Commissioning: Industry and DOD Approaches and Impacts

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Kimley-Horn and Associates, Inc.
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Speakers:
• Ian McIntosh, Ph.D., Lecturer, University of Wisconsin
• Dennis Milsten, P.E., Associate Executive Director, Department of Veterans Affairs, CFM Central Office
• Stan Yekalis, PE, LEED AP, CPMP, Mechanical Engineering Coordinator, NAVFAC Southeast
• Tom Jamieson, Mechanical Engineer, HQ USACE
• Col. David DeMartino, P.E., USAF, Director of Staff, AFCEC
The Commissioning Life Cycle

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05/22/14
Overview

• Understand what is commissioning, its various distinct types and approaches
• Recognize how types of commissioning relate to the timeline of a building’s life
• Understand how to implement the right type of commissioning at the right time
What is Commissioning?

Definition per ASHRAE Guideline 0-2005:
“The Commissioning Process is a quality-oriented process for achieving, verifying, and documenting that the performance of facilities, systems, and assemblies meets defined objectives and criteria.”

Simple Definition:
An Owner’s quality process to verify the owner receives at the END OF A PROJECT what they stated they wanted in The BEGINNING OF THE PROJECT.
What is Commissioning?

- NIBS Guideline 2 – Structural Systems Commissioning
- NIBS Guideline 3 – Building Enclosure Commissioning
- Etc.
“Commissioning the enclosure differs from commissioning other building systems … The enclosure is designed and field assembled from numerous materials with varying properties. These materials are manufactured by different companies… assembled …by many different tradespeople, working for different contractors … in all possible weather conditions with the intention of meeting well defined performance criteria.”
It increases building performance by identifying:
- air infiltration and leakage
- moisture diffusion
- surface condensation
- rain water entry
OPR Definition

Definition per ASHRAE Guideline 0-2005:
The Owner’s Project Requirements (OPR) is “a written document that details the functional requirements of a project and the expectations of how it will be used and operated. These include project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.”

Simple Definition:
A dynamic document that states clearly WHAT the owner WANTS based upon the project’s NEEDS.
OPR: The Vision of Commissioning

integrating the commissioning process piece by piece
[T1]: During or after Planning (P), but before Construction Documents (CD)

[T2]: During or after CD, but before Final Completion (FC)

[T3]: During or after FC, but before Renovations and Additions (RA)
Time T1 Commissioning \( (P \leq t < CD) \)

- New Construction (NC) Cx
  - Planning (Programming) Phase Cx
    - Owner’s Project Requirements (OPR)
    - Basis of Design (BoD)
    - Cx Plan
  - Design Phase Cx
    - Design Reviews
    - Cx Spec Integration
    - Early Pre-Functional Checklists
    - Early Functional Performance Tests
Time T2 Commissioning \((CD \leq t < FC)\)

- New Construction (NC) Cx
  - Construction Phase Cx
    - Submittal Reviews
    - Pre-Functional Checklists Reviews
    - Site Visit Reviews
    - Cx Meetings
  - Turnover Phase Cx (aka “Startup”)
    - Witness Systems/Startup Tests
    - Functional Performance Tests
Co$t of New Construction Cx

<table>
<thead>
<tr>
<th>Commissioned Systems</th>
<th>Total Commissioning Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVAC and Control Systems</td>
<td>2.0 - 3.0% of mechanical</td>
</tr>
<tr>
<td>Electrical Systems</td>
<td>1.0 – 2.0% of electrical</td>
</tr>
<tr>
<td>HVAC, Control &amp; Light Electrical</td>
<td>0.5 – 1.5% of construction</td>
</tr>
</tbody>
</table>

Cost Factors:
- System Complexity
- Systems to be Commissioned
- Duration of Commissioning Engagement
- Scope of Commissioning Tasks:
  - No LEED
  - LEED Fundamental
  - LEED Enhanced
  - Ongoing Commissioning

Data available from Portland Energy Conservation Institute
## Savings of New Construction Cx

<table>
<thead>
<tr>
<th>Project</th>
<th>State</th>
<th>LEED</th>
<th>Project Cost</th>
<th>Project Status</th>
<th>Cx Savings</th>
<th>% of Cx Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Food Store</td>
<td>WI</td>
<td>Yes</td>
<td>$2.1M</td>
<td>Complete</td>
<td>$85k-$604k</td>
<td>315%</td>
</tr>
<tr>
<td>Warehouse</td>
<td>IL</td>
<td>Yes</td>
<td>Confidential</td>
<td>Complete</td>
<td>Confidential</td>
<td>200%</td>
</tr>
<tr>
<td>Science Center</td>
<td>CO</td>
<td>Yes</td>
<td>$12M</td>
<td>15% Constr.</td>
<td>$319k</td>
<td>189%</td>
</tr>
<tr>
<td>Hospital</td>
<td>CO</td>
<td>Yes</td>
<td>$52M</td>
<td>20% Constr.</td>
<td>$425k</td>
<td>141%</td>
</tr>
<tr>
<td>Vivarium</td>
<td>NC</td>
<td>No</td>
<td>$28M</td>
<td>60% Constr.</td>
<td>$500k</td>
<td>152%</td>
</tr>
<tr>
<td>Science Bldg</td>
<td>AL</td>
<td>No</td>
<td>$49M</td>
<td>50% Constr.</td>
<td>$400k</td>
<td>105%</td>
</tr>
<tr>
<td>Elementary School</td>
<td>IN</td>
<td>No</td>
<td>$11M</td>
<td>95% Constr.</td>
<td>$60k</td>
<td>171%</td>
</tr>
</tbody>
</table>
Time T3 Commissioning \((FC \leq t < RA)\)

- New Construction (NC) Cx
  - Operation Phase Cx (1\(^{st}\) year only)
    - Warranty Reviews
    - Seasonal Tests

- Existing Building Commissioning (EBCx)
  - Retro-Cx
  - Re-Cx
  - Ongoing (Continuous) Cx
Existing Bldg Cx (EBCx)

- More than ASHRAE Energy Audit Levels I, II, III
  - Preliminary Phase
  - Investigation Phase
  - Analysis Phase
  - Implementation Phase
  - Verification Phase
- Most Common Savings Opportunities:
  - Equipment Running Unnecessarily
  - Badly Controlled Outside Air/Economizers
  - Simultaneous Heating & Cooling
  - Supply Air Temp/Static Pressure need Resetting
  - Improperly Scheduled Lighting/Controls
  - Oversized Equipment
### Costs and Savings of EBCx

<table>
<thead>
<tr>
<th>Building Type</th>
<th>Annual Savings ($/sf)</th>
<th>Implementation Costs ($/sf)</th>
<th>Simple Payback (yrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospitals</td>
<td>0.43</td>
<td>0.47</td>
<td>1.1</td>
</tr>
<tr>
<td>Laboratories/Offices</td>
<td>1.26</td>
<td>0.37</td>
<td>0.3</td>
</tr>
<tr>
<td>Classroom/Offices</td>
<td>0.43</td>
<td>0.23</td>
<td>0.5</td>
</tr>
<tr>
<td>Offices</td>
<td>0.22</td>
<td>0.33</td>
<td>1.5</td>
</tr>
<tr>
<td>Schools</td>
<td>0.17</td>
<td>0.34</td>
<td>2.0</td>
</tr>
</tbody>
</table>

- **Savings Sources:**
  - No-Cost (12%)
  - Low-Cost (29%)
  - Capital Retrofit (59%)

*Data available from ASHRAE Journal, September 2007*
A Cx Implementation Strategy

Leader  Team  Communicate  Process  Tools  Timing  Execute
Thank You; Questions?

For More Information:

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VA Mission & Vision

- **Mission**
  - To fulfill President Lincoln's promise “To care for him who shall have borne the battle, and for his widow, and his orphan” by serving and honoring the men and women who are America’s veterans.

- **Vision**
  - To provide veterans the world-class benefits and services they have earned - and to do so by adhering to the highest standards of compassion, commitment, excellence, professionalism, integrity, accountability, and stewardship
VA Services for Veterans

- **Health Care (FY 13)**
  - 8.9 Million Enrollees
  - 85 Million Outpatient Visits This Year
  - 678,000 Inpatients Admissions

- **Benefits (FY 14 Projected)**
  - 4.1 Million Veterans will receive Compensation
  - 783,000 Veterans will receive Education Support
  - 460,000 Veterans will receive Guaranteed Home Loans Support

- **Memorial Benefit (FY 13)**
  - 125,000 Internments in National Cemeteries
  - 3.3 Million Graves Maintained
  - 358,000 Headstones Provided for Veterans in Private Cemeteries
VA Facilities Inventory

- 6,037 Buildings
- 1,907 Leases
- 174,120,582 SF
- 34,396 Land acres
- Average age approaching 60 years
VA Construction Program

- **Major Construction**
  - Projects with a cost greater than $10 Million
  - Requires a line item appropriation by Congress
  - Also requires a specific authorizing legislation for medical projects
  - Typically designed by an Architectural/Engineering Firm and constructed by a general contractor

- **Minor Construction**
  - Projects with a cost less than $10 Million
  - Appropriation by Congress not project specific
  - Designed by an Architectural/Engineering Firm and constructed by a general contractor
  - Typically administered at each medical center, cemetery or VBA office building
VA Construction Program

- **Non-Reoccurring Maintenance (NRM)**
  - Primarily address correcting facility deficiencies and renovating existing space including the repair or replacement of existing building systems
  - Typically administered at each medical center or cemetery
  - NRM projects are funded through the VHA’s medical facilities account or NCA’s operations and maintenance account
  - Designed by an Architectural/Engineering Firm and constructed by a general contractor

- **Green Management Program**
  - Under Control of the Office of Asset and Enterprise Management
  - Energy Conservation Programs
  - Energy Generation Programs
  - Energy Assessments
VA Construction Program

- Leasing
  - Congressional approvals if rent is greater than $1 million
  - Varying approvals required based on space and rent levels
  - CFM’s Real Property Service manages the acquisition of large leases
  - Local or VISN personnel manage smaller leases
  - Typically contract with a developer
  - Leasing program at risk due to CBO scoring of leases
Construction Funding ($000’s)

![Construction Funding Graph]

- **Major**
- **Minor**

Commissioning Services

- Commissioning Services are employed in support of VA’s Construction Program to include major, minor, NRM and Energy Program

- Lease Program requires the developer to retain the services of a Commissioning agent
Commissioning Services
Major Construction

- Procured By Construction and Facilities Management
- Typically stand alone
- Generally GSA schedule actions
- Often limited to SDVOSB
- Onboard in early design phase
  - If LEED then Commissioning contractor onboard by 35% design
- Often include 1 year post construction follow-up
Commissioning Services
Minor and NRM Program

- Procured By VISN contracting offices
- Typically stand alone
- Generally not GSA Schedule
- Often limited to SDVOSB
- Onboard for construction
- Expected to onboard early in design in the near future
Commissioning Services
Leasing

- Procured By the Developer
- Tailored to match building requirements
- Systems to be commissioned include but not limited to:
  - HVAC Controls and Equipment
  - Domestic Hot Water
  - Onsite Renewable Energy
  - Plumbing Systems
  - Lighting and Daylighting Controls
Commissioning Services
Energy Program

- Procured By Green Team
- Commissioning Contractor Onboard early in design
- Commissioning Contractor included for construction phase
Questions…

- Available Resources

  - CFM Web Site: www.cfm.va.gov

  - VA Forecast of Opportunities:
    www.vendorportal.ecms.va.gov/eVP/fco/FCO.aspx

  - VA FY 2014 Budget & Capital Plan:
    www.va.gov/budget/products.asp
NAVFAC Commissioning Process

- New Buildings/LEED Process
- Existing Buildings

Stan Yekalis, PE, LEED AP, GGP, CPMP

NAVFAC SE, CI BL Core - C42/TDC

Mechanical Engineering Coordinator

5/22/2014
History of Commissioning (Cx)

Commissioning (Cx) is a Nautical Term

- Born in the “ship-building” industry & still used
  - Skilled, knowledgeable technicians
  - QA Process - Check out, Test & Verify all functions, all systems
- Cx then followed into Construction of large industrial mfg facilities
- Originally applied in commercial buildings in early 1980s (ASHRAE)
  - Ensure high performance of energy efficiency measures
  - Later, UEM staff realized that existing “ordinary” buildings could achieve significant energy savings by correcting deficiencies.

- Today – Many initiatives & Drivers
  - Utility Energy Programs, Performance Contracting
  - R&D: California Public Interest Energy Research (PIER) program
  - R&D: Future “Net-Zero Energy” buildings (Renewable technologies)
  - LEED (or 3rd Party) Certification (Required Step)
  - Operating costs of Cx bldgs. are lower.
Commissioning (Cx) is Quality Assurance

What is it? A Quality Assurance process

+ Building Commissioning (Cx) is a total quality-oriented, systematic process for achieving, verifying, and documenting that the performance of facilities, systems, and assemblies meets defined objectives and criteria of assuring that a building performs in accordance with the design intent and owner’s operational needs.

  • Assumes that the owner, planners, consultants, designers, and contractors are all fully accountable for their work.
  • The Commissioning Team uses tools, checklists, procedures and methods to verify that the Project is achieving the...
  • …Owner’s Project Requirements (OPR), the ‘metric’ for measuring project performance, throughout the delivery of the Project.
  • Enhanced Commissioning begins in ‘Pre-Design’ and continues through Design, Construction, and Occupancy of the facility.
  • Fundamental Commissioning is ‘Construction Phase’ Commissioning, only.

Why? Improves Project & Product Performance

+ The numerous benefits of Cx accrue to all stakeholders:

  • Articulating/verifying design intent, communications: Project Design Team
  • Construction observation; warranty enforcement: ACQ/OPS, CI5, FEAD
  • Controlling first cost: Program/Project Management, CI BL
  • Systems Manual & Training operators: OPS/PW/FM
  • Optimizing performance (comfort, reliability, safety, energy): Occupants, OPS, PW, BM & UEM
  • Enhancing safety and risk management: OPS/BM & CI/PW

  + Contributes to Economic & Energy Security of USA
  + Improves the Performance of NAVFAC’s execution (ECB 2008-01) of the US NAVY’s “Sustainability(2003) Policy”
  + Operating costs of Cx bldgs. are 8% to 20% lower (GSA)
Types of Commissioning Projects

• **Building Commissioning for New Facilities & Major Renovations.**
  - Construction Phase Commissioning
  - Commissioning Process is a LEED Prerequisite (EAp1)

• **Existing Building Commissioning Projects (EBCx)**
  - Full Building Commissioning
    - Optimizing the Performance of Building Systems.
    - Capital Intensive “Facility Improvement Measures”
  - Re-Commissioning (RCx)
    - Building Tune-up for Previously Commissioned Buildings
    - Implementing/Adding ‘Improvements’ (Renewable Energy, etc.)
  - Retro-Commissioning (ReCX)
    - Process of optimizing the performance of an existing building, which has never been formally commissioned.
    - NAVY: ReCx is usually coupled with DDC Controls upgrades and funded by Energy Conservation funding.
LEED Cx Process Requirements (New Facilities)

LEED Cx Process Requirements: can be found in LEED NC v3, - Energy & Atmosphere (EA) Category -

v3 Prerequisites:

→ p1 Fundamental Commissioning (Building Systems)
   p2 Minimum Energy Performance
   p3 CFC Reduction in HVAC&R Equipment

v3 Credits:

c1. Optimize Energy Performance (1-19 pts)
c2. Renewable Energy (1-7 pts)

→ c3. Enhanced Commissioning (2 pts)
c4. Enhanced Refrigerant Mgmt. (2 pts)

→ c5. Measurement & Verification (3 pts)
c6. Green Power (2 pts)

- Indoor Environmental Quality (IEQ) Category -

→ c3.1 Construction IAQ Management Plan – During Construction (1 pt)
## LEED v3 ~ Cx Responsibilities (New Facilities)

<table>
<thead>
<tr>
<th>Task</th>
<th>EAp1</th>
<th>EAc3</th>
<th>SMACNA II</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1- Designate CxA</strong></td>
<td>Owner or Project Team</td>
<td>Owner or Project Team</td>
<td>Owner or Project Team</td>
</tr>
<tr>
<td><strong>2- Document ~ OPR</strong></td>
<td>Owner</td>
<td>Owner</td>
<td>Owner</td>
</tr>
<tr>
<td><strong>3- Develop BOD</strong></td>
<td>Design Team</td>
<td>Design Team</td>
<td>Design Team</td>
</tr>
<tr>
<td><strong>4- Evaluate BOD vs OPR</strong></td>
<td>CxA</td>
<td>CxA</td>
<td>CxA</td>
</tr>
<tr>
<td><strong>5- Cx requirements into CDs</strong></td>
<td>Project Team or CxA</td>
<td>Project Team or CxA</td>
<td>CxA assists</td>
</tr>
<tr>
<td><strong>6- Cx Design Review</strong></td>
<td>N/A</td>
<td>CxA</td>
<td>CxA</td>
</tr>
<tr>
<td><strong>7- Develop &amp; Implement Cx Plan</strong></td>
<td>Project Team or CxA</td>
<td>Project Team or CxA</td>
<td>CxA</td>
</tr>
<tr>
<td><strong>8- Cx Review of MEP submittals</strong></td>
<td>N/A</td>
<td>CxA</td>
<td>CxA</td>
</tr>
<tr>
<td><strong>9- Verify Installation Checklists</strong></td>
<td>CxA</td>
<td>CxA</td>
<td>CxA</td>
</tr>
<tr>
<td><strong>10- Prefunctional Performance Testing (Acceptance Testing)</strong></td>
<td>CxA</td>
<td>CxA</td>
<td>CxA</td>
</tr>
<tr>
<td><strong>11- Systems Manual</strong></td>
<td>N/A</td>
<td>Project Team and CxA</td>
<td>Optional</td>
</tr>
<tr>
<td><strong>12- Verify Training</strong></td>
<td>N/A</td>
<td>Project Team and CxA</td>
<td>CxA</td>
</tr>
<tr>
<td><strong>13- Complete Summary Cx Report</strong></td>
<td>CxA</td>
<td>CxA</td>
<td>CxA</td>
</tr>
<tr>
<td><strong>14- Review Bldg Ops (10 to 12 months)</strong></td>
<td>N/A</td>
<td>CxA</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Existing Building Commissioning (EBCx): Systematic process for improving the controllability and operability of building systems to meet the Current Facility Requirements (CFR), by investigating, analyzing, and optimizing the performance of building systems through the identification and implementation of low/no cost Facility Improvement Measures (FIM), and ensuring their continued performance. The EBCx project phases include:

- **Planning**: Select Facilities, Identify Opportunities.
- **Site Investigation**: (Start with TAB Report, verification of ‘as-builts’, etc.)
- **Assessment**: Analysis & Report w/FIM Recommendations
  - Also, identifies maintenance items to improve performance
  - Presented to Owner & Engineer for consideration
- **Current Facility Requirements**: CFR development by Owner (w/ EBCxA input)
  - FIMs are evaluated/selected; CFR replaces OPR
- **Implementation** of CFR – (Construction Contracting)
  - EBCx guides selection of FIMs & develops Implementation Plan.
- **Optimization** of Building Systems (Field Commissioning)
  - Training: EBCx works to ensure Smooth Turnover to Building Staff
- **Measurement & Verification** of Savings
  - EBCx monitors and tracks performance of improvements
  - EBCx works with Owner/Manager to implement any additional FIMs
**Re-commissioning**: An application of the commissioning process requirements to a facility that has been delivered using the commissioning process.

- Cx documentation and metrics exist.
- Scheduled re-commissioning developed as part of an ongoing, or continuous commissioning process (CCP), or
- Facility use change, operations problems, or other needs.
- Current Facility Requirements (CFR) replaces OPR.

**Retro-commissioning**: The commissioning process applied to an existing facility that was not previously commissioned.

- ASHRAE Guidelines do not specifically address
- **The same basic Cx process should be followed**
- Current Facility Requirements (CFR) replaces OPR.
- Phases: From **predesign** through **implementation** and **operations**
- Commonly, Retro-Cx is coupled with new (or upgrades to) DDC Controls.
- Projects financed by energy cost savings.
- Optimize the benefits of implementing the commissioning process, in philosophy and in practice.
NAVFAC Atlantic – Field Engineering Centers

- NAVFAC NW
  - 3 PWDs

- NAVFAC MW
  - 4 PWDs

- NAVFAC WASH
  - 5 PWDs
  - 2 ROICCs

- NAVFAC MIDLANT
  - OICC MCI-East
    - 11 PWDs
    - 1 ROICC

- NAVFAC SOUTHEAST
  - 15 PWDs
  - 5 ROICCs

- NAVFAC SW
  - OICC MCI-West
    - 10 PWDs
    - 9 ROICCs

- NAVFAC MCI-West
  - 10 PWDs
  - 9 ROICCs

- NAVFAC MCI-East
  - 5 PWDs
  - 2 ROICCs
NAVFAC LANT/MIDLANT

- CIBL Performance Verification Team (PVT) for over 25 years, with the capabilities of TAB, Cx, and PVT.
  - “Lessons Learned” guidance
  - Empirical data on Cost of Cx

- Three IPTs with A&E IDIQ Contracts, include Cx services.
  - North Carolina IPT, Hampton Roads IPT, Northeast IPT

- Two Large PWDs w/CIBL design services, w/A&E IDIQ Contracts, include Cx services.
  - PWD Norfolk
  - PWD Portsmouth

- Several smaller PWD’s with CIBL services

- One large Cx Services IDIQ Contract (2012-2016); Jacobs Engineering

- NAVFAC EXWC Cx Services IDIQ contract: CH2M Hill
NAVFAC Southwest – PVT DDC Controls/UMCS

- Three IPTs w/ A&E IDIQ Contracts, include Cx services.
- 10 PWDs
- 9 ROICCs
  - OICC MCI West w/ PVT team
    - PVT Process for DDC Controls
    - "Lessons Learned" guidance; UFCs, UFGS,
    - Construction Basics
NAVFAC SOUTHEAST

• Three IPTs with A&E IDIQ Contracts, include Cx services.
  ▪ South Atlantic IPT, South Central IPT, Gulf Coast IPT
  ▪ In-house Cx of Chiller replacement projects
  ▪ In-house Cx teams have been formed to provide fundamental Cx services.
  ▪ Worked with PWBL to provide D-B, RFPs and full in-house designs for PWBL Retro-Cx Projects, multiple bases.

• 15 PWDs, 2 w/ small CIBL design groups, & w/A&E IDIQ Contracts, include Cx services.
  ▪ PWD Pensacola
  ▪ PWD Key West

• Several smaller PWD’s with CIBL services

• One small Cx Services IDIQ Contract (2013-2015); Sustainable Engineering Group
Questions?

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TOTAL BUILDING COMMISSIONING

Planned, Budgeted and Specified Systems to be Commissioned Heating, ventilating, air conditioning and refrigeration (HVAC&R) systems (mechanical and passive) and associated controls. (LEED & ASHRAE 189.1)
Lighting and daylighting controls. (LEED & ASHRAE 189.1)
Domestic hot water systems. (LEED & ASHRAE 189.1)
Renewable energy systems (e.g., wind, solar). (LEED & ASHRAE 189.1)
Water and Energy measurement devices. (ASHRAE 189.1)
Building Envelope (DA SDD Policy 27 Oct 2010)

Thomas J. Jamieson P.E. PMP CBCP
Mechanical Engineer
Engineering & Construction
United States Army Corps of Engineers
Headquarters – Washington D.C

“Building Strong”
Presentation Objectives

- Outline (USACE) approach to Total Building Commissioning
- Identify USACE current efforts on Policy & Guidance for the implementation and execution of Total Building Commissioning
Overview of USACE
(United States Army Corps of Engineers)

Federal agency and Army organization (major command) made up of 36,000+ civilian and military personnel
- HQ, 9 Divisions, 45 Districts [http://www.usace.army.mil](http://www.usace.army.mil)
- On-going projects in 100+ countries, physical presence in 34+ countries

Engineer Research and Development Center (ERDC) [http://www.erdc.army.mil](http://www.erdc.army.mil)
- Four Primary Facilities
  - ERDC Headquarters, Vicksburg, MS
  - Construction Engineering Research Laboratory, Champaign, IL
  - Cold Regions Research and Engineering Laboratory, Hanover, NH
  - Geospatial Research and Engineering Division, Alexandria, VA
- 2500+ Employees
- 990+ Scientists and Engineers

“Building Strong”
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.
Guidance & Criteria

For buildings, migration from USACE/DoD criteria to industry criteria with minor modifications.


  - UFC Unified Facility Code
  - UFGS Unified Facilities Guide Specifications

- Proper specifications are essential to ensure the design intent, material properties, and level of quality desired is realized during construction.
- Continuous review and update via Criteria Change Requests (CCR)
Legacy Guidance & Policy

- DCAF Bulletin 98-7, Commissioning of HVAC Systems
- DCAF Bulletin 99-1, Commissioning of HVAC Systems
- Construction Bulletin 95-18, Commissioning of HVAC Systems
- ETL 90-10, Commissioning of Heating, Ventilating, and Air Conditioning 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
- (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
- 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.
Guidance & Criteria (cont.)

- ER 1110-345-723, Systems Commissioning Procedures
- ER 25-345-1, Systems Operation and Maintenance Documentation
- ER 414-345-38, Transfer and Warranty
- ASHRAE Guideline 0-2005, The Commissioning Process
- 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), 12 Dec 13, Sustainable Design and Development Policy Update (Environmental and Energy Performance)
- Draft ECB 2014 Total Building Commissioning
Current Overarching Policy

By Memo dated 13 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 CxA should be determined at the start of the design phase. The CxA shall be independent of the team that executes design and construction.
Criteria & Process Synchronization

1. 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
Criteria & Process Synchronization (cont)

2. Document Owner’s Project Requirements (OPR)
   Responsibility: Owner or CxA
   - USACE Policy
     - Planning Charette Report
     - Design Charette Report
     - Commissioning Procedures (ER 1110-345-723)

3. Develop Basis of Design (BoD)
   Responsibility: Design Team
   - USACE Policy
     - Design Analysis (ER 1110-345-700)
     - Commissioning Procedures (ER 1110-345-723)

4. CxA reviews OPR and BoD
   Responsibility: CxA
   - USACE Policy
     - BCOES: Bidability, Constructability, Operability, Environmental and Sustainability Review (ER 415-1-11)
     - Independent Technical Review (ER 1110-1-12, Chapter 4)
Criteria & Process Synchronization (cont)

5. Document and implement Cx Plan
   Responsibility: Project Team or CxA
   - USACE Policy
     ✓ Commissioning Procedures (ER 1110-345-723)
     ✓ UFC 1-200-1 Sustainability (reference to ASHRAE 189.1)
     ✓ DBB: UFGS 23 09 23: Commissioning
     ✓ DB: ASHRAE Guideline 0

6. Incorporate commissioning requirements into construction documents
   Responsibility: Project Team or CxA
   - USACE Policy
     ✓ UFGS 23 09 23: Commissioning
     ✓ Commissioning Procedures (ER 1110-345-723)
     ✓ UFC 1-200-1 Sustainability (reference to ASHRAE 189.1)

7. Conduct commissioning design review prior to mid-construction CD’s
   Responsibility: CxA
   - USACE Policy
     ✓ BCOES: Bidability, Constructability, Operability, Environmental
       and Sustainability Review (ER 415-1-11)
Criteria & Process Synchronization (cont)

8. Reviews contractor submittals applicable to systems being commissioned
   Responsibility: CxA
   - USACE Policy
     ✓ Submittals Procedures ER 415-1-10
     ✓ DBB: HVAC submittals require Government Approval (ER 1110-1-12)
     ✓ Equipment, Controls, and Cx Plan
     ✓ DB: Quality Assurance Review of 10% of all for information only submittals (ER 415-01-10)

9. Verify installation and performance of commissioned systems
   Responsibility: CxA
   - USACE Policy
     ✓ USACE Quality Assurance Personnel will witness testing and/or review the results. (ER 1180-1-6).
     ✓ Commissioning Procedures (ER 1110-345-723)

10. Develop systems manual for commissioned systems
    Responsibility: Project Team or CxA
    - USACE Policy
      ✓ Systems Operation & Maintenance Documentation (ER 25-345-1)

“Building Strong”
11. Verify that requirements for training are complete
   Responsibility: Project Team or CxA
   - USACE Policy
     ✓ Commissioning Procedures (ER 1110-345-723)
     ✓ DBB: Training in various UFGS
     ✓ DB: Each system requires training.

12. Reviews building operation within 10 months after substantial completion
    Responsibility: CxA
    - USACE Policy
      ✓ Warranty Inspections of 4 & 9 months after government acceptance. Transfer and Warranty (ER 414-345-38)
      ✓ Conducted by Contractor, USACE, & Customer Representative

13. Completes a systems commissioning summary report
    Responsibility: CxA
    - USACE Policy
      ✓ Commissioning Report by CxC
      ✓ USACE approval of Cx Summary Report
      ✓ Building will not be accepted until Cx is complete
Construction Quality

Contract documents spell out roles, responsibilities, processes and deliverables to ensure quality.

- Based on ER 1180-1-6, Construction Quality Management
  - Contractor Quality Control (QC)
  - Government Quality Assurance (QA)

- UFGS 01 45 00.10 10, Quality Control System
  - Management and administrative requirements

- UFGS 01 45 00.00 10, Quality Control
  - Contents of QC Plan
  - Processes, documentation, deliverables

- NTP
- Preconstruction Conference
- Schedule review (coordinated with Customer)
- Submittals & Review
- Three Phase QA/QC
  - Preparatory Inspection
  - Initial Inspection
  - Follow Up Inspection
- Attend Progress Meetings
US Army Corps of Engineers
Improving Army Built Environment

Commissioning Flow Process

Design Phase
- OPR
- BOD
- Initial Cx Plan
- Contract Specifications
- Submittal Register
- Pre-functional checklist & test Plans

Construction Phase
- Update Cx Plan
- TAB Design review
- Update & Finalize pre-functional checklist & FPT
- Controls PVT
- Prelim TAB Report

Acceptance Phase
- Execute FPT
- Controls Endurance Testing
- Develop Systems Manual
- Prepare & submit Facility O&M
- Commerce Staff Training
- Submit Summary Commissioning Report

Warranty Phase
- Seasonal testing as required
- Review & Monitor Facility Operation
- Update Systems Manual
- Update Summary Commissioning Report
- Close-out Issues Log
- Review and Complete Staff Training

“Building Strong”
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.
New Terms Contained in ECB

Commissioning Specialist Application. The CxG is required for all project procurement methods. The CxD is typically required for DBB projects, and may be utilized during DB RFP preparation for DB projects. The CxC is typically required for all projects. For small (less than 50,000 square feet) DB projects that are not pursuing the enhanced commissioning credit (EA credit 3), the CxC may be considered the CA for purposes of completing LEED documentation for fundamental commissioning.
Contract Execution with New Terms

**Diagram Descriptions:**

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

**Figure 2:** Design – Build (D-B) Commissioning Organization Chart
For Army Users

Army Regulation 420-1, Army Facilities Management, paragraph 4-48. Systems commissioning, states:

“Individual operating systems testing to ensure that contractual requirements have been met are not always an adequate process to guarantee overall performance. For projects, which include various large, complex, or interactive utility systems, where significant operational degradation may occur in critical facility processes or in life, health, or safety features of the project if systems do not function as required, it may be necessary to ensure that design intent has been accomplished through the use of the systems commissioning process. Installations will identify and justify all such requirements and program all funds necessary to implement this process, including any MILCON funds required, in the project DD Form 1391, to ensure that appropriate resources are available when needed for each such project selected. IMCOM region directors will be prepared to support such requirements on a per project basis at HQDA PRB meetings.”

The following Corps of Engineers documents specifically address commissioning:

23 08 00.00 10 COMMISSIONING OF HVAC SYSTEMS
ER 1110-345-723, Systems Commissioning Procedures
ER 25-345-1, Systems Operation and Maintenance Documentation
Total Building Commissioning Criteria & Process Synchronization

Alignment to ASA policy on Sustainability

- Tri-Service commissioning specification effort at 90% completion stage
  - New Div 01 General Commissioning Requirements
  - New Div 22 Plumbing Commissioning
  - Update Div 23 HVAC Commissioning
  - New Div 26 Electrical Commissioning

- Update to current USACE ER 1110-345-723 Commissioning Procedures in progress

- Update to current USACE ER 1110-25-341-1 Commissioning System Manual in progress

- Improve commissioning competencies within USACE ranks

- Develop a Continuous Commissioning Process
Questions
Air Force Brief on Commissioning

Colonel David Demartino
Director of Staff
21 May 2014
Background

Planning and Integration Directorate
- Strategic enterprise-wide planning
- Enterprise-wide output standards
- AFCAMP Investment Plan – IPLS (Budget year) development / integration
- AFAMP Investment Plan (POM) development
- Enterprise Procurement

Facility Engineering Directorate
- Centralized Design & Construction services for MILCON and O&M funded projects
- Standardized designs for similar facility and infrastructure
- Expertise in all facility engineering disciplines

Energy Directorate
- Facility energy and utility rate negotiation support
- Energy clearinghouse
- Renewable energy focal point

Environmental Directorate
- Planning, program and project validation, prioritization, strategy, technical support & execution for:
  - Compliance
  - Restoration
  - Natural and Cultural Resources
  - NEPA Center

Operations Directorate
- Facility operations analysis, standardization support & infrastructure assessment
- Military CFM
- Preventative maint. oversight
- Airfield pavement evaluations & CE Maint, Inspection & Repair Teams

Installations Directorate
- Active Duty Real Estate Transactions, Real Property Asset Management
- Base Realignment and Closure (BRAC) Program
- Enhanced Use Lease Program
- Housing and utility privatization portfolio management

Readiness Directorate
- PRIME BEEF, RED HORSE, Expeditionary Engineering, Fire, EOD, and Emergency Mgmt
- AF Contract Augmentation Program (AFCAP) support
- Reach-back center support
- CE RDT&E

AFCEC Director
- Director of Staff
- Chief Financial Office
- Staff Judge Advocate Office
- Public Affairs
- Mission Support
- Human Resources
- Information Office
FY14 Facility Investments Summary

• AF MILCON: $1,053M
• MFH MILCON (PAIP): $76M
• ECIP MILCON: $35M
• SOF MILCON: $8M
• Medical MILCON: $72M
• NAF Major Construction: $75M
• FSRMD: $454M
• DLA Funded Projects: $100M

Total: $1.9B
FY15 Facility Investments Summary

- AF MILCON: $778M
  - UMMC (P-341) $23M
  - Planning & Design $11M
- ECIP MILCON: $43M
- SOF MILCON: $23M
- Medical MILCON: $95M
- NAF Major Construction: $13M
- FSRM: $658M
- DLA-Energy (Fuel Projects): $150M

Total: $1.8B
Commissioning Policy & Direction

- **Guidance**
  - AF Sustainable Design & Development (2011);
  - Full Compliance w/Fed HPSB standards;
  - Formal LEED Silver Certification;
  - UFC 1-200-02, High Perform/Sustainable Bldg
- **MILCON & Major Reno (Fundamental & Enhanced)**
  - Fundamental -- as part of project
  - Enhanced -- as determined beneficial (24%-40%)
- **Existing Building (Re/Retro Commissioning)**
  - Performed by CEMIRT (in-house labor)
  - Opportunity to perform some by contract
Re/Retro Commissioning

- **Requirement Identification:**
  - AFCEC Asset Visibility Teams
  - Sustainable Infra Assessments
  - Local CE Squadrons

- **Asset-Management Prioritization:**
  - Programmed in ACES (DD 1391)
  - CEMIRT quarterly pull
  - Risk-based Integrated Priority List model informs the schedule

- **Execution:**
  - TDY CEMIRT gov’t. employees
  - Central/local contract
Sustainable Infra Assess

- Energy Audits (Levels 1 & 2)
- High Perf Sustainable Building (HPSB) Checklist
- Facility Condition Assessments
- Space Utilization: S-file
- Real Property Installed Equipment Inventory (RPIE) *
- Real Property Review: additions/deletions/ DD1354 *

* Not done during SIA I
HVAC Recommissioning (RCx)

- Organic Team: 6 civil service positions
  - Centrally funded TDYs; bases request work (~175/yr)
  - ~40 facilities RCx/Yr;
  - 2.2M SF of conditioned space in FY13…saved $1.43M in utility costs

- Contracted Team (JM Waller) – 5 CMEs
  - Cost ~$1M/Yr for ~17 large facilities (50-250K SF)
  - Completed 17 facilities/~1.2M SF in FY13
  - Saved ~$650K on utility bills!
Thoughts/Opportunities

- Need your help to justify cost/expense
  - Design & MILCON dollars in short supply!
  - O&M (FSRM) funds are always at risk!
- How else can we execute?
  - Justify as part of ESPC…other contract/tool?
  - Pay w/Facility Operations/Utility costs
Air Force Civil Engineer Center

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Air Force Brief on Commissioning