DSOM® - Decision Support for Operations and Maintenance – Application to a USMC Base Centralized Energy System

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Discussion Topics

- Parris Island Background
- Central Energy Co-generation Plant
- Weapons Area Steam Plant
- Energy Management and Control System
- Wastewater Treatment SCADA System
- Savings Summary

Background

- USMC Facilities aging
- Various control systems could not talk to each other
- PNNL requested to provide latest technology solution
- PNNL designed technology applications from a facility-wide perspective
- Built in diagnostics and energy conservation recommendations

Central Energy Plant

- Three 400 psig steam boilers can provide steam to supply three 1-kW extraction steam turbine generators plus 125 psig site steam loads
- One 125 psig boiler to supply site steam when generation is not required
- Natural Gas fired with #2 oil backup
- Costly penalties for exceeding electrical demand peak for more than 15 minutes

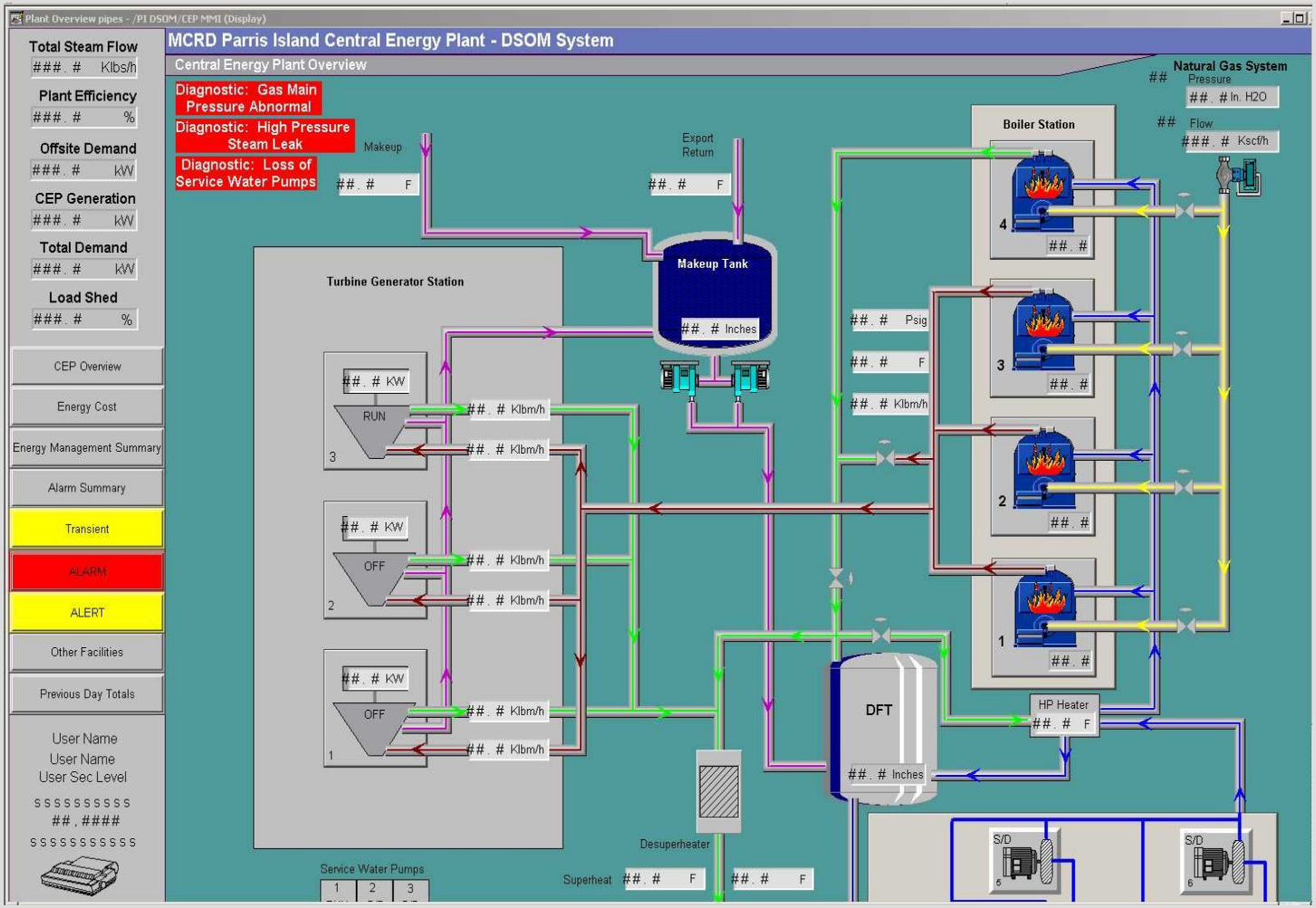
DSOM

- Tells operator :
  - What current condition is
  - What current condition should be
  - What to do about it
- Provides information for approximately 40 diagnostics
- Provides similar information for all alert and alarm conditions

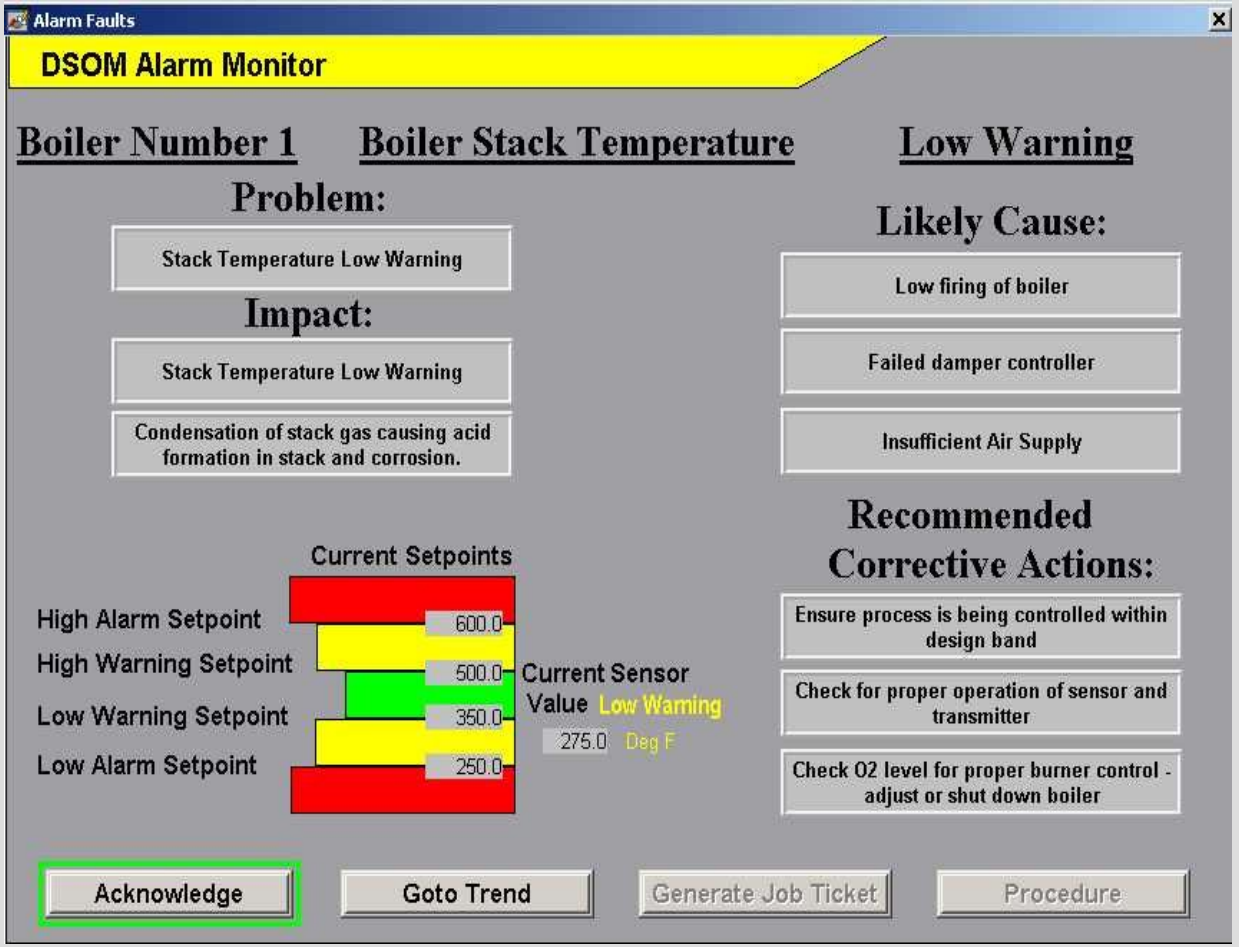
DSOM – CEP Asset Manager

- Provides operator guidance on:
  - When to start boilers
  - Which boilers to start
  - When to bring steam turbine generators on-line
  - Which generation combination is most efficient
  - How to distribute loading
  - When to shutdown generators
  - When to shutdown boilers

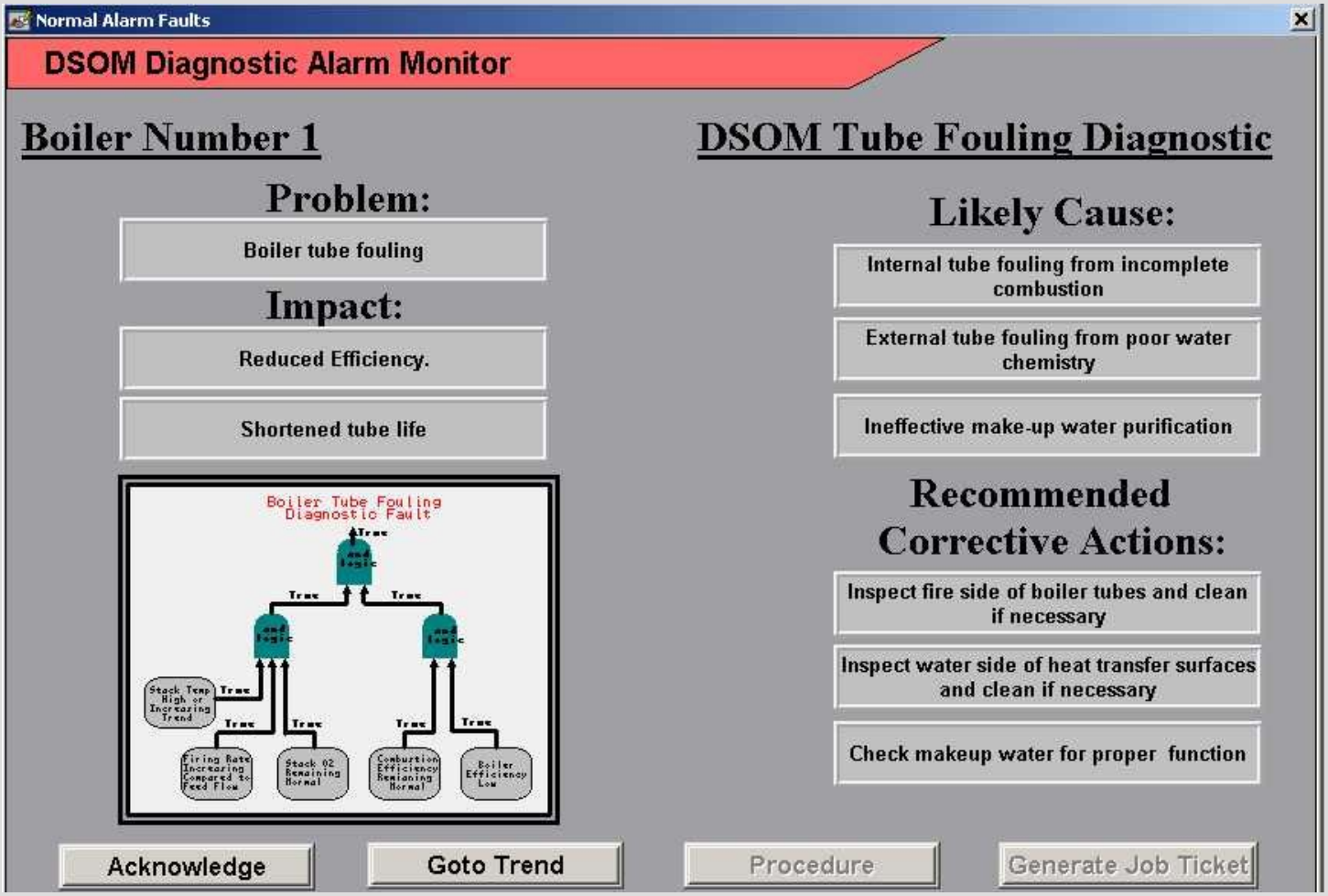
CEP Overview Display



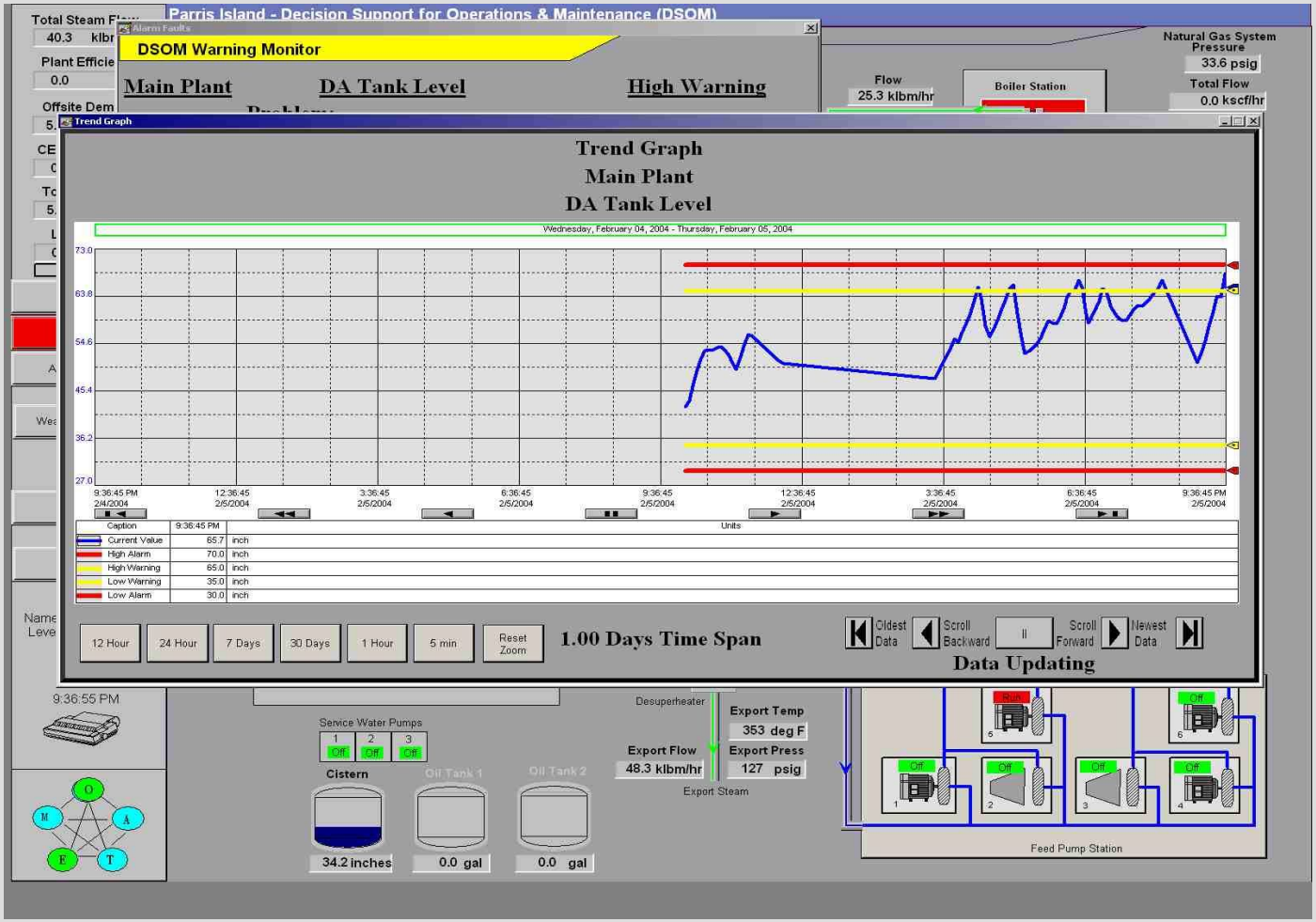
DSOM – CEP Alert Display Example



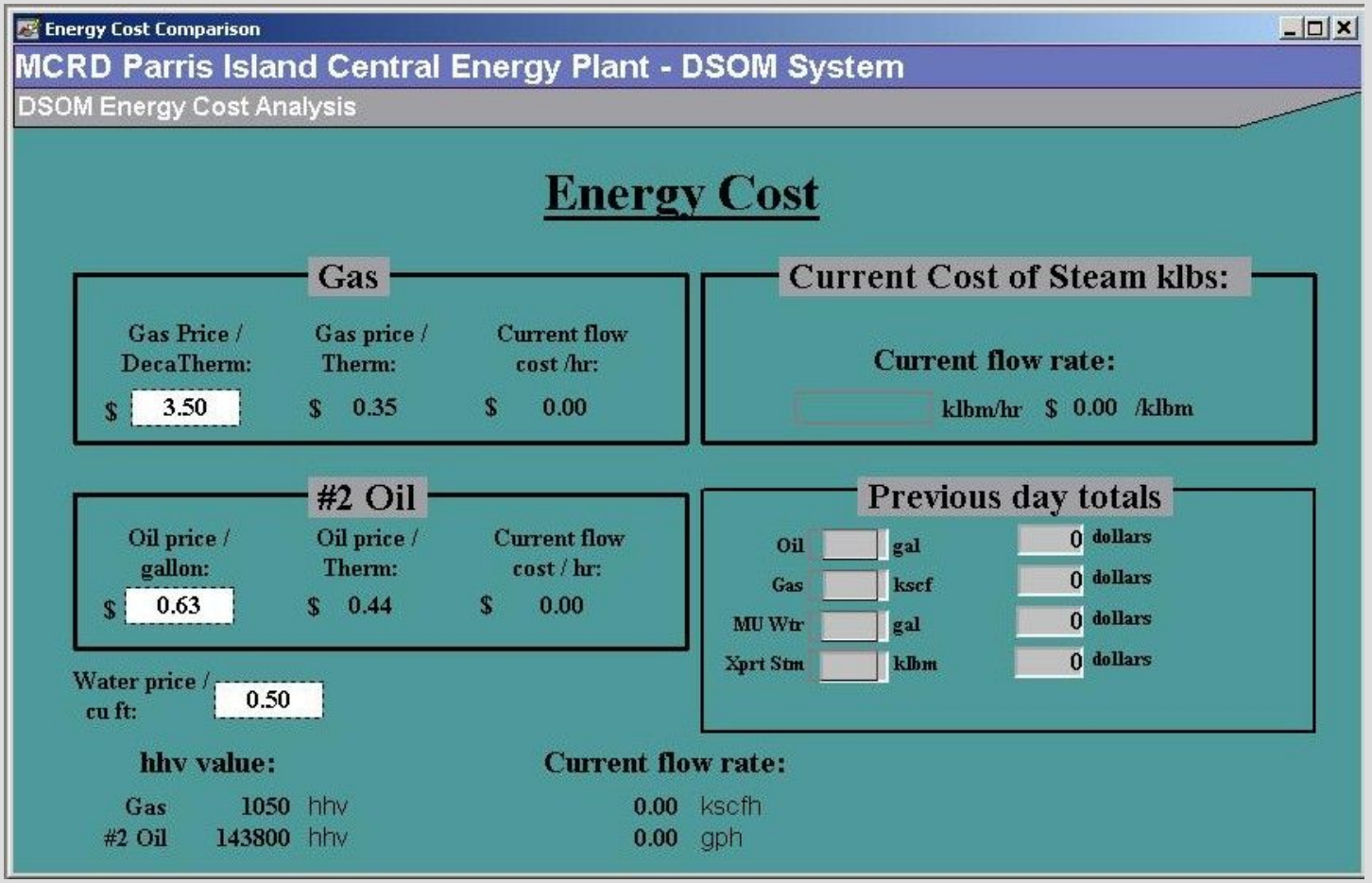
DSOM Diagnostic Display



DSOM – CEP Engineering Trend Display



DSOM – CEP Energy Cost Analysis



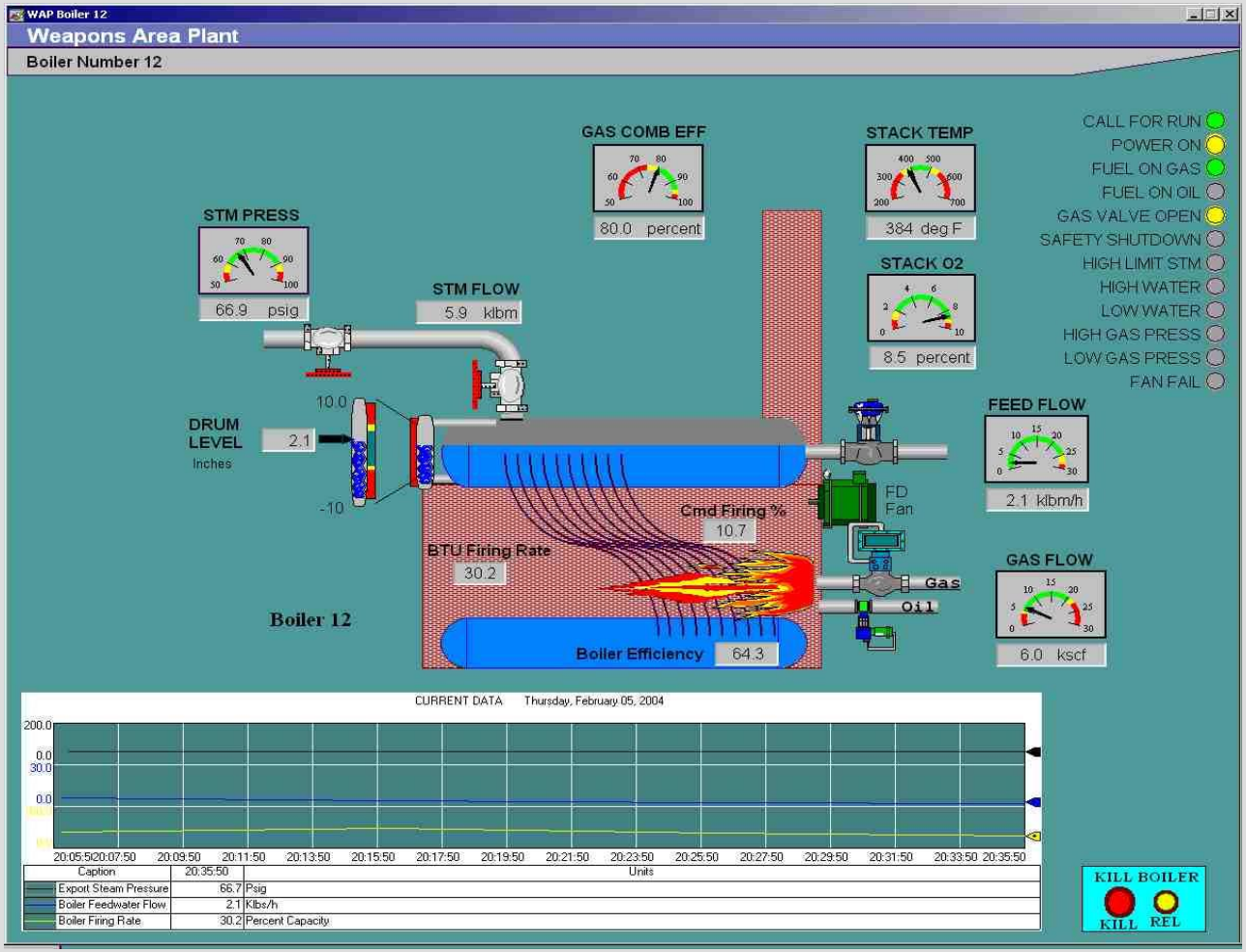
DSOM – Weapons Area Plant

- Three 125 psig steam boilers to supply Weapons Area loads
- Manned 24 hours, 7 days a week
- Lack of qualified personnel
- DSOM allowed full remote monitoring with S/D control from CEP
- DSOM allowed unmanning of the plant

DSOM – Weapons Area Plant

- Same software as used at CEP
- Efficiency and parameter monitoring
- Can detect
  - Boiler tube leakage
  - Boiler tube fouling
  - Steam drum water level control malfunctions
  - Excessive firebox heat loss
  - Over-firing and stack gas condensation alarms

DSOM – WAP Boiler 12 Display



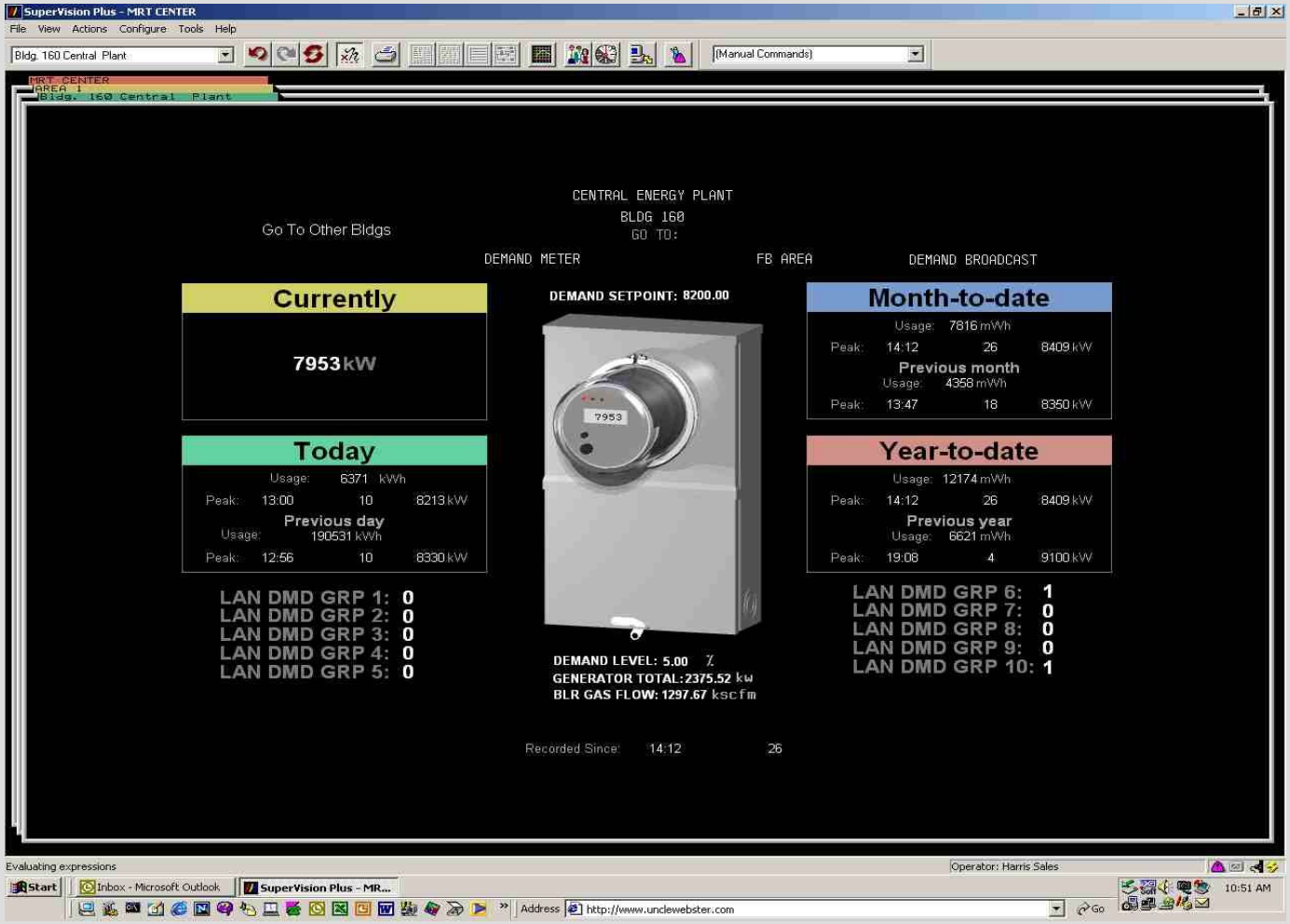
Energy Management and Control Systems

- Five different independent building control systems installed
- AC&R shop would send out personnel in trucks to reduce Base load demand
- PNNL engineered system upgraded all with open protocol system
- Designed to coordinate with DSOM at CEP to manage and automatically shed load

EMCS Load Shed Scheme

- CEP asset manager sequences generation requirements
- EMCS allows for building zone temperature control and occupied/un-occupied modes
- When target Base load is exceeded, load shedding sequence is activated
- Will not allow demand to exceed peak

EMCS Demand Load and Status



EMCS Load Shedding Sequence

Demand Group	Stage 1 (kW)	Stage 2 (kW)	Stage 3 (kW)	Stage 4 (kW)
1	7517	7617	7717	7817
2	7527	7627	7727	7827
3	7537	7637	7737	7837
4	7547	7647	7747	7847
5	7557	7657	7757	7857
6	7567	7667	7767	7867
7	7577	7677	7777	7877
8	7587	7687	7787	7887
9	7597	7697	7797	7897
10	7607	7707	7807	7907

EMCS LAN Demand Stages

- **LAN DEMAND Stage # 1** : Resets thermostat set points out 1° F from set point and the chilled water valves stay at 100% capacity.
- **LAN DEMAND Stage # 2** : Resets thermostat set points out 2° F from set point and the chilled water valves close to 75% capacity.
- **LAN DEMAND Stage # 3** : Resets thermostat set points out 4° F from set point and the chilled water valves close to 25% capacity.
- **LAN DEMAND Stage # 4** : Turns main chiller off, and as a backup, closes all the chilled water valves.

EMCS Summary

- Energy Controls Technician can program all load shedding groups and stages according to Base priorities

- 60 buildings are on-line and are controlled to reduce demand by nearly 2 MW over approximately 3.3 million square feet of building space

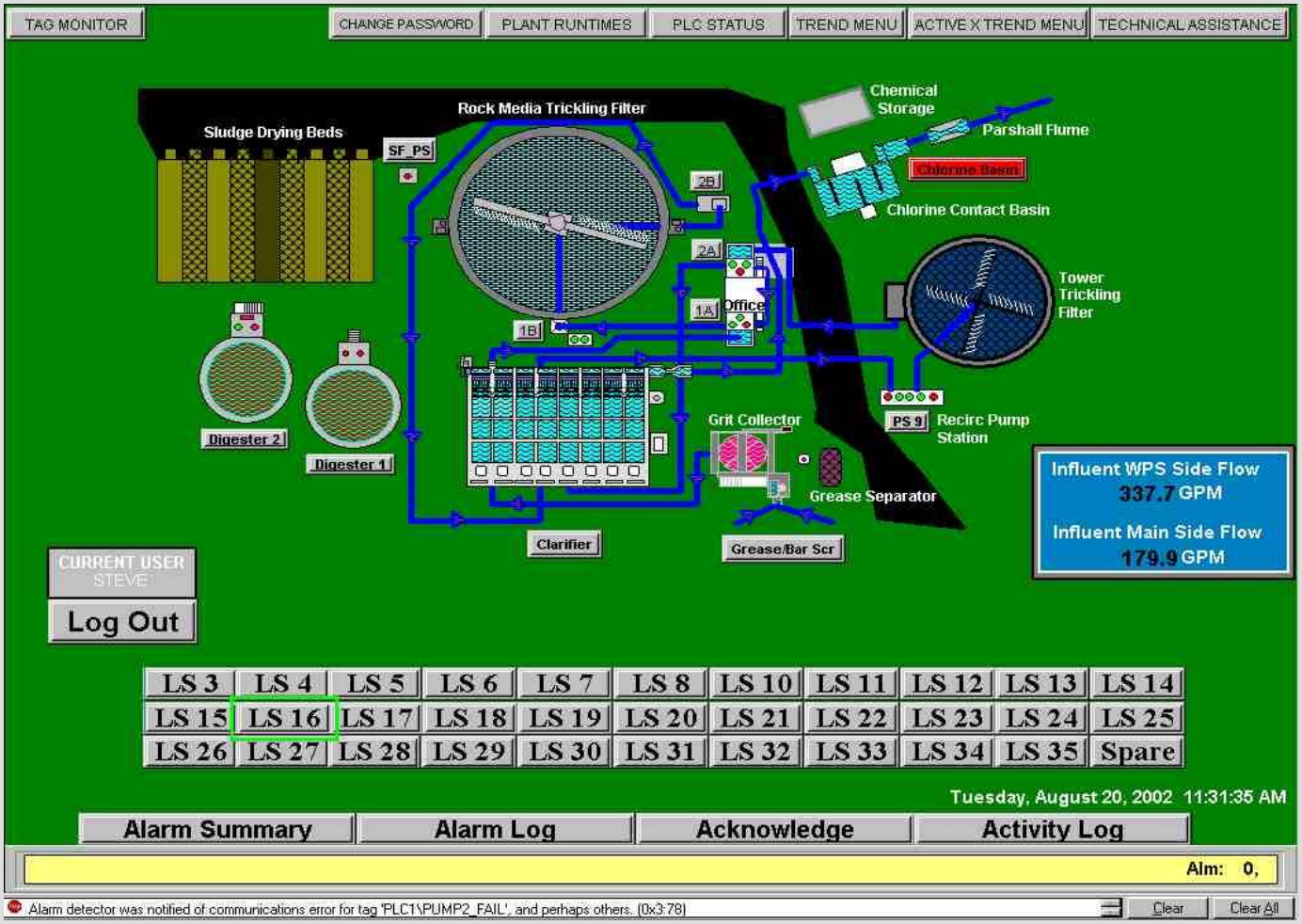
Wastewater Treatment Plant

- Main processing plant with 38 lift/pumping stations
- Capable of processing up to 1.5 million gallons per day
- Concern for spills and environmental conditions due to aging system in disrepair
- PNNL engineered master plan to modify, upgrade or replace all of the control software and hardware

Wastewater Treatment Plant Upgrades

- New SCADA control cabinets designed and installed at each lift station and main plant pumping stations
- Radio communications were upgraded
- UPS provided for lift station control cabinets
- Interfaced with DSOM system at CEP
- As with CEP, GUI designed by PNNL for simple point-and-click operation

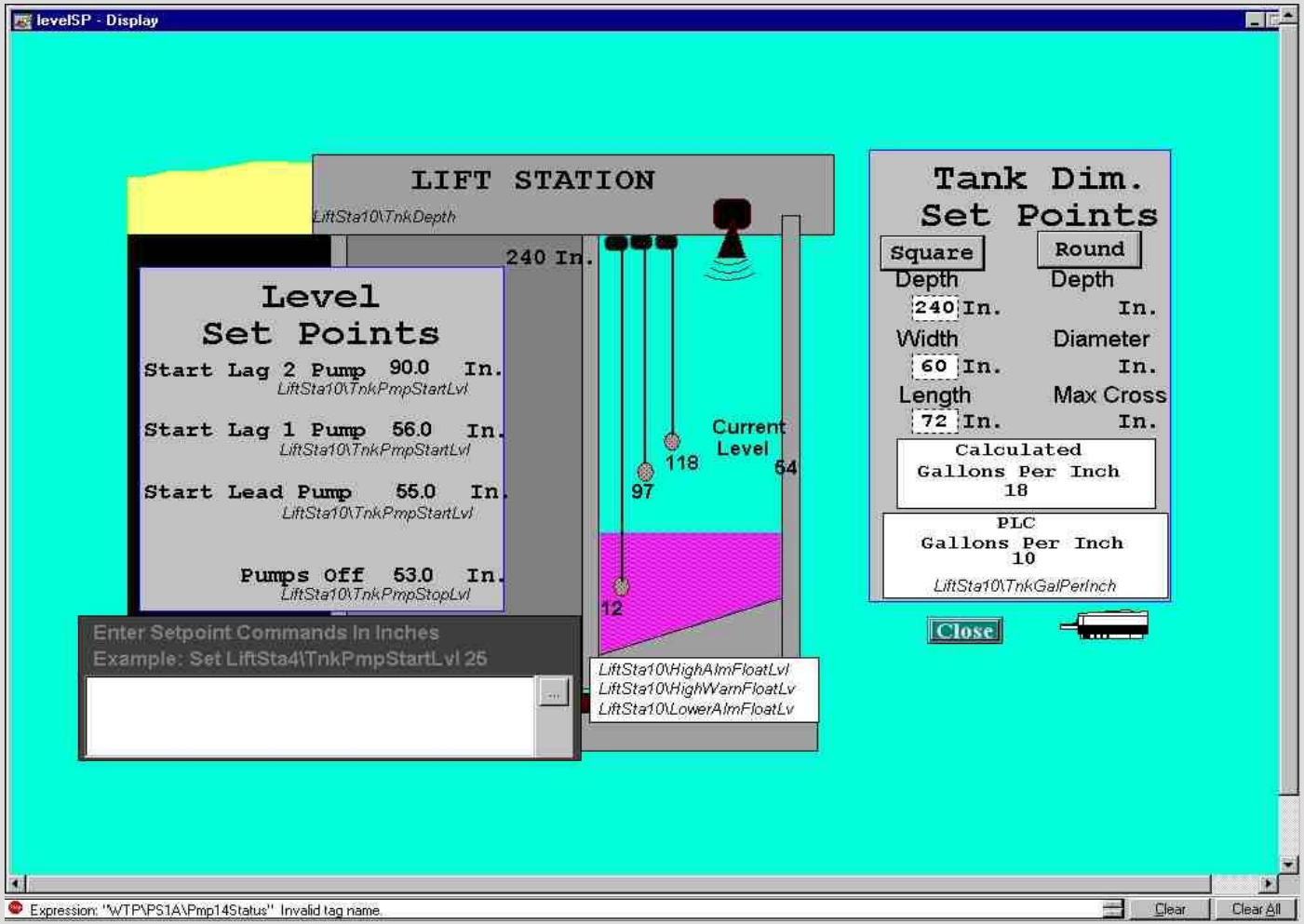
Wastewater Treatment Plant Main Display



Wastewater Treatment Plant Control

- WWTF office /Supervisor has ability to change
  - pump auto start/stop set points and
  - level alarm setpoints
  - Level control setpoints
- Lift station and main processing plant equipment is monitored full time with trending capabilities on run times, pump amperage, and pump capacity

Lift Station Set Points Screen



Energy Savings Summary

- Energy use per square foot went from 51.06 Btu/sqft/dd in the base year FY 1999 down to 45.73 Btu/sqft/dd in FY 2002.

- This is a reduction of 5.33 Btu/sqft/dd or a 10.4% reduction from the base year. This can be attributed to DSOM and EMCS activities resulting in coordinated energy control at Parris Island.

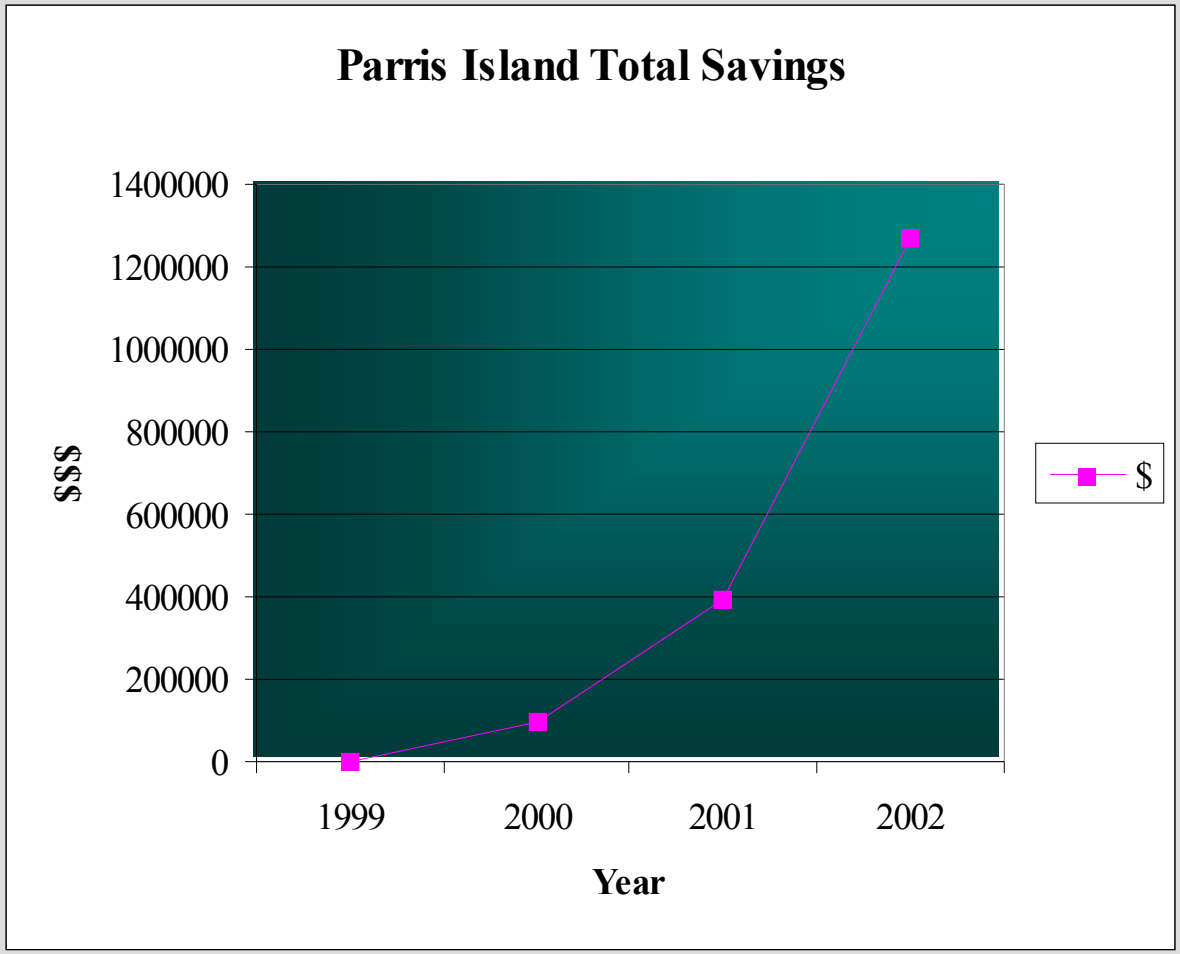
EMCS Load Shedding Sequence

Fiscal Year		Btu/sqft/dd)	Reduction from Baseline	$ Saved
1999		51.06		
2000		49.90	1.16	$94,761
2001		46.82	4.24	$293,501
2002		45.73	5.33	$513,491
2003				

Savings Total

- As of the end of FY 2002, savings total $901,753 dollars from the base year of avoided cost in energy only.
- When additional credit is taken for labor savings (Parris Island has had a net reduction of 8 FTEs because of the DSOM related work), a further reduction of $368K per year would apply starting in FY 2002
- The avoided cost of $513K for FY 2002 corresponds to a 10.4% energy dollar savings and a total labor and energy savings for FY 2002 of $881K for a 3 year total of $1.3M.

Parris Island Energy Savings Graph



Summary

- In the similar EMCS only project at MCAS Beaufort, installation of the PNNL engineered EMCS system has saved them approximately $2.4M over the last 3 years on a $2.6M investment.

- These projects demonstrate that the integration of new technologies engineered to provide a facility-wide approach can have a significant impact on energy and personnel savings.