On-Auto switches with indicating light jewels.
- D. Field mounted disconnects shall be provided for all motors and equipment.
- E. All 3-phase motors, including all VFDs, shall have auto-reset phase protection; ICM-450 undervoltage, overvoltage, loss of phase, phase reversal protection with time delay and auto reset. Phase protector may be furnished and installed by HVAC equipment manufacturers and/or field installed; coordinate with Division 16.
- F. Emergency Power (coordinate with Division 16)
  - 1. All rooftop mounted units and air handling units subject to ambient conditions that have a water-side heat exchanger shall have a minimally sized electric resistant heater and coil dependant jockey pump installed for freeze protection. This emergency heater and pump shall be placed on emergency power.
  - 2. Freeze protection heat trace and required basin heaters.
  - 3. Energy management panels controlling equipment on emergency power shall also be powered from emergency power circuits.
  - 4. Kitchen freezer and walk-in refrigerators shall be on emergency power.
  - 5. Chemical storage exhaust fan.
  - 6. High School Assembly Spaces: All assembly air handling equipment shall have emergency power for ventilation purposes. Load requirement shall include supply/return/exhaust fan(s), and control power for damper(s) operation (including smoke type not within unit). Heating/cooling operations are not required.
- G. EMS Coordination: Design coordination is required among the mechanical engineer, electrical engineer, and controls consultant.

1. HVAC drawings shall show space thermostat/temperature sensor locations. Rough-in of empty outlet boxes in wall and 3/4" conduit stubbed into ceiling cavity for EMS space temperature sensors shall be shown or otherwise accommodated on electrical drawings for installation by electrical contractor; inside of empty outlet boxes shall be painted purple to identify for EMS use.
  2. EMS controllers requiring 120V power shall be shown on HVAC drawings. Electrical power for EMS controllers shall be on dedicated circuits, accommodated on electrical drawings; EMS controller controlling roof mounted water-cooled/source equipment and heat tracing shall be on emergency power. Design work shall be coordinated with EMS consultant.
  3. Power to Heat Pump Controllers: Assure that electrical power drawings provide dedicated 120V circuits for EMS heat pump controllers. The EMS heat pump controllers have ~25VA power draw; each heat pump has a controller. EMS contractor will install transformers and disconnects for each controller. The 120V circuits do not need to be on emergency power; circuits should be clearly labeled in panelboards.
- 3.2 Mechanical/Architectural Requirements, Coordination: In addition to routine mechanical and architectural design coordination, assure that the following items are accommodated:
- A. Door undercuts, louvers required by mechanical are on architectural door schedule. These items may be incorporated within the design pending acoustical analysis and smoke partition requirements.
  - B. Door closers are provided on all mechanical equipment rooms and closets opening into corridors.
  - C. Access to roofs from inside the building to accommodate servicing of rooftop equipment.
  - D. Painting:
    1. Painting of mechanical rooms is provided in architectural specifications.
    2. Painting of ductwork, piping, equipment specified in mechanical sections is coordinated with architectural painting specifications.
  - E. Roof Penetrations: All penetrations thru roofs for ductwork, pipes and electrical conduits, refrigerant lines (including those for walk-in coolers and ductless split systems), shall be made water proof, have roof curbs 12" high minimum, stainless steel cover with piping exit on the side protected by rain hood and insect screen. Avoid pitch pockets.
  - F. Floor and Wall Penetrations: All penetrations thru floors and walls for ductwork, pipes, refrigerant lines, and electrical conduits shall be sealed.
- 3.3 Heat Pump Repair Station: Space shall be designated in the main pump/main mechanical room of each school for maintenance staff to repair heat pumps. Provide a cold water hose bib and a 120V convenience duplex receptacle.
- 3.4 Mechanical Drawings Content: In addition to routine mechanical design documentation, provide the following on the mechanical drawings:
- A. ASHRAE Standard 90.1 / IECC Building Envelope Compliance
  - B. Outdoor/Exhaust Air Ventilation Rates compliance matrices
  - C. Building Design Criteria (Summer/Winter outdoor/indoor design temperatures)
- 3.5 English/I-P Units: All equipment manuals, displays, nameplates, affixed instructions, wiring diagrams, etc. shall be in English and Inch-Pound units; temperatures shall be in Fahrenheit. Equipment documentation, operating instructions, displays, etc. utilizing metric and Celsius units as the primary measures are not acceptable.
- 3.6 Sound/Noise:
- A. Noise criteria of cooling towers, condensing units, air compressors, fans, unitary equipment, and other outdoor units shall not exceed the Montgomery County EPA and State of Maryland noise criteria levels: In general, noise levels shall not exceed the following criteria:
    - 55dBA at the property line for outdoor equipment.
    - 48dBA at 8' distance from units in occupied areas

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- B. Maximum classroom and core learning space mechanical system background noise shall not exceed 45 dBA. Comply with ANSI Standard S12.60-2002, and ASHRAE design strategies for Sound and Vibration Control (Chapter 47 of the Applications Handbook).

**END OF SECTION**