

Mechanical Systems Commissioning Fundamentals

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Course Content

- Why do we need commissioning?
- What is commissioning process?
- Who should be a commissioning team member?
- What needs to be inspected during installation verification?
- What needs to be tested during operational verification?



Course Content

- What needs to be tested during functional performance verification?
- What should be included in mechanical commissioning specification?
- What qualification should a commissioning agent have?
- Why is having a third party performing the commissioning a good idea?



What is Commissioning?

...systematic process for achieving, verifying, and documenting that the facility and its systems, subsystems, and equipment are planned, designed, installed, and tested, and are capable of being operated and maintained according to an Owner's Project Requirements (OPR) document.



Why do we need Commissioning?

- Mechanical systems never operate per design intent without commissioning.
- Project delivery system typically does not provide a responsible party for verifying systems operate per design intent.
 - Engineers are responsible for design.
 - Contractors are responsible for building.
 - Who verifies performance??



Why do we need Commissioning?

Advantages:

- System Safeties Function Properly
- Systems Operate Per Design Intent
- Optimized System Performance
- Optimized System Energy Efficiency
- Increased Occupant Comfort
- Better Trained Maintenance Staff
- Better Quality of Construction



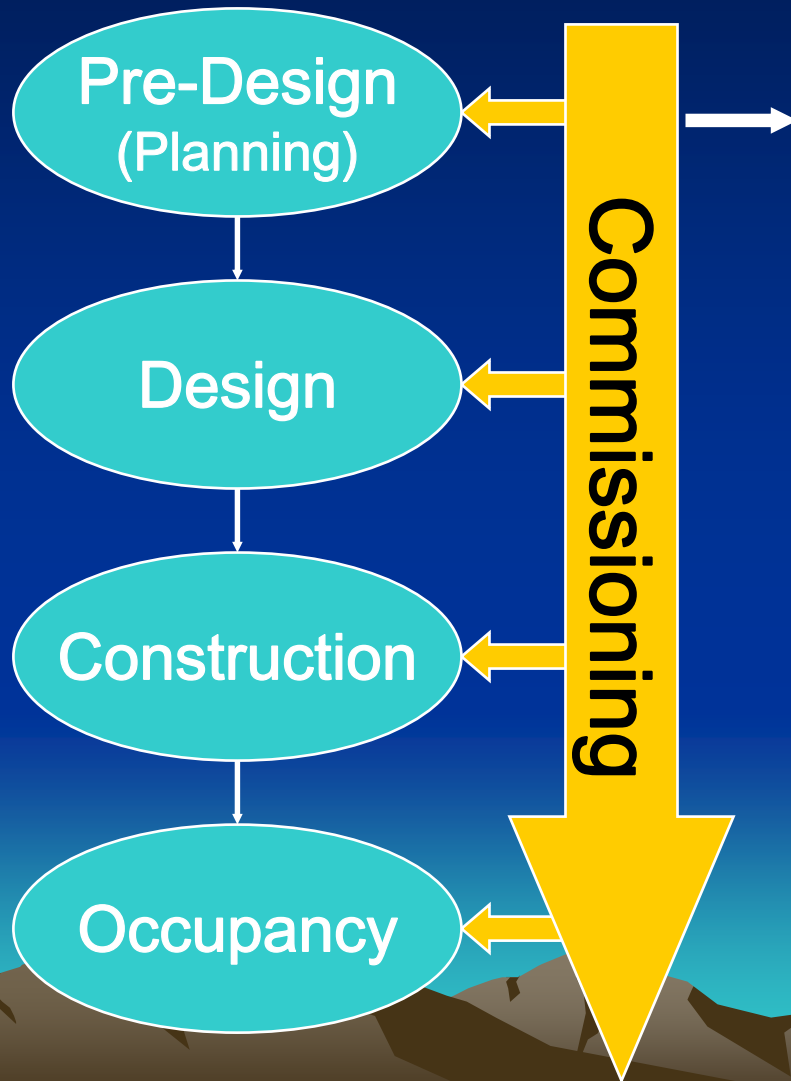
Why do we need Commissioning?

Advantages:

- Reduced Construction Change Orders
- Reduced Project Delays
- Reduced Warranty Callbacks
- Reduced Number of Lawsuits
- Better Communication During Design and Construction
- Sustained Property Value
- Improved Business Profitability



Commissioning Process



Establish Cx Team

- Owner Maintenance
- Owner User
- Commissioning Agent
- A/E Firm
- General Contractor

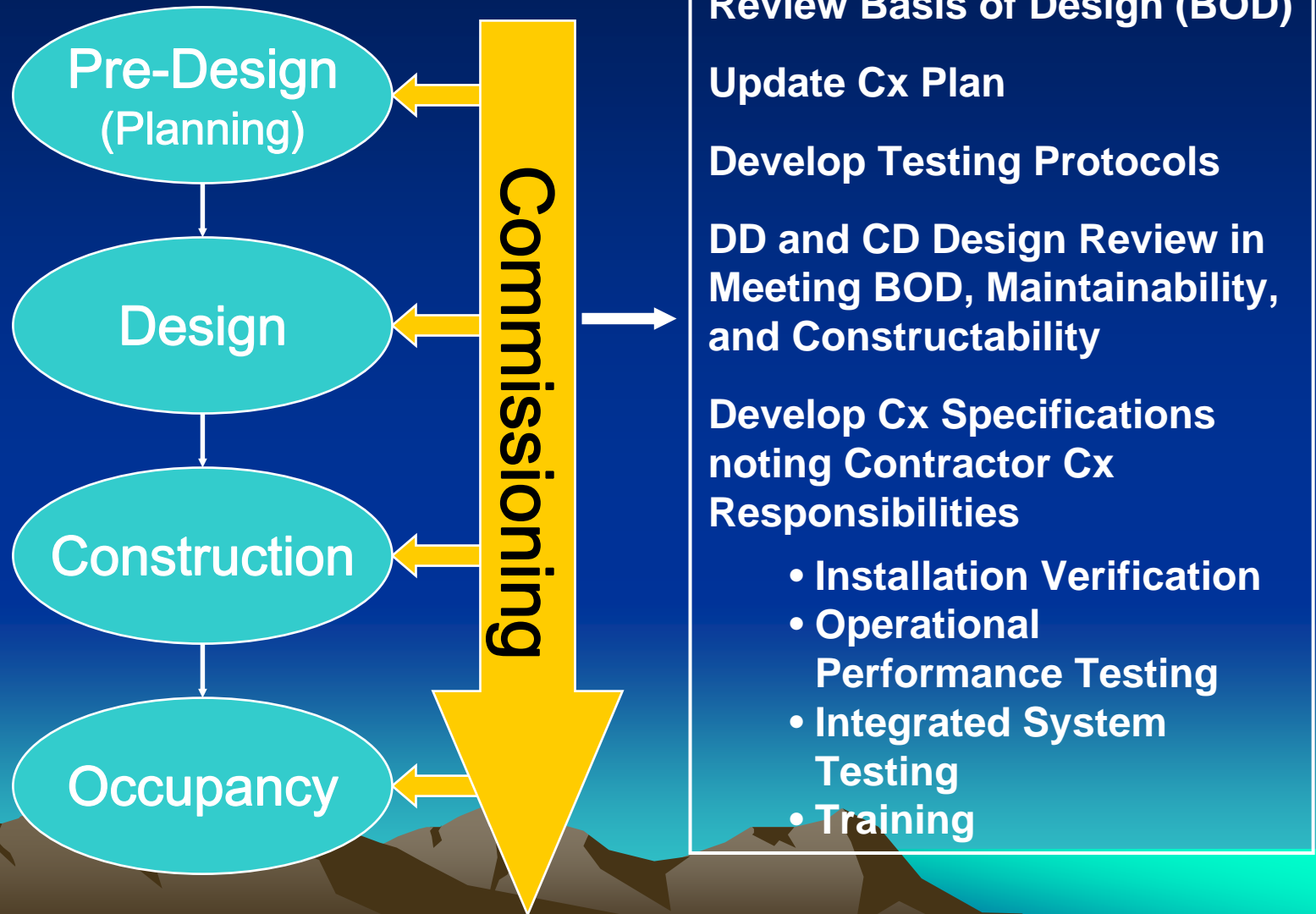
Review Owner Requirements

Cx Scope and Budget

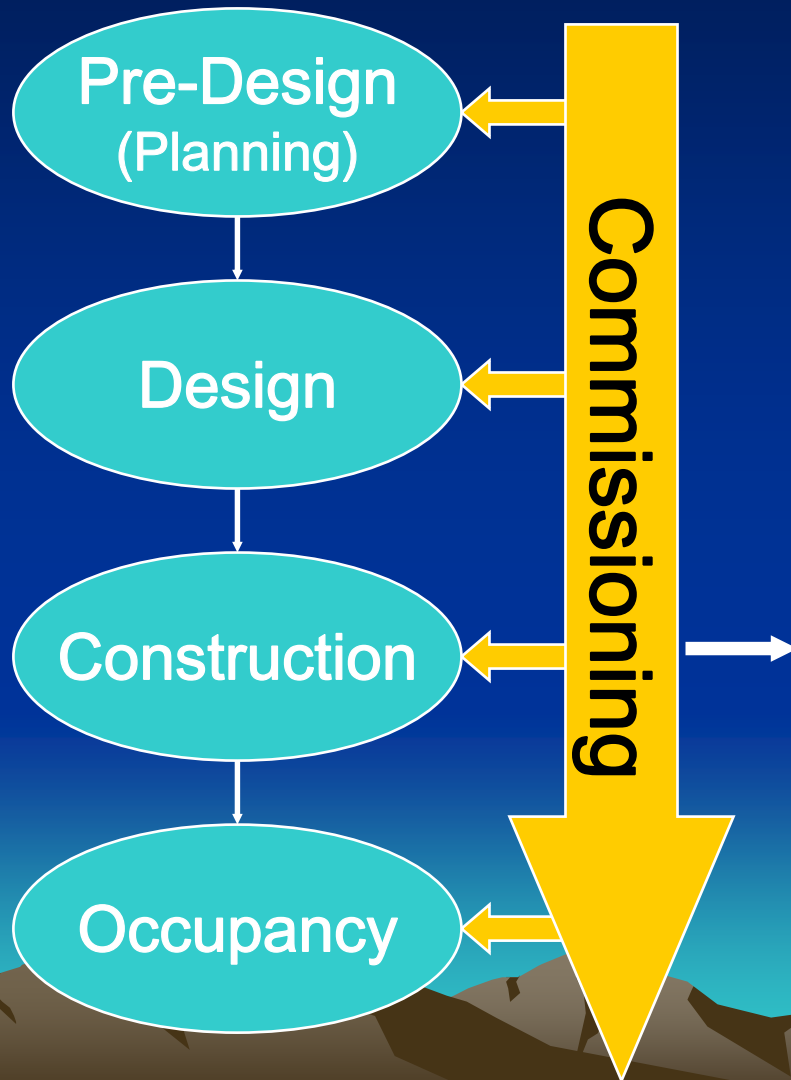
Develop Cx Plan Draft

- Cx Team Responsibilities
- Cx Scope of Work
- Cx Testing Protocols
- Cx Preliminary Schedule
- Cx Deliverables

Commissioning Process



Commissioning Process



Submittal Reviews

Cx Coordination Kick Off Meeting

Regular Construction Cx Meetings

Installation Verification Observations (FIV)

Operational Testing Observations (OPT)

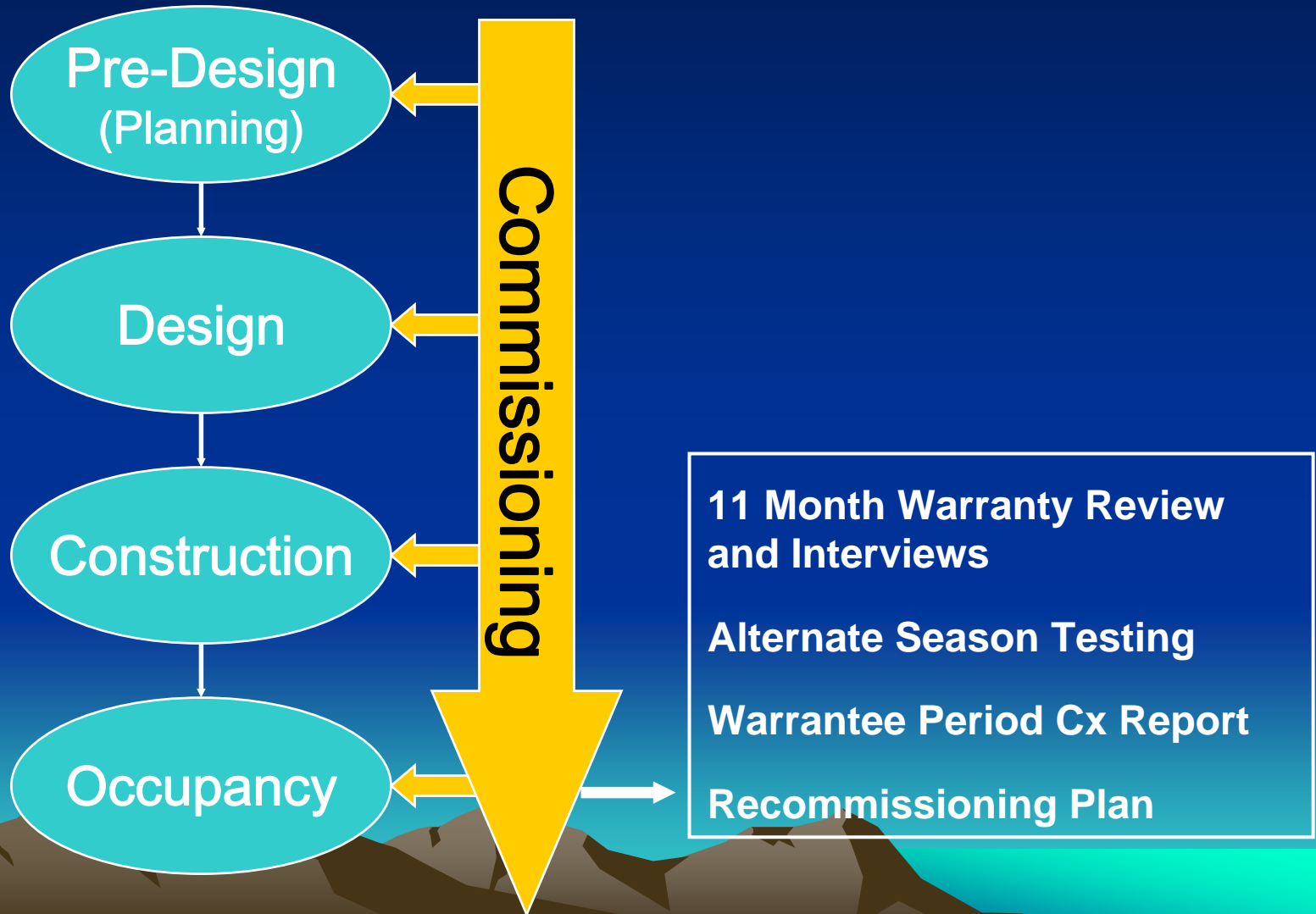
Integrated Testing Observations (FPT)

Cx Issue Log

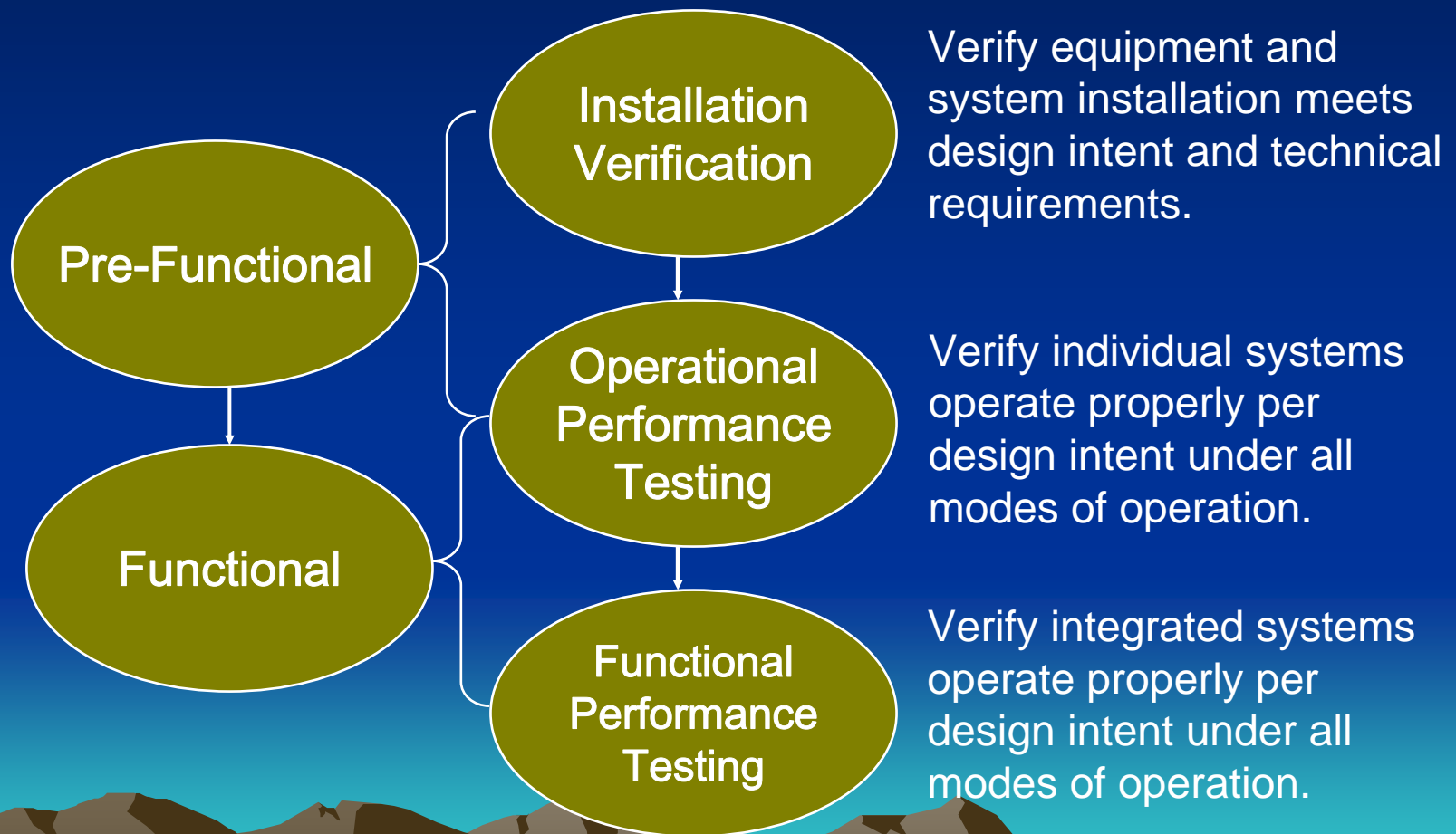
Training Scheduling

Commissioning Report

Commissioning Process



Commissioning Process



Who Should Be A Commissioning
Team Member?

**EVERYONE ASSOCIATED
WITH THE PROJECT**



Who Should Be A Commissioning Team Member?

- Design Engineers
- Design Architect
- General Contractor
- Mechanical Contractor(s)
- Electrical Contractor
- TAB Contractor
- Commissioning Agent
- Owner Groups (User, PM, Maintenance)



What needs to be inspected during Installation Verification?

- Actual Design meets Design Intent.
- What is Specified is Actually Provided.
- Installation Quality meets Industry Standard.
- Installation is Maintainable.
- Installation Operates per Design Intent.



What needs to be inspected during Installation Verification?

Equipment

- Inspect Equipment for Shipping Damage.
- Supplied Equipment matches Approved Submittal. Verify Equipment Size, HP, Voltage, and Other Criteria through Spot Measurements and Verify all Accessories are Provided.
- Equipment Installed per Manufacturer Recommendations. Does not include Means and Methods.



What needs to be inspected during Installation Verification?

Equipment

- Equipment is Properly Hooked Up (piping, electrical, ductwork). Verify Connected Services do not place Stresses on Equipment.
- Verify Equipment Access and Serviceability.



What needs to be inspected during Installation Verification?

Rotating Equipment (Pumps, Fans, Etc.)

- Verify Shipping Blocking and Blind Flanges are Removed.
- Verify Pump/Motor Shaft is Aligned.
- Verify Fan/Motor Sheaves are Aligned.
- Verify Vibration Spring Isolators have Adequate Travel, Centered under Load, and are Anchored.



What needs to be inspected during Installation Verification?

Rotating Equipment (Pumps, Fans, Etc.)

- Verify all Connecting Utilities have Properly installed Flexible Connections.
- Verify Shafts turn Freely.
- After Pump Flush Out, Verify Pump End Suction Strainer is Clean.
- Verify TAB Report including Flows, Pressure Differential, Vibration, and Amperage.
- Verify Pumps/Fans Rotate in Right Direction.



What needs to be inspected during Installation Verification?

Piping

- Verify Piping is Installed per CD Documentation (piping material/pressure classification, welding/solder, size, insulation, supports, slope, routing).
- Verify all Valves, Devices, and Instrumentation are Provided and Properly Installed.
- Verify Piping Leak/Pressure Test.



What needs to be inspected during Installation Verification?

Piping

- Verify Piping Systems were Flushed and Filled.
- Verify Piping System TAB Reports.



What needs to be inspected during Installation Verification?

Ductwork

- Verify Ductwork is Installed per CD Documentation (material and thickness, pressure classification, volume and fire dampers, access doors, sound attenuators, duct coils, humidifiers).
- Verify Duct is Sealed during Construction.
- Verify Duct Leakage Testing.
- Verify Duct Sound Testing.
- Verify TAB Report.

What needs to be inspected during Installation Verification?

Controls

- Verify Controls are Provided per CD Documentation (actuators, sensors, safeties).
- Verify Sensor Calibration.
- Verify Actuator Range of Operation.



What needs to be tested during Operation Verification?

- Verify Coil Capacity and Range of Operation.
- Verify Humidifier Capacity and Range of Operation.
- Verify Equipment and System Maintain Design Conditions and Operate Properly through whole Range of Operation.



What needs to be tested during Functional Performance Verification?

- All the Mechanical Systems Need to be Operated Together.



What Should be Included in Mechanical Commissioning Specification?

- Mechanical Installation Verification Observations to be Performed and Contractor's Responsibility.
- Mechanical Operational Performance Testing to be Performed and Contractor's Responsibility.
- Mechanical Functional Performance Testing to be Performed and Contractor's Responsibility.
- Testing Equipment to be Furnished by Contractor.
- Commissioning Documentation to be Provided by Mechanical Contractor.



What Qualifications should a Commissioning Agent have?

- Prior Design and/or Engineering Experience in the Equipment and Systems being Commissioned.
- Prior Facility Engineering and/or Construction Experience in the Equipment and Systems being Commissioned.
- Prior Commissioning Experience.
- Good Communication, Planning, and Organization Skills.
- Excellent People Skills.



Why is having a Third Party Commissioning Agent a Good Idea?

- The Commissioning Agent can Provide the Owner an Unbiased Report on Project Deficiencies, whether Design or Construction.
- Having the Design Firm or Contractor Provide Commissioning Services can Create a Conflict of Interest, Especially if the Commissioning Agent's Firm has a Large Exposure on a Specific Deficiency.



Questions



Thank You

