The Commissioning Process:

In Search of a Universal Definition and Application
Agenda

- Overview
  - The Current Reality
  - Defining Commissioning
  - The Commissioning Process

- Case Study
  - Pfizer B220
Why More Focus on Commissioning?

- Challenges created by “speed to market” push
- Focus on maximum building operational efficiency
  - Documented lower life cycle costs/higher operating efficiency through proper Cx
  - 8-10% reduction in Operation Cost
- Owners feel that the construction costs are increasing disproportionately with building performance
- Heightened focus on occupant satisfaction
- Today's building systems/new technologies are more complex & interdependent
The Current Reality

- A study of 60 newly constructed buildings revealed that:
  - 50% suffered from control problems
  - 40% had HVAC equipment problems
  - 15% had missing equipment
  - 25% had energy management systems, economizers and/or variable speed drives that did not function properly

  Lawrence Berkeley National Laboratory, 1996
The Current Reality

- Definitions and Expectations vary
  - Commissioning vs. validation
  - What systems should be included?
- Can become a “stepchild” of the design & construction process
  - Funding allocated – spent on other “priorities”
- Even R&D and process facilities do not always take an “Integrated System Cx” approach
The Current Reality

- Linear process with little collaboration

- Owner develops requirements
- A/E develops technical specifications
- Builder implements series of tests at the end of the project
- FM/O&M staff trained afterwards and given manuals
Defining Commissioning

**ASHRAE**: a quality-oriented process for achieving, verifying, and documenting that the performance of facility systems and assemblies meet defined objectives and criteria.

**USDOE**: a systematic process of ensuring that all building systems perform interactively according to the design intent and the owner’s operational needs.

**NIBS**: the systematic process of ensuring that performance of the facility and its systems meet the functional and operational needs of the owner and occupants.

**ISPE**: well planned, documented, & managed eng'ing approach to start-up & turnover of facilities, systems, & equip. to End-User that results in a safe & functional env. that meets estab'ed design req's & stakeholder expectations.
Defining Commissioning

- **Our consensus:**
  - A well-planned, documented and managed approach to the installation, start-up, turnover and verification of facilities, systems and equipment to the end-user which results in a safe, productive environment that meets the designers intent and the owner’s quality expectations.
Commissioning Objectives

- Document Owner’s goals & requirements
- Establish “common success criteria”
- Keep project team focused on owner’s goals & success criteria
- Verify and document that building systems meet owner’s intent & need
- Train facilities personnel to properly operate & maintain the systems
- Increase operational efficiency
Design Phase

- Work with Team to determine requirements/Document design intent (BOD)
- Review Design Documents (SD, DD, CD)
- Develop Commissioning Plan and Schedule with the Team
- Develop written protocols
- Develop Technical Specifications for incorporation into “buy-out” documents
Construction & Turnover Phase

- Develop commissioning sequences
- Review submittals
- Schedule, coordinate and document system testing (TAB, etc.)
- Perform additional functional performance testing
- Provide O&M training
- Coordinate turn-over activities
During Operation

- Perform any required seasonal testing & training
- Review equipment and system performance prior to warranty period expiration
- Conduct a “Lessons Learned” session
- Provide trouble shooting support
The Commissioning Team

- Owner Representatives
- Design Professionals
- Construction Manager
- Commissioning Authority/Agent
- Suppliers / Equipment Manufacturers
- O&M Representatives
- Trade Contractors
Legend:
D = Develop
R = Review
A = Approve
E = Execute

<table>
<thead>
<tr>
<th>Responsibilities</th>
<th>Commissioning Agent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design CPA</td>
<td></td>
</tr>
<tr>
<td>RFP for Commissioning Agent Services</td>
<td></td>
</tr>
<tr>
<td>Design Documents</td>
<td></td>
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<tr>
<td>• Schematic Documents</td>
<td>D &amp; E</td>
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<td>• Construction Documents</td>
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<td>Develop Commission Schedule</td>
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<td>Develop Estimate For Full Commissioning Plan Including Implementation Costs</td>
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<td>Pre-construction Services</td>
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<td>• Estimating</td>
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<td>• Scheduling</td>
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<td>• Buy Out</td>
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<td>Develop Project Specific Commissioning Plan</td>
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<td>Pre-Delivery Inspection (PDI) Report</td>
<td>D &amp; E</td>
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<td>Construction</td>
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<td>Implement Commission Plan (perform tests)</td>
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<td>Steady State (&quot;Burn In&quot;)</td>
<td>R</td>
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<td>Deliverables</td>
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<tr>
<td>• Commissioning Report</td>
<td>D &amp; E</td>
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<td>• As-Built Drawings</td>
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<tr>
<td>• O &amp; M / Turn Over Documents</td>
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<td>• Warranties</td>
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<td>• Manuals</td>
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<td>Training</td>
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<td>• Facilities Management/Users</td>
<td>D &amp; E</td>
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<td>Final Commissioning Summary Report</td>
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<td>Post-Acception Commissioning</td>
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<th>Owner's Project</th>
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Responsibilities
Case Study – Pfizer B220

- 600,000 SF
- 800-plus Occupants
- $50 Million-plus M/E/P Systems
- 7,000-plus Fan / Pump Horsepower
- 65 VFDs
- 450 Lab Hoods
Lab Compressed Air

- Field testing revealed a susceptibility to loss of cooling water
- System was modified to ease maintenance and reduce downtime during maintenance
Lab Vacuum Systems

- Field testing revealed a problem with exhaust backpressure that caused safety trip shutdowns at higher loads
- System has modified to meet design criteria
- Users wanted a deeper, higher volume vacuum that the system could not provide even though design criteria was clear
Chilled Water

- 6600 tons – 14,000 GPM @ 42F
- System automatically diverts to “free cooling” mode at 47F outside air and isolates from the campus supply
- Testing revealed need for rapid transition to maintain space temperatures; campus system required a slow transition so as not to impact chillers
- Sequence of operation was modified to protect the campus system with minimal impact to control
Steam Systems

- 140,000#/HR – Five PRVs
- Testing saw excessive AHU tripping on low temperature detectors in the 1st heating season
- Control strategies had to be modified to allow for a compromise between time to control at startup & tight control in steady state operation
- Research also indicated the need for additional drip traps, which helped solve the problem
- Problem was solved in the 1st season rather than lingering
- Information provided to designers re existing steam supply did not prove out
Manifolded Air Handlers

- 3 Units - >150,000 CFM delivered
- Pressure relief doors caused problems with pressure controls and related safeties
- Testing revealed a need to modify control strategies to suit both a rapid startup (e.g. restarting 1 unit after PM) and steady state control
Vivarium Controls

- Each room (>100)—individual T/RH/dP
- User introduced a 30 day “burn-in” requirement that was not part of the original Commissioning program and not in the schedule
- Combined accuracies of related controls (AHU through local) meant a practical limit on humidity available for many rooms that was not anticipated
Manifolded Lab Exhaust Systems

- 7 fans / > 400,000 CFM
- Field testing indicated problems with the automatic restart (one or more fans) sequence
- Sequence was revised to improve reliability and revise the automatic backup (running backup is now “rested”)

Lessons Learned

■ Phased occupancy of a Commissioned building means retesting and disruption to occupants of the earlier phases

■ Accurate information on the existing utilities to serve the building is critical to successful operation

■ Lab hood flow measurement needs to account for accuracies of available controls & test equipment

■ Users must clearly understand the design criteria – so that there are no surprises at occupancy & systems do what they need to do