

Chapter 13

Installation/ Commissioning

The entire EMS should be installed by skilled technicians, electricians and mechanics, all of whom are properly trained and qualified for this type of work. Electricians are obviously experts in electrical work; however, they may not have a background in the HVAC related field. (A mixed air sensor should not be located in the return air duct; a differential pressure switch will not provide proper air flow status/alarm of the fan if one of the sensing tubes is extended outside the building.) Similarly, a steamfitter mechanic may not know the first thing about wiring a motor starter or installing conduit. Each trade has their own separate procedures and regulations to guide them. For these reasons, each EMS project should require a vendor-supplied project manager. He should have a minimum of five years in the temperature controls/EMS business and has experience in managing previous EMS projects.

The system and materials should be installed in accordance with manufacturer's instructions, roughing-in drawings and details shown on submittal diagrams. All electric cables and polyethylene tubing should be extended and connected to numbered lines inside of all field panels. Sufficient spare cable (minimum of 5 feet) should be provided to allow final terminations. Be certain that all wires and air lines are alphanumeric coded.

The EMS contractor should be responsible for all installation including:

MATERIALS

- All EMS panels, automation devices, and enclosures
- All mounting hardware
- All interconnecting wire, junction boxes, terminal strips, etc.
- All sensors, relays, contractors, and other input/output field hardware required to satisfy approved point list sequence of operations.
- Any additional materials required to constitute a complete and functional installation.

INSTALLATION

- All wiring between panel and remote devices
- Mounting of panel(s)
- All electrical terminations required to satisfy approved point list and sequence of operation.
- Calibration and final check-out of all installed devices
- Installation of all devices/equipment specifically allocated to EMS contractor.
- Provide 10% spare wire pairs on multiconductor runs

ON-SITE SUPERVISION

- Continuous on-site supervision of installation personnel shall be provided by an employee of the EMS contractor regularly and primarily responsible for such supervision.
- Sufficient on-site supervision by the vendor's application engineer shall also ensure that all work is satisfactorily completed as submitted and approved.

AS-BUILT DRAWINGS

- Application engineer shall formulate “as-built” drawings showing any changes between submittal drawings and actual installation.

COORDINATION—WITH OTHER TRADES AND WORK

- The EMS contractor shall be responsible for providing necessary interface to mechanical equipment, lighting, etc. at time of submittal. EMS contractor shall not be responsible for providing additional interface required by significant changes to equipment/installation provided by other contractors.
- All materials and workmanship provided and performed under the specification shall be guaranteed by the EMS contractor for a period of one full year commencing on date of substantial completion of system installation and being placed in useful service providing the special functions. Modern day EMS vendors have been known to offer a 2 or 3 year guarantee because they have that much confidence in their product.

The implementation or installation phase is critical to the successful operation and ultimate control of an EMS. Knowledgeable and competent personnel should be assigned to monitor the installation activities of the contractor(s). The personnel selected should be: 1) familiar with the facility and system, 2) experienced in the present control network, and 3) have full understanding of the overall project scope that will provide assurance that all interfacing components and techniques are incorporated during the installation.

A continuing problem with design and construction is the fact that the design engineer has often completed his or her duties and has left the project by the time the design is ready for commissioning and start-up. This is a bad practice because it denies the engineer the important feedback that can be used to make the next project more effective. It is also harmful to the project because contractors, who do not necessarily understand the concepts behind the physical design, are the ones who must make it work. When systems are simple, little harm can come from this practice, but it can be very detrimental when advanced technology

systems are to be installed. Contractors who do not understand the intent of the design often make adjustments that operate counter to the intent of the design as they try to make the system perform properly.

The best solution is to see that the design engineer remains with the project through its start-up. The engineer retains responsibility for ensuring that the systems are brought to an operating state that meets all the design criteria. This includes taking direct charge of the development of all energy management system software that will provide the control sequences to operate the building. It also includes responsibility for providing the owner's staff with the understanding and training required to operate the building as desired.

EMS commissioning requires expert technicians skilled in the start-up of such systems. It becomes a tedious job, but each and every point should be tested 100% functional regardless of how long it takes.

Some earlier EMSs required an integral intercom system installed between all field panels and the head-end CPU. These proved to be valuable when commissioning a project as it provided a means to communicate with remote sites during the debugging process as well as maintenance procedures. However, an intercom system integral with an EMS is expensive and must be maintained. Most owners prefer to use a walkie-talkie system which are much less expensive and can be used for a variety of other functions.

Functional and operational tests of the hardware, subsystems, software and the complete EMS must be required and enforced.

A final test of the complete system in the fully-operational mode is required in the project documents and enforced in the field to assure compliance.

A "Substantial Performance Test Procedure" is used in British Columbia, Canada for an EMS project bid in early 1990. See following three pages which include an operational check-out, (7) Day Test, and documentation.

SUBSTANTIAL PERFORMANCE TEST PROCEDURES

Overview

Before the SEVEN (7)-day acceptance test may begin, the EMCS must be completely operational including the following:

- 1) Every point shall be checked end to end to ensure accuracy and integrity of systems. Each point will appear on one of the sheets in Clause 7 and be signed off by both persons involved in the commissioning procedure.
- 2) Basic control strategies shall be written in Operator Control Language (OCL).
- 3) Time schedules shall be built and in control, replacing time-controlled equipment.
- 4) Displays shall be built for each logical air handling system, boiler systems, chiller, etc.
- 5) Each control loop measured variable, controlled variable and set point if calculated; shall be placed on a FIFTEEN (15)- minute continuous trend for at least TWENTY-FOUR (24) hours to prove stability of loop.
- 6) Each space sensor shall be placed on a THREE (3)-hour trend for One Hundred (100) samples.
- 7) Runtime totalizer shall be set on all digital outputs.
- 8) Load/save of panel programs must be demonstrated.
- 9) If included, sample dynamic graphics shall be built as demonstration of graphic capabilities.
- 10) Ail features of system shall be exercised.
- 11) Operator shall be briefed on operation of system.
- 12) A trend on one panel shall be set up for a point from another panel. This point shall also be trended in its own panel for the same intervals. Comparison of the two trends will indicate if any communication problems are occurring during the SEVEN (7)-day test.

13) Related DIs and DOs shall be connected to show alarm condition.

During SEVEN (7)-day Test

1. Fire alarm will be tested to ensure correct action of all fire and smoke sequences.
2. Power failure for building will be simulated, system recovery monitored.
3. Control strategy upgrade shall be started which will exercise most features of the system.
4. Demonstration of modem operation will be required.
5. Demonstration of hardware low limits and damper interlocks will be required.
6. Spot checks of points end-to-end integrity will be carried out. If several problems are identified, a complete reconfirmation of system integrity will be required by Contractor.
7. Printer shall be left on for complete SEVEN (7)-day test. All print-outs will be kept for review at completion of list. An alarm printer shall be supplied by the Contractor if none is supplied in this contract.

Documentation

The following documentation must also be in place before completion of SEVEN (7)-day test and Substantial Acceptance is granted:

- 1) Panel layout sheets complete with point name, point address and wire identification number. One copy attached to each respective panel door.
- 2) All points tagged with point name, point address and panel number.
- 3) Points Check-Out data sheets showing final set points values during calibrations.

- 4) As-Built control drawings showing interface with existing controls.
- 5) As-Built ladder wiring diagrams showing all hardware interlocks.
- 6) Complete Operators Manual.
- 7) Apparatus and Maintenance Manual for all sensors, transducers, solid state relays, etc.
- 8) Reduced floor plans showing sensory, terminals and panel locations.
- 9) Electrical approval certificate.
- 10) All of the above information, with the exception of #2 (point tags) shall be bound and presented in FIVE (5) manuals to be left on site.

Once the basic above requirements are met and all other features of the system are complete and acceptable, Substantial Completion shall be granted. A deficiency list shall be prepared and holdbacks applied. All deficiencies shall be corrected prior to Total Performance. Warranty shall start from the date of Total Performance of the work.