

DTE Energy: an Enterprise PI approach

Fleet Optimization through Process Information

Gas Operations Update

Electric Distribution Condition Based Maintenance

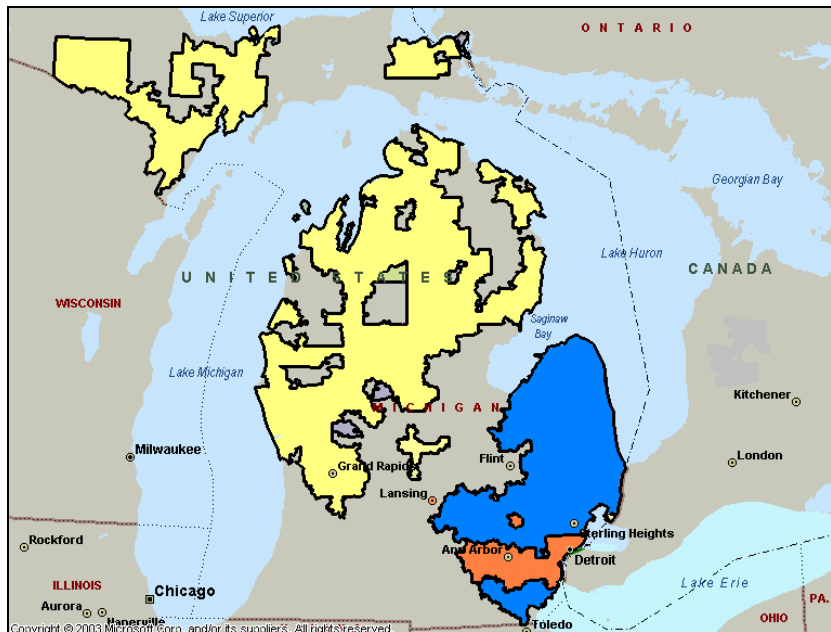
AMI Analytics

Space and Time Come Together; OSIsoft and ESRI

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



DTE Energy

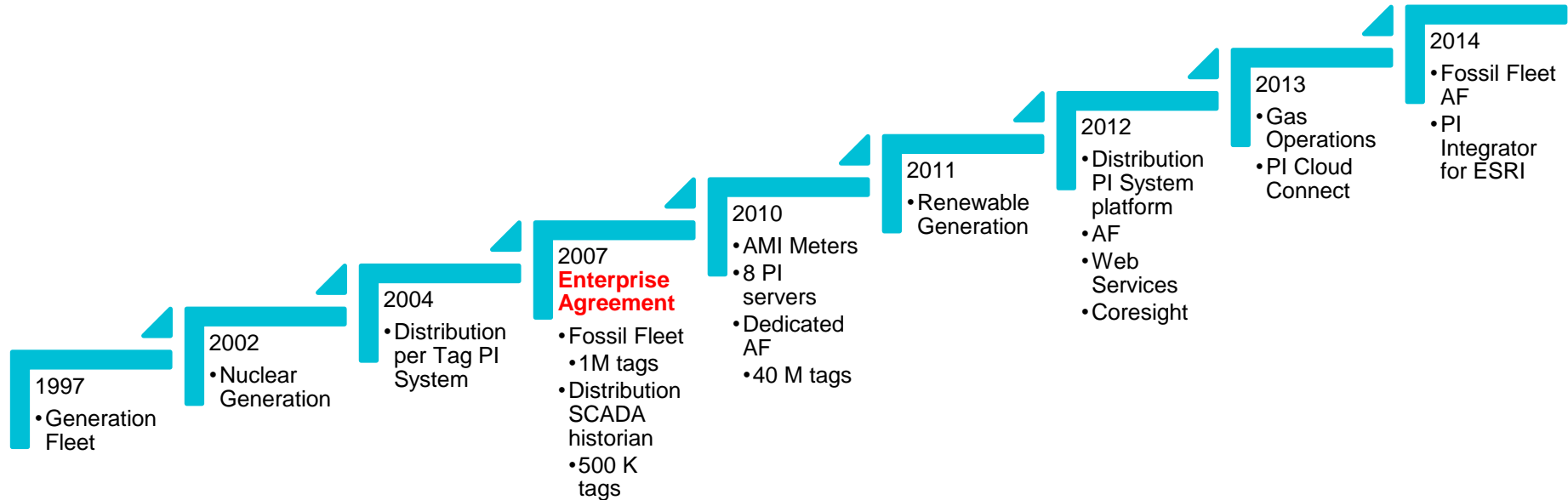


- Detroit Edison (Electric)
- 2.1 million customers
 - 1.6M AMI meters and growing
- 7,600 square mile service territory
- Generation: 11,086 MW
 - System Peak Load: 12,762 MW
 - Annual Sales: 54,000 GWH
- Michcon (Gas)
- 1.3 million customers
- 14,700 square mile service territory
- 679 bcf of gas sales
- 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



Monroe – 3,135 mw



Trenton Channel - 730 mw



River Rouge - 527 mw

750 MW wind
20 MW solar
and growing



Belle River – 1,260 mw



Performance Center – 11,588 mw



Greenwood – 785 mw

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

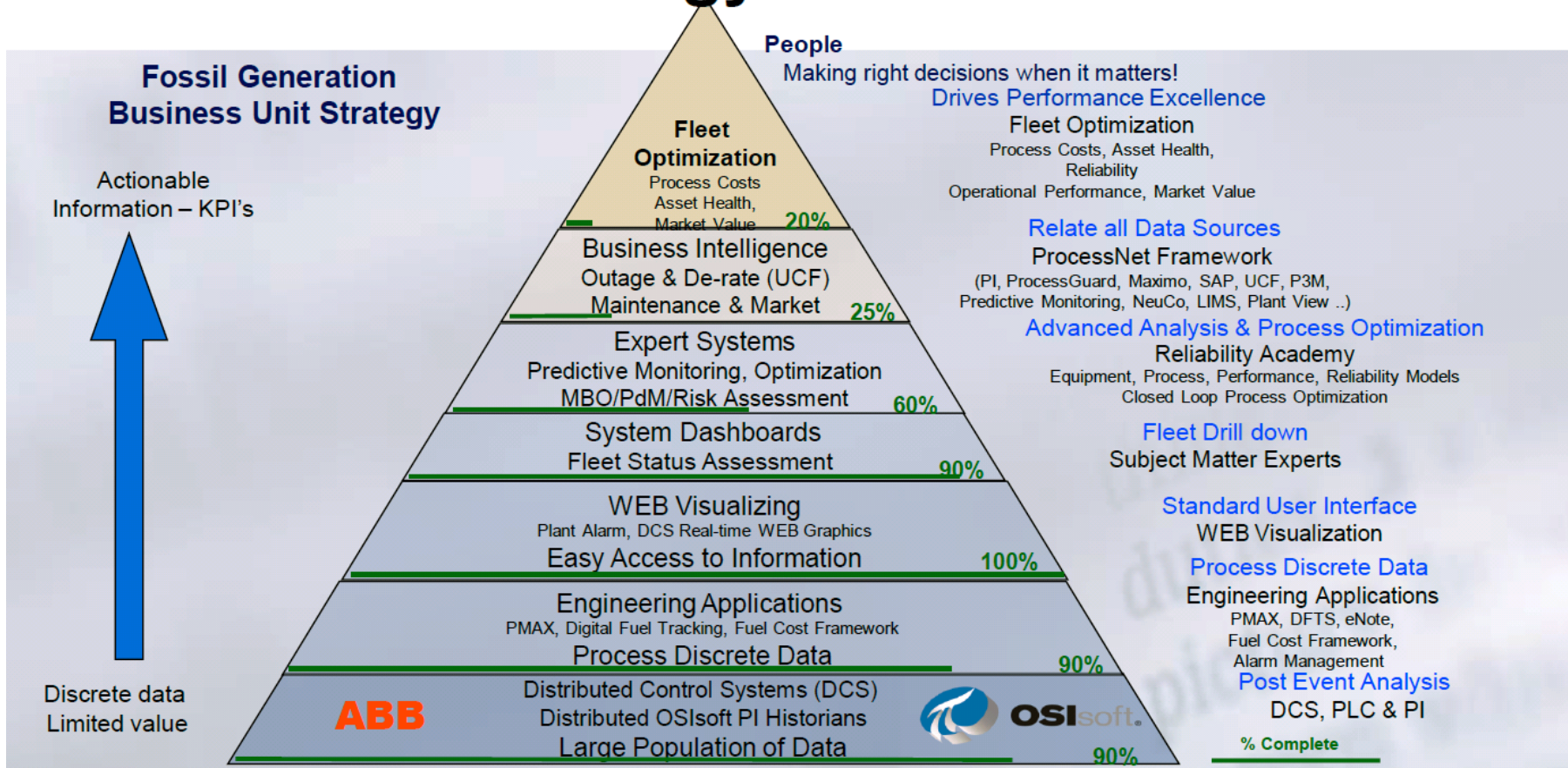
MISO
Day Ahead

Ancillary
Services

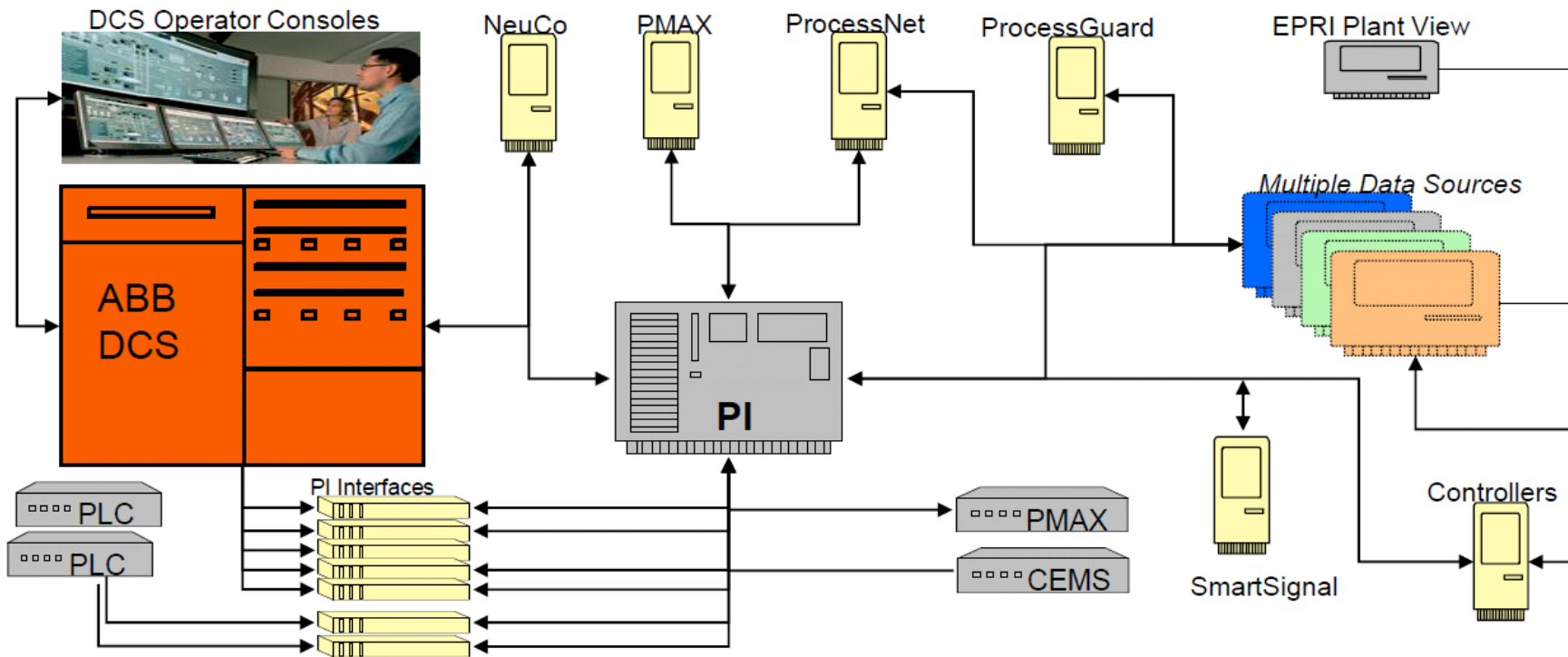
Fuel Cost

Market Data

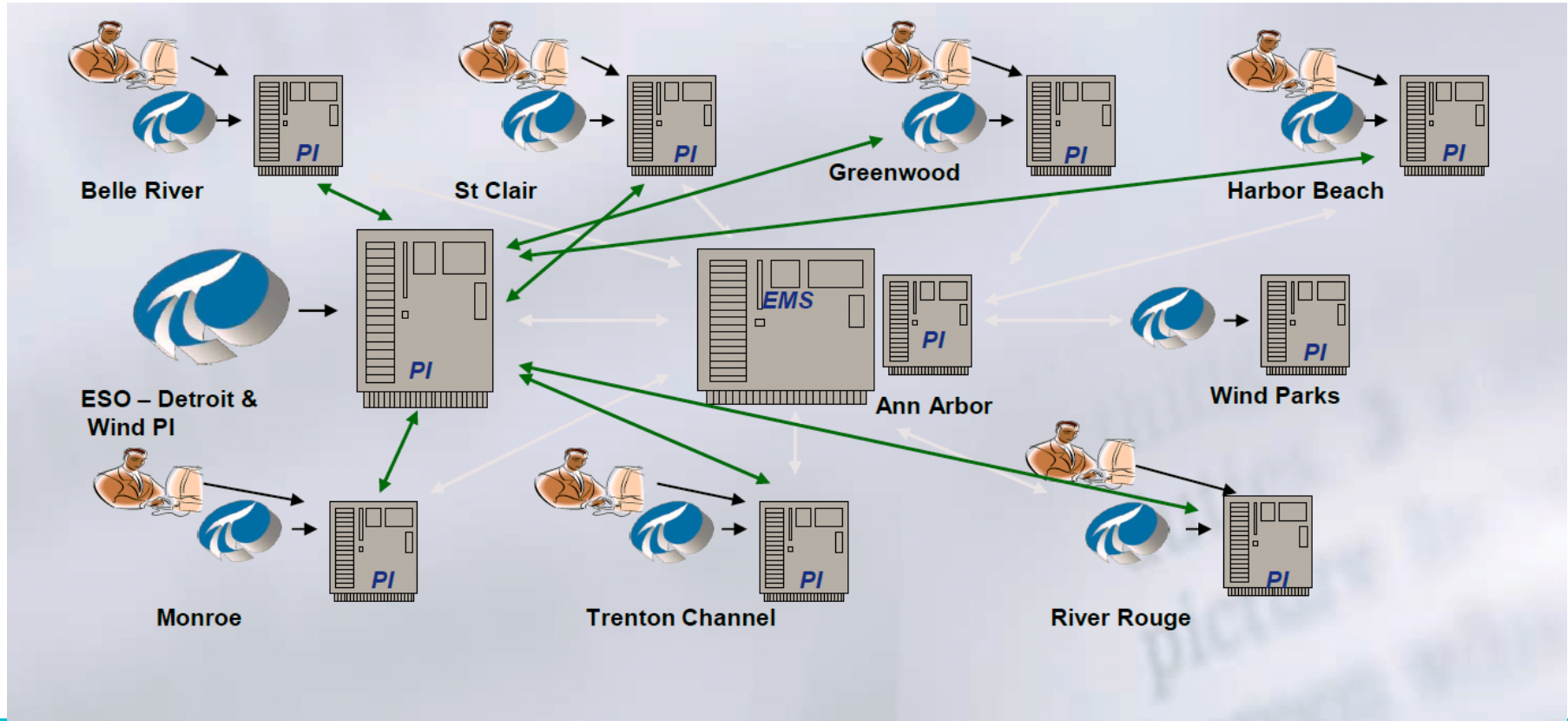
Control & Technology Framework



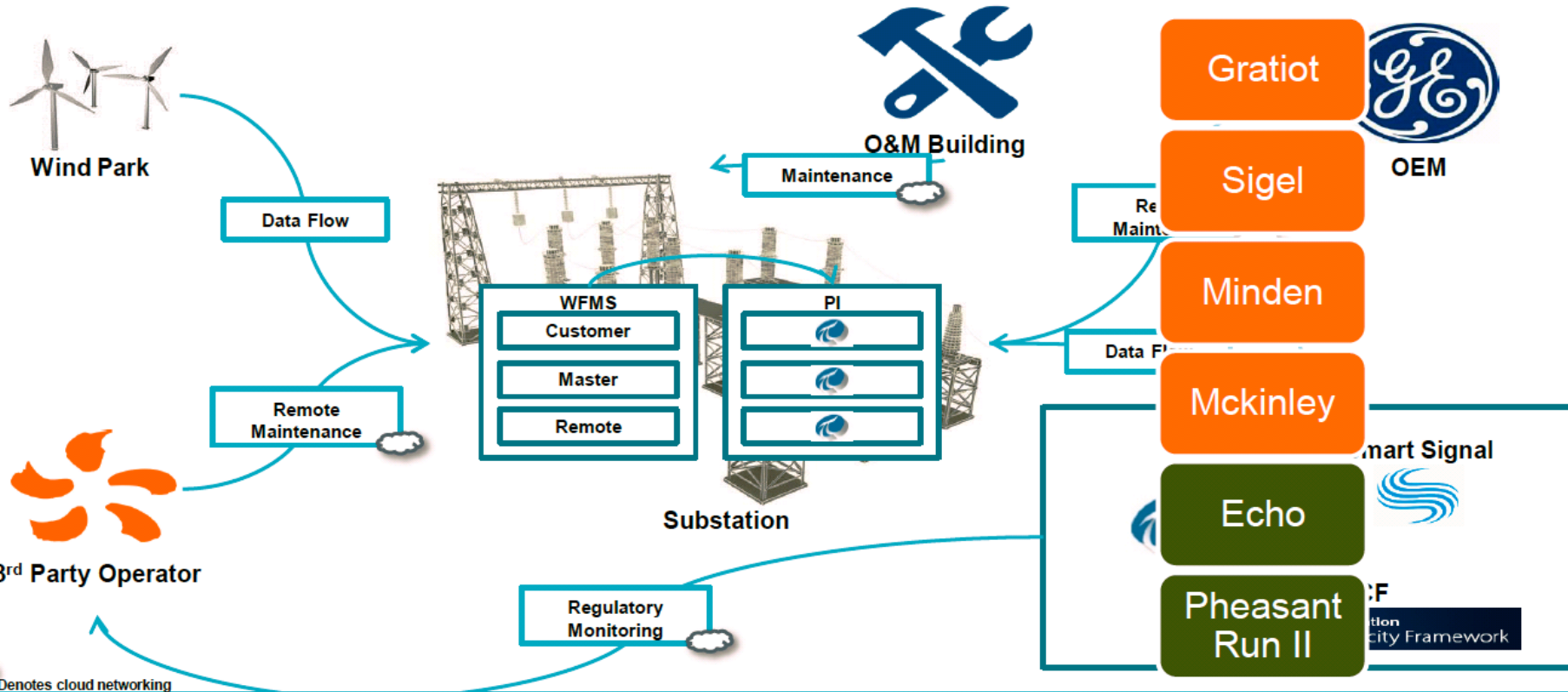
Control & Technology Infrastructure – Plants



PI to PI Process Data Conduit



Control & Technology Infrastructure – Wind Parks



Raw PI Data Analysis

PI Yields Benefits

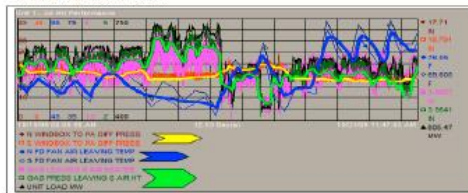
- Post trip analysis
- Process monitoring
- Optimization
- Early warning
- Alarming

UNIT 1 - COMBUSTION PRO (i.e., AIR HEATER PERFORMANCE VS COAL MILLS)

Exhibit 5

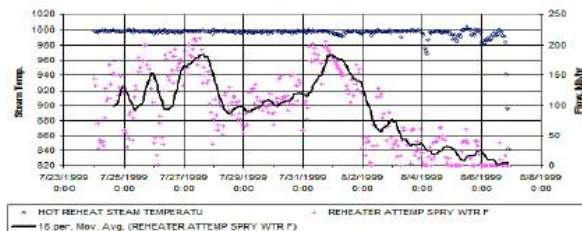
Concerns have recently arisen regarding degrading performance of Unit 1's Coal Mills over this past week. I would like to take this opportunity to **throw-caution-to-the-wind** in light of two factors: 1) Lack of good air heater radial seals, and 2) rising ambient air temperatures.

In the PI graph below of Unit 1's parameters, a review of **PA to Windbox Differential Pressure** (key to Coal Mill performance) is compared simultaneously to ambient air temperatures (FD Fan Air Leaving) and **Reheater Attemp Spry WTR F**. Past operating history has defined that when the PA to Windbox delta-P reaches a level of **15" H₂O**, the boiler combustion and coal mill performance is drastically impacted. This is the level at which air heater radial seal replacement is dictated if unit load is to be maintained without restrictions.



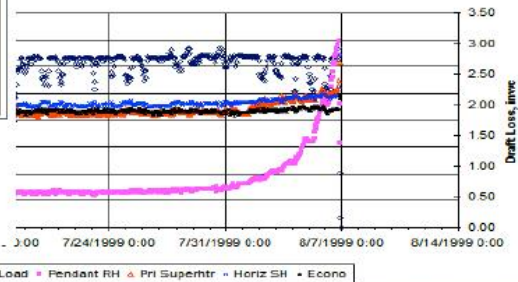
Understanding that air density changes as temperature changes and that it has an inverse effect on fan and air heater performance (i.e., as air temp. increases, efficiency of fan/air heater decreases) we can readily see in the above graph that since October 29th the ambient air temperature changed drastically. This was the reported time that Unit 1 coal mill output problems began to arise. As a result, **Reheater Attemp Spry WTR F** was reduced and coal mills removed from service in an attempt to maintain enough Hot PA **Reheater Attemp Spry WTR F** to the running mills. For a brief period, this provided a false impression that **PA to Windbox** pressure was not affected by rising ambient temperatures, yet when compared to the unit load one can easily surmise the error of this perception. It was on Oct. 27th that the true impact on **PA to Windbox** pressure can be seen in the PI graph above. **Please note in the above graph that air temperature had a POSITIVE impact on PA to Windbox pressure on Oct. 27th when it cooled down.**

Effect of Pluggage on Reheat Attenuation
Exhibit 2



Effect of Pluggage on Economizer Gas Outlet Temperature

Water, Superheater, and Economizer Draft Loss
Exhibit 4



PI Asset Framework (AF)

Elements

- [-] Elements
 - [-] Alternate FD Fan - maximo name in attribute
 - [-] Alternate FD Fan hierarchy - AF optimized
 - [-] DTE Energy
 - [-] Belle River Power Plant
 - [-] BLRPP Commons Units 1&2
 - [-] BLRPP Fuel Supply
 - [-] BLRPP Unit 1
 - [-] BLRPP Unit 1 Air/Flue Gas
 - [-] BLRPP Unit 1 Boiler / Steam Generator
 - [-] BLRPP Unit 1 Electrical/Control Systems
 - [-] BLRPP Unit 1 Fuel Burning
 - [-] Fuel Burning
 - [-] Alternate Fuel
 - [-] Coal Burning
 - [-] Pulverizer
 - [-] 01FSSYS01: SYSTEM RECORD, Coal Mill Systems that Controls Multi
 - [-] 1CMSYS05 PU INERTING MILL STEAM INERTING GENERAL: SYST
 - [-] 1CMSYS06 AIR DAMPER/ EXHA DAMPER OR EXHAUSTER GENER
 - [-] Coal Mill Blue 01A04-09
 - [-] 01BUSYS14-BLUE: System Burner & Burner Lines Unit 1-BLUE
 - [-] Blue H Mill #1 North Side
 - [-] Coal Mill Blue 1 Swing VLV Inlet
 - [-] Blue H Mill #2 North Side
 - [-] Blue H Mill #4 North Side
 - [-] Blue H Mill #6 North Side
 - [-] Blue H Mill #7 North Side
 - [-] 01FESYS14-BLUE: System Feeder & Bin & Feeder Pipes & Valves I
 - [-] 01ICSYS14-BLUE: Instruments And Controls Unit 1-BLUE
 - [-] 01LUSYS14-BLUE: System Mill Lube & Cooling Unit 1-BLUE
 - [-] 01PASYS14-BLUE: System Primary Air Dampers Unit 1-BLUE
 - [-] Blue Coal Mill Motor
 - [-] Coal Mill Buff 01A03-02
 - [-] Coal Mill Gray 01A03-04
 - [-] Coal Mill Orange 01A03-05
 - [-] Coal Mill Purple 01A04-06
 - [-] Coal Mill Red 01A04-07
 - [-] Coal Mill White 01A04-08
 - [-] Coal Mill Yellow 01A03-03
 - [-] BLRPP Unit 1 Grounds & Physical Plant
 - [-] BLRPP Unit 1 Plant Waste
 - [-] BLRPP Unit 1 Reclaiming / Plant Feed
 - [-] BLRPP Unit 1 Service Air & Gas
 - [-] BLRPP Unit 1 Switching & Mat
 - [-] BLRPP Unit 1 Turbine / Generator
 - [-] RI RPP Unit 1 Water Systems
 - [-] BLRPP Unit 2

Blue H Mill #2 North Side

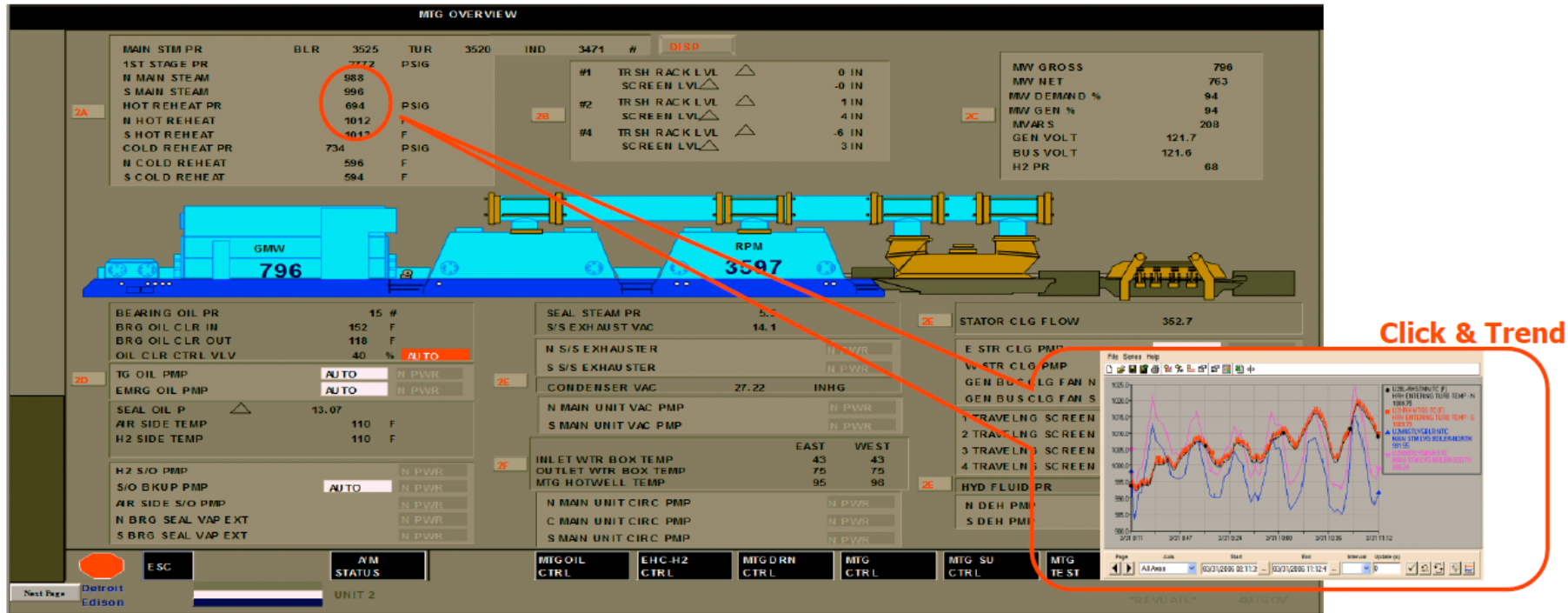
General
Child Elements
Attributes
Ports
Version

Filter

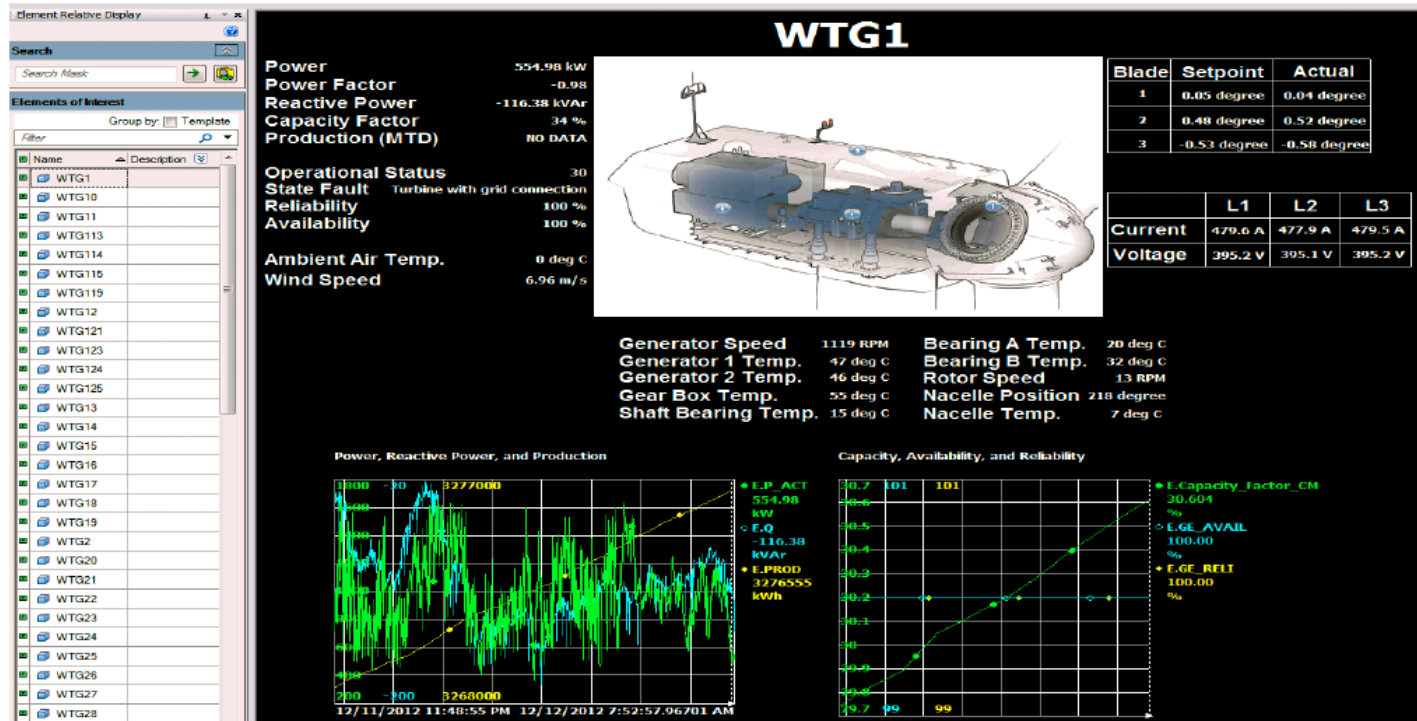
| | | Name | Value |
|--|--|-------------------------------|------------|
| | | A A FREQ | 14 |
| | | A A QUAL | 0 |
| | | A B FREQ | 15 |
| | | A B QUAL | 95 |
| | | A COMB INDEX | 0 |
| | | A INTENSITY | 84 |
| | | B A FREQ | 27 |
| | | B A QUAL | 99 |
| | | B B FREQ | 26 |
| | | B B QUAL | 100 |
| | | B COMB INDEX | 57 |
| | | B INTENSITY | 82 |
| | | Control Output | 26.74414 |
| | | COOLING POSITION | 0 |
| | | CTRLGRA DR | ?????????? |
| | | FLAME SCANNER A A DETECT | 0 |
| | | FLAME SCANNER A B DETECT | 1 |
| | | FLAME SCANNER A CHANNEL FAULT | 0 |
| | | FLAME SCANNER A FAULT STATUS | 0 |
| | | FLAME SCANNER A MODULE FAULT | 0 |
| | | FLAME SCANNER B A DETECT | 1 |
| | | FLAME SCANNER B B DETECT | 1 |
| | | FLAME SCANNER B CHANNEL FAULT | 0 |
| | | FLAME SCANNER B FAULT STATUS | 0 |
| | | FLAME SCANNER B MODULE FAULT | 0 |
| | | FLAME STATUS | 5 |
| | | LIGHTOFF POSITION | 0 |
| | | MODE LOCK | 0 |

Real-Time DCS Operator Displays

6000 real time dynamic actively linked WEB DCS graphics

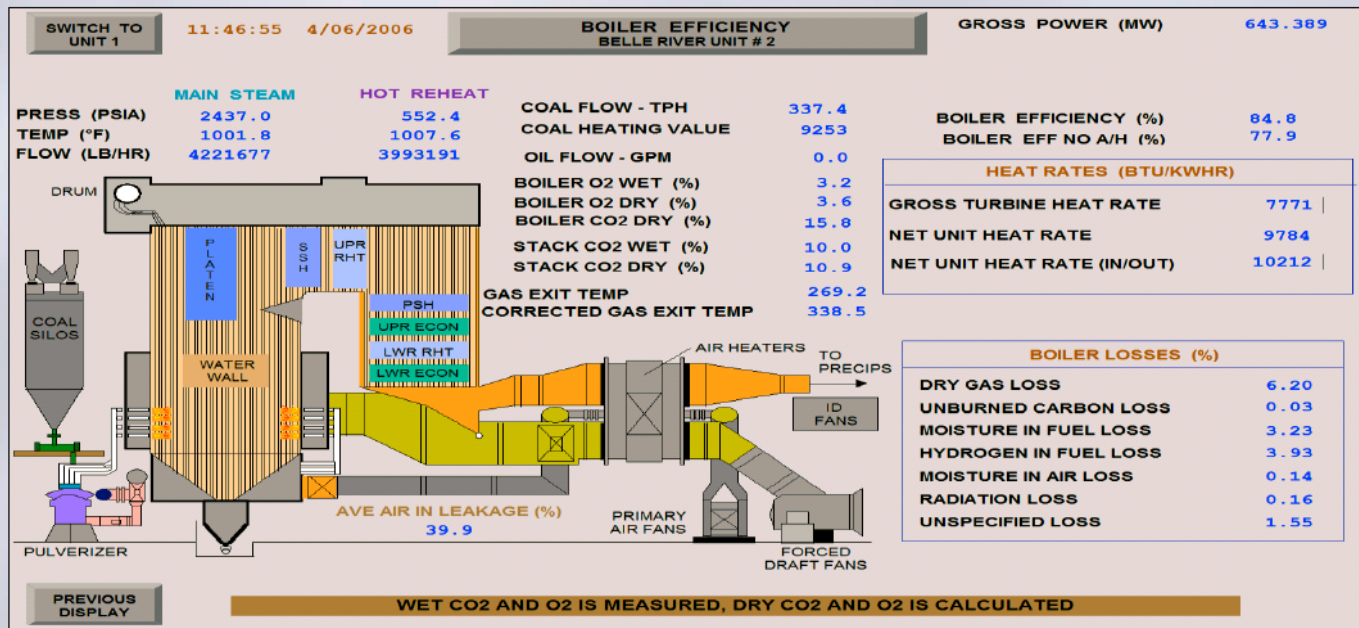


Real-Time Wind Turbine Display



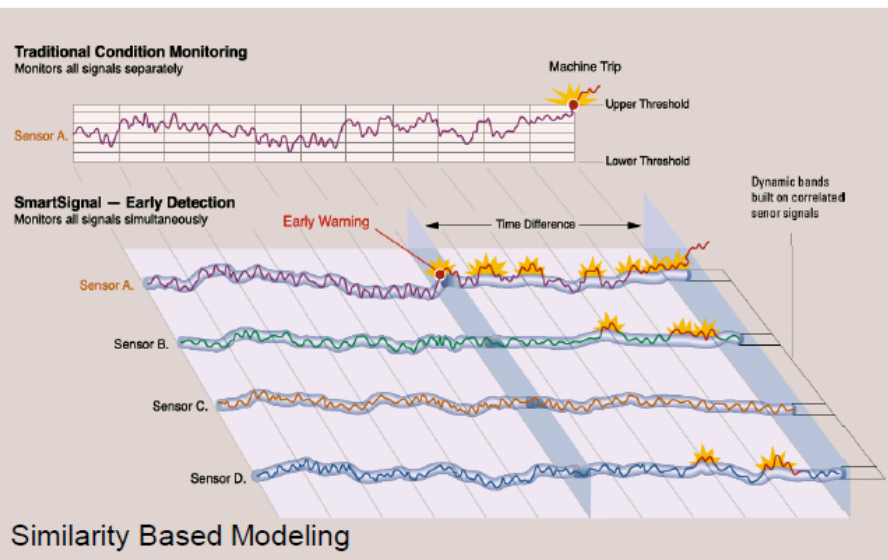
Fleet Performance Analysis (PMAx)

Thermal Performance Calculation Engine



Advanced Pattern Recognition

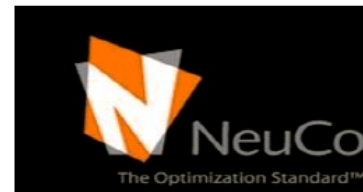
Equipment Condition Monitoring SmartSignal



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)



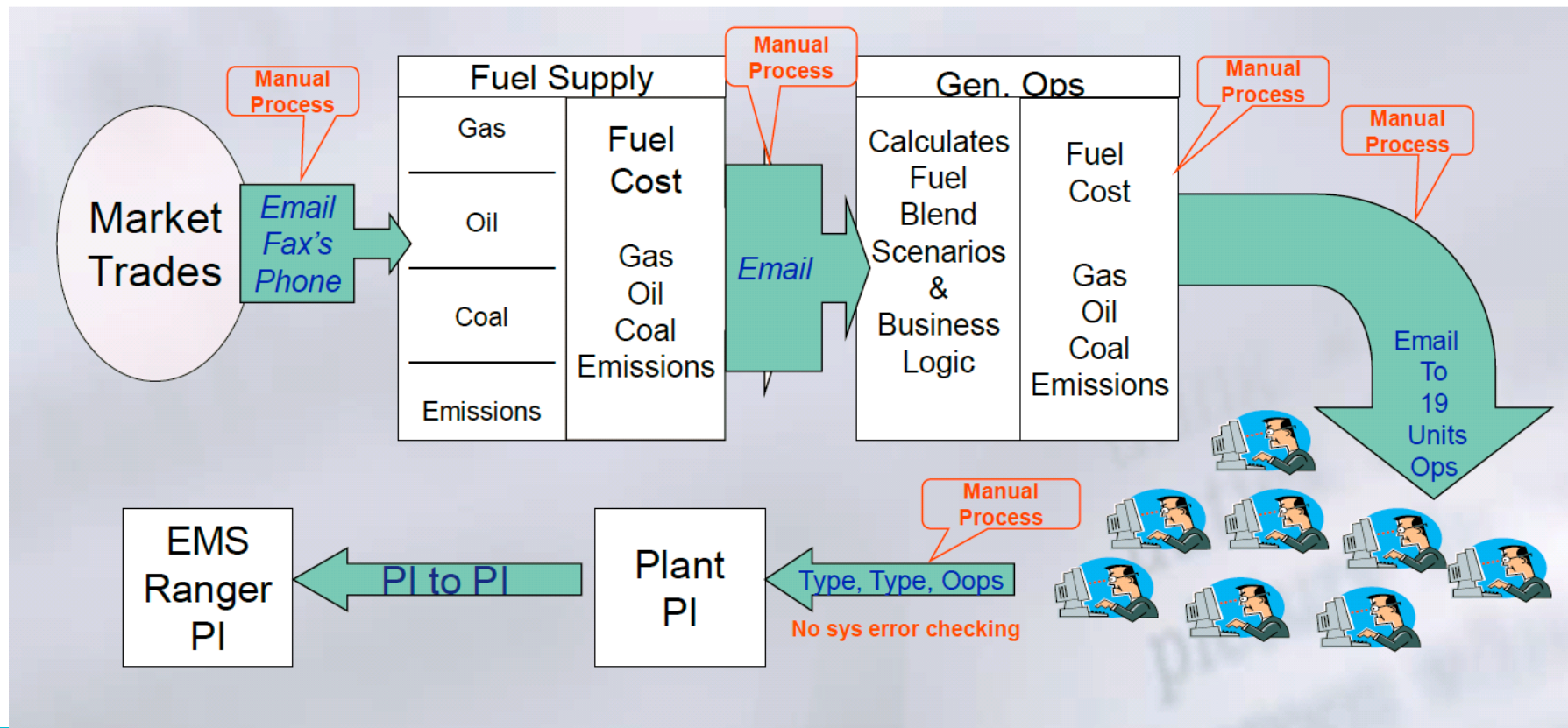
Fleet Status – PI WEB enabled

| Unit | Net MW | TMC | TCAP | Unit | Net MW | TMC | TCAP | Unit | Net MW | TMC | TCAP | Load Forecast | | |
|------------------------|--------|-----|------|-------------------|--------|-----|------|---------|--------|-----|------|---------------|-------|----------|
| BR 1 | 0 | 0 | 0 | CC 15 | 66 | 95 | 95 | HA 12-1 | 0 | 42 | 42 | HE | Today | Tomorrow |
| BR 2 | 609 | 635 | 635 | CC 16 | 53 | 125 | 125 | HA 12-2 | 0 | 42 | 42 | 0100 | 6041 | 8250 |
| FE 2 | 0 | 0 | 0 | | | | | HB 11 | 0 | 4 | 4 | 0200 | 6015 | 7862 |
| MON 1 | 645 | 730 | 730 | BR 12-1 | 77 | 77 | 77 | MON 11 | 0 | 14 | 14 | 0300 | 5691 | 7505 |
| MON 2 | 745 | 755 | 760 | BR 12-2 | 75 | 75 | 75 | NE 11-1 | 0 | 17 | 17 | 0400 | 5967 | 7457 |
| MON 3 | 753 | 760 | 760 | BR 13 | 76 | 76 | 76 | NE 11-2 | 0 | 16 | 16 | 0500 | 6212 | 7564 |
| MON 4 | 753 | 753 | 753 | DLRY 11 | 0 | 67 | 67 | NE 11-3 | 0 | 16 | 16 | 0600 | 6857 | 8010 |
| RR 2 | 245 | 255 | 255 | DLRY 12 | 0 | 69 | 69 | NE 11-4 | 0 | 16 | 16 | 0700 | 7250 | 8581 |
| RR 3 | 273 | 275 | 275 | GW 11-1 | 77 | 77 | 77 | NE 12 | 0 | 21 | 21 | 0800 | 7893 | 9183 |
| SC 1 | 105 | 105 | 135 | GW 11-2 | 54 | 54 | 54 | NE 13-1 | 0 | 21 | 21 | 0900 | 8893 | 10069 |
| SC 2 | 112 | 112 | 156 | GW 12 | 19 | 19 | 19 | NE 13-2 | 0 | 21 | 21 | 1000 | 9573 | 10593 |
| SC 3 | 125 | 135 | 150 | BR 11 | | | | | | | | | | |
| SC 4 | 135 | 140 | 140 | CC 11 | | | | | | | | | | |
| SC 6 | 255 | 255 | 280 | CF 11 | | | | | | | | | | |
| SC 7 | 329 | 329 | 329 | DA 11 | | | | | | | | | | |
| TC 7 | 94 | 105 | 105 | FE 11-1 | | | | | | | | | | |
| TC 8 | 73 | 80 | 80 | FE 11-2 | | | | | | | | | | |
| TC 9 | 460 | 500 | 500 | FE 11-3 | | | | | | | | | | |
| GW 1 | 369 | 450 | 785 | FE 11-4 | | | | | | | | | | |
| HB 1 | 84 | 84 | 84 | HA 11-1 | | | | | | | | | | |
| LUD 1 | 0 | 0 | 0 | HA 11-2 | | | | | | | | | | |
| LUD 2 | 0 | 0 | 0 | HA 11-3 | | | | | | | | | | |
| LUD 3 | 0 | 0 | 0 | HA 11-4 | | | | | | | | | | |
| LUD 4 | -319 | 0 | 319 | | | | | | | | | | | |
| LUD 5 | 0 | 0 | 0 | | | | | | | | | | | |
| LUD 6 | -322 | 0 | 322 | | | | | | | | | | | |
| Plant Generation 6281 | | | | Transactions | | | | | | | | | | |
| Ludington Generation 0 | | | | Firm Purchase | | | | | | | | | | |
| Peaker Generation 378 | | | | Non-Firm Purchase | | | | | | | | | | |
| Misc. Generation 85 | | | | Firm Sale | | | | | | | | | | |
| Total Generation 6745 | | | | Non-Firm Sale | | | | | | | | | | |
| Total Load 7978 | | | | Service Area Load | | | | | | | | | | |
| Steel Load 289 | | | | Retail Schedule | | | | | | | | | | |

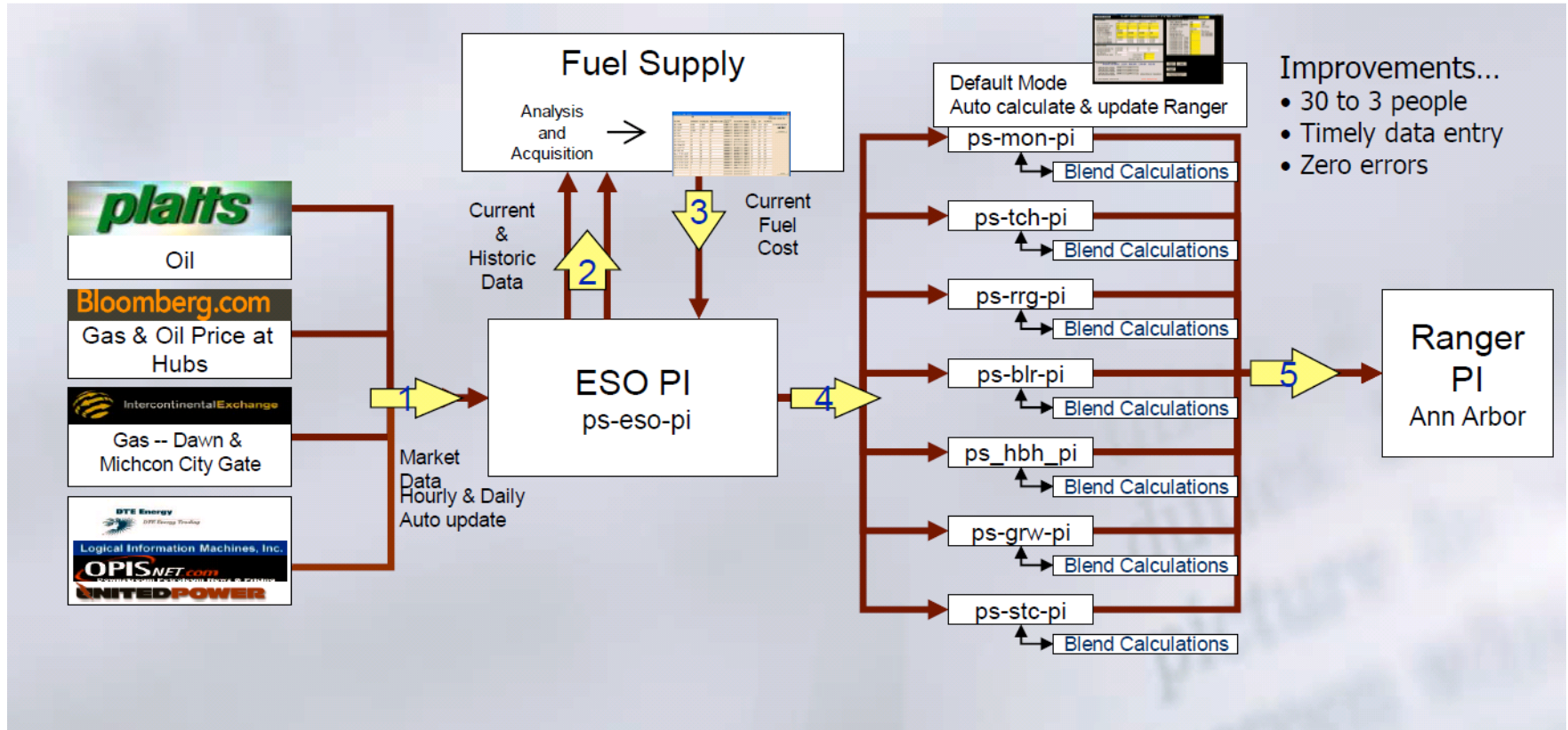
Process Cost Drill Down



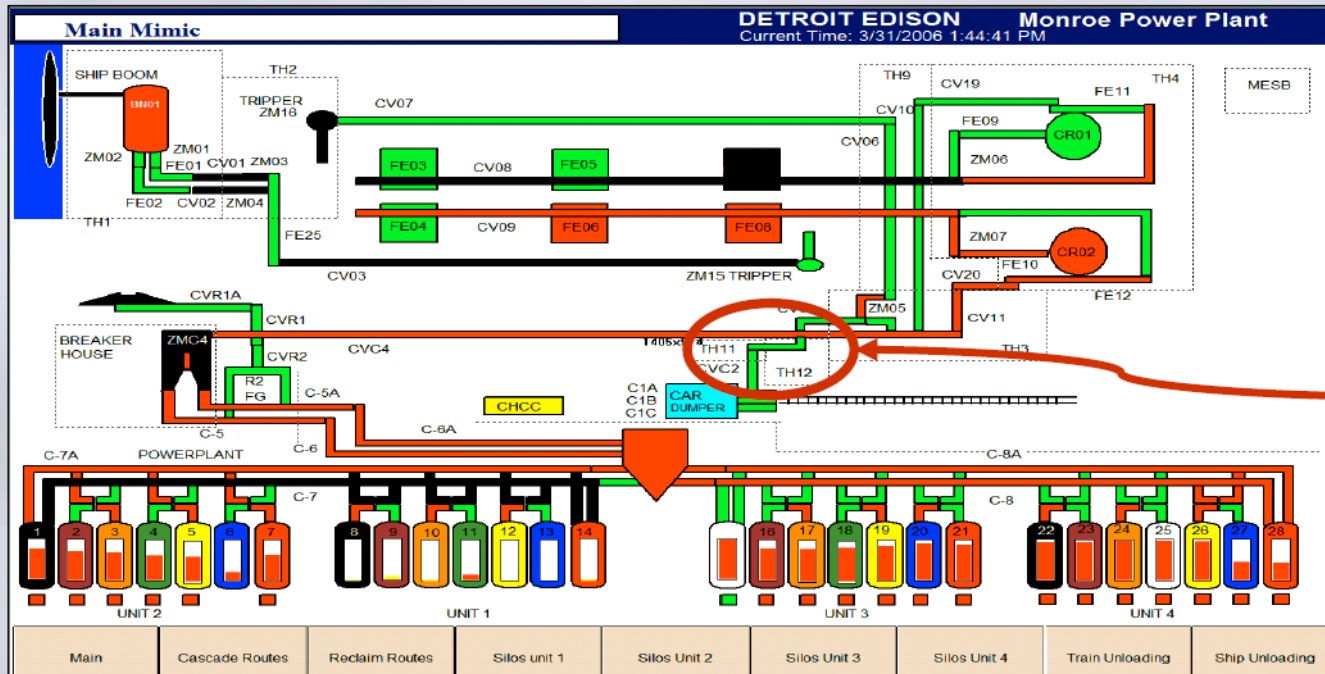
Before Fuel Cost Framework



Fuel Cost Framework



Digital Fuel Tracking System



On-line
Fuel Analyzer

PI to PI (AGC)

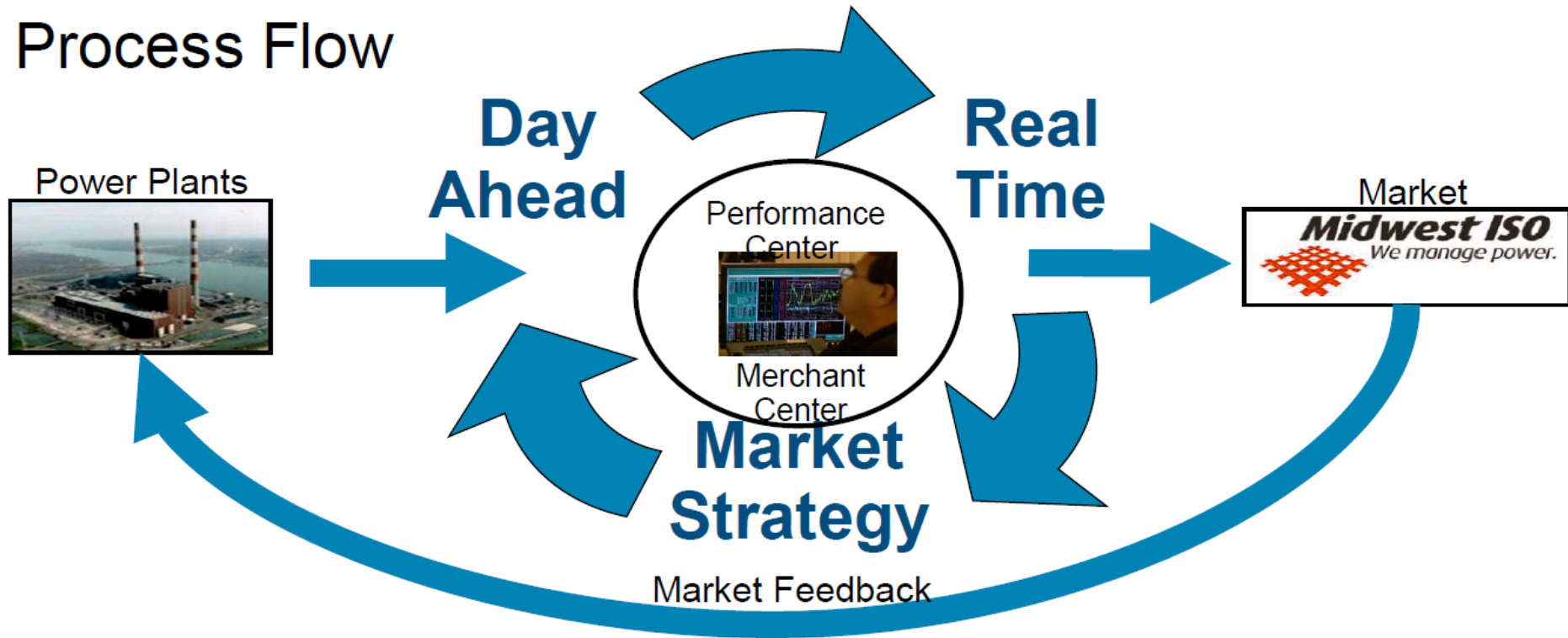
AGC – Automatic Generation Control

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



Unit Capacity Framework (UCF)

Process Flow



DTE Gas

Engaged Center of Excellence

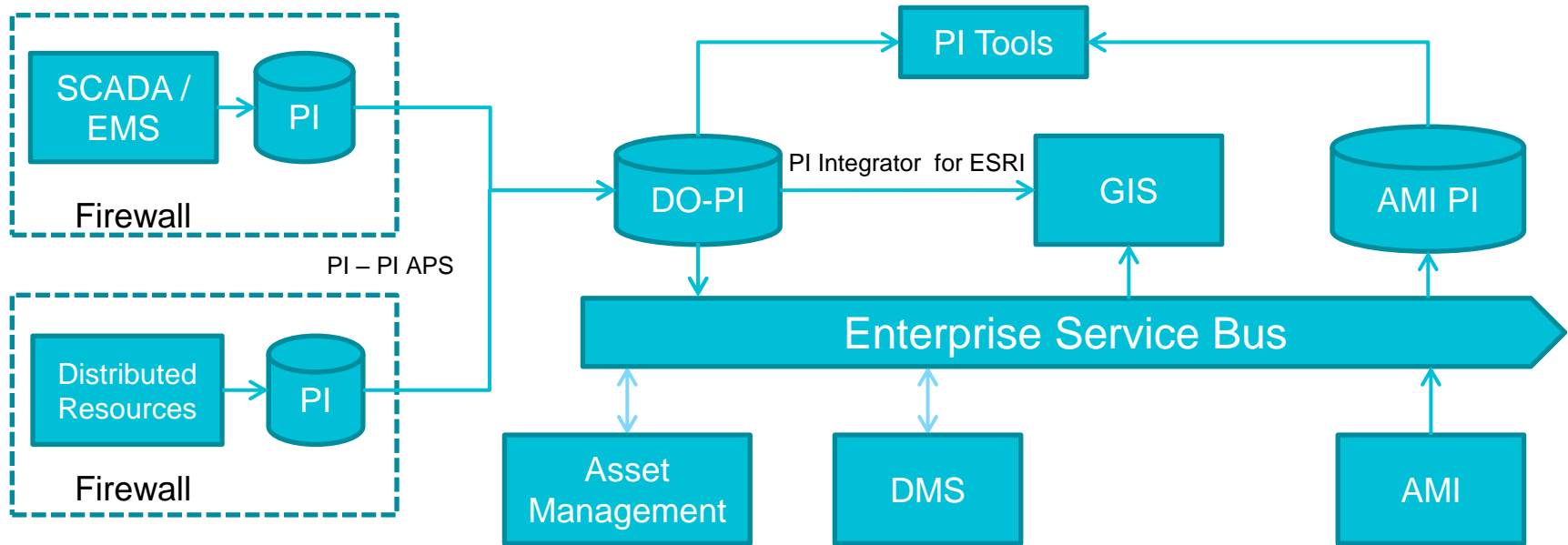
Leveraged training as part of EA agreement

- 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

Child Elements | Attributes | Ports | Analyses | Version

| Name | Schedule | Output(s) | Backfilling |
|--------------------|------------------|--------------|-------------|
| f() CAPACITOR X ON | Offset=82800;... | CAP_STATUS X | |
| f() CAPACITOR Y ON | Offset=82800;... | CAP_STATUS Y | |
| f() CAPACITOR Z ON | Offset=82800;... | CAP_STATUS Z | |

Name: CAPACITOR Y ON

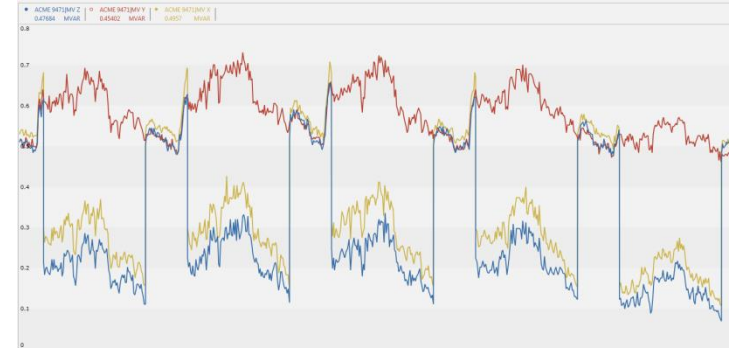
Description:

Categories:

Analysis Type: ☒ Expression ☐ Rollup

Expression

```
if Range('VALIDATOR MVAR Y', Bod('*')+'ON_TIME'*60+'-5m', Bod('*')+'ON_TIME'*60+'+5m')*1000 > 'KVAR'/3*'ADJUSTMENT_FACTOR' THEN 1 ELSE 0
```



Business Challenge

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

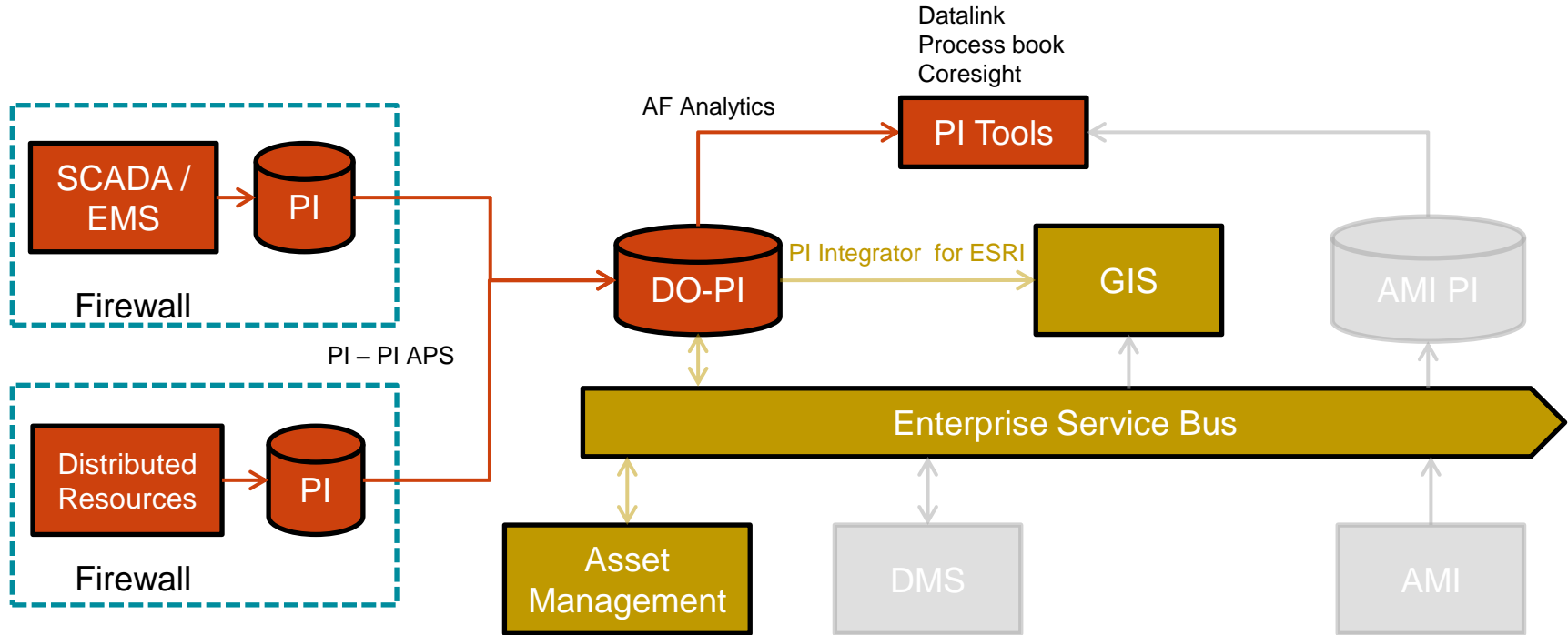
Solution

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

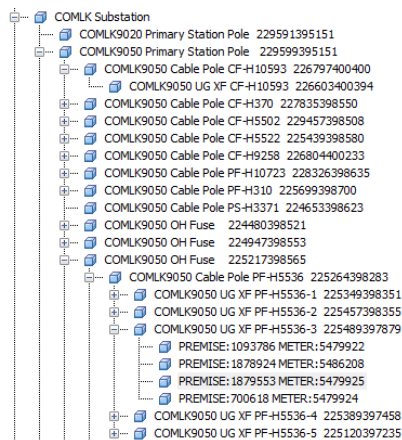
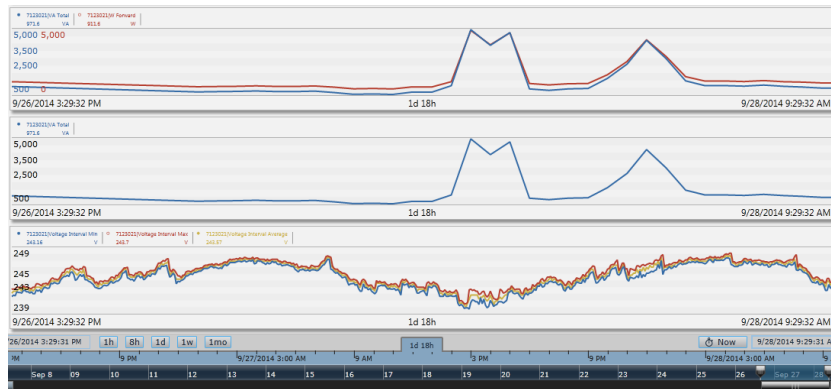
Results and Benefits

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

Using PI for equipment analysis



AMI PI system



| | | | |
|---------------------------------|----------------------|--------------------|-----------------------|
| Category: AMI Meter Max Voltage | | | |
| | Voltage Interval Max | 247.300003051758 V | 9/28/2014 12:00:00 AM |
| Category: AMI Meter Min Voltage | | | |
| | Voltage Interval Min | 246.699996948242 V | 9/28/2014 12:00:00 AM |
| Category: AMI Meter Total KVA | | | |
| | VA Total | 826 VA | 9/27/2014 12:00:00 AM |
| | W Total | 743 W | 9/27/2014 12:00:00 AM |
| Category: AMI Meter Total Watts | | | |
| | VA Total | 826 VA | 9/27/2014 12:00:00 AM |
| | W Total | 743 W | 9/27/2014 12:00:00 AM |
| Category: Measurements | | | |

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

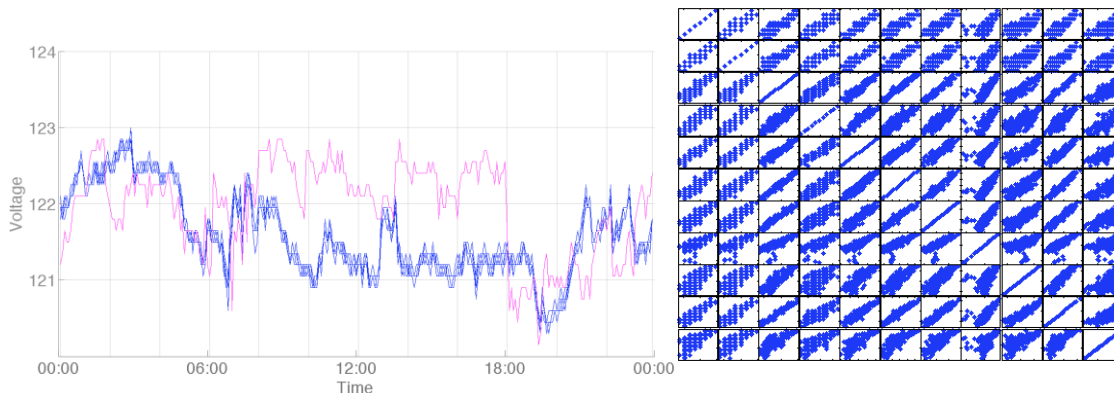
- Users can access full history of AMI information using process book, Datalink and Coresight
- Tags are grouped to meter through AF
- AFSDK applications

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

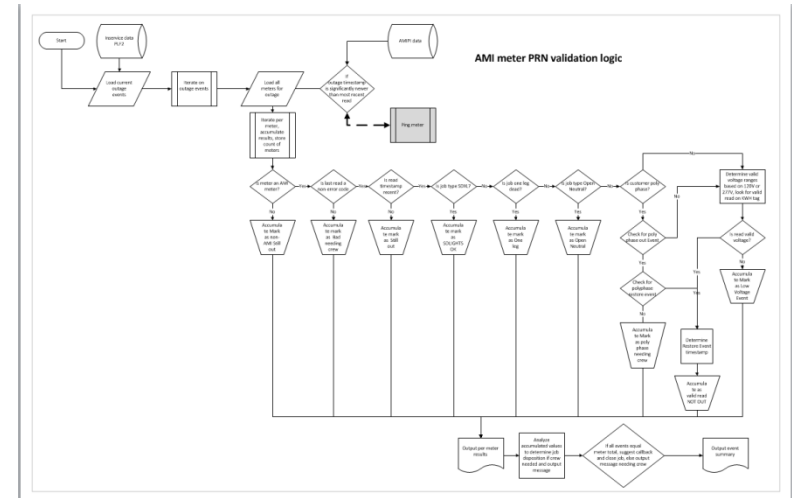
AMI & AFSDK

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

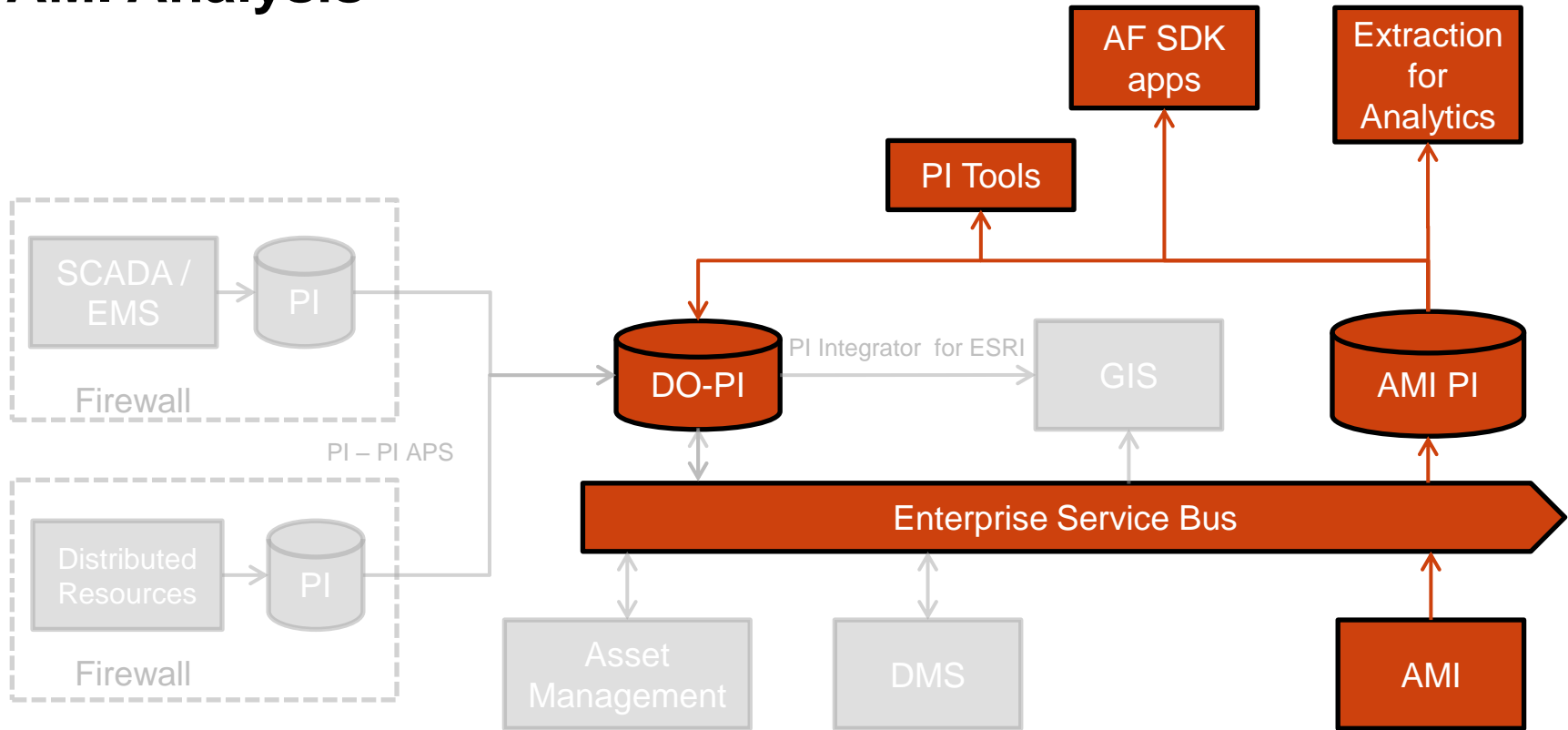
Solution

- 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

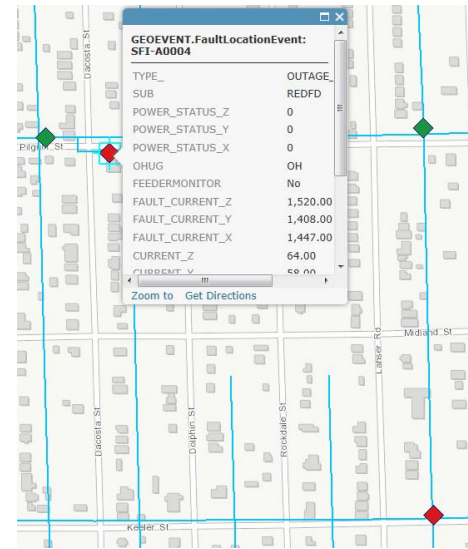


PI Integrator for ArcGIS

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)

| | | | |
|------------------|--|--|--|
| DEVICES | | | |
| BUS | | | |
| CABLE POLE | | | |
| CAPACITOR | | | |
| CIRCUIT | | | |
| CIRCUIT SWITCHER | | | |
| FAULT INDICATOR | | | |
| SFI-A0001-X | | | |
| SFI-A0001-Y | | | |
| SFI-A0001-Z | | | |
| SFI-A0002-X | | | |
| SFI-A0002-Y | | | |
| SFI-A0002-Z | | | |
| SFI-A0003-X | | | |
| SFI-A0003-Y | | | |
| SFI-A0003-Z | | | |
| SFI-A0004-X | | | |
| SFI-A0004-Y | | | |
| SFI-A0004-Z | | | |
| SFI-A0005-X | | | |
| SFI-A0005-Y | | | |
| SFI-A0005-Z | | | |
| SFI-A0006-X | | | |
| SFI-A0006-Y | | | |
| SFI-A0006-Z | | | |
| SFI-A0007-X | | | |
| SFI-A0007-Y | | | |
| SFI-A0007-Z | | | |

| | | |
|--------------------------|---------------------|---------------------------|
| Current | 249.6999996948242 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

| | | | |
|-----------------------|--|--|--|
| SFI | | | |
| FAULT_INDICATOR_SITE1 | | | |
| SFI-A0001 | | | |
| SFI-A0002 | | | |
| SFI-A0003 | | | |
| SFI-A0004 | | | |
| SFI-A0005 | | | |
| SFI-A0006 | | | |
| SFI-A0007 | | | |
| SFI-A0008 | | | |
| SFI-A0009 | | | |
| SFI-A0010 | | | |
| SFI-A0011 | | | |
| SFI-A0012 | | | |
| SFI-A0013 | | | |
| SFI-A0014 | | | |
| SFI-A0015 | | | |
| SFI-A0016 | | | |
| SFI-A0017 | | | |

| Name | Value |
|-----------------|-----------------------------|
| 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

PI Integrator for Esri ArcGIS Services Administration Tools Help

home / services / FaultLocationGeoService / SFI_Status

This version will expire on 10/14/2014. Services, layers and all other configurations will then become

There are warnings that need your attention

Layer SFI_Status

SFI Status

Created on 08/18/2014 02:37:53 (1 month ago), last modified on 08/28/2014 06:41:21 (1 month ago)

All Features Fields StreamServer DisplayServer ArcGIS

This layer exposes the following fields

| Name | Attribute Name |
|----------------|----------------|
| TYPE | TYPE |
| SUB | SUB |
| Power_Status_Z | Power Status Z |
| Power_Status_Y | Power Status Y |
| Power_Status_X | Power Status X |
| OHUG | OHUG |
| LOCATION | LOCATION |
| GLNXY | GLNXY |
| FEEDERMONITOR | FEEDERMONITOR |

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

Stream Service Layer SFI_Status (0)

Connect Disconnect Clear Receiving data (169 features received)

☒ Use secure web socket

☐ Use bulk mode (JSON array)

```
{
  "attributes": {
    "objectId": "1419103957",
    "type": "LIGHTHOUSE_MV_SENSOR",
    "sub": "MACHB",
    "power_status_z": null,
    "power_status_y": null,
    "power_status_x": null,
    "ohug": "OH",
    "location": "",
    "glaxy": "",
    "feedermonitor": "Yes",
    "fault_current_z": 0,
    "fault_current_y": 0,
    "fault_current_x": 0,
    "current_z": 78,
    "current_y": 115,
    "current_x": 90,
    "communications": "CELLULAR",
    "circuit": "8409",
    "time": "2014-08-28 06:17:22"
  }
}
```

View in services directory: [StreamServer](#) [DisplayServer](#)

Layer SFI_Status

SFI Status

Created on 08/18/2014 02:37:53 (1 month ago), last modified on 08/28/2014 06:41:21 (1 month ago)

All Features Fields StreamServer DisplayServer ArcGIS

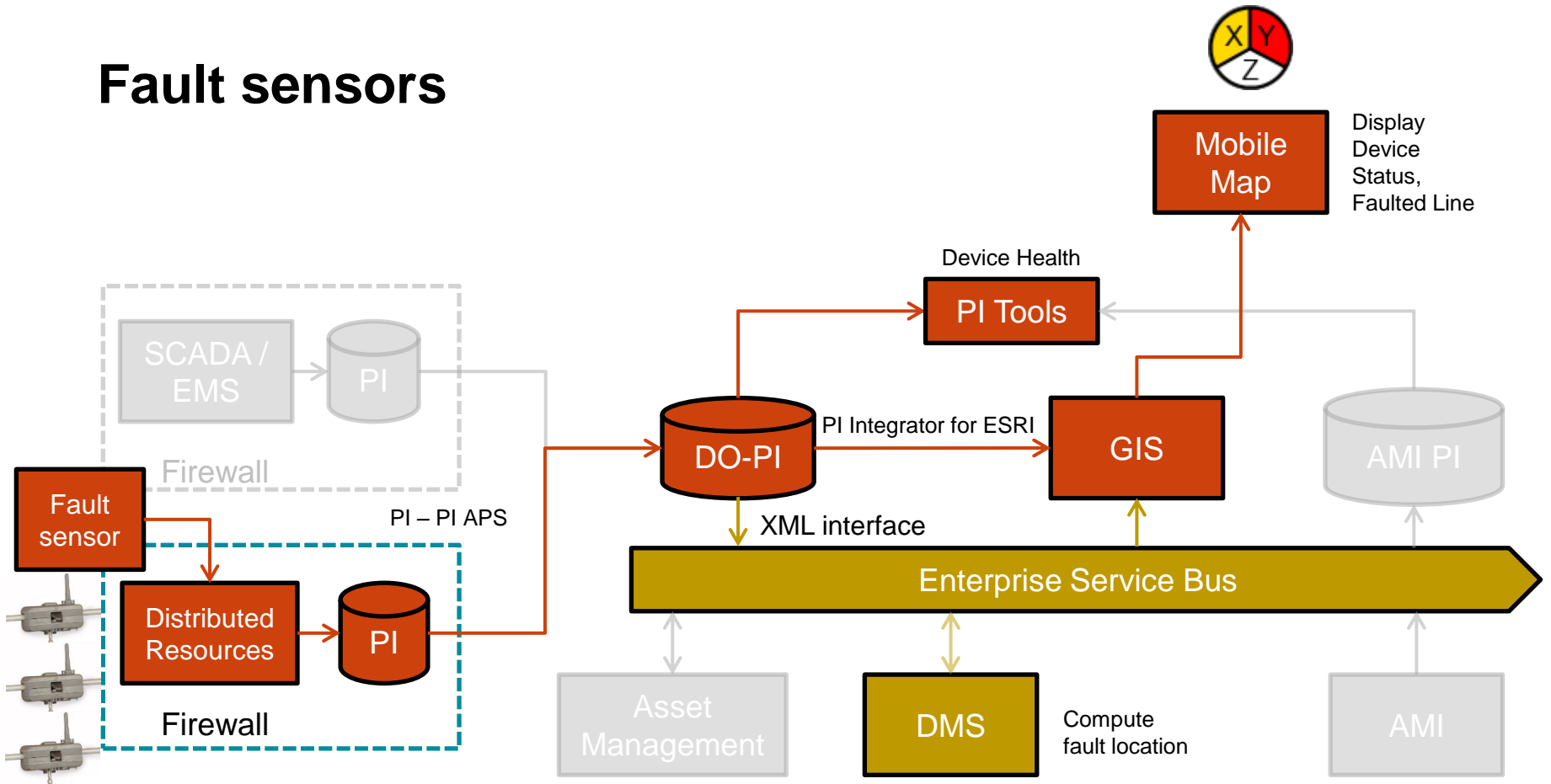
This layer is exposed as a StreamServer within the [services directory](#)

Layer connections

Show: All Time: *-1d Automatic refresh Clear

| Status | Updates | Total data | Host | Address | Secure | Created | Updated | Total time | Time since last | Avg update rate | Avg data rate |
|----------|---------|------------|---------------|---------------|--------|----------|----------|------------|-----------------|-----------------|---------------|
| ✓ Opened | 143 | 151.3 kB | 162.9.162.252 | 162.9.162.252 | ✓ | just now | just now | 00:00:07 | 00:00:21 | 18.15 updates/s | 19.2 kB/s |

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'

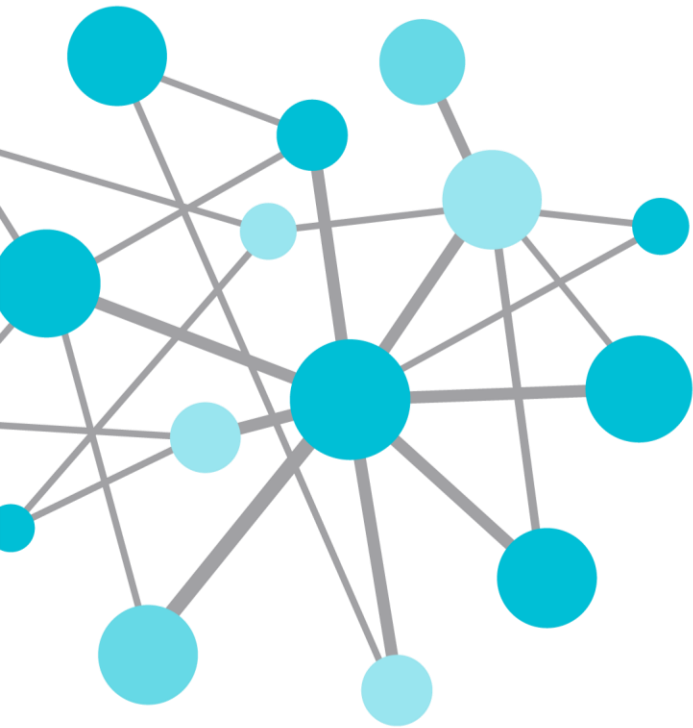
- Mobile 2 MW 13.2 KV diesel generators
- Clean Parallel to grid and island mode transition
- Synchronous operation of up to 5 units for 10MW anywhere
- System connection in less than 2 hours in emergency
- Onboard PI system on SEL 3355 computer
- Process book displays for HMI
- Multimode communications, 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

- muellerrj@dteenergy.com
- Supervising Engineer Power Systems Technology
- DTE Energy



THANK
YOU

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