



An Energy Efficiency Workshop & Exposition

Palm Springs, California

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and***

Set pagers to vibrate





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Palm Springs, California

Measurement and Verification; A Case Study and Partnership





Presenters

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Portsmouth Naval Shipyard (PNS)

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Select Energy Services, Inc. (SESI)



Portsmouth Naval Shipyard Kittery, Maine

- Mission: Nuclear Subs
- Island, Historical, Defense
- 297 Acres, 316 Buildings, 297 Housing Units
- Distribution Piping: 7 miles steam, 4 miles condensate, 6 miles hot water return and supply
- Controlled Industrial Area (CIA)
- Drydocks, Nuclear Facilities, Cranes
- Boiler / Central Power Plant
- Total Facilities Budget: \$35 Million
- Utilities Budget: \$12 Million



Getting Involved with ESPC

Pre-Dec 97 PNS performs efficiency upgrades using DSM

Dec 97 U.S. Navy SmartBase program introduces PNS to
ESPC

Dec 97 PNS holds 2-day Site Survey / Presentations Meeting

- **3 ESCOs**
- **Tour of Shipyard together**
- **Presentation of Qualifications**
- **Briefing to PNS of findings by ESCO**

Jun 98 ACOE & PNS Selection of ESCO

Oct 98 ACOE & PNS Sign MOA



A Program on a Mission

Dec 98 ESPC Kick Off Meeting

Mar 99 Site Survey Report Presentation / Meeting

- 10 year project, fully financed
- No cost avoidance claim allowed
- No maintenance savings claim allowed

May 99 Pre-Proposal Audit Presentation Meeting

Jun 99 Final Proposal Presentation

Aug 99 Task Order Award



Project Snapshot

- **\$10.9 Million Investment**
- **\$2.1 Million Annual Energy Savings**
 - **Power Plant Upgrade**
 - **Steam Trap Maintenance Program**
 - **Hot Water / Steam Distribution System Upgrade**
- **Sep 99 – 00 Construction in Progress**
- **Dec 00 – Installation Complete / Government Acceptance**



**Portsmouth Naval Shipyard Gas
Turbine Ribbon Cutting
(22 Feb 2001)**



June 2-5, 2002

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ECSM-1 Power Plant Upgrade

- Scope of Work
 - (1) 5.2 MW gas turbine generator w/HRSG
 - Retain steam TGs #5 & #7, TG #6 out of service
 - Operate gas turbine year round
 - Shut down 600# boilers in summer months
 - Operate all turbines in winter months



ECSM-1 Savings

- Savings result from:
 - Increased electric generation efficiency due to the cogeneration system (gas turbine with HRSG)
 - Increased efficiency of generating steam at 200 psi versus 600 psi
 - Increased electric generation
 - Ongoing maintenance of new and existing equipment



ECSSM-2 Steam and Hot Water System Improvements

- Scope of Work
 - Shut down 2,575 feet of steam and condensate piping
 - Install individual boilers in 5 buildings
 - Replace / maintain steam traps
 - Modify hot water pumping systems, VFD control



ECSSM-2 Savings

- Savings result from:
 - Improved boiler plant efficiency
 - Reduced steam distribution losses
 - Reduction in lost condensate
 - Reduction of steam leaks
 - Repair or replacement of a large quantity of improperly functioning steam traps
 - Improved hot water pumping efficiency



An M&V Plan is Kind of Like a Pre-Nuptial Agreement

- No one really likes to talk about it, but it lays out a plan for how to deal with the unexpected
- What's at stake?
 - Savings guarantee
 - Contractor payment
 - Integrity of system performance
 - Your relationship



Business Issues Related to the M&V Plan

- Realizing Savings = Contractor Payment
- How complex is your plan?
 - Financier's view on savings stream
 - Dollars saved vs. dollars spent
 - Accuracy vs. Precision
- Operations & Maintenance
 - Trade-offs with M&V



Selecting the Appropriate Level of Verification Effort

Energy Measure	Investment	Projected Annual Savings	Annual M&V Cost	Annual O&M Cost
ECISM-1 Power Plant Upgrade	\$9,941,217	\$1,789,842	\$23,630	\$236,068
ECISM-2 Measure	\$1,026,480	\$330,737	\$12,734	\$81,595
Total	\$10,967,697	\$2,120,579	\$36,364	\$317,663

ECISM-2 Measure Breakdown	Projected Annual Savings	Annual M&V Cost	Annual O&M Cost
Boiler Decentralization	\$48,282	\$2,678	\$1,451
HW Pumping Upgrades	\$9,958	\$2,168	\$795
Steam Traps	\$272,497	\$7,888	\$79,349



ECSSM-1 M&V Protocol

- Uses a combination of FEMP Guidelines, where SESI verifies *equipment performance and availability*
 - Option A involves stipulated values derived from engineering models and verification of the equipment's potential to perform
 - Option B involves procedures for verifying equipment performance through engineering calculations and long-term metering by end use



Year 1 - System Availability

- Cogeneration system will be available a minimum of 85% of the time annually for electricity and steam production

Month	Total Monthly Hours	Actual Equipment Availability (Hours)	Equipment Unavailability Due to SESI Responsibility (Hours)	Equipment Run-Time (Hours)	Hours Equipment Not Operated by PNS
Dec 2000 – Nov 2001	8,016	7,853	162	6,875	979
Dec 2001	744	460	284	460	0
Year 1 Totals	8,760	8,313	446	7,335	979
Year 1 %	N/A	94.9%	5.1%	83.7%	11.2%

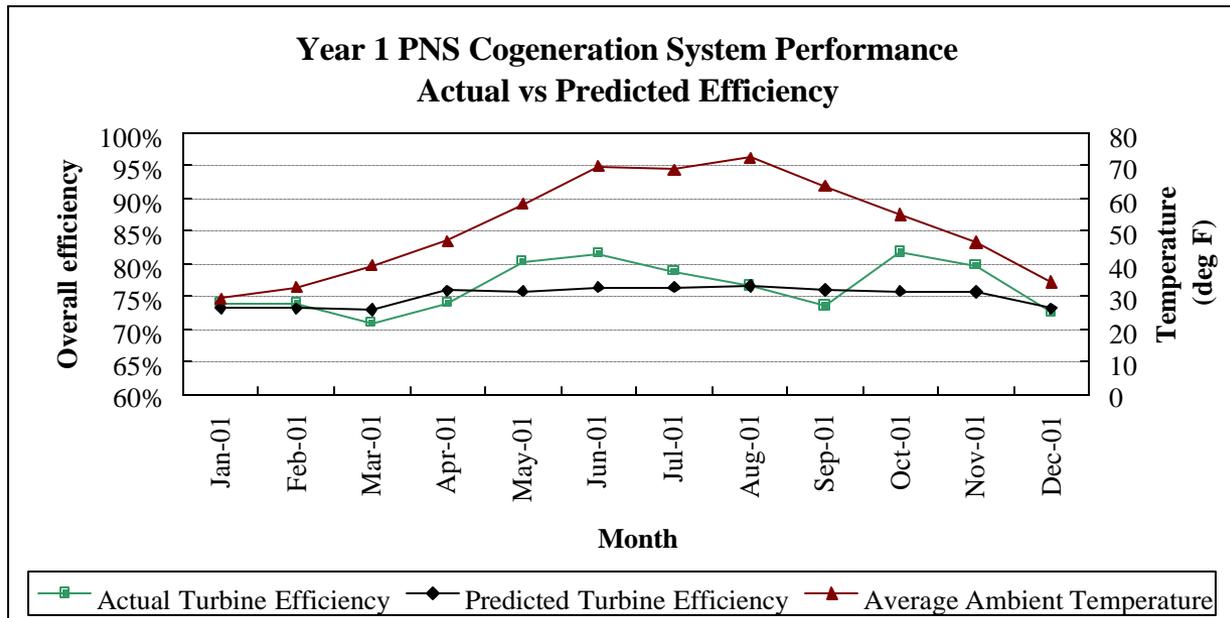


Year 1 – System Efficiency

Month	Average Ambient Temperature (°F)	Actual System Efficiency	Predicted Efficiency
Jan 2001	29.3	73.9%	73.3%
Feb 2001	32.7	73.8%	73.2%
Mar 2001	39.4	71.0%	73.0%
Apr 2001	47.1	74.0%	75.8%
May 2001	58.2	80.4%	75.8%
Jun 2001	69.8	81.6%	76.4%
Jul 2001	68.8	78.8%	76.3%
Aug 2001	72.5	76.6%	76.3%
Sep 2001	63.7	73.6%	76.0%
Oct 2001	55.0	81.8%	75.8%
Nov 2001	46.7	79.8%	75.7%
Dec 2001	34.4	72.6%	73.1%
Annual Averages	51.4	76.5%	75.1%



ECSTM-1 Cogeneration System Performance



Please note that the cogeneration system efficiency varies with ambient temperature, equipment loading, and duct burner operation.



ECSSM-2 M&V Protocol

- Boiler Decentralization Protocol (Option A)
 - This measure includes the installation of 5 new, decentralized no. 2 fuel oil fired boiler plants
 - Protocol verifies that the boilers are well maintained on an annual basis
- Hot Water Pumping Protocol (Option A)
 - This measure includes the installation of a variable speed drive on Pump #2 located in the boiler plant
 - Protocol verifies equipment performance through annual inspections



ECSSM-2 M&V Protocol

- Steam Trap Protocol (Option A and Option B)
 - Includes trap testing and repairs
 - 100% of steam traps (1162 building traps, 102 distribution traps, and 85 power plant traps) were tagged, tested initially and replaced or repaired as necessary
 - Created steam trap database documenting steam trap population, location, condition and repair action
 - Performance is demonstrated through annual inspections, testing, and maintenance conducted during the winter months.



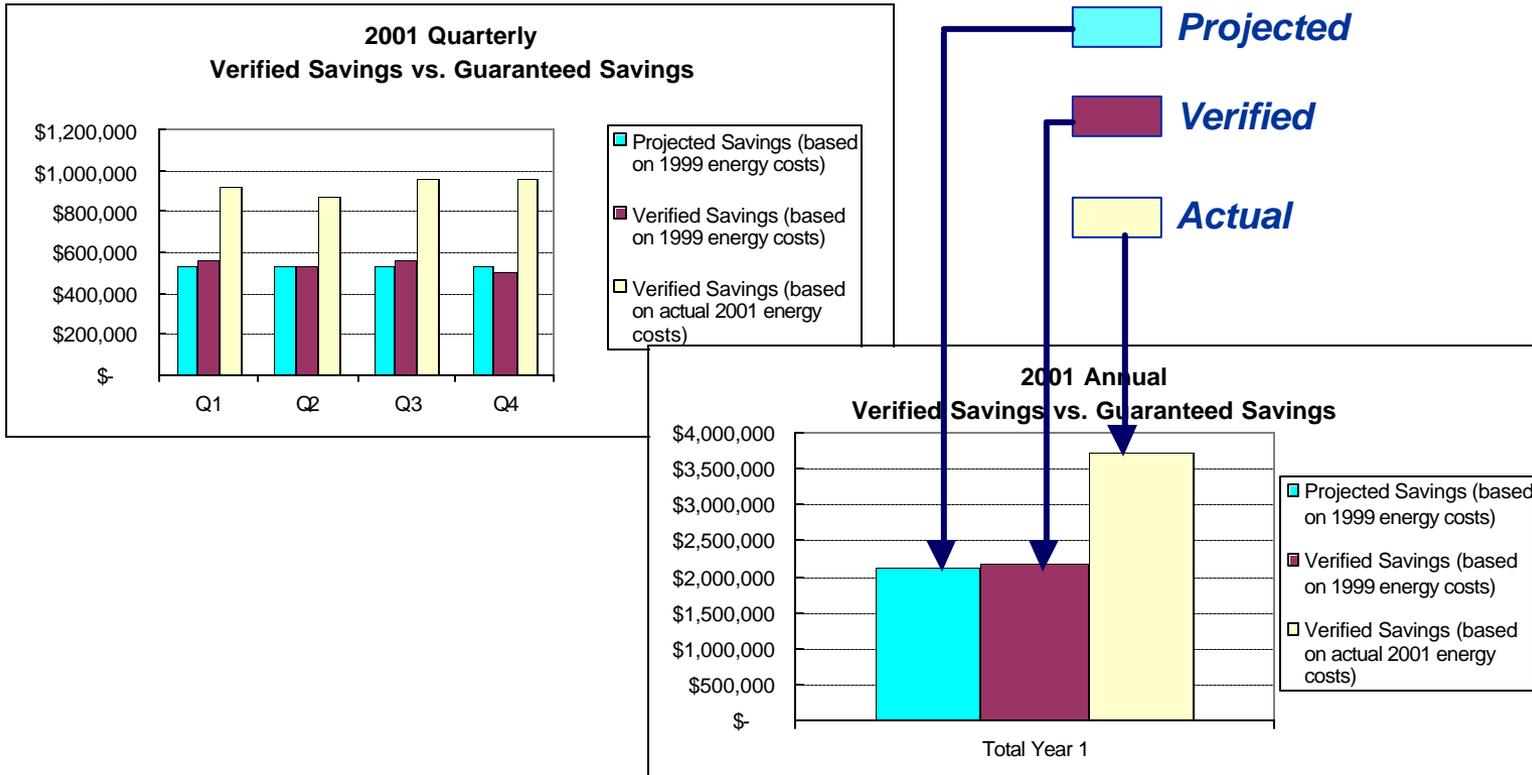
ESPC Projected & Verified Energy Savings

Total Year 1	Power Plant Upgrade	Steam / HW System Improvements	Total Savings
Projected Energy Savings (Based on 1999 energy costs)			
	\$1,789,842	\$330,737	\$2,120,579
Verified Energy Savings (Based on 1999 energy costs)			
	\$1,836,667	\$329,121 *	\$2,165,788
Verified Energy Savings (Based on 2001 energy costs)			
	\$2,821,571	\$889,363 *	\$3,710,934

* Verified Savings for Steam / HW Sys Improvements include a steam trap savings adjustment.



2001 ESPC Energy Savings





Purchased Electricity

	FY99 Before Deregulation		FY01 After Deregulation		
	Non-Winter Billing Months	Winter Billing Months	Winter	Off-Winter	Summer
	Apr – Nov	Dec - Mar	Dec - Mar	Apr, May, Sep, Oct, Nov	Jun - Aug
Demand Charge per kW					
On-Peak	\$2.10	\$10.95			
Shoulder	\$0.36	\$2.24			
Energy Charge per kWh					
On-Peak	0.047098	0.058710	0.1007	0.0939	0.1500
Shoulder	0.046670	0.055909	0.0991	0.0599	0.1497
Off-Peak	0.042242	0.047712	0.0605	0.0573	0.0668



Cost Comparisons

(Based on FY99 Energy Rates)

	FY01 Costs with ESPC 1	FY01 Costs without ESPC 1
Electricity Generated	40,635 MWH	10,080 MWH
Electricity Purchased	34,391 MWH	64,946 MWH
Purchased Electricity	\$3,041,763	\$6,115,336
Purchased Fuel	\$9,158,088	\$9,158,088
ESPC Payment	\$2,106,494	\$0
Electric Delivery Cost	\$133.01 / MWH	\$133.48 / MWH
Steam / Heat Delivery Cost	\$30.65 / MBTU	\$33.71 / MBTU



ESPC Project Benefits

- Paid through Energy Savings for 10 years
 - 10 year project, fully financed
 - No cost avoidance claim allowed
 - No maintenance savings claim allowed
- Contractor Owns and Maintains Equipment
- PNS Operates Equipment
- O&M and M&V are part of Annual Payment
- Significant reduction in future O&M costs



Was It All Roses?

- Commitment to a Partnership guided PNS and SESI through challenging issues
 - Utility Protest
 - Unexpected Shipyard-wide Power Failure
 - Rail strike and uncooperative State Highway Commissions during equipment delivery
 - Construction delays due to special Shipyard mission requirements



What's Next?

- Build on success of ESPC #1 with additional upgrades
 - Improve reliability / efficiency of Shipyard's generation capacity
 - Shipyard-wide lighting upgrades
 - Compressed Air System Maintenance Program
 - Decommissioning of Hot Water System



In Summary

- This is a long term deal
- Develop your M&V plan together
- Document, document, document
- Play nice: If majority of risk is borne unfairly by one party or the other, then there will sour grapes from the start
- Expect the unexpected



Question & Answer

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30