Fleet Optimization through Process Controls & Technology

Sumanth K. Makunur
Lead Engineer
November 13th, 2013
Fossil Generation
Process Controls & Technology

Fleet Optimization
……… through Process Controls & Technology

The Process Technology Enablers
Utility Businesses
- DTE Electric
- DTE Gas
- Citizens Gas Fuel

Non-Utility Businesses
- DTE Coal Services
- DTE Rail Services
- DTE Energy Trading
- DTE Gas Storage
- Midwest Energy Resources
- DTE Biomass
- DTE Energy Services
- DTE Energy Ventures

Detroit, MI
Profile of DTE Utility Business

DTE Electric
- Ninth largest electric utility in the U.S. with 2.1 million customers
- Over 11,080 MW of power generation, primarily coal fired
- 54,000 GWh in electric sales
- ~$8.79 billion in revenue

DTE Gas
- Fifth largest natural gas utility in the U.S. with 1.2 million customers
- 170 Bcf of gas sales
- 12% of national gas storage capacity with 124 Bcf of regulated gas storage
Why Focus on Controls & Technology?

We operated for years without Process Information!

- Information in **capable hands** always yields benefits.
- Every **facility** and group has an effect on the company.
- The company is affected by **outside** influences.
- Fleet Optimization requires **awareness** of Process Costs, Performance, Asset Health, Reliability and Market Value.
- Small investments in Technology yields large **returns**.
Agenda

Process Controls & Technology

- Control & Technology Framework
- Application Examples
- Work in Progress
- Successes
- Questions & Discussion

PI Asset Framework
Integrated applications environment: Consistent framework for data, analysis, reporting and consistent user graphical interface.
Power Plants & Performance Center

<table>
<thead>
<tr>
<th>Generating Unit</th>
<th>Capacity Unit</th>
<th>Capacity Plant</th>
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<tbody>
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<td>Belle River 1</td>
<td>625</td>
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<tr>
<td>Fermi 2</td>
<td>1110</td>
<td>1110</td>
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<tr>
<td>Greenwood 1</td>
<td>785</td>
<td>785</td>
</tr>
</tbody>
</table>

Expanding Renewable Portfolio

<table>
<thead>
<tr>
<th>Plant</th>
<th>Capacity</th>
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</thead>
<tbody>
<tr>
<td>Trenton Channel</td>
<td>766</td>
</tr>
<tr>
<td>Peakers</td>
<td>1224</td>
</tr>
<tr>
<td>Totals</td>
<td>10554</td>
</tr>
</tbody>
</table>
Control & Technology Framework

Fossil Generation Business Unit Strategy

Actionable Information – KPI’s

Fleet Optimization
- Process Costs
- Asset Health
- Market Value - 20%

Business Intelligence
- Outage & De-rate (UCF)
- Maintenance & Market - 25%

Expert Systems
- Predictive Monitoring, Optimization
- MBO/PdM/Risk Assessment - 60%

System Dashboards
- Fleet Status Assessment - 90%

WEB Visualizing
- Plant Alarm, DCS Real-time WEB Graphics
- Easy Access to Information - 100%

Engineering Applications
- PMAX, Digital Fuel Tracking, Fuel Cost Framework
- Process Discrete Data - 90%

ABB
- Distributed Control Systems (DCS)
- Distributed OSIsoft PI Historians
- Large Population of Data - 90%

People
- Making right decisions when it matters!

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

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

Advanced Analysis & Process Optimization
- Reliability Academy
- Equipment, Process, Performance, Reliability Models
- Closed Loop Process Optimization

Fleet Drill down
- Subject Matter Experts

Standard User Interface
- WEB Visualization

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

Post Event Analysis
- DCS, PLC & PI

% Complete

ABB Fossil Generation Business Unit Strategy

Making right decisions when it matters!
Performance Center – Mission
Equipment Performance Optimization of the Fossil Generation Portfolio through continuous “real time and predictive asset condition monitoring” to maximize the asset market value.

Performance Center – Vision
Fossil Generation’s Fleet-wide “Mission Control Center” for continuous monitoring and optimization of plant equipment performance.

Operating View of Fleet
• Drives consistent practices (UCF)
• Market interface w/MOC
• Proficient users of technology
• SME rotation mutually beneficial
• Reliability tools (SmartSignal & Plant View)
• Input in the budget process
Control & Technology Framework

Fossil Generation
Business Unit Strategy

Actionable Information – KPI’s

Discrete data
Limited value

ABB
Distributed Control Systems (DCS)
Distributed OSIsoft PI Historians
Large Population of Data
Plant Process Controls

• ABB Distributed Control Systems
  – All Units in the fleet
  – Installed investment $150 – $200 Million Dollars
  – Critical to
    • Plant Operation
    • Personnel Safety
    • Equipment Protection
• Many stand alone control systems.
• Process Information Historian (PI) & Interfaces
Raw PI Data Analysis

PI Yields Benefits

• Post trip analysis
• Process monitoring
• Optimization
• Early warning
• Alarming
Challenge - Process Data Everywhere!

- **DCS** installations on nearly every unit
  - Nearly 800,000 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**?
Control & Technology Framework

Fossil Generation Business Unit Strategy

Actionable Information – KPI’s

Discrete data Limited value

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

90%

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Distributed Control Systems (DCS)
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Large Population of Data

90%
Fleet Performance Analysis (PMAx)

Thermal Performance Calculation Engine

- Gross Power (MW): 643.389
- Boiler Efficiency (%): 84.8
- Boiler Efficiency No A/H (%): 77.9

Heat Rates (BTU/KWhr):
- Gross Turbine Heat Rate: 7771
- Net Unit Heat Rate: 9784
- Net Unit Heat Rate (In/Out): 10212

Boiler Losses (%):
- Dry Gas Loss: 6.20
- Unburned Carbon Loss: 0.03
- Moisture in Fuel Loss: 3.23
- Hydrogen in Fuel Loss: 3.93
- Moisture in Air Loss: 0.14
- Radiation Loss: 0.16
- Unspecified Loss: 1.55

Wet CO2 and O2 is measured, dry CO2 and O2 is calculated.
Digital Fuel Tracking System

On-line Fuel Analyzer
NOx Emissions Strategy

NOx Reduction with Improved Heatrate

Before Implementation

After Implementation

Primary focus is NOx reduction only

Focus on operating near NOx budget curve
Electronic Operator Rounds
RFID Technology / PI Manual Logger

RFID Tags

Industrial PDA (Symbol MC9060S)

Tablets

PI Manual Logger
PI Advanced Metering Infrastructure (AMI)

- Implemented an extensive PI Infrastructure for AMI data
- MSP Interface to capture
- 8 Server PI Farm
- 1 Million Plus meters data
- 25 Million PI tags and growing
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.
Before Fuel Cost Framework

Market Trades

EMS Ranger PI

Fuel Supply

<table>
<thead>
<tr>
<th>Gas</th>
<th>Fuel Cost</th>
<th>Gas Emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil</td>
<td></td>
<td>Oil Emissions</td>
</tr>
<tr>
<td>Coal</td>
<td></td>
<td>Coal Emissions</td>
</tr>
</tbody>
</table>

Gen. Ops

Calculates Fuel Blend Scenarios & Business Logic

Fuel Cost

<table>
<thead>
<tr>
<th>Gas</th>
<th>Oil</th>
<th>Coal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emissions</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Email

Manual Process

PI to PI

Plant PI

Type, Type, Oops

No sys error checking

Email To 19 Units Ops

Manual Process
Fuel Cost Framework

Fuel Supply

Analysis and Acquisition

Current & Historic Data

Current Fuel Cost

Default Mode
Auto calculate & update Ranger

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

1. Oil
2. Gas & Oil Price at Hubs
3. Gas -- Dawn & Michcon City Gate
4. Market Data Hourly & Daily Auto update
5. ESO PI ps-eso-pi
   - ps-mon-pi
   - ps-tch-pi
   - ps-rrg-pi
   - ps-blr-pi
   - ps_hbh_pi
   - ps-grw-pi
   - ps-stc-pi

Ranger PI Ann Arbor
AGC – Automatic Generation Control
5 largest Fossil units & Peaking Units are ramped through PI Set Point control
Control & Technology Framework

Fossil Generation Business Unit Strategy

Drive Performance Excellence

WEB Visualizing
Plant Alarm, DCS Real-time WEB Graphics
Easy Access to Information 100%

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PMAK, Digital Fuel Tracking, Fuel Cost Framework
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Large Population of Data 90%

Fleet Optimization

Fleet Perspective
• Methods
• Applications

Involves
• Operation
• Performance
• MISO Market
• Reliability
• Maintenance
• Reporting
• Budget

Actionable Information – KPI’s

Discrete data
Limited value
### Fleet Status – PI WEB enabled

<table>
<thead>
<tr>
<th>Unit</th>
<th>Net MW</th>
<th>TMC</th>
<th>TCAP</th>
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<tbody>
<tr>
<td>BR 1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>BR 2</td>
<td>609</td>
<td>635</td>
<td>635</td>
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<tr>
<td>FE 2</td>
<td>0</td>
<td>0</td>
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<tr>
<td>MON 1</td>
<td>645</td>
<td>730</td>
<td>730</td>
</tr>
<tr>
<td>MON 2</td>
<td>754</td>
<td>755</td>
<td>760</td>
</tr>
<tr>
<td>MON 3</td>
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<td>760</td>
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<tr>
<td>MON 4</td>
<td>753</td>
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<tr>
<td>RR 2</td>
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<td>255</td>
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<td>RR 3</td>
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<td>SC 4</td>
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<td>LUD 5</td>
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<tr>
<td>LUD 6</td>
<td>-322</td>
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</tbody>
</table>

Transactions:
- Plant Generation: 6281
- Ludington Generation: 0
- Peaker Generation: 378
- Misc. Generation: 85
- Total Generation: 6745
- Total Load: 7978
- Steel Load: 289

Fleet Status – PI WEB enabled

<table>
<thead>
<tr>
<th>Load Forecast</th>
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<tbody>
<tr>
<td>HE Today</td>
</tr>
<tr>
<td>0100</td>
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<td>0800</td>
</tr>
<tr>
<td>0900</td>
</tr>
<tr>
<td>1000</td>
</tr>
</tbody>
</table>

Legend:
- M: COAL MILLS
- F: FAN S
- K: FW PUMPS
- H: GCR
- E: VP
- L: HDP
- GB
Real-Time DCS Operator Displays

6000 real time dynamic actively linked WEB DCS graphics
Re-play events using historical PI data
## PI Coresight Displays

### UI Operational Data (Read Only)

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Value</th>
<th>Units</th>
<th>Trend</th>
<th>Minimum</th>
<th>Maximum</th>
<th>StdDev</th>
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<tbody>
<tr>
<td>U1SWID-GASLVGTC</td>
<td>SW ID FAN GAS LEAVING TEMP</td>
<td>67.145</td>
<td>F</td>
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<td>F</td>
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<td>U1GENWATTSS</td>
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<td>MW</td>
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<td>U1GEN-WATTSS</td>
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<td>15742</td>
<td>MW</td>
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<td>135407</td>
<td>17422</td>
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<td>U1DUCT-GASCPAC1</td>
<td>UNIT 1 DUCT CPRACITY</td>
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<td>[-11059] No Go</td>
<td>[-11059] No Go</td>
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<tr>
<td>U1BL-UNITQ2</td>
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<td>[-11059] No Go</td>
<td>[-11059] No Go</td>
</tr>
<tr>
<td>FTS-SiloModel:Discharge.Now.U1.Moisture</td>
<td>Silo Model Load Moisture Discharge from U1 Silos</td>
<td>Bad Input %</td>
<td></td>
<td></td>
<td>[-11059] No Go</td>
<td>[-11059] No Go</td>
<td>[-11059] No Go</td>
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<td>FTS-SiloModel:Discharge.Now.U1.IndoorLoading</td>
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<td>[-11059] No Go</td>
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<tr>
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<td>0%</td>
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</tr>
<tr>
<td>FTS-SiloModel:Discharge.Now.U1.Fuel.TypeRiend1</td>
<td>Silo Model Load Fuel Type Riend1 Discharge from U1 Silos</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Graphical Display

- PI Coresight Home Page
- Search PI System
- Related Assets/Events
- 10/15/2013 9:28:33 AM
Mobile Work Force

PI WEB reports available on your Mobile Device

<table>
<thead>
<tr>
<th>Unit</th>
<th>Gross MW</th>
<th>Rev/Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monroe Unit 1</td>
<td>547</td>
<td>3,599</td>
</tr>
<tr>
<td>Monroe Unit 2</td>
<td>44</td>
<td>3,600</td>
</tr>
<tr>
<td>Monroe Unit 3</td>
<td>438</td>
<td>3,599</td>
</tr>
<tr>
<td>Monroe Unit 4</td>
<td>545</td>
<td>3,599</td>
</tr>
</tbody>
</table>

Fossil Mobile Generation

Fri, March 7, 2008
PI Snapshot at 3/7/2008 10:53:29 AM
Plant Generation: 6230.75
Total Generation: 6934.89
Total Load: 6857.78
Fossil Generation
Business Unit Strategy

Actionable Information – KPI’s

Discrete data
Limited value

System Dashboards
Fleet Status Assessment 90%

WEB Visualizing
Plant Alarm, DCS Real-time WEB Graphics
Easy Access to Information 100%

Engineering Applications
PMAK, Digital Fuel Tracking, Fuel Cost Framework
Process Discrete Data 90%

ABB
Distributed Control Systems (DCS)
Distributed OSIsoft PI Historians
Large Population of Data 90%
System Dashboards – PI Enabled

2000 real time dynamic actively linked WEB System graphics
Control & Technology Framework

Fossil Generation
Business Unit Strategy

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ENGINEERING APPLICATIONS
P MAX, Digital Fuel Tracking, Fuel Cost Framework
Process Discrete Data

90%

90%

System Dashboards
Fleet Status Assessment
Equipment Condition Monitoring
SmartSignal Fleet wide

Traditional Condition Monitoring
Monitors all signals separately

Sensor A.

Machine Trip
Upper Threshold
Lower Threshold
Equipment Condition Monitoring
SmartSignal Fleet wide

Traditional Condition Monitoring
Monitors all signals separately

SmartSignal — Early Detection
Monitors all signals simultaneously

Early Warning
Time Difference

Dynamic bands built on correlated sensor signals
Objective – Coal pile to stack Optimization
- Closed loop Neural Net Optimization
- In Service St Clair Unit 7
- Installed on Belle River Units
- Planned for Monroe Units 1-4 (High PRB Utilization Project)
Control & Technology Framework

Fossil Generation Business Unit Strategy

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Predictive Monitoring, Optimization
MBO/PdM/Risk Assessment 60%

Business Intelligence
Outage & De-rate (UCF)
Maintenance & Market 25%

Distributed OSIsoft PI Historians
Large Population of Data 90%
- 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
Enterprise Business Systems (EBS)  
Maximo & SAP

- SAP
  - Financial Information
  - Human Resources
  - Supply Chain
- Maximo
  - Work Management System
Control & Technology Framework

Fossil Generation Business Unit Strategy

Actionable Information – KPI’s

People
Making right decisions when it matters!

Fleet Optimization
- Process Costs
- Asset Health, Market Value
  15%

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Large Population of Data
90%

Discrete data
Limited value
No Shortage of Information!

- Laboratory Information
- Operator Logs
- PI Data Historian
- Emissions Monitoring
- EPRI Plant View
- Alarms
- Combustion Optimization
- Performance Analysis
- Emissions Monitoring

Process Management

- Work Management
- Document Management

- SAP

- MISO Real Time
- Unit Capacity
- De-rate Management
- Outage Planning
- Fuel Cost
- Ancillary Services
- MISO Day Ahead
- Outage Planning
- Fuel Cost
- Ancillary Services
Common Methodology

**PI Asset Framework:**
Integrated applications environment: Consistent framework for data, analysis, reporting and consistent user graphical interface.

- **Standard GUI**
- **Single Method**

**Process Information**
- PI Data Historian
- EPRI Plant View
- Alarms
- Operator Logs
- Performance Analysis
- Combustion Optimization
- ECG AccuTrack
- Laboratory Information
- Emissions Monitoring

**Business Systems**
- Work Management
- Project Management
- Document Management
- SAP

**Market Data**
- MISO Real Time
- De-rate Management
- Unit Capacity
- Outage Planning
- MISO Day Ahead
- Ancillary Services
- Fuel Cost
Common Structure

Process Information

Business Systems

Market Data
Pulverizer Dashboard

Process Information

More information is need for Analysis
Pulverizer Assessment
What information is needed?

Pulverizer

- Milling Costs
- Process Costs
- Production Costs
- EAF
- SmartSignal Watch List
- Work Performed & Work Pending
- Alarms
Pulverizer
Multiple Data Sources

Consistent Reporting
- Common Methodology
- Common Structure

Alarms
EPRI PlantView
PI
P3M
SmartSignal
Maximo
SAP
Documentum

Unit Capacity

PI
Alarms
EPRI PlantView
PI
P3M
SmartSignal

DTE Energy
Equipment Hierarchy
- Hierarchical System Index (HSI)
- Work Breakdown Structure (WBS)

DTE Energy – Business Unit
Monroe Power Plant – Plant
  Generating Unit - Monpp4 – Unit
    Fuel Burn - Monpp4 – Primary System
      Fuel Burn - Monpp4 – Secondary System
        Pulverizer - Monpp4 – Sub System
          Coal Mill 1 - Monpp4 – Equipment / Sub Equip
            Breaker 4160V 64JU-U16 CM 1 - Monpp4
            Damper Coal Mill CM 1 - Monpp4
            Damper Hot Air CM 1 - Monpp4
            Damper Maintenance CM 1 - Monpp4
            Dampor Coal Mill CM 1 - Monpp4
            Oil Box Main Drive CM 1 - Monpp4
            Under-Press P11938 CM 1 - Monpp4
            Gear-Damper (OPS65) CM 1 - Monpp4
            Gear-Damper (OPS55) CM 1 - Monpp4
            Gear-Damper (OPS50) CM 1 - Monpp4
            Gear-Damper (OPS45) CM 1 - Monpp4
            Gear-Damper (OPS40) CM 1 - Monpp4
            Gear-Damper (OPS35) CM 1 - Monpp4
            Lubricator CM 1 - Monpp4
            Motor Drive CM 1 - Monpp4
Consistent Reporting
- Common Methodology
- Common Structure

Pulverizer
Multiple Data Sources

- EPRI PlantView
- PI
- P3M
- SmartSignal
- Maximo
- SAP
- Documentum

Common Data Sources

Unit Capacity

PI

Alarms
Asset Framework
Expanded System Dashboard

ProcessNet
Equipment Hierarchy

- DTE Energy
  - Monroe Power Plant
    - Generating Unit - Monp1
    - Generating Unit - Monp2
    - Generating Unit - Monp3
    - Generating Unit - Monp4
      - Air and Flue Gas - Monpp4
      - Boiler and Steam Generator - Monpp4
      - Diesel - Gas Generator - Monpp4
      - Electrical and Control Systems - Monpp4
    - Fuel Burn - Monop4
      - Fuel Burning - Monop4
        - Alternate Fuel - Monop4
        - Coal Burning - Monop4
        - Feeder/Scales - Monop4
        - Pulverizer - Monop4
          - Coal Mill 1 - Monop4
          - Coal Mill 2 - Monop4
          - Coal Mill 3 - Monop4
          - Coal Mill 4 - Monop4
          - Coal Mill 5 - Monop4
          - Coal Mill 6 - Monop4
            - Breaker 4160Y 64LU16 CM 6 - Monpp4
            - Damper Coal Mill CM 6 - Monpp4
            - Damper Hot Air CM 6 - Monpp4
### Process Cost Drill Down

#### Unit Summary

**MONROE UNIT 4**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mill 1</th>
<th>Mill 2</th>
<th>Mill 3</th>
<th>Mill 4</th>
<th>Mill 5</th>
<th>Mill 6</th>
<th>Mill 7</th>
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<td>Year To Date</td>
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<td>100.00</td>
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<td>99.79</td>
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<td>100.00</td>
<td>100.00</td>
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<td>100.00</td>
<td>100.00</td>
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**PROD COST (MWh)**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mill 1</th>
<th>Mill 2</th>
<th>Mill 3</th>
<th>Mill 4</th>
<th>Mill 5</th>
<th>Mill 6</th>
<th>Mill 7</th>
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<tbody>
<tr>
<td>Current Date</td>
<td>21.21</td>
<td>18.16</td>
<td>22.22</td>
<td>15.86</td>
<td>10.34</td>
<td>22.22</td>
<td>10.34</td>
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<tr>
<td>Previous Week</td>
<td>22.22</td>
<td>15.86</td>
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<td>22.22</td>
<td>15.86</td>
<td>10.34</td>
<td>22.22</td>
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</table>

**MILLING COST ($/T)**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mill 1</th>
<th>Mill 2</th>
<th>Mill 3</th>
<th>Mill 4</th>
<th>Mill 5</th>
<th>Mill 6</th>
<th>Mill 7</th>
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</thead>
<tbody>
<tr>
<td>Year To Date</td>
<td>1.87</td>
<td>1.82</td>
<td>1.73</td>
<td>1.43</td>
<td>1.87</td>
<td>1.82</td>
<td>1.73</td>
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<tr>
<td>Previous Week</td>
<td>0.26</td>
<td>0.30</td>
<td>0.29</td>
<td>0.27</td>
<td>0.28</td>
<td>0.30</td>
<td>0.29</td>
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**Heat Rate (BTU/hr/MWh)**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mill 1</th>
<th>Mill 2</th>
<th>Mill 3</th>
<th>Mill 4</th>
<th>Mill 5</th>
<th>Mill 6</th>
<th>Mill 7</th>
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<tbody>
<tr>
<td>Current Date</td>
<td>10732</td>
<td>10732</td>
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<td>Previous Week</td>
<td>10732</td>
<td>10732</td>
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</table>

#### Additional Data

- **Dispatch Costs**
- **Production Costs**
- **EAF**
- **Process Cost Drill Down**
- **Milling Costs**
Asset Framework
Expanded System Dashboard

PI

DCS

KPI’s

Health Assessment

Trends

SmartSignal Watch List

Alarms
Logical Display Flow

Fleet Overview → Plant Overview → Unit Overview

Plant Summary
- Primary System
  - Reclaim / Plant Feed
    - Units 1-4
- Primary System
  - Air / Flue Gas
    - Units 1-4
- Primary System
  - Fuel Burning
    - Units 1-4
- Primary System
  - Boiler Steam Generator
    - Units 1-4
- Primary System
  - Turbine Generator
    - Units 1-4
- Primary System
  - Water Systems
    - Units 1-4

Unit Specific
- Sec. System
  - Fuel Burn
    - Units 1
- Sec. System
  - Fuel Burn
    - Units 2
- Sec. System
  - Fuel Burn
    - Units 3
- Sec. System
  - Fuel Burn
    - Units 4
- Sub. System
  - Pulverizers
    - Units 1
- Sub. System
  - Pulverizers
    - Units 2
- Sub. System
  - Pulverizers
    - Units 3
- Sub. System
  - Pulverizers
    - Units 4
- Equipment
  - Coal Mills
    - Units 1
- Equipment
  - Coal Mills
    - Units 2
- Equipment
  - Coal Mills
    - Units 3
- Equipment
  - Coal Mills
    - Units 4

Develop As Needed
Unit Overview

### Monroe Unit 1 Overview

#### Reliability / Cost Summary

<table>
<thead>
<tr>
<th>Primary Systems</th>
<th>KPI</th>
<th>Value</th>
</tr>
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<tbody>
<tr>
<td>ASH Outage</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Process Cost</td>
<td>$</td>
<td>-</td>
</tr>
</tbody>
</table>
| Boiler & Steam Generators | No Heat | %
| Fuel Burner | - | - |
| Relays/Plant Feed | O&M Costs | - |
| Fuel Use | - | - |
| Turbine/Generator | O&M Costs | - |
| Water System | - | - |

#### Outages

<table>
<thead>
<tr>
<th>Primary System</th>
<th>YTD EAF</th>
<th>EAF Target</th>
<th>Health Assessment</th>
<th>O&amp;M Cost</th>
<th>O&amp;M Cost Previous Week</th>
<th>Capital Cost/YTD</th>
<th>Capital Cost Previous Week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monroe Unit 1 Total</td>
<td>50.0%</td>
<td>51.1%</td>
<td>80.0%</td>
<td>$1,500,000</td>
<td>$1,500,000</td>
<td>$1,500,000</td>
<td>$1,500,000</td>
</tr>
<tr>
<td>Refueling / Storage</td>
<td>50.0%</td>
<td>51.1%</td>
<td>80.0%</td>
<td>$1,500,000</td>
<td>$1,500,000</td>
<td>$1,500,000</td>
<td>$1,500,000</td>
</tr>
<tr>
<td>Refueling / Fuel Feed</td>
<td>50.0%</td>
<td>51.1%</td>
<td>80.0%</td>
<td>$1,500,000</td>
<td>$1,500,000</td>
<td>$1,500,000</td>
<td>$1,500,000</td>
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<tr>
<td>Fuel Burner</td>
<td>75.0%</td>
<td>75.0%</td>
<td>80.0%</td>
<td>$1,500,000</td>
<td>$1,500,000</td>
<td>$1,500,000</td>
<td>$1,500,000</td>
</tr>
<tr>
<td>Boiler / Steam Generator</td>
<td>75.0%</td>
<td>75.0%</td>
<td>80.0%</td>
<td>$1,500,000</td>
<td>$1,500,000</td>
<td>$1,500,000</td>
<td>$1,500,000</td>
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<tr>
<td>Air / IHx Gen</td>
<td>75.0%</td>
<td>75.0%</td>
<td>80.0%</td>
<td>$1,500,000</td>
<td>$1,500,000</td>
<td>$1,500,000</td>
<td>$1,500,000</td>
</tr>
<tr>
<td>Turbine Generator</td>
<td>75.0%</td>
<td>75.0%</td>
<td>80.0%</td>
<td>$1,500,000</td>
<td>$1,500,000</td>
<td>$1,500,000</td>
<td>$1,500,000</td>
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<tr>
<td>Water System</td>
<td>75.0%</td>
<td>75.0%</td>
<td>80.0%</td>
<td>$1,500,000</td>
<td>$1,500,000</td>
<td>$1,500,000</td>
<td>$1,500,000</td>
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<tr>
<td>Feed Water</td>
<td>75.0%</td>
<td>75.0%</td>
<td>80.0%</td>
<td>$1,500,000</td>
<td>$1,500,000</td>
<td>$1,500,000</td>
<td>$1,500,000</td>
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<tr>
<td>Electrical &amp; Control System</td>
<td>75.0%</td>
<td>75.0%</td>
<td>80.0%</td>
<td>$1,500,000</td>
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<td>Service AB &amp; Gas</td>
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<td>Switching &amp; Control</td>
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<td>75.0%</td>
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<td>$1,500,000</td>
<td>$1,500,000</td>
<td>$1,500,000</td>
</tr>
<tr>
<td>Pump / Generator</td>
<td>75.0%</td>
<td>75.0%</td>
<td>80.0%</td>
<td>$1,500,000</td>
<td>$1,500,000</td>
<td>$1,500,000</td>
<td>$1,500,000</td>
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<tr>
<td>Growth / Physical Plant</td>
<td>75.0%</td>
<td>75.0%</td>
<td>80.0%</td>
<td>$1,500,000</td>
<td>$1,500,000</td>
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#### Unit Status

<table>
<thead>
<tr>
<th>Monroe Unit 1 Gross Unit MW (24 Hour)</th>
</tr>
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<tbody>
<tr>
<td>750</td>
</tr>
<tr>
<td>750</td>
</tr>
<tr>
<td>750</td>
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<tr>
<td>750</td>
</tr>
</tbody>
</table>

#### Emergent Unit Derate or Unit Reliability Issues

**MON1**: Derate SCR Pluggage, Poor Mill Performance

#### Fuel Burning

#### Water System

#### Boiler / Steam Generator

#### Market (in $1000)

**Lost Market Opportunity**

- by System
- by De-rate

#### Budget

**DTE Commercial Availability Variance**

<table>
<thead>
<tr>
<th>Site</th>
<th>Date</th>
<th>YTD</th>
<th>YTD YOY</th>
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<tr>
<td>Units</td>
<td>May 08</td>
<td>May 08</td>
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<tr>
<td>Monroe Unit 1</td>
<td>$ (414,262)</td>
<td>$ (731,579)</td>
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**Capital Budget Tracking**

- Budget
- Actual

**OM Budget Tracking**

- Budget
- Actual
Coal Mill
# Coal Mill Health Status

<table>
<thead>
<tr>
<th>Coal Mills</th>
<th>MON1-1</th>
<th>MON1-2</th>
<th>MON1-3</th>
<th>MON1-4</th>
<th>MON1-5</th>
<th>MON1-6</th>
<th>MON1-7</th>
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<td>Acceptable</td>
<td>Acceptable</td>
<td>Acceptable</td>
<td>Acceptable</td>
<td>Acceptable</td>
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<tr>
<td>Coal Mill/Chamber Infrared Te</td>
<td>Acceptable</td>
<td>Acceptable</td>
<td>Acceptable</td>
<td>Acceptable</td>
<td>Acceptable</td>
<td>Acceptable</td>
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<tr>
<td>Mill - Capacity (max load)</td>
<td>312</td>
<td>312</td>
<td>312</td>
<td>312</td>
<td>312</td>
<td>312</td>
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<tr>
<td>Gearbox - #1 Bearing Bar</td>
<td>Acceptable</td>
<td>Acceptable</td>
<td>Acceptable</td>
<td>Acceptable</td>
<td>Acceptable</td>
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<tr>
<td>Gearbox - #1 Bearing Temper</td>
<td>128.25</td>
<td>128.25</td>
<td>128.25</td>
<td>128.25</td>
<td>128.25</td>
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<tr>
<td>dT Gearbox</td>
<td>177.00</td>
<td>177.00</td>
<td>177.00</td>
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<td>PA Damper Position</td>
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<td>Acceptable</td>
<td>Acceptable</td>
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<td>Acceptable</td>
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<td>Burner Air Register movement</td>
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<tr>
<td>Mill - Outlet Temperature</td>
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<td>137.00</td>
<td>137.00</td>
<td>137.00</td>
<td>137.00</td>
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<td>163.00</td>
<td>163.00</td>
<td>163.00</td>
<td>163.00</td>
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</tbody>
</table>
EPRI PRO* Process Model

Achieve the appropriate balance of:
- Preventative Maintenance
- Predictive Maintenance
- Corrective Maintenance

- SAP
  - Financials
  - Human Resources
  - Supply Chain
- Maximo
  - Work Management System
- Equipment / System Hierarchy
  - Plant
  - Unit
  - Primary System
  - System
  - Subsystem
  - Equipment
- System Owners
- Unit Engineers
- Performance Center Analysis
- Performance Engineers

* Plant Reliability Optimization
Total Fleet Management

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

Financials
Work Management
SAP
Maximo

Real-time
Process Applications
Expert Systems
SME Status Displays
WEB Portal
Applications
Distributed Control Systems (DCS)
Distributed PI Historians

Market
MISO,
Fuel Coat Framework
Unit Capacity Framework
Contributed to DTE’s recognition as a technology leader in North America.

Performance Center Tours -- Global visitors

Conference Presentation (past 12 Months)
- User Conferences -- SmartSignal, NeuCo, Matrikon, Coal-Gen, OSIsoft,
- Gartner, Inc. (NYSE: IT) is the world’s leading information technology research and advisory company.
- Vattenfall Workshop Copenhagen Denmark November 2007
- Marcus Evans Asset Management February 2008

Awards & Recognitions
- M2M Gold Award (Manufacturing Category)
- Matrikon (Most Visionary Initiative)

Articles
- Power Engineering October 2006
- Control December 2007
## DTE Energy - A Technology Leader

**Presentations, Articles & Awards**

<table>
<thead>
<tr>
<th>Audience</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tennessee Valley Authority - TVA</td>
<td>AMB</td>
</tr>
<tr>
<td>Allegheny Energy</td>
<td>Detroit</td>
</tr>
<tr>
<td>APS (Arizona)</td>
<td>Detroit</td>
</tr>
<tr>
<td>SCE&amp;G</td>
<td>Detroit</td>
</tr>
<tr>
<td>Santee Cooper - SC</td>
<td>Conference Call</td>
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<tr>
<td>CMS Energy</td>
<td>Detroit</td>
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<tr>
<td>MichCon OSSG - Gas Operations</td>
<td>AMB</td>
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<tr>
<td>Fermi2 Performance Management</td>
<td>Conference Call</td>
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<td>MichCon Compressor Station</td>
<td>Belle River</td>
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<td>Electric Power &amp; Light</td>
<td>Baltimore, MD</td>
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<td>SmartSignal Users Conference 2008</td>
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<td>Indra (Spain)</td>
<td>AMB</td>
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<td>Union Fenosa (Spain)</td>
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<tr>
<td>DTE Distribution Operations</td>
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<td>E.ON U.S. Services Inc, Louisville, KY</td>
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**Presentations in Process**

- AEP American Electric Power
- Emerson Process Management
- OSI Regional Conference
- Marcus Evans World Engineering Congress
- Tenaga Power Conference Malaysia

Requested to Present but DTE Declined

- Bangkok, Thailand
- Singapore, Malaysia
Fleet Optimization is about ……

People Making the right decisions when it matters!