

Total Building Commissioning (Cx) USACE Process

ECB 2015-6

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BUILDING STRONG





Presentation Objectives



- Introduce USACE Policy & Guidance for the implementation and execution of Total Building Commissioning
- Provide a brief narrative of US Army Corps of Engineers USACE Commissioning Process:
Then (HVAC Commissioning Only) &
Now (Total Building Commissioning - ASHRAE 189.1)
- Roles & Responsibilities of the Commissioning Team
- Outline (USACE) approach to Total Building Commissioning
(To be continued June 16)

- *Commissioning* means a **systematic process** of ensuring, using **appropriate verification and documentation**, during the period beginning on the initial day of the design phase of the facility and ending not earlier than one year after the date of completion of the facility, **that all facility systems perform interactively in accordance with the design documentation and intent of the facility**, the operational needs of the owner of the facility and preparation of operation personnel, and the primary goal of which is to ensure fully functional systems that can be properly operated and maintained during the useful life of the facility.
- The following are several common systems that **could be** included in the Commissioning plan per the OPR
 - HVAC
 - Building Envelope
 - Protective systems (Fire Suppression, Lightning Protection)
 - Plumbing (Water distribution, sanitary, storm water)
 - Electrical (Power distribution, lighting)
 - Communications Systems (Telecomm Sound, Video)
 - Alarm Systems (Fault detection, security, Leak Detection)



USACE Commissioning Definitions



Total Building Commissioning: is a method or process for delivering buildings or facilities that begins with project inception through one or more years of operation. The process involves a commissioning authority (CxA) that represents the interest of the owner in delivering the building or facility to meet the owner's needs. The objective is to integrate the total building commissioning into existing phases and steps of building construction delivery to achieve more benefits for the owner at the same or lower cost. **One of the key aspects of total building commissioning is that the owner's needs are determined during the planning and design stage, and then, articulated in the plans and specifications. The Commissioning Authority (CxA) is a person or team that carries this message from planning and design through construction and building occupancy.**

Commissioning Process: a systematic approach of ensuring, using appropriate verification and documentation, during the period beginning at the project initiation phase and ending not earlier than 1 year after the date of completion of construction of the facility, that all facility systems and assemblies perform interactively in accordance with

- the design documentation and intent of the Basis of Design (BoD).
- the operational needs of the owner of the facility, including preparation of operation and maintenance personnel.

The primary goal of which is to ensure fully functional systems and assemblies that can be properly operated and maintained during the useful life of the facility in accordance with the Owner's Project Requirements and consistent with the intent of Annex F of ASHRAE Guideline 0 and ASHRAE Guideline 1.1



USACE Commissioning Objectives



- Ensure the facility meets performance requirements as defined by Owner/User.
- Provide a safe and healthy environment.
- Provide optimum energy performance.
- Provide a facility that can be efficiently operated and maintained.
- Provide complete orientation and training to facility staff.
- Provide improved documentation of building systems.



Purpose & Background



- USACE existing commissioning processes, along with other Quality Management **activities such as Independent Technical Reviews (ITR), Biddability, Constructability, Operability, Environment, Sustainability Reviews (BCOES) and warranty requirements meet most but not all of the requirements for Total Building Commissioning in accordance with ASHRAE 189.1.**
- Prior directives mandated enhanced commissioning and identified select projects to earn LEED Enhanced Commissioning credit EAc3. LEED EAc3 is no longer mandated per SDD Policy Update.
- Current policy (ASA SDD Policy Update, Dec 2013) and criteria (UFC 1-200-02) requires meeting **Total Building Commissioning requirements per ASHRAE 189.1-2011** as opposed to LEED EAc3. ASHRAE 189.1 requirements is similar to LEED EAc3 credit although requires additional systems to be commissioned. Project Delivery Teams are not required but are encouraged to pursue achieving LEED EAc3 when possible.



New USACE Commissioning Process



- The ECB establishes the requirements for and provides information and guidance on Total Building Commissioning Processes on Army projects for Engineers, Project Managers and Construction Managers.
- There are four tasks identified as new or in our current process but need augmentation to achieve Total Building Commissioning:
 - 1) **NEW**: the designation of a USACE Commissioning Authority and supporting Commissioning team in the predesign/design phase (see section 4 of the ECB)
 - 2) **AUGMENT**: design review process to include a commissioning review (see section 4.3.2 of the ECB)
 - 3) **AUGMENT**: the construction submittal review process by including the Commissioning Authority (or designated member of Commissioning team) review for systems being commissioned, and
 - 4) **AUGMENT**: the warranty inspection with a Post Occupancy inspection by the commissioning team. Specific guidance in incorporating these tasks follows in the ECB



Chronology of Commissioning Guidance & Policy



- **ETL 90-10**, Commissioning of Heating, Ventilating, and Air Conditioning Systems
- **Construction Bulletin 95-18**, Commissioning of HVAC Systems
- **DCAF Bulletin 98-7**, Commissioning of HVAC Systems
- **DCAF Bulletin 99-1**, Commissioning of HVAC Systems
- **ECB No. 2006-2 19 May 2006** “Sustainable Design and Development (SDD)” Starting with the FY08 program, all vertical MCA climate controlled projects are required to be capable of achieving the USGBC’s LEED silver certification
FUNDAMENTAL COMMISSIONING IS A PREREQUISITE FOR LEED CERTIFICATION
- **Memorandum of Understanding (MOU), 06 Mar 06, revised 01 Dec 08**, Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings Commissioning. Employ commissioning practices tailored to the size and complexity of the building and its system components in order to verify performance of building components and systems and help ensure that design requirements are met. This should include an experienced commissioning provider, inclusion of commissioning requirements in construction documents, a commissioning plan, verification of the installation and performance of systems to be commissioned, and a commissioning report.
- **ECB 2010-14, 28 Jun 2010**, “Improving Building Performance through Enhanced Requirements for Energy Performance and Selected LEED Credits” EA credit 3 Enhanced Commissioning is selected LEED credit required to be pursued
- **ECB No. 2011-1, 19 Jan 2011** (superseded ECB 2010-14 above)
In addition to the prerequisites, the following LEED-NC/NR credits shall be included in all MCA projects where applicable
(f) EA 3 Enhanced Commissioning
- **ECB 2015-6 Total Building Commissioning “Building Strong”**



Relevant Commissioning Guidance & Criteria



- **ER 1110-345-723**, Systems Commissioning Procedures (revision in process)
- **ER 25-345-1**, Systems Operation and Maintenance Documentation
- **ER 414-345-38**, Transfer and Warranty
- **U.S. Green Building Council (USGBC) LEED Reference Guide for Green Building Design and Construction 2009 Edition**
- **ASHRAE Guideline 0-2005**, The Commissioning Process
- **ASHRAE Guideline 1.1-1996** The HVAC Commissioning Process (supersedes ASHRAE guideline 1-1989)
- **ASHRAE Standard 189.1-2011**, Standard for the Design of High Performance Green Buildings, Section 10 Construction and Plans for Operations
- **UFC 4-510-01** Design: Medical Military Facilities (Chapter 21)
- **UFC 1-200-02** High Performance and Sustainable Building Rqmts
- **Memorandum, DASA (I,E&E), Dec 2013, Sustainable Design and Development Policy Update (Environmental and Energy Performance)**



Current Overarching Policy



By Memo dated 16 Dec 2013 ASA (IE&E) Total Building Commissioning. Facility construction projects will **fulfill the commissioning requirements prescribed in UFC 1-200-02**. Construction projects will use Total Building Commissioning practices to develop the essential documentation, testing, training, and validation required to assure that the facility meets the design intent and post construction operational needs, as documented in the project Owner

Project Requirements (OPR). The Total Building Commissioning process shall focus upon documenting and verifying through the total life of the project that the facility is planned, designed, installed, tested, operated, and maintained to meet the OPR. During the development of the programming document (planning phase), the appropriate Total Building Commissioning level of rigor will be determined based on the size and complexity of the project. The estimated cost for the services of a qualified and experienced Commissioning Authority (CxA) will be budgeted for in the programming document and the cost will be validated prior to the finalization of the Parametric Design. **The use of contracted services or Government personnel as a qualified and experienced CxS should be determined at the start of the design phase.** The CxA shall be independent of the team that executes design and construction.



California Commissioning Collaborate

recommended min. requirements for CxS



Education	Professional Experience	Cx Experience	Cx Coursework and Testing
Professional engineer, architect or building contractor license	3 years' facilities operations/management, construction, design or consulting experience	2 major or 4 smaller new construction or rehab projects or equivalent existing building projects, including letters of reference	Cx coursework recommended Exam; minimum score 70%
Bachelor's degree in engineering, architecture or related field	6 years' facilities operations/management, construction, design or consulting experience	2 major or 4 smaller new construction or rehab projects or equivalent existing building projects, including letters of reference	Cx coursework recommended Exam; minimum score 70%
Associate's degree or technical diploma in building design, construction, construction management, facility operation, or a related field	7 years' facilities operations/management, construction, design or consulting experience	2 major or 4 smaller new construction or rehab projects or equivalent existing building projects, including letters of reference	Cx coursework recommended Exam; minimum score 70%
High school education or construction-related trades training or building operations training from a nationally or internationally recognized trade association	10 years' facilities operations/management, construction, design, or consulting experience	2 major or 4 smaller new construction or rehab projects or equivalent existing building projects, including letters of reference	Cx coursework recommended Exam; minimum score 70%



Tri-Service Commissioning Requirement: UFC 1-200-02



2-2.2 Commissioning.

- Employ commissioning practices appropriate to the **size and complexity** of the building and its system components in order to verify performance and ensure that design requirements are met. This must include an experienced commissioning provider. The use of contracted services or Government personnel as the commissioning provider will be determined at project level.
- **Meet the requirements of ASHRAE 189.1 Section 10.3.1.2** (Building Project Commissioning), with the following modifications:
 - For buildings and systems that are less complex, commissioning can be tailored as determined by the DoD Component AHJ.
 - “Schematic design” is the design charrette or similar conceptual design activity.
 - Delete the requirement to meet ASHRAE 55 Section 6.2 (Documentation).

3-2.2 Commissioning, Re-Commissioning, and Retro-Commissioning.

- Employ commissioning, tailored to the size and complexity of the existing building and its system components, in order to optimize and verify performance of fundamental building systems. Re-Commissioning or Retro-Commissioning must be performed by an experienced in-house or external provider. When building commissioning has been performed, the commissioning report and summary of actions taken must be documented.



ASHRAE std 189.1 paragraph 10.3.1.2 Building Project Commissioning.

For buildings that exceed 5000 ft² (500 m²) of gross floor area, commissioning shall be performed **in accordance with this section using *generally accepted engineering standards*** and handbooks acceptable to the *AHJ*.

For buildings less than 5000 ft², acceptance testing per ASHRAE std 189 paragraph 10.3.1.1.



ASHRAE std 189.1 paragraph 10.3.1.2.1 Activities Prior to Building Permit (i.e design phase commissioning)

- Designate Commissioning Authority (CX)
- Cx lead development of OPR
- Develop and document BOD
- CxA review OPR and BOD for sufficiency
- Incorporate construction phase commissioning requirements in to Spec two focused *OPR* reviews of the construction documents (50 % and 95%)
- Develop commissioning plan



ASHRAE std 189.1 paragraph 10.3.1.2.2 Activities Prior to Building Occupancy.

- Verify the installation with *construction checklist and verification*.
- Verify proper installation and start-up of the systems.
- Perform acceptance tests.
- Verify a system manual has been prepared that includes O&M documentation and full warranty information



ASHRAE std 189.1 paragraph 10.3.1.2.3 Post-Occupancy Activities.

- Complete any commissioning activities called out in the *commissioning plan* for systems whose commissioning can only be completed subsequent to building occupancy, including trend logging and off-season testing.
- Verify the *owner* requirements for training operating personnel and building occupants.



Systems Required to be Commissioned



ASHRAE 189.1 paragraph 10.3.1.2.4 Systems required to be commissioned:

- **HVAC**
- IAQ
- Refrigeration
- Building envelope
- **Lighting controls**
- Shading controls
- Irrigation
- Pumping
- Domestic and process water and pumping
- **Water heating**
- **Renewable energy system**
- Water measurement devices
- Energy measurement devices



- Designate the commissioning authority (CxA)

For all projects it executes as the Design and Construction Agent:

USACE is the Commissioning Authority

- Purpose of Cx and the mission of USACE is the same which is to deliver a product that meets the quality required by the owner and performs to the owner's requirements.
- USACE can be the CxA and still contract for assistance for the following reasons:
 - Complex project (i.e. high containment lab)
 - Lack of resources
 - Lack of expertise

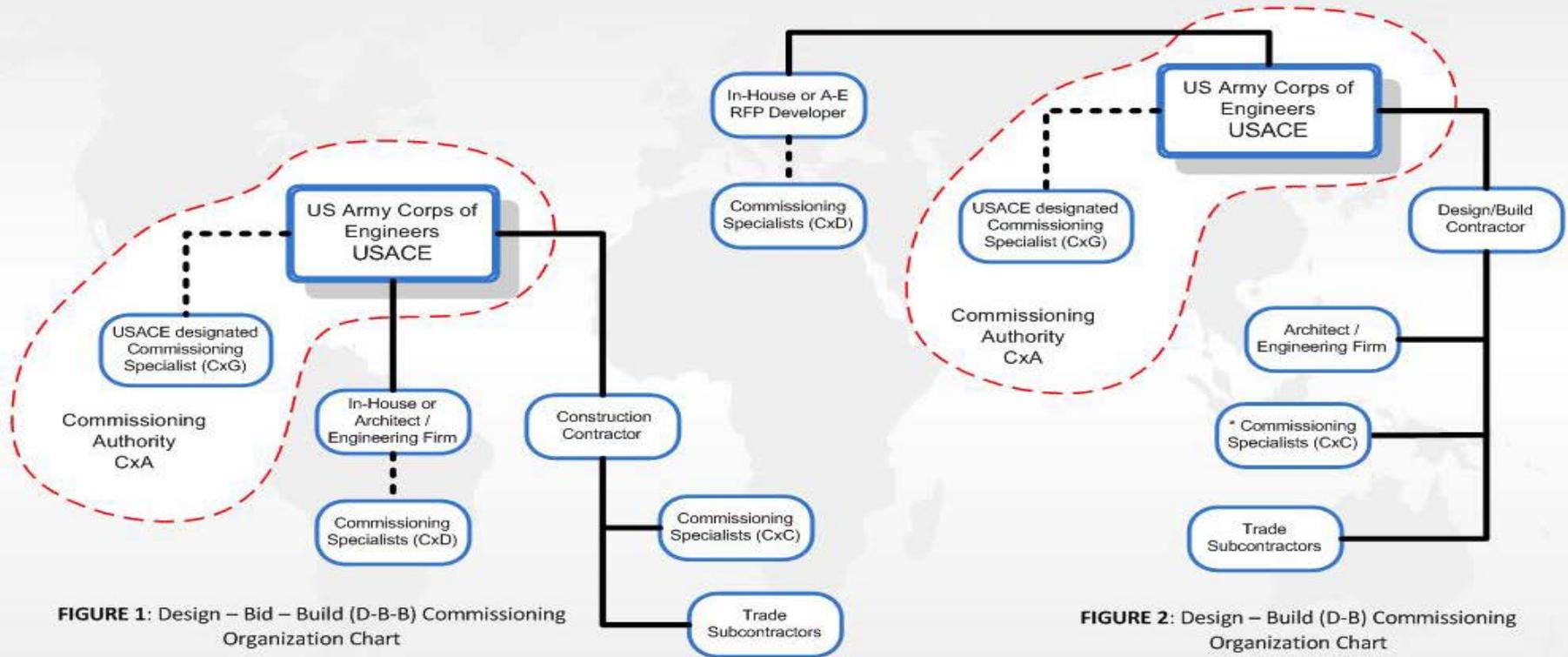


FIGURE 1: Design – Bid – Build (D-B-B) Commissioning Organization Chart

FIGURE 2: Design – Build (D-B) Commissioning Organization Chart

*For D-B contracts the CxC will also assume the responsibility for the design related commissioning tasks and duties associated with the design phase of the project.

- USACE is designated as the Commissioning Authority (CxA) and provides **oversight assurance** of the entire commissioning process
- CxG is the Commissioning Specialist for the Government and is either a qualified designated in-house Commissioning Professional or designated hired Commissioning Professional for the purposes of providing **oversight assurance** for the entire commissioning process.
- The **CxC is required for all projects.**



New Terms Contained in ECB



- **Commissioning Specialist:** an entity having expertise in the commissioning of facilities of a scope and complexity comparable to the individual project, and employed regularly in building commissioning.
- **Commissioning Specialist for the Government (CxG).** The CxG may be person(s) employed by the Design and Construction Agent (USACE), or an entity directly contracted by the Design and Construction Agent, but not affiliated with the construction contractor. The CxG shall provide management and oversight of the Commissioning process through the design, construction, and warranty phases to ensure it is effectively and thoroughly implemented.



New Terms Contained in ECB



Commissioning Specialist for the Design Phase (CxD). The CxD shall be an entity on the Design A/E staff, directly contracted by the A/E, or on the in-house USACE design staff, having expertise in the commissioning of facilities of a scope and complexity comparable to the individual project.

For DBB projects, the CxD shall be responsible for development of all design phase commissioning documentation, including hands-on development of the design phase Commissioning Plan, and commissioning specifications to include general construction phase commissioning plan requirements, Pre-Functional Checklists (PFCs) and Functional Performance Tests (FPTs) that demonstrate the level of rigor of testing for each type of system to be commissioned for that project.

For DB projects, the CxD shall be responsible for developing commissioning scope requirements for inclusion in the RFP which shall include sample PFCs and FPTs to demonstrate rigor of testing requirements.



New Terms Contained in ECB



Commissioning Specialist for the Construction Phase (CxC). The CxC shall be an entity employed as **a first tier subcontractor** by the construction contractor.

For DBB, the CxC shall be responsible for scheduling and coordinating all “Construction Phase” commissioning activities, refinement of PFCs and FPTs to match the specific purchased equipment, development of the detailed construction phase commissioning plan (to augment the design phase commissioning plan), development of the systems manual (to be augmented with design phase commissioning documentation by the CxG), and direct oversight and reporting/documenting of the execution of the Commissioning process.

For DB, the CxC shall be responsible for commissioning activities throughout the design after award, construction, and warranty phases. This includes development of all design-phase commissioning documentation, including hands-on development of the design and construction phase Commissioning Plan and commissioning specifications to include PFCs and FPTs; scheduling and coordinating all construction phase construction activities; refinement of PFCs and FPTs to match the specific purchased equipment; and direct oversight and reporting/documenting of the execution of the Commissioning process. PFC’s and FPT’s need to be defined first before we use them with further definition or explanation.



Appendix C (pg C-5) Roles & Responsibilities



APPENDIX C

Acceptance Phase (D-B-B & D-B)		CxA = Commissioning Authority COR = Contracting Officer Rep CxG= Gov't Comm Consultant A/E = Designer of Record CxC = Construction Comm Specialist O&M = Gov't Facility O&M					L = Lead P = Participate A = Approve R = Review O = Optional N/A = Not Applicable		
Commissioning Roles & Responsibilities									
Category	Task Description	CxG	COR	CxD	DOR	CxC	O&M	Notes	
Meetings*	Pre-Test Coordination Meeting	P	P	N/A	O	L	P	Appendix D - #14	
	Issues Resolution and Commissioning Report Review Meetings	P	P	N/A	O	L	P	Appendix D - #14	
Document Reviews*	Review Completed Pre-Functional Construction checklists	R	A	N/A	O	L	P	Appendix D - #13	
	Pre-Functional Construction Checklist Verification	R	A	N/A	O	L	P	Appendix D - #13	
	Review Operations & Maintenance Manuals	R	A	N/A	O	L	P	Appendix D - #13	
	Training Plan Review	R	R	N/A	O	L	P	Appendix D - #13	
	Warranty Review	R	R	N/A	O	L	P	Appendix D - #13	
	Review TAB Report	R	A	N/A	O	L	P	Appendix D - #13	
Site Observations*	Construction Observation Site Visits	L	P	N/A	O	P	P	Appendix D - #15	
	Witness Selected Equipment Startup	L	P	N/A	O	P	P	Appendix D - #19	
Functional Test Protocols*	TAB Verification	R	A	N/A	O	L	P	Appendix D - #13	
	Systems Functional Performance Testing	R	A	N/A	O	L	P	Appendix D - #19	
Reports & Logs*	Final Commissioning Report	R	A	N/A	O	L	P	Appendix D - #22	
	Submit Final System Manuals	R	A	N/A	O	L	P	Appendix D - #18	



APP D (pg D-2). Application of Funding



APPENDIX D

Tasks (D-B-B)	O&M	P&D	DDC	S&A	Construction Contract	Remarks
C. Construction Phase (cont'd)						
12. Develop the initial format to be used for Issues Logs throughout and for each phase of the Commissioning Process.					CxC	
13. A. In support of Contractor's CQC, prior to submission to government, conduct a quality review of submittal documents: TAB Plan, Submittal and Shop Drawings, Contractor Equipment Startup, Change Orders, ASI, RFI, Pre-Functional Checklists, O&M Manuals, Training Plan, and TAB Report.					CxC	
B. Review of Documents in support of DOR: TAB Plan, Submittal and Shop Drawings, Contractor Equipment Startup, Change Orders, ASI, RFI, Pre-Functional Checklists, O&M Manuals, Training Plan, and TAB Report.				(CxG)* (DOR)		*ER 37-1-30, Ch. 22, App B, B-2, z + ah
14. Schedule and attend commissioning related activities and meetings (i.e. commissioning progress and HVAC controls meetings).				(CxG)*	CxC	*ER 37-1-30, Ch. 22, App B, B-2, g.
15. Attend periodic construction observation site visits.				(CxG)*	CxC	*ER 37-1-30, App B, B-2, e.
16. Schedule a BoD review provided by the DOR for the owner. The initial owner training session will be held immediately before the contractor provided training. This session will be attended by the owner's O&M personnel, the design professionals, the contractor, and the Commissioning Authority. The Commissioning Authority will review OPR and the design professional(s) will review the BoD.			(DOR), (CxD)	(CxG)*	CxC	*ER 37-1-30, Ch. 22, App B, B-2, g.

The ECB was prepared with these two tools (Appendix C&D) for each PDT to identify their team configuration for funding and bidding purposes. PM must be engaged in identifying, requesting, tracking and managing funding.

Questions

