

Guideline 1-2007 HVAC&R Technical Requirements for The Commissioning Process

Charles E Dorgan, PE, PhD
University of Wisconsin - Madison

Synopsis

The commissioning process for delivering quality new construction projects has been formulated in Guideline 0-2005 for all building systems and assemblies. Guideline 0-2005 allows owners to set key project requirements that can be used to continuously verify the project is meeting the project requirements. These are defined as Owner's Project Requirements (OPR).

HVAC&R (Heating, ventilating, air-conditioning and refrigerating) systems and assemblies are a major OPR emphasis in all buildings. Guideline 0-2005 provides owners and commissioning authorities the guidance to integrate the commissioning process into their projects from pre-design through occupancy. This achieved by integrating the quality principles of the commissioning process into the owner's current process to achieve an improved process that will enhance all future projects. Guideline 1-2007 (expected to be published in late 2007) provides information on HVAC&R needs and tasks for specific requirements to be addressed during each phase of the project. In addition to providing specific phase needs, substantial guidance is provided in the 14 illustrative annexes. The annexes cover topics from sample verification checklist in all phases, sample construction document specifications, training, systems manual and other pertinent topics.

Since the Guideline 1-2007 is not a user's manual for implementing the commissioning process, this presentation will give "jump-start" information on how to effectively use the material in Guideline 0-2007.

About the Author

Charles Dorgan is professor emeritus at the University of Wisconsin – Madison where he has presented seminars and courses on the commissioning process since 1984. He has been involved in all commissioning process guidelines developed by ASHRAE and chaired several, including Guideline 0-2005 and 1-2007. He had a professional practice that innovated many of the current practices of the commissioning process.

He was the first recipient of the Benner Award, given each year to recognize those who have made significant contributions to making commissioning process business as usual.

Introduction

ASHRAE/NIBS Guideline 0-2005 describes the general process for implementing the commissioning process. Annex A of Guideline 0-2005 was developed to allow knowledge-based groups to develop technical guidelines to support specific topics. Annex A was used to develop the format for Guideline 1-2007, by an ASHRAE standards project committee. The guideline provides information for owners, the commissioning team and the commissioning authority to successfully delivery HVAC&R (Heating, Ventilating, Air-Conditioning, and Refrigerating) systems in buildings. At the time this paper was written the guideline had not been approved by ASHRAE board, although the final requirements by the project committee were finalized, and approval is anticipated in 2007.

Purpose and Scope

The OPR (Owner's Project Requirements) is the defining document in Guideline 0-2005. The purpose of Guideline 1-2007 is to provide specific information for achieving the OPR related to heating, ventilating, air-conditioning, and refrigerating systems in buildings.

The scope of Guideline 1-2007 includes information on full support of the commissioning process for HVAC&R systems with specific emphasis on:

- HVAC&R systems to fully support The Commissioning Process activities of Guideline 0-2005,
- verification during each phase of The Commissioning Process,
- acceptance during each phase,
- documentation during each phase,
- Systems Manual specific requirements, and
- training for operations and maintenance personnel and occupants

This paper provides an overview to assist owners and commissioning teams to effectively use Guideline 1-2007.

Guidance Information

The body of the guideline provides the essential guidance on requirements to supplement Guideline 0-2005 for HVAC&R systems. However, the real value is the examples in the annexes to support the requirements in the body of both guidelines 0-2005 and 1-2007. It further provides specific requirements to illustrate the information in Guideline 0-2005 annexes. In some cases it provides clarification of product requirements in Guideline 0-2005. This includes the CxPlan, OPR report, Basis of Design document, and checklists. Some of these are cover below.

Body of Guideline 1-2007

The Sections in ASHRAE Guideline 1-2007 follows the same numbering format as Guideline 0-2005 and all other technical supporting guidelines.

The body of the guideline only provides specific additional requirements for HVAC&R systems in buildings, to support and supplement Guideline 0-2007. The guideline must be used in conjunction with Guideline 0-2005. For example, in the pre-design phase additional CxTeam members suggested to achieve the requirements for HVAC&R systems are included in Section 5.2.1, as follows:

“ 5.2.1 Commissioning Team Members

In addition to those detailed in ASHRAE Guideline 0-2005 (5.2.1.3), the essential members of the Commissioning Team relative to HVAC&R systems during the Pre-Design Phase include:

*Facilities engineer,
Owner’s automatic controls and building automation technician,
Facility IT Network manager or technician
Owner’s HVAC&R technician,
Architect,
HVAC&R design professional,
Electrical design professional.”*

A list of milestones that need to be defined in the initial CxPlan during the pre-design phase were developed and listed in Section 5.2.4.2, as follows:

“5.2.4.2 Milestones

During the Pre-Design Phase it is critical to document key commissioning process milestones relative to the HVAC&R systems during Design, Construction, and Occupancy and Operations Phases. These include:

- (a) Pre-design meeting,*
- (b) Design review (multiple), including the Basis of Design requirements with each design submittal,*
- (c) Design Phase updated Commissioning Plan,*
- (d) Construction pre-bid meeting,*
- (e) Pre-construction meeting,*
- (f) Construction Phase updated Commissioning Plan,*
- (g) Commissioning meetings,*
- (h) Material and equipment submittal (including manufacturer’s operations and maintenance documentation) review, – including control equipment.*
- (i) Coordination drawing submission,*
- (j) Initial Systems Manual submission -- xx days after submittal approval,*
- (k) Submission of automatic control and building automation controls logic diagrams,*
- (l) Submission of automatic control and building automation controls software xx days after submittal acceptance,*
- (m) Training program implementation plan,*
- (n) Construction Checklist completion and tracking,*
- (o) Equipment factory testing,*
- (p) Equipment placement review,*
- (q) Testing procedure development (update Commissioning Plan),*
- (r) Contractor required test verification (duct pressure testing, pipe pressure testing, etc.)*
- (s) Initial automatic controls and building automation system acceptance,*
- (t) Testing, adjusting, and balancing report and verification,*
- (u) Final automatic controls and building automation system acceptance,*
- (v) HVAC&R system testing,*
- (w) Final Systems Manual submission,*
- (x) Operator, maintenance, and occupant training,*

- (y) *Turnover of systems/HVAC&R systems acceptance – start of warranties,*
- (z) *Draft Commissioning Process Report,*
- (aa) *Commissioning Authority site visits during first year of operation,*
- (bb) *Operator, maintenance, occupant additional training,*
- (cc) *Seasonal testing,*
- (dd) *XX-month warranty walk-through and verification,*
- (ee) *Lessons learned meeting,*
- (ff) *Final Commissioning Process Report.”*

The requirements for all applicable sections in Guideline 0-2005 have been supplemented with additional information for owner’s and the CxTeam. An additional example of added information related to first year occupancy and operations is given below. This is Section 8.2.6.4, related to Occupancy and Operations Phase Commissioning Activities:

“8.2.6.4 As part of the first year site visits, it is also the commissioning team’s role to facilitate the integration of the commissioning process activities into on-going operations and maintenance procedures. This includes the following key activities:

- (a) Maintaining the Owner’s Project Requirements document to reflect changes in use and operation of the HVAC&R systems and facility.*
- (b) Maintaining the Basis of Design to reflect changes in HVAC&R systems and components due to renovations or in response to changes in the Owner’s Project Requirements.*
- (c) Periodic (seasonal, annual, or bi-annual) evaluation of achievement of the current Owner’s Project Requirements against previous benchmarks by the use of appropriate tests.*
- (d) Maintaining the Systems Manual to reflect changes in the Owner’s Project Requirements, Basis of Design, and systems/assemblies.*
- (e) On-going training of operations and maintenance personnel and occupants on current Owner’s Project Requirements and Basis of Design, changes in HVAC&R systems and operation, and on maintaining current Record Drawings.*

Annexes

A very useful aspect of the guideline is the examples and information in the annexes. These are formats and examples developed by the guideline project committee and should not be used directly. They should be modified to meet specific owner project delivery process. They are substantially more detailed than previous examples in commissioning process guidelines. If these examples are used in conjunction with Guideline 0-2005 and 3-2006 (Exterior Envelope Technical Requirements for the Commissioning Process), owner’s project delivery process should be significantly improved and if used uniformly should improve the integration of the commissioning process for all new buildings and rehab projects.

The guideline provides substantially more detailed example documents than previous commissioning process guidelines that follow the commissioning process.

Although they will be condensed when placed in the published guideline format, the following are a list of annexes and length:

- Annex G – CxPlan: 19 pages
- Annex H – Acceptance Plan: 5 pages
- Annex J – Owner’s Project Requirements: 34 pages
- Annex K – Basis of Design: 14 pages
- Annex L – Specifications: 23 pages
- Annex M – Checklists: 33 pages

Sample checklist format is similar to Guideline 0-2005. An example checklist is shown below:

| 2. Design Checklist for the Mechanical Engineer’s First Design Submittal ASHRAE - Guideline 1-200X Example Checklist | | | | |
|---|--|--|----------|----|
| Instructions: Step 1: Circle Yes or No and fill in with requested information. Step 2: Explain all "No" responses at the bottom of the checklist. | | | | |
| Item | Task Description | Location of Information: Document, Drawing, or draft Project Manual | Response | |
| 1 | Owner’s Project Requirements | | | |
| A | Key Owner’s Project Requirements | | Complete | |
| 1 | Commissioning Plan Updated, provide date and enclose with this submittal | | Yes | No |
| 2 | Basis of Design for controls completed | | Yes | No |
| 3 | Basis of Design for accessibility completed | | Yes | No |
| 4 | Sustainability and LEED issues coordination addressed | | Yes | No |
| 5 | Do the general HVAC&R requirements the current OPR requirements? Has justification been document and approved by owner’s Project Manager? | | Yes | No |
| 6 | Control format, BACnet requirements complete and documented | | Yes | No |
| B | Owner’ Objectives | | | |
| 1 | Preliminary mechanical room layout complete | | Yes | No |
| 2 | Energy analysis meeting goal of 30% less than ASHRAE 90? | | Yes | No |
| 3 | Single line diagrams developed for controls and systems | | Yes | No |
| 4 | Report on safety factors and tolerance for facility system operations | | Yes | No |
| 5 | Have chillers been sized and pre-order to meet occupancy goal | | Yes | No |
| 6 | Environmental and sustainability initial design complete | | Yes | No |
| C | General Owner’s Needs | | | |
| 1 | Is current HVAC and control systems budget enclosed and within initial budget | | Yes | No |
| 2 | Mechanical rooms space and location coordinated with shops | | Yes | No |
| 3 | Has Electrical, Plumbing, Lighting and Communications coordination been completed? | | Yes | No |
| 4 | Does the initial design meet all Benchmark Established for HVAC&R? Document? | | Yes | No |
| 5 | Constructability and maintainability analysis completed | | Yes | No |

Annex I, OPR Workshop includes a number of typical questions that can be used related to HVAC&R Systems. Following is one example question included in the annex:

“8. What are your training requirements? This question is for the O&M staff, and sometimes the occupants, to understand what is needed to understand the systems and building. The knowledge base of the expected maintenance crew is key to defining the training requirements defined in the construction and commissioning documents.”

Other useful information are included in a number of annexes related to quality-based sampling, commissioning process testing, training, systems manual, references (which includes some key web sites), test procedures (examples items and forms), integration and coordination.

In Annex N (Quality-Based Sampling Examples) includes guidance on submittal review, review of OPR and BoD, construction documents and checklists, site visits, and operations.

Summary

Organizations need to use the commissioning guidelines (0, 1, 3, and others to follow) as guidelines, not a standard, but a standard format to implement the commissioning process. Using these guidelines as the basis will allow not only a more uniform and cost effective implementation of the commissioning process, but will allow a means for input as owners and practitioners develop improved means and methods for delivering a quality-based constructed project.

It should be remembered that these guidelines are developed by a limited number of practitioners (typically 15-25 members involved). They are developed with limit resources of volunteers. The use of the guidelines allow a much larger group of owners and practitioners to use the information and provide feedback to continuously improve the guidelines for the benefit of everyone and to improve the cost and quality effectiveness of the process for delivery new buildings and facilities and enhancing the value of existing buildings. Everyone is encouraged to share their best practice to improve the process of delivering the process from Pre-Design through the life of the buildings.