



Pay for Performance - NC Technical Topic

Commissioning Resources and Clarifications

Executive Summary

This Technical Topic provides resources and clarifications for commissioning requirements of the Pay for Performance New Construction Program, and is intended to be a supplemental reference to Section 6 of the Program Guidelines.

Commissioning (Cx) is an ongoing collaborative and quality process between the owner, design team, contractors, and the Cx Authority (CxA) to confirm that owner’s project requirements are being met. The process focuses on verifying and documenting the facility and its systems are designed, installed, tested, operated and maintained to meet these requirements, and as a result, is expected to take place from pre-design and design stages through construction completion and post-construction/occupancy.

Commissioning, including preparation of the Commissioning Plan, is a mandatory requirement of the P4P New Construction Program. Projects that are not commissioned are not eligible for any P4P NC incentives.

The tables and examples provided in the technical topic are intended to demonstrate the level of detail required for Cx plans and reports with the understanding that every project is unique. Although a Cx Plan Template is provided by the program, there is no specific format for commissioning reports and it’s expected that CxA’s will use their own templates. Topics included in this technical topic are highlighted in bold below.

Pre-design Stage	Design Stage	Construction Stage	Post-Construction / Occupancy & Operations:
<ul style="list-style-type: none"> • Project Initiation / Kick-off • Owner and CxA develop Owner’s Project Requirements (OPR) • Cx Plan Draft • Systems Manual Outline • Training Requirements Outline • Formats for Cx Report and Issues & Resolutions Log 	<ul style="list-style-type: none"> • Update / Expand Pre-design Stage Documents • Design Team Develops Basis of Design (BOD) • CxA confirms BOD meets OPR • Construction Specifications for Cx • CxA Design Document Review Comments • CxA Submittal Documents Review Comments • Issues and Resolution Log • Design Cx Process Report • Finalize Cx Plan 	<ul style="list-style-type: none"> • Update / Expand Design Stage Documents • System Coordination Plans • Pre-Functional and Functional Performance Checklists • Develop Test Procedures • Testing and Balancing Reports • Cx Meetings, Agendas, and Minutes • Training Plans • Systems Manual • Issues and Resolution Log • Final Construction Cx Report 	<ul style="list-style-type: none"> • Update Construction Stage Documents • Maintenance Program • Final Issues and Resolution Log • Final Issues Report • Final Commissioning Report • Re-Commissioning Plan

Figure 1 Commissioning Milestones and Sub-milestones

Commissioning Standards and Guidelines



ASHRAE Guideline 0-2005

The Commissioning Process

Approved by the ASHRAE Standards Committee on February 9, 2005, and by the ASHRAE Board of Directors on March 11, 2005.

This guideline is under continuous maintenance by a Standing Guideline Project Committee (SGPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely documented commission action on requests for change to any part of the guideline. The change submitted form, instructions, and guidelines for electronic submission from the ASHRAE website (www.ashrae.org) or paper form from the Manager of Standards. The latest edition of an ASHRAE Standard may be purchased from the ASHRAE website (www.ashrae.org) or from ASHRAE Customer Service, 1791 Tullie Circle, NE, Atlanta, GA 30329-1305. E-mail: orders@ashrae.org. Fax: 404-521-5478. Telephone: 404-521-8400 (toll-free), or toll-free 1-888-537-4723 (for orders in US and Canada). For reprint permission, go to www.ashrae.org/permissions.

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ASHRAE Guideline 0 - The Commission Process – This Guideline describes the Commissioning Process capable of verifying that a facility and its systems meet the Owner's Project Requirements. The procedures, methods, and documentation requirements in this guideline describe each phase of the project delivery and the associated Commissioning Processes from pre-design through occupancy and operation.

The guideline also contains numerous appendices that contain examples how to execute Cx activities as well as sample forms (e.g. construction / testing checklists).

ASHRAE Standard 202p - The Commission Process – This Standard describes how to plan, conduct, and document commissioning activities. Informative appendices provide sample documentation, including checklists, systems manual, reports, training plan, among other resources.

ASHRAE has two additional commissioning guidelines, Guideline 1.1 and Guideline 1.5. Guideline 1.1-2007 focuses on HVAC&R systems while addressing total building commissioning processes by validating interfaces and possible interferences between all building systems. Guideline 1.5 describes the technical requirements for the application of the Commissioning Process described in ASHRAE Guideline 0 that will verify that the smoke control system achieves the Owner's Project Requirements (OPR).

All ASHRAE Commissioning Guidelines are available at the ASHRAE bookstore in both electronic forms and print editions:

<https://www.ashrae.org/resources--publications/bookstore/commissioning-essentials>



ANSI/ASHRAE/IES Standard 202-2013

Commissioning Process for Buildings and Systems

Approved by the ASHRAE Standards Committee on June 22, 2013, by the ASHRAE Board of Directors on June 21, 2013, by the IES Board of Directors on June 28, 2013, and by the American National Standards Institute on July 1, 2013.

This standard is under continuous maintenance by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely documented commission action on requests for change to any part of the standard. The change submitted form, instructions, and guidelines may be obtained in electronic form from the ASHRAE website (www.ashrae.org) or paper form from the Manager of Standards. The latest edition of an ASHRAE Standard may be purchased from the ASHRAE website (www.ashrae.org) or from ASHRAE Customer Service, 1791 Tullie Circle, NE, Atlanta, GA 30329-1305. E-mail: orders@ashrae.org. Fax: 404-521-5478. Telephone: 404-521-8400 (toll-free), or toll-free 1-888-537-4723 (for orders in US and Canada). For reprint permission, go to www.ashrae.org/permissions.

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Owner's Project Requirements (OPR)

Definition¹— *A document that details the functional requirements of a project and the expectations of how it will be used and operated. These include project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information. (The term Project Intent is used by some owners for their Commissioning Process Owner's Project Requirements).*

Section 5.2.2.4 of ASHRAE Guideline 0 contains a comprehensive list of items that should be included in the OPR. Informative Annex I contains an example how to collect information for the OPR and Informative Annex J contains a sample format to compile this information into an OPR document.

The Owner's Project Requirements are generally a collaborative effort between the Owner and Commissioning Authority (CxA). During the pre-design phase, the Owner's Project Requirements (OPR) should be established to understand the owner's needs and goals. Information about the project is gathered, including program requirements, community context, codes and regulations, site and climate, facility context and function, facility technology, sustainability, cost, schedule, and the client's (including owner, occupants, operators, and maintenance personnel) needs and capabilities². The OPR is the basis of the commissioning plan, and informs the project team to properly design, construct, and operate a building and its systems.



“The OPR document must clearly reflect the priorities and objectives of the building owner. That’s why a successful project team must include a skilled CxA who can work closely with the owner to help capture the details of the owner’s requirements.”

Dave McFarlane, “Technical vs. Process Commissioning Owner's Project Requirements,” ASHRAE Journal, August 2013

Program Requirements

For the FY2017 program, per Section 3.2 of the Program Guidelines, to earn pre-design incentives, Partners must document how preliminary “simple box” energy modeling analysis informed building design decisions relative to owner's project requirements, basis of design, and eventual design of the project.

Inclusion of the Owner's Project Requirements (OPR) document in the Commissioning Plan (or as an Appendix to the Commissioning Plan) is required to demonstrate pre-design activities took place and earn pre-design bonus incentives.

¹ ASHRAE Guideline 0-2013 Section 4

² ASHRAE Guideline 0-2013 Section 5.1.1

Basis of Design (BOD) Document

Definition³— *A document that records the concepts, calculations, decisions, and product selections used to meet the Owner’s Project Requirements 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. The Basis of Design is developed by the design team and is reviewed by the CxA.*

The basis of design (BOD) document provides the design team with a tool to clearly present the assumptions and specifications used to develop construction documents to all parties involved from the owner through contractors and suppliers. The OPR can be considered as the foundation of the BOD. The BOD specifically addresses how each of the owner’s project requirements are included in the building design. The BOD should generally include the following⁴:

“The BOD transforms the raw data from the owner’s project requirements (OPR) document (the “what”) into a detailed, technical, actionable plan (the “how”) that will meet the owner’s objectives—which will also help avoid the “scope creep” that can derail the project schedule and lead to budget overruns.”

Vince Briones and Dave McFarlane, “Technical vs. Process Commissioning Basis of Design,” ASHRAE Journal, October 2013

System and assembly options

System and assembly selection reasoning

Facility, system, and assembly performance assumptions

- Assumptions for calculations/sizing
- Analytical procedures and tools
- Environmental conditions
- Limiting conditions
- Reference make and model
- Operational assumptions

Narrative system and assembly descriptions

Codes, standards, guidelines, regulations, and other references

Owner guidelines and directives

Specific descriptions of systems and assemblies

Consultant, engineering, and architectural guidelines for design developed by the design team or others

Program Requirements

For both legacy projects (pre-FY2017 projects) and FY2017 projects, the Basis of Design (BOD) must be included in Section 4 of the Program’s Commissioning Plan template.

³ ASHRAE Guideline 0-2013 Section 4

⁴ ASHRAE Guideline 0-2013 Section 6.2.2.1

Commissioning Scope for P4P – What About Systems and Components that are not Explicit P4P Measures?

While commissioning must cover all P4P measures, commissioning must also be performed on building components and systems that have a significant impact on projected energy savings of the building and operational needs of the owner, developer, and occupants. Excluding major systems from commissioning activities could have a significant impact on building operation post-construction and occupant comfort.

For example, a new construction multifamily building has a rooftop unit providing corridor OA that meets the Minimum Performance Standards and a new boiler that only meets ASHRAE 90.1 requirements. The scope of work includes wall and roof insulation, triple pane windows, and RTU measures, but the boiler is not included as a measure. The boiler must be commissioned because it impacts occupant comfort and has direct impact on the envelope measures.

For FY2017 projects, excluding major systems can significantly impact Incentive 3, which provides incentives for buildings that earn the ENERGY STAR Certification or ASHRAE Building Energy Quotient In-Operation Certification.

“Cx is intended to confirm that building equipment and systems meet the design intent and operational needs of the owner, developer, and occupants. Cx shall also confirm that the system performance assumptions documented in the Proposed ERP, ensuring the facility achieves the projected energy savings.”

Program Guidelines Section 6.1

Commissioning Sampling – Construction Phase Testing and Verification

The level of commissioning rigor will often be dictated by project size and complexity. For P4P NC, the sampling strategy used must demonstrate confidence in the energy savings presented in the ERP in addition to meeting owner, developer, and occupant needs. The Program will not require specific sampling rates as each project has unique functional requirements. However, the program requires that *quality based* sampling is performed as discussed in the following excerpt from Guideline 0⁵.

“Because the contractor is responsible for 100% construction and checking of work, the commissioning process utilizes a sampling strategy in accomplishing verifications and tests. For construction checklist verifications, during site visits, the completed construction checklists are verified (typically 2%–10%). The following is general guidance for selecting and verifying construction checklists.

1. Identify the construction checklists that have been completed since the last site visit.
2. The following is a general guide for sample rates based on the number of new construction checklists. ***Please note that this is not meant to be used directly for your project due to the many variables in determining acceptable sample rates and owner input.*** Randomly select the construction checklists to be verified. Note that you often want to sample similar components as a group so that if there is only 1 or 2 of a particular component, it is not missed. Because the sampling rate is lower for these than for other components, you can compare results between similar components more easily.”

# New Construction Checklists	Overall Sample Rate	Component Sample Rate
1–10	100%	70%–100%
11–20	80%	50%–70%
21–50	50%	30%–50%
51–100	30%	15%–30%
>100	2–20%	2%–10%

Figure 2 Recommend Sampling Requirements from ASHRAE Guideline 0, Informative Appendix N

Program Requirements

With respect to the equipment/component testing activities of commissioning, sampling of systems is permitted if it generally follows the approach described above. The sampling procedure used should be described in the final commissioning report. Note that this approach is a rule of thumb and will not apply for all projects and scenarios. For example, for some building types, the criticality of systems must be considered (e.g. the sampling rate of 11 CRAH units in a data center should be higher than 70%).

⁵ Informative Annex N, Quality Based Sampling Examples of ASHRAE Guideline 0-2013

Commissioning Resources, and Clarifications

Schedules

The Commissioning Plan must include a schedule of Cx process activities. Generally, construction and commissioning schedules will be much more detailed and include several sub-milestones as well as duration. For the purposes of developing a Cx plan for P4P, a schedule with the level of detail similar to the one below may be used. The schedule must demonstrate that all Cx process activities have been integrated into design and construction.

#	Tasks	Planned Date	Actual Date
1	Complete Draft of OPR		
2	Start Schematic Design		
3	Commissioning Kick-off Meeting (Design)		
4	Develop Draft of Commissioning Plan		
5	CxA Schematic Design Review		
5	Complete Schematic Design		
6	Develop Draft of BOD		
7	CxA Design Development Review		
7	Complete Design Development		
8	Complete Construction Documents		
9	Pre-bid Meeting		
10	Finalize Construction Contracts		
11	Pre-construction Meeting		
11	Start Construction		
12	Review and Approve All Submittals		
13	Commissioning Kick-off Meeting (Construction)		
14	Construction Inspections		
15	Complete Construction / Pre-Functional Testing Checklists		
16	Complete Functional Performance Testing		
17	Complete O&M and Systems Manual		
18	Complete Training Manual		
18	Conduct Maintenance Staff Training		
19	Project Completion		
20	Address All Outstanding Issues and Discrepancies		
20	Finalize Commissioning Report		
21	Warranty Review		
22	Lessons Learned Meeting		

Figure 3 Sample Cx Schedule

Program Requirements

Schedules for Cx activities are required for all commissioning plans and reports.

Commissioning Resources, and Clarifications

Issues and Resolutions Log

The Issues and Resolutions Log is the on-going list of issues, discrepancies, and questions throughout design and construction of a project that needs to be communicated to the project team for resolution or action. These are often shown in table format and supplemented with pictures and drawings where necessary. Below is an example of an acceptable Issues and Resolutions log to be included in commissioning reports.

Issue number	Date of Issue	Issue description	Effects of issue on building operation	Possible cause of issue or problem	Recommendation for resolution	Person assigned to issue	Resolution Approval & Date	Pictures of Issue	Picture(s) of Resolution	Notes

Figure 4 Sample Issues and Resolution Log

Program Requirements

An Issues and Resolutions Log must be included in the final commissioning report. The log must include the descriptions of issues and the measures taken to correct them. All significant issues impacting building energy performance must be resolved prior to the approval of the commissioning report.