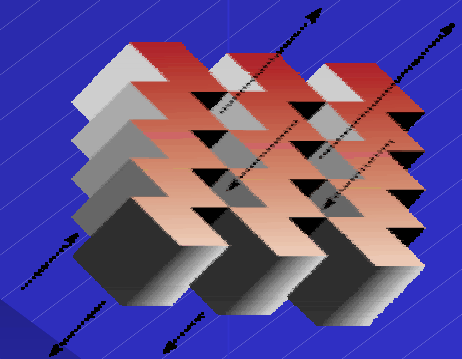


Building Systems Commissioning

Erik Jeannette, PE
Architectural Energy Corporation
Boulder, CO



ARCHITECTURAL ENERGY
CORPORATION

Integrated Engineered Solutions

AGENDA

- ◆ Commissioning - what is it?
- ◆ Commissioning Goals and Objectives
- ◆ Commissioning - history and evolution
- ◆ What gets commissioned?
- ◆ Commissioning Process
- ◆ How Commissioning fits into construction
- ◆ LEED related commissioning
- ◆ CX Organizations and References

Commissioning Definitions

- ◆ Commissioning (CX) is a comprehensive and systematic process to verify and document the systems of new or remodeled facility function completely as designed to meet the owner's requirements.
- ◆ A type of quality control to the systems being commissioned

Commissioning Person

- ◆ Commissioning is often performed by an independent third-party engineering company.
- ◆ Operates as an owner's representative to insure the installed systems meet the owners requirements and the plans and specifications
- ◆ Usually hired by the owner, sometimes by the architect, or general contractor. Can be a person or group within an A/E firm.

Commissioning - When?

- ◆ When hired by the owner or architect, CX agent is part of the design team. Contracted at early conceptual design phase.
- ◆ When hired by the GC, the CX agent is not involved until after bid day.
- ◆ Nearly always present for equipment startup and checkout (substantial completion)
- ◆ Ideally under contract through the warranty period

Commissioning Goals

- ◆ Cost and Energy Savings
 - Energy - 10 to 15 Percent over non-commissioned buildings
 - Reduced change orders
- ◆ Customer / Occupant Satisfaction
 - Improved comfort and indoor air quality
- ◆ Smoother Construction Process
 - Avoided construction problems, reduced callbacks
- ◆ Meet the LEED Rating prerequisite requirements

Commissioning Objectives

- ◆ Ensure the facility meets the owner's performance requirements
- ◆ 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 and occupants
- ◆ Provide improved documentation of system characteristics

Commissioning - What Did We Use To Do?

- ◆ CX of mechanical and electrical systems was done by the installing contractors
- ◆ No standardization, or clear approach
- ◆ Most of the real CX occurred during the warranty period as warranty calls
- ◆ Buildings operated less efficiently
- ◆ First year of occupancy was frustrating for the owner
- ◆ Contractors spent more money during the warranty periods

Commissioning - Why Do We Need It?

- ◆ Why do we need a CX agent?
 - Contractors can be rushed without enough time to double-check their work
 - Design Engineers do not have enough budget to oversee the construction in detail
 - Owners have had bad experiences with prolonged project closeout, and see CX as a solution
 - Hold contractors accountable for the specifications

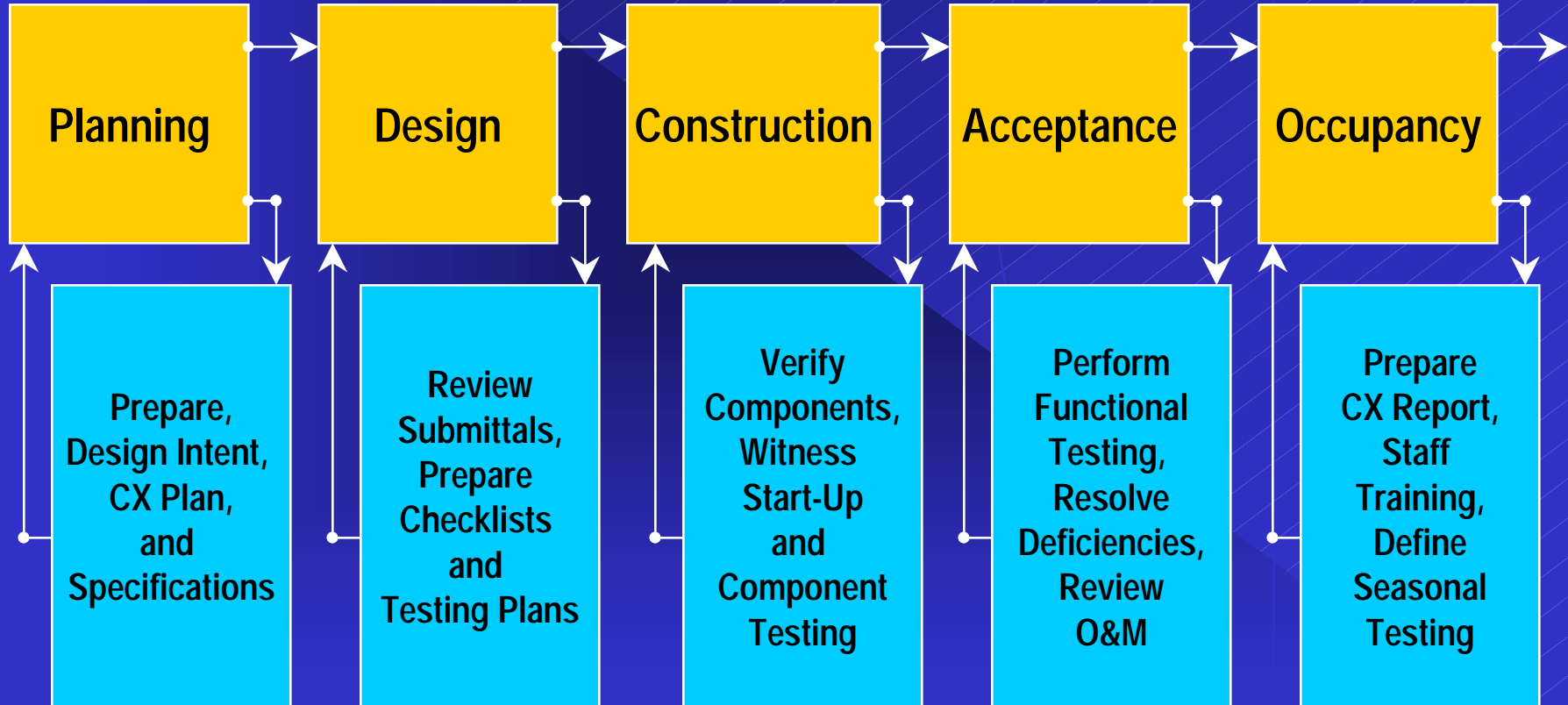
Commissioning Scope

- ◆ Mechanical Systems
 - All HVAC equipment
 - Building automation system and hardwired controls
- ◆ Electrical Systems
 - Switchgear, major disconnects, backup generators and UPS
- ◆ Fire Safety Systems
- ◆ Security Systems
- ◆ Kitchen equipment
- ◆ Irrigation system
- ◆ Laboratory Fume hoods, gas control

Commissioning Process

- ◆ Commissioning Plan
- ◆ Design Intent Summary Report
- ◆ Pre-Functional Inspection Checklists
- ◆ Functional Performance Tests
- ◆ Short-Term Diagnostic Monitoring
- ◆ Deficiency Report
- ◆ Operations and Maintenance Training
- ◆ Warranty Period / Seasonal Testing

Commissioning and Construction Phases



Commissioning Process

◆ Commissioning Plan

- Outlines the framework and process for organizing and implementing all commissioning activities.
- Defines scope of work, methods, roles and responsibilities
- Updated as project progresses

Commissioning Process

◆ Design Intent Summary Report

- Document owner's design requirements
- Establish baseline of performance expectations
- The Design Intent provides an explanation of the ideas, concepts and criteria considered to be important to the owner, resulting from the programming and conceptual design phases. Owner's requirements.
- The Basis of Design documents the assumptions behind design decisions. A/E responses.

Commissioning Process

◆ Pre-functional Inspection Checklists

- Completed for all major equipment and systems to be commissioned
- Ensures the as-built systems are complete and operational
- Created by CX Agent, filled out by contractors, verified by CX Agent
- Requires Manufacturer's start-up be followed

Commissioning Process

◆ Functional Performance Tests

- Verifies the intended operation of individual components and associated controls under various conditions and modes of operation
- Test plans prepared to verify the complete sequence of operations
- Proceeds from components to systems
- Static vs. Dynamic testing

Commissioning Process

◆ Short-Term Diagnostic Monitoring

- Records system operation for two to three week period
- Investigates dynamic interactions between components and systems
- Utilize data loggers and / or BAS trending
- Observing undisturbed system operation identifies faults difficult to detect using functional performance testing

Commissioning Process

◆ Deficiency Report

- Documents issues identified from pre-functional checklists, functional performance tests, and diagnostic monitoring
 - ◆ A punch list for commissioned systems
- Details of non-compliant components, date identified, method of testing, required actions, and responsibility
- Continuously updated as project progresses
- Used as a trigger for final payment

Commissioning Process

◆ Operations and Maintenance Training

- Review O&M manuals, training agendas
- Facilitate training seminars
- Focus on system and trade interactions and integration, effective troubleshooting, and preventative maintenance

Commissioning Process

◆ Warranty Period / Seasonal Testing

- Seasonal variation in operations or control strategies may require additional testing during the opposite season to verify performance
- Depends on season during functional performance testing
- Review operation before warranty period expires

LEED™ : Leadership in Energy and Environmental Design

- ◆ US Green Building Council (USGBC)
- ◆ Rating system for commercial buildings
- ◆ 6 credit categories

Sustainable Sites	14
Water Efficiency	5
Energy and Atmosphere	17
Materials and Resources	13
Indoor Environmental Quality	15
Innovation & Design Process	4
LEED Accredited Professional	1

LEED™ : Leadership in Energy and Environmental Design

◆	Energy & Atmosphere	17
Prereq. 1	Fundamental Building Systems Commissioning	0
Prereq. 2	Minimum Energy Performance	0
Prereq. 3	CFC Reduction in HVAC & R	0
EA 1	Optimize Energy Performance	10
EA 2	Renewable Energy	3
EA 3	Additional Commissioning	1
EA 3	Elimination of HCFC's & Halon	1
EA 5	Measurement and Verification	1
EA 6	Green Power	1

LEED™ : Leadership in Energy and Environmental Design

◆	Indoor Environmental Quality	15
Prereq. 1	Storage & Collection of Recyclables	0
Prereq. 2	Tobacco Smoke (ETS) Control	0
IEQ 1	CO2 Monitoring	1
IEQ 2	Increase Ventilation Effectiveness	1
IEQ 3	Const. IAQ Management Plan	2
IEQ 4	Low-Emitting Materials	4
IEQ 5	Indoor Chemical & Pollutant Control	1
IEQ 6	Controllability of systems	2
IEQ 7	Thermal Comfort	2
IEQ 8	Daylight & Views	2

LEED™ : Leadership in Energy and Environmental Design

- ◆ LEED prerequisite commissioning requirement
 - ◆ Engage a commissioning authority.
 - ◆ Develop design intent and basis of design documentation.
 - ◆ Include commissioning requirements in the construction documents.
 - ◆ Develop and utilize a Commissioning Plan.
 - ◆ Verify installation, functional performance, training and documentation.
 - ◆ Complete a Commissioning Report.

LEED™ : Leadership in Energy and Environmental Design

- ◆ The LEED Best Practice commissioning credit requirement
 - ◆ Conduct a focused review of the design prior to the construction documents phase.
 - ◆ Conduct a focused review of the construction documents when close to completion.
 - ◆ Conduct a selective review of contractor submittals of commissioned equipment.
 - ◆ Develop a system and energy management manual.
 - ◆ Have a contract in place for a near-warranty end or post occupancy review.

Other Types of Commissioning

- ◆ Retro-commissioning
 - Performed to existing buildings that have not previously been commissioned, after they have been occupied
 - Usually instigated as a result of high energy bills or poor occupant comfort
- ◆ Recommissioning
 - Performed 5 to 10 years after a building was previously commissioned
 - Sometime used as a form of deferred maintenance

What's in the Future?

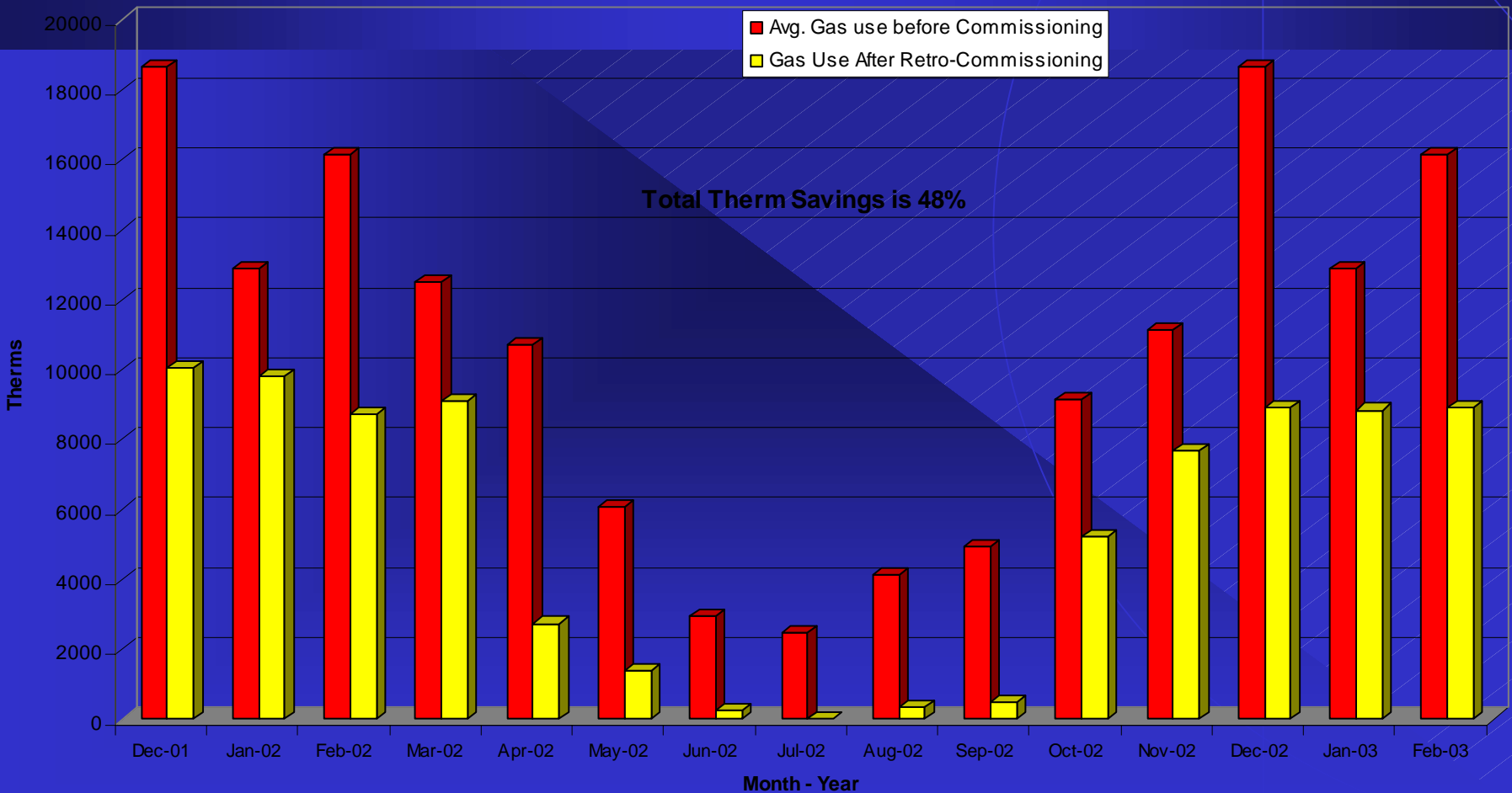
- ◆ Most government and public facilities
- ◆ LEED and commissioning
- ◆ Most owner occupied buildings
 - Owners realize the benefits in their own buildings
- ◆ Leased buildings will take longer to catch-on
- ◆ Retro-commissioning for energy savings and improved comfort

What's Does is Cost?

- ◆ New Construction and Major renovation
 - ◆ 0.5% to 1.0% of total construction budget
 - ◆ \$0.50 to \$1.00 per square foot
- ◆ "Retro" and "Re"commissioning
 - ◆ \$0.25 to \$0.50 per square foot
- ◆ Payback in energy savings is ~6 months

Retrocommissioning a Middle School

\$65,000 of Natural Gas Savings



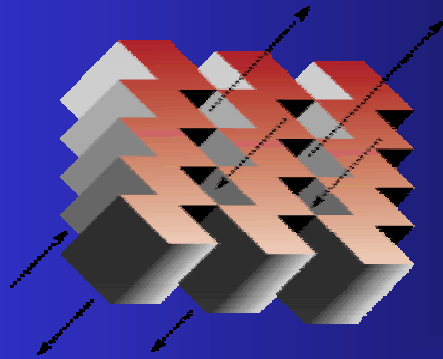
Commissioning Specifications & Organizations

- ◆ Commissioning specifications in section 01810
- ◆ ASHRAE - American Society of Heating Refrigeration Air-Conditioning Engineers. ASHRAE Guideline 1-1996
 - www.ashrae.org
- ◆ PECEI - Portland Energy Conservation Inc
 - www.peci.org
- ◆ Building Commissioning Association
 - www.bcxa.org

Clients & Projects

- ◆ Poudre Valley School District - LEED
- ◆ Adams Twelve Five Star Schools - N. Denver
- ◆ School District 11 - Colorado Springs
- ◆ Nestle Water North America - (5) MI,CA,TX,FL,TN - LEED
- ◆ Boulder Recreation Center - LEED
- ◆ University of Memphis
- ◆ Colorado Springs County Building - Pikes Peak Center
- ◆ Excel Energy - Recommissioning
- ◆ General Services Administration - Lakewood - LEED

Discussion



Erik Jeannette, PE
Architectural Energy Corporation
303-444-4149
ejjeannette@archenergy.com

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