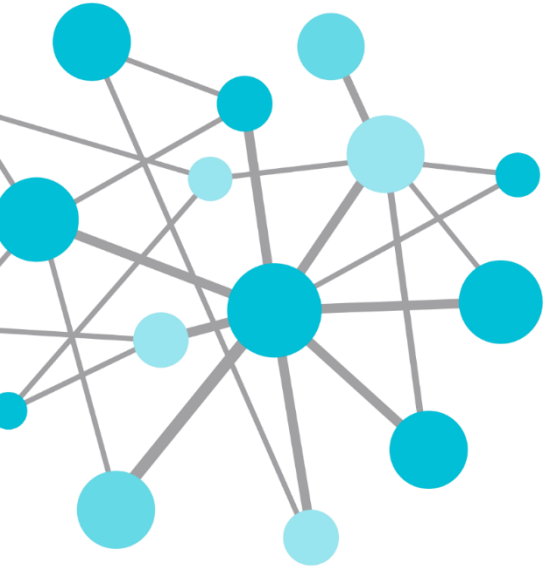


DTE Energy: an Enterprise PI approach

Fleet Optimization through Process Information

Gas Operations Update

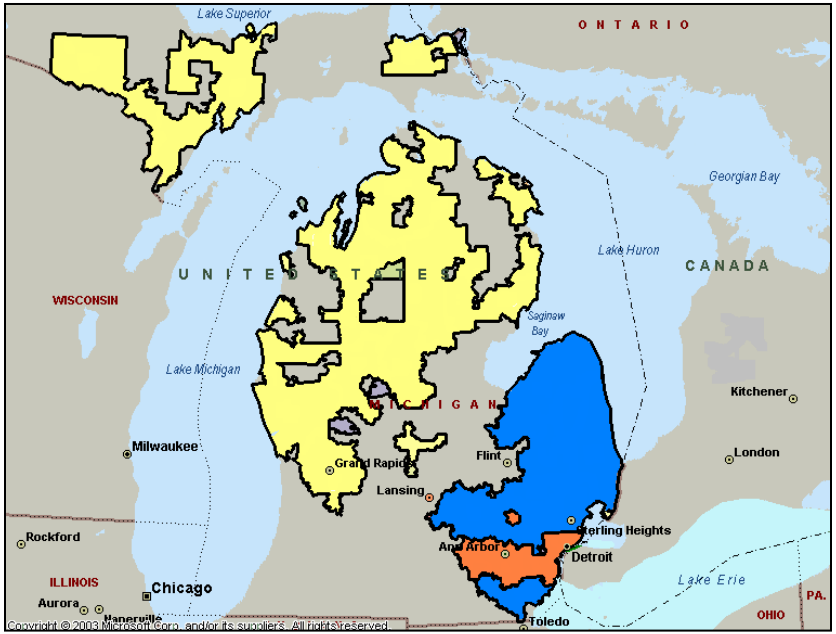
Electric Distribution Condition Based Maintenance

AMI Analytics

Space and Time Come Together; OSIsoft and ESRI

Presented by **Richard Mueller, Supervising Engineer**
DTE Energy

DTE Energy



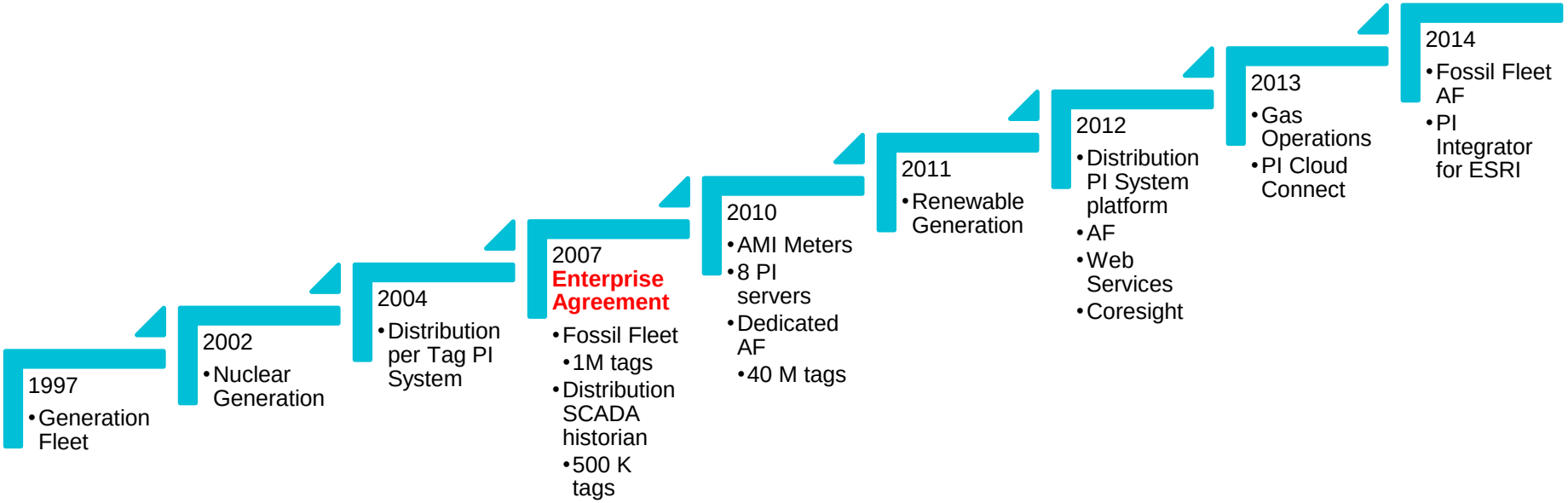
- <u>Detroit Edison (Electric)</u>
- 2.1 million customers
  - 1.6M AMI meters and growing
- 7,600 square mile service territory
- Generation: 11,086 MW
  - System Peak Load: 12,762 MW
  - Annual Sales: 54,000 GWH

- <u>Michcon (Gas)</u>
- 1.3 million customers
- 14,700 square mile service territory
- 679 bcf of gas sales
- Significant gas storage capacity 170 bcf
  - 12% of national gas storage
- Vector (IN-MI-ON), Millenium and Bluestone Pipelines in NY and PA

Agenda

- History of PI at DTE
- Generation – Performance Center
  - Performance Optimization Framework
  - Fuel Cost Framework
- Gas Operations
- Distribution Operations
  - Condition Based Maintenance
  - AMI Analytics
  - PI Integrator for ArcGIS
  - Future

History of PI at DTE



Power Plants & Performance Center

750 MW wind
20 MW solar
and growing

Monroe – 3,135 mw

Belle River – 1,260 mw

Trenton Channel - 730 mw

Performance Center – 11,588 mw

River Rouge - 527 mw

Greenwood – 785 mw

Generating Unit	Capacity Unit	Capacity Plant
Belle River 1	625	
Belle River 2	635	
Belle River		**1260**
Conners Creek 15	135	
Conners Creek 16	100	
Conners Creek		**235**
Fermi 2	**1110**	**1110**
Greenwood 1	**785**	**785**
Harbor Beach 1	**103**	**103**
Monroe 1	770	
Monroe 2	795	
Monroe 3	795	
Monroe 4	775	
Monroe		**3135**
River Rouge 2	247	
River Rouge 3	280	
River Rouge		**527**
St Clair 1	150	
St Clair 2	162	
St Clair 3	168	
St Clair 4	158	
St Clair 6	321	
St Clair 7	450	
St Clair		**1409**
Trenton Channel 7A	124	
Trenton Channel 8	122	
Trenton Channel 9	520	
Trenton Channel		**766**
Peakers	**1224**	**1224**
Totals:	**10554**	**10554**

Challenge - Process Data Everywhere!

- **DCS** installations on nearly every unit
- Over **1,000,000** process data tags
  - PI Systems at each plant (~20 PI collectives)
  - 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**?

The Performance Center

The Door into the Fleet

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**.

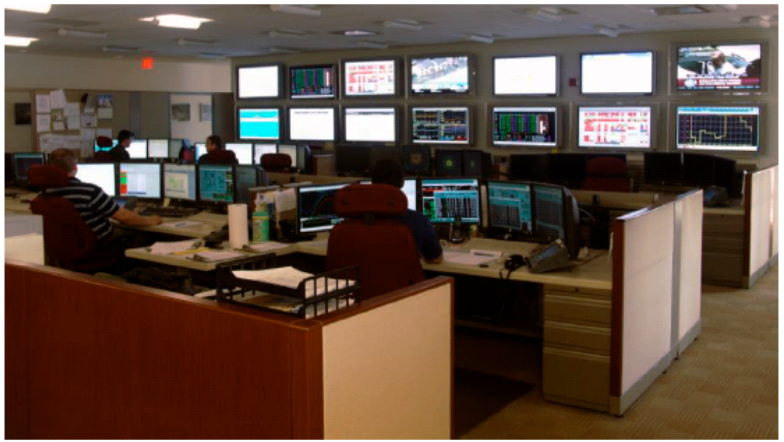
Performance Center – Vision

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

Virtual Control Room - 23 Units



Common Methodology

Standard GUI
Single Method

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

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

Process Information

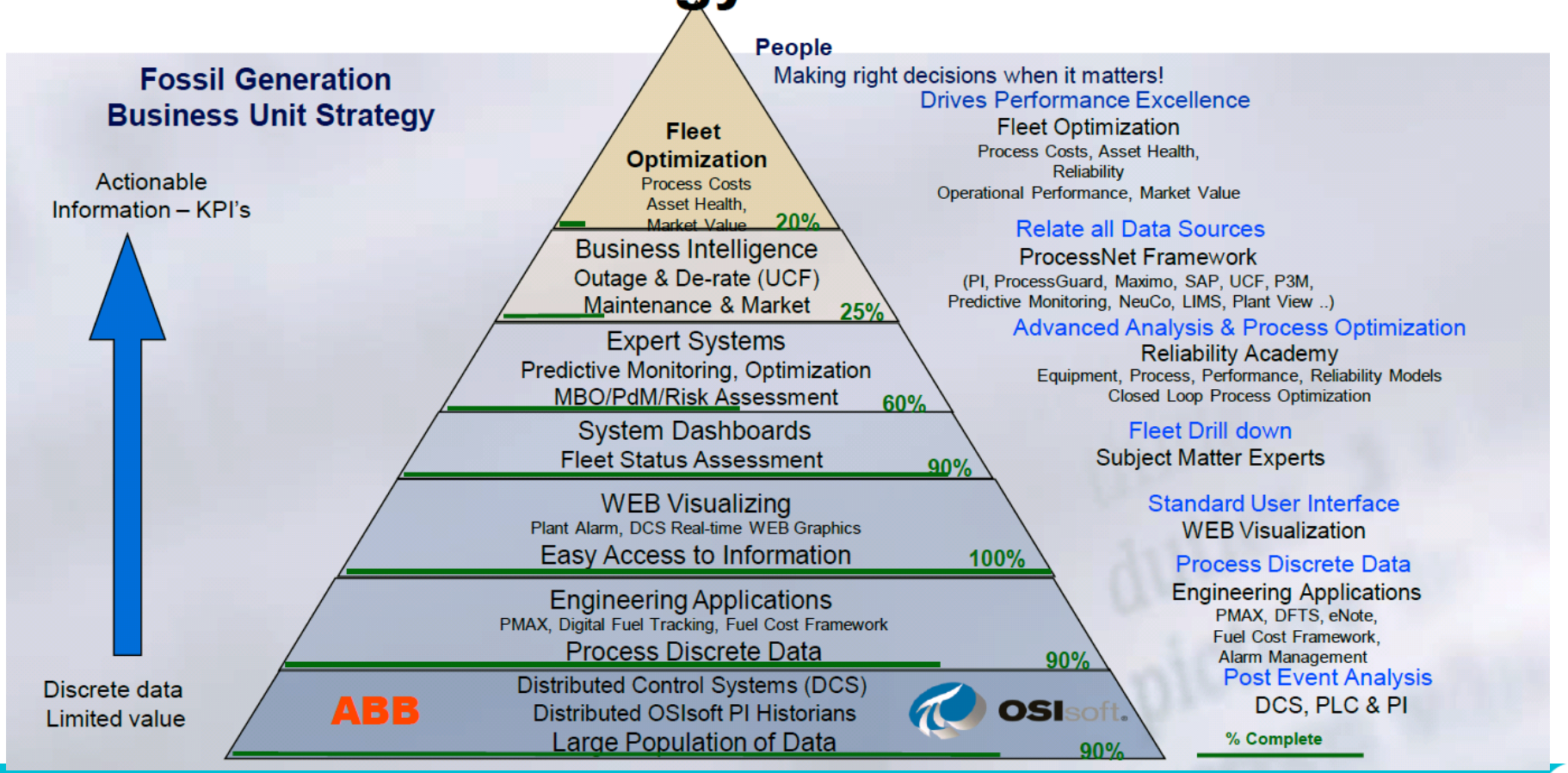
Work Management
Project Management
Document Management
SAP

Business Systems

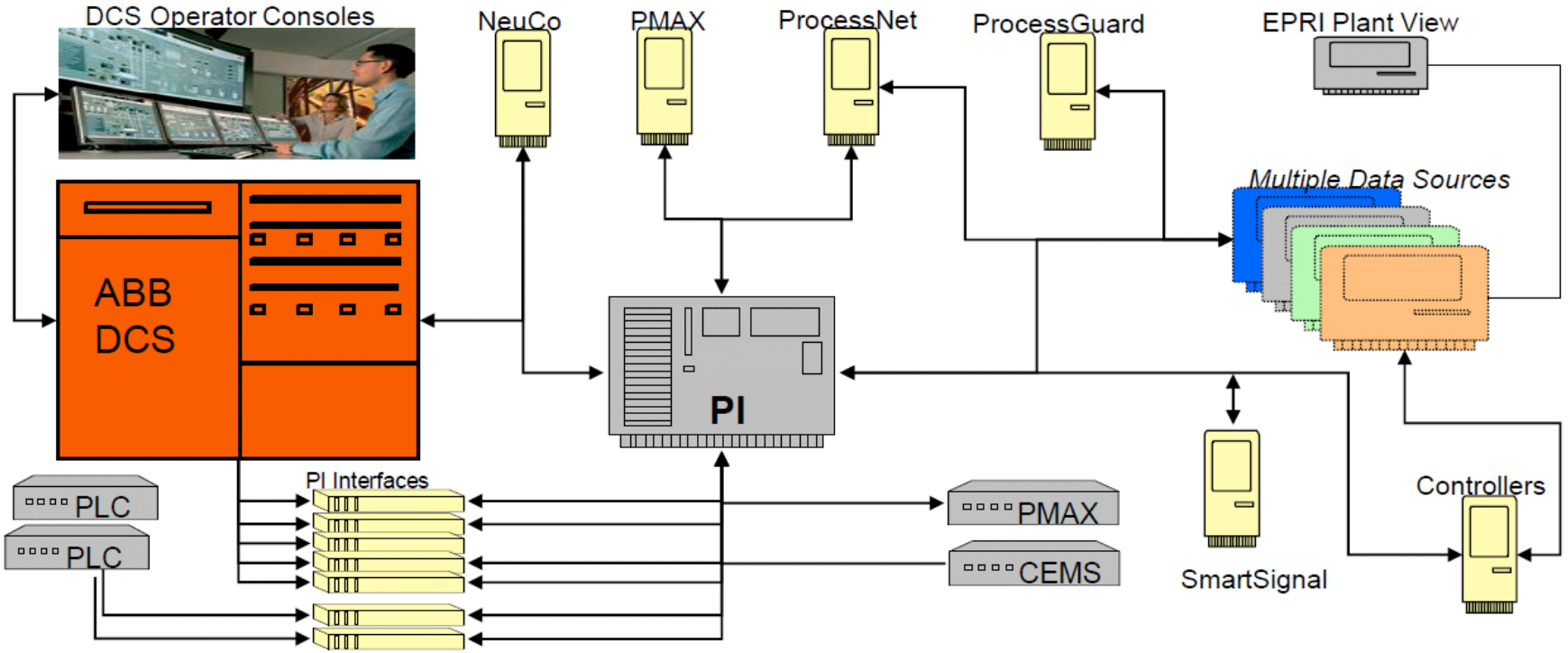
MISO Real Time
De-rate Management
Unit Capacity
Outage Planning
MISO Day Ahead
Fuel Cost
Ancillary Services

Market Data

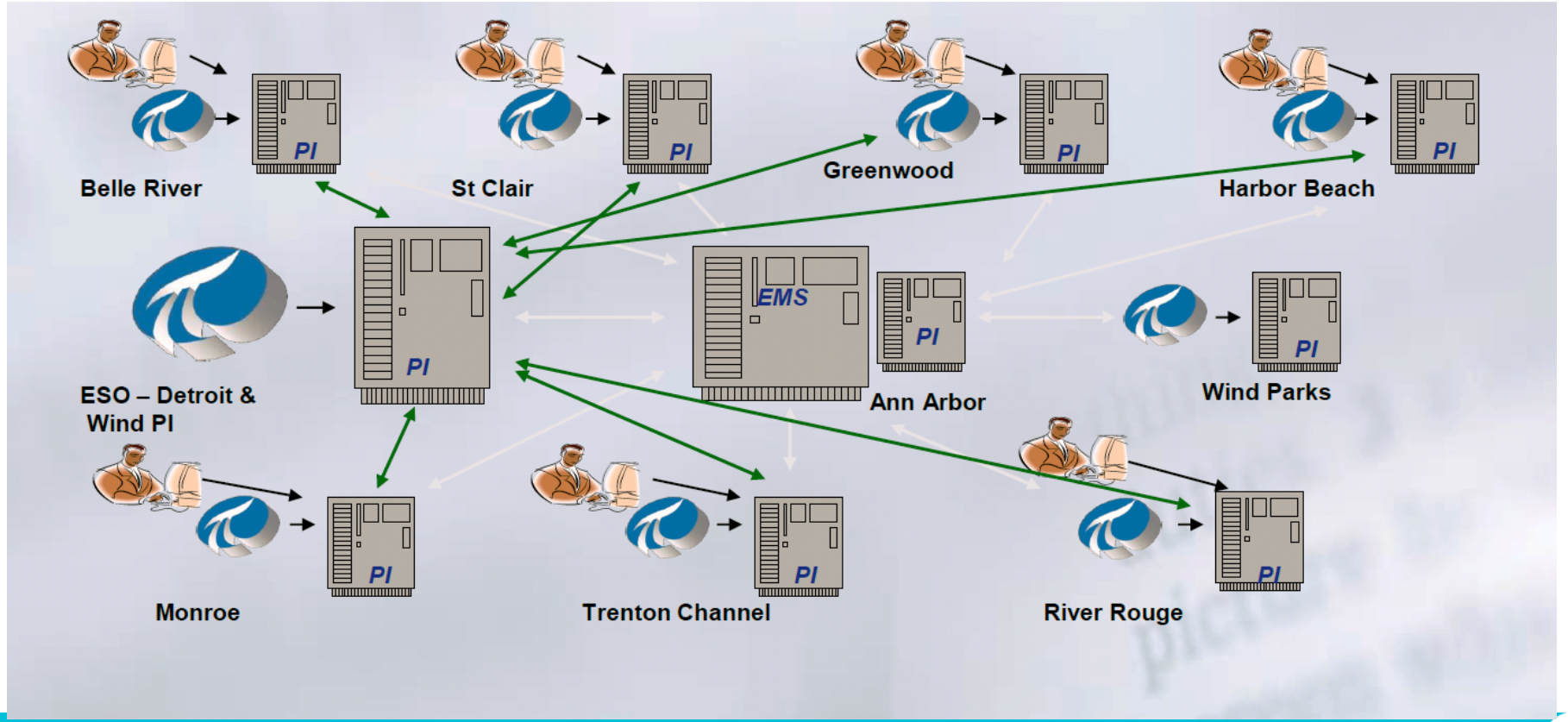
Control & Technology Framework



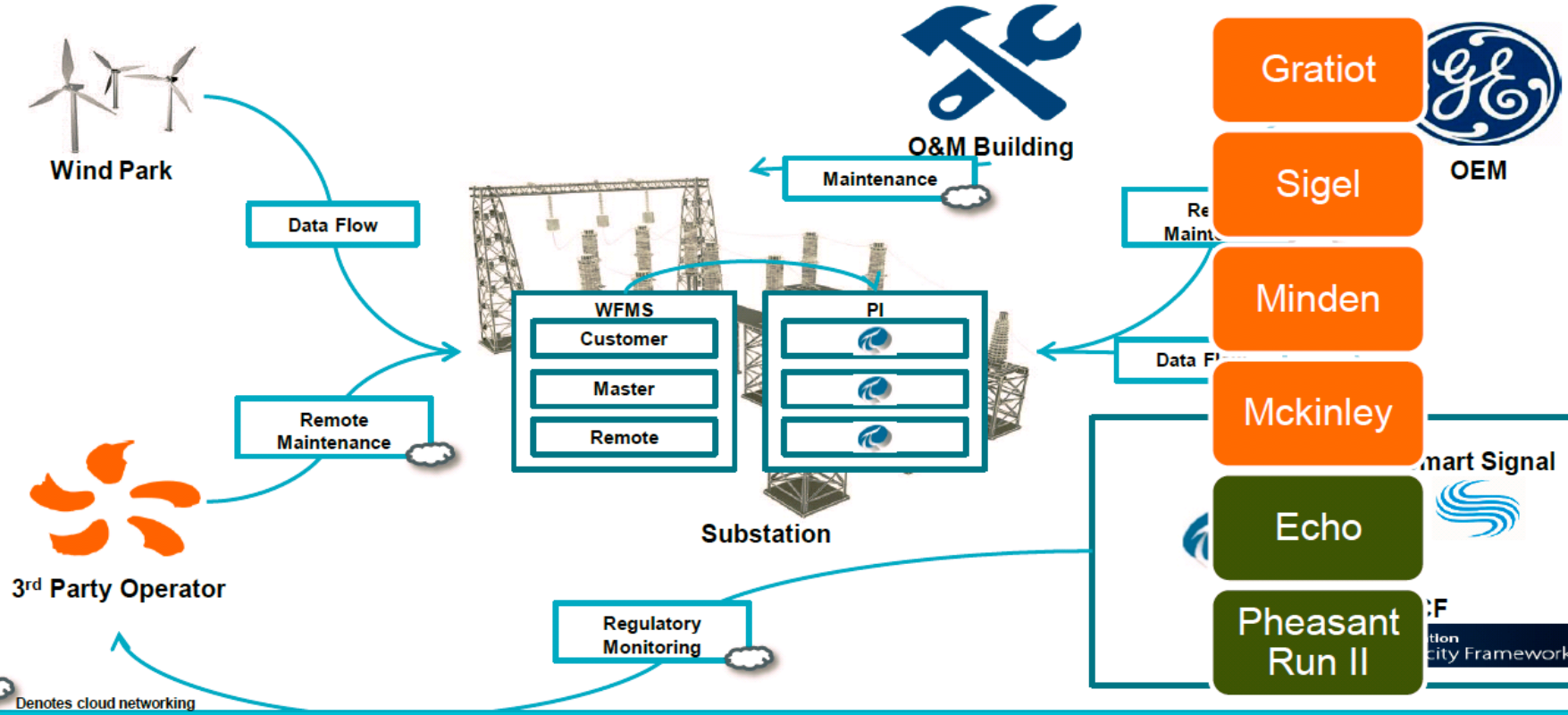
Control & Technology Infrastructure – Plants



PI to PI Process Data Conduit



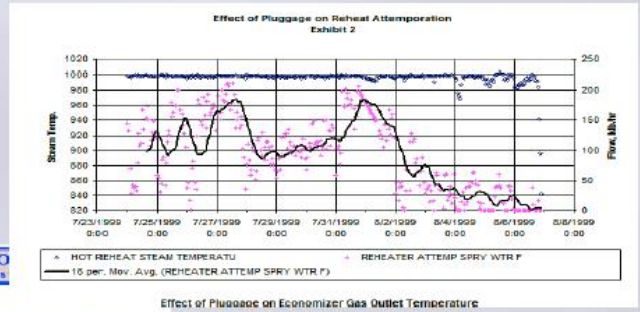
Control & Technology Infrastructure – Wind Parks

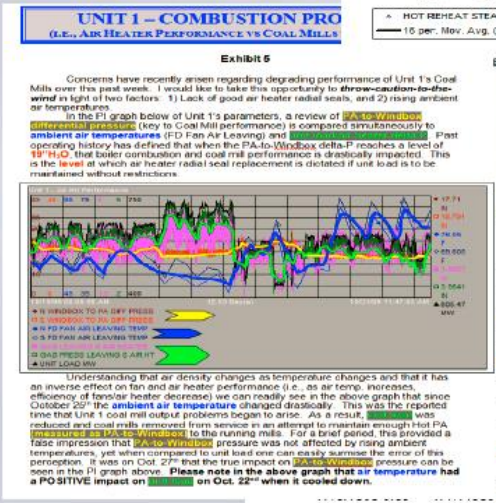


Raw PI Data Analysis

PI Yields Benefits

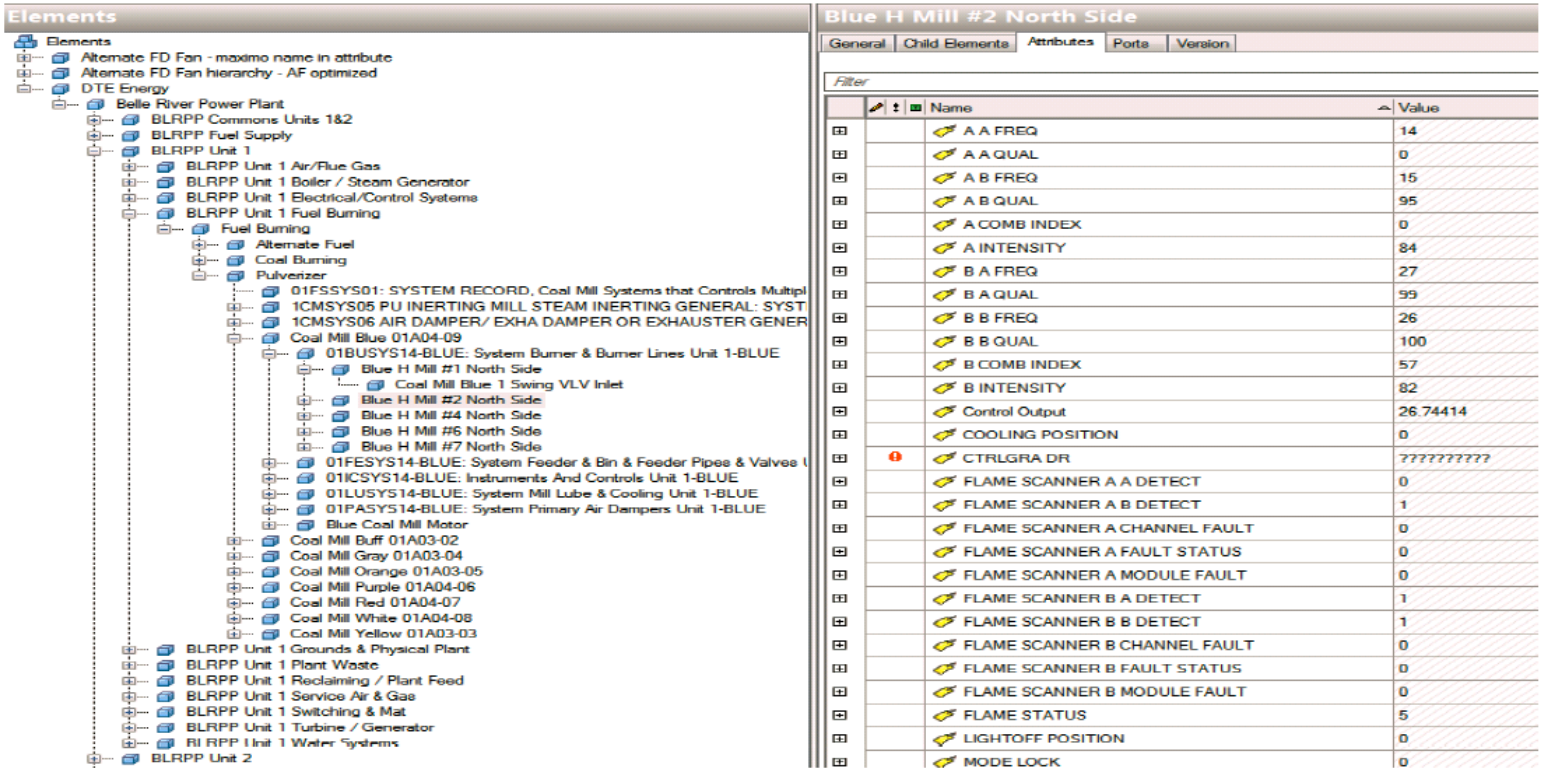
- Post trip analysis
- Process monitoring
- Optimization
- Early warning
- Alarming





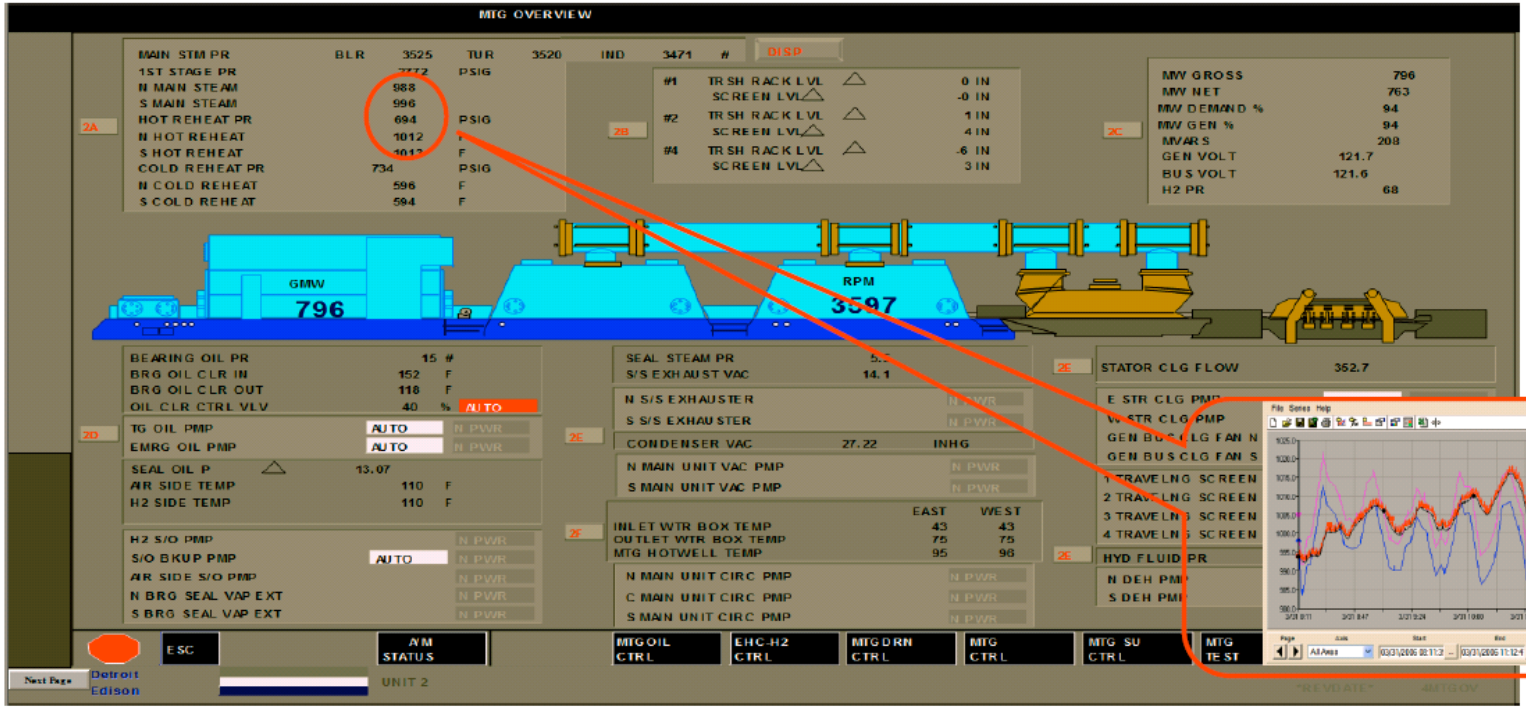
Effect of Pluggage on Economizer Gas Outlet Temperature

PI Asset Framework (AF)

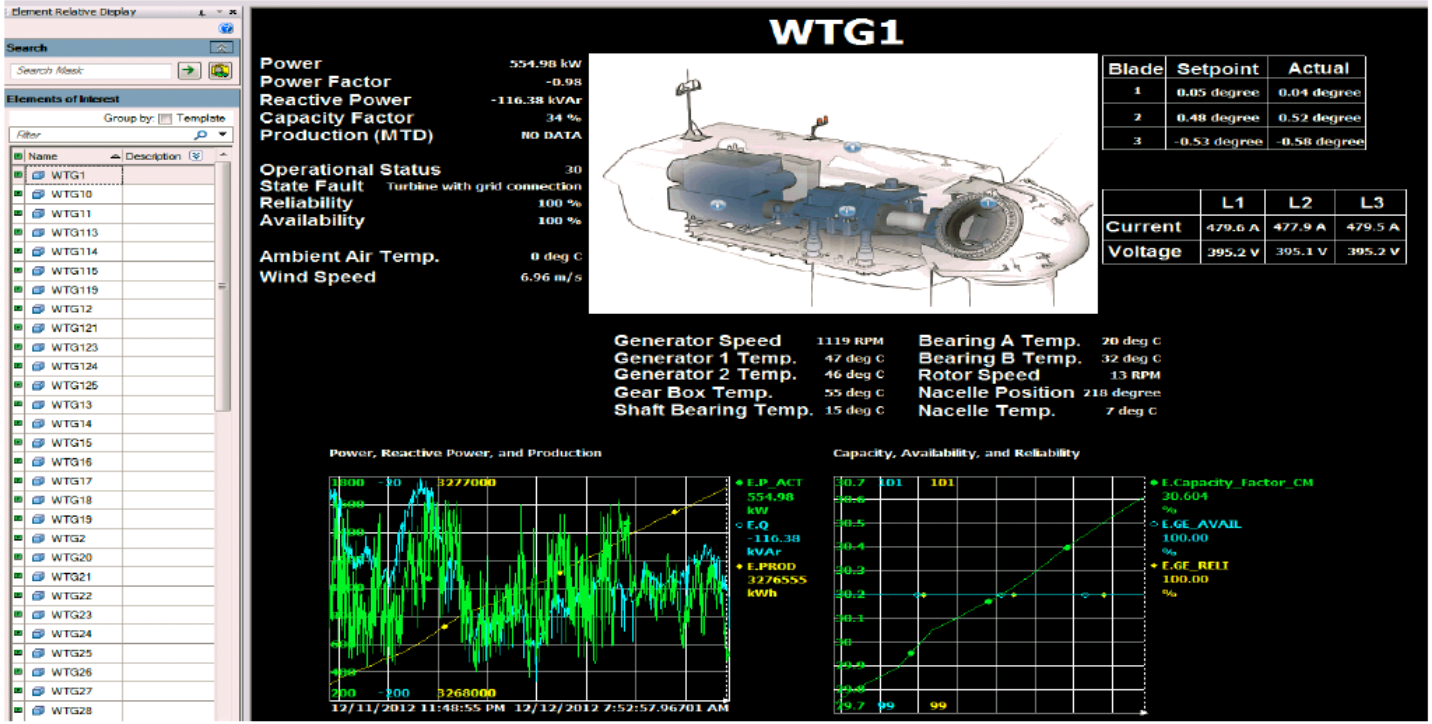


Real-Time DCS Operator Displays

6000 real time dynamic actively linked WEB DCS graphics

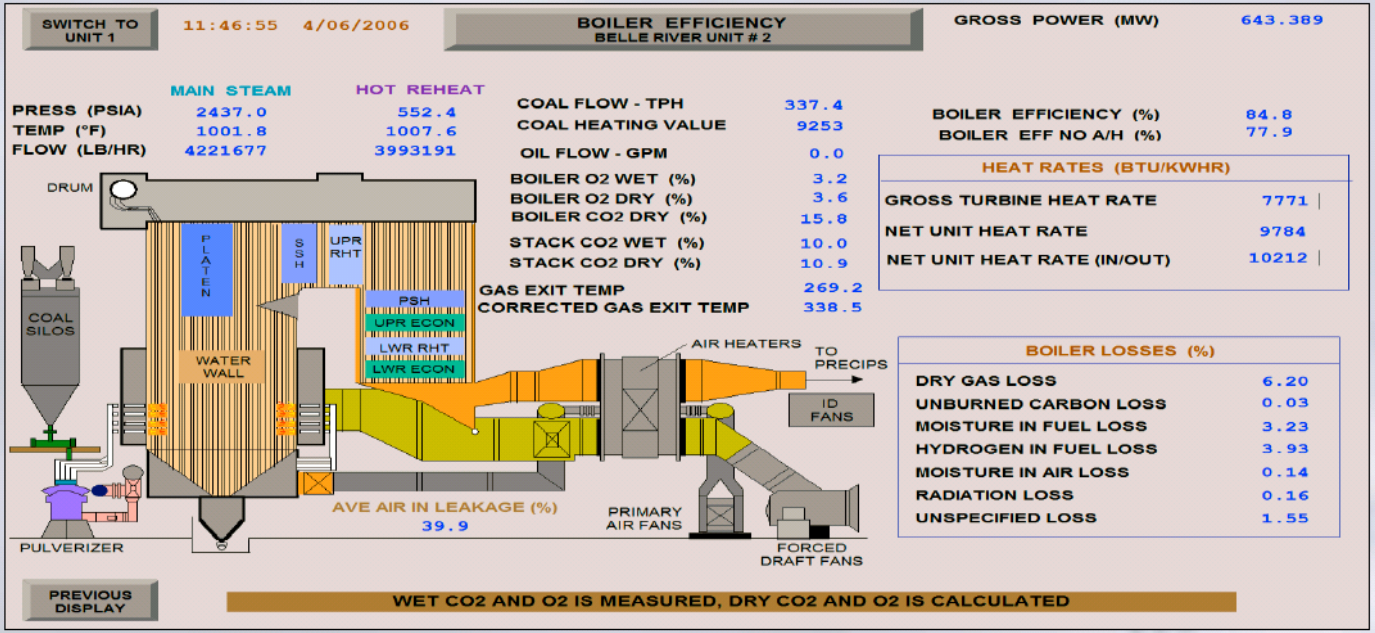


Real-Time Wind Turbine Display



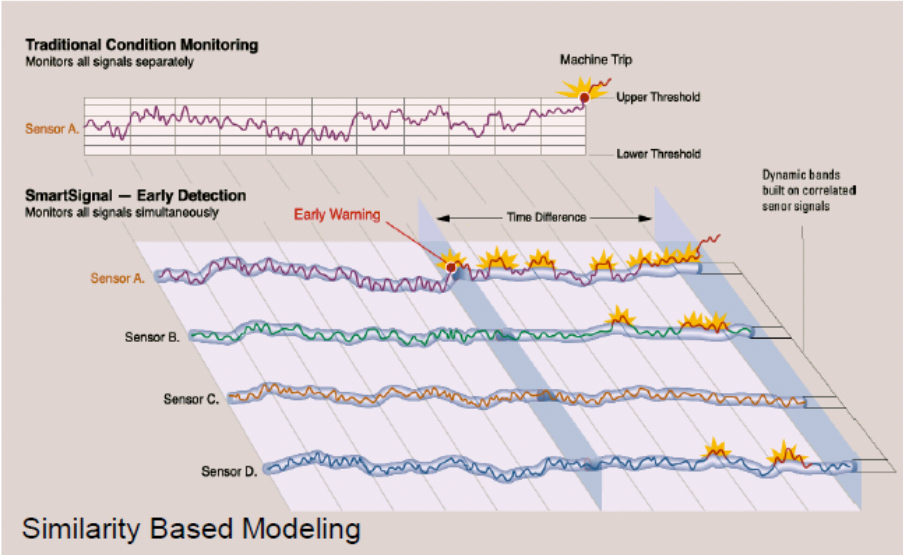
Fleet Performance Analysis (PMAX)

Thermal Performance Calculation Engine



Advanced Pattern Recognition

Equipment Condition Monitoring SmartSignal



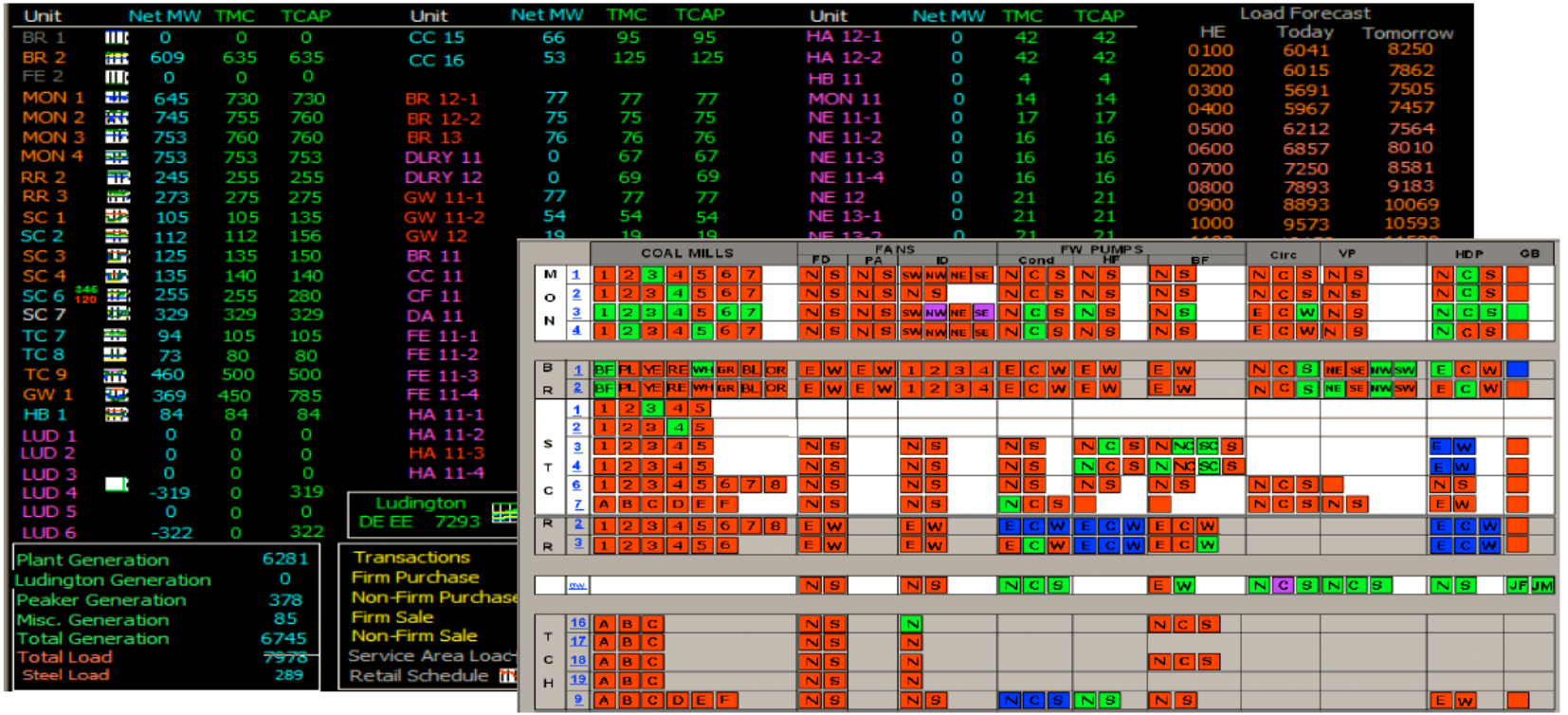
PI Dependent Expert Systems Combustion Optimization – NeuCo

Objective – Coal pile to stack Optimization

- Closed loop Neural Net Optimization
- In Service St Clair Unit 7 (Neural Mode November 2007)
- Installation in progress on Belle River 2 (2008)
- Planned for Monroe Units 1-4 (High PRB Utilization Project)

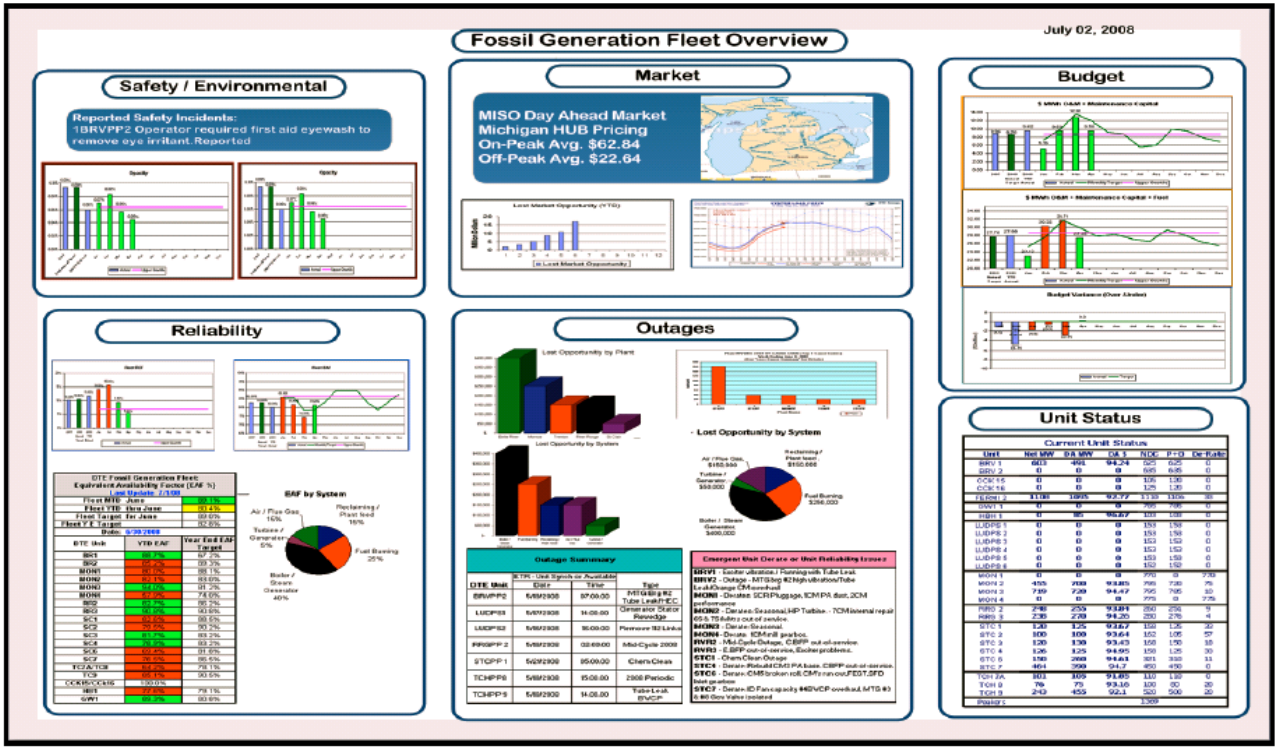
NeuCo
The Optimization Standard™

Fleet Status – PI WEB enabled

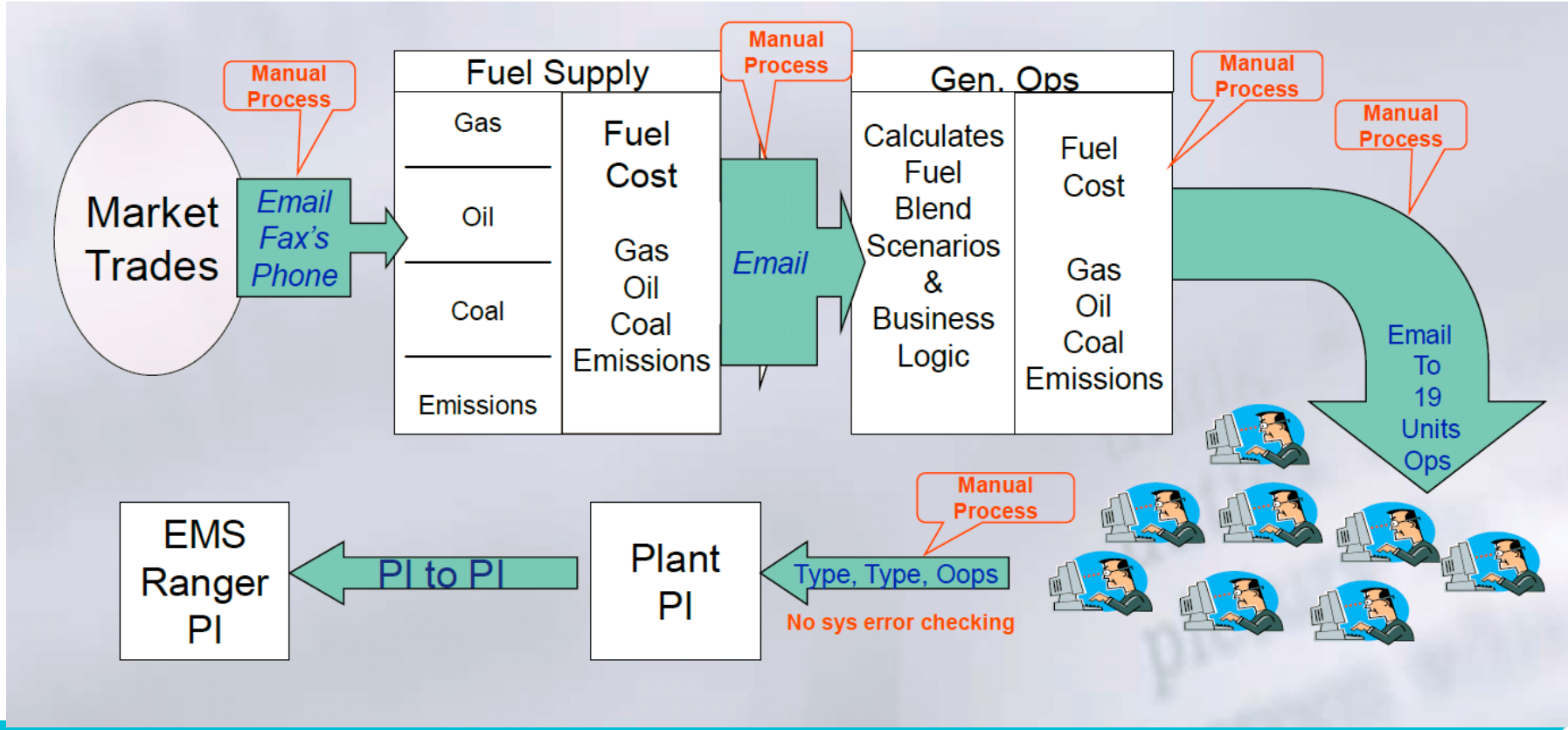


Process Cost Drill Down

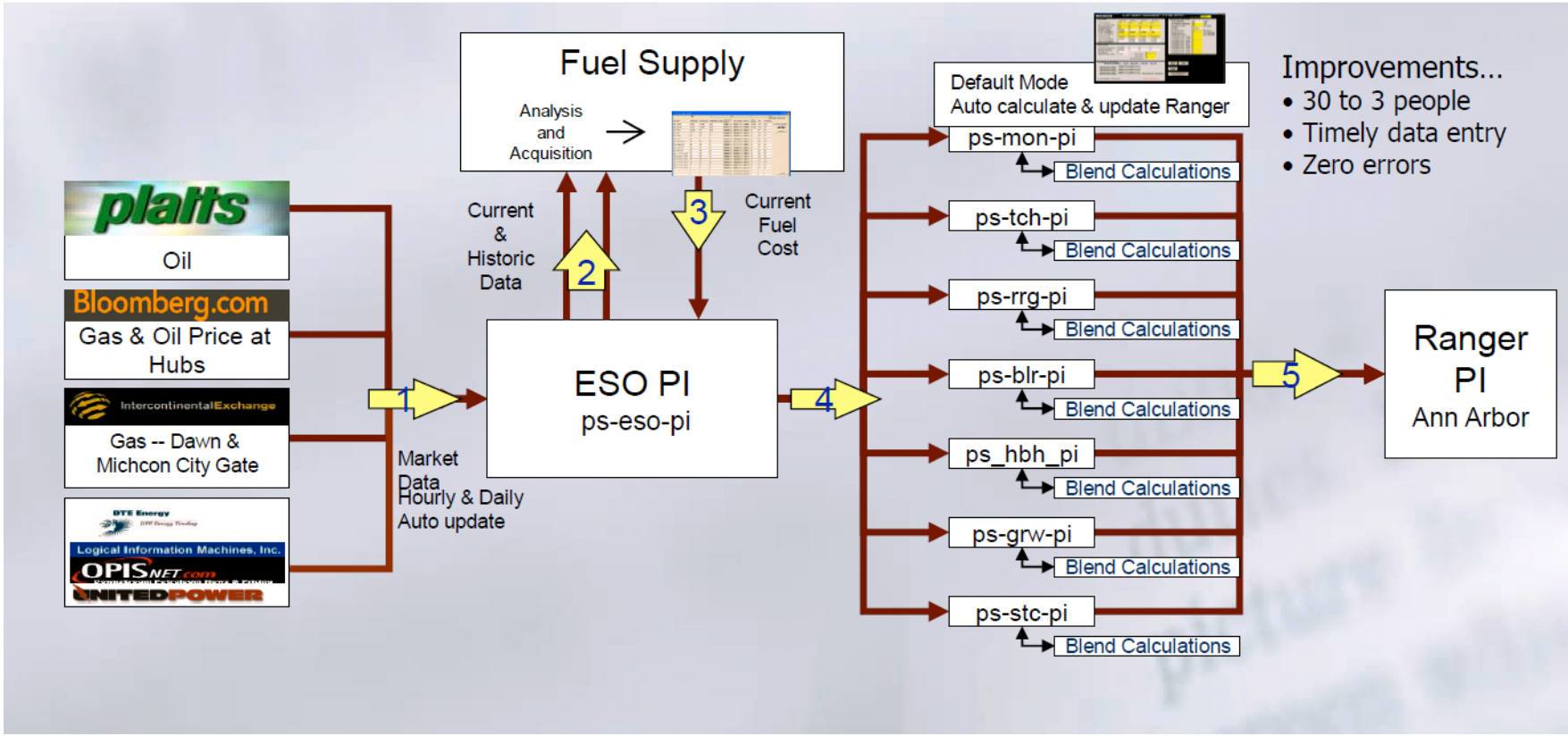
Fleet Overview



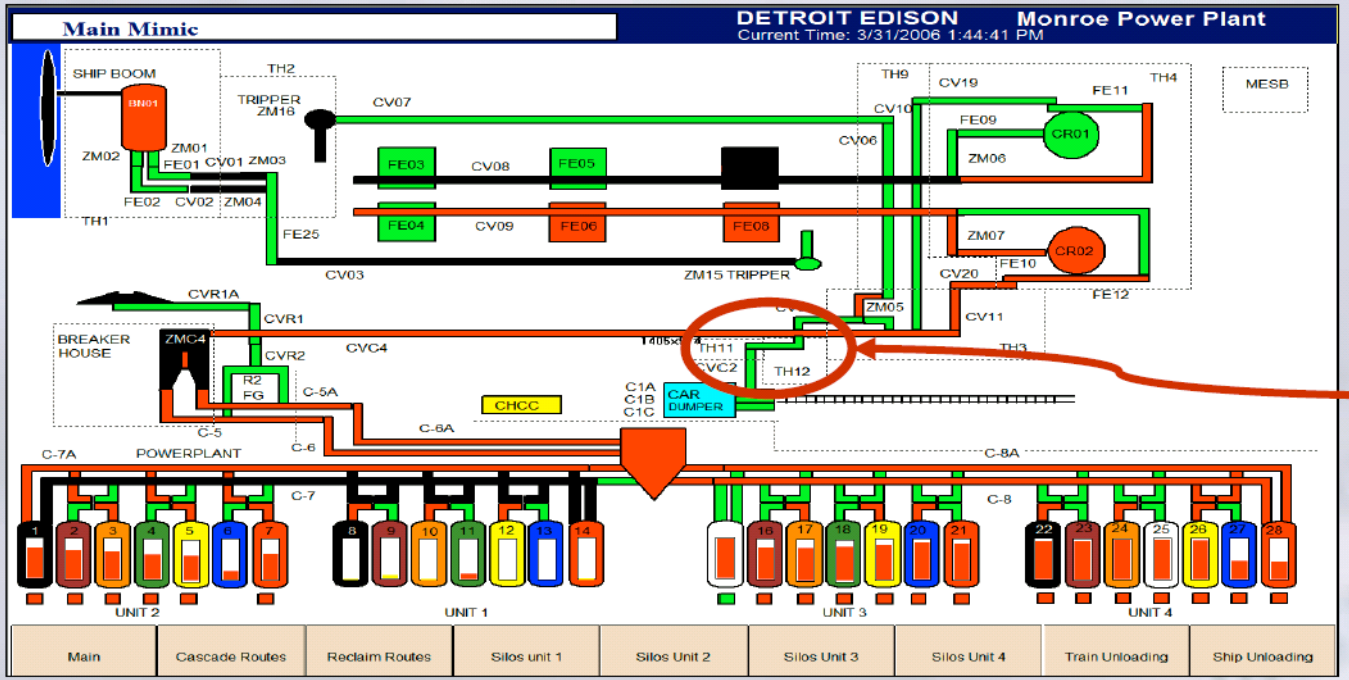
Before Fuel Cost Framework



Fuel Cost Framework



Digital Fuel Tracking System



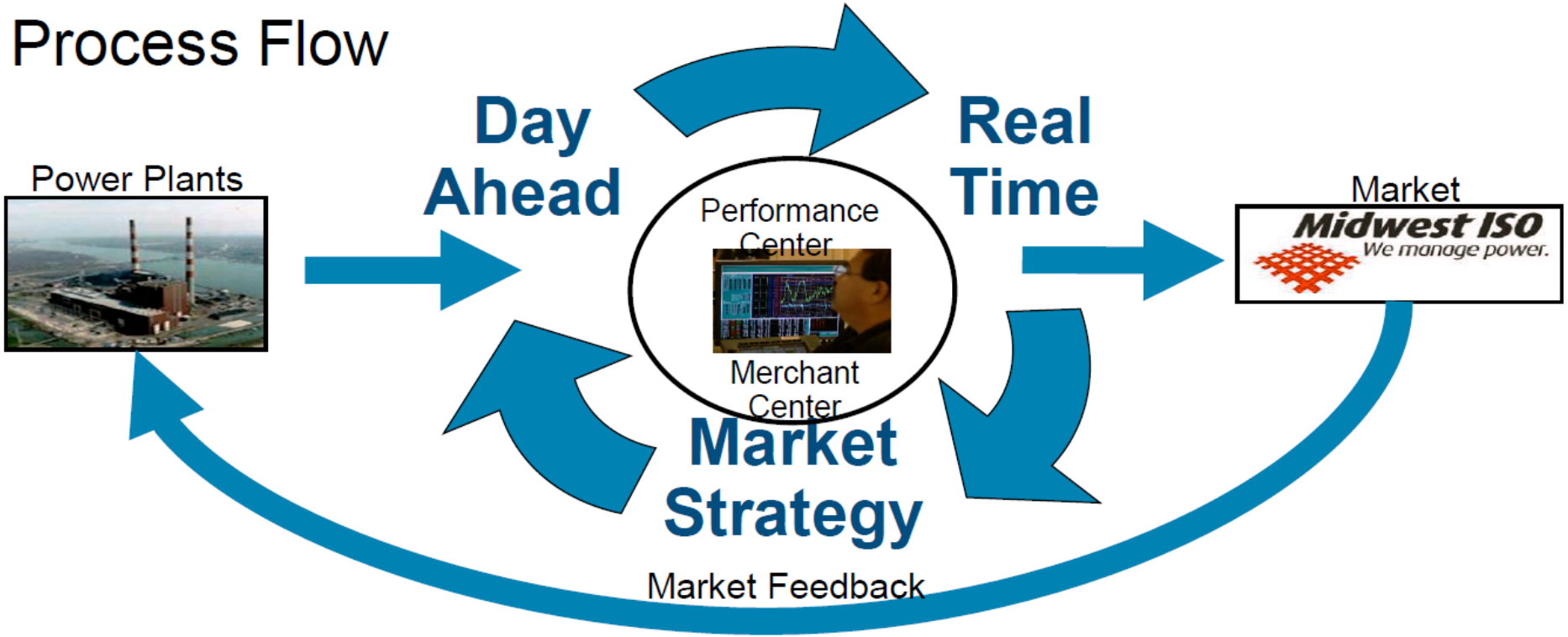
On-line
Fuel Analyzer

PI to PI (AGC)

AGC – Automatic Generation Control

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

Unit Capacity Framework (UCF)



DTE Gas

Engaged Center of Excellence
Leveraged training as part of EA agreement

- Gas Operation Compressor Stations
  - Install AF server for Belle River and Willow Compressor Stations
  - Upgrade PI Server to the latest release (14K tags)
    - Install Coresight to display Belle River and Willow data
    - Install PI Server at 6 other Compressor Stations
    - Install PI at Bluestone Pipeline
- Gas Control Control Center
  - Install SCADA-PI-Primate Control Center

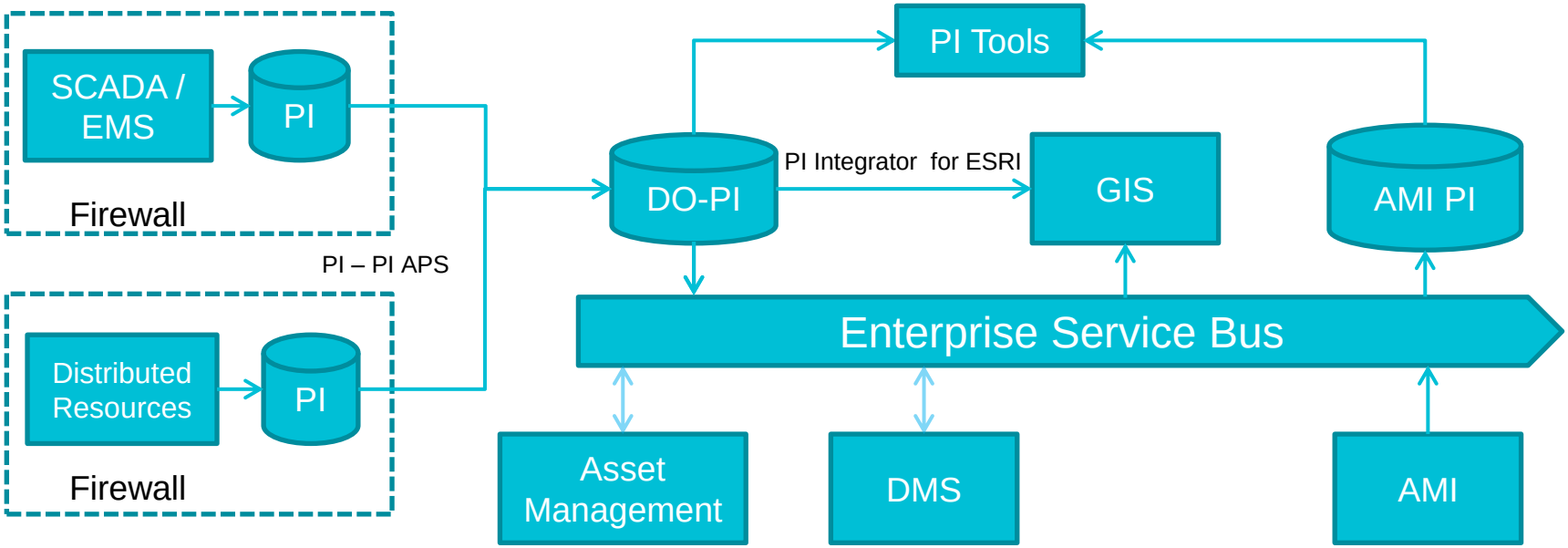
DTE Distribution Operations

- 450,000+ tags in SCADA historian
- 27,000,000 tags and growing in AMI PI

- PI to PI APS SCADA and DR historian to DO-PI

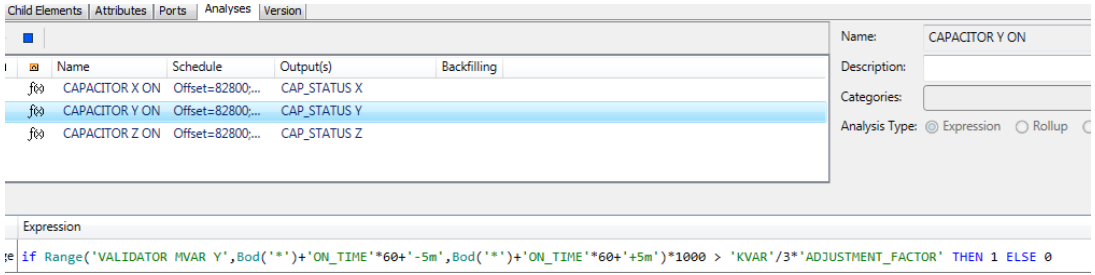
- PI Historian 2012 HA configuration
- AF 2012 (upgrading to 2014)
- Coresight 2013 (upgrading to 2014)

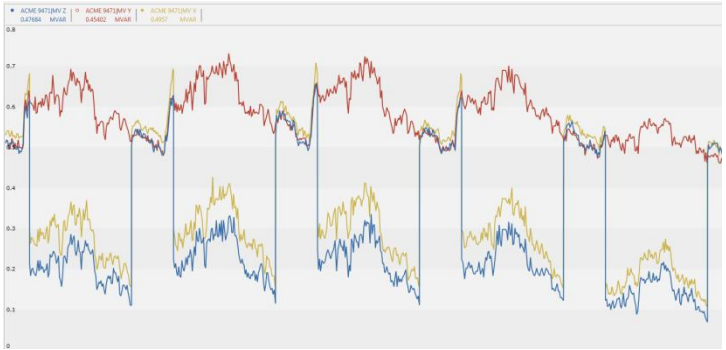
Distribution PI System



Condition Based Maintenance pilots

Detecting trouble before it causes a failure or escalates is key to Distribution's Asset Health Strategy





Business Challenge

- Detect abnormal operating behavior of devices before failure
- Reduce manual inspections
- Device may not have monitoring equipment

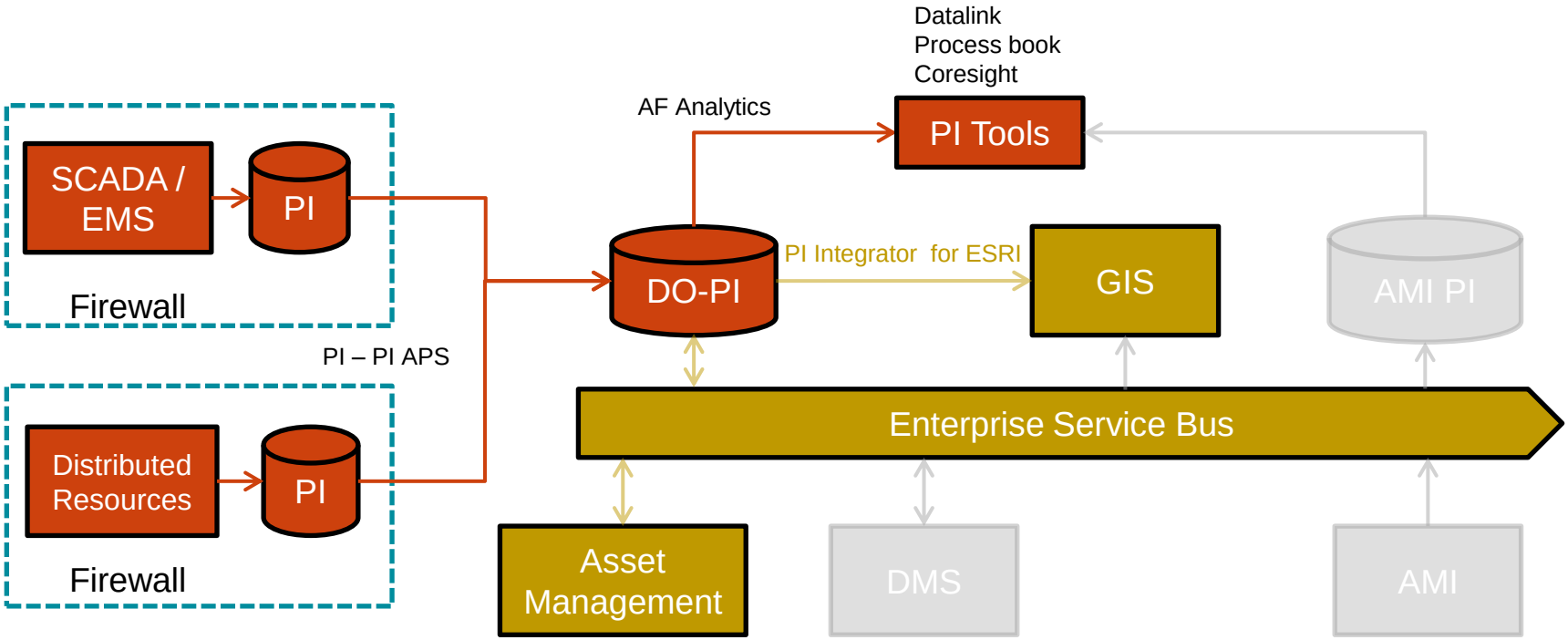
Solution

- Add assets to AF model
- Create calculations using AF analysis
- Visualize with Coresight and Datalink
- Webpage report

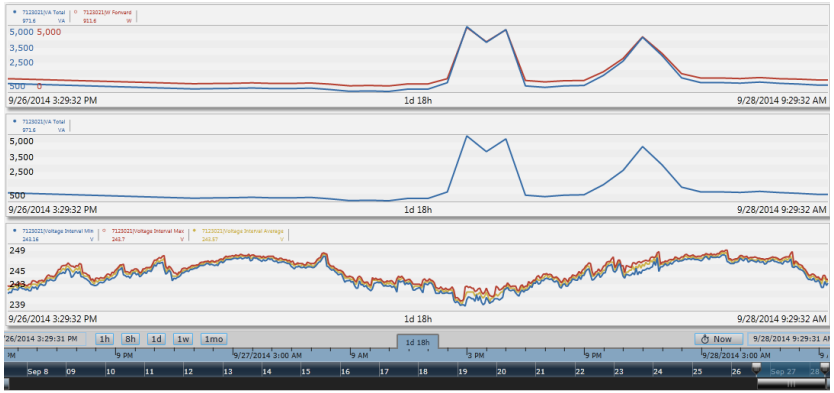
Results and Benefits

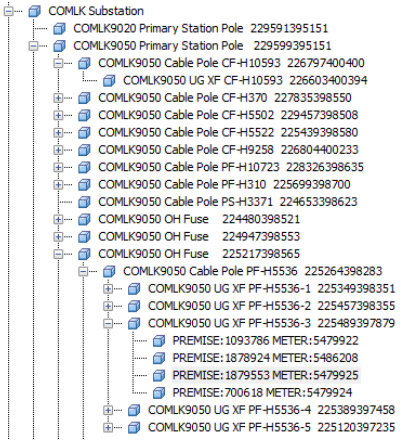
- Quickly determine which devices are out of range
- Provide consistant drill down capability to the end user

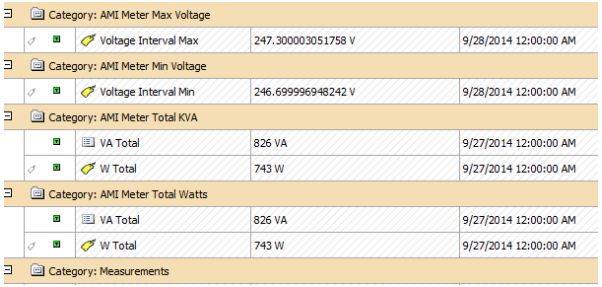
Using PI for equipment analysis



AMI PI system







Business Challenge

- 24-288 daily reads, 17 values, 2.7 Million meters (27 million tags YTD, projected 40M+ tags)
- Capture AMI information for Analysis
- Provide a common mechanism to view AMI trending information

Solution

- Consulted COE, 8 PI servers
- Implement MSP interface to DTE Enterprise Service Bus
- Utilize PI System tools for analysis and visualization
- Consolidate Events to Digital States

Results and Benefits

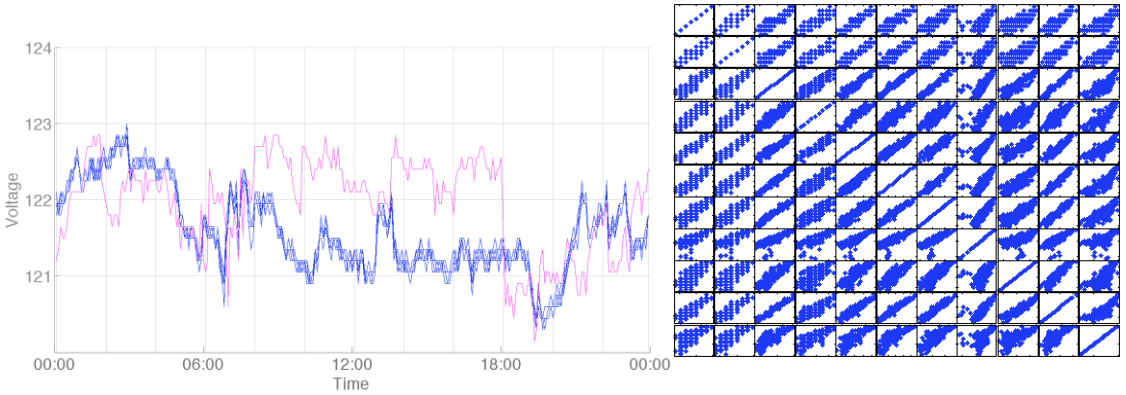
- Users can access full history of AMI information using process book, Datalink and Coresight
- Tags are grouped to meter through AF
- AFSDK applications

AMI Analytics

Aggregation allows condition based maintenance for devices with no sensors

Comparison of voltage on meters at same transformer to validate connectivity and phasing

Detect recurring events, usage patterns and loads, Plugin vehicles, Solar, momentary outages



Business Challenge

- How to use the vast amount of information generated by AMI

Solution

- Implement PI web services and SDK applications to move data to High performance compute system and specialized offline calculations

Results and Benefits

- Aggregation of Meter loading to transformer and distribution network for condition based maintenance
- Voltage analysis for phasing

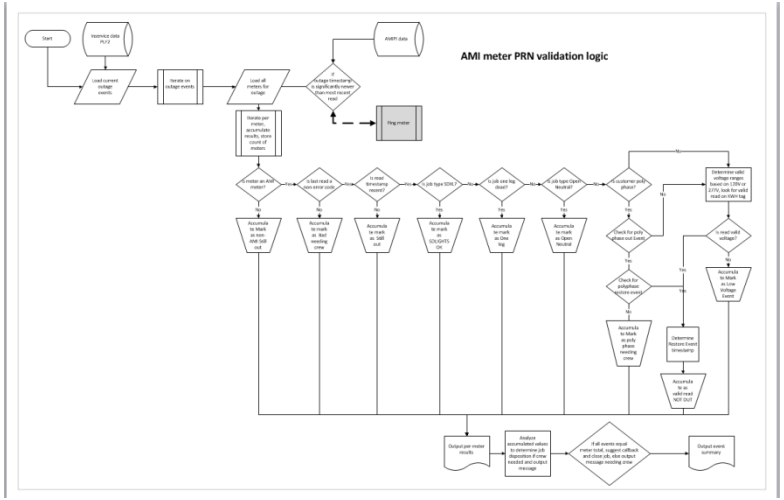
AMI & AFSDK

Web Status dashboards for operations and equipment engineers

Outage disposition recommendation based on Meter events

Analysis of momentary outage events and voltage events for planning and power quality

Data extraction for reporting



Business Challenge

- Custom calculations needed for specific business units
- Combining disparate sets of data across enterprise

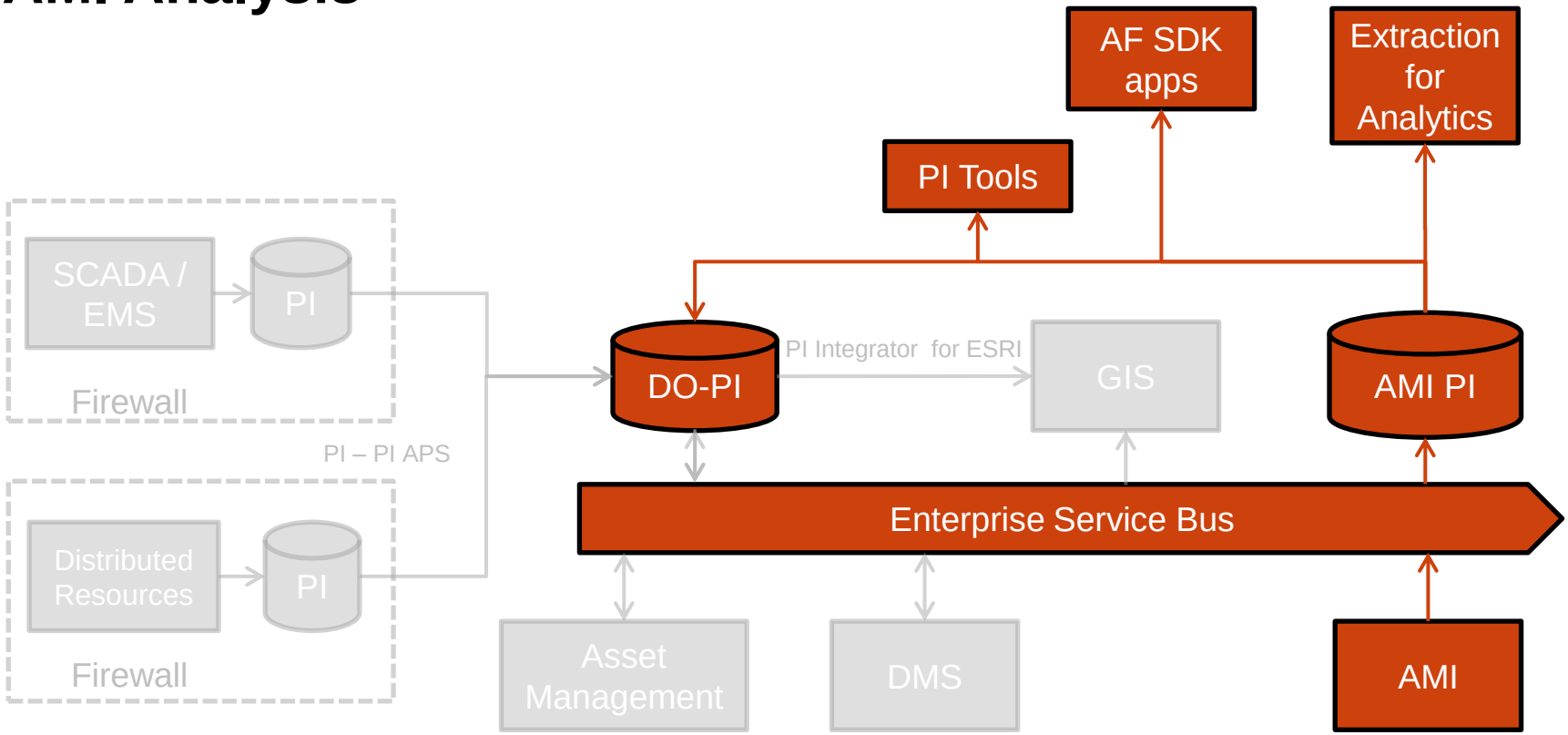
Solution

- Utilize AFSDK applications in c# and asp.net to mash up multiple data sources
- Utilize AF analytics and formula data references

Results and Benefits

- Rapid prototyping and iteration of algorithms and calculations

AMI Analysis

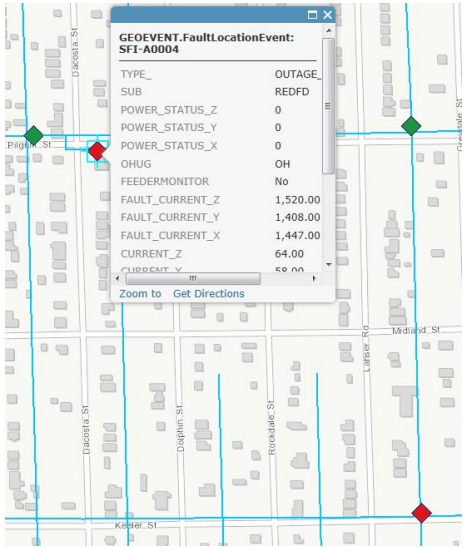


PI Integrator for ArcGIS

Spatially visualize Real Time data in the office and on mobile

Provide reporting at the point of activity

Worked extensively with Beta team and DTE field personnel



Business Challenge

- Determining where to send crew in an outage and minimize patrol time
- Multiple different types of sensors, similar data
- Allow crews to visualize sensor data in the field

Solution

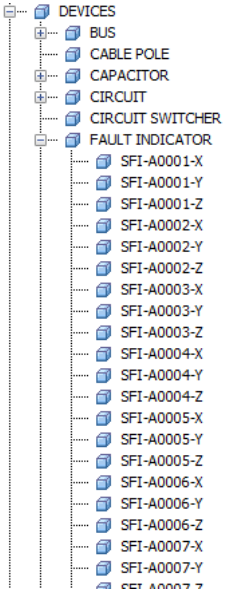
- Route Sensor data through PI AF
- Use AF data references to consolidate data
- Utilize PI integrator for ArcGIS

Results and Benefits

- Visualization of sensor status with Circuit map
- Visibility in the field for nearby devices
- History of device operation

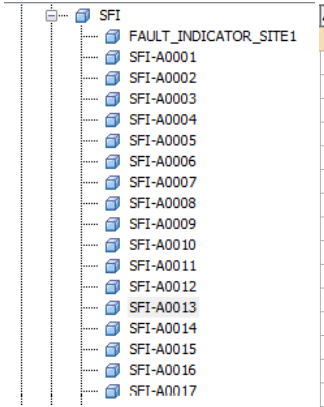
AF configuration

Specific Device Elements (1 Phase)



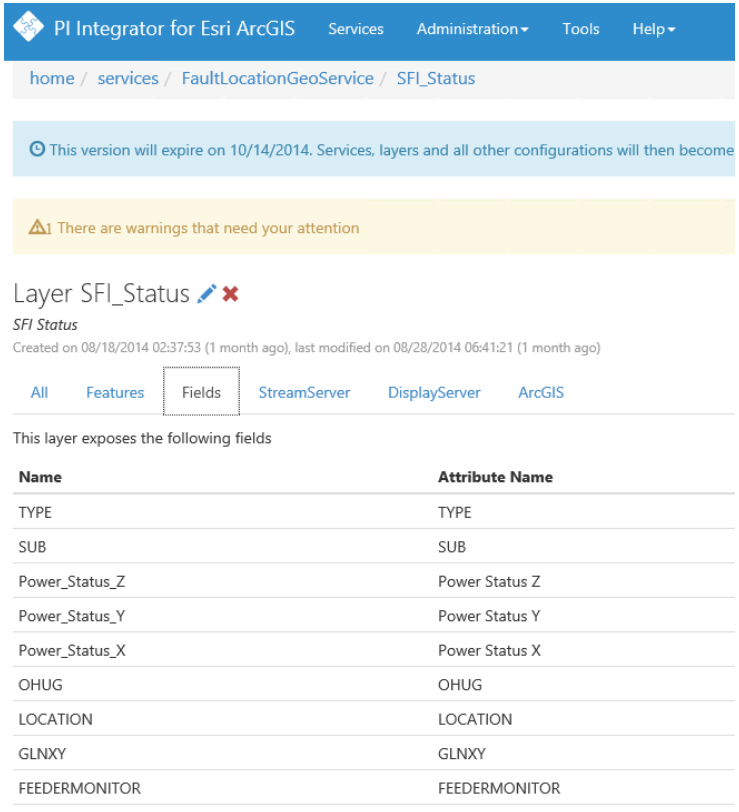
Current	249.699996948242 A	9/29/2014 10:05:01.109 AM
Fault Indication	Normal	9/29/2014 10:03:02.856 AM
Power Status	On	9/29/2014 10:03:02.856 AM
ory: Asset		
ory: Measurement		
AC Loss Count	I/O Timeout	9/13/2014 3:25:37 AM
AC Restore Count	I/O Timeout	9/13/2014 3:25:37 AM
Battery Charger State	Off	9/29/2014 10:03:02.856 AM
Battery Voltage	3.23200011253357 V	9/29/2014 10:03:03.738 AM
Charging Status	True	9/29/2014 9:53:02.428 AM
Communication Failure	Normal	9/29/2014 10:03:02.856 AM
Communication Status	Off	9/29/2014 10:03:02.856 AM
Demand Current	217.100006103516 A	9/29/2014 10:03:03.738 AM
DIDT Count	I/O Timeout	9/13/2014 3:25:37 AM
ECIO	0	9/29/2014 10:03:03.738 AM
Entering Low Power Mode	False	9/29/2014 10:03:02.856 AM
Entering Normal Mode	True	9/29/2014 10:03:02.856 AM
Fault Current	0 A	9/29/2014 10:03:03.738 AM
Fault Direction	Normal	9/29/2014 10:03:02.856 AM
Loss of Current Detected	False	9/29/2014 10:03:02.856 AM
Momentary Count	I/O Timeout	9/13/2014 3:25:37 AM

Aggregated Device (3 phase) Using data references

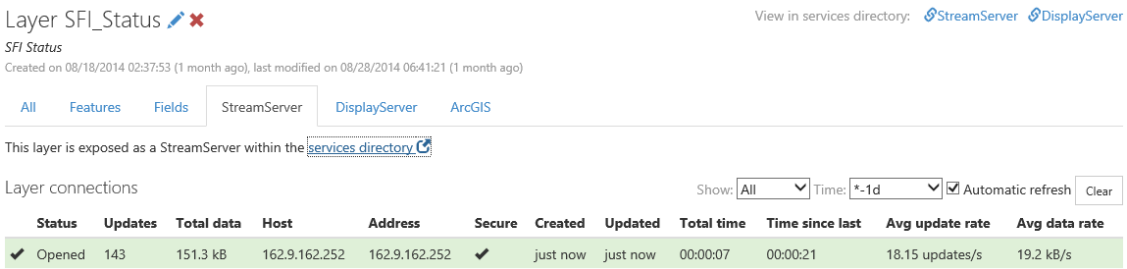


Name	Value
Category: <None>	
CIRCUIT	1552
COMMUNICATIONS	CELLULAR
Current X	85
Current Y	135
Current Z	120
Fault Current X	1826
Fault Current Y	1826
Fault Current Z	1165
Fault Status X	0
Fault Status Y	0
Fault Status Z	0
FEEDERMONITOR	No
GLNXY	285557320152
Latitude	42.373562
LOCATION	LS WADSWORTH 1PE WOODBINE_Z
Longitude	-83.276493
OBJECTID	9295
OHUG	OH
Power Status X	0
Power Status Y	0
Power Status Z	0
Sample PI Tag	216.68376159667969
SUB	VILLA
TYPE	OUTAGE_ADVISOR_V1

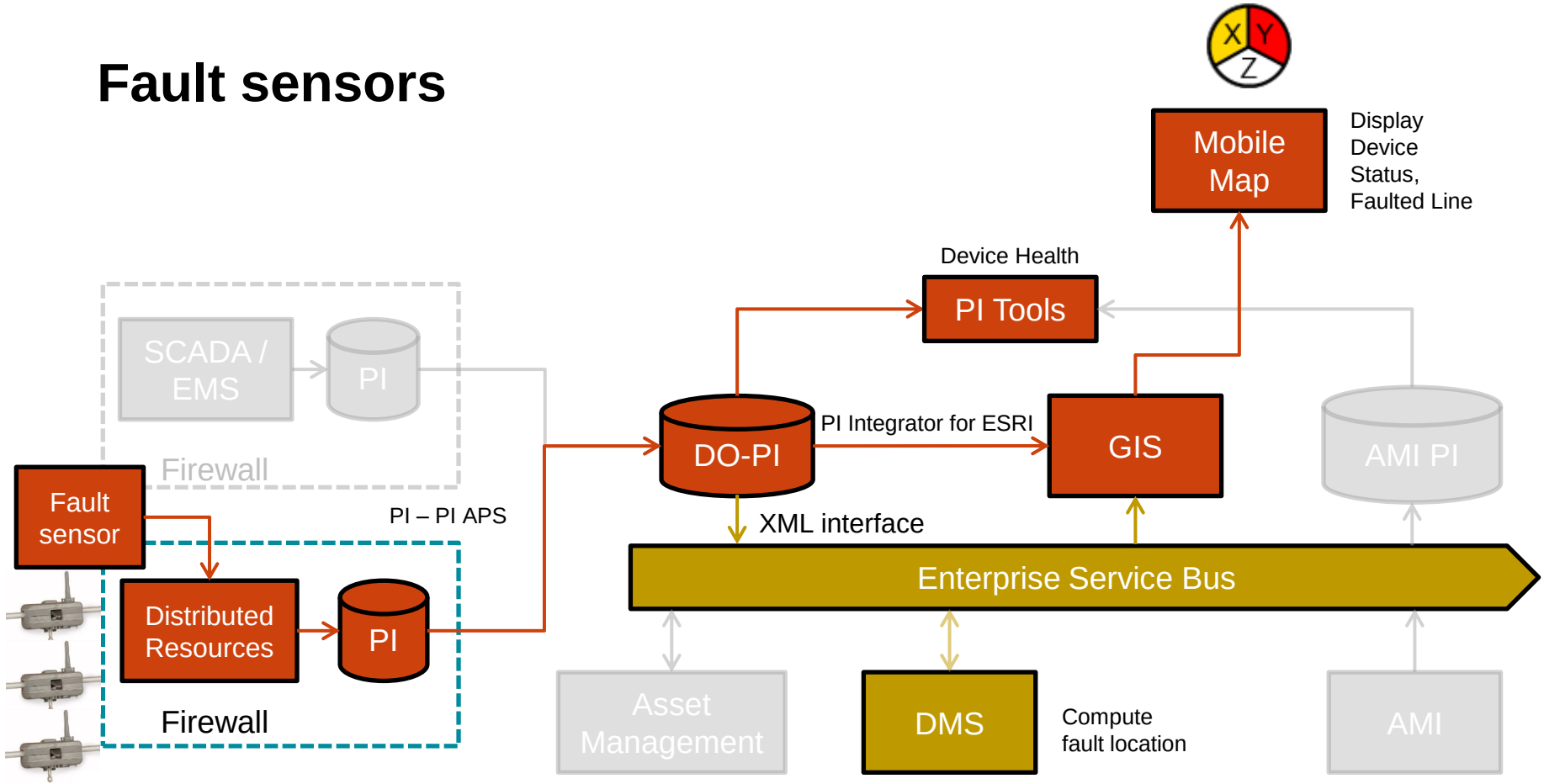
PI Integrator for ArcGIS Configuration



- Template and root element is selected in PI Integrator
- Key fields are identified
- (key, Latitude, Longitude)
- Streamserver is created and started



Fault sensors



Future Projects

- Manual Logger pilot
- Expanding asset health pilots for CBM
- Expand Devices on map, integration of coresight
- DRSOC upgrade
- Event Frames for Outage and Scheduled Maintenance

Mobile generators ‘Portable Microgrid’

- Mobile 2 MW 13.2 KV diesel generators
- Clean Parallel to grid and island mode transition
- Synchronous operation of up to 5 units for 10MW anywhere
- System connection in less than 2 hours in emergency

- Onboard PI system on SEL 3355 computer
- Process book displays for HMI
- Multimode communications, cellular, mesh, radio, buffering mode
- Archiving engine & equipment performance
- Synchrophasor data collection to analyze Start/stop, synchronization and islanding events

DTE 4.8 KV 1.5 MW portable generator

Richard Mueller

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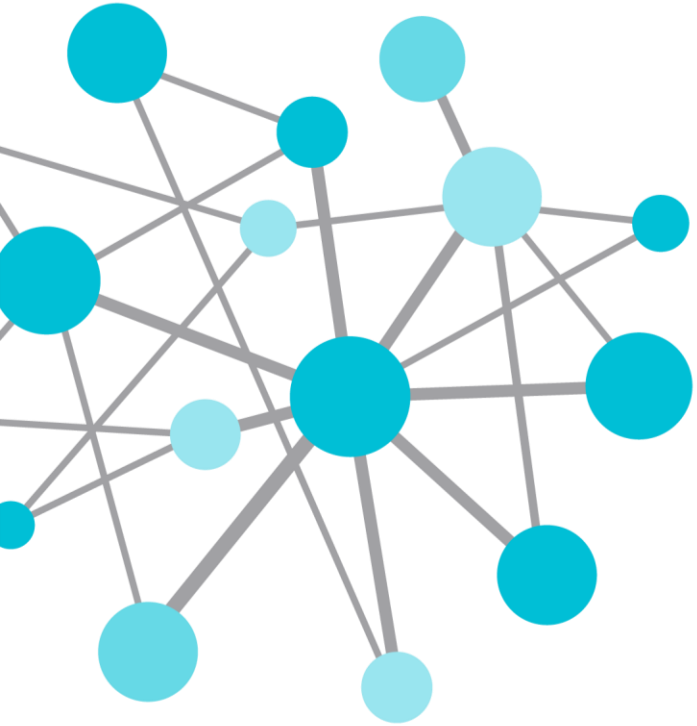

THANK YOU

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