SISTEMAS DE ÁGUA GELADA

PROGRAMA BRASILEIRO DE ELIMINAÇÃO DOS HCFCs

Projeto para o Gerenciamento de Chillers

Projeto Demonstrativo para o Gerenciamento Integrado no Setor de Chillers

Commissioning of the Built Environment - Technical Principles, Process, Procedures, and the Future"

Ross Montgomery – Quality Systems and Technology Inc. Commissioning USA

31/03/2016 - Fortaleza

Execução

SOMAR

Implementação

PNUD

Empoderando vidas. Fortalecendo nações.

Realização

Ministério do Meio Ambiente

GOVERNO FEDERAL BRASIL PÁTRIA EDUCADORA

? Where are we ? Brazil

Commissioning of the Built Environment - Technical Principles, Process, Procedures, and the Future"

(1-PDH by (DBPR)Professional Engineers , 1-CE by GBCI, 1-LU/HSW by AIA)

Ross D. Montgomery, P.E., CxA (2016)
Distinguished Lecturer

Fellow ASHRAE

ASHRAE member: Certified:
Commissioning Process Management Professional (CPMP)
Building Energy Modeling Professional (BEMP)
Building Energy Assessor Professional (BEAP)
High Performance Building Design Professional (HBDP)

ACG-AABC Commissioning Group Certified Commissioning Authority

ASHRAE Will Give You the World

T
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C
H

Give Back to ASHRAE

GROW

NETWORK

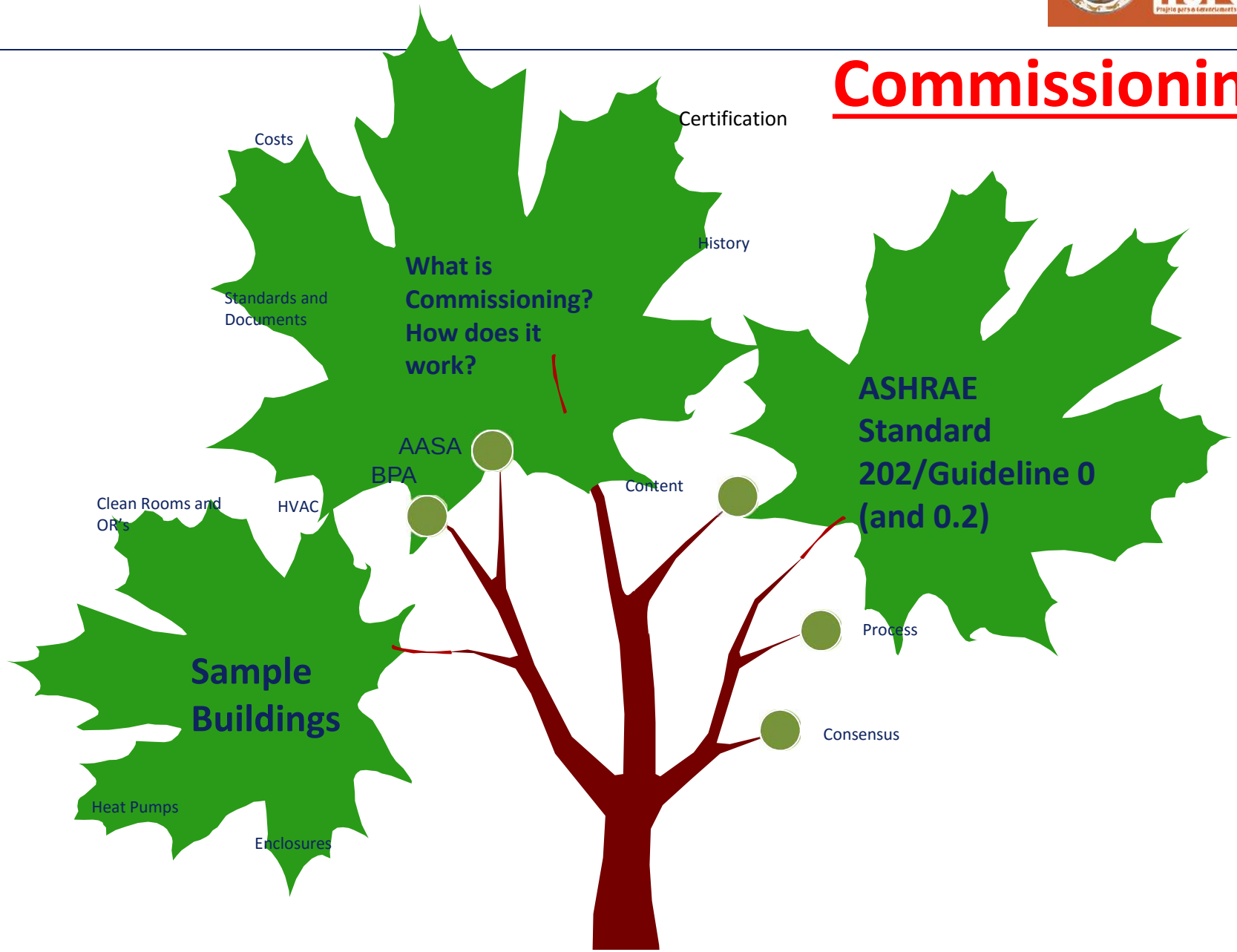
SHARE

LEARN

This ASHRAE Distinguished Lecturer is brought to you by the Society Chapter Technology Transfer Committee

Agenda for Today

Commissioning



Learning Objectives

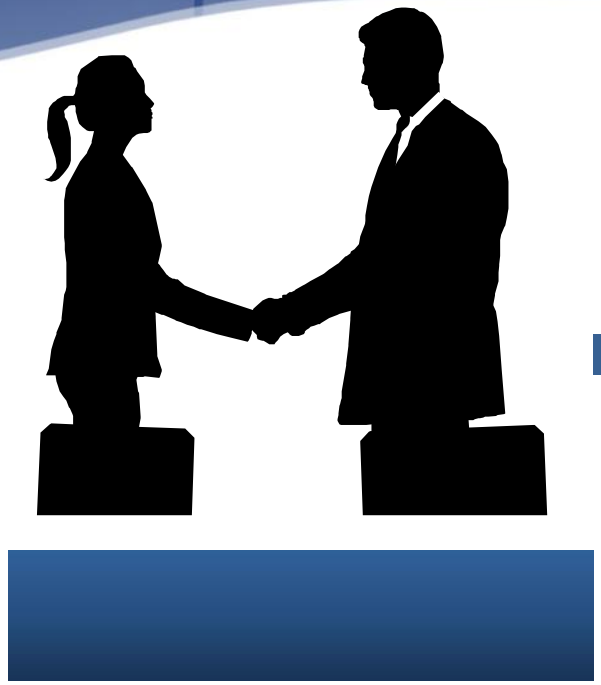
- Explain the technical and sustainable characteristics of commissioning activities

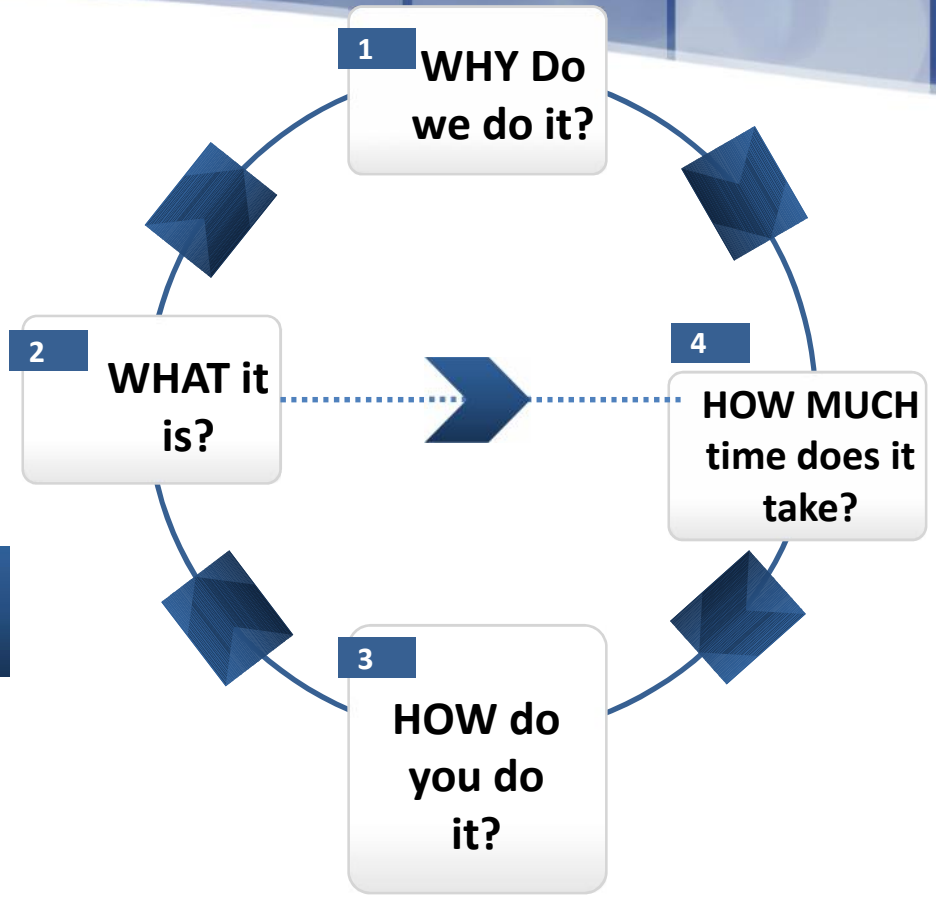
- Define commissioning activities that maintain and support sustainable design, operation, safety, and welfare of the occupants.

- Identify commissioning activities in Standard 202-2013 and Guideline 0, 0.2 and explain their use and applicability to sustainable design and practices

Questions to Answer

(Simple and Direct)



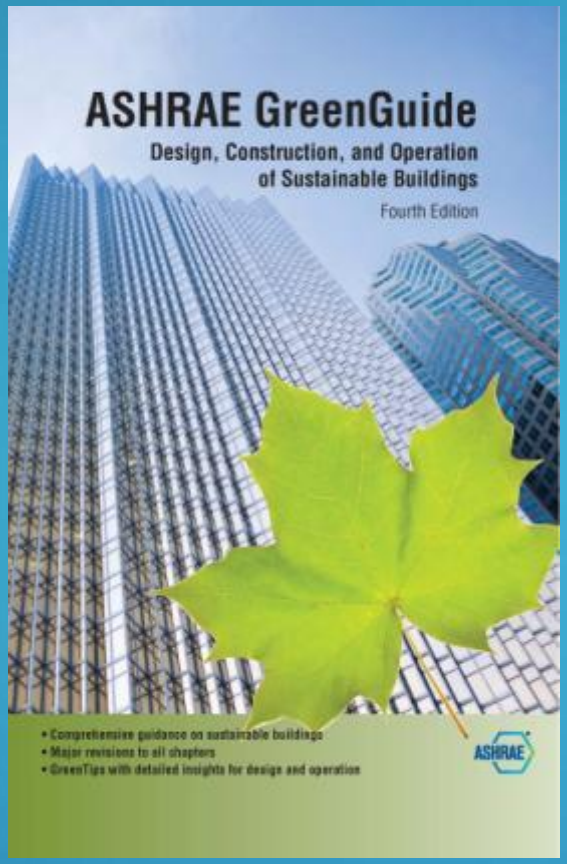


Some Publications We Use in Commissioning Activities

- ASHRAE Standard 202-2013, Commissioning Process for Buildings and Systems
- ASHRAE Refrigeration Commissioning Guide
- ASHRAE Guideline 0 AND 0.2
- ASHRAE Guideline 1.5, Smoke Control Commissioning Process
- Handbook of Smoke Control Engineering
- NFPA 3&4
- ASHRAE Strategic Guide to Commissioning

…….to name a few…..

A Green Resource for *All* Building Professionals



- ASHRAE GreenGuide
  - Geared towards HVAC&R system designers, architects, building owners, building managers/operators, or contractors
  - Four editions, 10 years, 158 GreenTips
- IEQ chapter completely revised; content references IAQ Guide
- Available as an e-book

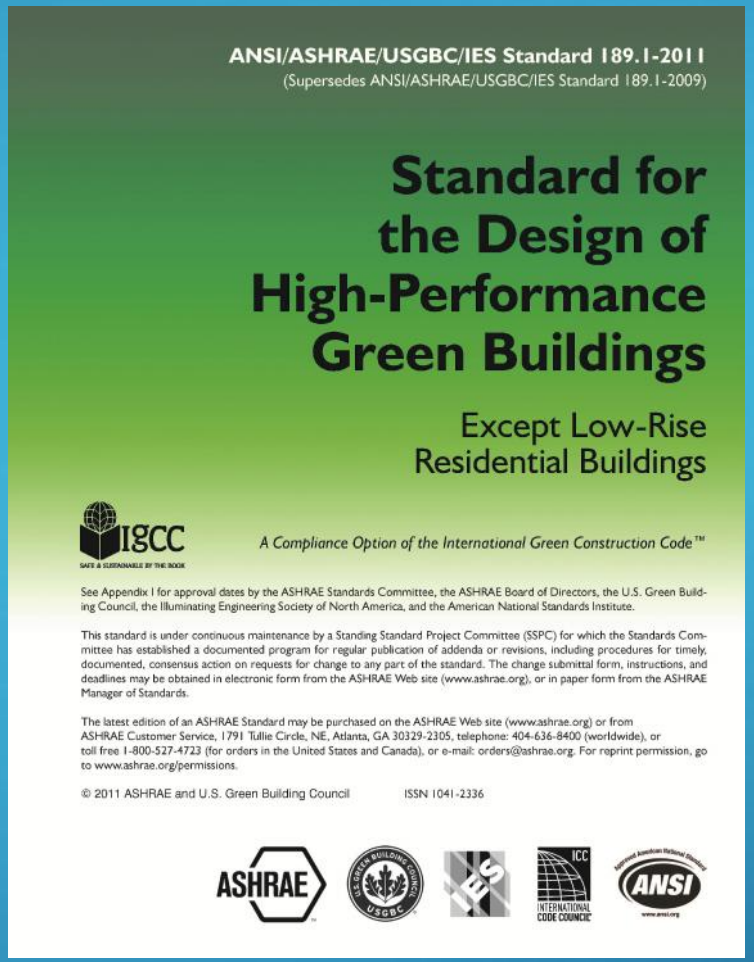
www.ashrae.org/greenguide

ASHRAE Resources for Designers

- ASHRAE Green Guide
- Advanced Energy Design Guides
www.ashrae.org/freeaedg
- Indoor Air Quality Guide
www.ashrae.org/FreeIAQGuidance
- Procedures for Commercial Building Energy Audits
www.ashrae.org/pcbea
- Refrigeration Commissioning Guide for Commercial and Industrial Systems
www.ashrae.org/freeRefCxGuidance

Standard 189.1-2014

- New for 2014:
  - IEQ requirements
    - Lighting quality
    - IAQ
    - Daylighting
  - Updated refrigeration tables
  - Requirements for recycling



ANSI/ASHRAE/USGBC/IES Standard 189.1-2011
(Supersedes ANSI/ASHRAE/USGBC/IES Standard 189.1-2009)

Standard for the Design of High-Performance Green Buildings

Except Low-Rise Residential Buildings

IGCC

A Compliance Option of the International Green Construction Code™

See Appendix I for approval dates by the ASHRAE Standards Committee, the ASHRAE Board of Directors, the U.S. Green Building Council, the Illuminating Engineering Society of North America, and the American National Standards Institute.

This standard is under continuous maintenance by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. The change submittal form, instructions, and deadlines may be obtained in electronic form from the ASHRAE Web site (www.ashrae.org), or in paper form from the ASHRAE Manager of Standards.

The latest edition of an ASHRAE Standard may be purchased on the ASHRAE Web site (www.ashrae.org) or from ASHRAE Customer Service, 1791 Tullie Circle, NE, Atlanta, GA 30329-2305, telephone: 404-636-8400 (worldwide), or toll free 1-800-527-4723 (for orders in the United States and Canada), or e-mail: orders@ashrae.org. For reprint permission, go to www.ashrae.org/permissions.

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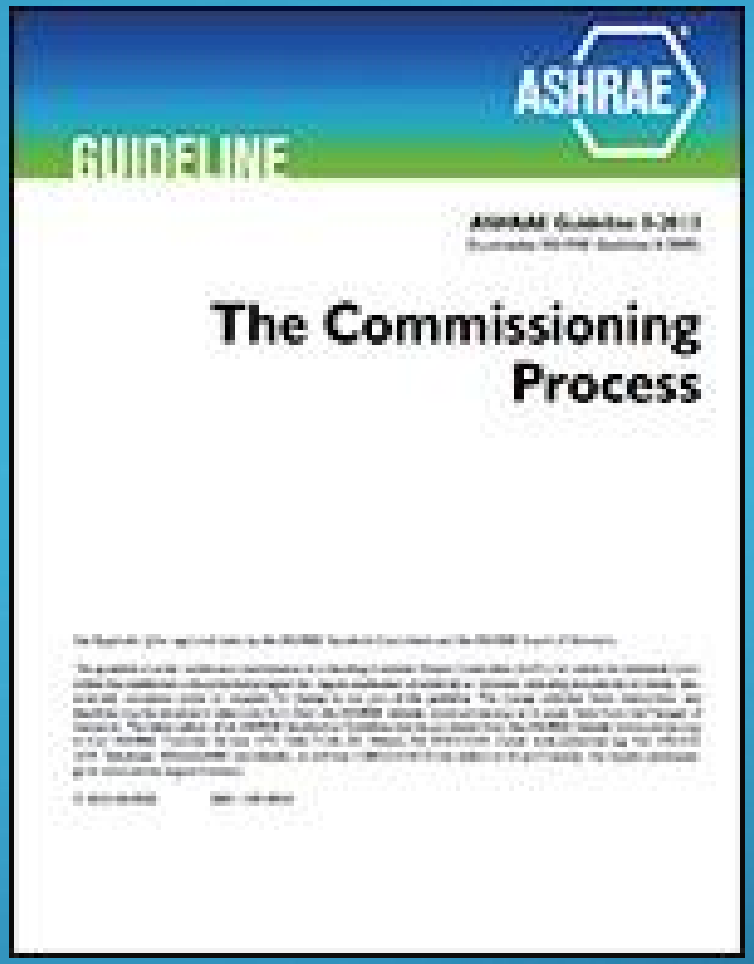
ASHRAE USGBC IES ICC ANSI

www.ashrae.org/greenstandard

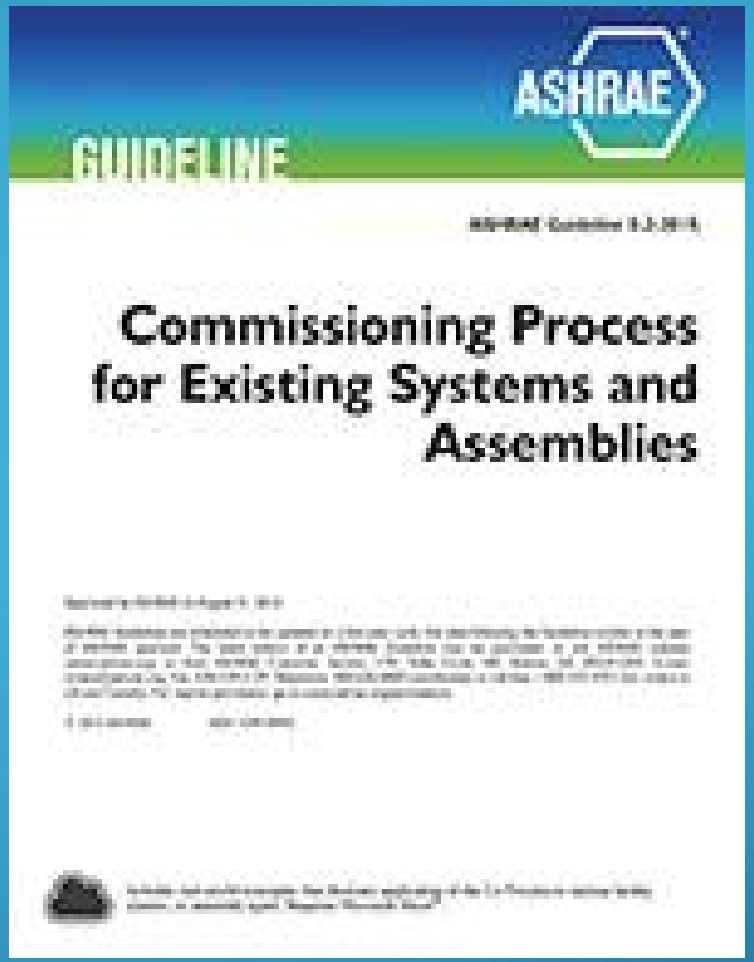
Guideline 0-2013

- The Commissioning Process
  - Companion Guideline for the ASHRAE Standard 202-2013
  - Updated from 2005
  - Coordinated with the SSPC 202 committee
  - Guidelines can go beyond “minimum”



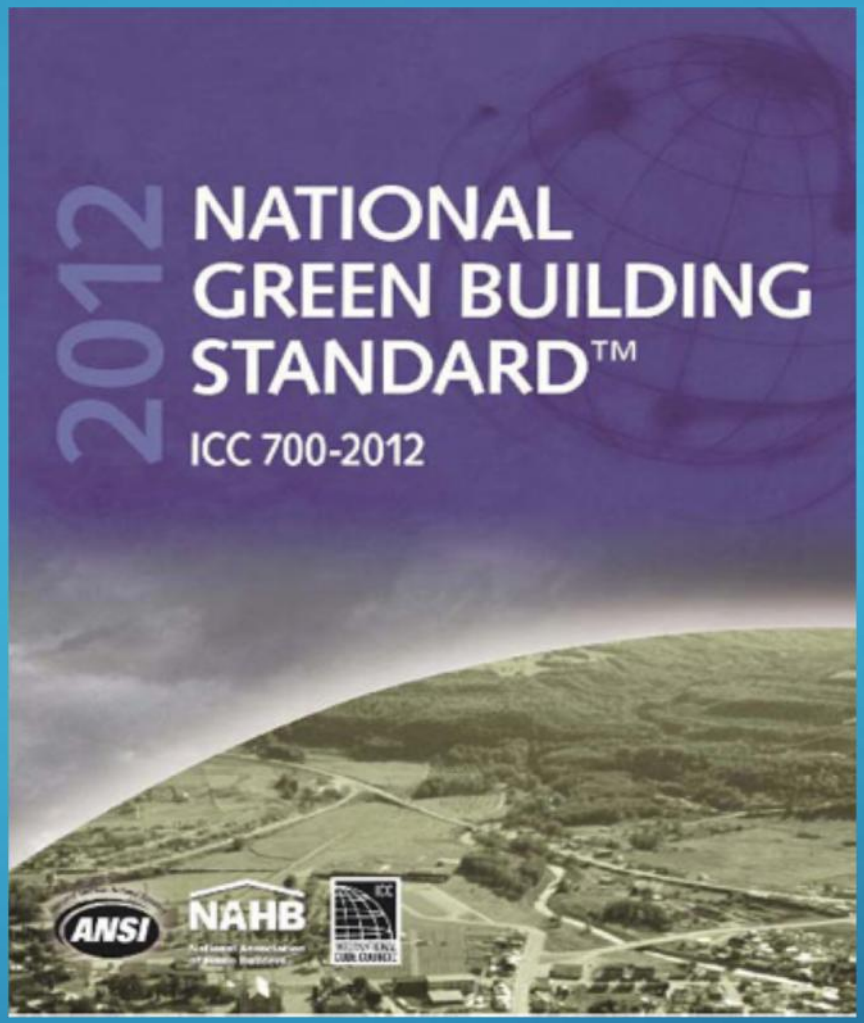
Guideline 0.2-2015

- The Commissioning Process for Existing Systems and Assemblies
  - Companion Guideline for the ASHRAE Guideline 0 (new buildings)
  - Updated from Guideline 1 1989 and 1996



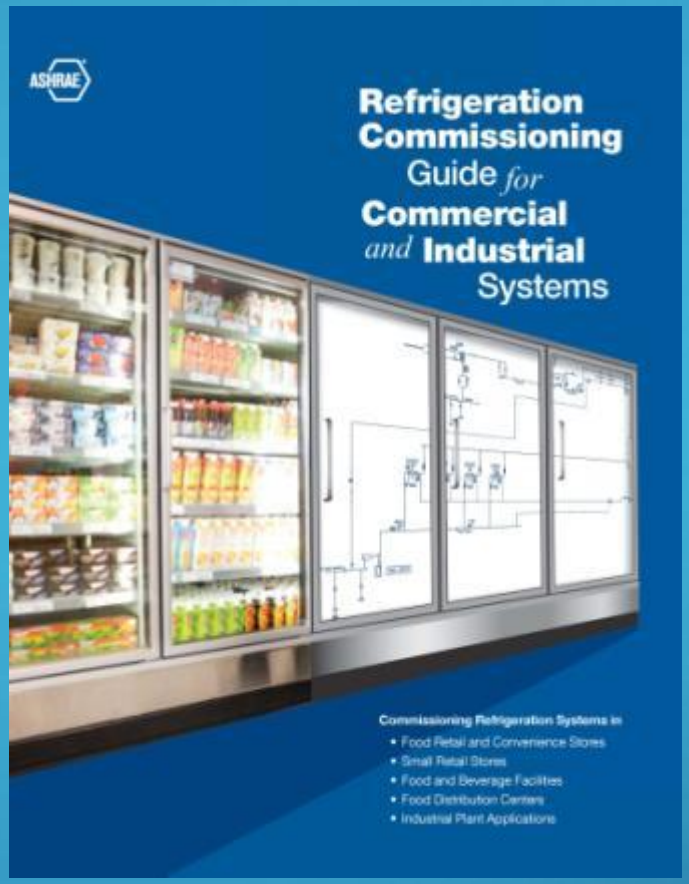
Residential Standard 189.2-2015

- Working with NAHB & ICC
- named ICC/ASHRAE 700-2015



Refrigeration Commissioning Guide

- (60%)Sixty percent of energy use in supermarkets is attributed to refrigeration
- Studies have shown commissioning could result in 7 to 25 percent energy savings.
- Guide outlines a commissioning process that would result in substantial savings.



Available for free at www.ashrae.org/freeRefCxGuidance

Commissioning Process for Buildings and Systems

ASHRAE Standard 202-2013

Smoke
Control Commissioning

ASHRAE Guideline 1.5-2012
(Supersedes ASHRAE Guideline 5-1994 [RA 2001])

ASHRAE GUIDELINE

The Commissioning Process for Smoke Control Systems

Approved by the ASHRAE Standards Committee on _____, and by the ASHRAE Board of Directors on _____

ASHRAE Guidelines are updated on a five-year cycle; the date following the Guideline is the year of ASHRAE Board of Directors approval. The latest edition of an ASHRAE Guideline may be purchased on the ASHRAE Web site (www.ashrae.org) or from ASHRAE Customer Service, 1791 Tullie Circle, NE, Atlanta, GA 30329-2305. E-mail: orders@ashrae.org. Fax: 404-321-5478. Telephone: 404-636-8400 (worldwide) or toll free 1-800-527-4723 (for orders in US and Canada). For reprint permission, go to www.ashrae.org/permissions.

ISSN 1049-894X

American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
1791 Tullie Circle NE, Atlanta, GA 30329
www.ashrae.org

Handbook of Smoke Control Engineering

John H. Klote
James A. Milke
Paul G. Turnbull
Ahmed Kashef
Michael J. Ferreira

ASHRAE
ICC INTERNATIONAL CODE COUNCIL
NFPA
SFPE

NFPA® 3 & NFPA® 4

Commissioning and Integrated System Testing

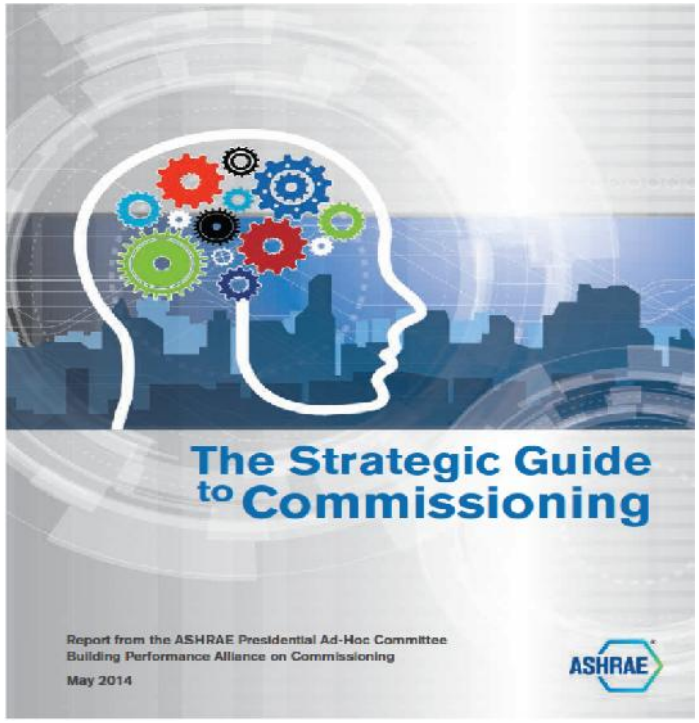
HANDBOOK

Matthew J. Klaus

2015 EDITION

NFPA®

Building Performance Alliance-2014



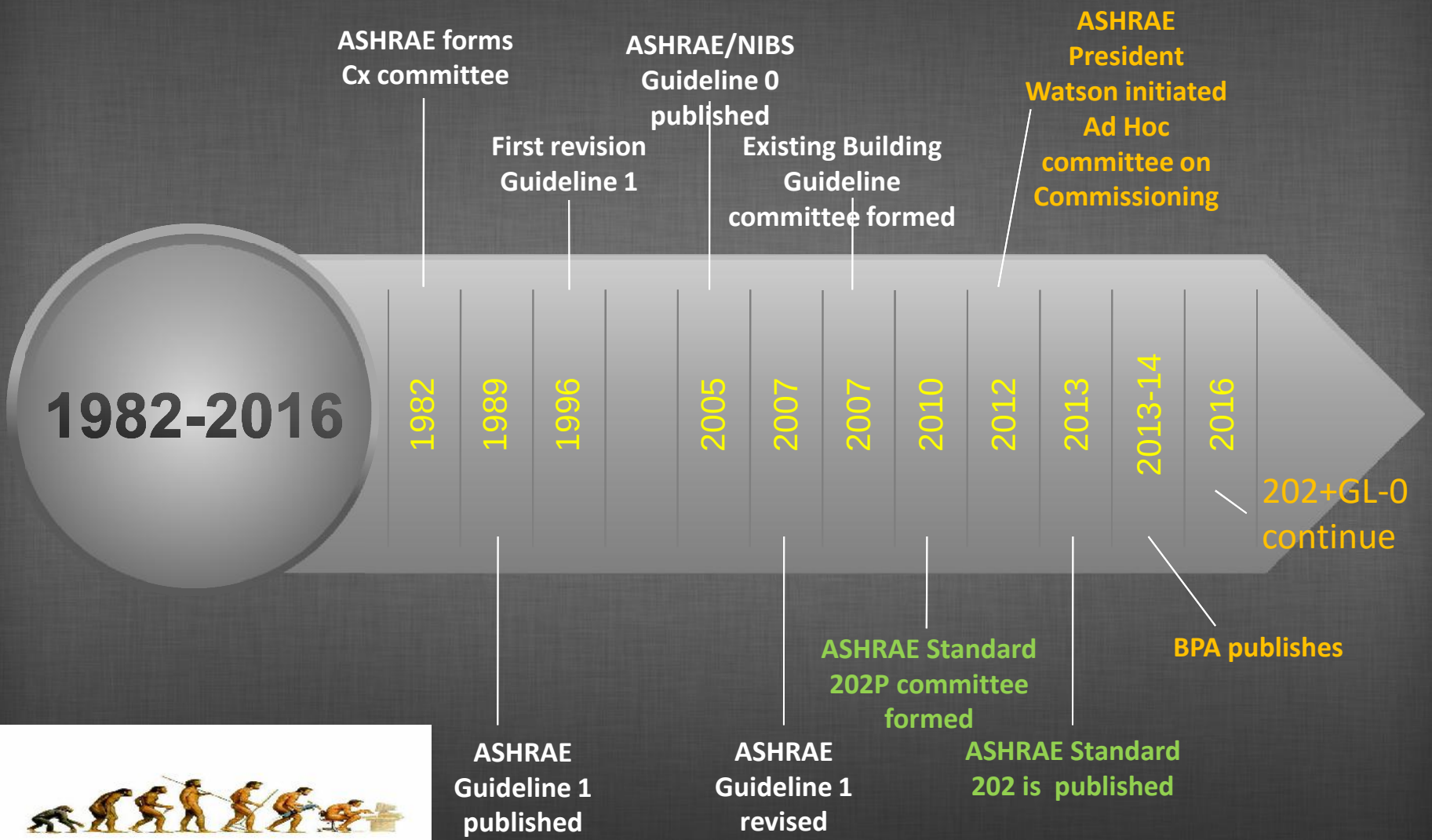
High Level and Strategic

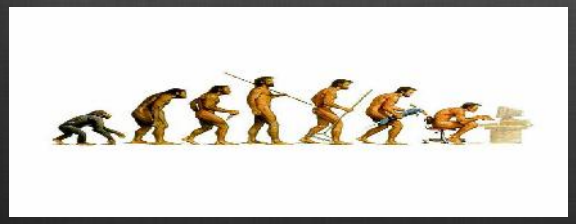
Produced by: 28 ASHRAE members and 14 major commissioning related organizations

https://www.ashrae.org/society-groups/meet-the-board/building-performance-alliance

Table of Contents (Strategic Guide to Commissioning June 2014)

History of ASHRAE Commissioning Documents





Std 202-Where are we going 2016?

- ASHRAE Standard 202 and ASHRAE Guidelines 0/1 are consolidating..
- Committees are consolidating..
- Much more content 'in planning' for St. Louis June 2016
- Comprehensive Users Manual coming…

Is it “Commissioning”

or? “Ommissioning” ?

?Why are we doing Commissioning?

Costs and Benefits

Costs $$$ are incurred by the members of the Commissioning team, such as the CxA, owner's representative(s), designer, contractor(s) subcontractors, TAB, major equipment providers, etc.: Items that cost $$ are:

- Report writing
- Meetings at jobsites
- Test instruments, devices, apparatus, protocols, lab tests,
- Operational, maintenance, and troubleshooting documentation requirements
- Construction checklists and Functional Performance Test protocols
- Facilitation and supervision of System manual assembly
- Supervision of Comprehensive training program for operation and maintenance personnel and users
- Review of Cx Plan at various phases in the process and delivering the OPR-Owners Project Requirements (CFR-Current Facility Requirements for existing building) and BOD-Basis of Design in a format specific for the owner.

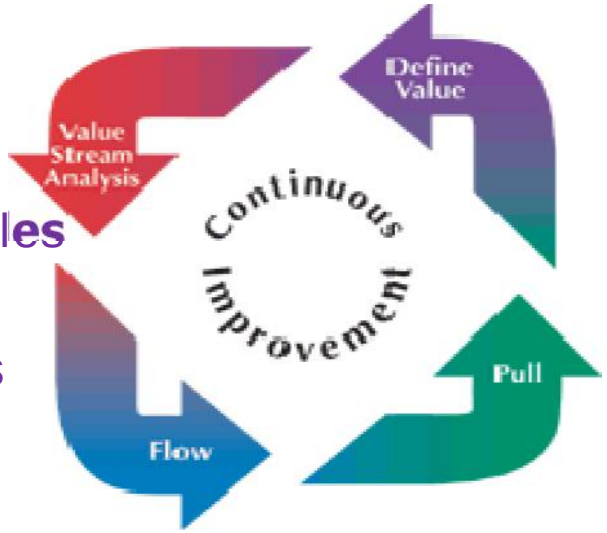
$$ Estimated COSTS $$ (2/2)

- The cost of Cx depends a great deal on the scope of services (systems commissioned) and the area of the country (or world).
- Does it start at Pre-Design, Design, or Construction?

  - **For example: A 100K SF office building could be $.02/sq.ft to $.25/sq.ft. ($2K-25K)**
  - **100K SF Schools and Institutional buildings range from $.25 to $.75 / SF. ($25K-75K)**
  - **100K SF Hospitals and labs could be up to $.5-1.50/ sq.ft.($50K-150K)**

➢ ***[Green Building Labeling costs are not included in these costs)]

Why do we use Commissioning? (Summary)



- Streamlines and improves:
  - The process and work flow
  - Meeting Milestones and Completion Schedules
  - Testing and Verification of Systems and Assemblies to meet project specifications
  - Training and M&O related activities
  - Warranty "experience"
- Reduces :
  - Material and labor waste
  - Change orders, delays, punch lists, and claims
  - Risk factors to all parties to reduce their costs
  - Warranty call-backs – disruptions of service

Delivers a performing building

Benefits of Commissioning

- **Owner:**
  - Improved operator knowledge of how to optimize the facility operation and maintenance due to the early inclusion of operators in the Cx process
  - Reduced training requirements due to the continuously updated documentation of how system should operate and be maintained; personnel will only need to be trained with regard to changes
  - Facility performance is in accordance with the owner's project requirements
  - Systems manual provides an easy reference document for systems and assemblies operation and maintenance
  - Reduced downtime due to better diagnosis of failures
  - Improved ability to provide accurate information to coordinate on facility operation and maintenance
  - Lower operating costs due to improve operational techniques
  - Benefits to building occupant including greater productivity, reduced complaints and reduced incidence of absenteeism

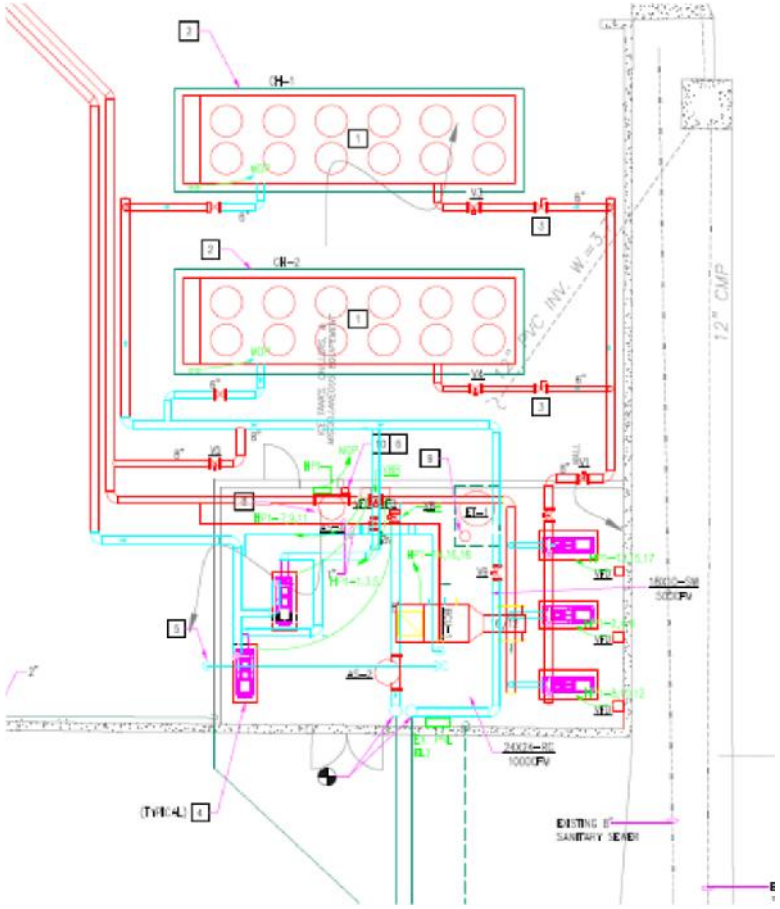
Benefits of Commissioning

- **Designer:**
  - Facility will achieve the OPR (Owners Project Requirements) or the CFR (Current Facility Requirements, if existing building)
  - Reduced risk exposure
  - Improved knowledge base for use in future designs and installation
  - Leads to a more cost-effective design
  - Reduced number of interference drawings during construction due to improved communication and coordination throughout the project

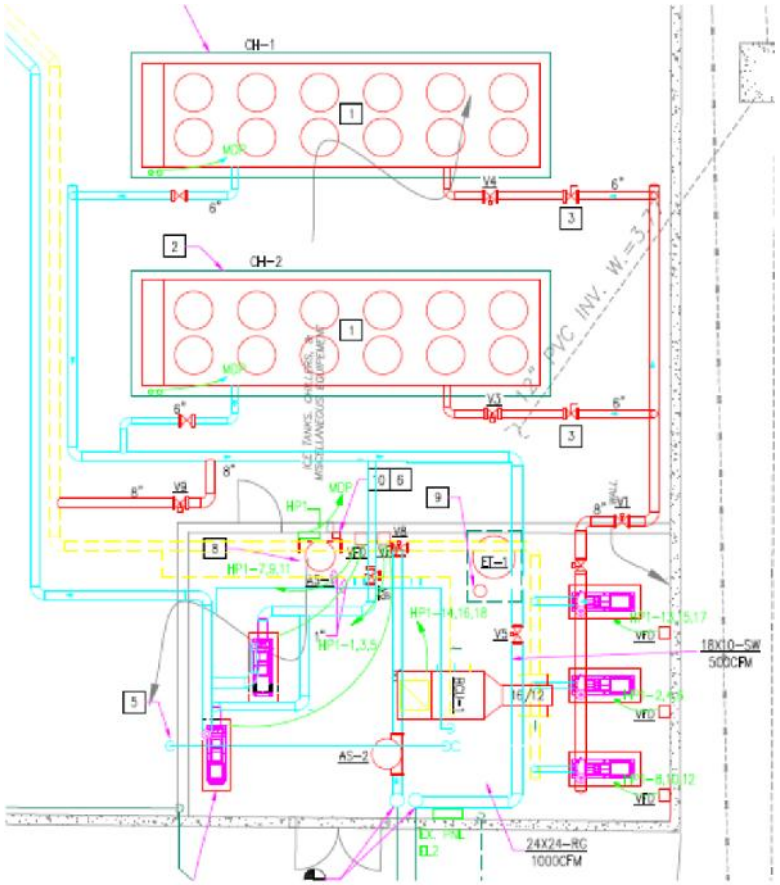
Benefits of Commissioning

- **Contractor:**
  - Improved planning and coordination through the implementation of the Cx plan
  - Improved coordination between different trades
  - Reduced likelihood of site interference drawings required of contractor throughout the project.
  - Reduced number of deficiencies at time of substantial completion.
  - Reduced number of callbacks during warranty period
  - Reduced number of warranty service calls for operational guidance, due to participation in training programs for operation and maintenance personnel

Field Workers working with incorrect drawings causing incorrect installations

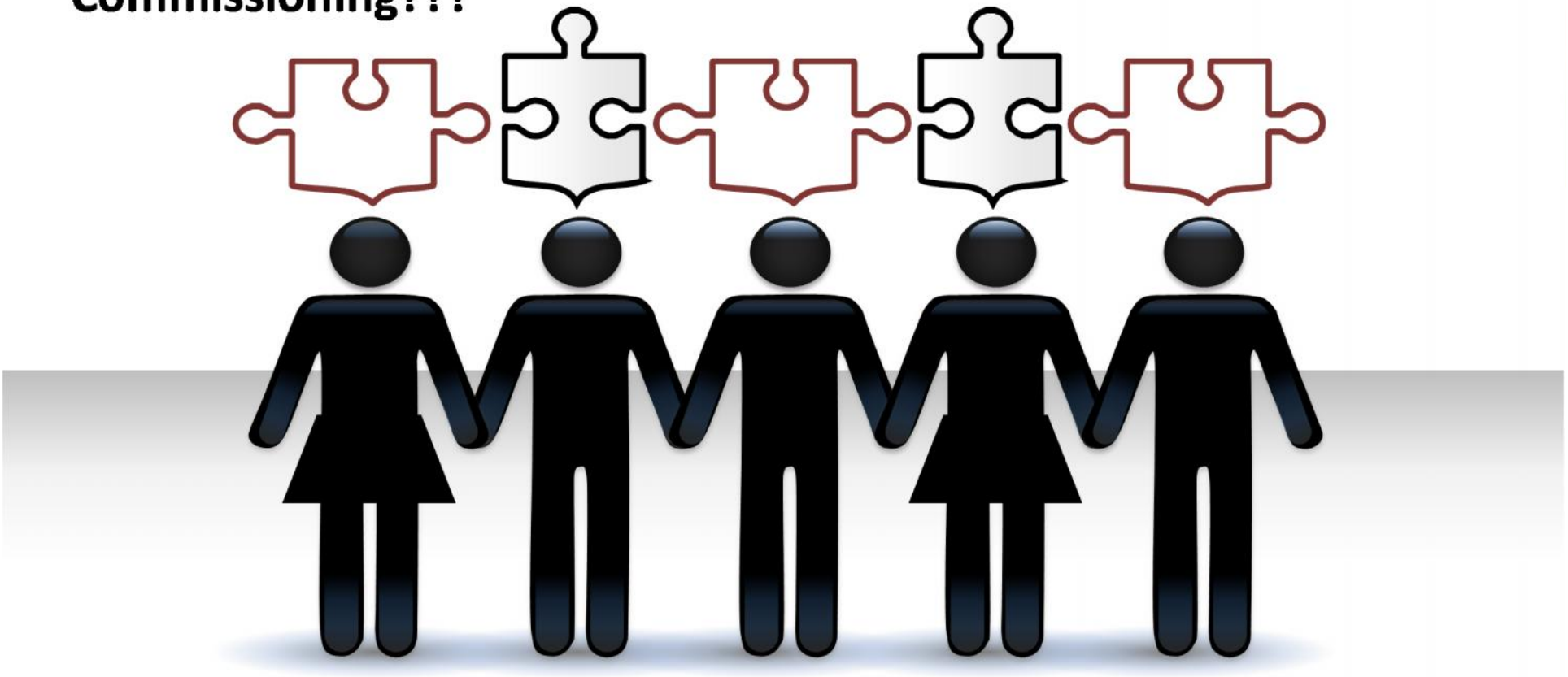


True submittals



Field Drawings

When is the best time in a Project to involve Commissioning???



- Pre-Design ?
- Design ?
- Construction ?

JUST SOMETIME !!

Building Commissioning Boom Under Way, Says Study

- BOULDER, Colo., 2013:

The demand for building commissioning services is accelerating worldwide, according to a new report by Navigant Research.

North America will lead the world in the expanding market, accounting for $13.8 billion, or nearly half, of the $28.8 billion in total worldwide revenue for building commissioning services during the period from 2012 to 2020.

Over time, the delivery of commissioning services will be transformed through the advent of building energy management systems with continuous commissioning capabilities, according to the report.

Survey says ! Building Enclosure Commissioning Process

- 2007 study: out of **17,000** construction defect
  – claims, 69% result of moisture related defects in building enclosure systems (July 2008 ASHRAE Journal).
- **$9 BILLION** ANNUALLY in North America
  – repairing & litigating damages from moisture intrusion (ASTM)
  (www.buildingcommissioning.com February 2012)

ASHRAE Journal (June 2013/August 2014)

- Titles: (1)Technical vs. Process Commissioning (2) Measurement and Verification
- Author: Dave McFarlane, Scott Gordon-Atkins; Ft. Myers, Fla. ;
- According to the **National Institute of Building Sciences** says, **"owners can achieve savings in operations of $4 over the first five years of occupancy as a direct result of every $1 invested in commissioning"**
- **"Process Commissioning"** – the CxA provides the outline of the process that is implemented by the design engineers and contractors.
- **"Technical Commissioning"-** the CxA uses "hands-on" and "on-site" observations, testing, and verification of building performance
- "**Measurement and Verification**" in Commissioning is important
  - Good articles—Specify what you want and expect—Get what you specify

ASHRAE Journal (2009)

- "Commissioning-Under Floor Air Distribution Study; MacDill Air Force Base; Central Command HQ"
- Author: Ross Montgomery, P.E.; CxA; Tampa , Fla.

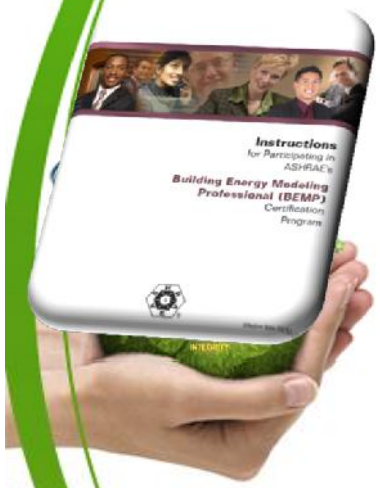
- Comprehensive article about commissioning a very large high security government complex
- Mechanical HVAC
- Electrical and Emergency Power systems
- Controls and Automation
- Redundancy
- Excellent results-"if I do say so myself"

Commissioning – NEWS FLASHES

- It is mandatory to commission all LEED projects to a specified level
- Some states have mandated that state owned or leased buildings be commissioned
- US FEDERAL GSA has mandated that GSA buildings be commissioned
- ARMY,NAVY, AIR FORCE and MARINE buildings require commissioning
- More and more hospitals are now requiring commissioning
- Commissioning is a standard in Canada
- Required in many European countries, included in Rating systems
- BRASIL is substantially increasing its commissioning activities- especially LEED related
- Some states have laws that specify “commissioning” does require a professional engineer to be in “responsible charge” of the project.

Certification

- Provides **professional designations** that demonstrate certification earners **"body of knowledge "**to the industry
- **Current program**
  - **CPMP-Commissioning Process Management Professional**

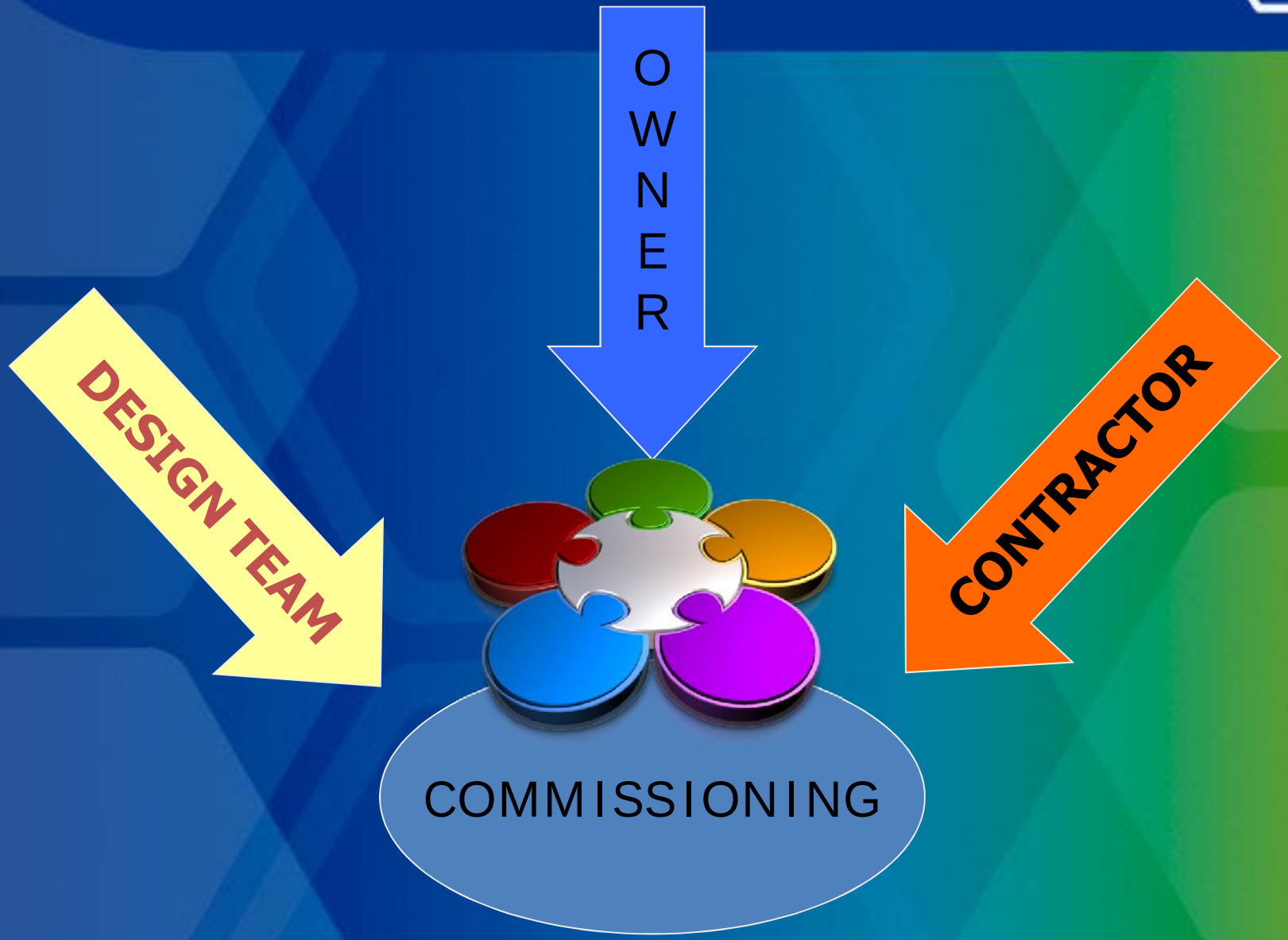


(note: CPMP is a "process management" certification)

Sample Exam is created-CPMP

www.ashrae.org/certification

Commissioning Builds Relationships



What is Commissioning?

- *Commissioning is a serious business and necessary task*
- *Lots of definitions out there*

- ***The commissioning process is a means for achieving, verifying, and documenting that the performance of facilities, systems and assemblies meet the owners and designers defined objectives and criteria/project requirements.***

What Commissioning is NOT

- Testing Adjusting and Balancing
- Initial Calibration and check-out process
- Punch listing
- Pre-start-up of systems and troubleshooting
- Contract Administration, Design, or Interpretations
- Routine Inspections
- Design or Construction assistance

!!! Commissioning is "All about the Proof" !!!!

- Talk is cheap
- Its one thing to make statements that the "systems are installed and operating"……
- A whole another thing to be willing (and be required to) to PROVE IT !!

Commissioning "measures, documents, and verifies" that the systems and assemblies are installed and working.

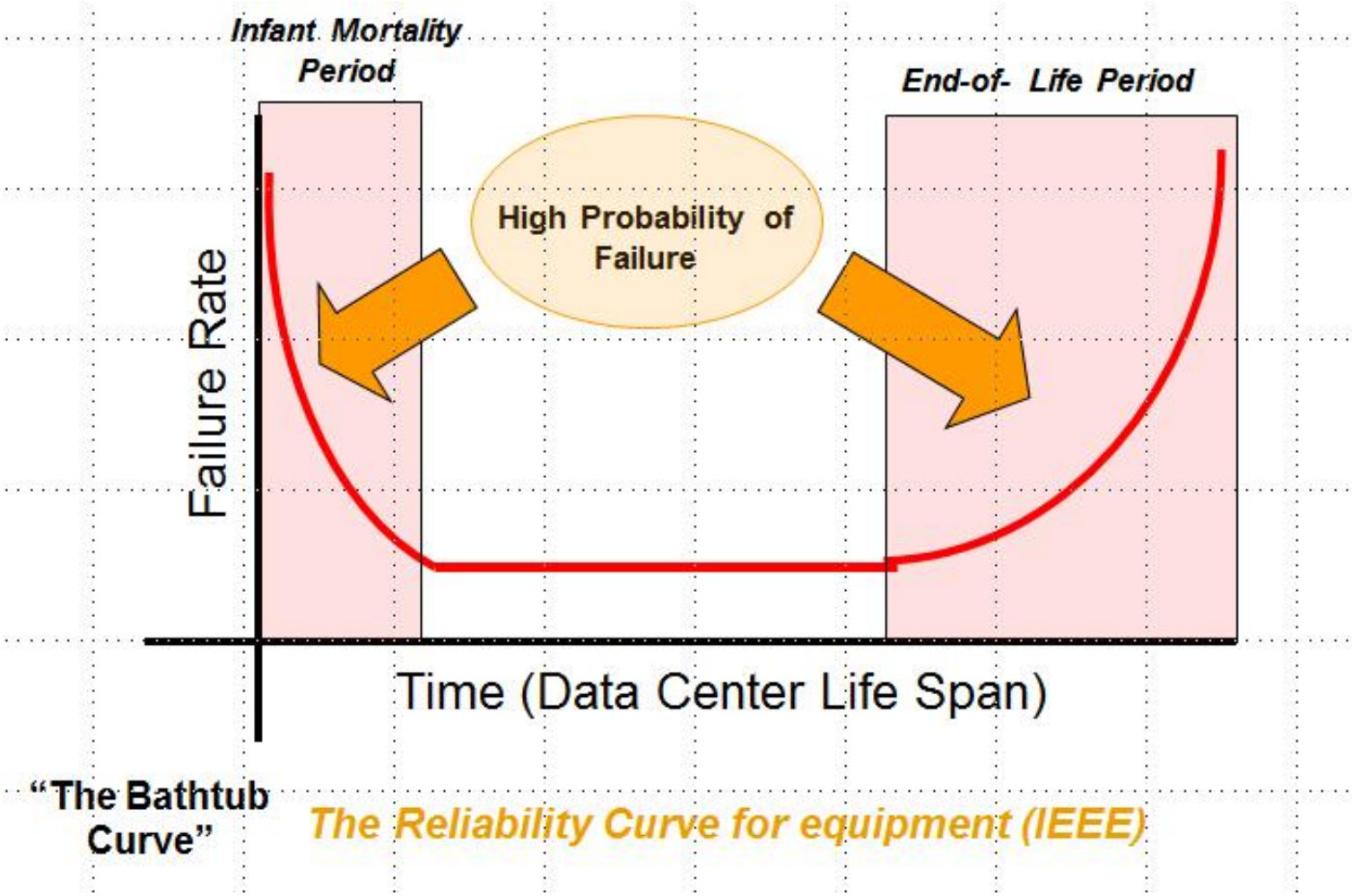
Common Question ?

- **Should I expect my "Design consultants or the Contractor" to commission their own project?**

Answer: { Big fat NO !!}

- Commissioning provides **3rd party independent** supervision, monitoring, testing, and verifications.
  - Building Commissioning is "a quality-focused process for enhancing the delivery of a new and existing building project."
  - People are human and can make honest mistakes, forget things, and sometimes things may just go wrong or just not as planned; those are just some of the situations that commissioning can help with.

There is Always ----- the Predictability of Failure

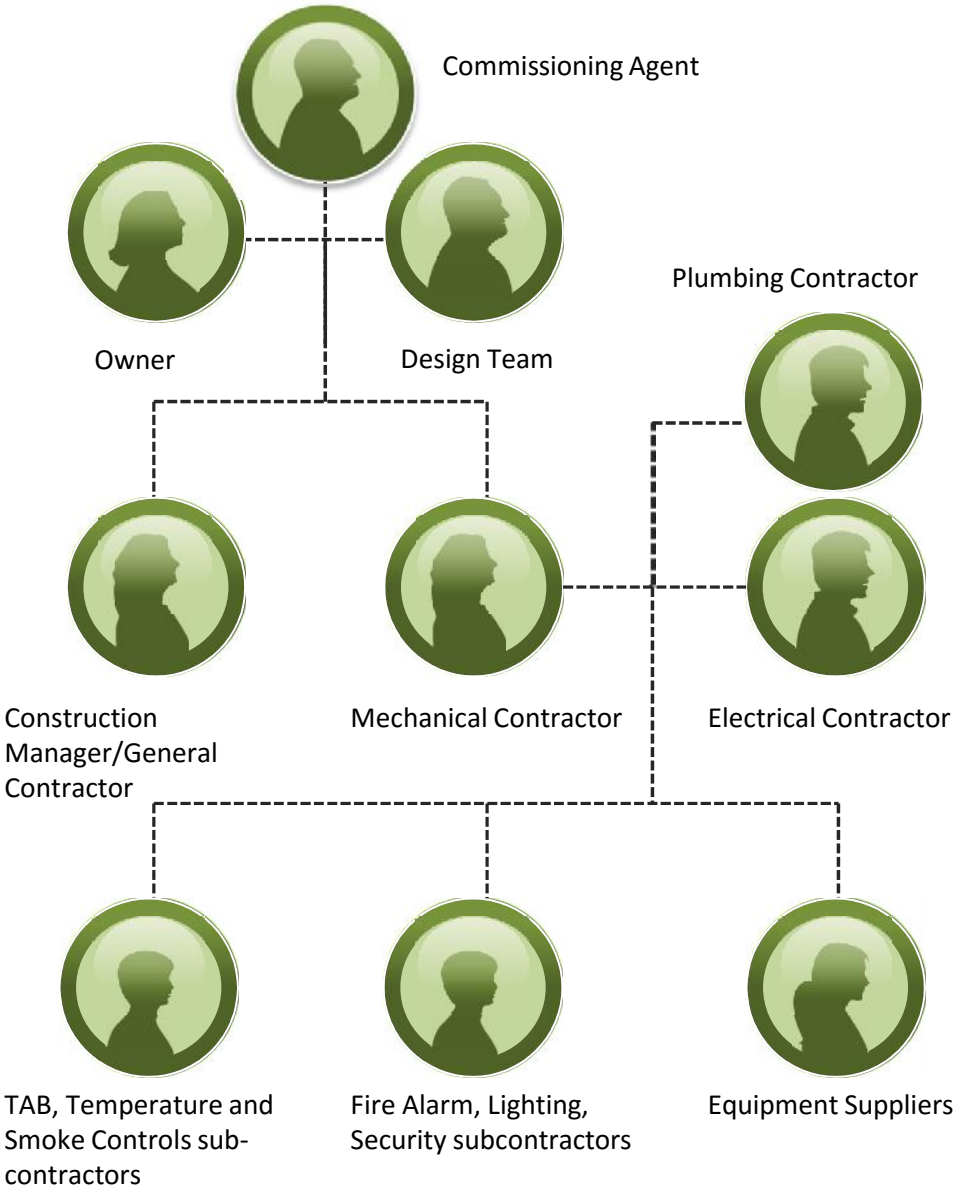


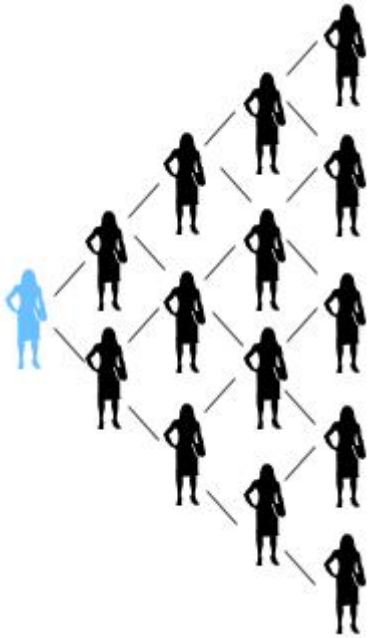
Good News!

Failure is Inevitable but Manageable

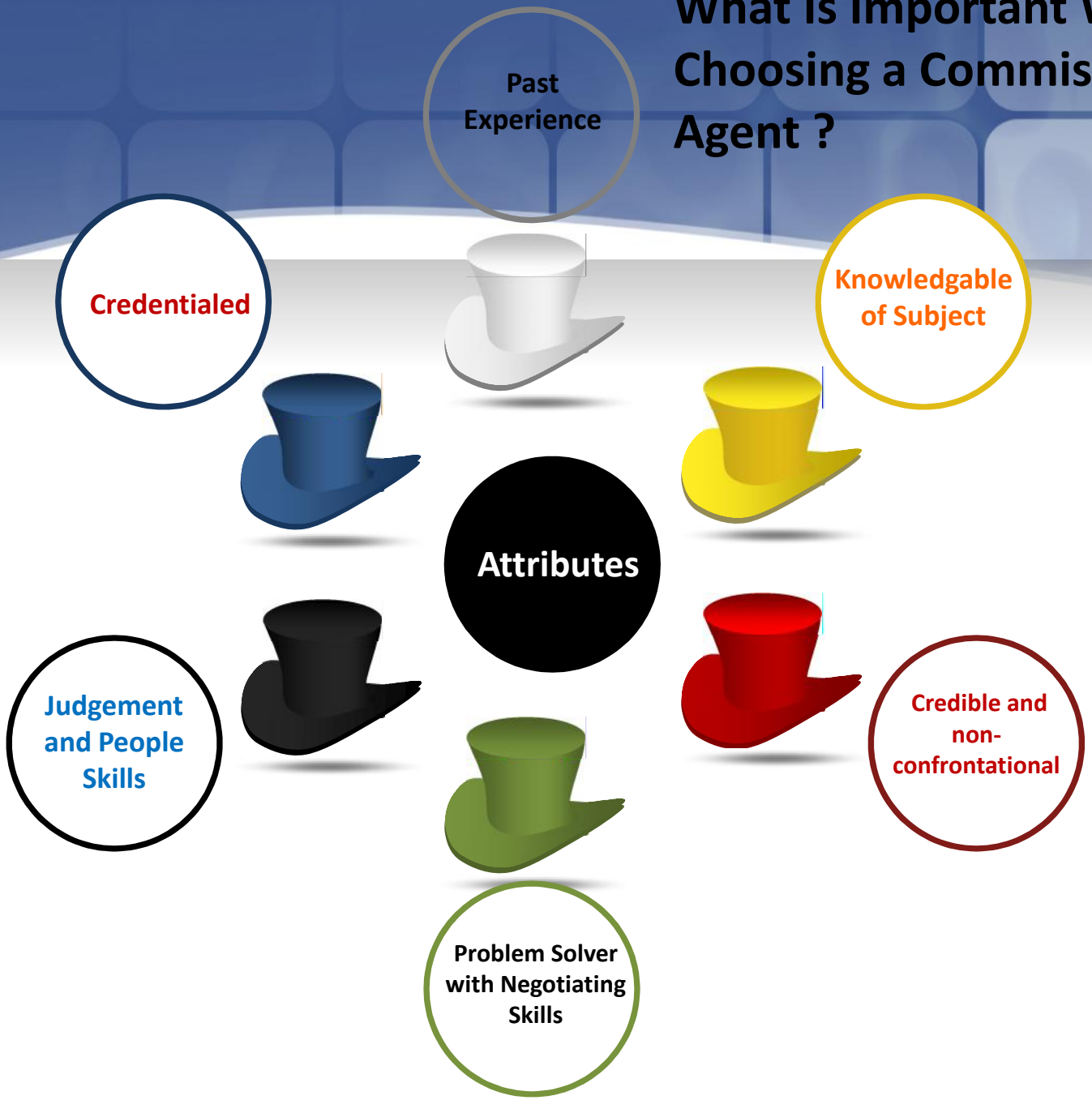
- Commission!
- Test, Document, Train
  - ✓ Map-out Foreseeable Failures
  - ✓ Fix them !
  - ✓ Develop SOP's, MOP's, EOP's (Standard/Maintenance/
  - ✓ Emergency)

Commissioning Team Members





What Is Important When Choosing a Commissioning Agent ?



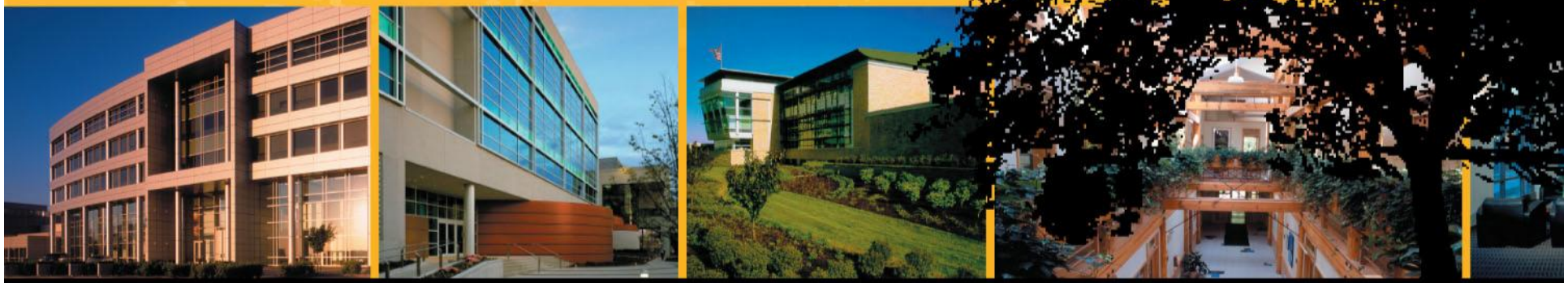
Commissioning Types

COMMISSIONING AND GREEN BUILDINGS

LEED

GREEN BUILDING RATING SYSTEM

U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED)



LEED Energy and Atmosphere

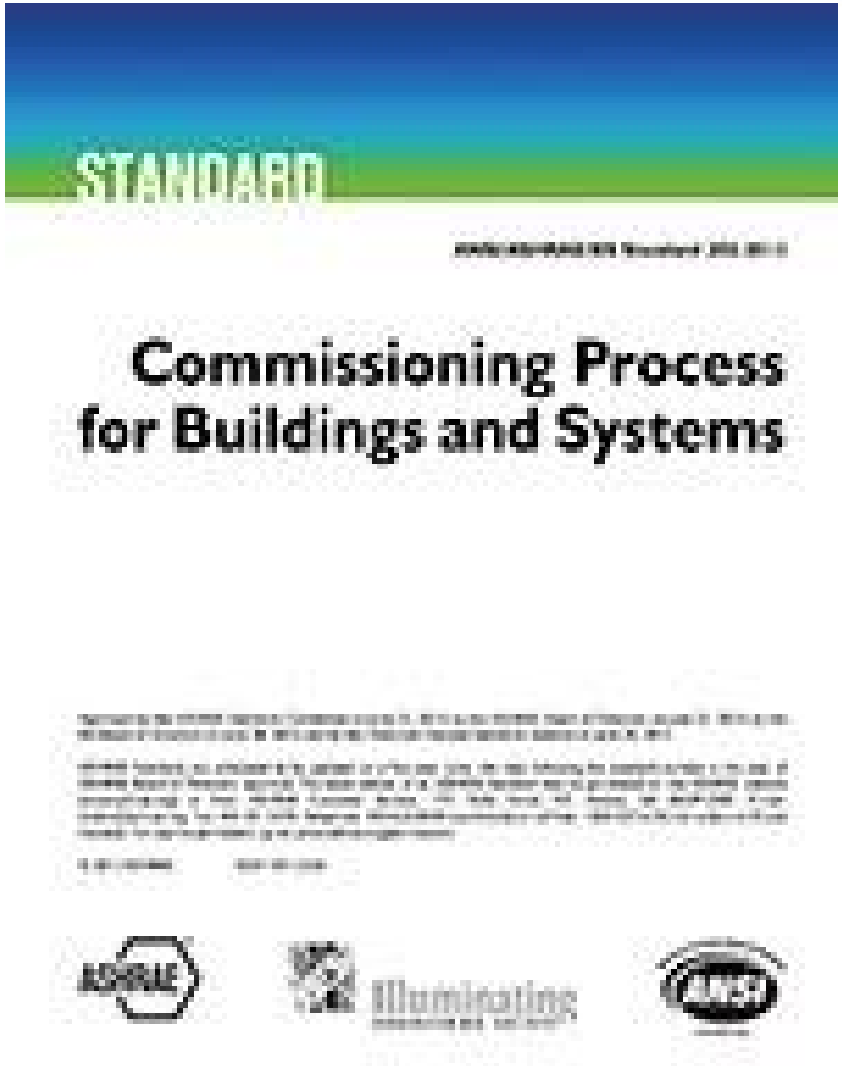
- Fundamental building system commissioning (Prerequisite 1)
- Minimum energy performance (Prerequisite 2)
- CFC reduction (Prerequisite 3)
- Optimize energy performance – ASHRAE 90.1
  - Note: ASHRAE is climate-specific with multiple Florida zones
- Renewable energy
- Additional commissioning
- Ozone depletion
- Measurement and verification
- Green Power

Standard 189.1-Compliance Option for IGCC

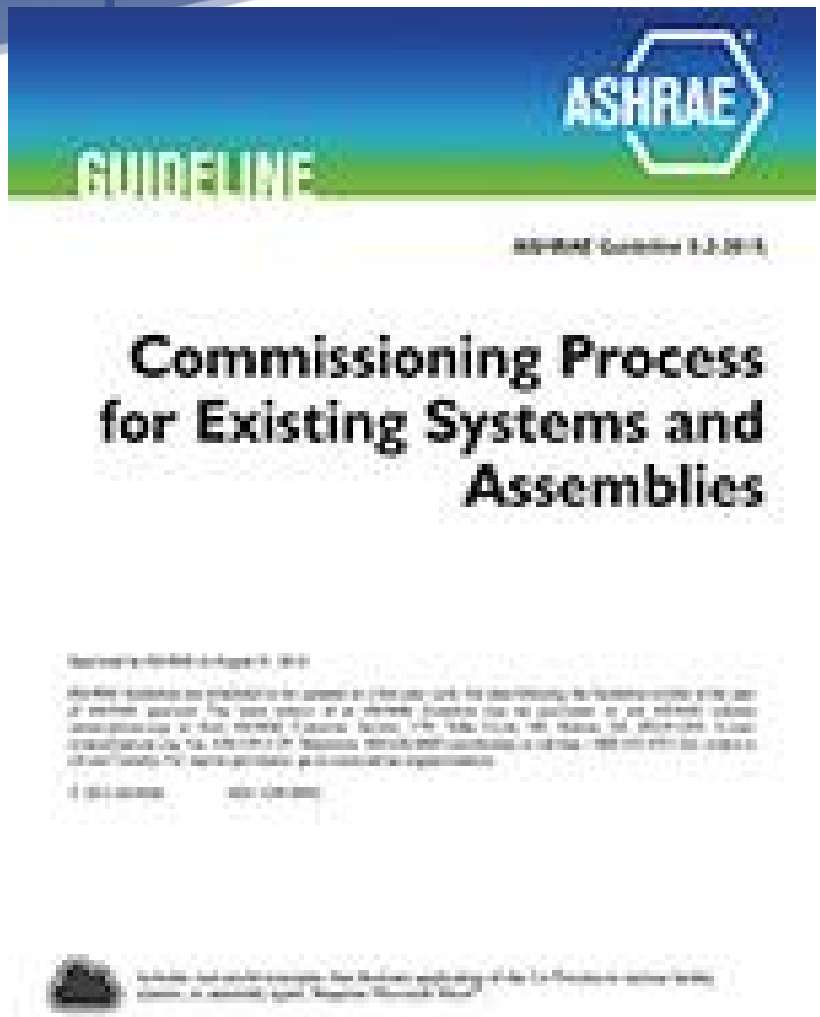
189-Construction and Operation Requirements

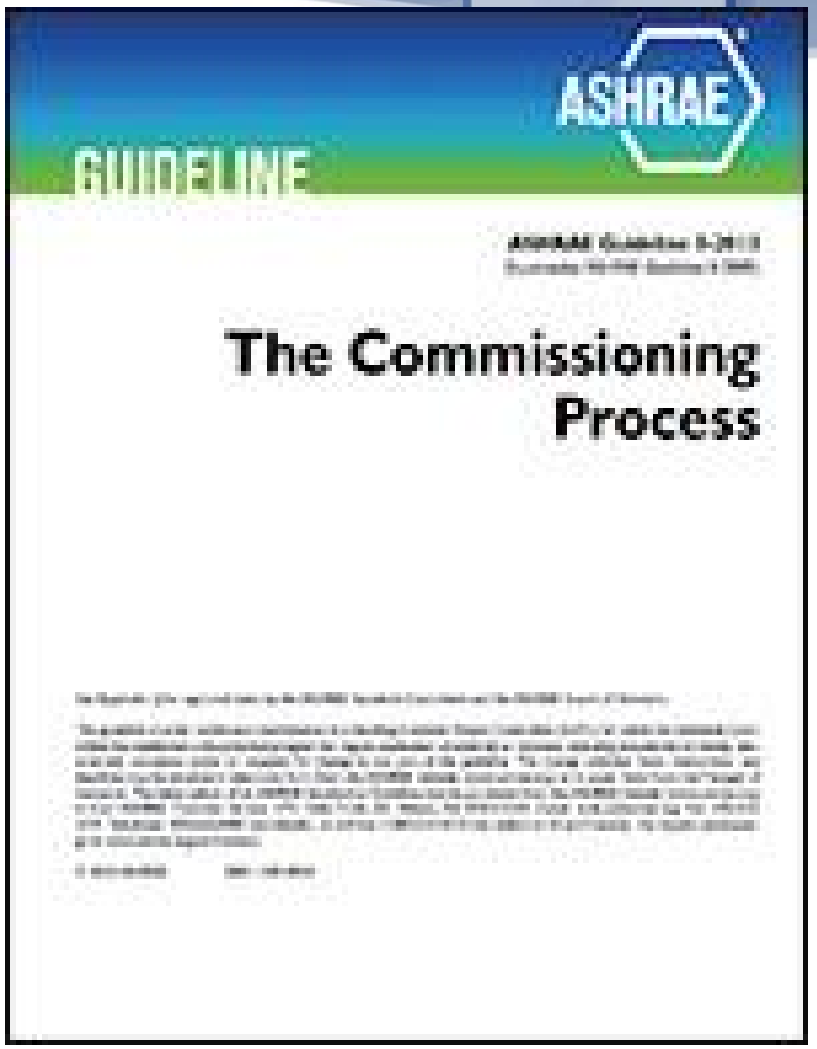
- Acceptance Testing/Commissioning
- IAQ Construction Management Plan
- Plans for Operation and Maintenance
  - High-performance building operation
  - Maintenance
  - Service life
  - Transportation management

Standard 202



Guideline 0.2 and 0





OPR (Definition)

- **Owners Project Requirements**
  - Defines what the owner wants
  - It is the Owners Baseline Document for Building Performance and the Commissioning Process
  - Forms the foundation for the design, construction, and occupancy/operation of the facility
  - Is the basis for the Cx plan and schedule.
  - Is the primary tool for benchmarking the success and quality of the process

ASHRAE Guideline-0
The Commissioning Process

- Guideline 0 is an ASHRAE guideline.
- Development of Guidelines follow procedures similar to those for ASHRAE standards except that :
  - a. committee balance is desired but not required
  - b. an effort is made to achieve consensus but is not required
  - c. guidelines are not appealable
  - d. guidelines are not submitted to ANSI
- Guidelines are not minimum level documents ; they have freedom to offer "better and best practices"

ASHRAE Guideline-0-2013

Index

ASHRAE Guideline-0-2013 Informative Annexes (1/2)

- A-Guide to Developing Supplementary Technical Guidelines for the Commissioning Process
- B-Commissioning Process flow chart
- C- Cost and Benefits of the Commissioning Process
- D-Commissioning Process Documentation Matrix
- E- Commissioning Process Request for Qualifications
- F- Roles and Responsibilities
- G- Commissioning Plan
- H- Acceptance Plan

ASHRAE Guideline-0-2013 Informative Annexes (2/2)

- I-Owners Project Requirements Workshop Guidance
- J-Owners Project Requirements
- K-Basic of Design (BOD)
- L-Specifications
- M-Construction checklists
- N-Quality based sampling examples
- O-Systems Manual
- P-Training Manual and Training needs
- Q-Addenda Description Information

Common Annexes (to Standard 202-2012 to Guideline 0)

(202)	(GL-0)
A– Commissioning Process Documentation Matrix	D-Commissioning Process Documentation Matrix
B – Quality Based Sampling Process	N-Quality based sampling examples
D – Owner's Project Requirements	J-Owners Project Requirements
E – Commissioning Plan	G- Commissioning Plan
F – Basis of Design	K-Basis of Design (BOD)
G – Commissioning Specifications	L-Specifications
L – Systems Manual	O-Systems Manual
M – Training Plans and Records	P-Training Manual and Training needs

What is ASHRAE Guideline-0-2013

- **The latest version of Guideline 0 continues to demonstrate the best practices for applying the whole building principles of the commissioning quality process in facility elements.**
- **Guideline 0 outlines the process for achieving, validating, and documenting the performance of the facility elements in meeting the defined objectives and criteria of the owner. This quality process extends through all phases of the new or major renovation projects from predesign to owner occupancy and operation with tasks during each phase to ensure verification of design, construction, and operator training; meeting the owners project requirements (OPR).**
- **Guideline 0 describes the overall commissioning process in providing a uniform, integrated, and consistent approach for commissioning facilities.**

Purpose: ASHRAE Guideline-0-2013

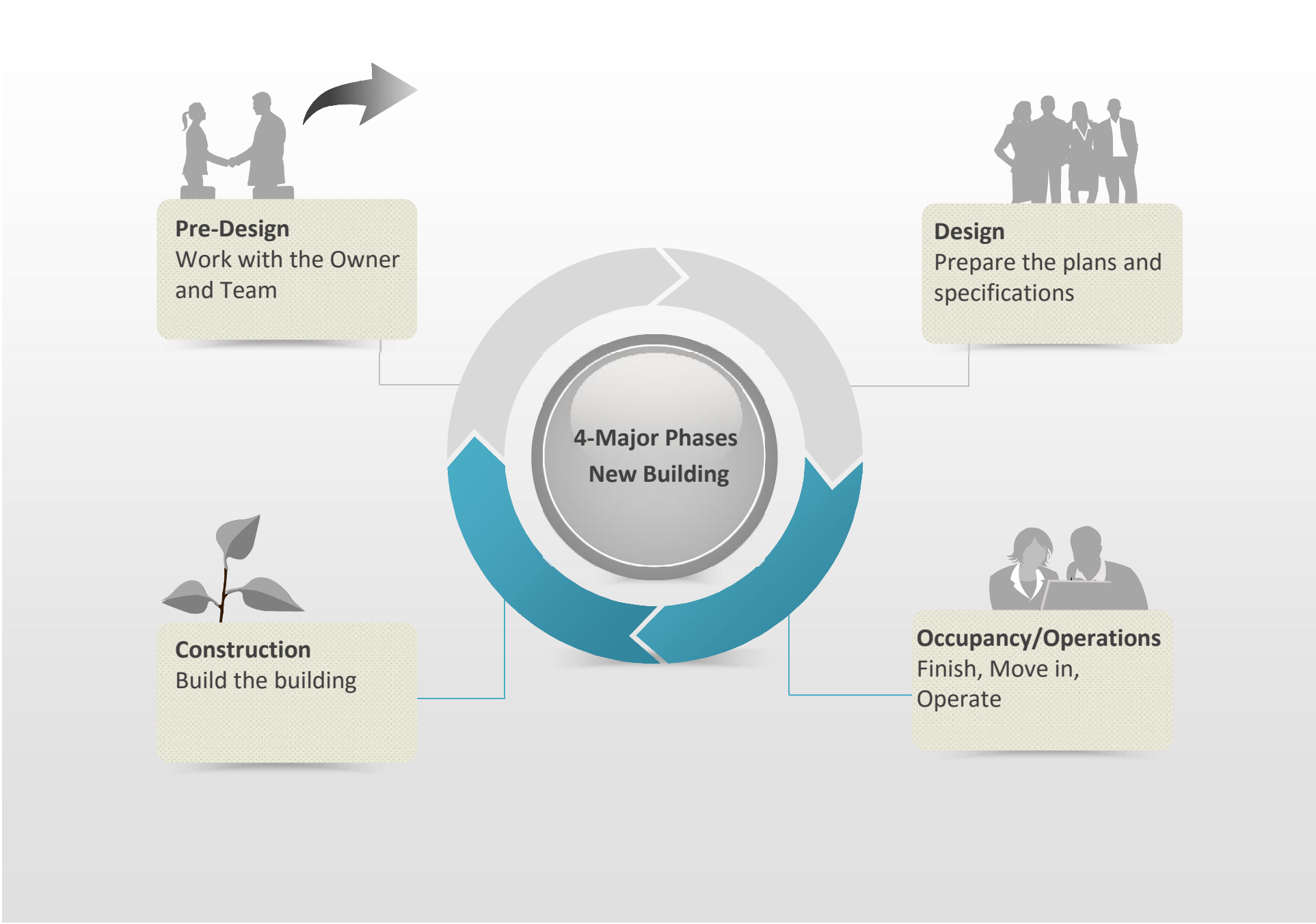
- The Purpose of the guideline is to describe the Commissioning Process capable of verifying that a facility and its systems meet the Owners Project Requirements (OPR).

- [Guideline-0 is for use with new buildings note: Guideline 0.2 is for existing buildings]

Scope: ASHRAE Guideline-0-2013

- Scope: The procedures, methods, and documentation requirement in this guideline describe **each phase** of the project delivery and the associated commissioning process from the predesign through occupancy and operation, without regard to specific elements, assemblies, or systems, and provide the following:
  - **Overview of commissioning process activities**
  - **description of each phase processes**
  - **requirements for**
    - **acceptance of each phase**
    - **documentation of each phase**
    - **training of O&M personnel**
- These Commissioning Process guideline procedures include the Total Building Commissioning Process (TBCxP) as defined by the National Institute of Building Sciences (NIBS) in its Commissioning Process Guideline 0.

Phases of New Building/Major Renovation Commissioning



Highlights of the ASHRAE Guideline -0-2013

- **Predesign Phase : (page ½)**
  - **Predesign is the preparatory phase of the project delivery process in which the OPR is developed and defined.**
  - ❖Cx Team is formed to oversee, implement, and accomplish the Cx process.
  - ❖Develop the OPR
  - ❖Develop the scope and formal for the systems manual
  - ❖Identify the scope and budget for the Cx process

Highlights of the ASHRAE Guideline -0-2013

- **Predesign Phase : (page-2/2)**
  - ❖Develop the initial Cx plan
  - ❖Acceptance of the predesign Cx process scope
  - ❖Establish Issues and Resolution Log Procedures
  - ❖Establish format for Cx progress reports
  - ❖Establish format for Training Plan
  - ❖Reconcile conflicting technical and project requirements and resolve within the commissioning team
  - ❖Review and use of “lessons learned” from previous projects

Highlights (continued) Guideline -0

- **Design Phase : (page ½)**
- **During the design phase of the project delivery process the OPR is applied to the construction documents.**

❖ (BoD) Basis of Design is created that clearly conveys the assumptions made in developing a design solution that fulfills the intent and criteria in the OPR document.

❖ Narrative descriptions of facility systems and assemblies are developed and included in the BoD and the Cx plan is expanded to include the details of the Construction and Occupancy/Operations phase activities.

❖ Cx Team works to verify that the construction documents meet and properly convey the OPR

❖ Establish milestones to be incorporated into the schedule

❖ Resolve Design issues before continuing with Design issue of documents.

Highlights (continued) Guideline -0

- **Design Phase : (page 2/2)**

❖ Updates the Cx plan to include systems and assemblies to be verified and tested, roles and responsibilities of Cx team members, and the Construction and Occupancy/Operations Phase documentation, procedures, reporting, communication protocols, process, and formats.

❖ Developing Cx process activities for inclusion into construction documents, such as submittal review, site visits and meetings, checklists, functional testing, issues and resolution logs, costs for Cx testing and verification activities and follow-up activities.

❖ Updating the scope and format of the project system manual

❖ Defining training requirements

❖ Performing commissioning-focused design review

❖ Acceptance of design phase process activities

Highlights (continued) Guideline 0

- **Construction Phase : (page ½)**
- **During the construction phase of the project delivery process, systems and assemblies are installed, inspected, tested and placed into service to meet the owner project requirements.**

❖ Work to verify that the systems and assemblies are installed in a manner to achieve the OPR

❖ Updating the OPR-Owners Project requirements

❖ Updating the Cx plan

❖ Verifying the submittals meet the OPR

❖ Developing the detailed test procedures and data forms

❖ Issue checklists to contractor(s) and major equipment suppliers

❖ Perform Functional Performance Tests

❖ Verifying that systems an assemblies comply with the OPR

Highlights (continued) Guideline 0

- **Construction Phase : (Page 2/2)**

❖ Accomplish Periodic Site visits and meetings to verify compliance with the OPR and contract documents

❖ Maintain Records of Commissioning work

❖ Maintain Issues and Resolution Logs to commissioning team members

❖ Developing and facilitating the systems manual with commissioning team

❖ Verifying and facilitating the training of the owner operation and maintenance personnel and occupants

❖ Insuring that the trainers are experienced in what they are training about.

❖ Acceptance of Construction phase Cx process activities

Highlights (continued) Guideline 0

- **Occupancy/Operations Phase: (page ½)**
- **The Occupancy/Operations phase of the project delivery process begins at substantial completion, and continues through the end of the contractual warranty/correction period (and ideally though-out the life of the facility).**

❖ Using the product knowledge and experience to minimize contractor callbacks

❖ Providing on-going guidance on operations and maintenance to achieve the objectives of the OPR

❖ Completing the seasonal testing of facility system and assemblies

❖ Conduct periodic performance evaluations of facility systems and assemblies

❖ Verify systems and assemblies meet updated OPR

Highlights (continued) Guideline 0

- **Occupancy/Operations Phase: (page 2/2)**

❖ Deferred seasonal training for systems and assemblies that got deferred.

❖ Update final commissioning report, with information not available at the end of the Construction phase.

❖ Updating of the OPR and BoD for changes made during warranty period.

❖ Update the final Systems Manual with added information.

❖ Migration into the "On-going Cx Process"

❖ Documenting lessons learned from applying the Cx process for application to the next projected of the Occupancy/Operations phase activities

PREVIEW (BRIEF) ASHRAE GUIDELINE 0.2 COMMISSIONING OF EXISTING BUILDING SYSTEMS AND ASSEMBLIES

Existing Building and On-going Commissioning Phases (GL-0.2)

Guideline-0.2-2015 The Commissioning Process for Existing Systems and Assemblies

- Chapter-1 Purpose
- Chapter-2 Scope
- Chapter-3 Definitions
- Chapter-4 Process Overview
- **Chapter-5 Multiple Facility Planning**
- **Chapter-6 Assessment**
- **Chapter-7 Investigation**
- **Chapter 8 Implementation**
- **Chapter 9 Hand-off**
- Chapter 10 On-going Commissioning
- + Informative Annex A-O

The Existing-Building Commissioning Process (EBCx)

- **The existing building commissioning process is used by owners and/or other facility decision makers to optimize the operation of their facilities and systems for their specific Current Facility Requirements (CFR).**
- The process is used to plan the facility operation programs and goals and then compare existing conditions and operations to those goals.
- This evaluation allows the owner to determine if another or the existing conditions require or warrant further attention.
- The process is also used to identify the causes of existing problems and shortfalls in achieving the CFR and to determine methods for resolving those problems.

The Existing-Building Commissioning Process (EBCx)

- Most importantly, the process provides the owner with a logical decision-making approach to evaluate, compare, prioritize, and implement recommendations for making their facilities operate as efficiently and effectively as is economically feasible given the owners specific requirements and resource's.
- When physical changes to the facility are requires as a consequence of the ECBx process, all such modification must meet applicable codes pertaining to the work being preformed.
- Additionally, following the process allows owner to maintain the benefits of these implemented recommendations over time.

The Existing-Building Commissioning Process (EBCx)

- **The Purpose of the guideline is to describe the procedures, methods, documentation requirements and physical activities of the commissioning process for existing building systems and assemblies using principles developed in ASHRAE Guideline 0, The Commissioning Process.**
- The scope of this guideline applies to existing buildings, systems, and assemblies.

The Existing-Building Commissioning Process (EBCx) -Phases

Multi-Facility Planning Phase	Main activity	Deliverables
	• Assemble EBCx Program Planning team	o EBCx Program Plan
	• Document EBCx Program Goals and Objectives	
	• Assemble Information and rank facilities	
	• Develop EBCx Program Plan	
	• Obtain Owner Acceptance and Decision to Proceed	

The Existing-Building Commissioning Process (EBCx) -Phases

Assessment Phase	Main activity	Deliverables
	• Define Owner EBCx Goals and Objectives	o CFR
	• Select the initial EBCx team	o EBCx Plan
	• Develop the Current Facility Requirements (CFR)	o EBCx Report, including Assessment Report
	• Develop the EBCx Plan	o Updated EBCx Program Plan
	• Establish the Systems Manual Outline	
	• Perform Assessment	
	• Initiate EBCx report with Assessment Report	
	• Obtain Owner Acceptance and Decision to Proceed	

The Existing-Building Commissioning Process (EBCx) -Phases

Investigation Phase	Main activity	Deliverables
	• Update EBCx team	o Updated EBCx Plan
	• Conduct Investigative Planning Meeting	o Updated EBCx Report including the addition of the Investigation Report
	• Review Facility Documentation	
	• Update EBCx Plan	
	• Perform Site Investigation and Testing	
	• Perform Issues and Opportunities Analysis	
	• Update EBCx Report with Investigative Report	
	• Obtain Owner Acceptance and Decision to Proceed	

The Existing-Building Commissioning Process (EBCx) -Phases

Implementation Phase	Main activity	Deliverables
	• Select Recommendations to Implement	o Updated EBCX plan
	• Implement Capital Projects	o Updated CFR
	• Update EBCx Team	o Updated EBCx Report including the addition of the Implementation Report
	• Incorporate Informal Training	o Update system manual material
	• Update EBCx Plan	
	• Implement Recommendations	
	• Verify Complete Recommendations and Performance	
	• Update the EBCx Documentation	
	• Obtain Owner Acceptance and Decision to Proceed	

The Existing-Building Commissioning Process (EBCx) -Phases

Hand-off Phase	Main activity	Deliverables
	o Develop the OCx Team	o EBCx Report, including the addition of the Lessons Learned report
	o Assemble Systems Manual	o Systems Manual, including facility guide
	o Train Facility Personnel	o OCx Plan
	o Verify Training Effectiveness	
	o Conduct Lessons-Leaned Workshop	
	o Finalize EBCx Report	
	o Provide Project Documents to Owner	
	o Obtain Owner Acceptance and Decision to Proceed	

The Existing-Building Commissioning Process (EBCx) -Phases

Ongoing Commissioning (OCx) Phase	Main activity	Deliverables
	• Assemble OCx Team	o Updated OCx Plan
	• Update the OCx Plan	o Updated CFR
	• Verify Achievement of the CFR	o Updated Systems Manual
	• Investigate Unacceptable Performance or Outcome	o OCx Report
	• Implement Recommendations	
	• Update Systems Manual	
	• Update Facility Personnel Training	
	• Write/Deliver OCx Report	
	• Obtain Owners Acceptance	

Commissioning Process for Buildings and Systems

ASHRAE Standard 202-2013

ASHRAE 202 is a Process Standard

- Commissioning 202 is a process standard, so it can be adapted to all processes
- Can be used for many things
  - HVAC-R
  - Electrical
  - Envelope-Enclosure
  - Energy
  - IAQ-IEQ
  - CIVIL
  - IT-Telecommunications
  - -etc……

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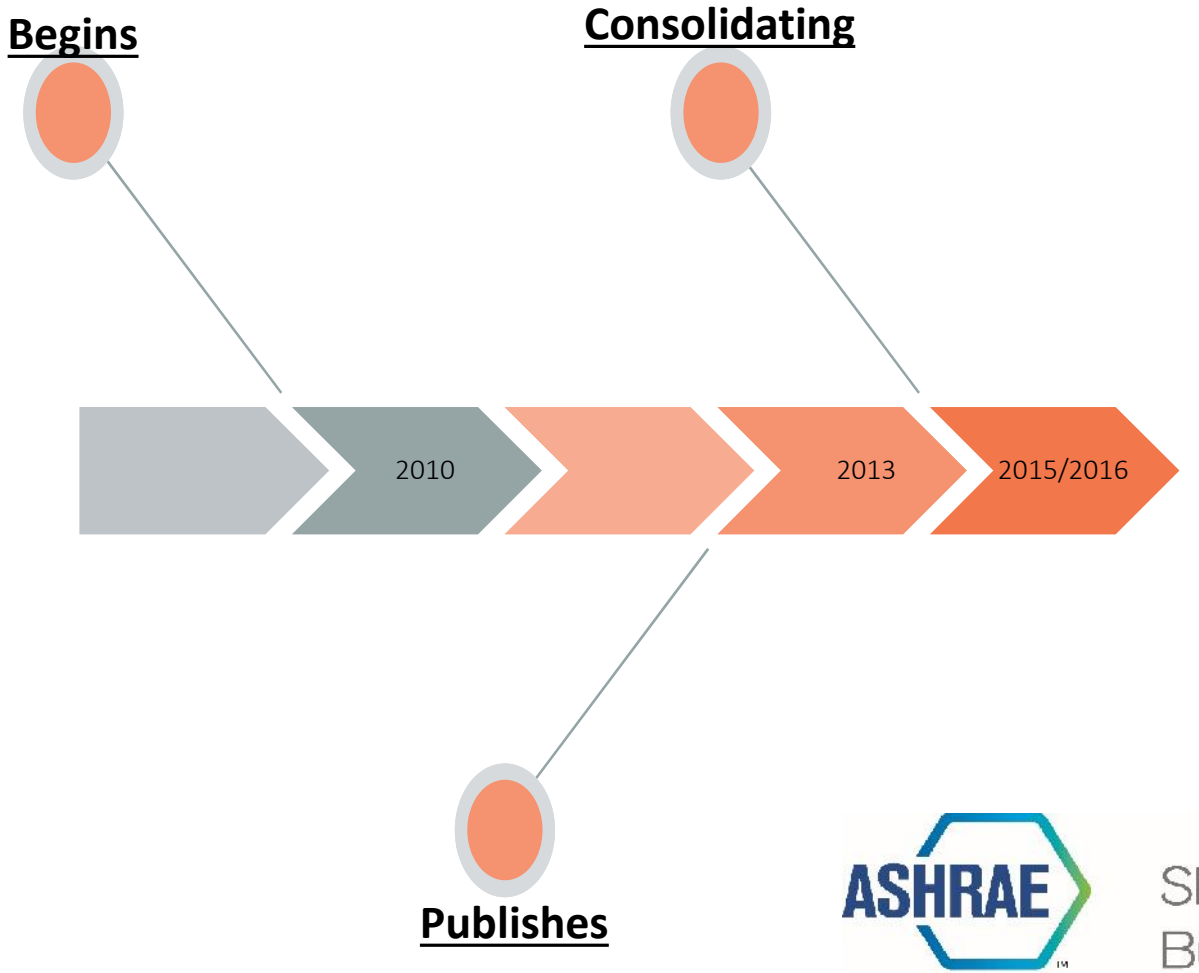
History and Progress of ASHRAE Standard 202-2013

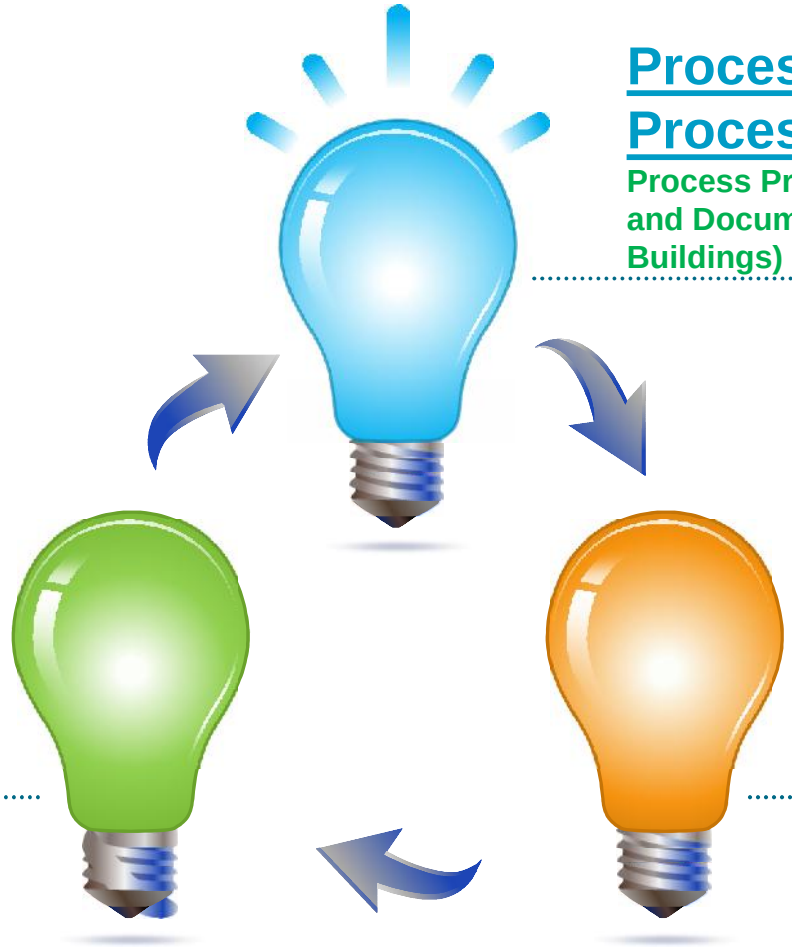


Standing Standard Project Committee : Commissioning Process for Buildings and Systems ASHRAE Standard 202

ASHRAE

Shaping Tomorrow's Built Environment Today

- **Commissioning Standard 202-<u>What is it?</u>**



<u>Process,Process, Process Document;</u>

Process Procedures, Methods and Documentation (New Buildings)

<u>Minimum Requirements</u>

Uses ASHRAE Guideline 0 as a basis guideline, process activities, documentation, acceptance criteria

<u>Consensus Development;</u>

protects integrity, acceptability, and value

Standard 202: What it IS NOT ?

- **IT DOES NOT:**
  - Define process for existing building projects **(next page)
  - Define specific procedures (it's a process document)
  - Define qualifications of commissioning providers
  - List building size, type or usage or list process variations for these
  - List systems or assemblies requiring commissioning
  - Include enforcement provisions

Notes about “existing system commissioning”

- Existing building are “complicated”…….
- Existing building commissioning is being developed under a different document;
  - Systems are not new and not covered under a new system warranty
  - Typically being maintained under a facility M&O program
  - Repairs are handled with work orders
  - Buildings are occupied so special care is taken to perform functional performance testing
  - Investigations of issues can take more time and resources and can involve multiple building systems and departments

ASHRAE Standard 202 Organization

- **PROCESS: listed by 13 functional steps and (note: not by project phase)**
  - **Each of 13 functional activity steps has deliverables**
- **The main body of the Standard has 17 chapters (Mandatory language)**
- **16 "Informative Annexes" explaining the deliverables. (non-mandatory language)**

Standard 202 Chapters

1. Purpose
2. Scope
3. Definitions
4. Utilization
5. Initiating the Commissioning Process
6. Owner's Project Requirements
7. Commissioning Plan
8. Basis of Design
9. Contractor, Supplier, and Manufacturer Commissioning Requirements
10. Design Review
11. Commissioning Submittal Review
12. Construction Observation and Testing
13. Issues Documentation and Resolution
14. Systems Manual
15. Training
16. Post Occupancy Operation
17. Commissioning Report

Standard 202
Annexes (Informative)

- A – Commissioning Process Documentation Matrix
- B – Quality Based Sampling Process
- C – Initiating the Commissioning Process
- D – Owner's Project Requirements
- E – Commissioning Plan
- F – Basis of Design
- G – Commissioning Specifications
- H – Design Review and Report
- I – Submittal Review and Report
- J – Construction Observation and Testing Checklists and Reports
- K – Issues and Resolution Log
- L – Systems Manual
- M – Training Plans and Records
- N – End of Warranty Commissioning
- O – Commissioning Report
- P – Commissioning Information

Chapter 3

DEFINITIONS

- 27 Updated Definitions (from Guideline-0-2005)
- 7 New Definitions
  - Mostly on Design Review and Documentation
- Covers New (and Existing) Buildings for Definitions
  - Establishes Base for Other Documents on Commissioning

Main Sections

- **(Important to note, as we read the chapters:)**
  - **Introduction**
  - **Requirements**
  - **Acceptance**

Chapter 4

UTILIZATION

- Establishes Chapter format using sections for Introduction, Requirements and Acceptance
- Provides Outline for Commissioning Process
- Establishes Minimum Activities for the application of the Cx process in the design, development, construction, operation, and modification of physical buildings, systems, and assemblies.
- Lists Deliverables for Each Activity

-
- Acceptance Required for Each Activity
  - Important-In 202 CxA is not required to “accept” design or construction for owner or jurisdiction.

Commissioning Process (13)

(A part of Chapter 4)

Activity		Deliverable
1. Initiate Commissioning Process	↓	Roles and Responsibilities
2. Project Requirements	↓	Owner's Project Requirements (OPR)
3. Develop Commissioning Plan	↓	Commissioning Process Plan (CxP)
4. Design Approach to Requirements (BOD)	↓	Basis of Design

Commissioning Process
(A part of Chapter 4)

Activity		Deliverable
5. Set Contractor Cx Requirements	↓	Cx Specifications
6. Design Review	↓	Design Review Report
7. Review Submittals	↓	Submittal Review Report
8. Observation & Reports	↓	Construction Checklists & Testing

Commissioning Process

(A part of Chapter 4)

Activity		Deliverable
9. Issues Resolution	↓	Issues and Resolution Log
10. Assemble Systems Manual	↓	Systems Manual
11. Conduct Training	↓	Training Plans and Records
12. Post Occupancy Operation	↓	End of Warranty Cx Report
13. Assemble Commissioning Report	↓	Commissioning Report

Chapter 5

INITIATING THE COMMISSIONING PROCESS

- **Owner's Responsibilities**
  - Determine the scope of the Cx plan
  - Reviews and Approvals
  - Select Systems and Assemblies to be Commissioned
  - Selecting Project CxA and Commissioning Team
  - 'Agreement' required for high level strategic activities and budget

Chapter 6

OWNER'S PROJECT REQUIREMENTS

- **Owners Baseline Document for Building Performance and the Commissioning Process**
- **Forms the foundation for the design, construction, and occupancy/operation of the facility**
- **Is the basis for the Cx plan and schedule.**
- **Primary tool for benchmarking the success and quality at all phases of the project delivery from inception throughout the life of the facility**
- **Updated as Project Evolves through its phases**

Chapter 7

COMMISSIONING PLAN

- **Written Plan (created as soon as possible); provides organization, documentation, insight, requirements, and tools, to evaluate and document that the design, construction and operation of the project or facility, system, or assembly that meets the OPR.**
- **Includes: - Project Specific Cx Process Description**
- **List of Systems and Assemblies to be Commissioned**
- **Roles and Responsibilities**
- **Schedules for Commissioning activities**
- **Checklists and Functional Performance Tests**
- **Process for Resolving Problems and Deficiencies**
- **Ideas to facilitate Training and Systems manual execution**

Chapter 8

BASIS OF DESIGN

- **Written document that provides detailed information about the Designer's Approach to meeting the Owner's Project Requirements, and to provide with a better understanding of design issues and secure the owners approval of critical design decisions.**
  - **Basic Design Information and Assumptions Defined**
  - **Platform for Review and Response during Project**
  - **Updated and expanded as Project Evolves**

Chapter 9

CONTRACTOR, SUPPLIER, and MANUFACTURER COMMISSIONING REQUIREMENTS

The responsibility of the contractors, subcontractors, manufacturers, major equipment's suppliers, TAB, Control contractors, CxA's (CxP's), etc.

- **Commissioning tasks required in Project Specifications**
- **Commissioning Included in all Contracts**
- **Adequate Documentation required so CxA can perform required duties**
- **Authority given to CxA to execute commissioning duties**

DESIGN REVIEW

Design Review is performed to verify that the contract documents are in Compliance with Owner's Project Requirements

- **Include Commissioned Systems and Assemblies**
- **Complete Review Before Construction**
- **Design Team to Respond to Issues raised**
- **Approved Quality Sampling or Expert Review**

- **Note: Commissioning Design Review is NOT**
  - **PEER Review**
  - **Code Review**
  - **Regulatory Review**

Chapter 11

COMMISSIONING SUBMITTAL REVIEW

This is for construction and/or renovation projects requiring submittal document review in order to verify compliance with plans/specs, the OPR, and Cx plan.

- **Provide comments to the Designer**
- **Covers Commissioned Systems and Assemblies**
- **CxA insures the process is followed**

- **Does Not Replace Designer's Review; CxA review made Concurrent with Designer's record review**
- **CxA does not have authority to make any changes**

Chapter 12

CONSTRUCTION OBSERVATION AND TESTING (IMPORTANT!)

OUTLINES EVALUATION OF SITE VISITS, OBSERVATIONS, AND TESTING.

- **Compliance with OPR, Cx Plan and Construction Documents**
  - **Approved Technical Procedures and Documents for Commissioning Systems and Assemblies**
  - **Kick Off, Scoping, and site Meetings**
  - **Evaluate Equipment, Installation and Performance**
  - **Approved Sampling Process (%?)**
  - **Checklists**
  - **Functional Performance Testing**

“Tools” used in Commissioning”

- “Pre-commissioning” tests done in submittal such as laboratory test statements, etc.
- Checklists
- Site visits and observations
- Issues and Resolution Logs
- Site Meetings
- Mock-ups
- Functional Performance Tests
- Training agendas and curriculum

Chapter 13

ISSUES AND RESOLUTIONS DOCUMENTATION

- List Issues, dates, progress, resolution and responsibilities identified during the Cx process
  - Show open and closed status of items
  - Distribute Issues/Resolution logs to all parties
  - Provide supporting documentation
  - Include Final Issue and Resolution Log in Final Commissioning Report

Chapter 14

SYSTEMS MANUAL

PROVIDES INFORMATION TO THE OWNER FOR USE IN BUILDING OPERATION AND THE TRAINING OF THE PERSONNEL.

- **Collection of Project Documents**
  - **Facility Design and Construction record documents**
  - **Systems and Assemblies Information submittals**
  - **M&O (Maintenance & Operation) documents**
  - **Training documents**
  - **Issues and resolution logs**
  - **Checklists and Functional Performance Testing reports**
  - **Final Commissioning Report**
- **Used to understand, and operate the buildings' equipment, systems and assemblies.**
- **Repository of design, construction, and testing information, including updates and correction to systems and assemblies as they occur during construction.**

Chapter 15

TRAINING

THE O&M STAFF WILL BE TRAINED ON THE SYSTEMS BEING COMMISSIONED IN ACCORDANCE WITH THE OPR, TO OPERATE AND MAINTAIN THE BUILDING SYSTEMS AND ASSEMBLIES.

- **Trains O&M Personnel and Building Occupants**
- **Requires Written Training Plan**
  - **Instructional Requirements/Curriculum**
  - **Locations, classroom, and Facilities to be used**
  - **Instructor Qualifications; specific to the task being trained about**
  - **Agendas for attendees; advance notice given.**
  - **Training materials, handouts, take-aways, M&O info.**
  - **Recording, DVD, audio, video.**
- **Records and Reports Retained**

Chapter 16

POST OCCUPANCY OPERATION

BEGINNING AT SUBSTANTIAL COMPLETION, INCLUDING DELAYED AND SEASONAL TESTING, AND WARRANTY ISSUES.

- Operations During Warranty Period
- Report on Repaired or Replaced Equipment and/or assemblies
- Delayed and Seasonal Testing
- At the end of Warranty:
  - Update OPR and Cx Plan
  - Update Systems Manual and M&O
  - Update Training Report and Documentation
  - Update Issues and Resolution Log

Chapter 17

COMMISSIONING REPORT

SUMMARIZES THE CX PROCESS OVERALL FOR THE BUILDING OPERATION DELIVERY.

- **Compiled Written Summary of Commissioning Process**
  - **Executive Summary**
  - **Commissioning Plan + OPR + BOD**
  - **Interim Progress Reports/ Site visits / Photos**
  - **Design and submittal review reports**
  - **Issue and Resolution Reports + Open items**
  - **Checklists and Functional Performance Testing reports**
  - **Lessons Learned**
  - **Incomplete Issues + Systems and Assemblies NOT meeting OPR or Contract Documents**

Commissioning Process for Buildings and Systems

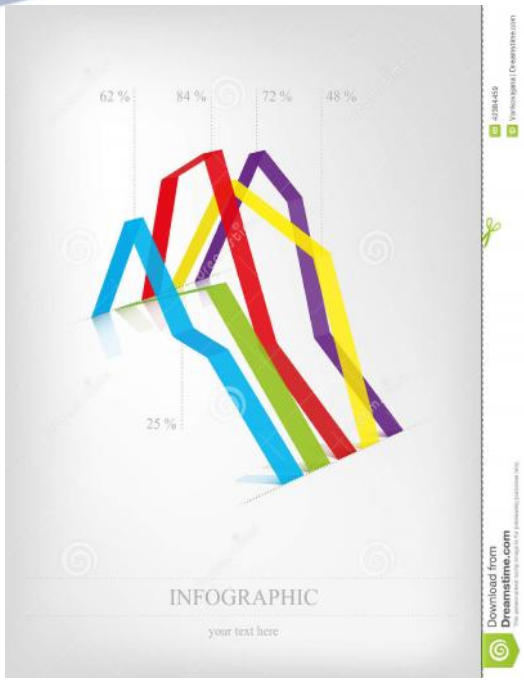
ASHRAE Standard 202-2013

COMMISSIONING USER MANUAL -Future—
Coming Attraction!!-

Proposed Sections…..

1. An Introduction to the Commissioning Process-Strategic Guide to Commissioning
2. The Commissioning Process, Activities and Practices
3. Commissioning Definitions
4. Commissioning Process Documentation – New Construction
5. Commissioning Process Documentation – Existing Buildings
6. System Specialty Commissioning Process Selection
7. Facility Use Commissioning Process
8. Commissioning for Code Requirements
9. CX in Green and sustainability Programs
10. Design Professionals in the Commissioning Process
11. Contractors and Suppliers in the Commissioning Process
12. Selecting and Hiring a Commissioning Provider
13. Reference Documents and Resources

Are you Kidding???

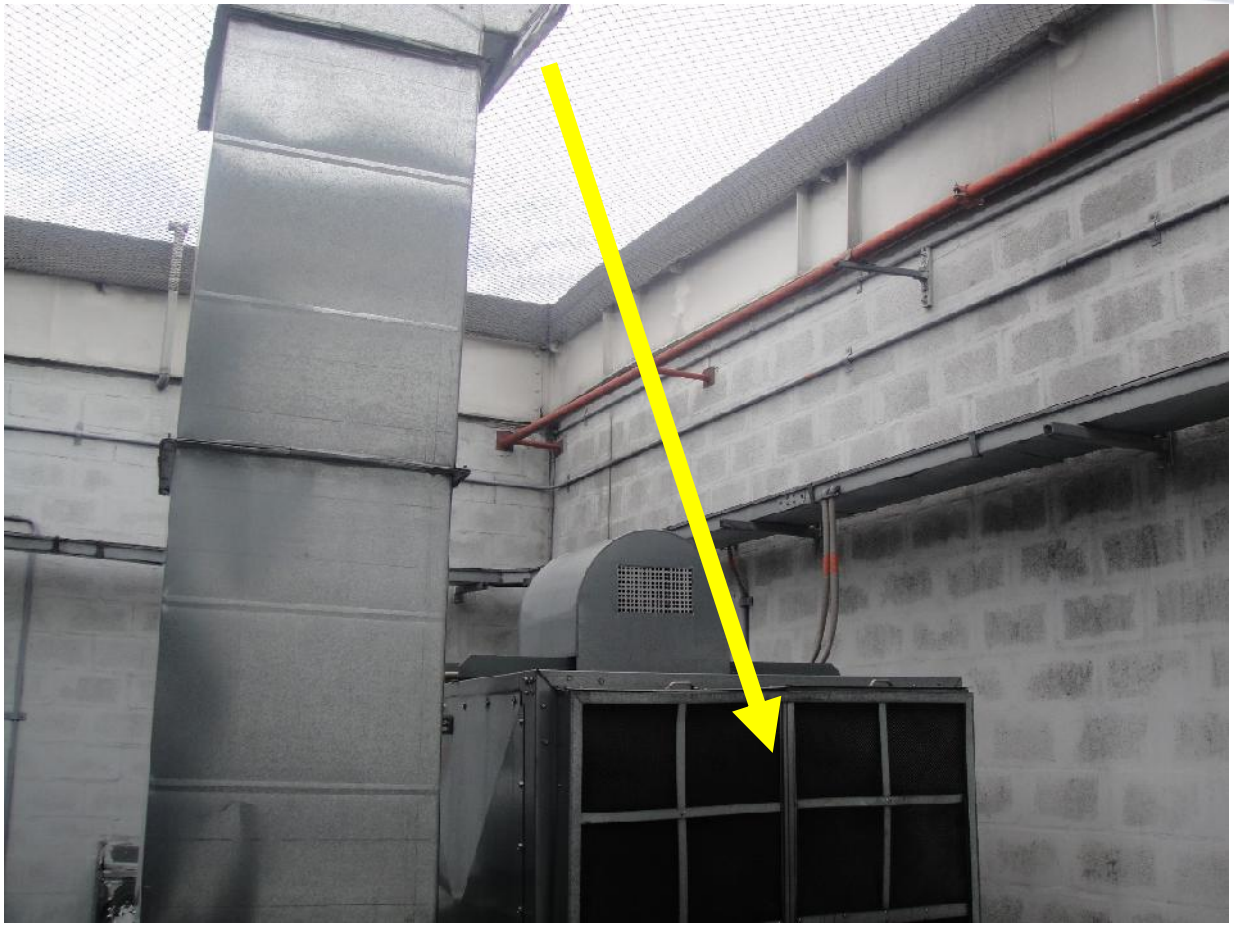


Really ?????

Isolation-Room fan not working

OR Room--Redundant Fans and redundant VFDs---but Single Power source-on Emergency Power

Exhaust duct feeds into OA intake?

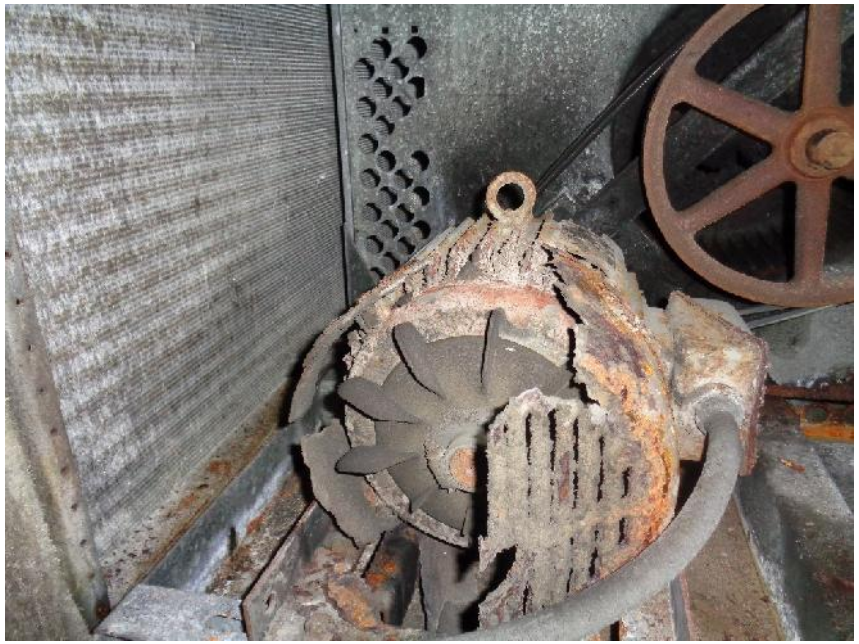


Ducts and Pipes installed too Low

Main Filters behind the Pre-filter

Boiler ‘blows up’ on start up

Fan motor ‘falling apart’ and reheat valve ‘disconnected’ “supposedly” performing dehumidification in hot-humid climate?



Thank you very much for inviting me to Speak about Commissioning……

www.ashrae.org

Ross D. Montgomery, P.E., CxA, CPMP, Fellow ASHRAE

SISTEMAS DE ÁGUA GELADA

PROGRAMA BRASILEIRO DE ELIMINAÇÃO DOS HCFCs
Projeto para o Gerenciamento de Chillers

Apoio Institucional:

ASHRAE Brasil Chapter

ABRAVA
ASSOCIAÇÃO BRASILEIRA DE REFRIGERAÇÃO, AR CONDICIONADO, VENTILAÇÃO E AQUECIMENTO

ABESCO
Associação Brasileira das Empresas de Serviços de Conservação de Energia

ABRAFAC
ASSOCIAÇÃO BRASILEIRA DE FACILITIES

ANPRAC
Associação Nacional dos Profissionais de Refrigeração, Ar Condicionado, Ventilação e Aquecimento

ASBRAV
Associação Sul Brasileira de Refrigeração, Ar Condicionado, Aquecimento e Ventilação

GBC BRASIL

BCxA Building Commissioning Association
BRASIL CHAPTER

SINDRATAR

Execução

SOMAR

Implementação

PNUD
Empoderando vidas.
Fortalecendo nações.

Ministério do Meio Ambiente

Realização

GOVERNO FEDERAL
BRASIL
PÁTRIA EDUCADORA