



01 7900 – Demonstration and Training of MEP Systems

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General:

- A. Demonstrations and Training of various MEP and other systems is very important to BSU Facilities, especially on new building or major renovation projects. The specification that follows shall be used by consultants and edited to fit the project requirements accordingly.
- B. On LEED projects or where commissioning of systems is otherwise required the Commissioning Authority is charged with managing the demonstration and training process.



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SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary
- B. Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.
 - 3. Demonstration and Training record forms.
- B. Related Sections include the following:
 - 1. Division 01 Section "Project Management and Coordination" for requirements for pre-instruction conferences.
 - 2. Divisions 02 through 49 Sections for specific requirements for demonstration and training for products in those Sections.

1.3 SUBMITTALS

- A. Instruction Program: Submit two copies of outline of instructional program for demonstration and training, including a complete schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module. Refer to Part 3 for blank forms to fill out.
 - 1. At completion of training, submit one complete training manual(s) for Owner's use.
- B. Qualification Data: For instructor.
- C. Attendance Record: For each training module, submit a completed Staff Training and Orientation Record form that includes a list of participants, job title, signature and date of completion. Refer to Part 3 for blank form to fill out.

1.4 QUALITY ASSURANCE

- A. Instructor Qualifications: A factory-authorized service representative complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and



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maintenance procedures and training and familiar with the specific project installation.

- B. Pre-instruction Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
1. Inspect and discuss locations and other facilities required for instruction.
 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
 3. Review required content of instruction.
 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.5 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.
- B. Coordinate instructors, including providing notification of dates, times, length of
- C. Instruction time, and course content.
- D. Coordinate content of training modules with content of approved emergency,
- E. Operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections, and as follows:
1. General building equipment, including projection screens, blinds, shades, revolving doors and postal specialties.
 2. Fire-protection systems, including fire pumps.
 3. Conveying systems, including elevators.
 4. Domestic water system including softeners, water heaters, heat exchangers and pumps.
 5. Sanitary and storm systems including drainage system and pumps.
 6. Hydronic heating system, including boilers, pumps and water distribution piping.
 7. Refrigeration systems, including pumps and distribution piping.
 8. HVAC systems, including air-handling equipment air distribution systems and terminal equipment and devices.
 9. HVAC instrumentation and controls including the BAS system.



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10. Electrical service and distribution, including transformers switchboards ,
uninterruptible power supplies and motor controls.
 11. Emergency distribution system including packaged engine generators, transfer
switches and distribution equipment.
 12. Fire alarm system.
 13. Lighting equipment and controls.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following:
1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria, if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 2. Documentation: Review the following items in detail:
 - a. Emergency manuals
 - b. Operations manuals.
 - c. Maintenance manuals.
 - d. Project Record Documents.
 - e. Identification systems
 - f. Warranties and bonds.
 - g. Maintenance service agreements and similar continuing commitments.
 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.



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5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a combined training manual.
- B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment. Instructors shall be persons familiar with the specific installation. In most cases this will be the actual installing and/or startup factory technician along with the foreman or site superintendent from the appropriate subcontractor.
 1. The installing subcontractor must be present and be an active participant in all training sessions. Failure by the subcontractor to participate in the training and/or the absence of qualified factory technicians familiar with the specific installation may result in the postponement of the training session. Training on some systems will require attendance by multiple subcontractors. All costs associated with rescheduling the training shall be borne by the contractor.



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- B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner, through the Commissioning Authority, with at least seven days' advance notice.
 - 2. Training shall not be scheduled until equipment and/or system is 100% complete, operational and commissioned.
 - C. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.
- 3.3 FORMS - Refer to appendix following this section
- A. Training Schedule
 - B. Staff Training and Orientation Record
 - C. Training Agenda
- 3.4 SYSTEM SPECIFIC TRAINING REQUIREMENTS
- A. General Building Equipment
 - 1. The installing subcontractor foreman and a qualified factory technician familiar with the specific installation shall conduct this training.
 - 2. Provide operating and maintenance instruction on motorized projection screens, shades and blinds. Manually operated screens, shades and blinds do not require Owner's training. Provide operation and maintenance instruction on post office boxes per specification. Provide operation and maintenance training on revolving doors. Demonstrate how to make adjustments to revolving doors.
 - B. Fire Protection System
 - 1. The fire protection system subcontractor project foreman as well as the project fire pump startup technician shall conduct this training session. The electrical subcontractor foreman will also need to be present for this session to assist with running the fire pump on normal and emergency power. The fire alarm manufacturer's technician needs to be present to operate the fire alarm system during the pump demonstration.
 - 2. Starting with the vault discuss location of the city water main tap, tap size and pipe route from the tap to the vault and into the building. Open the vault and discuss the operation of any valves, backflow devices, check valves, tamper switches and any other equipment in the vault. Pump groundwater from the vault prior to the training session if needed. Identify location of the fire pump test connection, the fire department connection and the PIV. Identify location of the nearest storm drain for conducting a fire pump flow test.
 - 3. Inside the building, walk down all piping locations including pump test header, the fire department connection piping, number and locations of risers, locations of control or zone valves, locations of all flow and tamper switches. Discuss how the building is zoned. Locate low point drains and inspector's test stations.



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4. Discuss in detail the operation of the fire pump. Discuss what valves are normally open and those that are normally closed. Discuss the pump bypass, where present. Demonstrate performing a fire pump churn test. Demonstrate running the pump on normal and emergency power. Provide pump flow test data at the training session. Actual flow test need not be performed at the training session. The acceptance flow test needs to have been completed and passed prior to Owner's training. Discuss any maintenance instruction and common trouble shooting techniques. Discuss operation of the jockey pump and provide pressure set points for the jockey pump and the fire pump. Demonstrate how to completely drain down the system and how to drain down the fire pump test header. Demonstrate how to disable the system in the event of required maintenance on a zone.
 5. Provide emergency contact information.
- C. Conveying Systems
1. The elevator subcontractor project foreman shall conduct this training.
 2. Demonstrate normal and emergency operation of all elevator cabs. Provide emergency contact information.
- D. Domestic Water System
1. The plumbing subcontractor foreman, the water softener startup technician, the pump manufacturer startup technician and the water heater startup technician shall conduct this training session.
 2. Identify the location of the water meter and walk down system plumbing from that point into the building. Identify the location of any backflow devices. Locate the water softener, water heater, geothermal pre-heat heat exchanger, thermostatic mixing valves, booster pumps, and circulating pumps. Provide training on the operation and maintenance of each piece of equipment. Discuss common troubleshooting techniques. Discuss brine system. Identify locations of plumbing risers.
 3. Discuss operation and maintenance of any automatic faucets or flush valves.
- E. Sanitary and Storm Systems
1. The plumbing and site utility subcontractor foremen as well as the sump and sewage ejector pump manufacturers rep shall conduct this training.
 2. Walk down storm and sanitary risers and mains. Identify where mains exit the building and to what structures they drain to.
 3. Provide operation and maintenance training on any sump or sewage ejector pumps. Identify pump discharge piping. Discuss common troubleshooting techniques.
- F. Hydronic Heating System
1. The mechanical subcontractor foreman, controls subcontractor primary technician, hydronic pump startup technician, condensate receiver startup technician, snow melt system startup technician and related equipment including but not limited to valence units, radiant heaters manufacturers' representatives familiar with the project installation shall conduct this training.
 2. Start with geothermal curb or tunnel isolation valves and walk down the geothermal piping system as it enters the building. Identify isolation valves, control valves, BTU and flow meters, filters, dp switches and all related instrumentation. Describe pump operation and train on operation and



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- maintenance. Discuss normal operating temperature and pressure ranges and flow rates. Locate and identify main risers and locations of isolation valves. Locate all equipment served by the hydronic heating water system including valence units, radiant heaters and snow melt system.
3. Identify all components of the snow melt system and describe normal operation and maintenance procedures.
 4. Describe domestic water pre-heat operation.
 5. Describe steam backup heating system operation and provide training on the condensate receiver including operation and maintenance. Demonstrate how to switch from geothermal water heating mode to steam generated hot water heating mode.
- G. Refrigeration and Chilled Water Systems
1. The mechanical subcontractor foreman, any DX equipment startup technicians, the chilled water pump startup technician and the controls subcontractor shall conduct this training.
 2. Starting at the curb or tunnel isolation valves walk down the chilled water piping system as it enters the building. Identify isolation valves, control valves, BTU and flow meters, filters, dp switches and all related instrumentation. Describe pump operation and train on operation and maintenance. Discuss normal operating temperature and pressure ranges and flow rates. Locate and identify main risers and locations of isolation valves. Locate all equipment served by the hydronic chilled water system including valence units and any chilled water cooled equipment.
 3. Identify any DX cooled equipment and provide training on the proper operation and maintenance.
- H. HVAC System
1. The mechanical subcontractor foreman, the air handling unit startup technician, the exhaust fan startup technician and the controls subcontractor shall conduct this training.
 2. Identify each air handler and exhaust fan and provide training on operation and maintenance. Describe how to change filters, grease bearings and replace belts. Describe operation of the enthalpy wheels.
 3. Walk down supply, return, exhaust and relief duct systems. Identify locations of exterior louvers, fire dampers, duct smoke detectors. Identify and describe laundry exhaust system. Describe typical locations of balancing dampers.
- I. HVAC Instrumentation and Controls
1. The controls subcontractor shall conduct this training.
 2. Provide 24 hours of on-site orientation provided in 6 - four hour sessions by a system technician who is fully knowledgeable of the specific installation details of the project. This orientation shall, at a minimum, consist of a review of the project as-built drawings, the BMS software layout and naming conventions, and a walk through of the facility to identify panel and device locations. The first 4 - four hour sessions will take place at the beginning of the warranty period. Another 2 - four hour sessions shall take place over the remainder of the warranty period.
 3. Development of all equipment schedules will be demonstrated during the training session. Owner shall direct zoning of equipment at times as it pertains to schedules.



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4. Provide training on the navigation of the software and provide a projection screen and projector as required for demonstration.
- J. Electrical Service and Distribution
1. This training shall be conducted by the electrical subcontractor foreman and a factory representative from the electrical distribution equipment supplier and the UPS equipment startup technician familiar with the specific project installation.
 2. Starting at the oil filled primary transformer(s) walk down the system identifying major feeders, the main switchboards and all panelboard locations. Identify the main service disconnects and the fire pump normal service disconnect.
 3. Provide instruction on changing adjustable breaker settings and provide current setting information to the Owner.
 4. Demonstrate how to operate the Main-Tie-Main setup.
 5. Provide training on the operation and maintenance of the central UPS and provide emergency contact information. Demonstrate network connectivity and monitoring software.
- K. Emergency Distribution System
1. This training shall be conducted by the electrical subcontractor foreman, the generator startup technician and the automatic transfer switch startup technician shall conduct this training.
 2. Starting at the emergency generator provide training on the operation and maintenance of the unit. Demonstrate manual and automatic startup, start delay setting, return to normal setting and cool down setting and adjust per Owner's request. Demonstrate operation and maintenance of the ATS's and program the exercise timer per Owner's request.
 3. Walk down feeder routes and identify distribution equipment and any remote alarm panels. Describe all the loads connected to each branch of the emergency system.
 4. Demonstrate the kirk-keyed interlocks and backfeeding the building from the generator and manually switching back to normal. This shall be a live demonstration, not just a description of the procedure.
- L. Fire Alarm System
1. This training shall be conducted by the electrical subcontractor foreman and the fire alarm system installing technician familiar with the project.
 2. Train Owner's maintenance personnel in the procedures and schedules involved in operating, troubleshooting, servicing and preventive maintaining of the system. Provide a minimum of 8 hours training.
 3. Schedule training with the Owner at least seven days in advance. This training shall occur prior to and be independent of the Owner witnessed 100% test and demonstration of the system.
 4. Training shall include basic operation of the fire alarm control panel and remote annunciators. Explain and demonstrate how to acknowledge, silence and reset alarms. Demonstrate how to read the display and respond accordingly. Explain any control functions such as AHU shutdown, elevator recall or smoke control systems. Demonstrate how to operate the disable buttons or switches. Conduct a walkthrough of main system components including the FACP, any annunciators, any amplifiers, NAC panels or remote transponder panels. On voice annunciated systems, demonstrate the paging system and emergency buttons and fireman's phones if present. Demonstrate the system printer and



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internet connectivity.

M. Lighting Controls

1. This training shall be conducted by the electrical subcontractor's foreman and the dimming system (where present) startup technician familiar with the project.
2. Provide instruction on all automatic lighting controls such as occupancy sensors and photocells. Locate exterior lighting contactors or relays and photocells. Provide instruction on how to adjust each type of occupancy sensor sensitivity and time out settings. If a dimming system is present provide a complete demonstration of the operation of the system.

3.5 TURN OVER OF SPARE PARTS AND KEYS

- A. Turn over any spare parts and keys required by the specifications at the training session for the specific system such as filters, belts, cabinet keys, lamps, fire alarm devices, etc.
- B. An authorized Owner's representative shall sign receiving for the items turned over.

3.6 FORMS



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STAFF TRAINING AND ORIENTATION RECORD

Project:

System:

[Attendees should sign this form at the completion of the training session and return it to the trainer]

Attendee Title	Name	Signature (at the completion of training)	Date of Completion

Instructor's

Company

Owner's Representative

Commissioning Agent



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TRAINING AGENDA

Equipment / System:

Section 1 Instructors [To be filled in by trainer prior to training.]

ID	Trainer	Company	Position/Qualifications
1) _____	_____	_____	
2) _____	_____	_____	
3) _____	_____	_____	

Section 2 Agenda [The responsible contractors have their trainers fill out this section and submit to Owner and Commissioning Agent for review and approval prior to conducting training.]

Location: _____ Date _____

(√ all that will be covered)

	Instructor Initials	Completed (√)
<input type="checkbox"/> Systems Training		
<input type="checkbox"/> General purpose of this system or equipment (design intent)		
<input type="checkbox"/> Review of control drawings and schematics (have copies for attendees)		
<input type="checkbox"/> Startup, loading, normal operation, unloading, shutdown, unoccupied operation, seasonal changeover, etc., as applicable		
<input type="checkbox"/> Building automation controls (BAS): programming, troubleshooting, alarms, manual operation, interface with integral controls		
<input type="checkbox"/> Integral controls (packaged): programming, troubleshooting, alarms, manual operation		
<input type="checkbox"/> Interactions with other systems, operation during power outage and fire		
<input type="checkbox"/> Relevant health and safety issues and concerns and special safety features		
<input type="checkbox"/> Energy conserving operation and strategies		
<input type="checkbox"/> Any special issues to maintain warranty		
<input type="checkbox"/> Common troubleshooting issues and methods, control system warnings and error messages, including using the control system for diagnostics		
<input type="checkbox"/> Special requirements of tenants for this equipment's function		
<input type="checkbox"/> Service, maintenance, and preventative maintenance (sources, spare parts inventory, special tools, etc.)		
<input type="checkbox"/> Question and answer period		
<input type="checkbox"/>		
<input type="checkbox"/>		
<input type="checkbox"/>		
<input type="checkbox"/>		



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Training methods that will be included (clarify as needed): (Trainer checks all that apply)

- Use of the O&M manuals, illustrating where the verbal training information is found in writing
- Each attendee will be provided:
 - 1) the control drawing schematic and sequence of operations;
 - 2) a copy of this agenda.
- Discussion/lecture at site _____
- Site demonstration of equipment operation _____
- Written handouts _____
- Manufacturer training manuals _____
- Classroom lecture _____
- Classroom hands-on equipment _____
- Video presentation _____
- Question and answer period _____

Section 3 Approvals and Use [Once the Agenda has been filled out by the Trainer, the Owner and Commissioning Agent review, make edits, sign and return to Contractor who provides to the Trainer for use during training. Copies of Agenda shall be provided to trainees.]

This *plan* has been approved by the following individuals, subject to the additions and clarifications noted in the left columns marked "add." (*This is not an approval of training completion.*)

Owner's Representative

Date

Commissioning Agent

Date



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END OF SECTION