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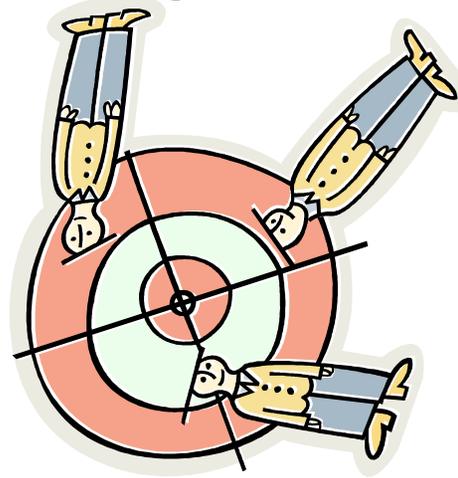
# Combined Heat & Power Plant

A Federal Sector Success Story



# Presentation Objectives

- Describe project process and measures of success
- Identify potential pitfalls for others pursuing CHP



# Who are the Partners?

- VA San Diego Healthcare System
- Honeywell/SES
- Department of Energy



**Honeywell**

Honeywell Building Solutions SES



# VA San Diego Healthcare System



Tertiary-care affiliated hospital and clinics  
serving San Diego and Imperial Counties



# VA San Diego Healthcare System FY05 Statistics

- 53,980 enrolled patients
- 512,771 annual outpatient visits
- 238 beds; 6,941 admissions
- 2,061 FTE
- \$305 million operating budget
- \$62 million Research funding
- \$4 million utilities budget



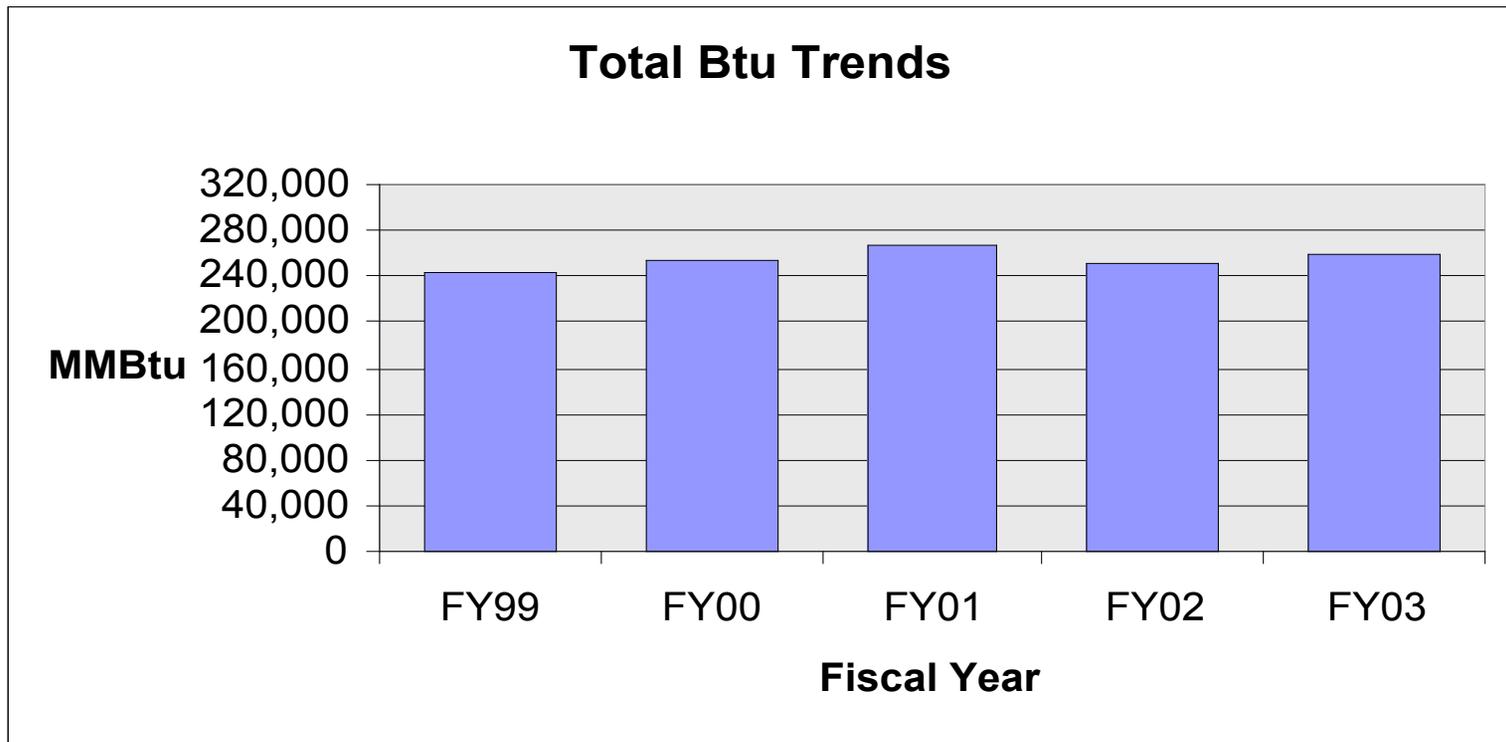
# Honeywell Building Solutions SES

- A Fortune 100 Company
  - 120,000 employees in nearly 100 countries
  - 2005 sales of \$27.6 billion
  
- Global Leader in the Energy Services Industry
  - Helps organizations conserve energy
  - Optimizes facilities and equipment
  - Improves security
  
- A Pioneer in Performance Contracting
  - Completed more than 4,000 energy-saving projects
  - Delivered more than \$3 billion in energy and operational savings to customers
  
- *Frost & Sullivan* 2006 Industry Innovation & Advancement Award recipient

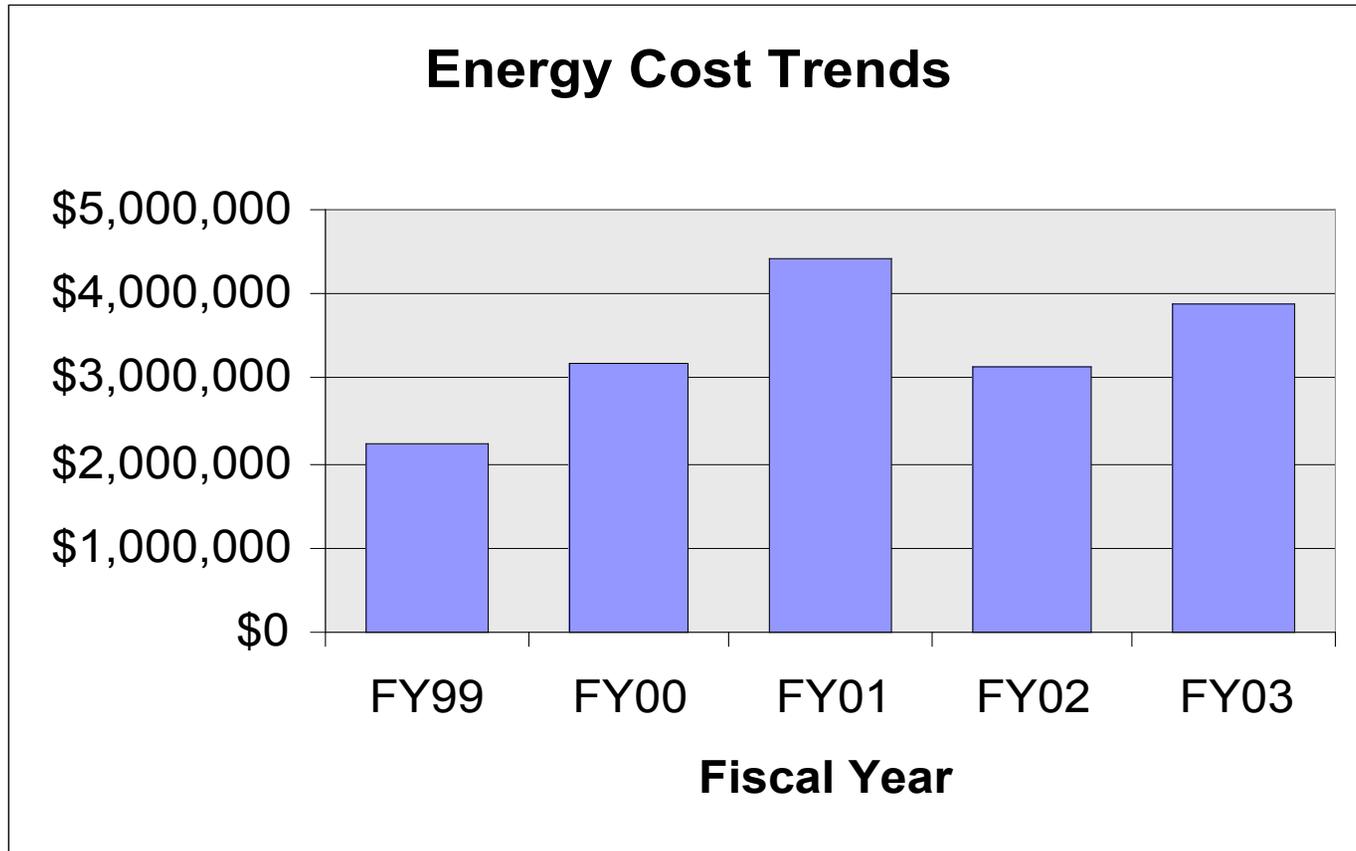
## Background – 2001 to 2003

- Mandated energy reduction goals
- Unstable electrical prices
- 15-yr. old 880 KW cogeneration turbine needing overhaul
- Limited capital funds
- Existing authority for ESPC
- Cogeneration + boiler emissions = Title V pollution limit for minor source

# Energy Use Trends



# Energy Cost Trends



# Desired Changes

- Reduction of operating costs
- Physical hedge – electricity costs
- Pollution prevention through reduced emissions of NOX
- Replacement of capital equipment before failure
- Improved electrical security and reliability

# Other Project Drivers

- Physical hedge against the future cost of electricity
- Provide increased on-site generation to mitigate impact of utility outage through operation in Islanding Mode
- Provide Infrastructure Improvements, and reduce existing on site emissions
- Energy Savings Performance Contracting and CHP application in Veterans Affairs Medical Center
- Avoid Capital Budget Challenges; eliminate Capital appropriation, payments made through guaranteed energy savings.

# Project Objectives

- Infrastructure upgrade with no Out-of-pocket Cost
- Debt Service through Guaranteed Energy Savings
- Demonstrated multiple State-of-the-Art Technologies
- CHP will provide up to 80% of facility's electric and 60% of facility's steam requirements
- Reduced Air Pollutants (NOx) from the Existing Facility CHP
- On-site generation capacity increased system surety and reliability



# Super ESPC Partnership

- Key aspects of the ESPC process
- Role of Dept. of Energy
- The Partnership in practice



**Honeywell**  
Honeywell Building Solutions SES



# Engineering Analysis – Technical Proposal

- Replace 880 kW cogen with 2 @ 2,000 kW gas reciprocating engines
- CHP included HRSG and SCRs
- Replace absorber & centrifugal chiller + new cooling tower
- Add VSDs to air handlers & exhaust fans

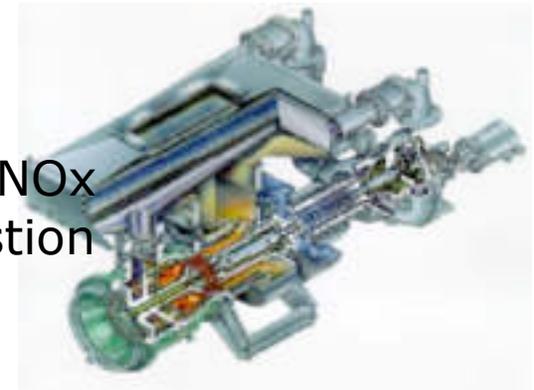
- Assumption of risk
  - Price
  - Commodity
  - Emissions
  - System performance
  - Beta Unit
- Guaranteed energy and cost savings
- Measurement and verification
- Value of emission credits
- Expiration of ESPC authority 9/30/03

# Project Overview

- Equipment Installed:
  - Solar Mercury 50; 4.6MWe Gas Turbine
    - Recuperated gas turbine with Ultra Lean Premix Combustion technology.
    - Controls equipped with Black Start and Islanding functionality
    - Load Shed capabilities
  - Heat Recovery Steam Generator
    - Production of approx. 13,000 lb/hr steam from turbine exhaust.
  - Trane 500-ton Double Effect Absorber
  - New Cooling Tower for Absorber

# Prime Mover Selection

- Project was originally sold with two 2 MW CAT reciprocating engines including:
  - Post combustion Emission Controls (SCR and Urea Systems)
  - Continuous Emission Monitoring -CEMS
- After project award the Solar Mercury 50 was selected for the following reasons:
  - Reduced first costs – no SCR, CEMS, or Urea
  - Better fit for heat production
  - Increased Availability
  - Clean burning technology < 5 ppm NO<sub>x</sub>
    - Ultra Lean Premix (ULP) combustion technology developed by Solar
  - Reduced life cycle costs



## Solar Turbines

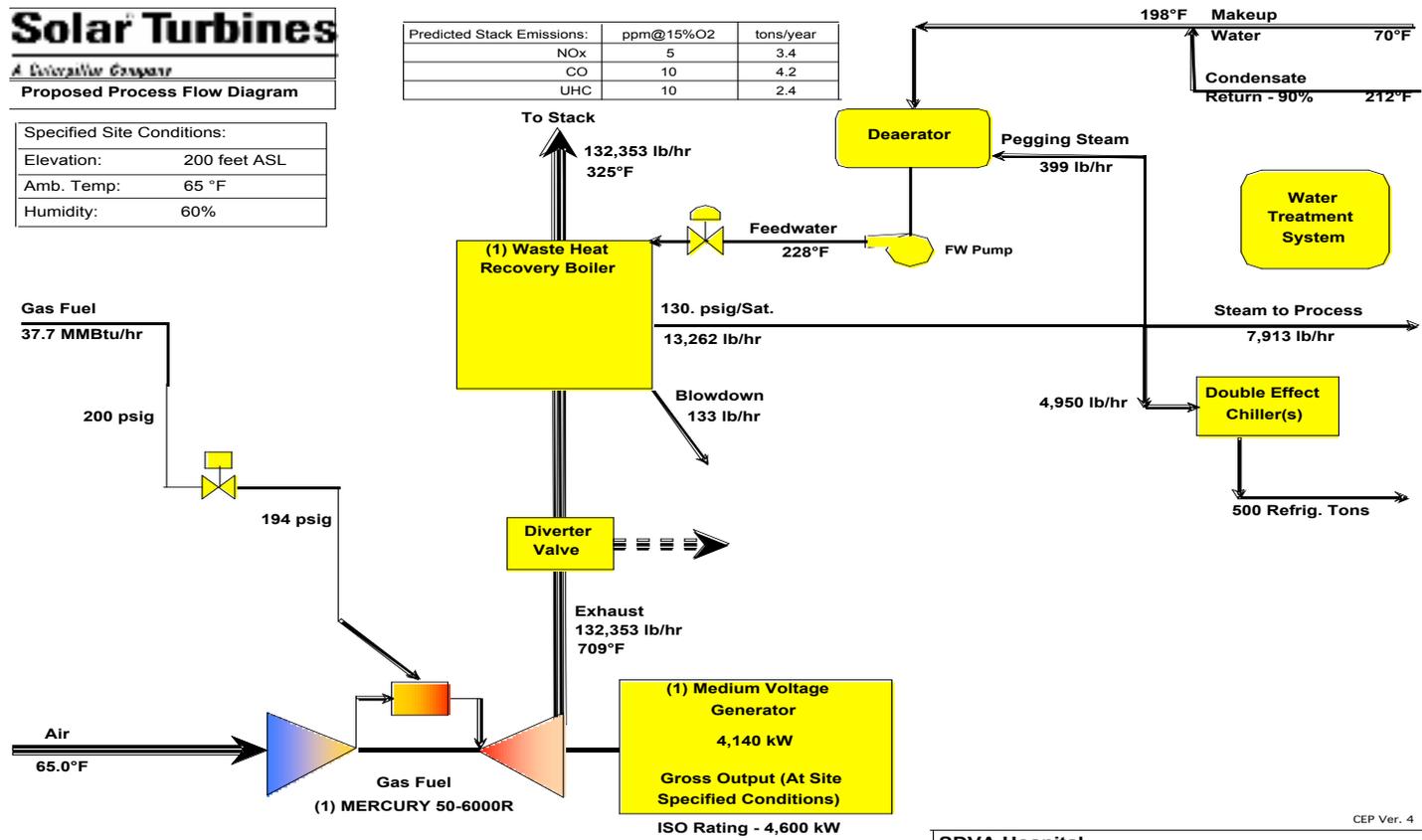
A Dresser Industries Company

### Proposed Process Flow Diagram

#### Specified Site Conditions:

Elevation:	200 feet ASL
Amb. Temp:	65 °F
Humidity:	60%

Predicted Stack Emissions:	ppm@15%O2	tons/year
NOx	5	3.4
CO	10	4.2
UHC	10	2.4



Fuel Flow(s) based on Lower Heating Value **Note: Off Design Performance Values Shown**

Note: For Estimating Purposes only. For Guaranteed Performance, see your Solar Turbines Representative.

SDVA Hospital

Ref. # 1/0/1900

1/11/2006

Designed by Chris Lyons

CEP Ver. 4

# Construction Period

- Solar Mercury turbine option drove site design changes
- Unanticipated construction issues
  - UST piping changes
- The foggy day
- What went well
  - Schedule control
  - Emissions results
- Absorption chiller



# Solar Mercury Turbine



VA San Diego Healthcare System and  
Honeywell Building Solutions/SES

# What's Really Inside the Enclosure?





# Heat Recovery Steam Generator



VA San Diego Healthcare System and  
Honeywell Building Solutions/SES



## Absorber Key Facts

- Manufacturer-Trane
- Cooling Capacity: 438-tons
- Steam Flow: 4,397 lbs/hr



# Cooling Tower

- Cooling Tower – BAC
  - Cooling Tower design allows utilization of existing towers for redundancy
  - Absorption chiller and cooling tower primarily used for Operating Rooms delivering 40 F water



- Installed cost per KW approx \$1,575/kw
  - Cost per KW does not include Absorption Chiller
- One time buy-down of \$4.2M generated from sale of NOx ERCs
- Guaranteed savings from cogen is \$1.3M/yr
  - Savings allowed for additional plant improvements that had no savings associated with them.
- Simple Payback approx. 2.3 yrs



# Project Implementation

- Aggressive Schedule to complete in 9 months
- Design began March 2004
- APCD ATC application and Interconnect Application submitted April 04
- Construction began May 04
- Subcontracts let in phases to expedite construction
- Mercury 50 delivered mid August 04
- Interconnect and start up November 04
- APCD Source test December 04
- Commissioning completed January 05
- Performance Period began Feb.1, 2005



# System Commissioning

- Coordination issues
- Scheduled power outages
- Training opportunity for staff
- Test scenarios – islanding, black start, parallel



# 1<sup>st</sup> year Operating Results

Feb. 1, 2005 – Jan. 31, 2006

- Cost savings
- Electrical energy produced
- Peak and non-coincident demand
- Heat Rate
- Uptime
- HRSG steam produced
- Environmental impacts

# Total Cost Savings – 1<sup>st</sup> Year

- Forecast = \$1,555,126
- Guaranteed = \$1,494,587
- Actual utilities savings= \$575,647

Summary of Savings Variance						
Gas	Therms/yr	\$/therm 2004	\$/therm 2006	Total Gas Cost projected	Total Gas Cost Actual	Delta Increase in gas Cost
	2,228,538	\$ 0.50	\$ 0.70	\$ 1,114,269	\$ 1,559,977	\$ 445,708
Chilled Water	Tons Cooling Absorber 95% Available	Kw/Ton Electric Chillers	Total Tons cooling 8 months	Total Kwh	Blended \$/kwh	Total cost no absorber on line
	416	0.6	2,396,736	1,438,042	\$ 0.13	\$ 186,945
Total gas and CHW increased costs=						\$ 632,653
Utility meter Measured Savings =						\$ 575,647
Discount given to VA for GT =						\$ 500,000
<b>Total year 1 corrected savings =</b>						<b>\$ 1,708,300</b>

- The difference?
  - Natural gas costs 40% higher than assumed in 2003
  - Expected Beta Unit nuisance tripping (demand costs)
  - Absorption Chiller on line for only 4 months of the year.
    - Electric Chillers forced to run during summer months
    - Large portion of waste heat vented to atmosphere



# Net Electrical Energy Produced

- Projected: 24,804,949 kWh
- Actual: 26,363,451 kWh



# Natural Gas Used

- Forecast = 2,972,220 therms/yr
- Actual = 2,228,538 therms/yr

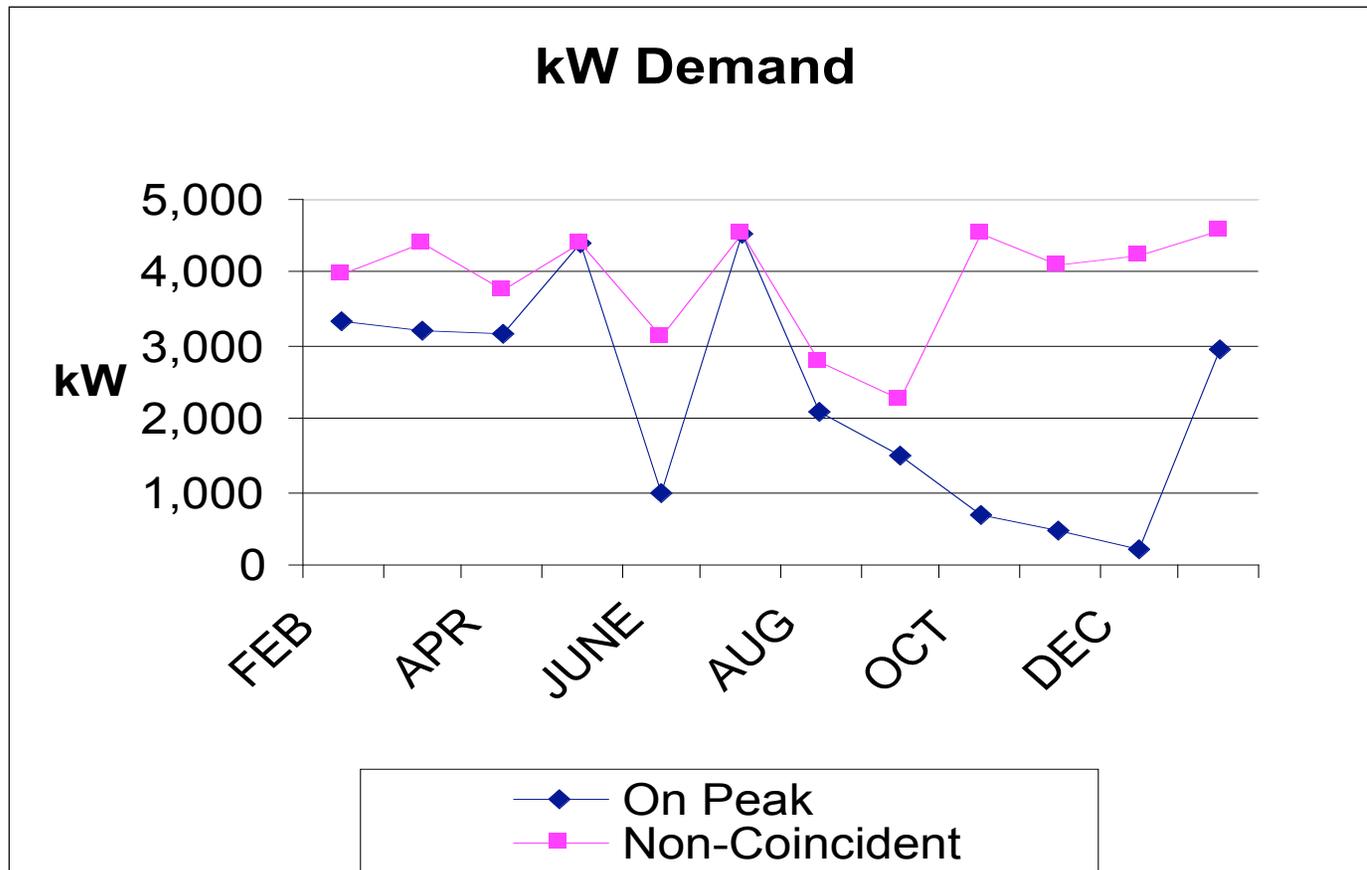


# Electric Demand Savings

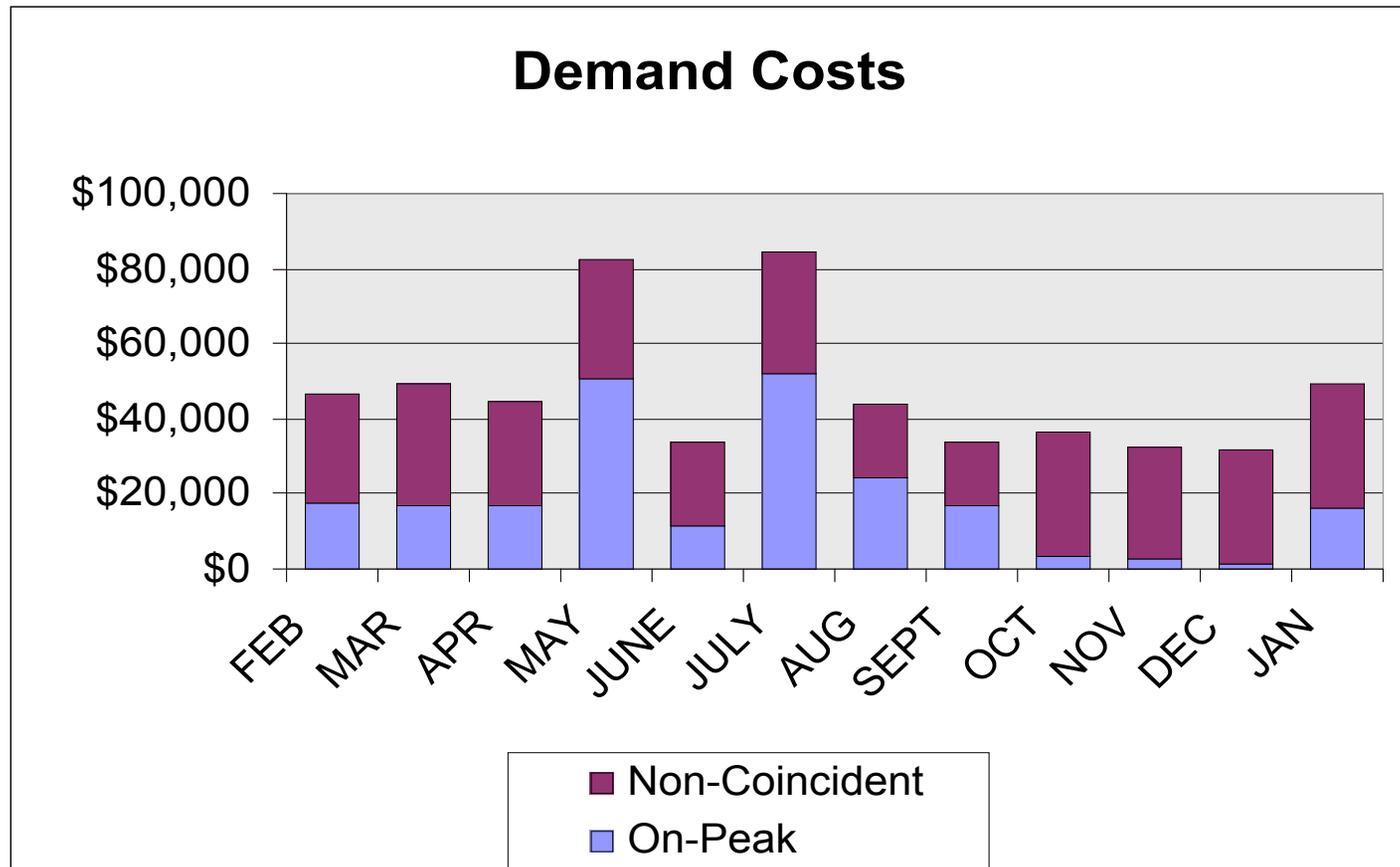
- Forecast = 4,259 kw
- Actual = See next graph

Demand Charges	Summer \$/kW	Winter \$/kW	Year around \$/kW
Peak Demand	11.47713	5.363046	
NonCoincidental Demand			7.267086
Standby Demand			3.268602

# Actual Demand Billed



# Demand Costs



# Weighted Average Heat Rate

- Heat Rate Summary – Efficiency of Electrical production:
  - Proposed: 10,086 Btu/kWh
  - Actual: 9,851 Btu/kWh



- Unit Uptime (Availability) for years 1 and 2 was reduced for the following reasons:
  - Mercury 50 was a beta unit and some unexpected shutdowns were planned to occur
  - Increased inspection downtime for data analysis on beta unit
- Availability of Production Summary:
  - Guaranteed: 91%
  - Actual (With beta) 95%

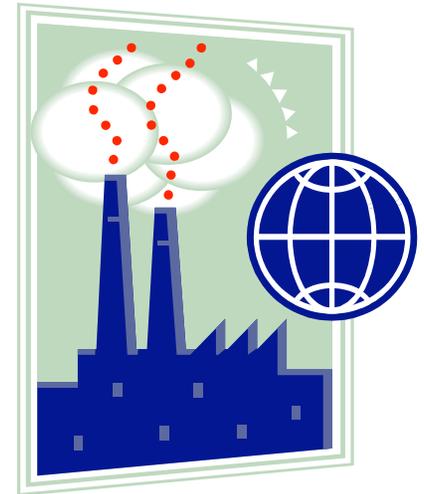
## ■ Steam Production Summary

- Projected: 70,485,312
- Actual: 51,126,091\*\*
  - \*\*Absorber was brought on line in late September 05. 1<sup>st</sup> year performance period ended January 06.



# Environmental Impacts

- NOX permitted 7 ppm
- NOX guaranteed 5 ppm
- NOX actual 3 ppm
  
- Reduced NOX emissions >40 tons/year
  - Annual NOx emissions for Mercury 50: 3.4 tons/yr
- Reduced VOCs
- VA Environmental Excellence award for pollution prevention



# Other Factoids

- SDVA CHP Project Received Energy Star Certificate
  - SESC will submit for Energy Star Award in 2006
- Cogen FERC Efficiency – 46%
- Overall Cogen Efficiency – 57%
- Availability; 95%
- Guaranteed Savings have been met for year 1



# Status at Press Time

- Replacement of “beta” turbine on May 1, 2006
- Absorber tube failures - repaired
- [Click here to link to real-time operating data](#)





# Key Lessons Learned

- Risk and reward
- Price risk of natural gas
- Single vs. multiple prime movers
- Staff engagement – operational responsibilities
- Technology changes



# Contact Information

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  - [michael.moriarty@honeywell.com](mailto:michael.moriarty@honeywell.com)



# Questions?