



US Army Corps
of Engineers®

ENGINEERING AND CONSTRUCTION BULLETIN

No. 2015-6

Issuing Office: CECW-CE

Issued: 19 Feb 2015

Expires: 19 Feb 2017

Subject: Total Building Commissioning Process for USACE Projects

Applicability: Directive & Guidance

References:

- a. AR 420-1, Army Facilities Management.
- b. ER 1110-345-723, Systems Commissioning Procedures.
- c. ER 25-345-1, Systems Operation and Maintenance Documentation.
- d. ER 414-345-38, Transfer and Warranty.
- e. ER 37-1-30, Financial Administration - Accounting and Reporting.
- f. U.S. Green Building Council (USGBC) LEED Reference Guide for Green Building Design and Construction 2009 Edition.
- g. Memorandum, ASA (IE&E), 16 Dec 2013, subject: Sustainable Design and Development Policy Update.
- h. ECB 2012-14, 23 Apr 2012, subject: Update to High Performance Energy and Sustainability, Leadership in Energy and Environmental Design (LEED) Certification Guidance.
- i. ECB 2013-5, 13 Feb 2013, subject: Continuity of the High Performance Energy and Sustainability Policy.
- j. ASHRAE Guideline 0-2005, The Commissioning Process.
- k. ASHRAE Guideline 189.1-2011 Standard for the Design of High Performance Green Buildings, Section 10 Construction and Plans for Operations.
- l. Unified Facilities Criteria 1-200-02, 1 March 2013, subject: High Performance and Sustainable Building Requirements.
- m. High Performance and Sustainable Buildings Guidance, 1 Dec 2008.

1. **Purpose:** This 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. USACE currently performs commissioning on all projects per Systems Commissioning Procedures ER 1110-345-723 (Reference b). This ECB provides a review of the Corps' existing processes, additional tasks and additional building systems needed beyond our existing commissioning processes to meet the new requirements of Total Building Commissioning. Currently the Corps existing processes address the majority of tasks needed to comply with total building commissioning. There are four tasks identified as new or in our current process but need augmentation 1) **NEW:** the designation of a USACE Commissioning Authority and supporting Commissioning team in the predesign/design phase (see section 4 of this ECB), 2) **AUGMENT:**

ECB No. 2015-6

Subject: Total Building Commissioning Process for USACE Projects

design review process to include a commissioning review (see section 4.3.2 of this 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 this ECB.

2. **Scope:** This directive applies to all Military Construction, Army (MCA) projects executed by USACE that are subject to any of the above referenced documents regardless of location (CONUS/ OCONUS) that include over 5,000 gross square feet (GSF) of interior space or the construction cost is greater than \$2.5 million. For overseas construction activities on permanent basing and overseas construction activities in support of contingency operations, this policy will apply to the greatest extent practical considering mission objectives and Host Nation agreements.

Issuance of Unified Facilities Criteria (UFC) 1-200-02 (Reference l) and Sustainability Design and Development (SDD) Policy Update (Reference g) supersedes the requirements of previous ECBs regarding the commissioning process (references h and i). UFC 1-200-02 references ASHRAE 189.1 section 10.3.1.2 (Reference k) as the commissioning requirement for new construction, new additions and renovations. It is important to note, that for renovations, only the systems that are replaced must be commissioned. Total Building Commissioning includes commissioning of a variety of building systems, not just HVAC systems, and establishes the required level of effort for commissioning on USACE projects. Buildings greater than 5,000 GSF must comply with ASHRAE 189.1 section 10.3.1.2. If a building is less than 5,000 GSF building acceptance testing is sufficient as outlined in ASHRAE 189.1 section 10.3.1.1.

3. **Background:** USACE existing commissioning processes (References b, c & d), 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. Refer to Appendix A, table 1 for a comparison of the existing Commissioning requirements and the Total Building Commissioning process as prescribed in this ECB. Tasks to meet Total Building Commissioning that may require augmentation beyond our normal quality management processes are highlighted yellow in the table located in Appendix A.

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 requires meeting Total Building Commissioning requirements per ASHRAE 189.1-2011 as opposed to LEED EAc3 (Reference h and i). Project Delivery Teams are not required but are encouraged to pursue achieving LEED EAc3 when possible (see Appendix A for specific guidance).

4. **General Guidance:** Total Building Commissioning is a process (see Appendix B) in which building systems and their interactions are tested and verified to work in accordance with the Owner's Project Requirements (OPR) and Construction Documents/Contract Documents (CD). It involves engagement of a Commissioning Authority and Commissioning Team during pre- design, design, construction, occupancy and warranty phases.

For Army MCA projects and tenant facilities on Army installations requiring commissioning, USACE is designated as the Commissioning Authority (CxA) and provides oversight assurance of the entire commissioning process. The building design and construction industry uses the term "Commissioning Authority" (CxA), as defined in ASHRAE guideline 0, to refer to the "entity identified by the Owner who leads, plans, schedules, and coordinates the commissioning team to

ECB No. 2015-6

Subject: Total Building Commissioning Process for USACE Projects

implement the Commissioning Process.” USACE is the Army’s Design and Construction Agent and in that capacity represents the Owner’s interests with respect to commissioning. In the context of USACE MILCON design and construction processes, certain Cx roles and responsibilities are assigned to other entities and/or lead individuals in contractual relationships with USACE, while USACE still maintains overall Cx process oversight.

The leadership structure of the Commissioning Team, including roles and responsibilities, must be fully defined in the project requirements documents, as the structure may vary depending on the acquisition strategy, size, expertise of the participants, and complexity of the project. This ECB provides appendices to be used as tools in planning and executing the commissioning process. Regardless of leadership structure, the process requires full and open communication for all parties to maximize the benefits of the process. Current Corps documents make reference to the CxA and the CxS. The CxS has typically been the Contractor’s Commissioning Specialist or the design phase Commissioning Specialist. The CxS is now redefined; the Commissioning Specialist is broken down into three different roles: CxG, CxD, and CxC (defined in Appendix F). In order to help understand the delegated roles and responsibilities of these specialists, a Cx leadership structure has been defined as follows:

a. Commissioning Specialist for the Government (CxG)

For the purpose of meeting industry’s “enhanced” Cx requirements (i.e. USGBC’s LEED Rating system, EA Credit 3), the CxG is considered the CxA. 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, and is the entity responsible for government oversight of the commissioning process. (see Appendix F for full definition)

b. Commissioning Specialist for the Design Phase (CxD)

The CxD must 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, and is the individual responsible for coordinating the commissioning activities during the design phase. (see Appendix F for full definition)

c. Commissioning Specialist for the Construction Phase (CxC)

The CxC must be a certified commissioning provider with the experience and expertise in the commissioning of facilities of a scope and complexity comparable to the individual project. The CxC must be employed regularly in building commissioning and is the individual responsible for coordinating the commissioning activities during the construction and post-occupancy phases. (see Appendix F for full definition). Ideally, the CxC would be a first tier subcontractor hired by the construction contractor, however with requisite experience and qualifications in consideration of the size and complexity of the project the CxC may be an employee of the prime construction contractor. The CxC in a Design-Build Acquisition will also assume the responsibility for the design related commissioning tasks and duties associated with the design phase of the project.

The CxG is required for all project procurement methods. The CxD is typically required for Design-Bid-Build (DBB) projects, and may be utilized during Design-Build (DB) RFP preparation for DB projects. The CxC is required for all projects. Individuals within the commissioning leadership structure must have the appropriate qualifications for LEED documentation purposes. The Commissioning Specialists defined above may also be supported by discipline specific specialists, as dictated by the size and complexity of the project.

ECB No. 2015-6

Subject: Total Building Commissioning Process for USACE Projects

The following subsections further define the systems to be commissioned, the roles and responsibilities of the commissioning team and specific guidance on the commissioning process.

4.1 Commissioned Systems. The systems to be commissioned will be determined during project scope development and at a minimum comply with ASHRAE 189.1 as referenced in UFC 1-200-02 and SDD Policy Update, as applicable. The systems and equipment to be commissioned and the Commissioning Team roles and responsibilities will be outlined in the Commissioning Plan during the planning and design process and further refined and detailed throughout all phases of the project. It is inclusive of the following systems, if included in the project and determined to be required based on complexity and size of the building: HVAC, building envelope, lighting controls, shading controls, irrigation, plumbing, domestic and process water and pumping, water heating, renewable energy system, indoor air quality, refrigeration, water measurement devices, energy measurement devices and other systems as warranted and required by the Authority Having Jurisdiction (AHJ).

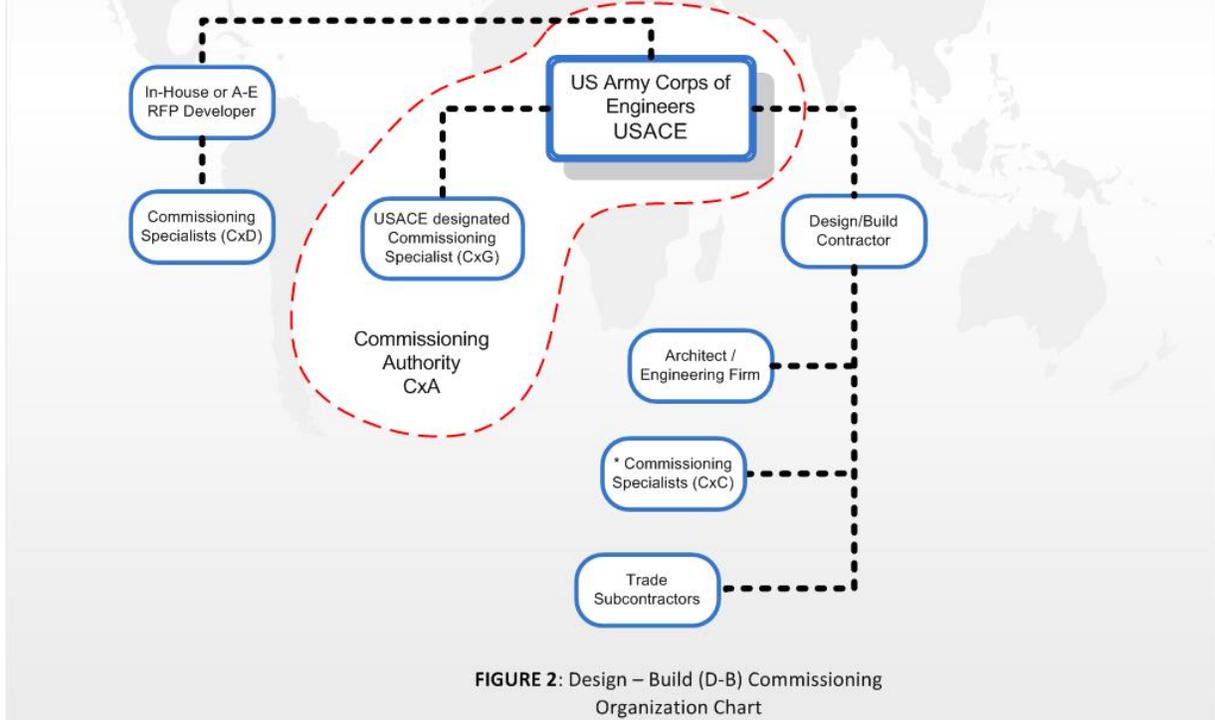
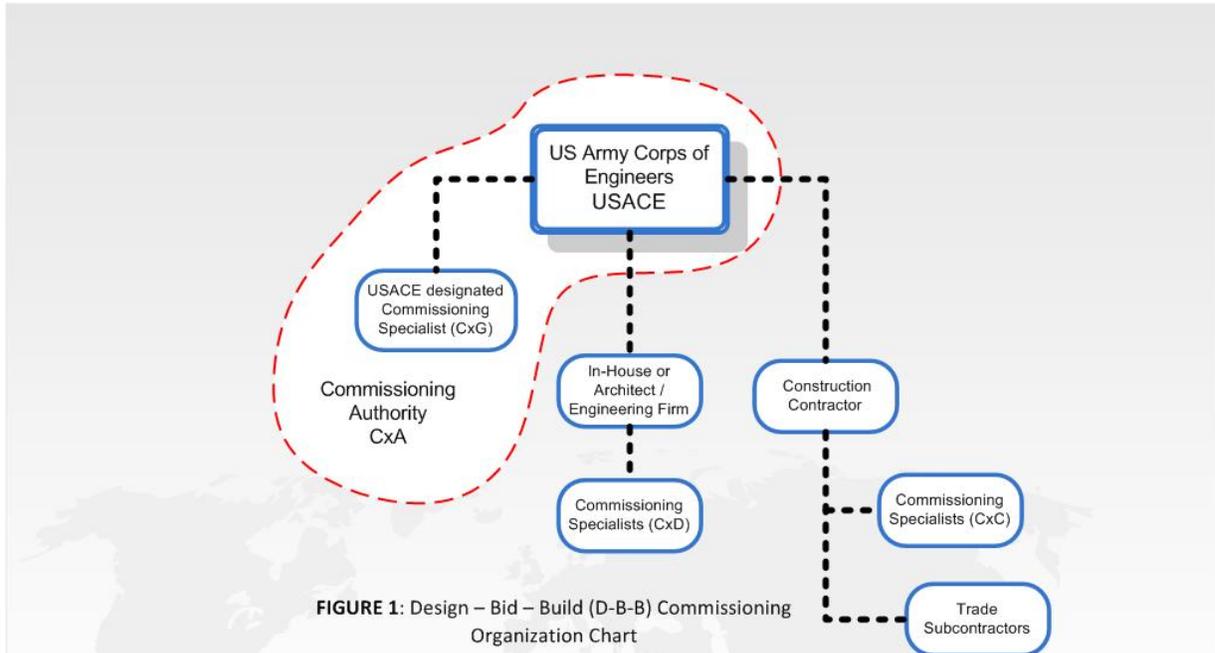
4.2 Roles and Responsibilities. Roles and responsibilities related to Total Building Commissioning are interwoven and complex and can vary based on the acquisition strategy. The Project Delivery Team (PDT) will develop a Responsibility and Accountability Matrix and document it in an initial Commissioning Plan. This must be followed by updates to the Commissioning Plan at each phase of a project by providing more specific details, roles and responsibilities. Refer to Appendix C which is a sample Responsibility and Accountability Matrix.

The Responsibility and Accountability Matrix to be developed by the PDT highlights the task description, the level of involvement and the personnel for each task. Many tasks have several people involved. The level of involvement is defined as to lead, to participate, to approve and to review. The list of roles is CxG, Contracting Officer Representative (COR), Designer of Record (DOR), CxD, CxC and Government Facility O&M. The level of participation by each role changes depending on project phase and task. The matrix must be developed prior to bidding to properly allocate costs among stakeholders.

Figures 1 & 2 below provide the organizational structure for Design-Bid-Build (DBB) and Design-Build (DB) acquisitions. The commissioning team is responsible to assure that the operation of the final constructed facility meets the Owner's Project Requirements (OPR); this does not mean that all tasks are performed by one entity or individual. In no way does the designation of a CxG alleviate the Construction Contractor's requirement for a CxC. The Construction Contractor has a significant role in the quality of the building systems as well as scheduling and documenting meetings, reports, reviews, functional tests and operator training. USACE provides the oversight and executes commissioning through its established processes. For size and complexity of the project, where appropriate and required to supplement its geographic in-house personnel, USACE may seek out public resources from outside its geographic region or contract with a private enterprise to execute the roles and responsibilities of the CxG.

In all cases the Construction Contractor provides for a CxC for further detailed development, execution and completion of the Commissioning Plan which includes development of pre-functional construction checklists and functional performance testing procedures for the actual submitted systems and equipment. The CxC provides all reports to include the final summary Commissioning Report that validates compliance of the constructed facility with construction documents.

Figures 1 & 2 Total Building Commissioning Process Commissioning Organization Roles & Responsibilities for D-B-Band D-B acquisitions



*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.

ECB No. 2015-6

Subject: Total Building Commissioning Process for USACE Projects

4.3 Specific Guidance on Commissioning Tasks during Phases of the Project. USACE current processes achieve many of the tasks needed to achieve Total Building Commissioning. The table in Appendix A shows a crosswalk of existing Corps Processes and commissioning tasks with that of Total Building Commissioning per ASHRAE 189.1. The commissioning tasks identified in yellow highlight (in Appendix A) may require augmentation from our current Corps processes and/or additional funds. These tasks are summarized in the four project phases (Planning and Parametric Design, Design, Construction, and Post Occupancy) below:

4.3.1 Planning and Parametric Design. During planning and development of DD Form 1391 and/or ENG Form 3086, determine the level of rigor of Total Building Commissioning based on the size and complexity of the project using the tools provided in Appendix C for designation of roles and responsibilities and Appendix D for funding guidance. Estimate and incorporate into the DD Form 1391 and/or the ENG Form 3086 the cost for commissioning services beyond our current quality control/quality assurance processes which are already included in the DoD Unit Price with justification and approval from ACSIM. The Planning and/or Design Charrette teams must include a member knowledgeable in the Total Building Commissioning process.

DoD Unit Price for facilities is an average price based on several years of actual Federal construction project costs. Building projects have historically incorporated the requirements for LEED Fundamental Commissioning and the requirements of Engineering Regulations (References b, c, and d) which represent many of the tasks of Total Building Commissioning.

The costs included in the DD Form 1391 and/or ENG Form 3086 must reflect only those services beyond the requirements of LEED Fundamental Commissioning and Engineering Regulations. Such costs may include, but are not limited to:

- Commissioning services for additional systems beyond those required by LEED to be commissioned.
- Additional design and submittal reviews performed by a designated CxG.
- Costs associated with contracting CxG for large or complex projects.

The Owner's Project Requirements (OPR) during the planning phase is comprised of the charrettes meeting notes and must be included in Tab C of the final DD Form 1391. During Code 3, the notes must also be included in the PDR Report (ENG Form 3086). An initial commissioning plan developed during this phase documents the expected activities, systems to be commissioned and designated roles and responsibilities of the Commissioning Team. It is recommended to utilize the appendices of this ECB as tools to develop the initial commissioning plan. *It is important to note the DoD unit price may not include all costs for commissioning activities.*

4.3.2 Design. Early in the design phase, designate the CxG that will have oversight responsibilities to assure the execution of the commissioning process. While Total Building Commissioning is a team effort, it is a best management practice to have continuity of the CxG from the beginning of a project to the end, if possible.

ECB No. 2015-6

Subject: Total Building Commissioning Process for USACE Projects

The Owners Project Requirements (OPR) document will be developed at this phase with the Owners and the designer of record (DOR) to describe the project's goals and specific functional and operational requirements for the commissioned systems. Prepare the OPR document by compiling information related to the systems to be commissioned from the DD Form 1391, PDR (ENG Form 3086), design charrette minutes, and applicable criteria, standards and guidance.

The design team is responsible for development of the Basis of Design (BoD) which describes how the design addresses the OPR. The OPR, BoD and CD form the basis for development of the commissioning plan at the design phase. The Commissioning Plan must be reviewed by the CxG.

During design phase, the commissioning specifications will include the required forms and procedures (i.e., representative/sample pre-functional construction checklists and functional performance tests (FPT)) for the complete testing of all equipment, systems and controls that demonstrate the level of rigor for such testing. As design progresses, these checklists and FPTs must be further developed by the project team with review by the CxG. During Construction, the checklists and FTPs developed during design are updated and detailed by the CxC only to the extent needed to reflect specifics of the approved equipment and systems. Construction phase commissioning requirements must be incorporated into the CDs.

The commissioning plan will be updated during design phase. The commissioning plan documents the OPR and at a minimum defines the systems to be commissioned, designates roles and responsibilities and required tasks in order to develop cost estimates and identify the funding source (see funding section below). In addition, the commissioning plan and CDs must include any required post occupancy trend data logging, seasonal testing and inspections.

The commissioning plan is intended to be progressively developed, gaining more details as the project progresses through its phases (planning, design, construction and post construction/occupancy). Post award of a construction contract, the design phase commissioning plan can be shared with the successful contractor as for information only (FIO). The CxC will have ultimate responsibility to develop the construction phase commissioning plan consistent with the construction contract documents.

As a minimum, the CxG or CxD perform a commissioning design review and backcheck at least twice prior to solicitation of the construction contract. The first review must occur at or near 50% of design completion and the second review must be the review of the final CDs prior to release for bid solicitation. All commissioning comments must be documented with resolution verified by CxG prior to release for solicitation. The design review verifies that the design is commissionable and meets the OPR.

4.3.2.1 Design-Build. For a Design-Build (DB) acquisition, define the qualifications of the CxC and identify the roles and responsibilities of the CxC and other sub-contractors in the RFP. The RFP will require CxC qualifications and supporting documentation as one of the technical factors for rating the contractor's proposal.

ECB No. 2015-6

Subject: Total Building Commissioning Process for USACE Projects

4.3.3 **Construction:** After award of a construction contract, the CxC must develop the construction phase commissioning plan with input from the Construction Contractor and pertinent sub- contractors. The commissioning plan must include detailed pre-functional construction checklists and functional performance testing with specific testing procedures. The CxG or a subject matter expert from the USACE District must review the commissioning plan and any revisions or updates prior to approval by the Contracting Officer Representative (COR).

The Project Engineer (PE) in collaboration with the Contractor's Quality Control (CQC) designee must ensure that the submittals identified in the specifications for CxG and CxC review are designated in the submittal register for routing and review concurrent with the Designer of Record (DOR) review. The CxG review may be supplemental to the current USACE processes.

The commissioning activities shall be incorporated into the overall construction schedule, identifying specific milestones, testing to be performed and testing duration. Commissioning schedule considerations shall include conveyance of activities sequence, durations, reviews, testing, reworks, etc. HVAC FPTs should only commence after successful completion of HVAC Controls performance verification tests (PVT) and witnessing/review of trended data to demonstrate controls and systems are performing in a stable manner.

A systems manual is prepared by the CxC to include warranty information and information needed to understand and operate the integrated commissioned systems as designed and must be developed in accordance with ASHRAE 189.1. This is consistent with our current process of developing a systems manual per ER 25-345- 1, Systems Operation and Maintenance Documentation (Reference c). The CxG or a subject matter expert from the USACE District must review the systems manual and the CxC must resolve all comments and concerns identified by the CxG prior to COR approval.

The Contractor and the CxC must continuously update the commissioning plan including refining any post occupancy required activities. Prior to systems acceptance, the CxC will prepare and submit a complete summary commissioning report, documenting all performance testing and recommendations, for review by the CxG. The CxG and CxC must verify that all systems have successfully passed inspection and testing prior to acceptance. As discussed in the next subsection, systems requiring alternate season testing may be accepted at post occupancy.

Verification, development of commissioning plans, commissioning reports and provision of training are all part of USACE typical construction process as outlined in the table in Appendix A. The commissioning report must document the commissioning process and validate the facility is operating in accordance with the OPR, BoD (for D-B) and CD as well as include results of any construction phase review and testing.

4.3.4 **Post Occupancy.** 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 alternate season testing. Verify all owner training requirements for operating personnel and building occupants are completed for all systems including systems whose tests were seasonally deferred. It is ideal to conduct any monitoring and testing as required in the commissioning plan while the building is occupied; however, in absence of full occupancy, complete any seasonal or deferred testing within the warranty period.

ECB No. 2015-6

Subject: Total Building Commissioning Process for USACE Projects

The commissioning report will be updated and submitted to include the results of any post occupancy testing, review and inspection. The report must include problems or concerns identified during the inspection that will be corrected within the contract warranty clause, addressed by O&M staff or identified for future correction.

The Post Occupancy Inspection must execute those tasks identified in paragraph 8.2.1.3 of ASHRAE Guideline 0-2005 (Reference j) with the following exceptions. Subparagraph (a) of 8.2.1.3, "Coordinate Contractor callbacks," will be executed by the installation's O&M staff. Subparagraph (f) of 8.2.1.3, "Conduct and verify periodic performance, evaluations of facilities systems and assemblies," will be required to be performed one time at a minimum, ideally during the warranty period.

The Post Occupancy Inspection of commissioned systems can be performed concurrent with the warranty inspection by the CxG and CxC, as outlined in the commissioning plan.

5. **Funding** (Reference b, see page 4, paragraph 6). For Corps of Engineers costs associated with commissioning, funding must be in accordance with the activities performed.

5.1 For design activities occurring prior to award of the construction contract, appropriate Planning and Design (P&D) funds must be utilized.

5.2 For design activities occurring after award of the construction contract, CxG commissioning activities are considered an extension of the design phase and therefore must be funded by Engineering During Construction (EDC) resources (also referred to as Design During Construction (DDC). EDC and DDC are often referred to as construction phase services ¹. These activities have been identified and noted as DDC funded in Appendix D of this ECB.

5.3 Construction agent activities must be funded with Supervision and Administration (S&A) resources. Design agent quality assurance support must be available to and under the control of the construction agent. QA support would be S&A funded.

5.4 Construction contractor activities associated with executing the commissioning process during construction must be included as contract requirements and therefore would be funded with project construction funds.

Refer to Appendix B, which reflects how funding sources can be visualized across the phases of the Total Building Commission Process diagram. Additionally, Appendix D provides a detailed listing of the commissioning tasks per ASHRAE Guideline 0-2005 that may be applied across the phases of a project and the distribution of the parties involved. These appendices are provided as samples used to formulate a strategy to appropriately estimate and assign funding sources to the associated commissioning tasks.

¹ ER 37-1-30 *Financial Administration Accounting and Reporting, Change 11, Chapter 22, Section 22-3, dated 31 January 2012 has been reviewed and the S&A prohibition is only applicable to post-award commissioning activities that are considered an extension of design phase.*

ECB No. 2015-6

Subject: Total Building Commissioning Process for USACE Projects

5.5 **Project Manager Function:** Funding sources cross functional lines and cross over the phases of the project. The Project Manager must be engaged in identifying, requesting, tracking and managing funding so that no interruptions of commissioning services occur. Commissioning costs must be validated in the Code 3 process in order to ensure that sufficient funds are available to execute commissioning in compliance with Army requirements.

In the unlikely event that compliance with the specific requirements contained within this ECB cannot be executed, an exception request must be submitted in accordance with the SDD Policy Update.

6. **Costs:** Utilizing cost per GSF or percentage of total costs provides for a rough order of magnitude for programming purposes. USACE TechNote – Enhanced Commissioning Strategy was developed in October 2010 to provide information including industry estimates for commissioning. This TechNote is available at https://www.wbdg.org/ccb/browse_cat.php?c=266

However, much of USACE commissioning costs are already accounted for in our standard processes. The cost for Total Building Commissioning must be refined by the development of a more detailed cost estimate for those tasks and building systems not part of our former processes. The detailed cost estimate must assign the appropriate resources to the specific commissioning tasks for all systems to be commissioned, identify the funding source for those resources and determine if that cost is already in our DoD unit cost for facilities. Appendix C and D have been developed to assist in this effort.

Most of the commissioning costs are covered within our existing specifications, as tasks for the CxC, and thus covered by contract costs. Many other design phase tasks are covered by our normal QA processes.

Areas that have been defined as needing supplemental tasks to meet Total Building Commissioning beyond our normal processes are highlighted yellow in the table located in Appendix A. Beyond what is built into the Current Working Estimate (CWE) for Construction and part of the normal QM processes, areas that may require more effort than already required on a project would include design phase commissioning review, commissioning submittal review, post occupancy review and inspection by the CxG. Additional incremental costs for Total Building Commissioning must be developed in these areas. It is recommended to consult with a Commissioning subject matter expert (SME) in your district or region to assist in development of these costs.

ECB No. 2015-6

Subject: Total Building Commissioning Process for USACE Projects

7. **Training and Resources:** For professionals that want more information about the Commissioning processes or want to know about available training, see Appendix E.
8. **Definitions:** (see Appendix F)

The HQUSACE (CECW-CE) point of contact for this ECB is Thomas Jamieson at (570) 615-7052 or Thomas.J.Jamieson@usace.army.mil.

//S//
JAMES C. DALTON, P.E., SES
Chief, Engineering, and Construction
U.S. Army Corps of Engineers

//S//
RICHARD A. HANCOCK, P.E., SES
Chief, Programs Integration Division
Directorate of Military Programs

//S//
STACEY K. HIRATA, P.E., SES
Chief, Installation Support Division
Directorate of Military Programs

Distribution: All E&C Chiefs and All PM Chiefs

ATTACHMENTS

- Appendix A - LEED Guidance + LEED/ASHRAE Comparison
- Appendix B - Funding Commissioning Process
- Appendix C - Roles and Responsibilities Matrix
- Appendix D - Funding TBCx Chart
- Appendix E - Training and Resources
- Appendix F - Definitions

APPENDIX A

Guidance with LEED

LEED assigns tasks and responsibilities for commissioning to one of three phases it identifies as Predesign-Design Phase; Construction Phase; Occupancy. Tasks performed by the CxA are listed below by phase:

- a. Predesign-Design Phase
 - i. Review owner's project requirements and basis of design
 - ii. Conduct commissioning design review prior to mid-construction documents

- b. Construction Phase
 - iii. Review contractor submittals applicable to systems being commissioned
 - iv. Verify installation and performance of commissioned systems
 - v. Complete a summary commissioning report

- c. Occupancy
 - vi. Review building operation within **10 months** after substantial completion

Two additional tasks in the predesign-design phase required to earn Enhanced Commissioning may be performed by the Commissioning Authority or the Project Team. These tasks include;

- vii. Develop and implement commissioning plan
- viii. Incorporate commissioning requirements into construction documents

Two additional tasks in the construction phase required to earn Enhanced Commissioning may be performed by the Commissioning Authority or the Project Team. These tasks include;

- vii. Develop systems manuals for commissioned systems
- viii. Verify that requirements for training are completed

Note: See page 220 of the LEED Reference Guide for Building Design and Construction 2009 Edition for a complete table of tasks and responsibilities for both fundamental and enhanced commissioning. These tasks are outlined below in the "Crosswalk USACE Existing Processes Compared to ASHRAE 189.1, LEED EAp1 Fundamental Commissioning and EAc3 Enhanced Commissioning Requirements" table which identifies the gaps, highlighted in yellow, between USACE's existing quality management processes and ASHRAE 189.1 Total Building Commissioning.

All MCA projects must achieve a LEED silver rating from USGBC per SDD Policy Update (Reference g). In order to achieve this, all prerequisite credits must be achieved. Therefore, all MCA projects must meet the requirements of LEED Fundamental Commissioning of Building Energy Systems prerequisite 1. Implementing our current processes will achieve this Prerequisite providing that it is documented sufficiently.

Many projects pursue the LEED Energy and Atmosphere Credit 3 (EAc3) for “Enhanced Commissioning.” One of the differences from Fundamental Commissioning is that LEED Enhanced Commissioning requires third party oversight of project commissioning through all phases from pre-design to post occupancy phases of the project. USACE’s current Quality Management processes include checks and balances that provide a “disinterested third party” review. Additionally, USACE is the project owner until transfer and acceptance of the DD Form 1354 is completed. Therefore qualified USACE employees not directly involved with the design or construction of a project may serve as CxG. The designated CxG also must not hold any duties other than commissioning activities on the project.

**Crosswalk USACE EXISTING PROCESSES COMPARED TO ASHRAE 189.1,
LEED EA_{p1} FUNDAMENTAL COMMISSIONING and EA_{c3} ENHANCED COMM REQUIREMENTS**

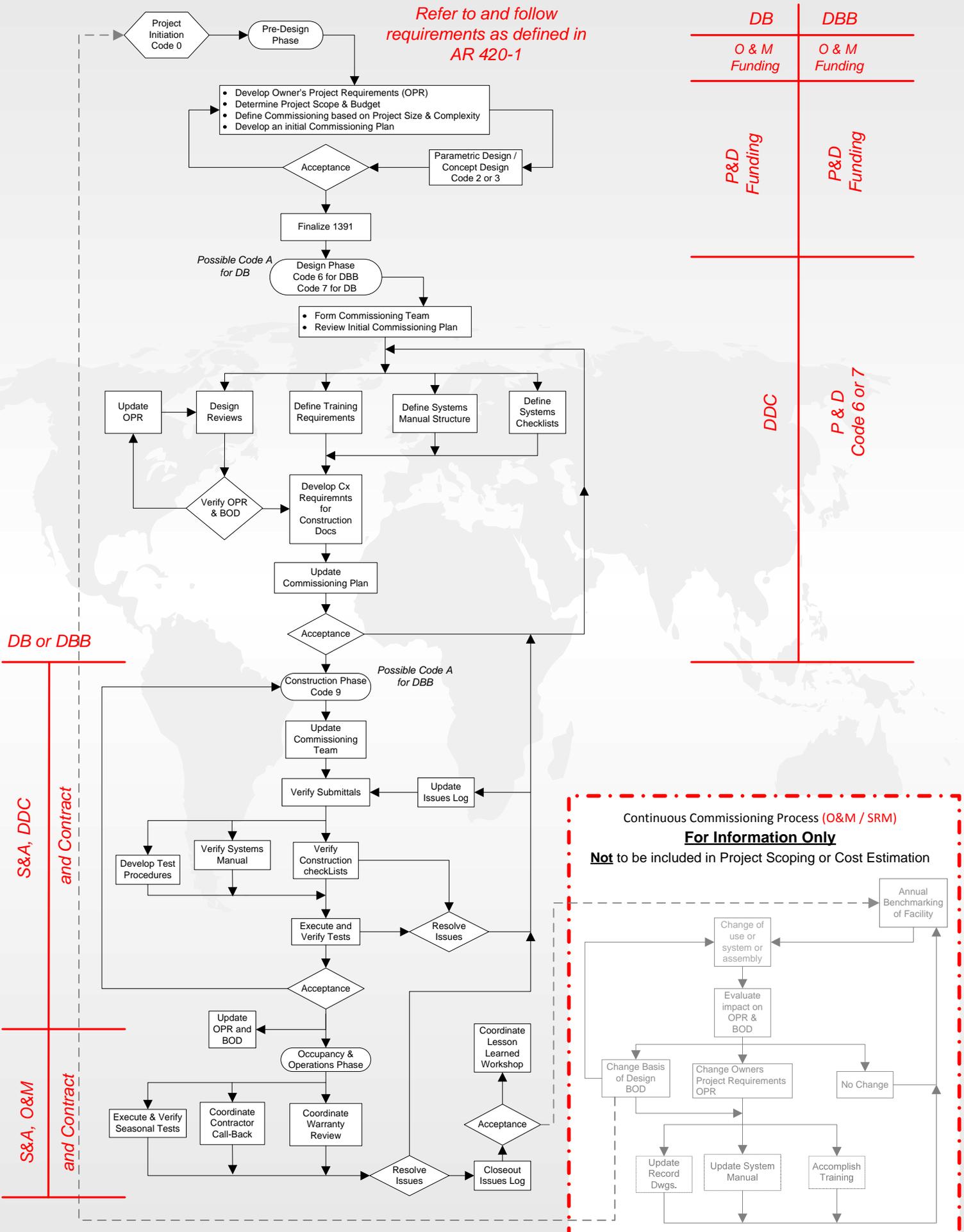
* *Highlighted* tasks are required for Total Building Commissioning beyond USACE current commissioning processes.

USGBC LEED EA p1 and EA _{c3} tasks (EA _{c3} additional tasks in bold)	EA _{p1}	EA _{c3}	USACE Processes	REFERENCES: Corps Engineering Regulations or SOPs or document	ASHRAE 189.1 For bldg >5000sf
Designate independent CxA with experience with at least 2 similar building projects	X	X	USACE provides quality assurance oversight for Army client (owner) as designated <i>May need to augment government commissioning specialist with contract for CxG support.</i>	UFC 1-200-02 1	10.3.1.2.1.a
Document Owner's Project Requirements (OPR)	X	X	Charrettes	ER 1110-345-723 1391	10.3.1.2.1.b
Develop Basis of Design (BoD)	X	X	Design	ER 1110-345-723 Design Analysis	10.3.1.2.1.c & d.
Review OPR and BoD	X	X	Design Review	ER 1110-345-723	10.3.1.2.1.c & d.
Develop and implement commissioning plan	X	X	Design and Construction Management	ER 1110-345-723 Commissioning 23 09 23 ASHRAE 0 and ASHRAE 1.1 Plan	10.3.1.2.1.g containing all required forms and procedures for the complete testing of all equip, systems and controls
Incorporate Commissioning requirement into the construction documents	X	X	Design	ER 1110-345-723 UFGS 23 08 00 and 23 09 23 for HVAC. (note Tri-Service effort underway for development of UFGS for plumbing & electrical systems as it relates to commissioning)	10.3.1.2.1.e

USGBC LEED EA p1 and EAc3 tasks (EAc3 additional tasks in bold)	EAp1	EAc3	USACE Processes	REFERENCES: Corps Engineering Regulations or SOPs or document	ASHRAE 189.1 For bldg >5000sf
Conduct Commissioning design review prior to mid-construction documents		X	ITR, BCOE review, Dr. Checks <i>CxG verifies that the documents achieve OPR and the BOD fully supports OPR with sufficient details.*</i>	ER1110-1-12 ch 4 ER-415-1-11 1 Sep 1994 ER 1110-345-723	10.3.1.2.1.f.
Review contractor submittals applicable to systems being commissioned (concurrent with DOR)		X	Resident engineer plus AE and DOR <i>Define roles and responsibilities in contract for CxG, CxD & CxC. Adjust submittal register and/or refine UFGS 01 45 00 QC and 01 33 00 Submittals*</i>	ER-415-1-10 15 Apr 1997	
Verify the installation and performance of commissioned systems	X	X	CQC three phase inspection	ER 1110-345-723 UFGS 23 09 23	10.3.1.2.2.a
Develop systems manual for commissioned systems		X	CxC responsibility	ER-25-345-131 Jan 91 UFGS 23 09 23 UFGS 01 78 23	10.3.1.2.2.d
Verify that requirements for training are completed		X	Project Team and/or CxC responsibility	ER 1110-345-723 UFGS 01 78 23	10.3.1.2.2.b &10.3.1.2.3.b
Complete a summary commissioning report	X	X	CxC responsibility	ER 1110-345-723 UFGS 23 08 00 Paragraph 3.3.	10.31.2.2.c
Review building operation within 10 months after substantial completion		X	USACE Warranty Inspections at 4 months and 9 months <i>Need to augment contract specifications with the roles and responsibilities of CxG and CxC. Need to expand warranty requirements in UFGS 01 78 02 *</i>	ER 415-345-38 Transfer and Warranty UFGS 01 78 02	10.3.1.2.3

*** TOTAL BUILDING COMMISSIONING PROCESS ***

Refer to and follow requirements as defined in AR 420-1



APPENDIX C

Pre-Design Phase(D-B-B)/RFP Development(D-B)		CxG = Gov't Comm Specialist COR = Contracting Officer Rep DOR = Designer of Record CxD = Design Comm Specialist 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-Design Kick-Off Meeting	P	P	O	L	N/A	P	<i>Appendix D - #1</i>	
	Owner's Project Requirements Meeting	P	P	P	L	N/A	P	<i>Appendix D - #1</i>	
	Commissioning Planning Meetings	P	P	L	O	N/A	P	<i>Appendix D - #1</i>	
Coordination	Coordinate with [COR, DOR, etc.] to ensure that Cx is incorporated into project planning and documents.	L	P	P	P	N/A	P	<i>Appendix D - #2</i>	
Cx Plan & Spec	Draft Commissioning Plan	R	A	L	R	N/A	P	<i>Appendix D - #4</i>	
Schedules	Preliminary Commissioning Schedule	R	A	L	R	N/A	P	<i>Appendix D - #3</i>	
OPR and BOD	Prepare Owner's Project Requirements	R	A	P	L	N/A	P	<i>Appendix D - #1</i>	
	Basis of Design	R	A	P	L	N/A	P	<i>Appendix D - #6</i>	
Commissioning Documents	Identify systems to be commissioned	R	P	L	P	N/A	P	<i>Appendix D - #1</i>	
	Preliminary acceptance criteria	R	P	L	P	N/A	P	<i>Appendix D - #8</i>	
	Commissioning Documents preliminary templates	R	P	L	P	N/A	P	<i>Appendix D - #7</i>	

Note: (Appendix C) is just a sample to depict how such a matrix would be developed. There are many more commissioning tasks to be identified beyond what the sample identifies. The type of involvement shown is for instruction purposes only and would need to be developed on a project by project basis for the size, complexity and degree of rigor required.

APPENDIX C

Design Phase (D-B-B)		CxG = Gov't Comm Specialist COR = Contracting Officer Rep DOR = Designer of Record CxD = Design Comm Specialist 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	
Coordination Cx Plan & Spec Schedules	Coordinate with [COR, AHJ, Vendors, etc.] to ensure that Cx interacts properly with other systems as needed to support OPR and BoD	P	P	P	L	N/A	P		
	Preliminary Commissioning Plan	R	A	L	R	N/A	P	<i>Appendix D - #4</i>	
	Preliminary Cx Specifications	R	A	L	R	N/A	P	<i>Appendix D - #7</i>	
	Design Phase Commissioning Schedule	R	A	P	L	N/A	P	<i>Appendix D - #3</i>	
OPR and BoD	Maintain OPR on behalf of Owner	P	P	P	L	N/A	P	<i>Appendix D - #1</i>	
	Review Basis of Design Document vs. OPR	R	P	L	P	N/A	P	<i>Appendix D - #6</i>	
	Maintain BoD on behalf of Owner	P	P	P	L	N/A	P	<i>Appendix D - #7</i>	
Reviews	Focused Concept Design Review	R	A	P	L	N/A	P	<i>Appendix D - #8 +9</i>	
	Focused Design Development (35-50%) Review	R	A	P	L	N/A	P	<i>Appendix D - #8 +9</i>	
	Focused Construction Document Review	R	A	P	L	N/A	P	<i>Appendix D - #8 +9</i>	
	Focused Pre-Final Construction Document	R	A	P	L	N/A	P	<i>Appendix D - #8 +9</i>	
	Focused Final Construction Document	R	A	P	L	N/A	P	<i>Appendix D - #8 +9</i>	
	Final Construction Document Comment Backcheck	R	A	P	L	N/A	P	<i>Appendix D - #8 +9</i>	
Functional	Draft Pre-Functional Construction Checklists (PFC)	R	P	L	R	N/A	P	<i>Appendix D - #7</i>	
Test Protocols	Draft System Functional Performance Tests (FFT)	R	P	L	R	N/A	P	<i>Appendix D - #7</i>	

Note: (Appendix C) is just a sample to depict how such a matrix would be developed. There are many more commissioning tasks to be identified beyond what the sample identifies. The type of involvement shown is for instruction purposes only and would need to be developed on a project by project basis for the size, complexity and degree of rigor required.

APPENDIX C

Design Phase (D-B)		CxG = Gov't Comm Specialist COR = Contracting Officer Rep DOR = Designer of Record CxD = Design Comm Specialist 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		CxG	COR	CxD	DOR	CxC	O&M	Notes	
Category	Task Description								
Coordination Cx Plan & Spec Schedules	Coordinate with [COR, AHJ, Vendors, etc.] to ensure that Cx interacts properly with other systems as needed to support OPR and BoD	P	P	N/A	L	P	P		
	Preliminary Commissioning Plan	R	A	N/A	R	L	P	Appendix D - #4	
	Preliminary Cx Specifications	R	A	N/A	R	L	P	Appendix D - #7	
	Design Phase Commissioning Schedule	R	A	N/A	L	P	P	Appendix D - #3	
OPR and BoD	Maintain OPR on behalf of Owner	P	P	N/A	L	P	P	Appendix D - #1	
	Review Basis of Design Document vs. OPR	R	P	N/A	P	L	P	Appendix D - #6	
	Maintain BoD on behalf of Owner	P	P	N/A	L	P	P	Appendix D - #7	
Reviews	Focused Concept Design Review	R	A	N/A	L	R	P	Appendix D - #8 +9	
	Focused Design Development (35-50%) Review	R	A	N/A	L	R	P	Appendix D - #8 +9	
	Focused Construction Document Review	R	A	N/A	L	R	P	Appendix D - #8 +9	
	Focused Pre-Final Construction Document	R	A	N/A	L	R	P	Appendix D - #8 +9	
	Focused Final Construction Document	R	A	N/A	L	R	P	Appendix D - #8 +9	
	Final Construction Document Comment Backcheck	R	A	N/A	L	R	P	Appendix D - #8 +9	
Functional	Draft Pre-Functional Construction Checklists (PFC)	R	P	N/A	R	L	P	Appendix D - #7	
Test Protocols	Draft System Functional Performance Tests (FPT)	R	P	N/A	R	L	P	Appendix D - #7	

Note: (Appendix C) is just a sample to depict how such a matrix would be developed. There are many more commissioning tasks to be identified beyond what the sample identifies. The type of involvement shown is for instruction purposes only and would need to be developed on a project by project basis for the size, complexity and degree of rigor required.

APPENDIX C

Construction Phase (D-B-B & D-B)		CxG= Gov't Comm Specialist COR = Contracting Officer Rep CxD = Design Comm Specialist DOR = 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*	Construction Commissioning Kick Off meeting	P	P	N/A	O	L	P	Appendix D - #11	
	Commissioning/Issues Resolution Meetings	P	P	N/A	O	L	P	Appendix D - #14	
	Project Progress Meetings	P	P	N/A	O	P	P	Appendix D - #14	
	Controls Meeting	P	P	N/A	O	L	P	Appendix D - #14	
Coordination*	Coordinate with [COR, AHJ, Vendors, etc.] to ensure that Cx interacts properly with other systems as needed to support OPR and BoD	P	P	N/A	O	L	P		
Cx Plan & Spec*	Final Commissioning Plan	R	A	N/A	O	L	P	Appendix D - #10	
Schedules*	Duration Schedule for Commissioning Activities	R	A	N/A	O	L	P	Appendix D - #11	
Doc Reviews*	TAB Plan Review	R	A	N/A	O	L	P	Appendix D - #13	
	Submittal and Shop Drawing Review	R	A	N/A	O	L	P	Appendix D - #13	
	Review Contractor Equipment Startup Checklists	R	A	N/A	O	L	P	Appendix D - #13	
	Review Change Orders, ASI, and RFI	R	A	N/A	O	L	P	Appendix D - #13	
Site Observation*	Witness Factory Testing	L	P	N/A	O	P	P	Appendix D - #19	
	Construction Observation Site Visits	L	P	N/A	O	P	P	Appendix D - #15	

Note: (Appendix C) is just a sample to depict how such a matrix would be developed. There are many more commissioning tasks to be identified beyond what the sample identifies. The type of involvement shown is for instruction purposes only and would need to be developed on a project by project basis for the size, complexity and degree of rigor required.

**For D-B-B acquisition, tasks assigned to DOR under these categories may be considered additional services that require funding consideration*

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	
	Systems Manual	R	R	N/A	O	L	P	Appendix D - #18	
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 Systems Manuals	R	A	N/A	O	L	P	Appendix D - #18	

Note: (Appendix C) is just a sample to depict how such a matrix would be developed. There are many more commissioning tasks to be identified beyond what the sample identifies. The type of involvement shown is for instruction purposes only and would need to be developed on a project by project basis for the size, complexity and degree of rigor required.

**For D-B-B acquisition, tasks assigned to DOR under these categories may be considered additional services that require funding consideration.*

APPENDIX C

Post Occupancy Phase (D-B-B & D-B)		CxC= Gov't Comm Specialist COR = Contracting Officer Rep CxD = Design Comm Specialist DOR = 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	CxC	COR	CxD	DOR	CxC	O&M	Notes	
Document Reviews*	Systems Monitoring Trended Data	R	R	N/A	O	L	P	Appendix D - #24	
	Systems Manuals Update	R	A	N/A	O	L	P		
Site Observations*	Periodic Warranty (4 & 9 Month) Site Visits	L	P	N/A	O	P	P	Appendix D - #24	
Functional Test Protocols*	Deferred and/or seasonal Testing	R	A	N/A	O	L	P	Appendix D - #26	
Technical Activities*	Commissioning/Issues Resolution/Lessons Learned Meetings	P	P	N/A	O	L	P	Appendix D - #24	
	Post-Occupancy Warranty Checkup and review of Significant Outstanding Issues	R	P	N/A	O	L	P	Appendix D - #24	
Reports and Logs*	Final Commissioning Report Amendment	R	A	N/A	O	L	P	Appendix D - #25	
	Issues Logs Closure Report	R	R	N/A	O	L	P	Appendix D - #25	

Note: (Appendix C) is just a sample to depict how such a matrix would be developed. There are many more commissioning tasks to be identified beyond what the sample identifies. The type of involvement shown is for instruction purposes only and would need to be developed on a project by project basis for the size, complexity and degree of rigor required.

** For D-B-B acquisition, tasks assigned to DOR under these categories may be considered additional services that require funding consideration.*

APPENDIX D

Building Commissioning Tasks

Design – Bid – Build

Application of Funding

DOR = Designer of Record, CxD = Commissioning Specialist (Design Contractor), CxG = Commissioning Specialist (Government), CxC = Commissioning Specialist (Construction Contractor)

Note: Parentheses () denote Reviewer status in the chart below; otherwise the indicated party is the lead responsible for the activity.

Tasks (D-B-B)	O&M	P&D	DDC	S&A	Construction Contract	Remarks
A. Pre-Design						
1. Facilitate and document the Owner's Project Requirements (OPR) Identify systems that will be commissioned.	CxG*					*When Pre-design Cx activities are centrally funded by HQDA or Installation with Garrison Concurrence.
B. Design Phase						
2. Verify that the Commissioning Process activities are clearly stated in all scopes of work and maintain OPR on behalf of Owner.		CxG				
3. Integrate the Commissioning Process activities into the project schedule.		CxD (CxG)				
4. Prepare a Commissioning Plan that describes the extent of the Commissioning Process to accomplish the OPR.		CxD (CxG)				
5. Update the Commissioning Plan during design phase of the project to incorporate design changes and additional information.		CxD (CxG)				
6. Review and comment on the ability of the design documents (BoD) to achieve the OPR for the commissioned systems and assemblies.		CxD (CxG)				
7. Prepare the Commissioning Process activities and Commissioning template documents to be included as part of the project specification. Include a list of all individual trade contractor responsibilities for all the Commissioning Process activities. (list contractors by name, firm, and trade specialty after contract award).		DOR, CxD (CxG)				
8. Review the plans and specifications with respect to their completeness in all areas relating to the Commissioning Process. This includes verifying that the OPR have been achieved and completely incorporated into the contract documents, and that there are adequate devices included in the design to properly test the systems and assemblies and to document the performance of each piece of equipment, system, or assembly.		CxD (CxG)				
9. Schedule all document review coordination meetings.		DOR, (CxG)				
C. Construction Phase						
10. Update the Commissioning Plan and Process activities included as part of the project specification (see B7) during construction phase of the project to incorporate changes and additional information. Review the individual trade contractor responsibilities for all the Commissioning Process activities. (List contractors by name, firm, and trade specialty).				(CxG)*	CxC	*ER 37-1-30, Ch. 22, App B, B-2, h.
11. Schedule and attend the Kick-Off Commissioning Process meeting within 60 days after the award of the contract at some convenient location and at a time suitable to the attendees. This meeting will be for the purpose of reviewing the complete Commissioning Process, establishing tentative schedules for the Construction Phase commissioning activities, and review and establish roles and responsibilities for Commissioning.				(CxG)*	CxC	*ER 37-1-30, Ch. 22, App B, B-2, g.

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.
17. Review proposed contractor-provided training program to verify that the OPR are achieved as indicated in the contract documents.				(CxG)*	CxC	*ER 37-1-30, Ch. 22, App B, B-2, ah.
18. Receive and review the Systems Manual as submitted by the contractor. Verify that it achieves the OPR as indicated in the contract specifications. Insert systems descriptions as provided by the design professional(s) in the Systems Manual.				(CxG)*	CxC	*ER 37-1-30, Ch. 22, App B, B-2, ah.
19. Conduct system and assembly testing. Verify the results and include a summary of deficiencies.				(CxG)*	CxC	*ER, 37-1-30, Ch. 22, App B, B-2, c.
20. Periodically review Record Drawings for accuracy with respect to the installed systems. Request revisions to achieve accuracy.					CxC	
21. Verify that the Systems Manual and all other design and construction records have been updated to include all modifications made during the Construction Phase.					CxC	
22. Repeat implementing of tests to accommodate seasonal tests or to correct any performance deficiencies. Revise and resubmit the Commissioning Process Report.				(CxG)*	CxC	*ER, 37-1-30, Ch. 22, App B, B-2, c.
23. Recommend acceptance of the individual systems and assemblies to the Contract Officer Representative (COR) (to validate compliance with the OPR and contract documents).				(CxG)*		*ER 37-1-30, Ch. 22, App B, B-2, f.
D. Post Occupancy Phase						
24. Conduct and attend warranty inspections at 4 & 9 months post-BOD with a focus on commissioned systems and prepare the final Commissioning Process Report to include issues for resolution under warranty or by O&M staff.				(CxG)*	CxC	*ER 37-1-30, Ch. 22, App B, B-2, ac.
25. Assemble the final documentation, which includes the Commissioning Process Report, the Systems Manual, and all record documents. Submit this documentation to the COR for review and acceptance.				(CxG)*	CxC	*ER 37-1-30, Ch. 22, App B, B-2, ah.
26. Recommend acceptance of the individual systems and assemblies with deferred and/or seasonal testing to the COR (to validate compliance with the defined project requirements).				CxG*		*ER 37-1-30, Ch. 22, App B, B-2, f.

APPENDIX D
Building Commissioning Tasks
Design – Build
Application of Funding

DOR = Designer of Record, CxD = Commissioning Specialist (Design Contractor), CxG = Commissioning Specialist (Government), CxC = Commissioning Specialist (Construction Contractor)

Note: Parentheses () denote Reviewer status in the chart below; otherwise the indicated party is the lead responsible for the activity.

Tasks (D-B)	O&M	P&D	DDC	S&A	Construction Contract	Remarks
A. Pre-Design Phase						
1. Facilitate and document the Owner's Project Requirements (OPR). Identify systems that will be commissioned.	CxG*					* When Pre-design Cx activities are centrally funded by HQDA or Installation with Garrison Concurrence.
B. RFP Development						
2. Verify that the Commissioning Process activities are clearly stated in all scopes of work and maintain OPR on behalf of Owner.		CxG				
C. Design Phase						
3. Integrate the Commissioning Process activities into the project schedule.			(CxG)*		CxC	*ER 37-1-30, Ch. 22, App C, C-2.
4. Prepare a Commissioning Plan that describes the extent of the Commissioning Process to accomplish the OPR and consistent with the RFP and project specifications.			(CxG)*		CxC	*ER 37-1-30, Ch. 22, App C, C-2.
5. Update the Commissioning Plan during design phase of the project to incorporate design changes and additional information.			(CxG)*		CxC	*ER 37-1-30, Ch. 22, App C, C-2.
6. Review and comment on the ability of the design documents (BoD) to achieve the OPR for the commissioned systems and assemblies.			(CxG)*		CxC	*ER 37-1-30, Ch. 22, App C, C-2.
7. Prepare the Commissioning Process activities and Commissioning template documents to be included as part of the project specification. Include a list of all individual trade contractor responsibilities for all the Commissioning Process activities. (list contractors by name, firm, and trade specialty).			(CxG)*		DOR, CxC	*ER 37-1-30, Ch. 22, App C, C-2.
8. Review the plans and specifications with respect to their completeness in all areas relating to the Commissioning Process. This includes verifying that the OPR have been achieved and completely incorporated into the contract documents, and that there are adequate devices included in the design to properly test the systems and assemblies and to document the performance of each piece of equipment, system, or assembly.			(CxG)*		CxC	*ER 37-1-30, Ch. 22, App C, C-2.
9. Schedule all document review coordination meetings.			(CxG)*		DOR	*ER 37-1-30, Ch. 22, App C, C-2.
D. Construction Phase						
10. Update the Commissioning Plan and Process activities included as part of the project specification (see C7) during construction phase of the project to incorporate changes and additional information. Review the individual trade contractor responsibilities for all the Commissioning Process activities. (List contractors by name, firm, and trade specialty).				(CxG)*	CxC	*ER 37-1-30, Ch. 22, App B, B-2, h.
11. Schedule and attend the Kick-Off Commissioning Process meeting within 60 days after the award of the contract at some convenient location and at a time suitable to the attendees. This meeting will be for the purpose of reviewing the complete Commissioning Process, establishing tentative schedules for the Construction Phase commissioning activities, and review and establish roles and responsibilities for Commissioning.				(CxG)*	CxC	*ER 37-1-30, Ch. 22, App B, B-2, g.

APPENDIX D

Tasks (D-B)	O&M	P&D	DDC	S&A	Construction Contract	Remarks
D. 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*		*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, Ch. 22, 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 CxG.			(DOR), (CxD)	(CxG)*	CxC	*ER 37-1-30, Ch. 22, App B, B-2, g.
17. Review proposed contractor-provided training program to verify that the OPR are achieved as indicated in the contract documents.				(CxG)*	CxC	*ER 37-1-30, Ch. 22, App B, B-2, ah.
18. Receive and review the Systems Manual as submitted by the contractor. Verify that it achieves the OPR as indicated in the contract documents. Insert systems descriptions as provided by the design professional(s) in the Systems Manual.				(CxG)*	CxC	*ER 37-1-30, Ch. 22, App B, B-2, ah.
19. Conduct system and assembly testing. Verify the results and include a summary of deficiencies.				(CxG)*	CxC	*ER, 37-1-30, Ch. 22, App B, B-2, c.
20. Periodically review Record Drawings for accuracy with respect to the installed systems. Request revisions to achieve accuracy.					CxC	
21. Verify that the Systems Manual and all other design and construction records have been updated to include all modifications made during the Construction Phase.					CxC	
22. Repeat implementing of tests to accommodate seasonal tests or to correct any performance deficiencies. Revise and resubmit the Commissioning Process Report.				(CxG)*	CxC	*ER, 37-1-30, Ch. 22, App B, B-2, c.
23. Recommend acceptance of the individual systems and assemblies to the Contract Officer Representative (COR) (to validate compliance with the OPR and contract documents).				(CxG)*		*ER 37-1-30, Ch. 22, App B, B-2, f.
D. Post Occupancy Phase						
24. Conduct and attend warranty inspections at 4 & 9 months post-BOD with a focus on commissioned systems and prepare the final Commissioning Process Report to include issues for resolution under warranty or by O&M staff.				(CxG)*	CxC	*ER 37-1-30, Ch. 22, App B, B-2, ac.
25. Assemble the final documentation, which includes the Commissioning Process Report, the Systems Manual, and all record documents. Submit this documentation to the COR for review and acceptance.				(CxG)*	CxC	*ER 37-1-30, Ch. 22, App B, B-2, ah.
26. Recommend acceptance of the individual systems and assemblies with deferred and/or seasonal testing to the COR (to validate compliance with the defined project requirements).				CxG*		*ER 37-1-30, Ch. 22, App B, B-2, f.

APPENDIX E

Training and Resources

1. **Training:** Commissioning is emerging as a large issue in building sciences and coming to the forefront as an important feature of construction quality management. There are several training opportunities available and are listed below with a brief description so that the reader can select the one that most fits their needs.

1.1 Association of Energy Engineers (\$1350) This program will examine all aspects of building commissioning, including project scheduling, roles and responsibilities of the project team, new building commissioning, retro and recommissioning of existing buildings, system by system commissioning requirements, TAB and verification procedures, the LEED rating system, building code issues, and commissioning tools and technologies. Additionally, if desired, this can be followed up with an examination for an additional (\$300) to become a certified Building Commissioning Provider (CBCP)
http://www.aeeprograms.com/store/detail.cfm?id=807&category_id=4
(Recommended for Construction QA personnel)USACE Prospect Course 327 HVAC Commissioning (\$1830)

1.2 USACE Prospect Course 327 HVAC Commissioning (\$1830)
This is a 5 day course that includes 2 days of hands-on laboratory. The course provides practical technical information to fulfill construction quality verification duties for commissioning of mechanical systems. The course identifies procedures for startup, sequence of operation and testing that pertain to mechanical equipment and repetitive deficiencies in system performance. Through lecture, visual aids, conferences, and testing, this course presents the following mechanical HVAC subjects: commissioning of mechanical systems, cooling systems, heating systems, air side systems, and control systems. A 2-day lab experience is included where students observe proper performance testing of HVAC Systems.
<http://ulc.usace.army.mil/downloads/PurpleBook2014.pdf>
(Recommended for the 0800 government series employees)

1.3 The PECEI has recently developed with the Building Commissioning Authority (BCA) and with funding from many state entities including NYSEERDA. It is a 24 course on-line curriculum (24-48 hrs) that can be taken over the period of a year as a prerequisite to a 5 day long hands-on laboratory (\$2800 or \$2400 without the laboratory). See the description
http://www.wbdg.org/project/plan_comm_process.php

The courses can also be taken individually for about \$70 up to \$265 each.

<http://learn.peci.org/register.php>. PECEI was originally called Portland Energy Conservation, Inc and is a not-for-profit company that designs and manages energy efficiency programs for utility providers, government organizations, and other clients.

(Recommended for personnel wishing to act as the Commissioning Authority)

1.4 ASHRAE instructor led course (6hrs) on the Commissioning Process

<https://www.ashrae.org/education--certification/instructor-led-courses/the-commissioning-process-in-new-and-existing-buildings>

(Recommended for all personnel; but specifically Project Managers and Design Managers)

ASHRAE On-line instructor led (3hrs \$249) Commissioning for High-Performance Buildings. The focus is on the Commissioning process and developing an OPR.

<https://www.ashrae.org/education--certification/2015-spring-online-courses/half-day-short-courses/new-commissioning-process-standard-202>

(Recommended for Project Managers and Design Managers)

2. **Resources:** Whole Building Design Guide, PECEI, Veteran Affairs, GSA and NEBB has prepared detailed guidance on commissioning as shown in the links below:

a. **Guidance documents:**

- i. WBDG- General Guidance http://www.wbdg.org/project/plan_comm_process.php
- ii. PECEI's Functional Testing Guide <http://www.peci.org/ftguide/>
- iii. VA May 2013 150 page manual
http://www.wbdg.org/ccb/VA/VACOMM/va_cxmanual.pdf
- iv. NEBB 2009 manual 155 page procedural standards for whole building commission
http://www.nebb.org/assets/1/7/PST_BSC_2009.pdf
- v. 2005 GSA 83 page commissioning guide
<http://www.wbdg.org/ccb/GSAMAN/buildingcommissioningguide.pdf>

b. **Certification programs** are available from a wide variety of organizations. The link provides a table that describes the requirements for certification.

http://www.cacx.org/resources/provider_cert.html

c. **Commissioning Tools** - sample plans <http://www.cacx.org/resources/cxtools/index.html>

3. **USACE Center of Expertise in Sustainability (CXS) for Commissioning** provides a web page <http://www.usace.army.mil/Missions/Sustainability/CentersofExpertiseinSustainability/Commissioning.aspx> for reference and future criteria updates such as those planned for the ER on Commissioning Procedures now in progress as well as an updated ER on O&M documentation. The Criteria Management System (CMS) through the Tri-Service community is in the process of updating the UFGS for Division 23 HVAC commissioning and developing guidance for Division 1 and other technical divisions. Webinars targeted to different communities of practice (PM, CM and Engineering) are being planned to assist with interpretation of this ECB and commissioning execution in general.

APPENDIX F

DEFINITIONS

Acceptable Performance: A component or system being able to meet properly developed and specified design parameters under actual load and/or other properly developed simulated operating conditions. Commissioning goes beyond the normal quality assurance role of ensuring contract compliance, by identifying and correcting design and construction defects which are revealed only by the commissioning procedures.

Acceptance Phase Commissioning: Acceptance Phase Commissioning tasks are executed after the construction has been completed, all Site Observations and Static Tests have been completed and all Pre-Functional Testing has been completed and accepted. The main commissioning activities performed during this phase are verification that the installed systems are functional as verified by conducting Functional Performance tests and Government Training.

Basis of Design (BoD): The Engineer's Basis of Design is comprised of two components: the Design Criteria and the Design Narrative, these documents record 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. See also: Design Narrative.

Checklists: Lists of data or inspections that should be verified to ensure proper system or component installation, operation and function. Verification checklists are developed and used during all phases of the commissioning process to verify that the Owner's Project Requirements (OPR) is being achieved.

Commissioning Authority (CxA): The commissioning authority (CxA) is defined as the person(s) or entity responsible, on the owner's behalf, for assuring the commissioning process is properly carried out according to OPR and BoD during the life of the project. This includes witnessing functional performance tests and verifying acceptable performance of the Commissioning Process. The CxA assures the required documentation is produced and in the context of the overall total building commissioning process. The primary role of the CxA is to verify achievement of the Owners Project Requirements (OPR) and validate the Basis of Design (BoD) throughout the phases of the project, from Pre-Design Phase through Occupancy and Operations Phase. The CxA does not perform testing; it assures the execution of the commissioning process that includes testing and assures the recording and documenting of the process and its results. The CxA participates as a member of the PDT in the planning and oversees of the Total Building Commissioning process and its activities to verify achievement of the OPR and validation of the BoD. For MCA projects and tenant facilities on Army installations requiring commissioning, USACE, as the Army's Design and Construction Agent is the CxA. With respect to commissioning, USACE as the CxA specifically represents the Owner's interests.

Commissioning Consultant: Dependent upon the size and complexity of the project and/or available USACE resources, the need for the services of a consultant may be identified and budgeted at the planning phase. The government may elect to procure the services of a commissioning consultant at the beginning of the design phase. The commissioning consultant as a member of the USACE commissioning team is defined as the person, persons or company responsible to execute or augment the duties, roles and responsibilities of the CxG and is also considered as an extension of the owner's staff. Depending on contract acquisition (DB or DBB) or the complexity of the project, it would not be uncommon for the government to utilize multiple consultants (i.e. one during the programming, pre-design and design phases and another during the construction and warranty phase).

Commissioning Execution: The government in its capacity as the Commissioning Authority (CxA), shall oversee and assure the execution of commissioning process activities from design through post occupancy/warranty phase to assure the Owner's Project Requirements (OPR) are achieved and the Basis of Design (BOD) is validated. At the time of construction contract award, the Contractor shall provide the services of a certified Commissioning Specialist (CxC) with defined roles and responsibilities as outlined in the Commissioning Plan (CP) consistent with Annex F of ASHRAE Guideline 0. The CxC shall be neutral and unbiased of the design and construction contract. The CxC shall not be an employee of the design professionals (i.e. the Designer of Record (DOR) or their firm(s)). The CxC shall be an independent subcontractor and not an employee of the Construction Contractor nor an employee or any other construction subcontractor on the project. The CxC will communicate and report directly to the Government's commissioning team in execution of commissioning activities. The Contracting Officer's Representative (COR) will act as the Owner's representative in performance of duties spelled out under OWNER in Annex F of ASHRAE Guideline 0 and ASHRAE Guideline 1.1

Commissioning Issue: Any component or system condition (static or dynamic) that adversely affects the commissionability, operability, maintainability, or functionality of a system, equipment or component. Any condition that is in conflict with the Contract Documents and/or performance requirements of the installed systems and components.

Commissioning Plan (CP): The overall document, usually prepared by the designer for the commissioning team, captures important decisions about the commissioning process and ensures that everyone understands their responsibilities. The commissioning plan should incorporate or reference the project requirements; identify the projects commissioning goals; identify the Commissioning Authority (CxA) and commissioning team members and their roles; establish the scope commissioning in terms of systems and equipment; outline the major commissioning steps during design, construction, activation and operation; and discuss line of communication and authority. Identify acquisition strategy for commissioning. The plan outlines the expectation of the contractor's organization, scheduling, allocation of resources, documentation, etc., pertaining to the overall total

building commissioning process. The commissioning plan must be included in the contract documents to specify the contractor's performance, roles and responsibilities. This plan shall be included as part of the Corps overall Project Management Plan for executing the specific project.

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

Commissioning Report: The final document which presents the commissioning process results for the project. Cx reports include an executive summary, the commissioning plan, issue log, correspondence, and all appropriate completed check sheets and test forms, TAB and TAB Verification forms, PVT reports and any other documents related to execution of the commissioning process.

Commissioning Specialist (CxC): The CxC must be a certified commissioning provider with the experience and expertise in the commissioning of facilities of a scope and complexity comparable to the individual project. The CxC must be employed regularly in building commissioning and is the individual responsible for coordinating the commissioning activities during the construction and post-occupancy phases. (see Appendix F for full definition). Ideally, the CxC would be a first tier subcontractor hired by the prime construction contractor, however with requisite experience and qualifications in consideration of the size and complexity of the project the CxC may be an employee of the prime 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 cx 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 after award, the CxC shall be responsible for commissioning activities throughout the design, 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.

Commissioning Specialist (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.

Commissioning Specialist(CxG): For the purpose of meeting industry's "enhanced" Cx requirements (i.e. USGBC's LEED Rating system, EA Credit 3), the CxG is considered the CxA and is the entity responsible for government oversight of the commissioning process. The CxG is 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. 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.

Commissioning Specialist: The commissioning specialist as a member of the commissioning team is defined as the person, persons or company responsible for supporting the detailed implementation of the commissioning process executed by the CxG, CxD and CxC, to include but not limited to: equipment & systems start-up, drafting & completion of checklists, perform test procedures, record and document test results, and accomplishes other execution of the Commissioning Process. It is important to recognize that the commissioning specialist's role is usually carried out by a team, rarely by one person, except on very small projects. Usually, the commissioning specialist's responsibilities are during the construction phase of a project. However, in situations where commissioning specialist are appointed during the design or pre-design (program) phases, they may have input with respect to the planning of the commissioning process at those earlier times. In particular, this may include coordinating and documenting the on-site tests described in the commissioning plan.

Commissioning Team: The qualified group that will plan and carry out the overall commissioning process. The team is composed of USACE Design Manager (DM), USACE Project Manager (PM), designers (USACE and/or Architect-Engineers), commissioning specialists (USACE and/or Architect-Engineers - CxG and/or CxD), users (facility, tenant, O&M), the Administrative Contracting Officer (ACO) for the construction contract, Contracting Officer's representative (COR) (representing Corps construction, the construction contractor and the contractor's commissioning specialist (CxC). The individual participants on the team may change as the design and construction process proceeds. Participation by the user is not mandatory, but the value of this service to the customer is directly proportional to their participation. The team is supported by the contractor (including appropriate subcontractors, suppliers and manufacturers). The Corps Design Manager (DM) is the facilitator/mediator for the team during the design phases. During design, the CxD Architect-Engineer or in-house designers will prepare commissioning plans for approval of the team. The ACO for the construction contract is the team facilitator/mediator during the construction phase. In the construction phase, the commissioning specialists (CxC) will finalize the commissioning plans to make them equipment specific and match as-built conditions. The (CxC) will also perform the actual commissioning procedures for review of the team. It is critical that the numerous commissioning responsibilities of the A-E and contractor are clearly identified in their respective contracts. If necessary, the commissioning team should recommend to the appropriate contracting officer representative (COR)(design or construction) that contract modifications be prepared. If the commissioning team is unable to reach consensus on a particular issue, the situation must be promptly resolved by the active facilitator/mediator. Contractual disputes must receive final resolution by the appropriate contracting officer.

Commissioning Test Procedures: Initially developed by the designer's commissioning specialist (CxD) and contained in the Commissioning Plan to express the expected level of rigor and then fully developed and prepared by the contractor's commissioning specialist (CxC) for the commissioning team, which outlines the contractor's organization, scheduling, allocation of resources, instrumentation, operating parameters, test tap locations, qualifications of testing personnel, performance criteria, documentation, etc. required to perform the functional performance testing in accordance with the commissioning plan.

Construction Phase Commissioning: All commissioning efforts executed during the construction process after the design phase and prior to the Acceptance Phase Commissioning.

Deferred System Functional Test: Functional Performance or Integrated Systems Tests that cannot be completed at the end of the acceptance phase due to ambient conditions, schedule issues or other conditions preventing testing during the normal acceptance testing period.

Designer of Record (DOR): The Architect-Engineer or Corps in-house design group responsible for the design and preparation of contract documents for the construction project.

Enhanced commissioning: is a term defined by the LEED green rating system in the energy subcategory. Enhanced commissioning is achieved when supplemental tasks above Fundamental commissioning are performed as outline on page 220 of the LEED guide 2009 edition. It involves engagement of a commissioning authority from pre-design, design, construction and through occupancy phases. This is a precursor or sub part of total building commissioning.

Executive Summary: A section of the Commissioning Report that reviews the general outcome of the project. It also includes any unresolved issues, recommendations for the resolution of unresolved issues and all deferred testing requirements.

Functional Performance Testing (FPT): That full range of checks and tests carried out to determine if all components, subsystems, systems, and interfaces between systems function in accordance with the (BoD), as identified in the contract documents. In this context, "function" includes all modes and sequences of control and operation, all interlocks and conditional control responses, and all specified responses to abnormal emergency conditions. Functional Performance Tests include static testing, dynamic testing, failure modes, and integrated systems testing. FPT tests are done after all Pre-Functional Checklists are complete.

Functional Test Procedure (FTP): A written protocol that defines methods, steps, personnel, and acceptance criteria for tests conducted on components, equipment, assemblies, systems, and interfaces among systems.

Integrated Systems Test: A functional performance test intended to verify interaction of two or more systems. Examples include Loss of Power Response Test, Fire Alarm - HVAC Control system for HVAC system shutdown.

Issues Log: A formal and ongoing record of issues, observations, problems or concerns - and their resolution - that have been raised by members of the commissioning team during the course of the commissioning process.

Manual Test: Testing using hand-held instruments, immediate control system readouts or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the 'observation').

Monitoring: The recording of parameters (temperature, flow, current, status, pressure, etc.) of equipment operation using data loggers or the trending capabilities of control systems.

Owner's Project Requirements (OPR): A written document that details the project requirements and the expectations of how the building and its systems must be used and operated. These include project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

Performance Verification Testing (PVT): A testing and documentation process required by the HVAC and Other Building Control System sections that validate the control system(s) operate and function in accordance with the (BoD) to satisfy the OPR in accordance with the contract documents.

Pre-Design Phase Commissioning: Commissioning tasks performed prior to the commencement of design activities that includes project programming and the development of the commissioning process for the project.

Pre-Functional Checklist (PFC): A form used by the Commissioning specialist (Cx) to verify that appropriate components are onsite, correctly installed, set up, calibrated, functional and ready for functional performance testing. See also Checklists.

Post-Occupancy Phase Commissioning: Commissioning efforts executed after a project has been completed and accepted by the Government. Post-Occupancy Phase Commissioning includes follow-up on verification of system performance, measurement and verification tasks and assistance in identifying warranty issues and enforcing warranty provisions of the construction contract.

Sampling: Performing observation, review, testing or other verification on only a fraction of the total number of identical or near identical pieces of equipment, drawings, events, etc. Sampling techniques include random statistical sampling and less formal professional judgment methods.

Seasonal Testing / Second Season Testing: See Deferred System Functional Test.

Systems Manual: A system-focused composite manual organized by system which contains the information needed to optimally operate the building systems. Much of the Systems Manual is not found in traditional vendor O&M Manuals. For reference, ASHRAE includes all maintenance and design documentation in their definition of Systems Manual. Further, USGBC provides Systems Manual guidance in LEED documentation.

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, well 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

User / Using Agency: The organizational groups that combine to provide facilities, perform facility operation and maintenance and perform actual missions at Corps construction project sites. For Army construction this includes the major command, the installation, the Directorate of Engineering and Housing and the Tenant.

Whole Building Commissioning: for the purposes of this ECB it is the same as Total Building Commissioning