How Project Collaboration Produced "Best in Class" Results

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INTERNATIONAL DISTRICT ENERGY ASSOCIATION

The University of New Mexico

VANDERWEIL POWER GROUP

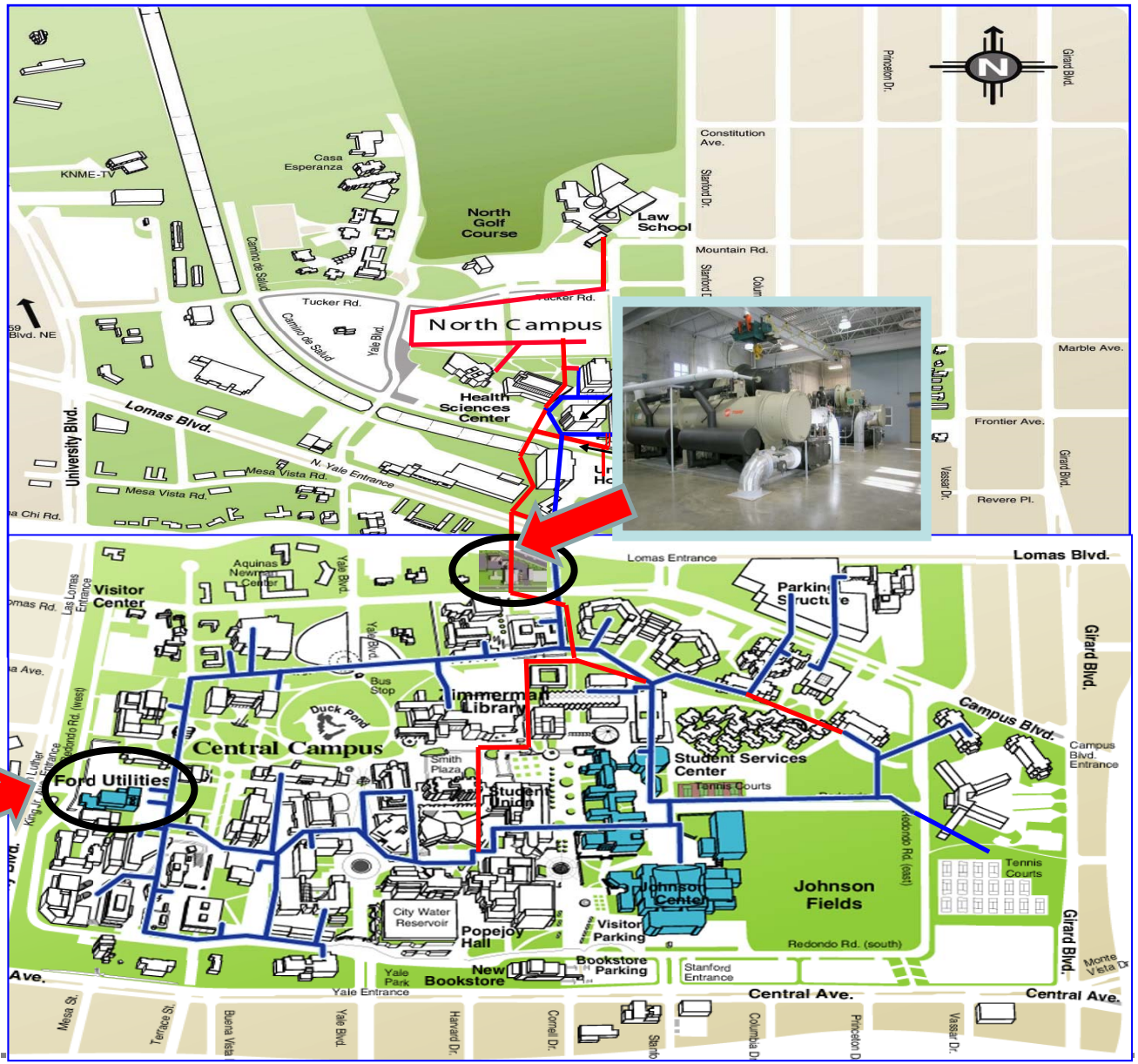
Agenda

- Campus Utility History
- The Problem
- Execution Options
- Selection Process
- Team Goal Setting/Alignment
- Project Execution Tools/Phases
- Lessons Learned
- Key Take-Aways

UNM Campus

The University of New Mexico's Albuquerque campus:

- 700 acres
- 3 Locations
- 6.8 million sq. ft.
- 26,000 students
- 5,000 faculty/services staff



Campus Utilities - Today

Chilled Water System:

- 13,300 Tons (47.50 MW)
- 8 Chillers (6 centrif, 2 abs)
- 15,000 gpm (3,400 m^3/h)
- 11 miles (18 km) main pipe
- Supply press 50 psig (4 bar)
- Supply temperature 40 F (4 C)
- 100 connected buildings

Steam System:

- 270 million BTU/hr (79 MW)
- 5 gas-fired boilers & 2 HRSG's
- 230,000 lbs/hr (80.5 m^3/h)
- 6 miles (9.5 km) main pipe
- Supply pressure 120 & 40 psig (8 & 3 bar)
- Supply temperature 350 F (175 C)
- 105 connected buildings

Electrical network:

- 28 MW Peak Demand
- 15 MW Generating Capacity
- 12.47 KV dual radial campus distribution system
- 2 major 115 /12.47 KV substations owned by UNM
- 3 switching stations

Business Formulation

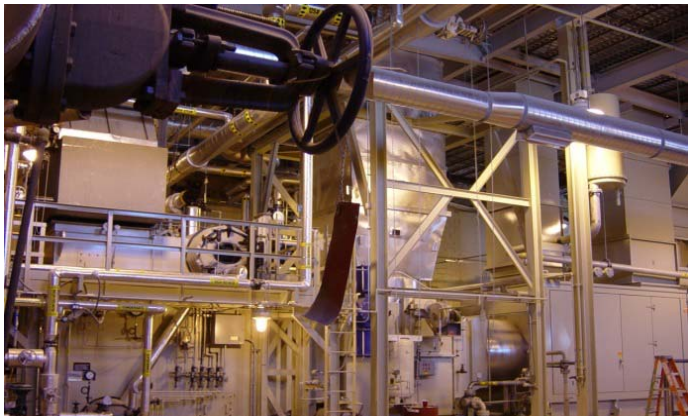
- Lobo Energy, Inc. LEI
- Formed to address:
  - Severe utility issues
  - Business plan for infrastructural renewal
- Wholly Owned 501(c)3 non-profit Corporation
  - Formed under the provisions of the NM University Research Park Act
  - Acts as private corporation with respect to third parties and as State institution with respect to other State institutions
- Purchasing Capabilities
- Funding Structure
- Financing Capabilities - Debt vs Lease

LOBO ENERGY, INC.

Central Utility Plant "Business" Options

A. Owned/Operated by State
B. Owner/Operated by 3rd Party
C. 3rd Party Owned or Leased but Operated by Univ.
D. Independent Corporation Owned/Operated but Controlled by University

CHP Implementation / Evolution



- Phase 1 (Completed 2005)
  - 7 MW CTG with 26,000 PPH HRSG
  - Two planned, only one installed
    - "Spark spread" decreasing and steam load not as large as originally projected
- Interim Phase 2 (Completed 2011)
  - Needed additional steam capacity planned by 2nd CTG – Added boiler
  - 1 MW Backpressure Steam Turbine Generator and Auxiliary 30,000 PPH steam plant
  - Revenue from STG retires bond debt for project

CHP Implementation / Evolution

Phase 3 completed 2014

- 7.2 MW CTG with 28,000 PPH Steam

Completed CHP Provides:

- **65% Campus Average Electrical Use;**
- **50% Peak demand**
- **80% Campus Average Heating Load**
- **25% Campus Average Cooling Load**

The Problem

Owner's Challenge:

- Phase 3 CHP Expansion
  - Capital Cost Capped
  - Estimate 20% over budget
  - Limited window for project completion
  - Maintain campus 24/7 utilities during installation
  - Space for 2nd unit inadequate (STG installed)
  - Negotiated Price for 2nd Turbine in Phase I expired

Project Execution Options (Pro/Con)

- Design-Bid-Build
  - + Maintain full control of design and equipment selection
  - – Continued budget concerns
  - – Split project responsibilities
  - – Needed expedited answer (schedule) if project could be built for budget
- Design-Build
  - + Meets criteria for early budget/schedule confirmation
  - + Provide single source responsibility for entire project
  - - Requires increased oversight by Owner
  - - Need flexible RFP to permit creativity & team selection
  - - Concerns that design would not enable Owner input
  - - How to insure qualified GC, subs and Eng? How to get it all?
  - - Must Meet Procurement Rules

D-B Team Selection Criteria (Desires)

- Local GC with Knowledge & Experience Plant
- CHP Engineer with extensive design, vendor procurement and Cx resume
- Local Installation Subs with UNM experience
- Major Equipment Suppliers with proven performance and Local Service
- Risk Sharing
- Innovation and Creative Problem Solving
- Ability to Meet the Budget and Schedule

Final Roles and Responsibilities

- *Owner:* Lobo Energy, Incorporated (LEI)
- *PM*: UNM –PPD Utilities Staff seconded to LEI
- *O&M*: UNM –PPD Utilities
- *Design-Build Team:*
  - General Contractor (RMCI)
  - Engineer of Record (Vanderweil)
  - Equipment Procurement (Vanderweil/RMCI)
  - Quality Local subcontractors/Installation (2)
  - Controls Integration (Thermo Systems)
  - Startup/Commissioning/Training (Vanderweil/Vendors)

D-B Team Value Engineering Solutions

- Bid Equipment but proposed transfer to Owner Savings GC Markup
- Owner Purchased - No Gross Receipts Tax for Owner Procured Equipment
- Equipment Re-Use vs purchase new:
  - Use existing Fuel Gas compressors - 1 per CTG
  - Use existing Plant Control System (HW and I/O)
  - Foundations / Platform steel
- What is Needed or “Nice to Have”?
  - Delete 2nd unit By-Pass Stack
  - Silencer not required
- Risk Sharing

Major Equipment Procurement Process

- Eng./GC Prepare Spec, Perf. Guarantees, Startup and Training Needs & Negotiate Final Cost
- Owner Executes P.O.
- Eng./GC Responsible to Manage the following for Owner:
  - Budget/Schedule Compliance
  - Changes both commercial and technical
  - Submittals / Document Control
  - Shop Testing/Commissioning/Training
  - Interface and compliance with other equipment and existing plant systems
- Owner Takes Over at COD (warranty/service)

Team Goal Setting & Alignment

- Define requirements/services/schedule early
- Continuous collaboration was imperative
- Meet the budget/schedule
- Share: “good news and bad”
- Monthly/Ad-hoc Team Goal Alignment & Check Process during design period
- Provide Risk Sharing Opportunities (incentives/ costs)
- Value given to team members working together (equal seat at the table)

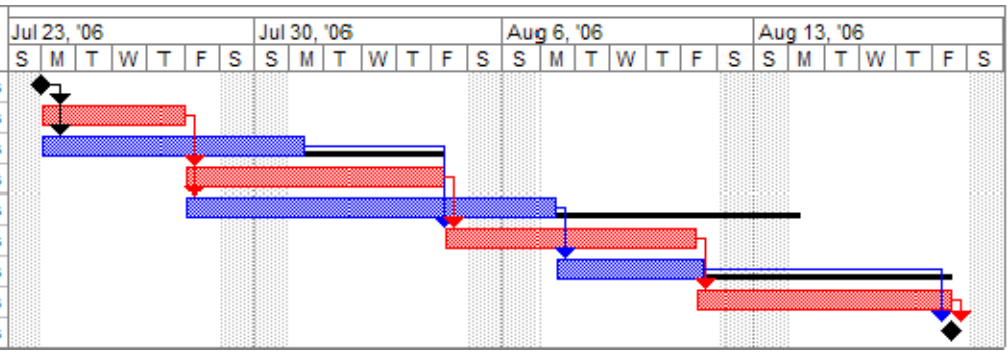
What Needs to Happen When?

Project Phases:

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

Concurrent Activities

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



D-B Project Management Tools

- Owner/Supplier/D-B Project Management Responsibilities
- Document Controls (Define)
  - What GC Performs?
  - What Engineer Tracks?
  - What does GC/Eng do for Owner Procured Equipment?
- Safety
- QA/QC
- Change Management Process

Design Phase

- Formal Design Submittals/Reviews: 30%/60%/100%
- Informal Over-the-Shoulder
- D-B Responsible but Owner Participates:
  - Vendor Equipment Submittals and Review Process
  - Contractor and Subcontractor Submittal Reviews

Construction: Keys to Implementation

How Project insured 24/7 operation during construction:

- Daily Coordination Meetings
- Weekly 3 Week Look-Aheads / Planning Sessions
- Direct Access to Engineer by Owner and O&M Staff for Immediate Problem Solving
- GC/Subs past experience with plant was helpful

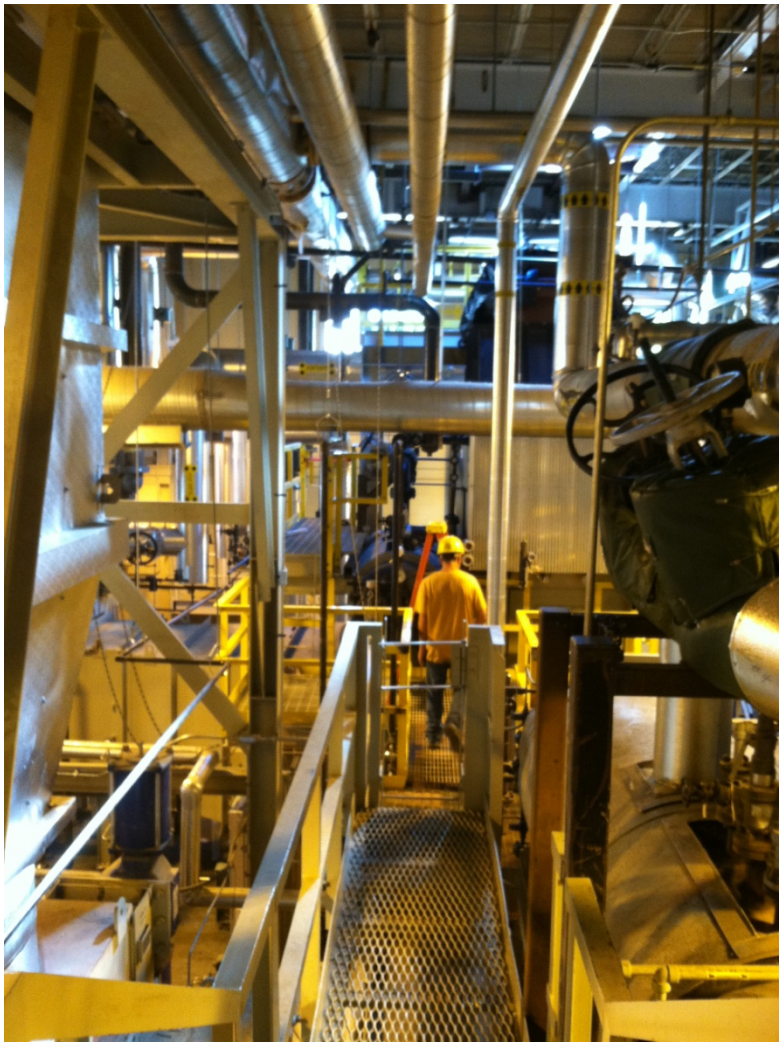
Keys to Successful Commissioning

- Authority of Cx Agent established early
- Cx staff involved during design and procurement
- Vendor coordination
- Detailed Cx Plan
- Functional Testing Procedures
- Plant Integrated Performance Testing
- Training Program

Lessons Learned

University of New Mexico 7MW CHP (Expansion)

- X Owner did not know what the interactions and consequences of testing and running existing equipment with new would be.
- X Lack of some vendor data slowed trouble shooting
- ✓ Qualified operators made the difference
- ✓ CTG failure during startup: Local service made difference quick back in service
- ✓ Forced on-site interaction between parties during startup and final commissioning enhanced problem resolution.



Key Take-Aways

- Owner should be prepared to take an active leadership role in project management
- Select qualified/experienced GC, Engineer and local install subs
- Get operators involved early
- Owner procurement of Long Lead Equipment =
  - Establish long term vendor/owner relationship ASAP
  - Also saves time and $$
- Design-Build decision requires significant Cx planning/development up front
- Value Given to All Parties Working to Same Goal (By meeting project goal, individual goals also met)

Results: “Best in Class” Project

- Met Extremely tight Capital Budget
- Delivered 3 Months ahead of Summer Demand
- Incentives Provided and paid to D-B Team
- Plant met Performance for capacities, efficiencies, performance, emissions and noise
- High quality design, equipment selection, installation and commissioning process
- Great Relationships with All Stakeholders
- Project was “Fun” to Execute