2016 ENERGY EFFICIENCY EXPO

THE COMMISSIONING PROCESS FOR REFRIGERATION SYSTEMS

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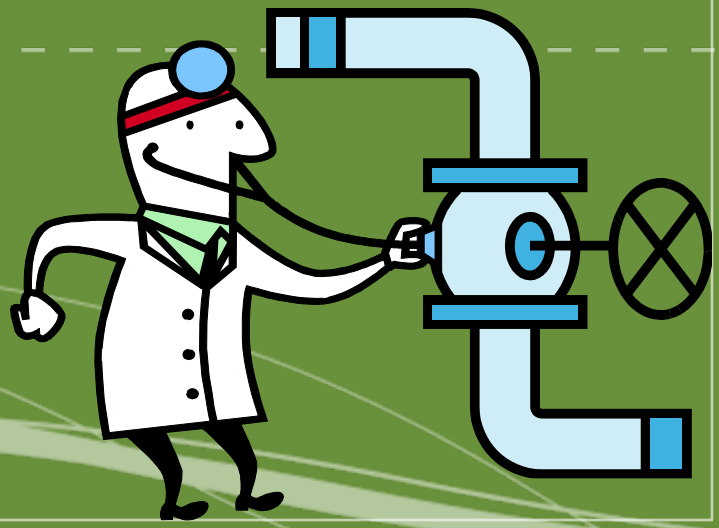


IRC

www.irc.wisc.edu

XCEL ENERGY REBATES

- Xcel Energy offers rebates for **tuning-up existing** commercial refrigeration systems in grocery outlets, convenience stores and other facilities with refrigerated cases.
  - Rebate amount is based on expected energy savings*
  - Maximum rebate is 75% of the Recommissioning tune-up cost

- **Prescriptive rebates** available:
  - DLC-qualified Refrigerated LED case lights $100/door
  - Anti-sweat heater controls $60/door
  - Electronically Commutated (EC) motors $40–$70
  - Close-the-case doors $50/linear foot (cooler) and $75/linear foot (freezer)
  - Zero-loss energy doors $150/door (freezer) and $100/door (cooler)

- **Custom rebates*** up to $400/kW and/or $5/Dth saved for projects not listed above

*Requires preapproval prior to starting project

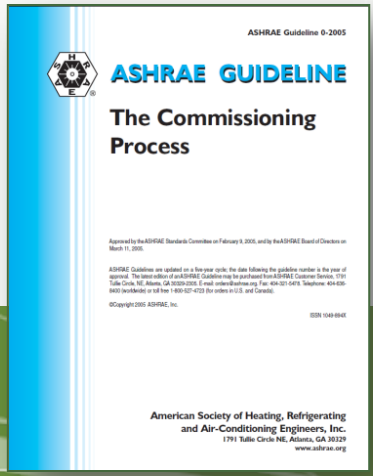
WHAT IS COMMISSIONING?

- ASHRAE Guideline 0: The Commissioning Process

  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.

  – 59 pages including 16 Annex providing samples of schedules, plans and checklist

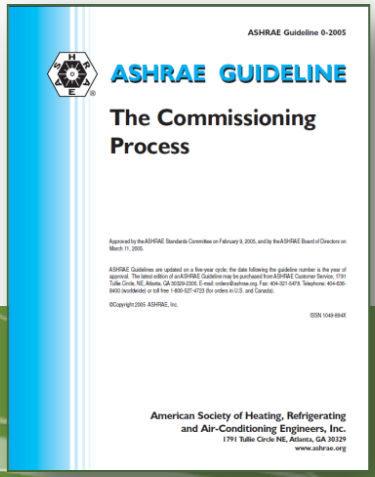
- ASHRAE Guideline 1.1-2007: How to apply the Cx Process to HVAC systems
  – Describes technical requirements for applying Guideline 0



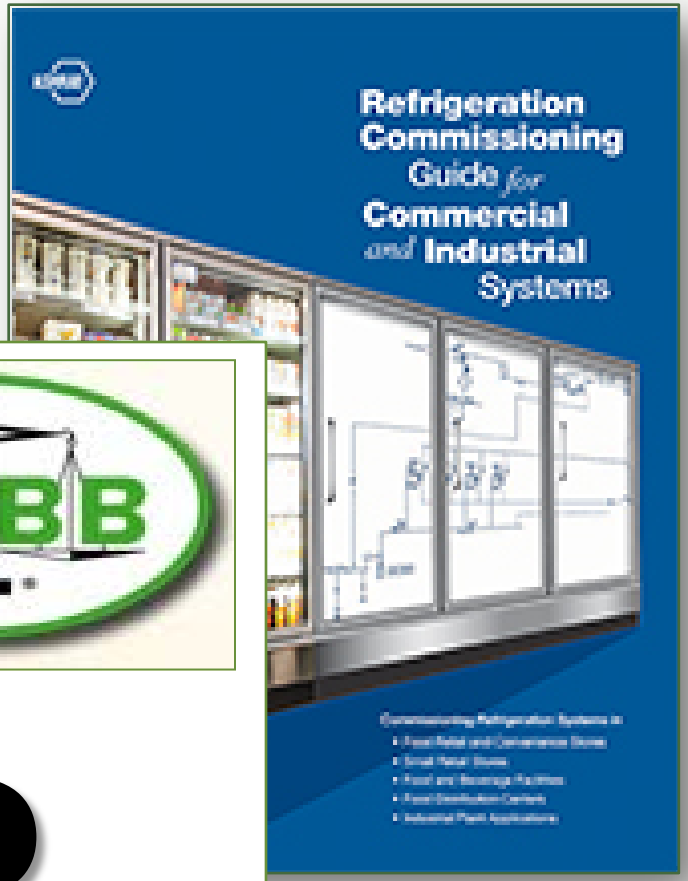
OBJECTIVE OF COMMISSIONING

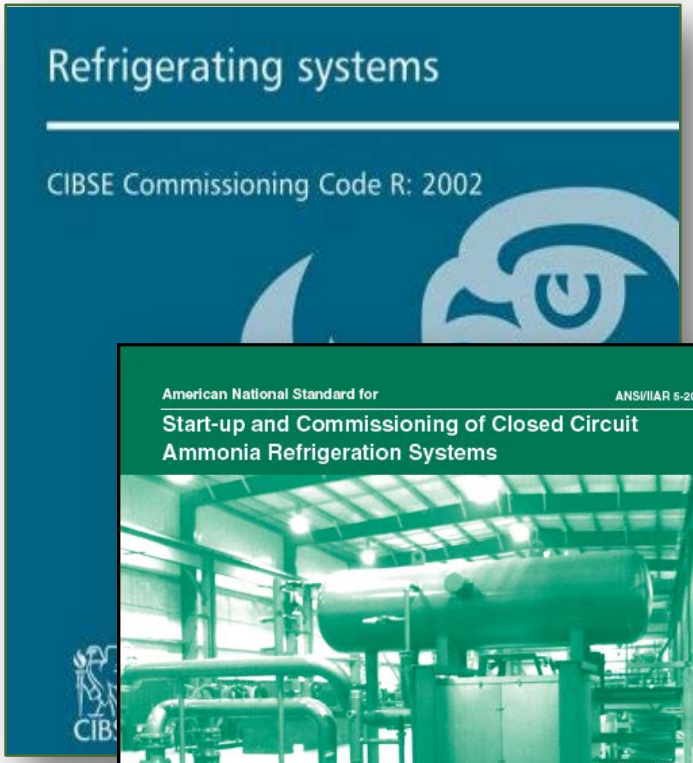
- ASHRAE Guideline 0: The Commissioning Process
  - Typically begins at project inception (pre-design phase)
  - Verify design is to Owner's Project Requirements (OPR)
    - OPR: Documentation of the functional requirements of a project and the expectations of how it will be used and operated
  - Verify construction and system operation meets OPR
  - Verify O&M personnel are properly trained on SOP's
  - Deliver a quality construction project on schedule, on budget
  - Use sampling to uncover systemic problems
  - Verify proper coordination among all involved

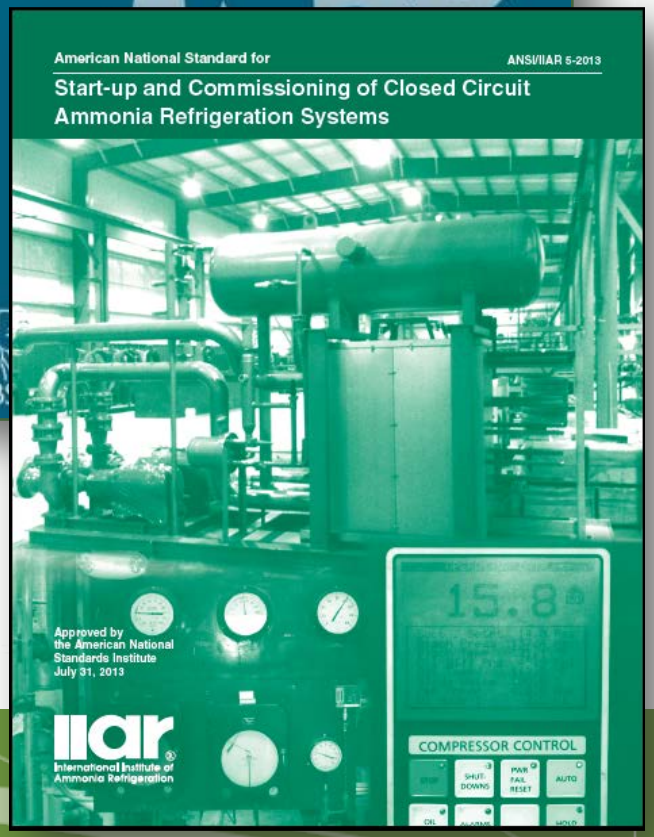
Remember these *Objectives* for a later comparison.



WHAT ELSE EXISTS?







NEBB

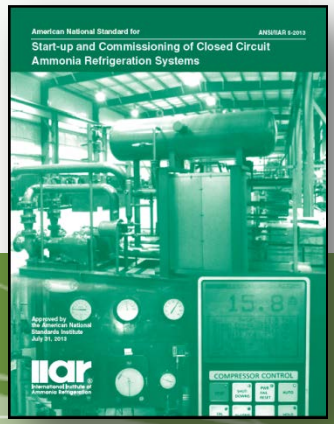
?

Commercial & Industrial Refrigeration Systems

INDUSTRIAL REFRIGERATION COMMISSIONING

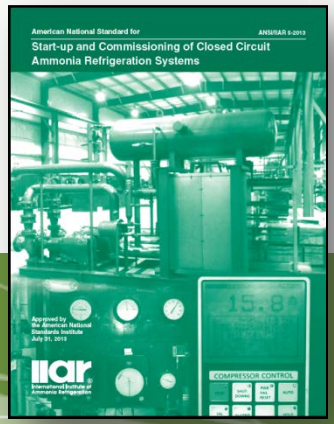
- IIAR Standard 5: Standard: *Start-up and Commissioning of Closed-Circuit Ammonia Mechanical Refrigerating Systems*

  - *Purpose: This Standard specifies criteria and procedures for start-up and commissioning of closed-circuit ammonia mechanical refrigerating systems.*
  - *Scope: 2.1 Provides basic minimum requirements for the safe start-up and commissioning of completed ammonia refrigerating systems …*

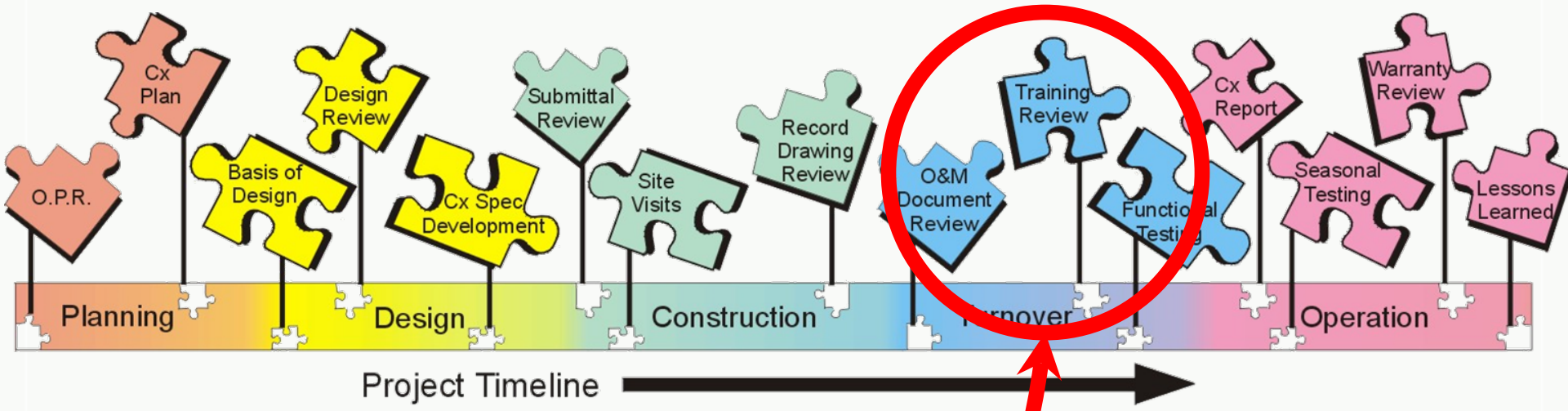


IIAR STANDARD 5

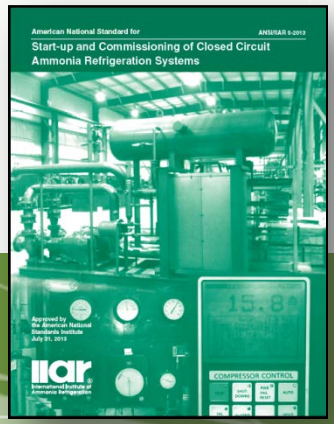
- Commissioning requirements:
  - 7.15.2 During the commissioning of the system the trained start-up technician shall involve the persons responsible for the day-to-day operation of the system.
  - 7.15.3 The system shall be operated under the available heat load to demonstrate correct function…
  - 7.15.4 Following the training of the system operators…and there has been a period of continuous and fault free running, the refrigeration system may be handed over...



THE COMMISSIONING PROCESS



IIAR Standard 5 requirements fall in this area.



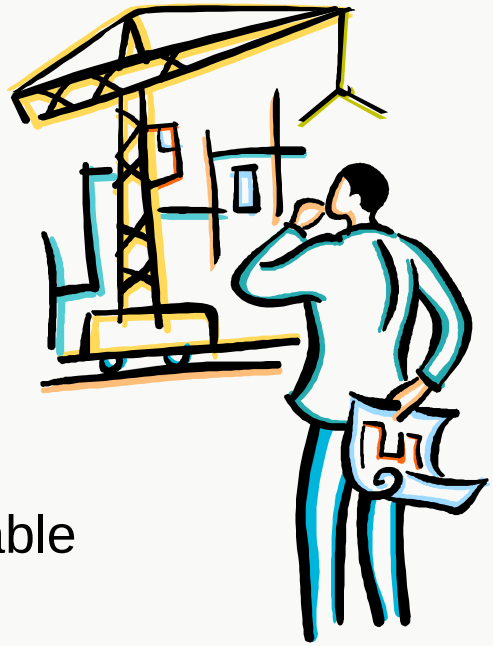
BARRIERS TO CXP

- What barriers prevent implementation of the Commissioning Process (CxP) for Industrial & Commercial Refrigeration systems?
  - *What is "Commissioning" for refrigeration systems?*
  - *What level of commissioning necessary?*
  - *What level of commissioning feasible?*
  - *Will implementation of commissioning be a choice in the future or a requirement?*

MILT GARLAND (1896-2000)

- 1915 – Built motorcycle from spare parts to ride to school
- 1918 - WWI
- 1920 – Started working in the refrigeration field as technician for Frick
- 1967 – “Retired” from Frick but continued on
- 1998 – Authored ***Industrial Refrigeration 102***
- 2000 – Named “America’s Oldest Worker”

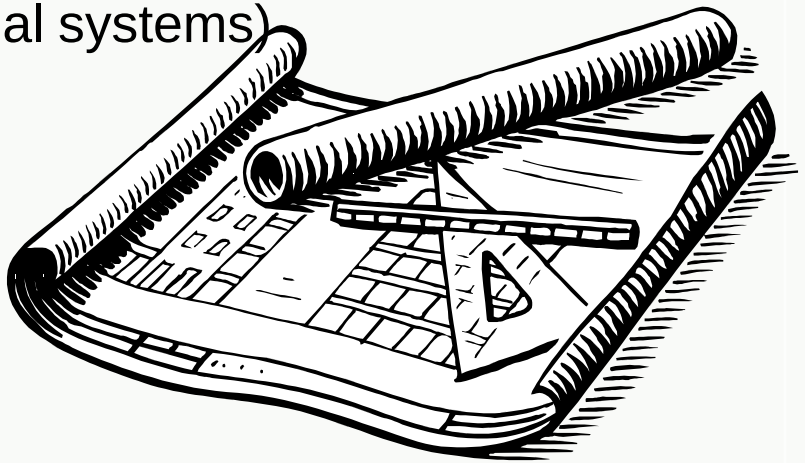
INDUSTRIAL REFRIGERATION SYSTEMS PECULIARITIES



- The technology
  - Custom-engineered
    - Every system different…no “cookie cutter design”
    - System constantly growing & evolving
  - Field-erected
    - Quality/skill of installation crews highly variable
    - Uncontrolled environment for construction
- Application
  - Highly variable (e.g. food, pharmaceutical, fertilizer)
  - *Many* choices in operational set points

INDUSTRIAL REFRIGERATION SYSTEMS PECULIARITIES

- End user requirements
  - Long life (longer than most commercial systems)
  - High reliability
  - Cost-effective (a.k.a. profitable)
  - Flexible
- System procurement options
  - Design-build (95% of projects)
  - Single prime contractor has primary responsibility with multiple trade or discipline-specific sub
    - Contractor heavily influences scope of work
    - Contractor may also be equipment manufacturer's rep.
  - Designed to speed project from initiation to completion



BARRIERS TO CXP

- Contractor
  - *We have 300 years combined experience!*
  - *We have our own internal processes to ensure our designs are flawless and fabrication is perfect.*
- End-User
  - *We hired a company that has a combined 300 years of experience…*
  - *Our project costs are high enough already! Is commissioning going to increase costs/add delay?*

OPPORTUNITIES FOR COMMERCIAL REFRIGERATION CX

- "Superstores" mix together traditional retail with supermarket
  - Larger corporations familiar with Cx in their offices and stores
  - Always looking for any advantage
- California Title 20 & 24…
- New/revised AHRI standards
  - AHRI 1250
- Energy simulation software under development

OPPORTUNITIES FOR COMMERCIAL REFRIGERATION CX

- As EPA continues to phase out refrigerant for commercial refrigeration, the industry looks for new options:
  - R-22 essentially phased out
  - R-404A & R507A phasing out for most applications
  - Other HFC's in jepordy
  - HFO refrigerants coming on-line but very expensive
- Commercial refrigeration looking to natural refrigerants (i.e. ammonia, CO2)
  - With it comes possible regulation

OPPORTUNITIES FOR INDUSTRIAL REFRIGERATION CX

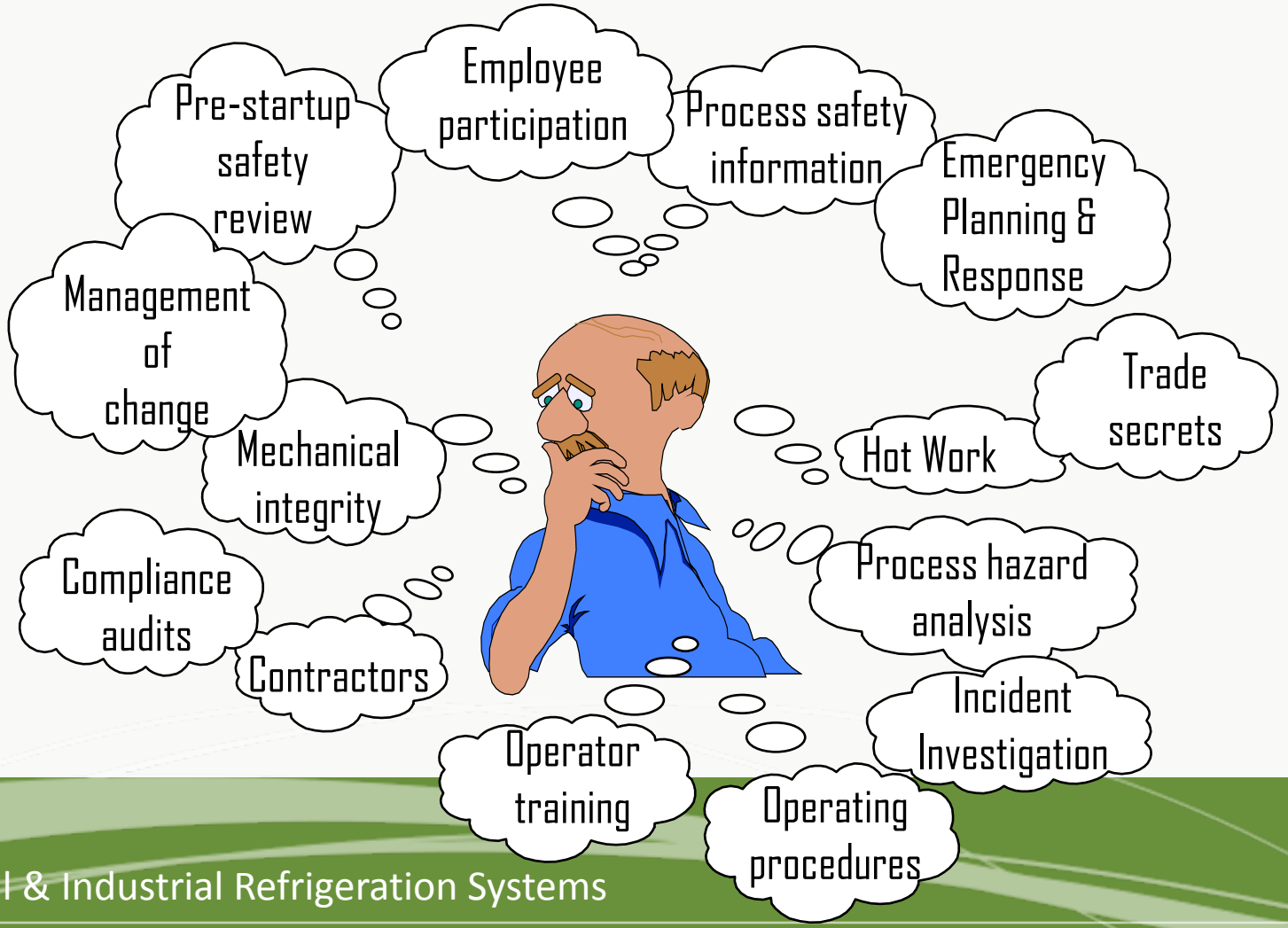
PSM

- OSHA Process Safety Management (29 CFR 1910.119)
- Performance-based safety standard for ammonia systems above 10,000 lbs refrigerant inventory
- Smaller systems covered by “General Duty Clause”

RMP

- EPA Risk Management Program (40 CFR Part 68)

PSM HAS 14 ELEMENTS



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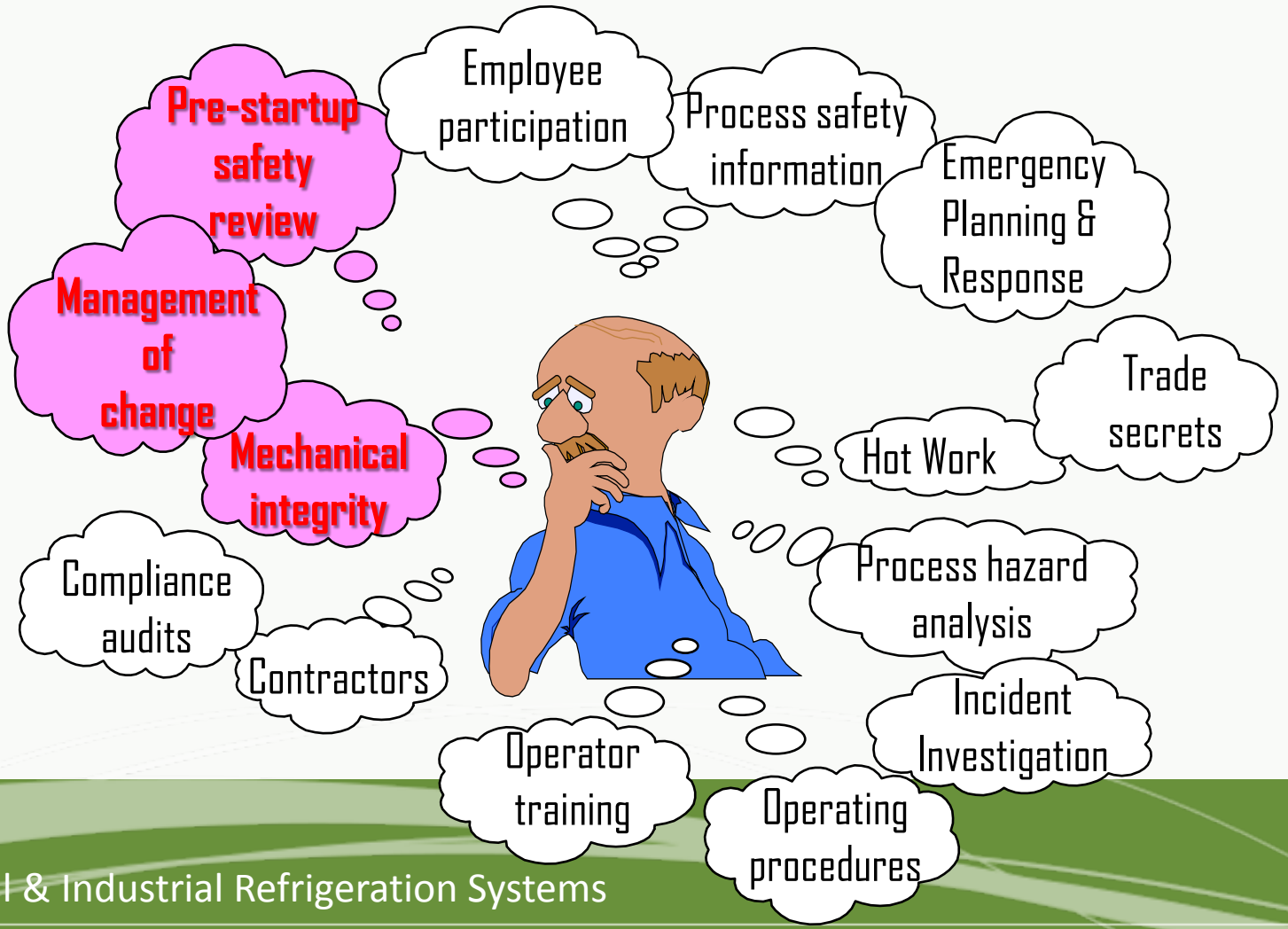

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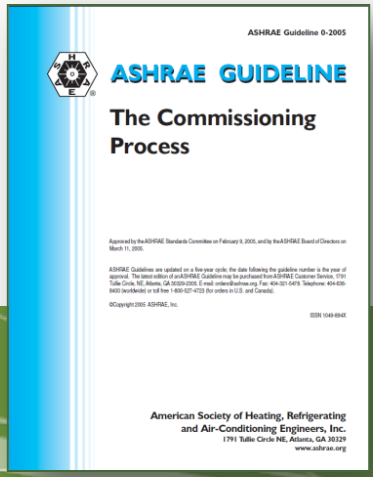
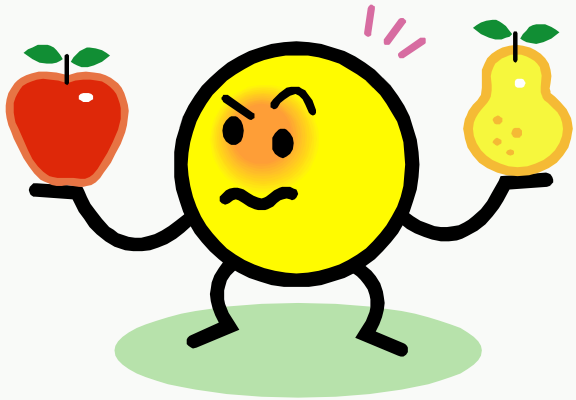
Remember these?



How do PSSR and commissioning match up?



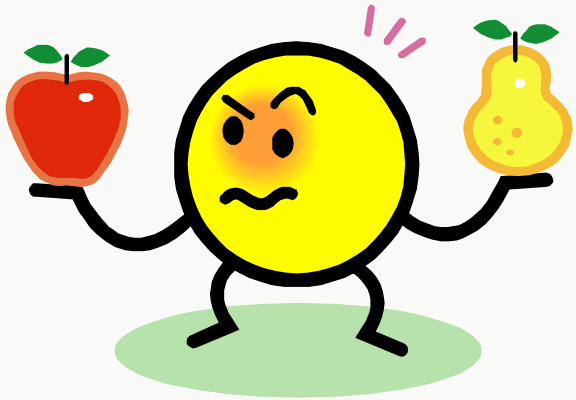
1910.119(i) Pre-Startup Safety Review

- *The employer shall perform a pre-startup safety review for new facilities and for modified facilities when the modification is significant enough to require a change in the process safety information.*

1910.119(i) Pre-Startup Safety Review

- *The pre-startup safety review shall confirm that prior to the introduction of highly hazardous chemicals to a process:*
  - *Construction and equipment is in accordance with design specifications;*
  - *Safety, operating, maintenance, and emergency procedures are in place and are adequate;*
  - ~~*For new facilities, a process hazard analysis has been performed and recommendations have been resolved or implemented before startup; and modified facilities meet the requirements contained in management of change, paragraph (l).*~~
  - *Training of each employee involved in operating a process has been completed.*

How do MOC and commissioning match up?



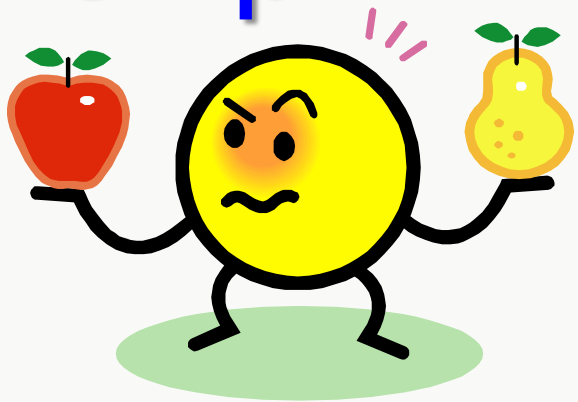
1910.119(l) Management of change

- *The employer shall establish and implement written procedures to manage changes (except for "replacements in kind") to process chemicals, technology, equipment, and procedures; and, changes to facilities that affect a covered process.*

1910.119(l) Management of change

- The procedures shall assure that the following considerations are addressed prior to any change:
  - *1910.119(l)(2)(i): The technical basis for the proposed change;*
  - *1910.119(l)(2)(iii): Modifications to operating procedures;*
  - *1910.119(l)(3): Employees involved in operating a process and maintenance and contract employees whose job tasks will be affected by a change in the process shall be informed of, and trained in, the change prior to start-up of the process or affected part of the process.*

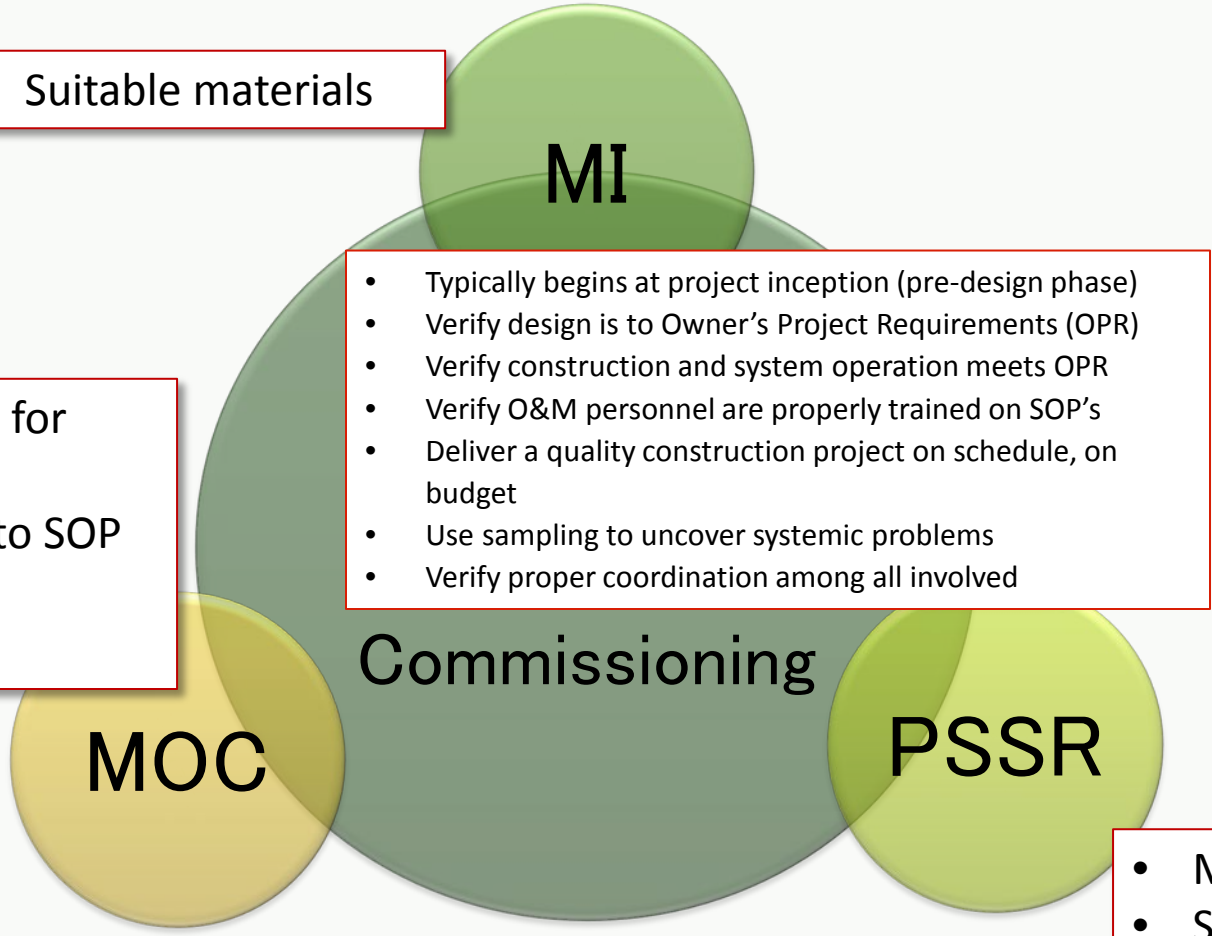
What is the relationship between MI and commissioning?



1910.119(j)(6)(i) Mechanical Integrity – Quality Assurance

- *In the construction of new plants and equipment, the employer shall assure that equipment as it is fabricated is suitable for the process application for which they will be used.*

COMMISSIONING VS. PSM?



- Suitable materials

- Typically begins at project inception (pre-design phase)
- Verify design is to Owner's Project Requirements (OPR)
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- Use sampling to uncover systemic problems
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- Technical basis for change
- Modifications to SOP
- Training
- Time period

- Meet design
- SOP's
- Training

EXAMPLES

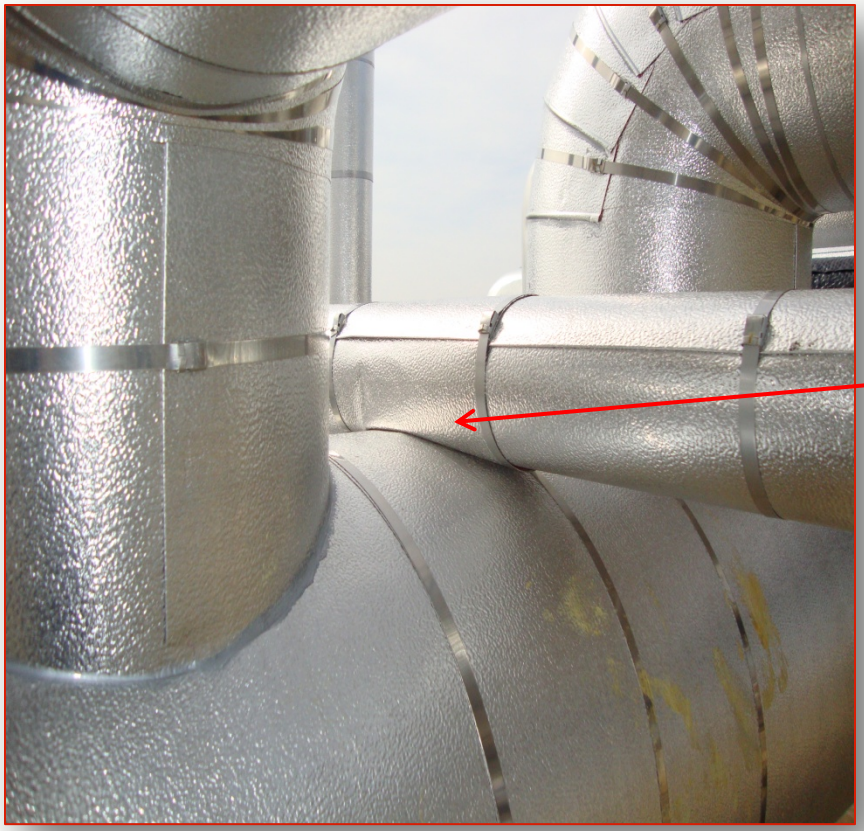
Is this refrigerant piping properly supported?

EXAMPLES

Result of implementing improper sequences of control on a brand new installation along with defective welds and insufficient inspection.

A formal commissioning process could have prevented this incident!

EXAMPLES

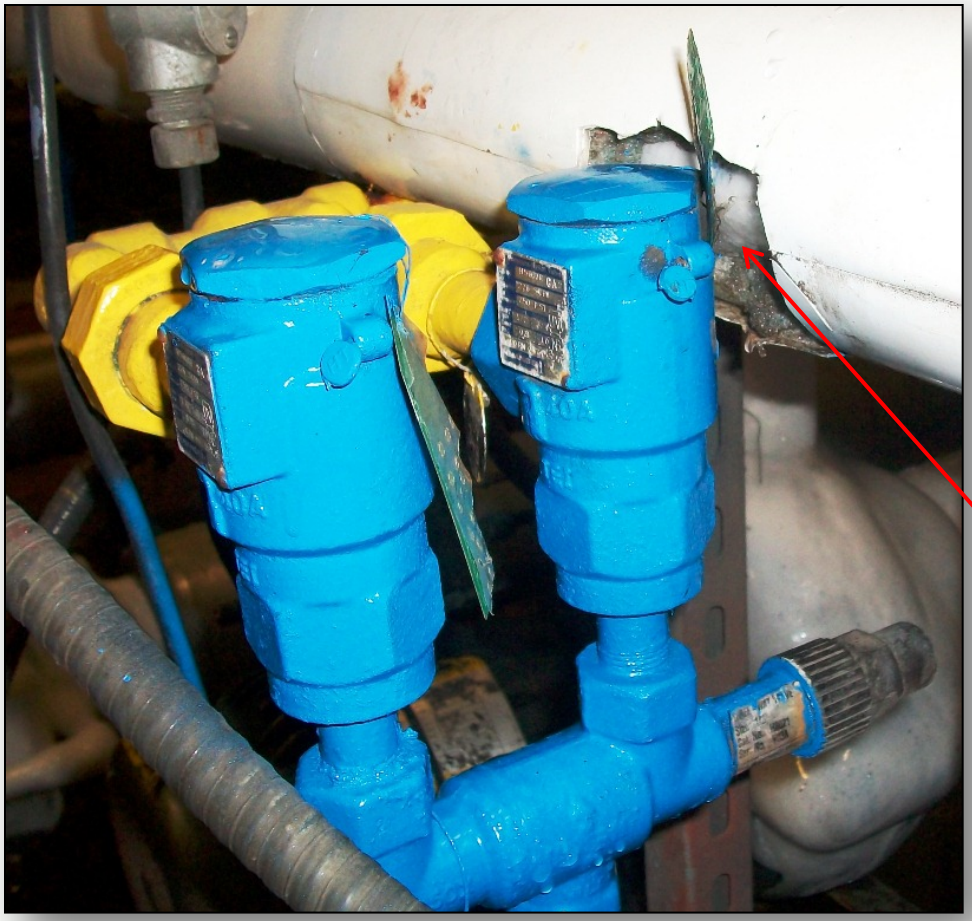


In adequate planning of pipe and insulation routing results in improper installation practices.

Inadequate planning of pipe routing that accounts for insulation thickness.

A formal commissioning process may have caught this defect.

EXAMPLES



Was the insulation trimmed per designer's instructions?

Inadequate planning of pipe routing that accounts for insulation thickness.

A formal commissioning process may have caught this defect.

CXP CHALLENGES

- No equipment performance standards (IR)
  - Compressors, condensers, evaporators, pumps, valves, controls
  - Outdated standards for CR
- Diffuse design guidance
- Dynamic nature of owner requirements
- Many doing design are without any credentials
  - Engineering degree
  - Professional license
- Construction project managers may not have essential skills
  - Primarily concerned with schedule and budget
- Lack of enforcement of project scope
  - Construction defects allowed
  - Poor workmanship tolerated
  - Little or no project documentation (PSM-related)

BENEFITS OF CXP

- Improved articulation of owner requirements
- Refrigeration systems that are:
  - Safer
  - A better match for the project requirements
  - Cost-effective
  - More efficient
  - Less start up issues
  - Easier and less problems to integrate
- Capable of delivering what the owner requested

WHAT DOES THE FUTURE HOLD FOR REFRIGERATION COMMISSIONING?

- Development of a IR CxP Standard?
- Standardizing the CR CxP Guidance?
- Expansion of ASHRAE's Cx Guidelines?
  - *Refrigeration Commissioning Guide* published
  - Provides how to information on how to apply the CxP to commercial refrigeration systems.
  - Some refrigerated warehouse/industrial refrigeration systems have utilized a streamlined version of CxP
- Development of more Cx Guidelines by others?
- Implementing CxP will have to be driven by end-users…or regulators

THANK YOU