



GUIDELINE

ASHRAE Guideline I.4-2014

Procedures for Preparing Facility Systems Manuals

Approved by the ASHRAE Standards Committee on June 28, 2014, and by the ASHRAE Board of Directors on July 2, 2014.

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ISSN 1049-894X

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NOTE

Approved addenda, errata, or interpretations for this guideline can be downloaded free of charge from the ASHRAE Web site at www.ashrae.org/technology.

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FOREWORD

A Systems Manual contains information and documentation on a building's planning, design, construction, and commissioning, along with operational requirements, maintenance information, training and testing documentation for the use of building operations, and maintenance and optimization of the facility over its useful life.

Developing the Systems Manual encompasses gathering information from the facility, planning, design, construction, testing, commissioning, and training activities and adding operations and maintenance information to create a usable information resource. This resource includes final project documentation, including Owner's Project Requirements (OPR), Basis of Design, the final Commissioning Plan, Commissioning Progress Reports, submittals, manufacturer installation manuals, manufacturer Operation and Maintenance (O&M) manuals, system schematics, record drawings, checklists, inspections, testing results, and training and other relevant materials. This information is edited and organized to focus on key systems (roofing, walls, fire alarm, chilled water, hot water, etc.) in the facility. Coordination with O&M personnel in developing standard formats and divisions (shops) is accomplished to simplify future Systems Manual revisions.

It is the intent that the Systems Manual be assembled in electronic format to facilitate access and reduce storage requirements. The electronic format also reduces the possibility of loss of parts or all of the information. For Systems Manuals assembled in hardcopy format, larger documents such as record drawings, specifications, submittals, and O&M documents can be stored in secure locations, with these locations referenced in the Systems Manual.

Also included in the Systems Manual is the development of periodic maintenance and information for insertion into a computer maintenance management system, including equipment make and model, checking requirements, maintenance requirements, and troubleshooting items.

If the Systems Manual is assembled during a commissioning process, the Commissioning Authority (CxA) should be responsible for evaluating the development of the Systems Manual. At other times, the responsible person or agency will be designated by the Owner.

The entity responsible for developing the Systems Manual should include all items involved in the project and capture the system and assembly data in either an electronic or printed version. In addition, printed operations, service, maintenance, spare parts lists, and repair manuals may be provided. This entity (Owner, contractor, design professional, CxA, other) shall have the skills of design, construction, and operations required to develop a cohesive Systems Manual.

For existing facilities, the Systems Manual will have multiple sections, depending on the Owner's Current Facility Requirements and the number of systems focused on during the facility development, renovation, or repair process.

The format and content of the Systems Manual provided in this guideline can be effectively used in both new construction and for an existing building, even if the building is not commissioned.

Systems Manual Documentation Collection Requirements

The Systems Manual process captures project requirements, design documentation, construction details, evaluation and testing results, and training programs as the information becomes available. Additionally, the recommended operating and maintenance procedures and ongoing documentation requirements are assembled and included. Changes to the manuals are expected as the building maintenance systems are developed and changes to the systems occur.

The arrangement of the Systems Manual shown in Section 4 is based on collection of documentation during the normal construction process. It is also acceptable to arrange the documentation by system if that is the Owner's preference. This system arrangement may require substantial additional time and documentation effort to rearrange the information and should be specified at the time of OPR development.

1. PURPOSE

This guideline provides procedures for producing a Systems Manual as a resource for training, operations, maintenance, and upgrading of facilities.

2. SCOPE

This guideline applies to information from planning, commissioning, design, construction, testing, and training activities, and operations planning for new, renovated, and existing facilities, equipment, and assemblies.

3. DEFINITIONS

acceptance: a formal action, taken by a person with appropriate authority (which may or may not be contractually defined) to declare that some aspect of the project meets defined requirements, thus permitting subsequent activities to proceed.

Basis of Design (BoD): a document that records the concepts, calculations, decisions, and product selections used to meet the Owner's Project Requirements (OPR) and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.

checklists: project- and element-specific checklists that are developed and used during all phases of the Commissioning Process to verify that the OPR is being achieved. Checklists are used for general evaluation, testing, training, and other design and construction requirements.

commissioning (Cx): see *Commissioning Process*.

Commissioning Authority (CxA): an entity identified by the Owner who leads, plans, schedules, and coordinates the commissioning team to implement the Commissioning Process.

Commissioning Plan (Cx Plan): a document that outlines the organization, schedule, allocation of resources, and documentation requirements of the Commissioning Process.

Commissioning Process (Cx Process): a quality-focused process for enhancing the delivery of a project. The process focuses on verifying and documenting that all of the commissioned systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the OPR or Current Facility Requirements (CFR).

Commissioning Process Activities (Cx Process Activities): components of the Commissioning Process.

Commissioning Process Progress Report (Cx Process Progress Report): a written document that details activities completed as part of the Commissioning Process and significant findings from those activities and is continuously updated during the course of a project.

Commissioning Team (Cx Team): the individuals and agencies who, through coordinated actions, are responsible for implementing the Commissioning Process.

commissioning testing: the evaluation and documentation of the equipment and assemblies, delivery and condition, installation, proper function according to the manufacturer's specifications, and project documentation to meet the criteria in the Owner's Project Requirements.

construction checklist: a form used by the commissioning team to verify that appropriate materials and components are on-site, ready for installation, correctly installed, functional, and in compliance with the OPR. See also, *checklists*.

construction documents: includes a wide range of documents, which will vary from project to project and with the Owner's needs and regulations, laws, and jurisdictional requirements. Construction documents usually include the project manual (specifications), plans (drawings), and general terms and conditions of the contract.

contract documents: a wide range of documents, which will vary from project to project and with the Owner's needs, regulations, laws, and jurisdictional requirements. Contract documents frequently include price agreements, construction management process, subcontractor agreements or requirements, requirements and procedures for submittals, changes, and other construction requirements, timeline for completion, and the construction documents.

coordination drawings: drawings showing the work of all trades to illustrate that equipment can be installed in the space allocated without compromising equipment function or access for maintenance and replacement. These drawings graphically illustrate and dimension manufacturers' recommended maintenance clearances.

Current Facility Requirements (CFR): a written document that details the current functional requirements of an existing facility and the expectations of how it should be used and

operated. This includes goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information to meet the requirements of occupants, users, and owners of the facility.

design checklist: a form developed by the Commissioning Team to verify that elements of the design are in compliance with the Owner's Project Requirements (OPR). See also, *checklists*.

design review

design review, code or regulatory: a review of a document conducted by staff or designated entity of an Authority Having Jurisdiction (AHJ) to determine whether the content of the document complies with regulations, codes, or other standards administered by the jurisdiction.

design review, commissioning: a review of the design documents to determine compliance with the Owner's Project Requirements (OPR), including coordination between systems and assemblies being commissioned, features and access for testing, commissioning and maintenance, and other reviews required by the OPR and Commissioning Plan.

design review, constructability: the review of effective and timely integration of construction knowledge into the conceptual planning, design, construction, and field operation of a project to achieve project objectives efficiently and accurately and at the most cost-effective levels to reduce or prevent errors, delays, and cost overruns.

design review, peer: an independent and objective technical review of the design of the project or a part thereof, conducted at specified stages of design completion by one or more qualified professionals for the purpose of enhancing the quality of the design.

evaluation: the process by which specific documents, components, equipment, assemblies, systems, and interfaces among systems and their performance are confirmed with respect to the criteria required in the Owner's Project Requirements (OPR).

existing building Commissioning Process (existing building Cx Process): a quality-focused process for attaining the Current Facility Requirements (CFR) of an existing facility and its systems and assemblies being commissioned. The process focuses on planning, investigating, implementing, verifying, and documenting that the facility and/or its systems and assemblies are operated and maintained to meet the CFR, with a program to maintain the enhancements for the remaining life of the facility.

facility guide: a basic building system's description and operating plan with general procedures and confirmed facility operating conditions, setpoints, schedules, and operating procedures for use by facility operations to properly operate the facility.

final Commissioning Report (final Cx Report): a document that records the activities and results of the Commissioning

Process and is developed from the final Commissioning Plan with all of its attached appendices.

issues and resolution log: a formal and ongoing record of problems or concerns and their resolutions that have been raised by members of the Commissioning Team during the course of the Commissioning Process.

Ongoing Commissioning Process (OCx Process): a continuation of the Commissioning Process well into occupancy and operations to continually improve the operation and performance of a facility to meet current and evolving CFR or OPR. OCx Process activities occur throughout the life of the facility; some of these will be close to continuous implementation and others will be either scheduled or unscheduled as needed.

Operation and Maintenance (O&M) Manual: the documentation, usually in generic form, that the manufacturers provide to install, operate, and/or maintain a specific piece of equipment or specific assembly.

Owner's Project Requirements (OPR): a written document that details the requirements of a project and the expectations of how it will be used and operated. This includes project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information. (The term *project intent* or *design intent* is used by some Owners for their Commissioning Process OPR.)

performance test (PT): the process used to verify that a material, product, assembly, or system meets defined performance criteria. The methods and conditions under which performance is verified are described in one or more test protocols.

recommissioning: an application of the Commissioning Process requirements to a project that has been delivered using the Commissioning Process. (See *existing building Commissioning Process*.)

retrocommissioning: the Commissioning Process applied to an existing facility that was not previously commissioned. (See *existing building Commissioning Process*.)

Systems Manual: a system-focused composite document that includes the design and construction documentation, facility guide and operation manual, maintenance information, training information, Commissioning Process records, and additional information of use to the Owner during occupancy and operations.

test procedure: a written protocol that defines methods, personnel, and expectations for tests conducted on components, equipment, assemblies, systems, and interfaces among systems to verify compliance with the Owner's Project Requirements (OPR).

training plan: a written document that details the expectations, schedule, duration, and deliverables of Commissioning Process activities related to training of project operating and maintenance personnel, users, and occupants.

4. SYSTEMS MANUAL CONTENT AND ORGANIZATION

4.1 Introduction. The Systems Manual contains information on the Owner's initial and current facility and project require-

ments, and documentation of building design and construction, along with testing and training documentation, operational requirements, and maintenance information for the use of building occupants, operators, and maintenance staff, and for optimization of the facility performance over its useful life.

The format and content of the Systems Manual provided in this guideline can be effectively used in both new construction and for assembling a Systems Manual for an existing building, even if the building is not commissioned.

4.2 Systems Manual Content Preparation. The Systems Manual is intended to

- a. provide necessary information to the facility occupants and operating staff, and the maintenance function to understand the design and construction of the facility (new or existing) and how to operate and maintain the building;
- b. assemble the facility planning, design, construction, and testing results for building systems in one set of documents and provide the format for the updating of this information;
- c. provide a documentation source to be used in training materials; and
- d. provide documentation for building performance improvement and ongoing commissioning.

4.3 Systems Manual Documentation Organization

4.3.1 The Systems Manual process captures project requirements, design and construction documentation, evaluation and testing results, and training programs as the information becomes available. Additionally, the recommended operating and maintenance procedures and ongoing documentation requirements are assembled and included. Changes to the manuals are expected as the building maintenance systems are developed and changes to the systems occur.

4.3.2 The Systems Manual should be organized as follows. The six major documentation assembly subjects are labeled as "Parts" of the Systems Manual in this guideline. These headings may also be called *sections*, *chapters*, *divisions* or another term that is compatible with the project documentation requirements.

Part 1. Executive Summary

Part 2. Facility Design and Construction

- 2.1 Owner's Project Requirements
- 2.2 Basis of Design Requirement
- 2.3 Facility/Project Design and Record Documents (or directions to their location)

Part 3. Building, Systems, and Assemblies Information

- 3.1 Facility and Equipment Specifications
- 3.2 Approved Submittals
- 3.3 Coordination Drawings
- 3.4 Manufacturer's Operation and Maintenance (O&M) Data
- 3.5 Warranties
- 3.6 Contractor/Supplier Listing and Contact Information

Part 4. Facility Operations

- 4.1 Facility Guide (including Operating Plan; Facility and Equipment Operating Schedules; Set-points, Ranges, and Limitations; Systems Operation Control Sequences of Operation; and Emergency Procedures)
- 4.2 Maintenance Plans, Procedures, Checklists, and Records
- 4.3 Maintenance Schedules
- 4.4 Ongoing Commissioning Operational and Maintenance Record Keeping
- 4.5 Janitorial and Cleaning Plans and Procedures
- 4.6 Utility Measurement and Reporting

Part 5. Training

- 5.1 Training Plans and Materials
- 5.2 Training Records
- 5.3 System Manual Maintenance and Documentation, including Operator's Ongoing Documentation of Modifications and Adjustments to the Facility Systems and Assemblies

Part 6. Commissioning (Cx) Process Report

- 6.1 Executive Summary
- 6.2 Cx Plan(s)
- 6.3 Cx Design and Submittal Review Reports
- 6.4 Testing and Start-Up Reports, Permits, Inspections, Evaluation Checklists, and Testing Checklists Completed for Commissioned Systems and Assemblies
- 6.5 Cx Process Progress Reports
- 6.6 Issues and Resolution Logs
- 6.7 Item Resolution Plan for Open Items

4.4 Sources and Content of the Documents in the Systems Manual

Part 1. Executive Summary

The executive summary contains an overview of the building design, construction, and operational requirements. The information is intended to provide general guidance on the intended operation, performance, and maintenance of the building in conformance to the Owner's Project Requirements and/or Current Facility Requirements (CFR).

Part 2. Facility Design and Construction

- 2.1 *Owner's Project Requirements (OPR)/Current Facility Requirements (CFR)*: Insert final copy of OPR/CFR developed and revised during the project and Cx Process. This provides the operations and maintenance (O&M) staff, as well as future owners, the information on the original intent for the design and use of the facility.
- 2.2 *Basis of Design (BoD)*: Insert final copy of BoD document and any other design information developed during the project and Cx Process. This provides the O&M staff, as well as future owners, the information on the design of the facility.
- 2.3 *Construction/Project Record Documents*: Insert final program and design documents, and insert

or describe locations of record drawings and documents. Digitized Systems Manuals can also contain copies of the record documents and minimize the loss of these documents.

Part 3. Facility, Systems, and Assemblies Information

- 3.1 *Specifications*: Insert final copy of facility and equipment design specifications.
- 3.2 *Approved Submittals*: Insert final copy of specific approved submittals by specification section sequence, including a copy of final approved and commissioned sequences of operation for equipment and systems, along with limitations to operation.
- 3.3 *Coordination Drawings*: Insert a copy, or designate the location of, the system installation coordination drawings and related information.
- 3.4 *Manufacturer's Operation and Maintenance Data*: Insert manufacturer provided installation and O&M manuals that have been verified and localized to the installed building system or equipment by specification section sequence.
- 3.5 *Warranties*: Insert system and equipment warranties arranged by specification section sequence.
- 3.6 *Contractor/Supplier Listing and Contact Information*: Insert a listing of all contractors and major suppliers, including address, phone, and e-mail to facilitate repairs and replacements. Insert the design team members listing along with contact information to facilitate information transfer on original designs and maintenance and optimization.

Part 4. Facility Operations

- 4.1 *Facility Guide (Operating Plan, Building and Equipment Operating Schedules, Setpoints and Ranges, Sequences of Operation, Limitations, and Emergency Procedures Actions)*
 - Insert a copy of the completed facility operating plan with explanations of the intended use and operation of the facility.
 - Insert a copy of the final commissioned sequences of operation for all operating equipment.
 - Insert a copy of final commissioned setpoints of all equipment with operational adjustments. Include the setpoint normal intended ranges and limitations.
 - Insert a copy of routine maintenance requirements.
 - Insert a copy of emergency procedures and locations of applicable controls.
- 4.2 *Maintenance Procedures, Checklists, and Records*: Insert procedures, forms, and checklists for facility operation and maintenance. Include updating requirements. Describe inspections and testing required on a routine basis and standard forms required.