


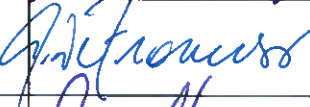




Commissioning Process

Building Automation System

8/4/2015

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Special Commissioning Process – Building Automation System

1. Objective and Scope

1.1. Objective

1.1.1. This Special Commissioning Process is intended to direct the commissioning activity in the execution of the Building Automation System for all new, expanded or renovated systems. This is not intended to provide installation direction, instead to provide a process and responsibility matrix ensuring consistent delivery of the commissioning task. This Special Commissioning Process is distinguished from the Commissioning Process for other components of the building because of the special nature of the systems and the broader number of participants involved.

1.2. Scope

1.2.1. This process is to be used for all changes to existing or new installations.

2. Definitions

Term	Definition
BACnet Instance Numbers	Used to uniquely identify devices to the BACnet.
BACnet Metamodel Definitions	The precise definition of the constructs and rules needed for creating BACnet objects.
Building Automation System (BAS)	The entire Distributed Digital Control system as applied to a specific project or building, each BAS is integrated into the EMRS.
Basis of Design (BOD)	Documentation of the primary thought processes and assumptions behind design decisions that were made to meet the owner's project requirements (OPR). The basis of design describes the systems, components, and methods chosen to meet the OPR.
BAS Controller	A fully programmable device capable of carrying out a number of tasks including controlling and monitoring via direct digital control (DDC) of specific systems, acting as a communications router between the F&S LAN and serial fields busses, and data storage for trend information, time schedules and alarm data.
Calibration Tolerance Limits (CTL)	The acceptable variation in instrument indication for a given input, for which no adjustment is required. The CTL is derived from the Instrument Manufacturer Limits. The CTL is within the Process Calibration Tolerance Limit of an instrument.
Change	Any addition to, deletion from, or modification to an aspect, material, facility, utility, equipment, logic or practice within the scope of the Building Automation System (BAS). This differs from a deviation due to unplanned events requiring temporary actions to be remediated to the initial conditions prior to the unplanned event.
Commissioning Authority	An individual or company identified by an owner to lead the commissioning activity in the implementation of the commissioning process.
End Device	A device in the field that measures, monitors or controls connected to the BAS
Enterprise Monitoring and Reporting System	A campus wide administration application level system provided by and maintained by F&S, each BAS is integrated with the EMRS.



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(EMRS)	
Functional Performance Testing	A range of tests under actual load, conducted to verify that specific systems, subsystems, components, and interfaces between the systems conform to a given criteria.
Human Machine Interface (HMI)	A device designed to enable humans to access the BAS and / or the EMRS by using a set of custom built graphics
Internet Protocol (IP) Address	A numeric label assigned to each Internet Protocol capable device
Network Switch	A network device that connects devices together on a computer network
Operational Training	Training of the individuals who use (owner), operate (facility personnel), or maintain (skilled trades, technicians, and engineers) using current versions of the commissioning documents including operations and maintenance manuals. The training shall be designed specifically for each group delivered both in classroom and on-site.
Operation and Maintenance Manual	A document that describes in lay terms, the operation of all systems and equipment in a facility. An operations manual details modes of operation with associated diagrams to illustrate the sequence of operation for each system and interaction between systems. The maintenance manual describes maintenance requirements and sequences, with the required bill of material.
Owner’s Project Requirement (OPR)	Document that provides the explanation of the ideas, concepts and criteria that are considered to be very important to the owner. The OPR cites specific measureable goals for the owner’s objective.
Patch Panel	A device with a number of ports between field environments and network (EMRS) switches
Process Calibration Tolerance Limits (PCTL)	The maximum allowable deviation of a quality subject to measurement from the true value before there is an impact on the control of the process.
Service Tool	A device capable of connecting to, or accessing a BAS or EMRS for service, upgrade, monitoring or repair of the BAS.
Static Verification	The verification and documentation that all system elements are in accordance with the design requirements, correctly installed, connected and labelled with consideration for accessibility.
Startup Verification	The verification that documentation is complete, sensors are calibrated, control wiring integrity checked, correct response of all points in system verified with correct response of all end devices in the system.
System Graphic Screen	EMRS Built-in Graphic User Interface that provides the basic information on the BAS and / or EMRS related to any particular BAS data object for the commissioning task only.

3. Responsibilities

3.1. Owner’s Representative / Project Manager

- 3.1.1. Represents the interests of the facility as directed by the University
- 3.1.2. Provides project final delivery requirements as directed by the University
 - 3.1.2.1. Explaining ideas, concepts and criteria considered important to the University
 - 3.1.2.2. Identifying specific, measureable expectations deliverable to the University
 - 3.1.2.3. Oversees and is responsible for the creation of the Owners Project Requirement (OPR)

3.2. Design Engineer

- 3.2.1. Develops the Mechanical / Electrical design so that the completed facility will function as intended by the Owner’s Representative as communicated through the Owners Project



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Requirement (OPR), functionally described in the Basis of Design, and instructed by the University Design Standards.

- 3.2.2. Provides detailed design requirements for the intended facility change.
- 3.2.3. Reviews the constructed work, process changes if necessary and identifies deficiencies in the contractor's work.
- 3.2.4. Ensures adherence of the design to Regulations, Standards and Practices including those specific to the University in the execution and product delivered.

3.3. Contractor / Vendor

- 3.3.1. Responsible to execute the specific directions of the detailed design requirements provided by the Design Engineer
- 3.3.2. Responsible to execute the detailed design requirements as specified in compliance to all Regulations, Standards and University accepted practices.
- 3.3.3. Execute the component and system commissioning in accordance with the Commissioning Authority's requirements.

3.4. Commissioning Authority

- 3.4.1. As defined in the CSA Standard Building Commissioning, Z320–11 modified by the University of Toronto in Schedule 2, and directed by the University's documented expectations, the commissioning of the installation from the design phase to the complete operational cycle including preparation of manuals and training oversight and sign off.

3.5. Area Manager

- 3.5.1. The Facility User, Operator and Maintainer to whom the mechanical electrical and controls aspects are delivered.
- 3.5.2. Ensure the installed project as designed and demonstrated through the commissioning process is manageable in the daily operation of the facility to meet the Owners Project Requirements within the Operations responsibilities.

3.6. Information Technology

- 3.6.1. The provision of resources both equipment and human to implement system components as defined in the detailed design requirements provided by the Design Engineer.

4. Training Requirements

4.1. Individual Procedure Training

- 4.1.1. The functional areas responsible for the Management, Operation, Maintenance, Planning, Design and Construction of the BAS systems inclusive but not restricted to personnel in Facilities and Services and University Planning Design and Construction.



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- 4.1.2. The Contracted service providers that impact change into any aspect of the Building Automation System, documentation of such training will be included in the completed Commissioning document as described in the Commissioning Documentation Section of this procedure.
- 4.1.3. Training of this procedure will be documented via a sign off document forwarded to the Administration Assistant of the Director of Utilities and Building Operations for filing.
- 4.1.4. Update training via the reading of this procedure will be required annually by the Facilities and Services, University Planning Design and Construction, and 3rd party contractors. Individual projects will require acknowledgement of this requirement as part of the bid process.

5. Procedure

5.1. General

- 5.1.1. The Building Automation System will conform to the following structure
 - 5.1.1.1. Owners Project Requirement (OPR)
 - 5.1.1.2. Basis of Design (BoD)
 - 5.1.1.3. Static Verification
 - 5.1.1.4. Startup Verification
 - 5.1.1.5. Functional Performance Testing
 - 5.1.1.6. Operational Training
 - 5.1.1.7. Operation and Maintenance Manuals

5.2. Specific Commissioning Procedure

- 5.2.1. Check installation in field to verify built to detailed design requirements including accepted Change Orders as per the Design Engineer.
- 5.2.2. Verify and document with completed signed Calibration report all sensors and instruments installed, cross reference to Detailed Design requirements to verify process range capability
- 5.2.3. Verify wiring integrity for each end device output to BAS Controller using service tool for existence and correctness as per Detailed Design, identify 100% of IP Addresses and BACnet Instance Numbers for existence and correctness.
- 5.2.4. Verify all connections between BAS Controller and Patch Panels by using a cable test management tool with integrated recording and reporting capability.
- 5.2.5. Verify all connections between Patch Panel and F&S Network Switch manually, documenting 100% of connections
- 5.2.6. Using Service Tool loop test 100% of connections from F&S Network Switch to End Device verifying integrity of signal, response to commands, and Range of Process Control Tolerance. This requires visual confirmation at the End Device and at the Service Tool / Network Switch simultaneously.
- 5.2.7. Verify operation of Un-interruptible Power Supply (UPS) at the F&S Network Switch / Panel Device
- 5.2.8. Using existing Enterprise Monitoring and Reporting System (EMRS) verify 100% acquisition of data to "System Graphic Screen" from End Devices for specified functionality simultaneously at



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both EMRS station and End Device locations in compliance with the BAS object naming convention, according to the project's BACNET Metamodel Definitions document provided by the University.

- 5.2.9. Using existing Enterprise Monitoring And Reporting System (EMRS) verify integrity of Graphics HMI as specified in System Design

5.3. Commissioning Documentation

5.3.1. Verification of "As Built" versus "Detailed Design Requirement"

- 5.3.1.1. Table identifying "Detailed Design Requirement" and corresponding "As Built" found in the field with sign off by the Commissioning Authority.
- 5.3.1.2. Calibration certificate of end devices requiring calibration that identifies the device Calibration Tolerance Limits (CTL), and, comparison of the CTL to the Process Calibration Tolerance Limits (PCTL) tabulated and signed off by the Commissioning Authority.
- 5.3.1.3. Documentation of wiring used and the documented 100% verification of individual connections between the End Devices to the BAS Controller identifying individual IP Addresses and BACnet Instance Numbers for existence and correctness, tabulated and individually signed off by the Contractor
- 5.3.1.4. Documentation of the connections between the BAS Controller and the BAS Patch Panel identifying the individual End Device, BAS Controller and BAS Patch Panel connection location, tabulated and individually signed off by the Contractor.
- 5.3.1.5. Documentation of the individual connections between the BAS Patch Panel and the Network Switch, tabulating all connections identifying individual BAS Patch Panel connection ports and F&S Network Switch connection ports, signed off by the University of Toronto (Central IT).
- 5.3.1.6. Documentation of loop test of 100% connections, F&S Network Switch to End Device, tabulated to document integrity of signal and demonstrated Range of End Device process control capabilities, signed off by University of Toronto (IT), Contractor and Commissioning Authority.
- 5.3.1.7. Document capability of Un-interruptible Power Source (UPS) for operation and capacity, sign off by Contractor.
- 5.3.1.8. Document Graphics delivered to the Human Machine Interface (HMI) to Detailed Design Requirement with tabulated signoff and signed screen shots by the University of Toronto (IT), Contractor and Commissioning Authority.
- 5.3.1.9. All above described documentation will be collated in order as listed above into a bound document and signed off by the Contractor, University of Toronto (IT) and the Commissioning Authority with a preface acceptance covering letter.

5.3.2. Operational Training

- 5.3.2.1. Training of System Maintenance and Component Bill of Materials to be delivered to the University of Toronto Control Technicians to enable system maintenance. The documents will be reviewed with the Control Technicians in class with a sign off sheet identifying the instructors and participants. Onsite training, review will also be provided



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with instructor and participant signoff. All Training participant records will be included in the signed off bound Commissioning Document.

5.3.2.2. Training of System Operations will be delivered to the University of Toronto Building Operators which will include documents to be reviewed in class and on site system use by an instructor with instructor and participant sign off to be included in the signed off bound Commissioning Document.

5.3.3. Operations and Maintenance Manuals

5.3.3.1. Operations and Maintenance Manuals defining the system components and operating methodology will be developed and will be comprised of system explanation as well as cut sheets. The document developed by the contractor will be reviewed by the Commissioning Authority and Owner Representatives with sign off by the Contractor, Commissioning Authority and Area Manager.

5.4. Specific Roles & Responsibilities Matrix (Commissioning)

	Owner's Rep./ Proj. Mgr.	Area Manager	Designer	Contractor	U of T (Central IT)	Operations (Control Tech.) (Building Eng.)	Commissioning Authority
Owner Project Requirement (OPR)	R						
Basis of Design (BoD)	P	P	R			P	
Design	P	P	R			P	
Project Execution							
1. End device to Patch Panel				R			
2. Patch Panel to EMRS incl.					R		
3. EMRS Graphics					R		
Commissioning Procedures							
1. Verify OPR to BOD	P		P				R
2. Static Verification (As built to Design)				R			O
3. Instrument Calibration to Process Requirement				R			O
4. Verify wiring End Device to BAS Controller				R			O
5. Verify Wiring BAS Controller to Patch Panel				R			O
6. Verify wiring Patch Panel to Network Switch					R		O
7. Verify Network Switch to End Device				R	O		O
8. Verify UPS operation capability				R			O
9. Verify data to EMRS Systems Graphic Screen				O	R		O
10. Verify integrity of Graphics HMI to Design Requirement				O	R		O



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11. Prepare Commissioning Report							R
12. Operational Training		P		R		P	P
13. Operations and Maintenance Manuals		P		R		P	P
14. Signoff Project Turnover Document	P	P	P	P	P		R

R: Responsible

P: Participating

O: Oversight

Blank: Not Required



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