Simulating Success at Antelope Valley Station

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Basin Electric Power Cooperative

Antelope Valley Station

- Coal
- Nuclear
- Renewable Power
- Oil, Diesel, Jet Fuel
- Natural Gas
- Hydropower

Unspecified purchased power 5.5%
Recovered energy 0.7%
Wind 20.3%

6,697.9 MW Maximum Winter Generation Capacity End of Year 2017

- Coal 44.7%
- Natural gas 20.4%
- Oil/diesel/jet fuel 2.8%
- Hydro 4.7%
- Nuclear 0.9%
Basin Electric Power Cooperative

Serving 3 Million Consumers

Incorporated 1961

Member Owned

Member Driven

2,300+ Miles High-Voltage Transmission

141 Members

More Than 2,300 Employees
Justification

• Operations staff age/turnover
• On-The-Job training relied upon
• Unexpected events
• Insurance requests
• Only coal station in fleet without simulator
Previous Simulator Struggles

• Not enough attention on the simulator
  – Part of Distributed Control Systems (DCS) projects
  – Lacking tight specs
  – Vendor driven
  – DCS checkout tool

• Contract structure
  – Simulator was a sub-contract under the DCS vendor
Decisions

• Key plant personnel involvement
• Where to locate simulator
Decisions

• Fidelity table

**Table 3-1: Scope/Fidelity of System Simulation**

<table>
<thead>
<tr>
<th>System Models</th>
<th>Level of Model Complexity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Full</td>
</tr>
<tr>
<td>I. Boiler / Furnace / Fuel / Air / Flue Gas Systems</td>
<td>Describe any simplification being Proposed</td>
</tr>
<tr>
<td>Boiler including water walls, superheaters, reheaters, economizers, drains, vents, air leakage</td>
<td>![ ]</td>
</tr>
<tr>
<td>Boiler drum and forced circulation, safety valves</td>
<td>![ ]</td>
</tr>
<tr>
<td>Superheat and Reheat attemperators and spray valves</td>
<td>![ ]</td>
</tr>
<tr>
<td>Boiler Blowdown system</td>
<td>![ ]</td>
</tr>
</tbody>
</table>
Contracting Strategy

Owner’s Engineer

Furniture

DCS Hardware

Room Renovation

Model Vendor

CASSPER Simulation Solutions

BASIN ELECTRIC POWER COOPERATIVE
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Timeline of Project

Dec 2014
Conceptual Project Development

Feb 2016
Estimation & Approval

Mar 2016
Owner’s Engineer

Aug 2016
Model Award

Sept 2016
Testing Begins

Dec 2016
Hardware Purchase

April 2017
Room Renovation

Aug 2017
Site Acceptance
Cassper’s Involvement

• Project planning
• Model vendor selection
  – Bid review
  – Reference phone calls
• Heat and mass balance review
• DCS Hardware review
• Project design and testing oversight
• DCS configuration and backups
Keys to the Simulator Spec

• Focused on engineering scope and engineering metrics
  – Not software capabilities or plant’s equipment.

• Used all project-specific wording and removed the rest.
  – Kept it clean and itemized, not simple.

• Required bidder itemization
  – To allow for comparison, follow-up questions, and bid evaluation.

• Make sure Utility is in control
  – Defined/required project milestones, gates, deliverables, methodology, and meetings.
Owner’s Engineering for the Spec

• Discussion and Education:
  – Discussed challenges and needs of the plant.
  – Educated them on what is available in the industry.
  – Integrated what they thought they wanted with what they didn’t know they wanted.

• Agreed to Quantities:
  – Not all projects do this. Customized the metrics, quantities, deliverables, and acceptance criteria.

• Balance Scope, Schedule, and Budget:
  – Worked toward a budget, but allowed for an opportunity to be surprised by the bids.

• Customized spec & project plan accordingly.
Bids and Evaluation

• Matched/Narrowed bidders based on needs of the plant. (Top Tier)

• Evaluations:
  – The evaluation table can only be as good as the spec’s bidding requirements.
  – Some read-between-the-lines was required. Went beyond the marketing material.
  – Asked follow-up questions of the Bidders on:
    • Typical “difficult to model” areas.
    • Problem areas that are important to the plant.
    • The known vendor problems.

• Existing references are very informative but have to be taken with caution.
Owner’s Engineering for Evaluations

• Presented/educated the plant on:
  – The advantages/disadvantages of each option and each vendor.
  – The value of the proposed features to the plant. (or lack there of).
  – The unacceptable, the deal-breakers, and the must-haves.
  – The lesson’s learned from past experiences.
  – How important the “controls side” of the project is.
  – And many other things.

• Customized the recommendation based on the plant’s feedback.
Stages of the Sim Project

Data and Definitions:
• Provide initial data before Kick-off.
• Kick-off meeting refines scope and adds details.
**Stages of the Sim Project**

**Aug 16 (1 month)**

**Fall 2016 (2 months)**

**Data and Definitions**

**Design Spec and Model Baseline:**

- Review/approve Design Spec – reconfirms/restates the spec metrics, not change them.
Stages of the Sim Project

- **Aug 16 (1 month)**
  - Date and Definitions
- **Fall 2016 (2 months)**
  - Design Spec and Model Baseline
- **Dec 2016 (2 months)**
  - Controls configuration, integration, and communication Test
    - Tested DCS/Sim bridge software after I/O connected.
Stages of the Sim Project

Aug 16 (1 month)  Fall 2016 (2 months)  Dec 2016 (2 months)  Jan 17 (2 weeks)

Date and Definitions
Design Spec and Model Baseline
Controls config, integration, & comm test

Programming and Milestone Design Reviews
Stages of the Sim Project

Aug 16 (1 month)  
Fall 2016 (2 months)  
Dec 2016 (2 months)  
Jan 17 (2 weeks)  
April 17 (5 months)

Date and Definitions
- Design Spec and Model Baseline
- Controls config, integration, & comm test
- Programming & Milestone design reviews

Testing Phases:
- Steady-state review (no controls)
- Pre-FAT, FAT, Shipment, SAT
Why Simulator Projects Fail

• Poor pre-project work with the plant/utility, or poor budgeting.
• Poor scoping to match what the plant needs, or is required to make it usable. Or no spec at all.
• Not enough testing. Vendors underbid testing.
• Poorly defined acceptance criteria.
• Poor preparation to use it long term.
• All non-simulator areas have to be “right”:
  – The room, lights, electrical, HVAC, chairs, noise level, training material, on-going maintenance.
Challenges

• DCS Hardware
  – Multi-network
  – New switches, PCs
  – New Virtual Controller software
  – Monitor selection

• Model Development
  – Theoretical vs. historical data
  – Data capture included odd operational states

• Testing
  – Consistent personnel
  – Schedule
  – Managing expectations

• On-site
  – Backup & remote connection
  – First use after delivery
Simulator Room Location
Room Renovation
Final Installation
Testing
Questions?