

Rethinking Pre-Commissioning from the Contractor Perspective

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Learning Objectives

- 1. Participants will be able to describe the current state of pre-commissioning by examining the commissioning readiness process of many contractors**
- 2. Participants will be able to analyze why so many projects encounter issues during commissioning by discussing the main causes of commissioning issues**
- 3. Participants will be able to compare the merits of a similar approach to quality control and pre-commissioning by learning about the program**
- 4. Participants will be able to apply the advantageous pieces of our program to their future projects by identifying universal aspects presented**

Course Description

In this presentation I will describe many of the issues facing contractors and commissioning providers, specifically during pre-commissioning. I will highlight an increasing trend in construction, which is a dedicated contractor commissioning coordination role and I will detail how our proactive approach to mechanical QA/QC not only reduces the amount of time spent on pre-commissioning activities but also saves all commissioning team members stress. Additionally, I will explore ways that commissioning providers can help implement some facets of the role on projects that don't feature this type of dedicated commissioning resource.

Pre-Commissioning

The general group of activities that happen after submittal review, but before functional performance testing that prepare the systems to be demonstrated operationally.

- Installation
- Pre-functional Checklists
- Startup
- Programming/Pre-testing
- Test, Adjust and Balance



CxP Challenges

The Commissioning Provider faces plenty of obstacles during this period. Some of the most common I faced in my time as a CxP were:

- Incomplete Prefunctional Checklists
 - Lack of understanding or defensive
 - Lack of attention
 - Jobsite politics
 - Lack of budget
- Poor communication from Contractors
 - Missed startups
 - Unclear progress
 - Last minute "ready" calls
 - Other Missed Docs/Tests

Common Causes

- Incomplete Prefunctional Checklists
 - Owner or Contractor Unfamiliarity with the Commissioning Process
 - Misunderstanding of entire process and intent of Cx
 - Contractor doesn't take it seriously
 - Poor Contractor relationships can mean using Cx as leverage
 - Low and unrealistic Commissioning budget expectations
- Poor Communication from Contractors
 - Inadequate education of Project Team on the Cx Process
 - Poor communication of responsibilities from CxP
 - No kick-off and/or regular meeting
 - "It was in the Cx Plan"

Contractor Challenges

Some common Commissioning Process challenges for Contractors include:

- Unclear Commissioning Requirements
- Excessive Commissioning Requirements
- Moving Targets and Shifting Activities
- Late checklist or test procedure delivery
- Redundant work
 - Duplicating many forms
 - Excessive data to report

Common Causes

- Unclear Commissioning Requirements
 - Vague or confusing specs and Cx Plans
- Moving Targets and Shifting Activities
 - Delays can cause dates to change unpredictably
 - Certain critical path activities get missed
- Late Checklist or Test Procedure Delivery
 - Report forms not shared in timely manner
 - Contractor not notified of availability
- Redundant Work
 - PFCs often contain identical info as other docs such as startup reports
 - PFCs can often be difficult to complete in one inspection

Unclear Requirements and Excessive Work

- B. General: Prefunctional checklists are important to ensure that the equipment and systems are hooked up and operational. It ensures that functional testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full prefunctional checkout. No sampling strategies are used. The prefunctional testing for a given system must be successfully completed prior to formal functional testing of equipment or subsystems of the given system.
- C. Start-up and Initial Checkout Plan: The CxA will assist the contractor in developing pre-functional checklists and a detailed start-up plan for all commissioned equipment. The primary role of the CxA in this process is to ensure that there is written documentation that each of the manufacturer-recommended procedures have been completed.
 - 1. The subcontractor responsible for the purchase of the equipment shall develop the full start-up plan. The plan shall include checklists and procedures with specific boxes or lines for recording and documenting the checking and inspections of each procedure and a summary statement with a signature block at the end of the plan.
 - 2. The full start-up plan could consist of something as simple as:
 - a. The CxA's, contractor's or manufacturer's prefunctional checklists.
 - b. The manufacturer's standard written start-up procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end.
 - c. The manufacturer's normally used field checkout sheets.
 - 3. The subcontractor shall submit the full startup plan to the CxA for review and approval.
 - 4. The CxA reviews and approves the procedures and the format for documenting them, noting any procedures that need to be added.
 - 5. The full start-up procedures and the approval form may be provided to the PM for review and approval, depending on management protocol.

Unclear Requirements and Excessive Work (cont.)

General Installation Checks - Mechanical Contractor

	CHWP-B1-1 (A)	CHWP-B1-2 (B)	CHWP-B1-3 (C)	HHWP-B1-1 (D)	HHWP-B1-2 (E)	HHWP-B1-3 (F)
Make and model match submitted equipment (1)	BM	BM	BM	BM	BM	BM
Pumps in place and properly supported (2)	BM	BM	BM	BM	BM	BM
Pipes are supported independently of the pump (3)	BM	BM	BM	BM	BM	BM
Seismic anchoring installed and functional where applicable (4)	BM	BM	BM	BM	BM	BM
Installation matches detail 8/M6.02 (5)	BM	BM	BM	BM	BM	BM
Equipment labels permanently affixed (6)	BM	BM	BM	BM	BM	BM
Pipe labels including directional arrows installed (7)						
Alignment checked and adjusted if needed (8)	BM	BM	BM	BM	BM	BM

Systems Optimization Role

Many large contractors now feature some sort of dedicated commissioning coordination role. Our company aims to take a wider view on quality through our Systems Optimization Department. Some goals of this department include:

- Optimize our labor commitment to the Commissioning Process by involving a Cx subject matter expert on large or complex projects.
 - Have a single point of contact for Commissioning coordination and issues
 - Have somebody accountable who “speaks the language” and has familiarity with the process and what to expect
- Improve internal quality control and quality assurance processes and protocols
 - Reduce Cx issues related to integration or cross-trade coordination
 - Attempt to flag likely Cx issues early and produce the best possible work product
- Offer specific task support to common project blind spots
 - Startup and Commissioning scheduling
 - Owner’s Training coordination
 - Ensure thorough operational testing prior to FPT

What Can You Do?

- Focus on your prefunctional checklists.
 - Don't just copy/paste your "closest to accurate" checklists.
 - If it's a hydronic RTU, remove the refrigeration questions.
 - Think about if the info you're asking for is in service of the project.
 - Good - Unit data, instrumentation checks, safety/clearances, etc.
 - Questionable – Design data, redundant startup data, etc.
- Be specific when writing your specs
 - Try to define success
 - Outline specific contractor expectations for documentation, FPT support, meetings and more.
 - Clarity makes for more accurate bids and better Cx support
 - Help clients improve their Cx specs and evolve their Cx programs
- Communicate and try to be flexible
 - Be clear about your plans and their responsibilities. Details matter.
 - If or when you get pushback, try to find creative solutions instead of digging in.

Checklist Arrangement

SECTION 1 – PRE-START CHECKS:

The Contractor shall have personnel with direct knowledge complete this checklist to verify that systems are installed complete and operable, before the commencement of TAB work. Contractor shall be responsible for ensuring that work by subcontractors is completed and checked off. Prior to commencement of TAB work, the Contractor shall submit a written request to the Owner, including completed construction checklists for mechanical inspection of the project to establish to the satisfaction of all parties that the systems are ready for testing and balancing.

1. HVAC Units & Built-Up Units	Ready		Int.
	Yes	No	
a) GENERAL			
Louvers installed			
Manual dampers adjusted and locked			
Automatic dampers operating			
Housing construction complete			
Access doors closed			
Condensate drain piping and pan			
Free from dirt and debris			
b) FILTERS			
Type and size			
Number			
Clean			
Frame - Leakage			
Temporary			
c) COILS (HYDRONIC)			
Size and rows			
Fin spacing and condition			
Obstruction and / or debris			
Airflow and direction			
Piping leakage			
Correct piping connections and flow			
Valves open or set			
Air vents or steam traps			
Provisions made for TAB measurements			

2. Duct Systems	Ready		Int.
	Yes	No	
a) GENERAL			
Manual dampers adjusted and locked			
Access doors closed and tight			
Fire dampers open and accessible			
Terminal units open or set			
Registers and diffusers open and set			
Turning vanes in square elbows			
Provisions made for TAB measurements			
Ductwork sealed as required			
b) ARCHITECTURAL			
Windows installed and closed			
Doors closed as required			
Ceiling plenums installed and sealed			
Access doors closed and tight			
Air shafts and openings as required			
3. Pumps			
a) MOTORS			
Rotation			
Lubrication			
Alignment			
Set screws tight			
Guards in place			
Starters and disconnect switches			
Electrical service and connections			

3. Pumps	Ready		Int.
	Yes	No	
a) PIPING			
Correct flow and connections			
Leakage			
Valves open or set			
Strainer clean			
Air vented			
Flexible connectors			
Cavitation possibilities			
c) BASES			
Vibration isolation			
Grouting			
Leveling			
4. Hydronic Equipment			
a) BOILERS			
Operating controls and devices			
Safety controls and devices			
Lubrication of fans and pumps			
Draft controls and devices			
Piping connections and flow			
Valves open or set			
Water make-up provisions			
Blow-down provisions			
Electrical connections			
b) HEAT EXCHANGERS			
Correct flow and connections			
Valves open or set			
Air vents or steam traps			
Leakage			
Provisions made for TAB measurements			

4. Hydronic Equipment	Ready		Int.
	Yes	No	
c) COOLING TOWERS AND EVAPORATIVE CONDENSERS			
Correct flow and connections			
Valves open or set			
Leakage			
Provisions made for TAB measurements			
Sump water level			
Spray nozzles			
Fan / pump rotation			
Motor / fan lubrication			
Drives and alignment			
Guards in place			
Starters and disconnect switches			
Electrical connections			
5. Refrigeration Equipment			
Crankcase heaters energized			
Operating and safety controls and devices			
Valves open or set			
Piping connections and flow			
Flexible connectors			
Oil level and lubrication			
Guards in place			
Vibration isolation			
Starters, contactors and disconnect switches			
Electrical connections			

5. Refrigeration Equipment	Ready		Int.
	Yes	No	
6. Hydronic Piping Systems			
Leak tested and flushed			
Fluid levels and make-up			
Relief or safety valve settings			
Compression tanks / air vented			
Steam traps and connections			
Strainers clean			
Valves open or set			
Provisions made for TAB measurements			
7. Control Systems			
Data centers operating			
Outdoor / return dampers set			
Economizer controls set			
Static pressure control set			
Space controls operating			
Complete system operating			
8. Other Checks			
a) Other trade or personnel notified of TAB work requirements			
b) Preliminary data complete			
c) Test report forms prepared			

Redundant Information



Air Handler pre start up

Job Name: _____ Date: _____
Unit Tag: _____ Job Number: _____

- 1.- Inspect equipment for shipping and installation damage
- 2.- Verify all packing material has been removed from the unit.
- 3.- Inspect unit splits for proper re-assembly
- 4.- Verify all compartments are clean and free of any obstruction or loose debris
- 5.- Remove fan shipping blocks
- 6.- Verify spring isolators are functioning properly
- 7.- Check fan wheel set screws for tightness, and alignment of fan and motor sheaves
- 8.- Check belt tensioning

L1-L2 L2-L3 L3-L1

- 9.- Check main supply voltage

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- 10.- Check condensate drain traps (Refer to instalation and operation manual)
- 11.- Inspect piping and coils for leaks
- 12.- Verify proper clean filters are installed
- 13.- Check all access doors are propely aligned and close tightly
- 14.- Check damper operation to assure freedom of movement
- 15.- Momentarily start fan motor and verify correct fan wheel rotation
- 16.- If unit is equipped with VFD, please reffer to manufacturers start up procedure

TESTED BY

Name

Date

Cabinet and General Installation Checks - Mechanical Contractor

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Macdonald-Miller Mechanical Contractor	AHU-B1- 1	AHU-B1- 2	AHU-RF- 1	AHU-RF- 2
Installed equip. as submitted (model, serial, manuf., etc.)	BM	BM	BM	BM
Maintenance access acceptable for unit and components	BM	BM	BM	BM
Casing condition good: no dents, leaks, door gaskets installed	BM	BM	BM	BM
Access doors close tightly, no leaks	BM	BM	BM	BM
Shipping blocks removed from spring isolators	BM	BM	BM	BM
Instrumentation installed as specified (thermometers, pressure gauges, flow meters, etc.)	BM	BM	BM	BM
Permanent labels affixed	BM	BM	BM	BM
Clean-up of equipment completed as per contract documents	BM	BM	BM	BM
Filters installed with replacement type & efficiency label affixed to housing	BM	BM	BM	BM
UV Array installed per schedule note 5,6 (M-002)	BM	BM	BM	BM
High limit duct static pressure sensor installed per scheduled note 4 (M-002)				

What Can You Help Others Do?

- Identify Accountable People Early
 - Ask your GC and Subs early if they have someone assigned to coordinate Cx
 - If not, who will be the main point of contact? Will that person change later?
 - Talk about who will be performing the work and try to identify specific trade leads
 - Who will be tracking and closing assigned issues? Is this person technical or a PM?
 - Don't get too granular assigning issues. Try to keep the circle small.
- Establish a Culture of Quality
 - Collaborate and request feedback
 - Ask about QC processes and plans
 - Demonstrate leadership and be an example
- Improve the Schedule
 - Review the master schedule and try to dissect the relevant activities

Conclusion

- When in doubt, just follow the golden rule. How would you feel in our shoes?
- Help us help you
- Be clear and to the point
- Take a proactive leadership role on quality
- One contractor, one contact

Questions?

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