Owners: How to Insure Your CHP Commissioning is Effective? Tools & Lessons Learned

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CHP Commissioning (Cx) Agenda

- The Problem
- Roles & Responsibilities
- Design-Bid-Build vs. Design-Build
- What Needs to Happen and When?
- Tools and Where To Get Them
- Top Lessons Learned

The Problem

Owner's Challenge:

- How to Insure your CHP will be effectively Commissioned?
  - CHP plants added once every 10-20 years
  - Don't know what they need or want
  - Wide range of services and $ can be provided
  - Is Cx different for Design-Build or Design-Bid-Build?
  - What needs to be defined in RFP or developed later
  - Project Schedule: "Time is not your friend"

Goals of Commissioning

- Define requirements/services/schedule early
- Verify design performance
- Validate plant operating conditions
- Confirm safety for plant/operations
- Document process for future
- Insure proper training for operating staff

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Define Roles and Responsibilities

- Owner: Facilities Staff (Management)
- O&M: Direct Hire or 3rd Party?
- RFP Developer: Owner with Owners Engineer
- Engineer
- Major Equipment Vendors
- General Contractor and Subcontractors
- Startup and Commissioning Team
- Training Team

Early Key Decisions

- Design-Bid-Build (DBB) or Design-Build (DB)?
- Are in-house resources available or need high quality, Owner's Engineer?
- O&M: Your staff or 3rd party running the plant?
- Who is buying the major equipment?
- Eng & CM RFP together or in sequence
- Will loads be available for testing?
- Are you going for LEED?
- Who will oversee the Commissioning Process?
- Do you need Sequence of Operation (SOO) or Standard Operating Procedures (SOP)?

Cx Differences

Design-Build:

Pro

- Owner has “single point of contact”
- Delivery Team is integrated
- Cx staff on early to work with operators

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- Challenging to make sure Cx clearly defined in RFP
- Process moves quickly

Cx Differences

Design-Bid-Build:

Pro

- Longer Duration to develop what you want
- Can develop Cx in parallel with Design

Con

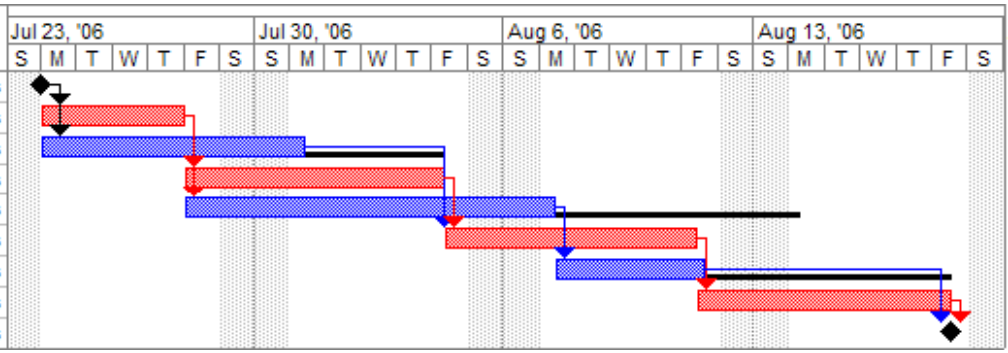
- Multiple Parties that Owner or CM needs to coordinate

What Cx Needs to Happen When?

Project Phases:

- RFP Development
- Engineering/Design
- Permitting/Utility Interconnection
- Equipment Procurement
- Construction
- Commissioning
- Training
- Warranty

ID	Task Name	Predecessors	Duration
1	Start		0 days
2	a	1	4 days
3	b	1	5.33 days
4	c	2	5.17 days
5	d	2	6.33 days
6	e	3,4	5.17 days
7	f	5	4.5 days
8	g	6	5.17 days
9	Finish	7,8	0 days



Commissioning Activities

RFP Development

- If DB, need to define complete Cx/training program
- Schedule trips for FM/O&M staff to CHP(s)

Engineering/Design (with O&M)

- If DBB, define Cx/training program for Constructors
- 3D walk thru: “Operability & Maintainability”
- Define how system will be operated
- Determine desired Level of Automation

Critical RFP Commissioning Tasks

RFP needs to define the following:

- Commissioning Organization
  - Owner/O&M Oversight
  - Commissioning Authority (CxA)
- Contents of your Commissioning Plan
- Contents of your Commissioning Manual
- Desired SOO or SOP
- Training Requirements

Commissioning Manual

Defines and contains the following:

- Roles & Responsibilities and Authorized to sign off
- Subsystems
  - Pre-startup (constructor)
  - Pre-functional testing (constructor)
  - Functional Testing Procedures (commissioning team)
- Plant Performance Testing
- Plant Reliability Testing
- Plant Emissions Testing

Commissioning Activities

Major Equipment Procurement:

- Specify proven products and services
- Insure local service resources
- Specify level of vendor support during construction, Cx, testing, training, and warranty

Permitting/Interconnection:

- What testing is required by Air Board?
- What testing is required by Electric Utility for interconnect?
- What testing is required by Gas Utility?

Commissioning Activities

Construction:

- Constructors - Good at building
  - Not-so-great at paperwork
- Who is in charge of Cx (DB, Contractor or Owner)
- Tools to manage your Vendor support “Burn Rate”
- Mandate early Owner/O&M engagement
- Develop/submit/approve Cx Plan – Min. 9 mo.
- Develop/submit/approve Cx Manual – Min. 6 mo.
- Subsystem Turnover Packages development/ sign-off
- Develop/submit/approve Sequence of Operations
- Develop/submit/approve Training Plan – Min. 3 mo.

Project Execution

Commissioning:

- Daily tailgates 6am (Owner, Constructor & Cx)
- Weekly 2 Week Look Ahead
  (C, Cx+Vendors)
- Daily Report from CxA
- Owner notifications (24 hrs) for witness
- Weekly monitoring of subsystem turnover package development
- Observations:
  - What was expected
  - What was actually observed

Project Execution

Training:

- Curriculum Development
- Who will be trainers?
- Training Schedule
  - Classroom
  - Vendor (factory, FAT, and field)
  - On-the-Job Training (OJT)
- Who needs to attend?
- Schedule in advance to match O&M shifts
- Video or Not

Value of “OJT”

- Gets operators involved early in project
- The more they know, the better they are prepared to take ownership
- Should start at end of construction
- Pre-startup, pre-functional, functional, and performance testing
- Encourage contractors “use” operators during system checkouts
- Work closely with PCS Suppliers (system integrator) System Set-up

Cx Tools & “Leave Behinds”

In Control Room:

- Cx Manual with test results
- Subsystem Turnover Packages
- SOO or SOP
- Project Manuals
- Vendor O&M Manuals
- Plant Control System “Off Line” Simulation Programs
- Training Curriculum/Videos

Lesson Learned

29 Palms 9MW CHP
(Mission Critical)

- X Operators not available
- X Inadequate loads for testing
- X Problems with other distribution projects
- X Clearly spell out sign offs and Owner's observations (checklist)
- ✓ Early - Get Owner to define "Flight Test"
- ✓ Monitor Contractor progress on Subsystem Turnover Packages

Lessons Learned

Molycorp 49 MW Off-Grid CHP
(Mineral Processing)

- ✗ Lack of qualified operators
- ✗ Inadequate loads to test full plant
- ✗ Lack of Owner engagement
- ✓ Commission staff showed up early
- ✓ Assisted contractor with Pre-Startup
- ✓ Finished early

Lessons Learned

University of New Mexico 7MW CHP
(Expansion)

- ✗ Owner did not know how they wanted to test and run old with new
- ✗ Lack of some vendor data slowed trouble shooting
- ✓ Qualified operators made the difference
- ✓ CTG failure: Local service made difference quick back in service
- ✓ Completed ahead of schedule

Lessons Learned

<u>Algonquin Power 15 MW Retrofit</u>
(Existing Station)

- ✗ Super fast 18 month Design to COD challenging
- ✗ Existing plant controls system proved problematic, required significant trouble shooting
- ✓ Quality GC made the difference to success
- ✓ Operators involved early and often
- ✓ SG vendor set, program and upload relay settings
- ✓ Met the Owner deadline

Key Take-Aways

- Design-Build decision requires significant Cx planning/development up front
- Select qualified/experienced Engineer and Owners Engineer
- Get operators involved early
- Owner procurement of Long Lead Equipment = comprehensive startup/training
- Commissioning is often relegated to “after-thought”
- Do your homework early = pay dividends at completion