OSIsoft. REGIONAL SEMINAR 2011 APAC INDIA

23 September 2011

WESTIN GARDEN CITY, MUMBAI

PI System in Power Generation – Does the Type of Fuel Really Matter?

Chris Crosby, Business Development Executive
OSIsoft

Agenda

- OSI Power Generation Experience
- Power Generation Market in India
- Different Fuel Types
- Customer Business Results in Power Generation
- DTE Energy Benefits
- GenOn Benefits
- Entergy Benefits
- Other Customer Benefits
- Conclusion

Underlying Assumption

"*Household electricity consumption is widely viewed and accepted as providing substantial standard of living (quality of life) gains.* These gains come in many areas…refrigeration of food (health), lighting for reading (literacy), computers and internet access (education), productivity (income)…and suggest that observable household electricity consumption may provide useful insights into the nature of standard of living across countries and its changes over time."

by

Roselyne Joyeux and Ronald D. Ripple in *The Evaluation of Standard of Living and the Role of Household Electricity Consumption*

OSI Power Generation Experience

- 55% of 475 GW average USA power generation is monitored by the PI System (coal, natural gas, renewables, hydro and nuclear)
- 75% of nuclear power generators in the USA use the PI System
- The US Nuclear Regulatory Commission (US NRC) uses the PI System
- 85% of total 23 GW USA wind generation is monitored by the PI System
- 90% of the ISOs/RTOs in the USA use the PI System
- 17 of the top 20 wind generating producers in the world use the PI System
- Over 50% of the Concentrated Solar Plants (CSPs) in the world use the PI system
- Many of the largest solar companies in the world use the PI System (SunPower, EDF-EN, E.ON, Iberdrola, EGP, Abengoa Solar, Sempra)
- Many solar, wind, turbine and other major equipment power generation OEMs in the world use the PI System
- Many power generation customers in India use the PI System

The PI System – The Defacto Standard in Power

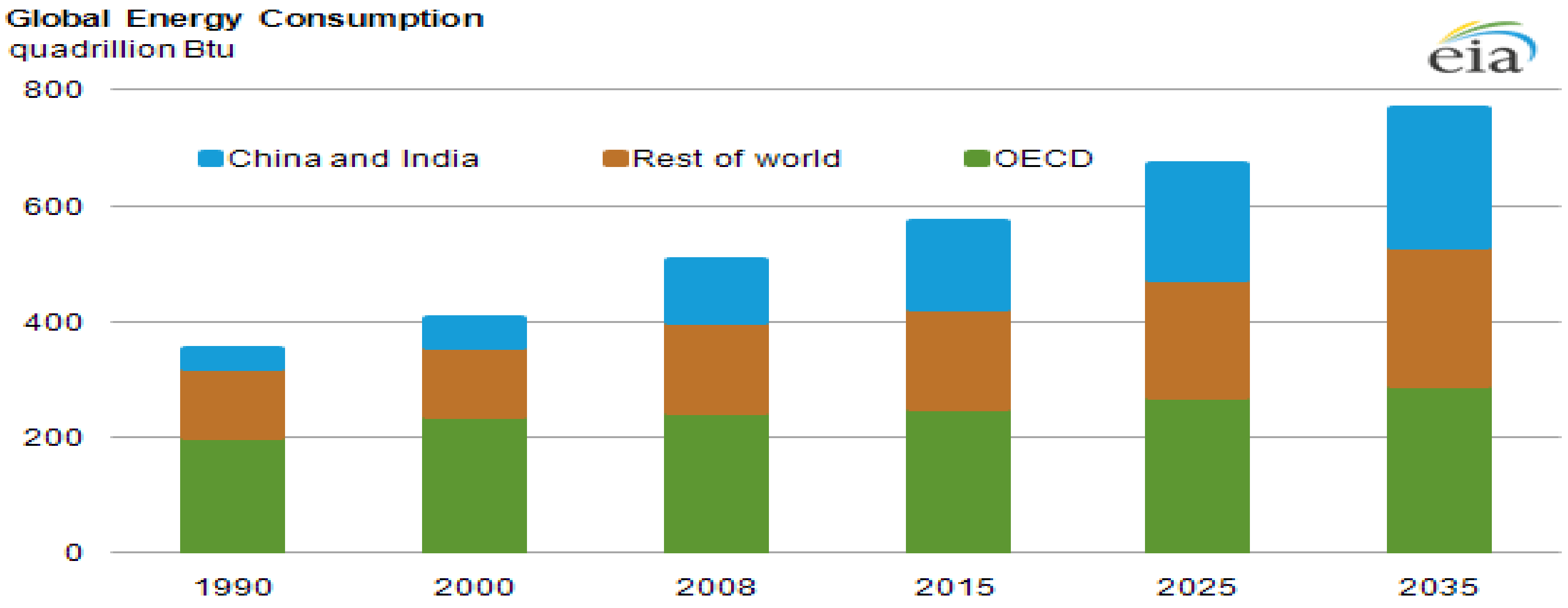
City of San Antonio

Power Generation Market in India

- Population (1.2) (1/3) (50%, 25) (400)
- GDP (3rd)(8%)
- Electricity growth & consumption (7%, 2x,10)(5th)(728)(111th)(5000)
- Resource constrained
- Nuclear
- Politics & ideology
- Fossil fuels
- Renewables

Source of data: BP Statistical Review and IEA 2010 Key World Energy Statistics for 2008 data; presented at India Nuclear Summit by Arun Srivastava, V.P Raja, K.J. Sebastian

Power Generation Market in India - Consumption

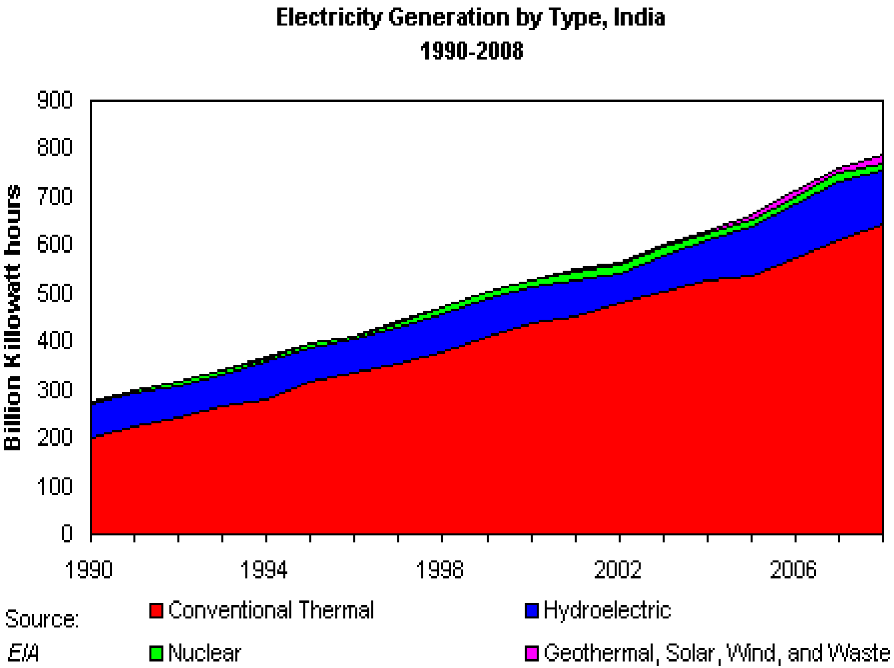


Strong economic growth leads China and India to more than double their combined energy demand by 2035, accounting for one-half of the world's energy growth. Source EIA's International Energy Outlook 2011 – 9th September, 2011.

Power Generation Market in India – by Fuel Type

Installed Capacity
31 March, 2011

Total	173,626 MW
Thermal	112,825 MW
Nuclear	4,780 MW
Hydro	37,567 MW
Renewables	18,454 MW



Different Fuel Types

What's Different?

- Fuel/Fuel handling
- Availability of fuel
- Staffing levels
- Designed busbar cost
- Technologies
- Equipment types
- Efficiencies
- Optimum operating modes
- Regulators/Requirements
- Emissions and waste
- Bi-products
- Catastrophic failure risk

What's the Same?

- Need for qualified, trained staff
- Need for highly available units
- Need for highly reliable equipment/systems
- Need for proactive environment
- Need for minimum outages
- Need for timely, informed decision making
- Need for low O&M costs
- Need for low busbar cost
- Need for low life-cycle cost
- Need for high efficiencies
- Need for high safety and environmental performance
- Need to meet regulatory requirements

Customer Business Results in Power Generation

nationalgrid The power of action	• $9 million in heat rate savings and ISO regulation penalty disputes/DMNC testing
DTE Energy	• Annual savings in excess of $20 million fleet-wide
Entergy	• $8.00 annual benefit per $1.00 invested cost
Reliant Energy	• Reduced forced outages by 1% and as a result increased margin by over $2 million annually
PSEG We make things work for you.	• 10% overall reduction in maintenance expenses
RWE	• Reduced start-up costs by approximately 1/3
GenOn	• PI System + advanced analytics (CBM) pilot $1million, one combined cycle unit in 6 months, deploy fleet-wide

DTE Energy History of PI System

- Pilot at Monroe PP in 1998
- Fossil Generation Fleet 1999 (18 units)
- GenOps – EMS Ranger 2001
- SOC SCADA– 2002
- Fermi Nuclear– 2003 (1 unit)
- DTE Subsidiaries – 2007
- **Enterprise Agreement** – 2007
- Continuous PI Expansion – 2007 on
- IT Monitoring – 2009

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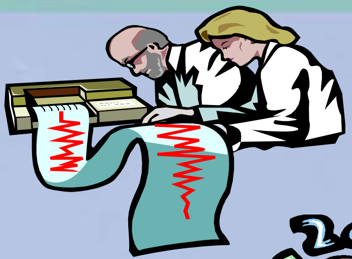
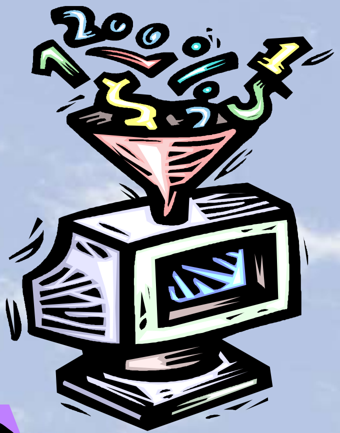
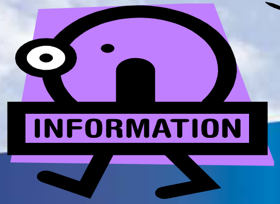
DTE Energy Challenge - Process Data Everywhere!



- **DCS** installations on nearly every unit
- Nearly **300,000** process data tags
  - PI Systems at each plant
  - PI Interfaces to DCS & many PLC's



- What is that **data screaming** at us?
- How do you effectively **utilize** the data?
- How do you turn data into **information**?



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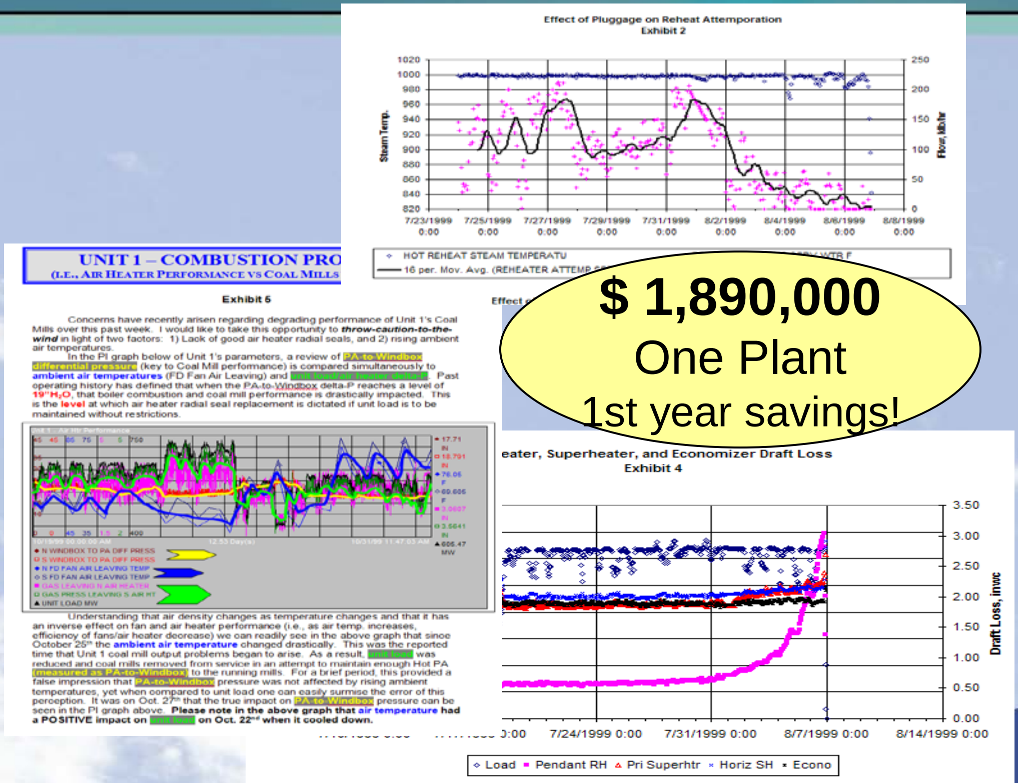
DTE Energy Raw Data Analysis

- Post trip analysis
- Process monitoring
- Optimization
- Early warning
- Alarming



$ 1,890,000
One Plant
1st year savings!

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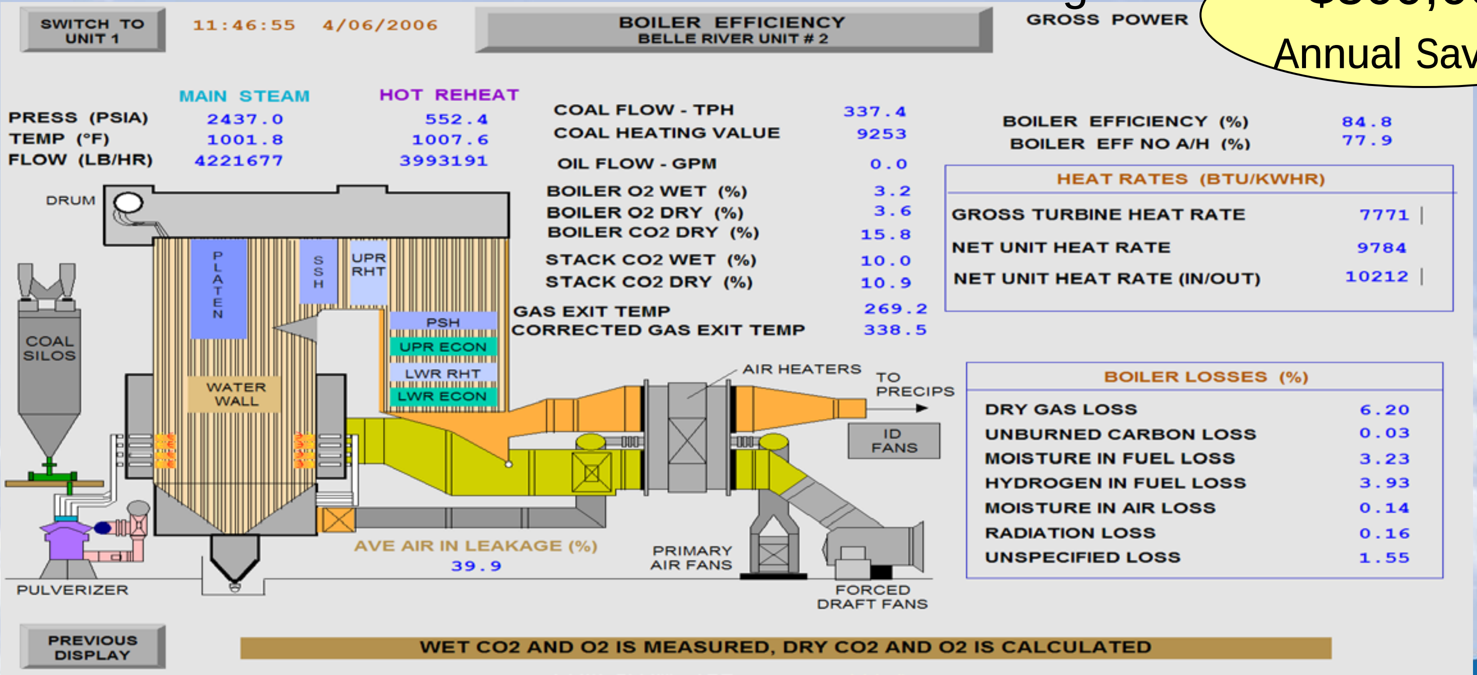
DTE Energy Engineering Applications
Fleet Performance Analysis (PMAX)

Thermal Performance Calculation Engine

$500,000
Annual Savings!



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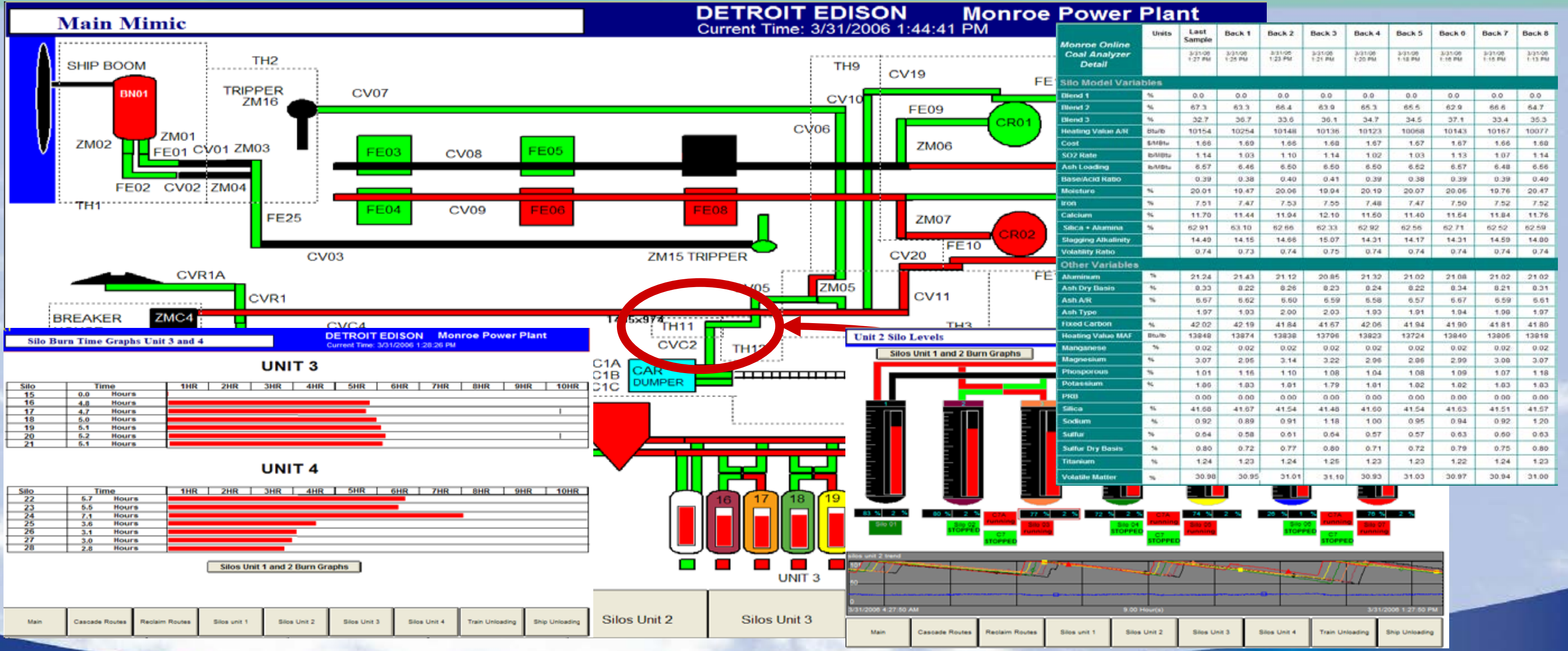
DTE Energy Engineering Applications
Digital Fuel Tracking System

$1,200,000
Annual Savings!



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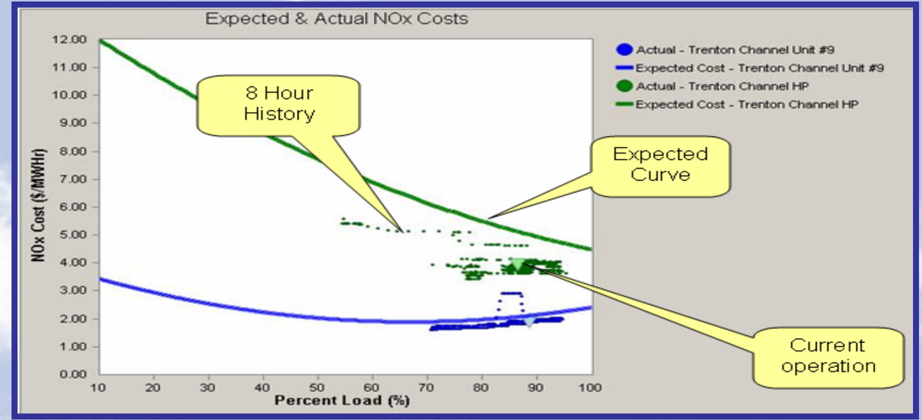
DTE Energy Engineering Applications
NOx Emissions Strategy

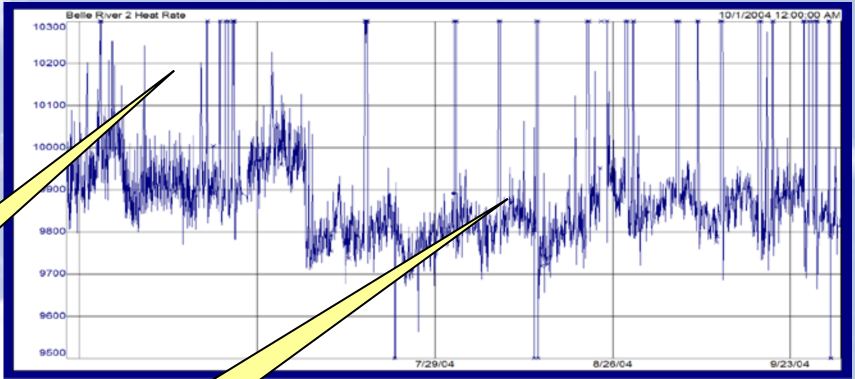
$2,200,000
Annual Savings!



NOx Reduction with Improved Heatrate

Before Implementation

After Implementation



Primary focus is NOx reduction only

Focus on operating near NOx budget curve

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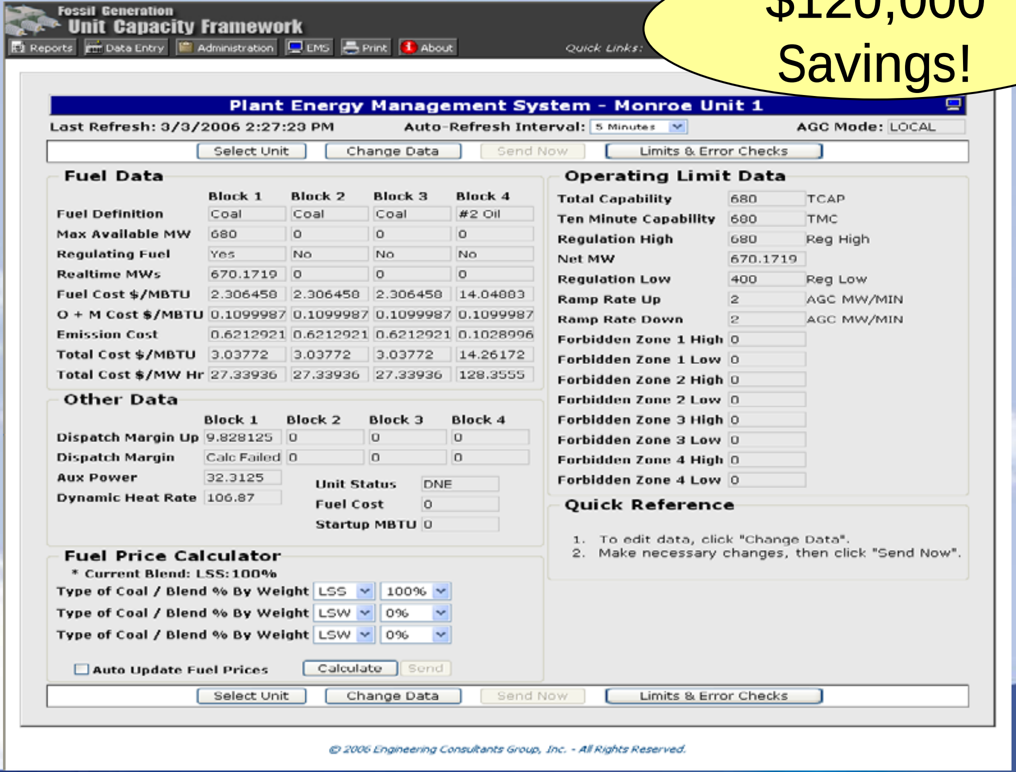
DTE Energy Engineering Applications
Energy Management System (EMS)

- The Plant Energy Management System is used to automatically control unit dispatch
- Implements data validation on all fields
- Performs several calculations based on PI data to determine validity of inputs.
- Transported to EMS Ranger via PI



$120,000 Savings!

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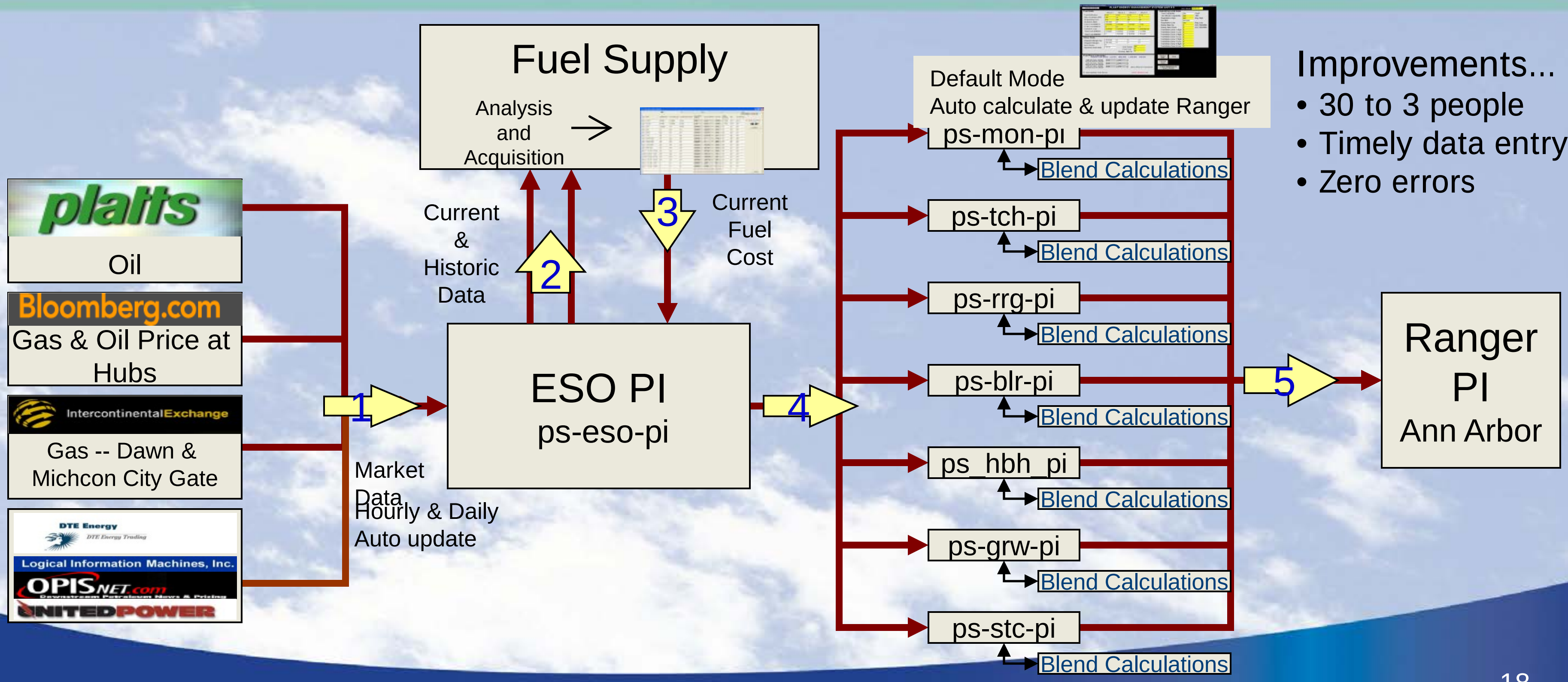
DTE Energy Engineering Applications
Fuel Cost Framework

$530,000
Annual Savings!



Improvements...
- 30 to 3 people
- Timely data entry
- Zero errors

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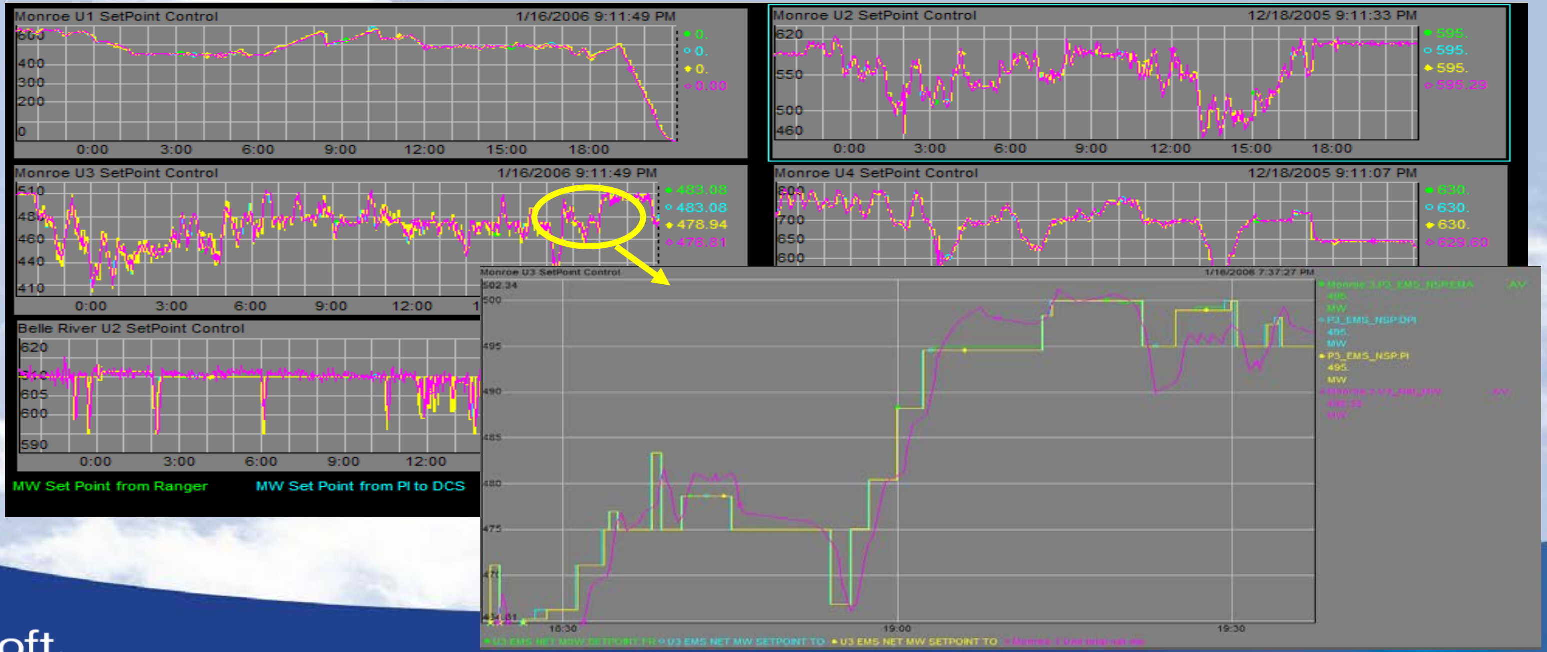
DTE Energy Engineering Applications
PI to PI (AGC)

$200,000 Savings!

AGC – Automatic Generation Control

5 largest Fossil units & Peaking Units are ramped through PI Set Point control



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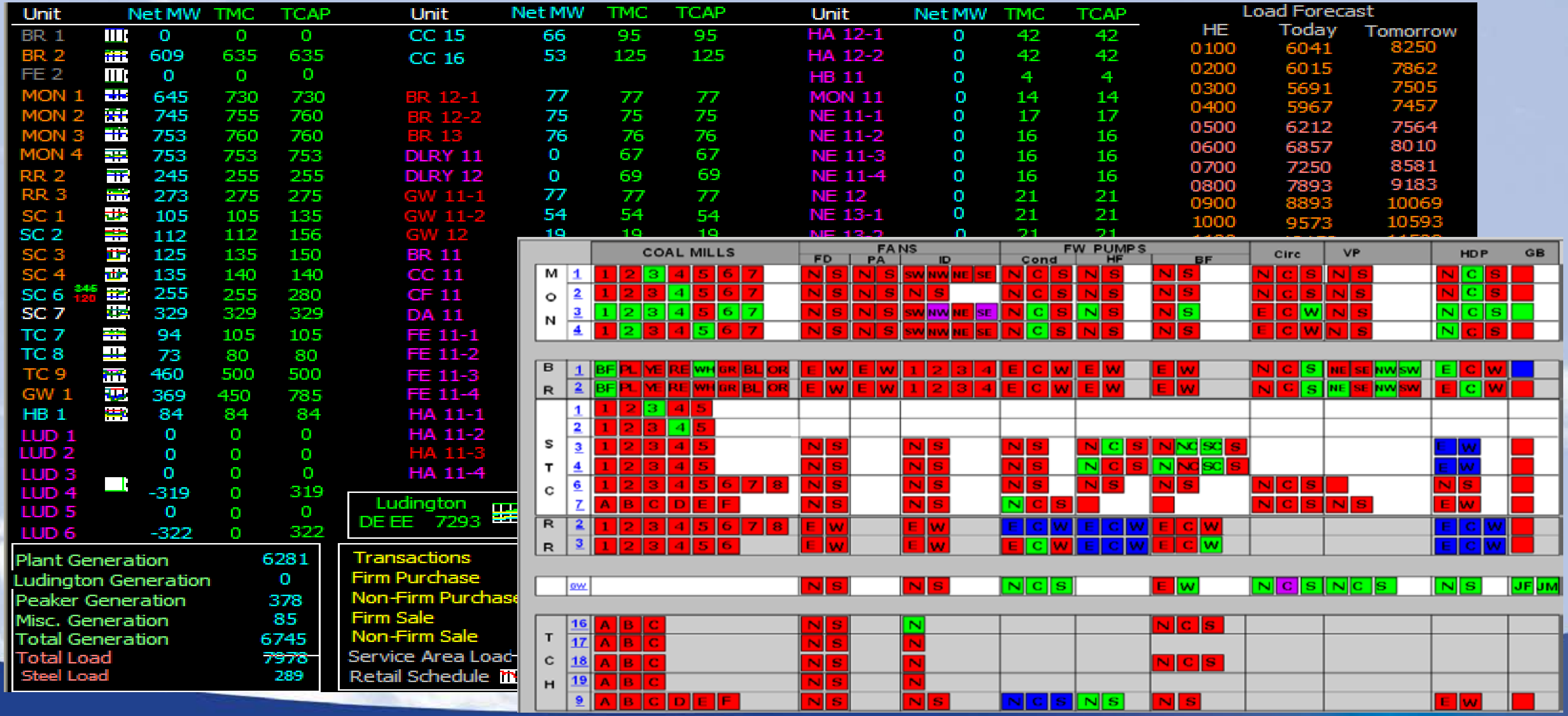
DTE Energy Web Visualization
Fleet Status – PI WEB enabled



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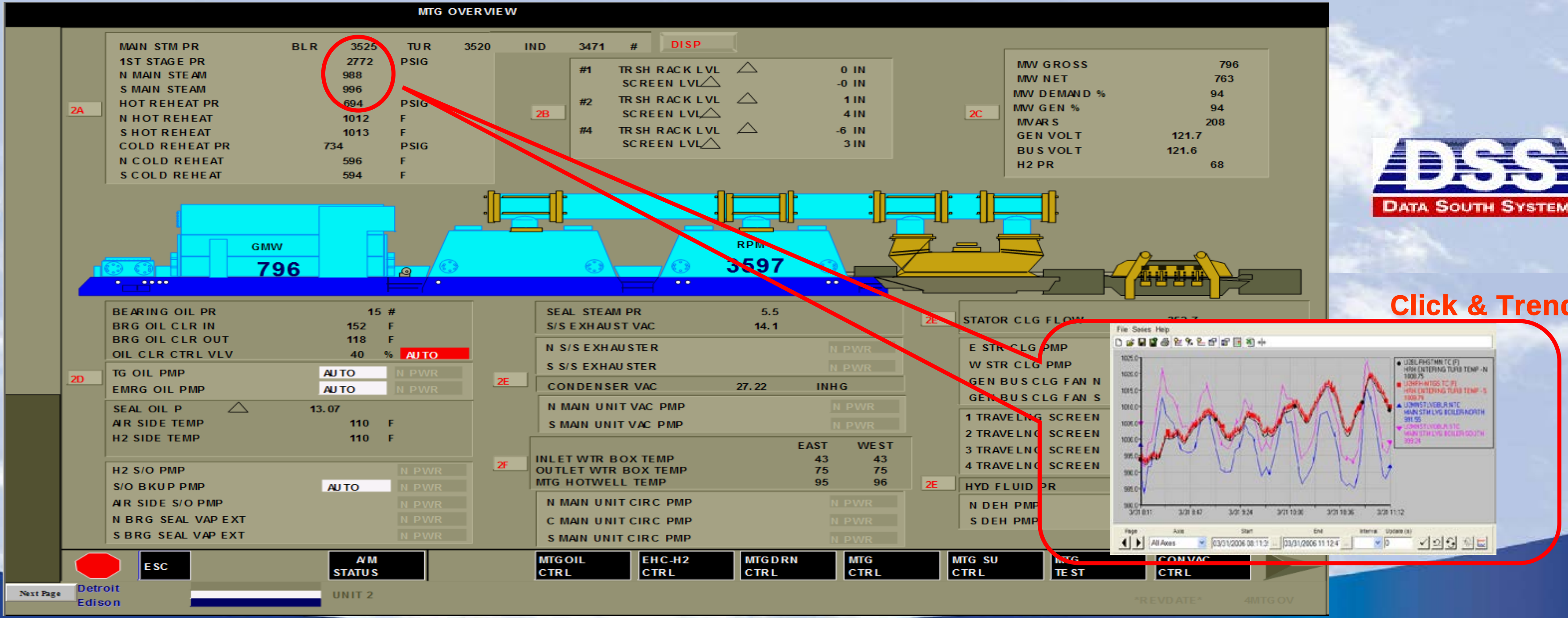
DTE Energy Web Visualization
Real-Time DCS Operator Displays

6000 real time dynamic actively linked WEB DCS graphics



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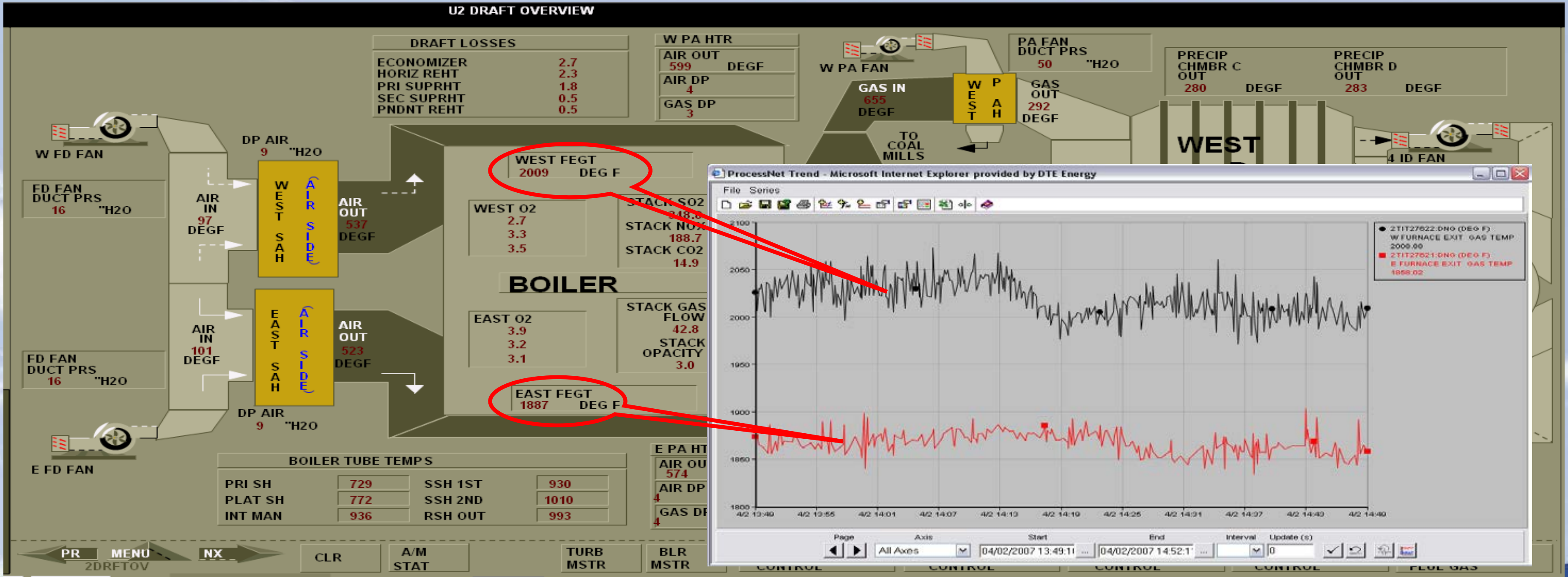
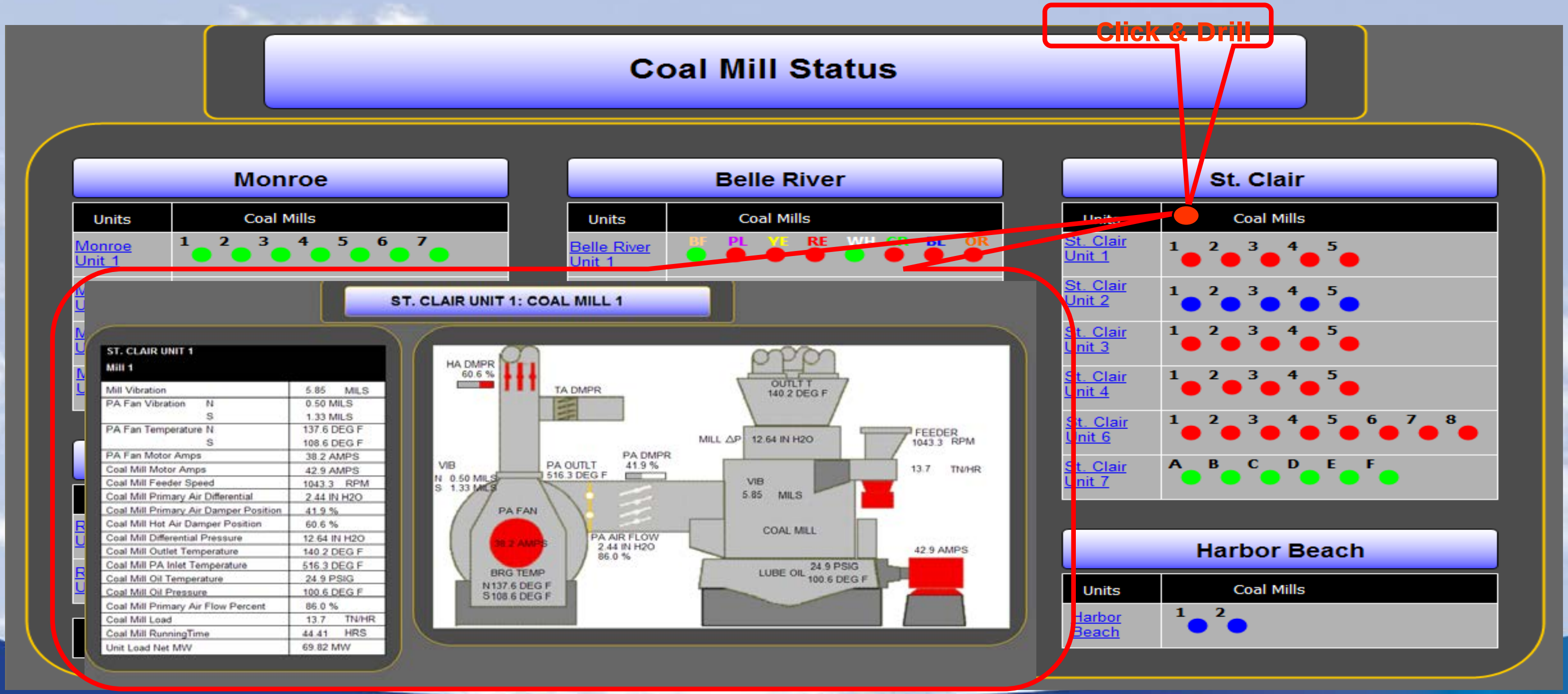
DTE Energy Web Visualization
PI enabled - Event Re-play



Re-play events using historical PI data

DTE Energy System Dashboards
PI Enabled

2000 real time dynamic actively linked WEB System graphics



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DTE Energy Expert Systems PI Dependent

- Equipment & Process Monitoring – Advanced analytics
  - Fleet wide implementation 2006
  - A Primary Performance Center Application

$7,769,680 Annual Savings!

- Combustion Optimization – NeuCo
  - Startup on St Clair Unit 7
  - Installation in progress on Belle River 2
  - Planned for Monroe Units 1-4

$330,000/unit Annual Savings!

DTE Energy Technology Framework 2007

Actionable Information – KPI’s

Discrete data
Limited value

KPI’s
Dashboards
Fleet Optimization

Business Intelligence
Reliability, 4-Block
Outage & De-rate (UCF) & Market

Expert Systems
Predictive Monitoring, Optimization

System Dashboards
Fleet Status Assessment

WEB Visualizing
Easy Access to Information

Engineering Applications
PMAX, Digital Fuel Tracking, Fuel Cost Framework
Process Discrete to Data

Distributed OSIsoft PI Historians
Large Population of Data

Annual Savings

Fleet Optimization
$20,000,000
(Projected Savings)

$11,000,000

$1,000,000

$5,500,000

$4,500,000

$3,000,000

DTE Energy Technology Framework 2009

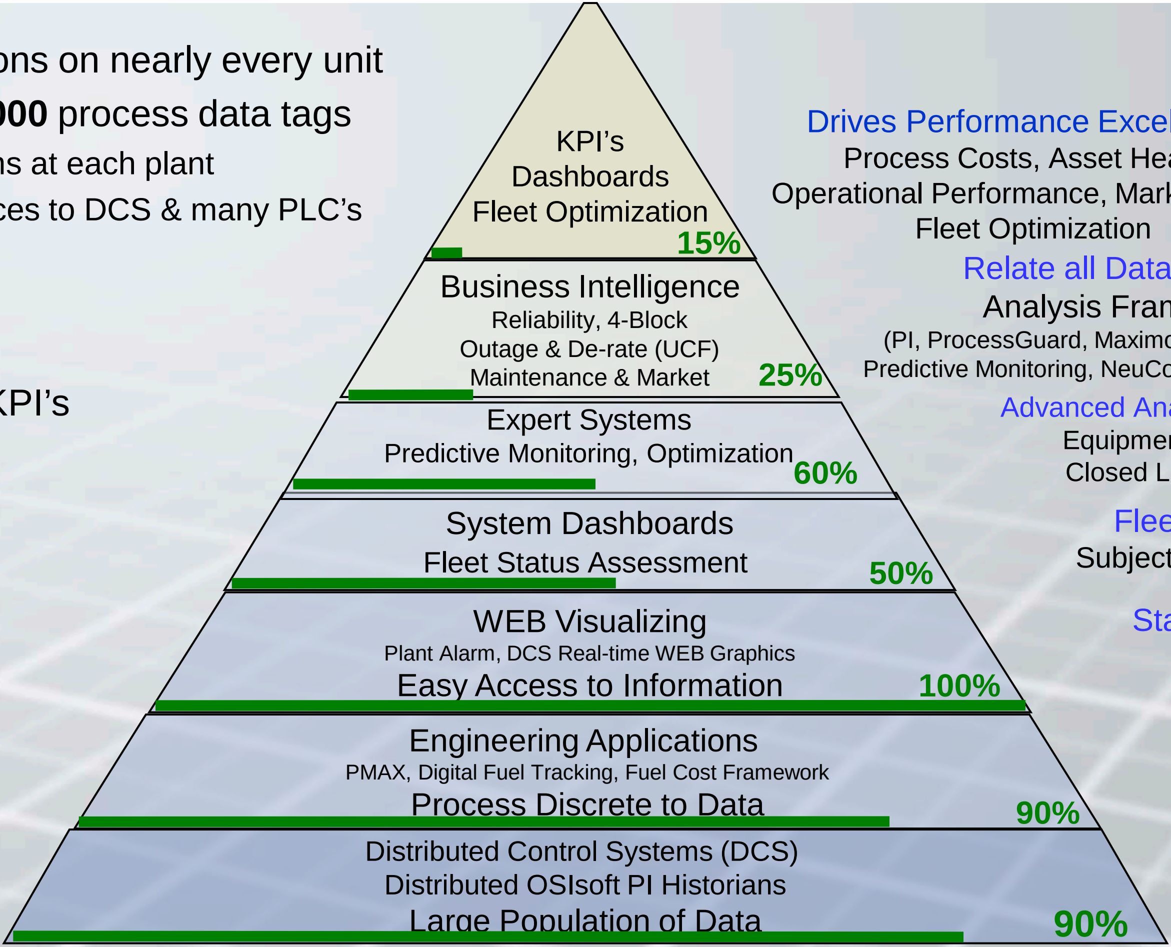
DCS installations on nearly every unit

Nearly **1,000,000** process data tags

- PI Systems at each plant
- PI Interfaces to DCS & many PLC's

Actionable Information – KPI's

Discrete data Limited value



Drives Performance Excellence
Process Costs, Asset Health, Operational Performance, Market Value, Fleet Optimization

Relate all Data Sources
Analysis Framework
(PI, ProcessGuard, Maximo, SAP, UCF, P3M, Predictive Monitoring, NeuCo, LIMS, Plant View ..)

Advanced Analysis & Process Optimization
Equipment and Process Monitoring
Closed Loop Process Optimization

Fleet Drill down
Subject Matter Experts

Standard User Interface
WEB Visualization

Process Discrete Data
PMAX, DFTS, eNote, Fuel Cost Framework, Alarm Management

Post Event Analysis
DCS, PLC & PI

% Complete

DTE Energy Unit Capacity Framework (UCF) 2009

Process Flow

DTE Energy Unit Capacity Framework (UCF) 2009

OSIsoft.

- Manages all Unit Capacity and De-rates - Interfaces to MISO, P3M & EMS
- Automatically Generated Status Report (Availability on BlackBerry)
- Dynamically linked with Outage and de-rate process

$6,900,000

Savings To Date!

Fossil Generation
Unit Capacity Framework

Reports | Data Entry | Options | Quick Links:

Date/Time: 4/6/2006 12:46:00 PM Go

☐ Show Optional Fields ☑ Group Peaker Units ☐ Group Cycler Units ☐ Group Base Units

Sort: Alphabetically Historical Time: Current ☑

Export to Excel
Export to Word
Field Definitions

Fossil Generation Status Report

Thursday, April 06, 2006 12:46:56 PM

Last Modified By: David W Skiver (E49449) on Apr 6 2006 6:24AM

Unit	On	NDC	Pr Avail	Pr+Of Avail	Current Blend	Unit Constraints/Special Conditions	Primary Econ. Blend	Unit Econ. Blend	Primary Sched.	Primary Rand.	Unit Sched.	Unit Rand.	Total Sched.	Total Rand.
BRVPP 1	☐	625	600	625	{100%LSW}+{100%2OIL}		0	0	0	0	0	0	0	0
BRVPP 2	☑	635	610	635	{100%LSW}+{100%2OIL}		0	0	0	0	0	0	0	0
CCKPP 15	☐	135	135	135	{100%NGAS}		0	0	0	0	0	0	0	0
CCKPP 16	☐	100	100	100	{100%NGAS}		0	0	0	0	0	0	0	0
FERMI 2	☐	1110	0	0	{100%NUC}	*Outage:* refuel outage; May 10@0900; Dugan	0	0	0	0	0	0	0	0
GW1PP 1	☑	785	785	785	{60%NGAS/40%HSOIL}		0	0	0	0	0	0	0	0
HBHPP 1	☑	103	90	103	{100%LSS}+{100%2OIL}		0	0	0	0	0	0	0	0
MONPP 1	☐	770	0	0	{65%LSW/35%MSE}+{100%2OIL}	*Outage:* Periodic Outage; May 6@2000; F. Wszelaki	0	0	0	0	0	0	0	0
MONPP 2	☐	795	0	0	{65%LSW/35%MSE}+{100%2OIL}	*Outage [F]:* Tube leak; Apr 10@0655; Essex || *Derate [F]:* (0) Mill Performance; Apr 22@2100; P. Fessler || *Derate [F]:* (0) 6&7 SFWH; Jun 22@2100; P. Fessler || *Derate:* (0) 2-2 CM in 5K; Apr 7@1400; F. Wszelaki	0	0	0	0	0	0	0	0
MONPP 3	☑	795	795	795	{65%LSW/35%MSE}+{100%2OIL}	*Derate [F]:* (0) No. 3 FWH Tube Leak; Jun 1@0600; P. Fessler	0	0	0	0	0	0	0	0
MONPP 4	☑	775	775	775	{65%LSW/35%MSE}+{100%2OIL}		0	0	0	0	0	0	0	0
RRGPP 2	☐	247	0	0	{70%LSW/30%LSS}+{100%NGAS}	*Outage:* Spring 2006 Per. Outage; May 24@0700; C.P. Mumaw	0	5	0	0	5	0	0	0
RRGPP 3	☑	280	280	280	{70%LSW/30%LSS}+{100%NGAS}		0	0	0	0	0	0	0	0
STCPP 1	☑	150	125	125	{100%LSW}		0	25	0	0	25	0	0	0
STCPP 2	☐	162	0	0	{100%LSW}	*Outage:* 2006 Periodic Outage; May 22@0600; John Quaine	25	25	25	0	25	0	25	0
STCPP 3	☑	168	125	125	{100%LSW}		0	43	0	0	43	0	0	0
STCPP 4	☑	158	125	125	{100%LSW}		0	33	0	0	33	0	0	0
STCPP 6	☑	321	281	321	{85%LSW/15%HSE}+{100%NGAS}		0	0	0	0	0	0	0	0
STCPP 7	☑	450	360	386	{80%LSW/20%HSE}+{100%2OIL}	*Derate [F]:* (58) E CM ; Apr 17@0800; Dan Lorenzetti || *Derate [F]:* (24) Opacity and SO3 Cond'ing; Nov 1@0000; Lorenzetti || *Derate [F]:* (6) #7 FWHtr; Nov 1@0600; Lorenzetti	0	0	0	0	0	64	0	64
TCHPP 7A	☑	210	110	110	{60%LSW/40%MSE}+{100%2OIL}		0	100	0	0	100	0	100	0
TCHPP 8	☑	122	100	100	{80%LSS/20%MSE}+{100%2OIL}		0	22	0	0	22	0	22	0
TCHPP 9	☑	520	350	370	{80%LSS/20%MSE}+{100%2OIL}		150	150	150	0	150	0	150	0
Peakers	?	792	186	186	N/A	N/A	0	606	0	0	606	0	0	0
Totals:		10208	9031	9564			175	1009	175	0	1009	64	297	64

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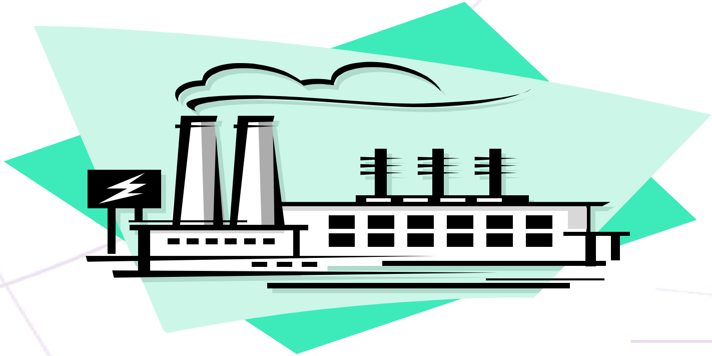
Empowering Business in Real Time.

VALUE NOW, VALUE OVER TIME

Entergy Performance Monitoring & Diagnostics Center (PM & DC)

Support plant objectives to achieve fleet commercial excellence through improved unit performance, equipment condition, and operational risk management



Entergy's PM & DC PI Infrastructure

- PI Servers located at 16 plants
- Operations Information Systems (OIS) implemented on 30 units:
  - Real-time performance monitoring & diagnostics thru pre-built PI-Process Book displays and General Physics EtaPro™
- Advanced Pattern Recognition (APR) implemented for 33 units:
  - Anomaly detection and alerting via advanced pattern recognition software using near real-time data from the plant PI servers

Entergy PI Use in the PM & DC

- OIS/PI is primary means of accessing plant data for routine monitoring
- Build custom ProcessBooks and DataLinks for trip analysis, unit/equipment problem diagnostics, and special monitoring
- Using PI Alarm View and PI ACE for PM&DC's Alarm Management System
- All based on the foundation of the PI data collected and stored at each plant

Entergy PM & DC Monitoring Tasks

- Unit trip monitoring and diagnostics
  - Plants can use extra eyes during upsets
- Unit Start-up monitoring
  - Complex process with many opportunities for error
- Routine monitoring
  - Looking for early signs of emerging equipment problems or failed instrumentation
- Purchased Advanced Pattern Recognition (APR) software to greatly enhance anomaly detection capability and data mining
- Performs special analysis requested by plants - lost MWs, performance issues, and equipment problems

Entergy PM & DC Benefits

- Early identification of changes in equipment physical, thermal, operational & environmental performance
- Improved ability to mitigate degrading equipment condition and unit performance
- Improved ability to maximize unit value considering current market opportunities
- Leverage expertise and technology
- Enhanced teamwork

Entergy PM & DC Results

- PM&DC Benefit to cost:
  - First year: 2 to 1
    - Including initial set up cost
    - O&M dollars only
  - Ongoing after first year 3 to 1
    - O&M dollars only
  - Ongoing after first year 8 to 1
    - O&M + fuel & replacement power)
- Catches:
  - First year 252
  - Ongoing 400-500 / yr

GenOn - Driving Factors for OSIsoft Solution

Problem: Many disparate plant systems and the need to turn data into actionable information

- DCS, PLC, CEMS, Analyzers…
- Various timestamps
- Data accessibility & integrity

Solution: OSIsoft, Enterprise Wide Infrastructure

- Common real-time database
- Common visualization and analytic toolset
- Common technology for development and advanced analytics
- Leverage SMEs (Central & Plant)

IPP, not a utility requires effective maintenance practices

GenOn OSIsoft Continuous Value Proposition

- Fleet Wide Deployment 2002
- Condition Based Maintenance on Critical Assets 2004
- Advanced Pattern Recognition Fleet-wide Rollout 2005
- Water Chemistry Automation 2007
- Automated Operator / Maintenance rounds 2008 - 2010
- Environmental Monitoring 2008
- Proactive Maintenance Data Gateway 2009 - 2011

Every phase a business value and positive ROI

GenOn Boilers Highest Lost Margin System

Boilers – "The race car tire of Power Generation"

- Highest Lost Margin Opportunity
- Most outages / de-rates
- Improve Water Chemistry
  - Make visible via PI
  - Transformation of data
- Track Temperature Excursions

Highest LMO makes easy ROI with technology solution…

GenOn Water Chemistry Automation

- Improve and interface to analyzers
- Cycle Water Chemistry screens
- Response Procedure Reports (EPRI standards)
- Calculate minutes in / out of spec
- Notifications on limits

Transform and use data in a new way…

GenOn APR Modeling

Business case developed from history :

- Review equipment failures
- Outages and related lost margin
- Combined cycle plant pilot had 5 catches (~value $948K)
- Decision to apply fleet wide
- Model critical systems and equipment

Very intelligent rules based monitoring of critical systems…

GenOn Summary

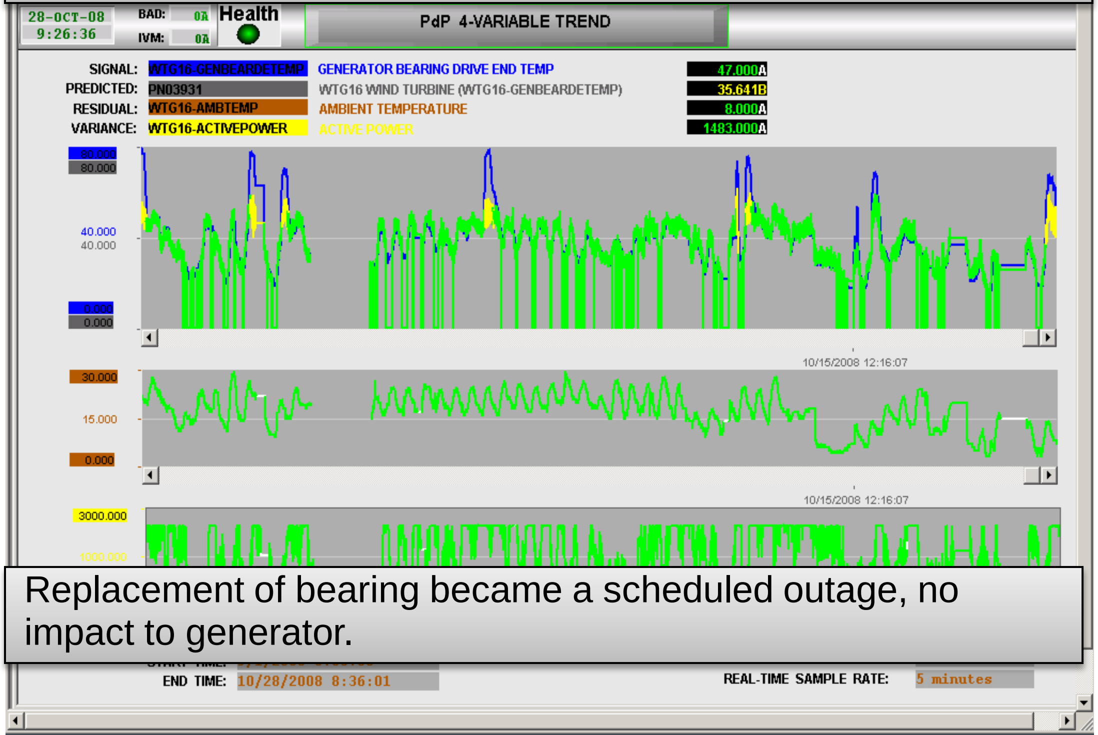
- Implement Enterprise Wide Infrastructure (EWI)
- Use for core business processes
  - Operations, Maintenance, Engineering
  - Equipment and Vendor performance
  - Common Tools, Visuals, Notifications & Training
  - Common Solutions and Advanced Analytics
  - Leverage staff and expand their skills sets

Every phase has positive ROI!

EDF Wind – Avoiding Significant Failure

WTG16 Generator Bearing Drive End Temp

(Actual in Blue, Predicted in Green



Replacement of bearing became a scheduled outage, no impact to generator.

PI System alerts and notification allow failure conditions to be identified early

PI System replacement before causing significant failures

- Scheduled maintenance vs. unscheduled maintenance

Example:

- Observe the bearing temperatures to determine bearings approaching failure
- Replace the bearing before the generator fails
- Plan for equipment/tool need to service in advance

SunPower Solar

SunPower O&M Overview

- > 500 MW monitored
- > 550 systems monitored
- > 95 power plants >1MW
- > 10 years of O&M experience
- Guaranteed performance

- 24/7/365 real-time plant monitoring
- Customer visibility of system performance via web portal
- Regional service centers

Conclusion

- There exists a huge electricity supply and demand gap in India
- Many new plants need to be built…and there are many obstacles
- In the mean time, we need to maximize the availability and output of existing plants at the lowest achievable cost
- Many characteristics and requirements of fuel-to-electricity conversion processes vary as a function of the fuel-type
- Many core characteristics and requirements do not
- The PI System can support nearly 100% of those that do not vary and can be a core infrastructure technology to help close the supply and demand gap in India

India and America – Common Values, Shared Success
op ed this week, USINPAC Blog Network

“The remarkable deepening of US-India ties over the past decade is only a start, as the relationship has still not reached its full potential. If Indians and Indian-Americans continue to contribute their ideas, their energy and their commitment, I am sure that even more exciting days lie ahead.”

Senator Richard Lugar, the Republican leader of the U.S. Senate Foreign Relations Committee

Quotes: Mahatma Gandhi

"Strength does not come from physical capacity. It comes from an indomitable will."

"You must be the change you want to see in the world."

"Whatever you do will be insignificant, but it is very important that you do it."

Thank you