Combined Heat & Power Project Delivery Options

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Attributes of a successful project

Overview of project delivery methods

Planning for a successful project

Case study examples
Attributes of Successful Projects

“A doctor can bury his mistakes but an architect can only advise his clients to plant vines.” - Frank Lloyd Wright
Combined Heat & Power
lower costs, lower emissions, higher resiliency

How would you like your project?
done fast, done right, or done cheap

Priority list
1. CHP configuration (scope) will ultimately dictate the ongoing life cycle performance
2. Budget (cost) is a set number under which the financial proforma will be realized
3. Schedule (time) is critical to meet owner milestones and realize operational savings
Priority list

1. CHP configuration (scope) will ultimately dictate the ongoing life cycle performance
   • Engineering and design is a good place to invest

2. Budget (cost) is a set number under which the financial proforma will be realized
   • Contractor involvement early will increase budget certainty

3. Schedule (time) is critical to meet owner milestones and realize operational savings
   • Contractor involvement early will result in a better plan
**Decision Gates**

1. **Feasibility Screening**
   - Low cost investigation to justify investment grade evaluation
   - Broad approach to options

2. **Investment Grade Analysis**
   - Full 8760 modelling
   - Detailed options
   - Fully developed Owner’s program and basis of initial GMP proposal
   - Go/No-Go decision

3. **Design**
   - Equipment procurement
   - 3D modelling
   - Initial interconnet submission
   - Local permitting
   - Air permitting

4. **Construction**
   - Utility interconnect
   - Equipment deliveries
   - Coordination and risk management with existing operation
   - Compliance testing
   - Training
   - Performance verification
   - Turnover documentation

5. **Start-up**
   - Training
   - Performance verification
   - Turnover documentation
Overview of Project Delivery Methods

“The road to success is always under construction” – Arnold Palmer
Owner retains design, engineering, permitting, and equipment procurement functions. Then bids the construction as a competitive solicitation.

- **GC** - Traditional general construction which typically involves self-performing trades.
- **CM** - Construction specialist that contracts trade subcontractors and suppliers.
Experience has demonstrated that a comprehensive preconstruction process is essential to the success of the construction and commissioning:

- budget development,
- value engineering,
- Comprehensive scheduling,
- constructability assessments and logistical planning,
- regulatory approvals,
- Development of risk registers, and
- Commissioning, training, and turn-over planning

Should be completed at various stages of the project:

- Conceptual development
- Schematic Design
- Design Development
- 50% Construction Documents
- 90% Construction Documents
DBB Conceptual Schedule

- Initial Feasibility (SD)
- Decision Gate 1
- Investment Feasibility (DD)
- Decision Gate 2
- Equipment Procurement
- Construction Documents
- Equipment Manufacture
- Permitting
- Construction Bidding
- Construction
- Equipment Deliveries
- Start-up & Commissioning
- Compliance Testing
- Commercial operation

Months

Select Option

Go/No-Go
Owner delegates responsibility for entire project delivery

- Resource constraints
- Enhanced project integration
- Risk assignment
- Fast track delivery
DB Conceptual Schedule

- Initial Feasibility (SD)
- Decision Gate 1
- Investment Feasibility (DD)
- Decision Gate 2
- Equipment Procurement
- Construction Documents
- Equipment Manufacture
- Permitting
- Construction Bidding
- Construction
- Equipment Deliveries
- Start-up & Commissioning
- Compliance Testing
- Commercial operation

Select Option
Go/No-Go

Months
Owner delegates responsibility for project delivery but is directly responsible for project scope

- Resource constraints
- Procurement rules (study consultant cannot participate in design)
- Enhanced competitive solicitation
EPC Conceptual Schedule

- Initial Feasibility (SD)
- Decision Gate 1
- Investment Feasibility (DD)
- Decision Gate 2
- EPC Solicitation
- Equipment Procurement
- Construction Documents
- Equipment Manufacture
- Permitting
- Construction Bidding
- Construction
- Equipment Deliveries
- Start-up & Commissioning
- Compliance Testing
- Commercial operation

Timeline:
- 0 months: Select Option
- 12 months: Go/No-Go
Planning for a Successful Project

“Experience is what you get when you don’t get what you want.” – Chinese fortune cookie
PLANNING FOR A SUCCESSFUL PROJECT

- **Experience**
  - Mission critical operations
  - Engineering & technical capability
  - Training & turnover

- **Preparation**
  - Logistics / Schedule
  - Mitigation Plans
  - Enhanced Use of Technology

- **Transparency**
  - Full Open Book Approach
  - Open and Honest Communication

- **Collaboration**
  - Experienced with OEMs and Engineering firms
  - High Integrity

- **Budget Certainty**
  - Estimating Competency
  - Well-Coordinated, Understandable Bid Packages
  - Best-in-Class Project Controls
Preconstruction Partnerships
- Feedback to Design Team – Confirm Stakeholder Issues
- Optimize Value to Client
- Constructability of the Details
- Pre-Planning – Single Voice to OEM & Sub Market
- Budget certainty – work to the budget

Inclusion in Procurements
- Review of Subs Invited / Prequalification Process
- Team Descopes to Manage Expectations
- Value Management – Encouraged to Max Value
- Involvement in Lean – Pull Planning to Optimize Delivery
A LEAN APPROACH – REDUCE WASTE, ADD VALUE

1. Identify Value
2. Organize Work Through A Value Stream
3. Create a Smooth and Continuous Work Flow
4. Pull Planning Sessions
5. Continuous Improvement
**PROJECT CONTROLS**

### Financial
- Program and Project Budgets
- Cash Flow / Cost Management
- Earned Value Analysis
- Contingency Reporting

### Master Schedule
- Integrated Program Master Schedule
- Detailed Project Schedules
- Industry Best Practices for CPM
- “What If” Planning and Resource Optimization

### Information / Document Management
- Standardized System Across Program / Used by Project Teams

### Reporting
- Monthly Program Reports to Senior Leadership Team
  - Cost / Schedule / Progress / Issues and Challenges
  - Trending and Analysis
- Monthly Detailed Project Reporting
OPERATIONS & MAINTENANCE READINESS PROGRAM

The “I” in BIM

- Establish Asset Naming Conventions
- Integrate Client Standards
- O+M Review of Systems
- Preventative Maintenance
- Populate Current CMMS
- Work with Equipment Suppliers on Pre-Commissioning Checklist
- Integrate Staff into Commissioning Process

Start with the end in mind.

QA/QC | BIM 360 Issues Checklist

BOND Team | Tracking Deficiencies on the Jobsite
Corporate QA/QC Program
- Database of Checklists for Entire Team’s Use

Project Quality Plan
- Specific Project Checklists Tailored to Elements of Project

Application on Your Project
- Superintendent and Field Staff Inspect Installation in Progress / Take Photos / Document in BIM 360
- Subcontractors Use BIM 360 to Document Corrective Work
SAFETY

- “Focus on Today”
- Safety Audits
- Site Specific Safety & Security Plans
- Toolbox Talks
- Technology
- Risk Management

BOND | Safety Dashboard

Construct Secure Safety Spotlight

- Number of Inspections: 44
- Total Findings: 3,003
- Positive Findings: 1,934
- Negative Findings: 89

Summary of Findings

BOND Superintendents | Daily Site Safety Inspections

BOND | Weekly Toolbox Session

BOND Project Team | Weekly Toolbox Session

44 inspections across 16 current projects, submitted by 10 safety managers
Case Study Examples

“Knowing what’s right doesn’t mean much unless you do what’s right” — Theodore Roosevelt
Cornell University (Ithaca, NY)

**SCOPE**
- 2 x 15 MW combustion turbines
- Dual-Pressure Fired HRSGs w/ SCR
- Black start and Islanding capability
- Dedicated HP gas line for plant
- 115/13.2 kV Substation renewal

**COST**
- $83 Million

**DELIVERY**
- Design-Bid-Build Solicitation
- Construction Manager
- GMP contract
MIT (Cambridge, MA)

SCOPE
- 2 x 22MW combustion turbines
- Dual fuel
- Fired HRSGs w/ SCR
- 2MW Black start
- Islanding capability
- Gas compression
- Boiler fuel oil conversion

DELIVERY
- Design-Bid-Build Solicitation
- Construction Manager with precon
- GMP contract

COST
- Not public
Yale University (New Haven, CT)

**SCOPE**
- 2 x 8MW combustion turbines
- Dual fuel
- Fired HRSGs w/ SCR
- Islanding capability
- Gas compression

**DELIVERY**
- EPC Solicitation
- General Contractor with precon
- Lump sum contract
- Bridging documents

**COST**
- $50.2M

### Cost Breakdown
- **Engineering** 7%
- **Equipment** 38%
- **Construction** 55%
Lahey Clinic (Burlington, MA)

**SCOPE**
- 1 x 3MW RICE
- 15kV Substation
- Islanding capability
- Steam HRSG with SCR & CEMs

**DELIVERY**
- EPC Solicitation
- General Contractor
- Lump sum contract
- Bridging documents

**COST**
- $14 Million

![Pie chart showing the breakdown of costs: Engineering 7%, Equipment 40%, Construction 53%]
Questions?