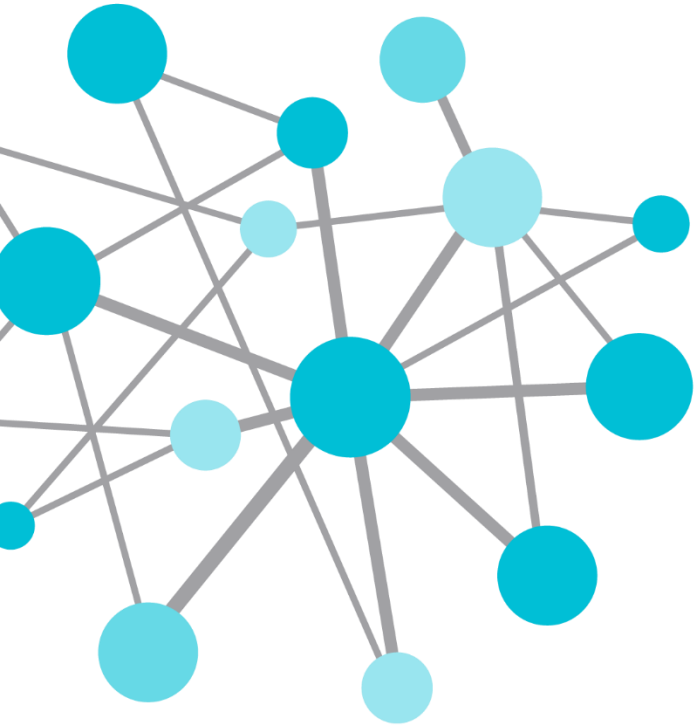
OSIsoft®

SEMINÁRIO REGIONAL 2014

The Power of Data

L A T A M

DECISION READY IN REAL-TIME



The PI System…. Infrastructure for the Utility of the Future

Presented by **Kevin P Walsh**
kwalsh@osisoft.com
Industry Principal – T&D

About OSIsoft

- Established in 1980 by J. Patrick Kennedy
- Still privately held
- Independence is our strength
- Headquarters - San Leandro, CA
- 1050+ employees
- 200 + employees in product development
- PI System Installed base
  - 16,000 + systems
  - 110 + countries

- **Over 200 GW of the total 350 GW average daily power generated & transmitted in US is monitored by the PI System software**
- **100% of ISO/RTO's in North America use the PI System**
- **18 out of the top twenty wind producers use the PI System**
- **More than 200 T&D customers worldwide**

Defacto Standard in Power and Utilities

WHY PI in T&D

- Standardizing your T&D / Smart Grid data infrastructure on OSIsoft's PI System provides value to a utility in many areas such as;
  1) Provides greater Situational Awareness
  2) Increases equipment life
  3) Improves Operations
  4) Reduces CapEx and O&M spend
  5) Broadens access to a common source for all OT data
  6) Improves decision-making capabilities of staff
  7) Provides End to End Visibility to drive Innovation
  8) Provides Lower Total Cost of Ownership
- Users across the enterprise include: Operations, Engineering, Energy Trading, Customer Service, Maintenance, and Executive Management

Transmission & Distribution

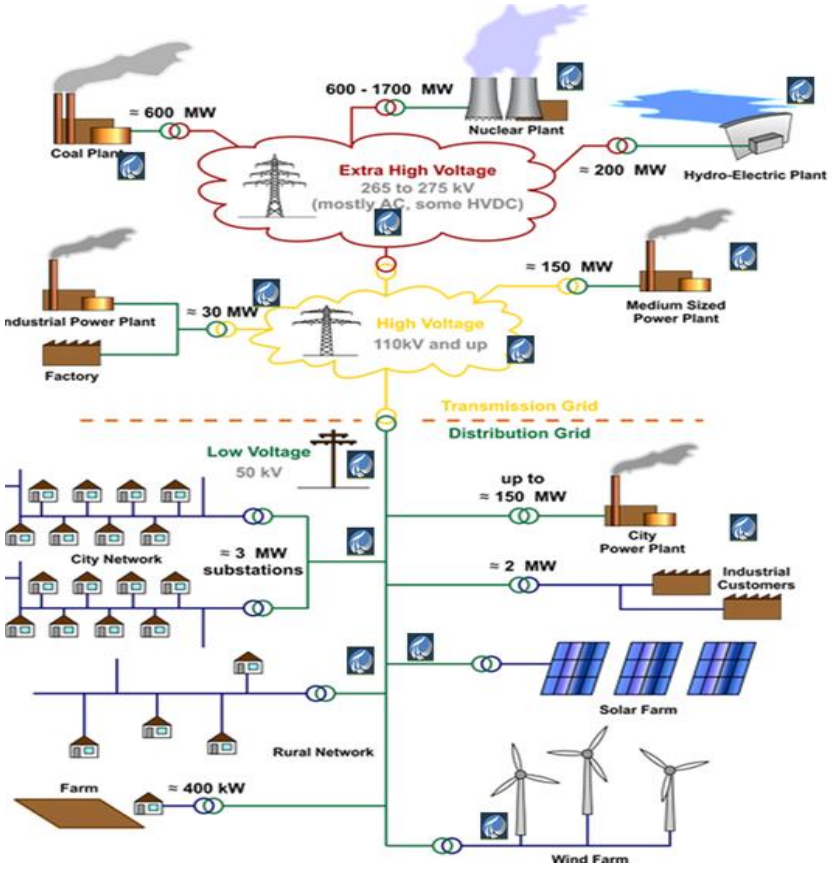
- Best of class Data Historian
- Substation Automation
- Planning for Availability
- Improve Asset Management
- Condition Based Maintenance
- Prioritized Outage Management
- Demand Side Management/Demand Response
- Renewable Integration and Optimization

Agenda

- **Smart Grid – What does it really mean?**
- Smart Grid – Does it come with Directions?
- What are the Parts?
- What's important in Smart Grids?
- End to End Visibility and Monitoring
  - PI Customer Use Cases
    - SMUD – Operational value of smart meter data
    - PJM – Situational Awareness
    - PSE&G – Asset health
    - ComEd – Analytics and Visualization
    - PowerStream – Operations to Microgrids
    - Sempra (SDG&E) – PI across the Utility

Smart Grid – What does it really mean??

- Does it mean AMI? Smart Meters?
- Does it mean HEMS? (home energy management systems)
- Does it mean DA/DMS?
- Does it mean PMUs?
- Does it mean DER?
- Does it mean Micro Grids?
- Renewable integration?
- Situational Awareness?
- Smart Cities
- All of the above?
- None of the above?
- Do we know our acronyms?



Smart Grid – What does it really mean??

"The Smart Grid isn't a thing but rather a vision and to be complete, that vision must be expressed from various perspectives – its values, its characteristics, and the milestones for achieving it."

Joe Miller – Smart Grid News.com

Smart Grid – What does it really mean??

- We know the following;
  - It must be more reliable
  - It must be more secure
  - It must be more economic
  - It must be more efficient
  - It must be more environmentally friendly
  - It must be safe

Smart Grid – What does it really mean??

- 5 Key technologies that enable the Smart Grid
  - Integrated Communications
  - Sensing and measuring
  - Advanced Components
  - Advanced Controls
  - Improved interfaces and decision support
- Two main bi-products of this
- **Wide Area Situational Awareness and…**
- **Data, lots and lots of data**

Key Drivers of the Grid Transformation

CURRENT STATE

- Centralized
- One-way flow
- Stable load
- Static/Reactive
- Analog/Electromech
- Single purpose
- Proprietary
- Silo-oriented
- Latent/data overload
- OT/IT disconnect
- Limited customer interaction
- Data center Security
- Fragile

DRIVERS

- Intermitted Renewables
- Energy Storage
- Micro Grids
- Electric Vehicles
- Cyber Security threats
- Premise “Internet of Things”
- Aging Infrastructure
- Stranded Assets
- “Big Data” Complexity

Strategy

1. Internet Protocol
2. Translation
3. Contextualization
4. Security
5. Analytics

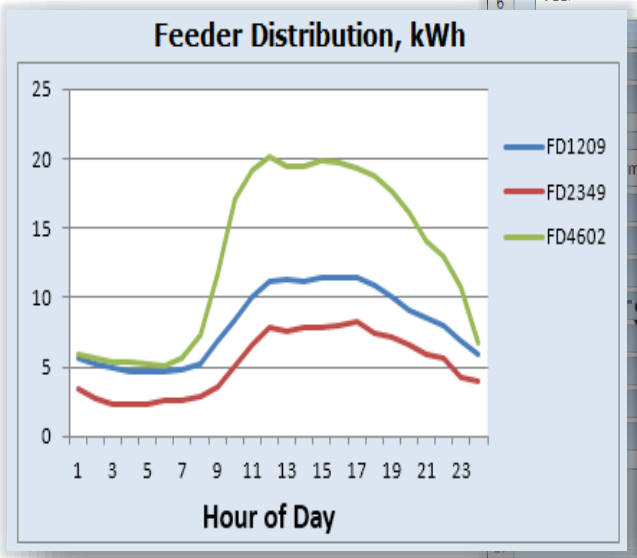
FUTURE STATE

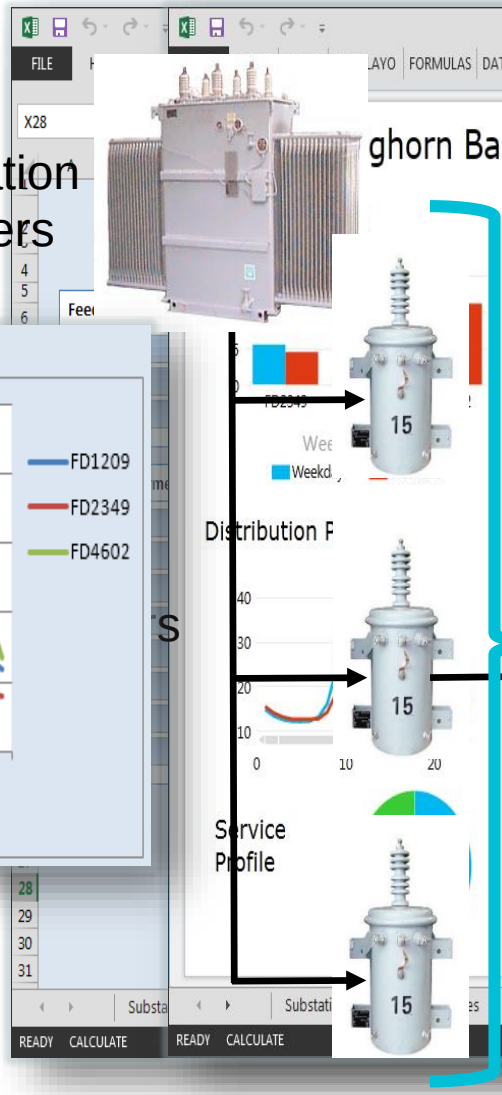
- Distributed and Centralized
- Multi-direction flow
- Stochastic Load
- Dynamic/Proactive
- Digital/Automated
- Multi-function
- Open Standards/Modular
- Interoperable/Integrated
- Timely/Filtered data
- OT/IT Convergence
- Virtual Hand-shake
- Enterprise-wide Security
- Resilient

Situational Awareness

Excel

Substation Feeders

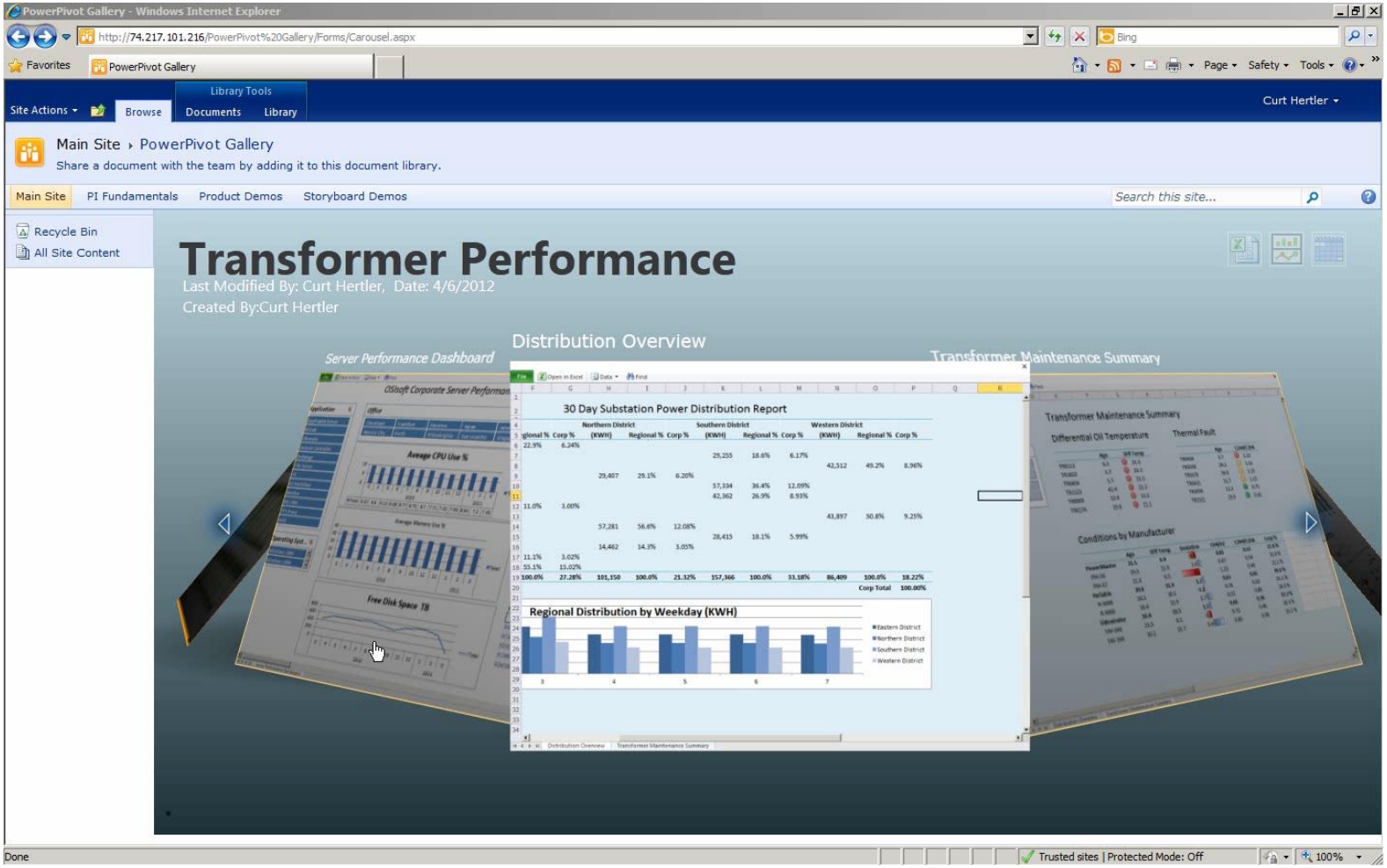




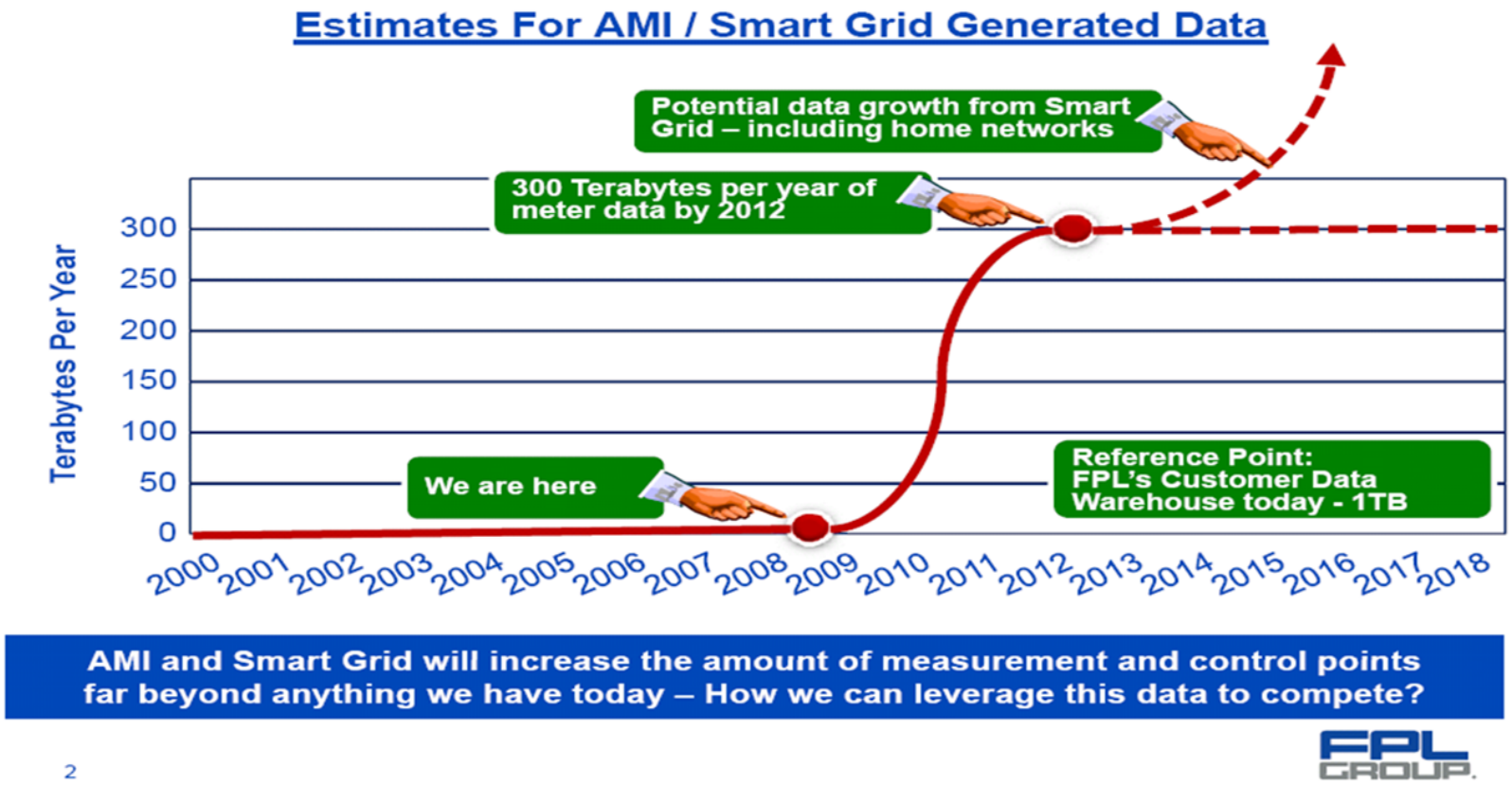
Pole Loads at Peak (9 am - 4 pm), kWh

	Jan KWH		Feb KWH		Mar KWH		Apr KWH	
PT0398	4.4		4.5		5.0		5.3	
PT1324	3.5		3.6		3.5		4.0	
PT2235	3.4		3.9		4.1		4.5	
PT4537	2.8		3.2		3.3		3.7	
PT7465	3.1		3.2		3.5		3.8	
PT7745	3.2		3.2		3.1		3.3	
PT8356	10.6		11.0		11.0		11.7	
PT8461	3.3		3.3		3.6		3.8	

What if?



Smart Grid – What does it really mean??



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Smart Grid – Does it come with Directions?

- AMI and Smart Grid could be viewed as a box of Legos
- Legos are great; One can build almost anything

Smart Grid – Does it come with Directions?

- But they start out in pieces

Solar PV
Energy Storage
DMS
PMU

Weather Stations
Line Sensors
Intelli Switches
ADMS
Smart metering

AMI/Smart Meters

Smart Meters
HAN
Customer portals
Res solar
PEV

Smart Grid

Smart Grid – Does it come with Directions?

- No, it does not come with directions like Legos

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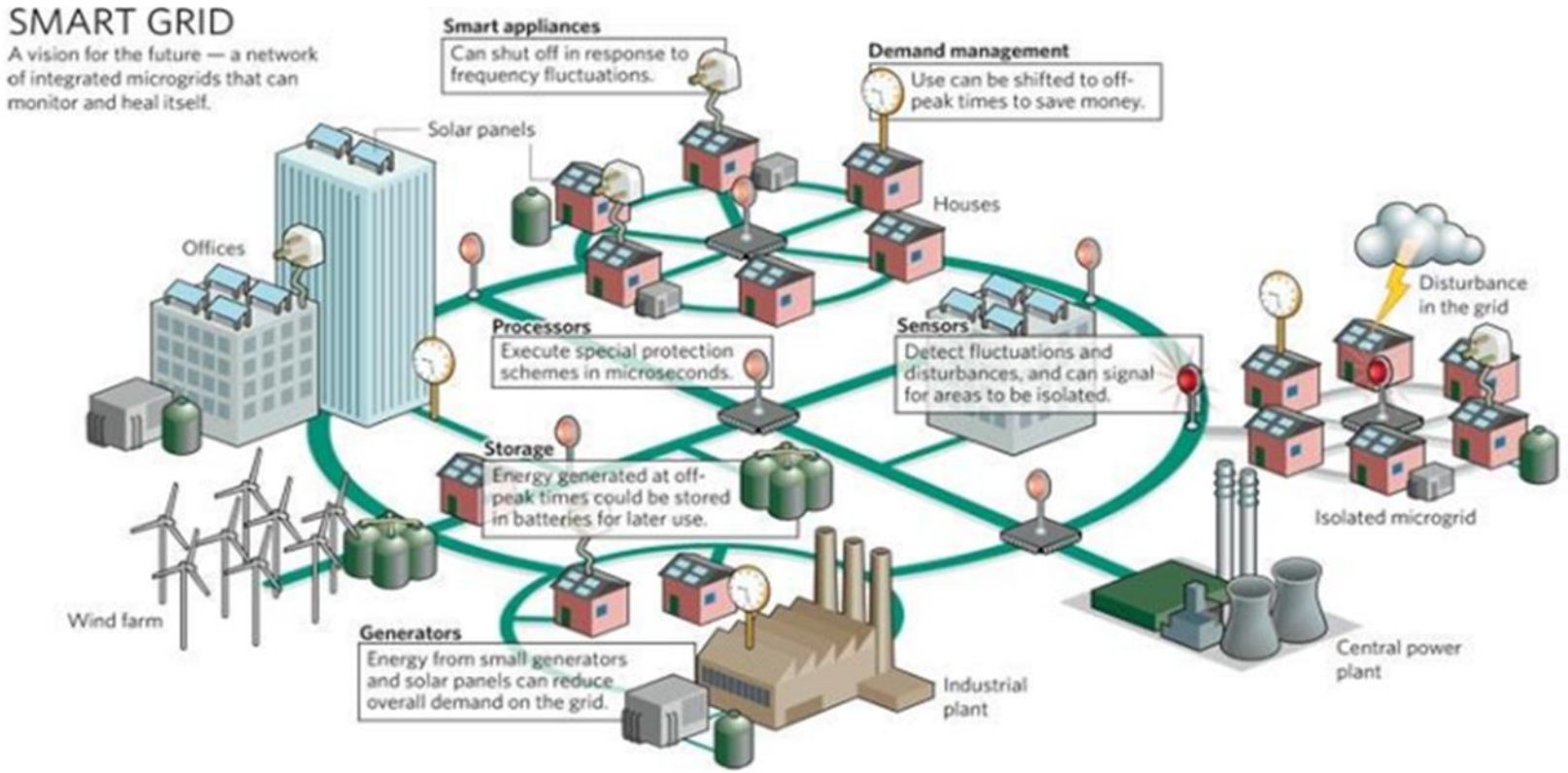
What are all the parts?



What are all the parts?

- PMUs
  - "SCADA is the X-ray of the Power Grid where PMUs are the MRIs of the new Power Grid"

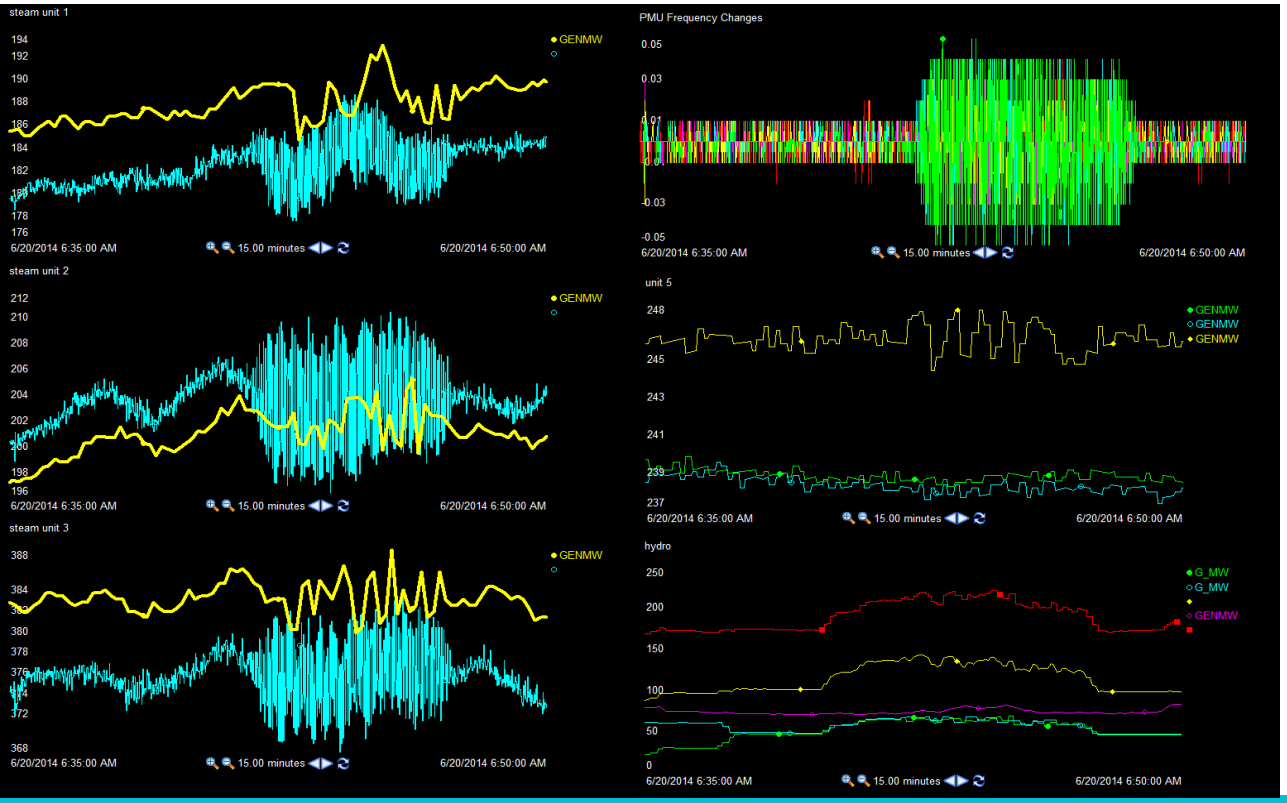
X-Ray

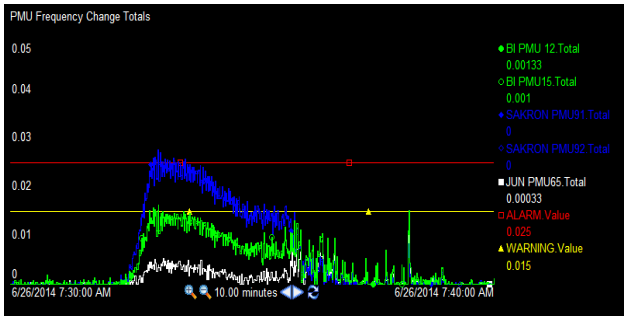
MRI

What are all the parts?

- PMUs - Identifies Instability before Escalation
  - Example of a switching event

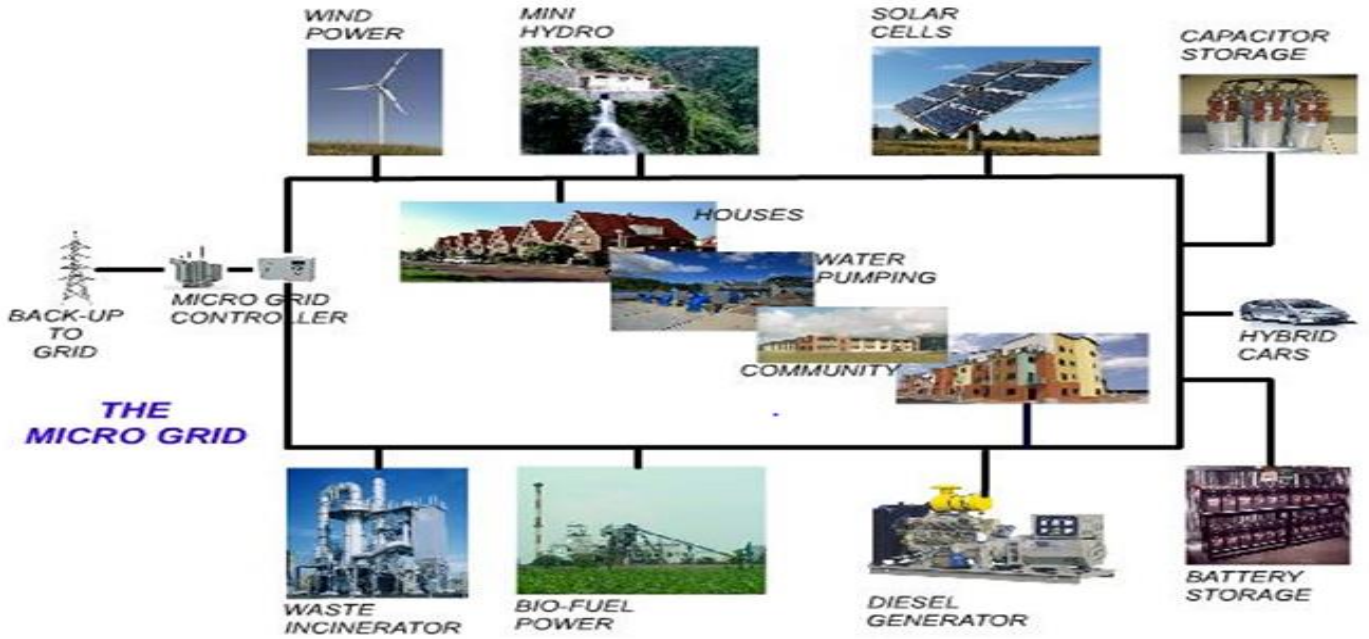
SCADA MW / calculated MW using PMU data





What are all the parts?

- Micro Grids
  - It's a small-scale power supply network that is designed to provide power for a small community



What are all the parts?

Agenda

- Smart Grid – What does it really mean?
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What's important in Smart Grids?

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- **End to End Visibility and Monitoring**
  - PI Customer Use Cases
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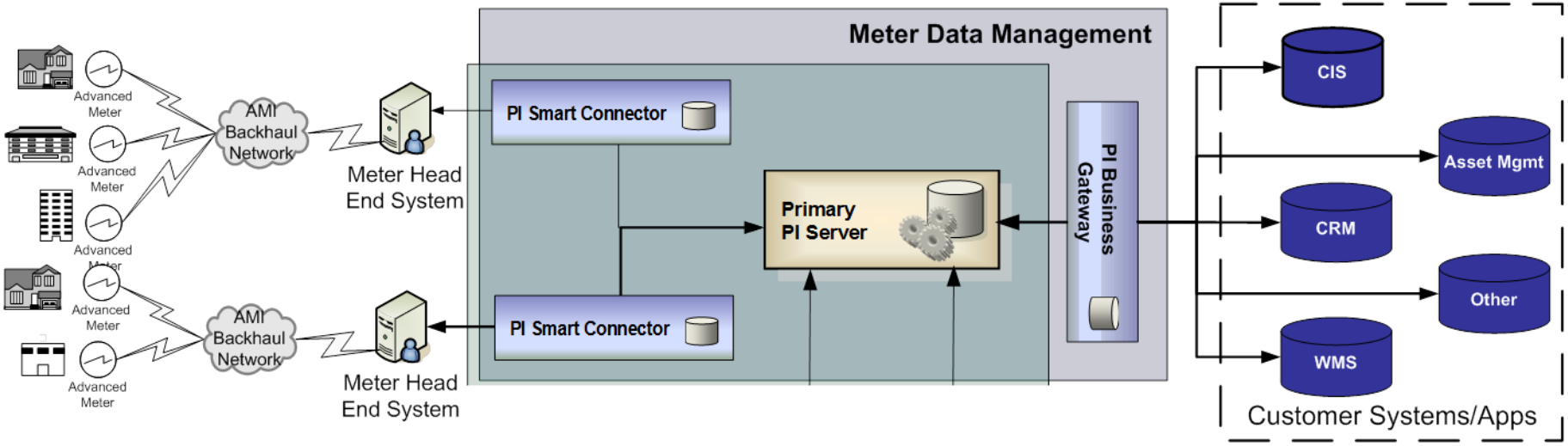
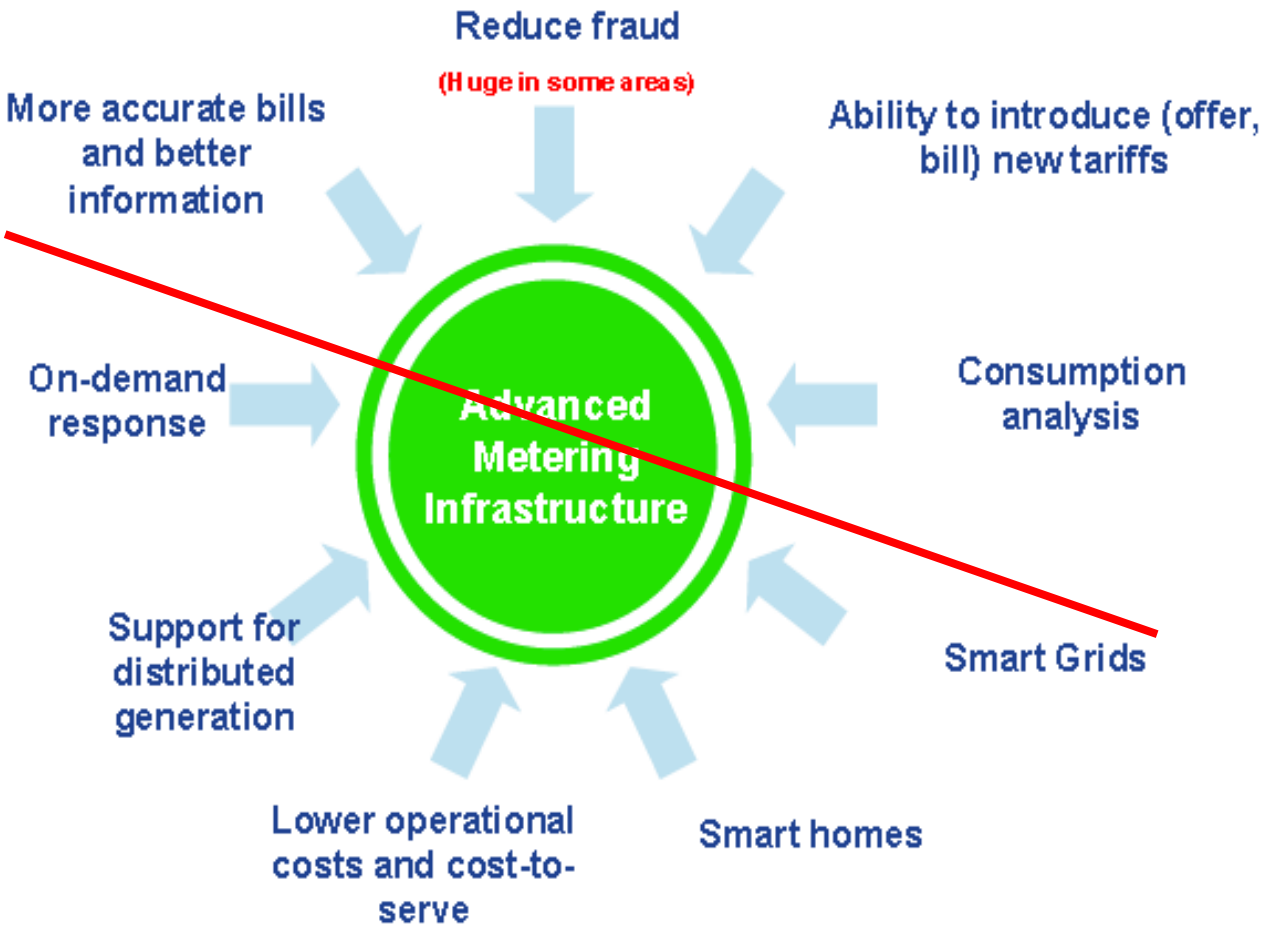
End to End Monitoring



End to End Monitoring

True AMI solutions are based on smart meters with 2 – Way communicat-ion, enabling remote metering capabilities and configuration



SmartSacramento Distribution Automation

SMUD™

SMUD – Business Case
Operational Meter Data

- 595,076 Customers
  - Residential accounts: 526,980
  - Commercial accounts: 68,096
- 2,007 employees
- 900 Square Mile service territory
- Seven member elected Board of Directors
- 6th largest community-owned electric utility in the nation
- Committed to a high level of customer satisfaction

SMUD – Business Case Operational Meter Data

- Customer load data
  - Transformer sizing
  - Delayed capital spending
  - System operations

- Meter voltage Information
  - Power quality
  - Conservation voltage reduction

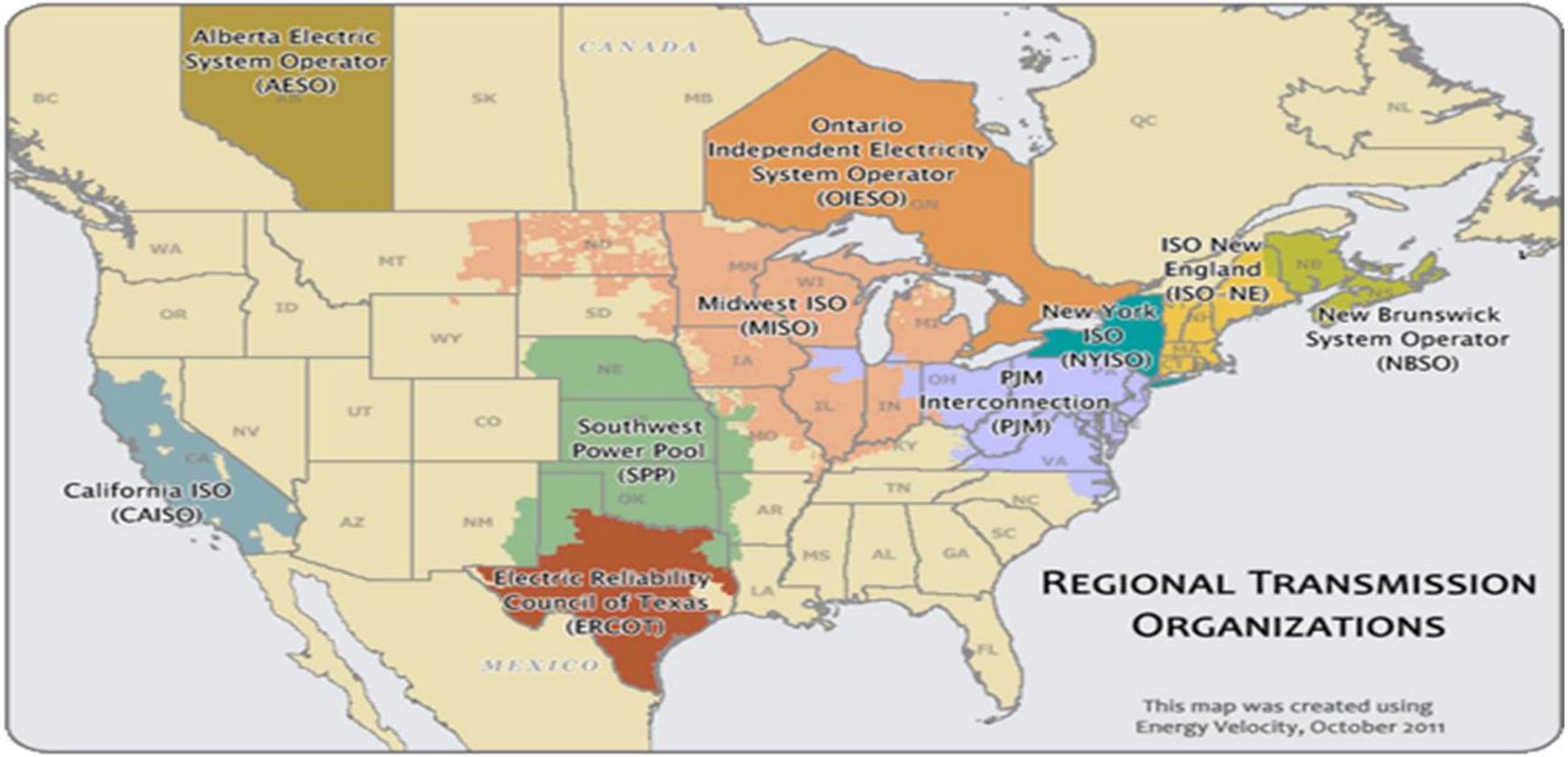
SMUD – Business Case Operational Meter Data

- Operational smart meter data - roughly 600k smart meters
  - Transformers
    - Customer load data to assist in transformer sizing, which delayed capital expenditures. They were over sizing transformers so by right sizing, saved 5% and
    -
  - Delayed capital expenditures
    - By having real time information, saved 0.5% of capital budget by either delaying or canceling capital projects
  - System Operations
    - Number of no touch days in the summer which impacts productivity on the system. By having the real load

      of system, reduced the number of “no touch days, increasing productivity.

The Value of the PI System at PJM Interconnection

Regional Transmission Organizations



PJM Territory

About PJM

- Responsible for the reliable operation of the high-voltage electric grid in all or parts of 13 states and Washington DC.
- Balancing Authority – responsible for balancing supply and demand
- Operate world's largest wholesale electricity market.
- Peak Demand - 163,000 MW
- Territory includes 6,000 substations
- 62,000 miles of transmission lines in PJM territory (69-765KV)
- Dispatch 1,300+ generators

Control room software vendors

- EMS
  - Siemens Spectrum EMS
    - Dual hot control centers at two different sites
- Market System
  - Alstom-Energy Market Systems
    - Day ahead and real-time market
- Visualization
  - OSIsoft
    - The PI System

Data collected in PI System

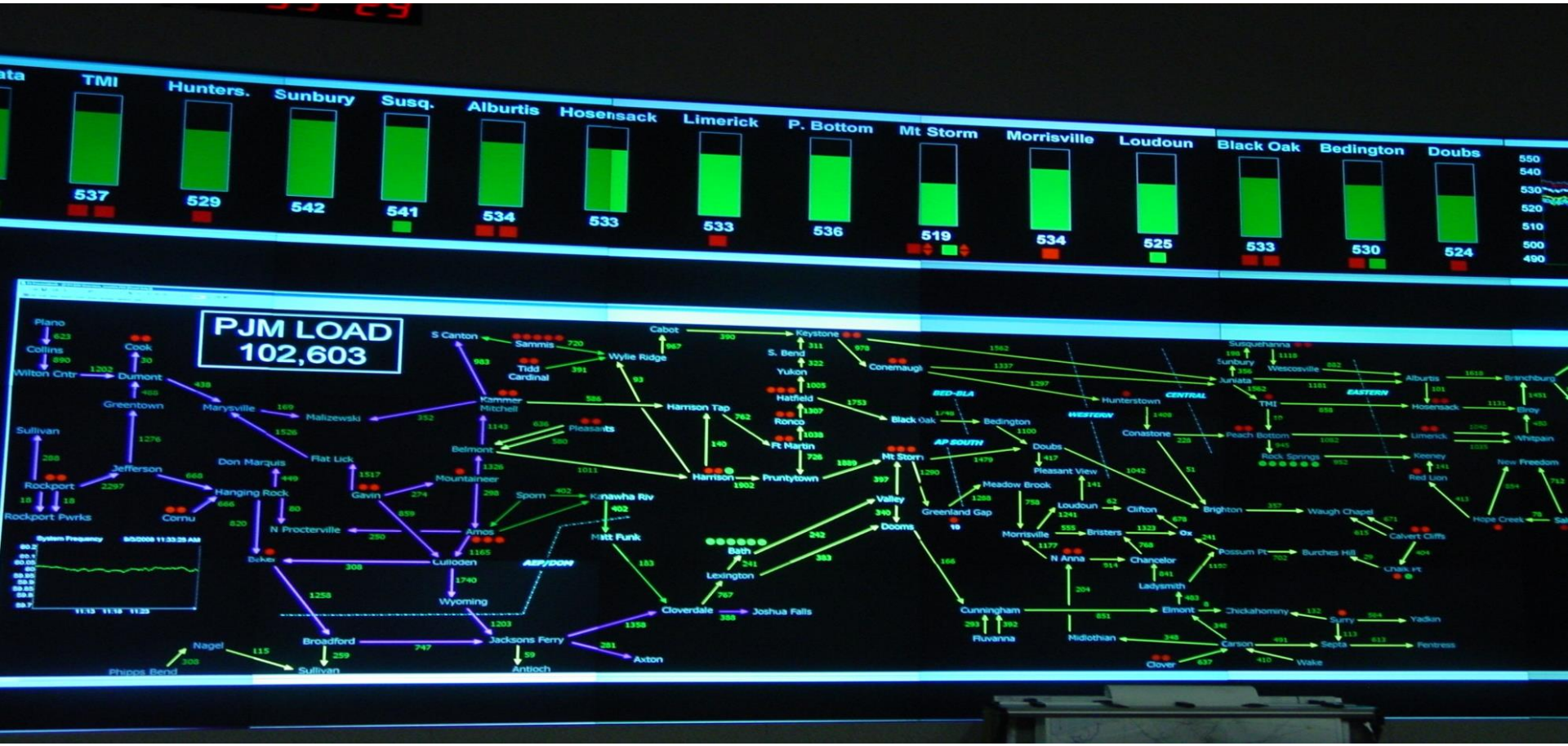
- Real-time SCADA data – voltages, MW, MVAR, loads, Circuit Breaker Status, MW reserves
- State Estimator data
- Market data – Generator bid information, Dispatch rates
- PMU data (synchrophasor)
- Line and transformer outage data
- All PI data stored for 7 years except for phasor data which is stored for 90 days.

Visualization Challenges

- Situation Awareness for large geographical area
- Tracking of 1300 generators- unit status, MW and MVAR output, unit reserves
- Tracking system voltages throughout 13 state territory
- Viewing transmission zone overviews for a large grid
- Keeping track of wind generation output and forecast
- Track MW transfers into PJM and across the transmission system
- Consistent displays in each control room

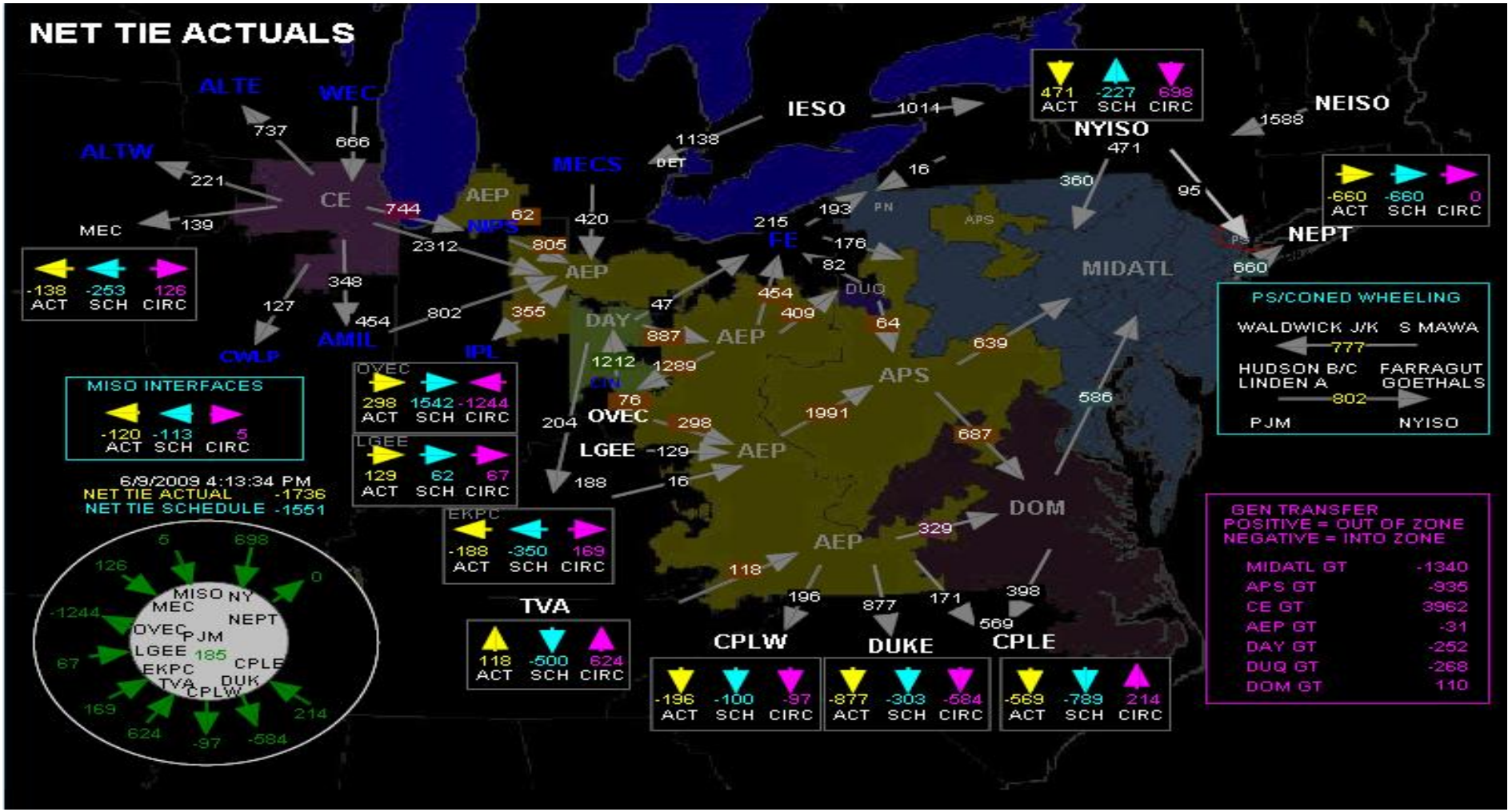
View of control room video walls

Situational awareness in control room

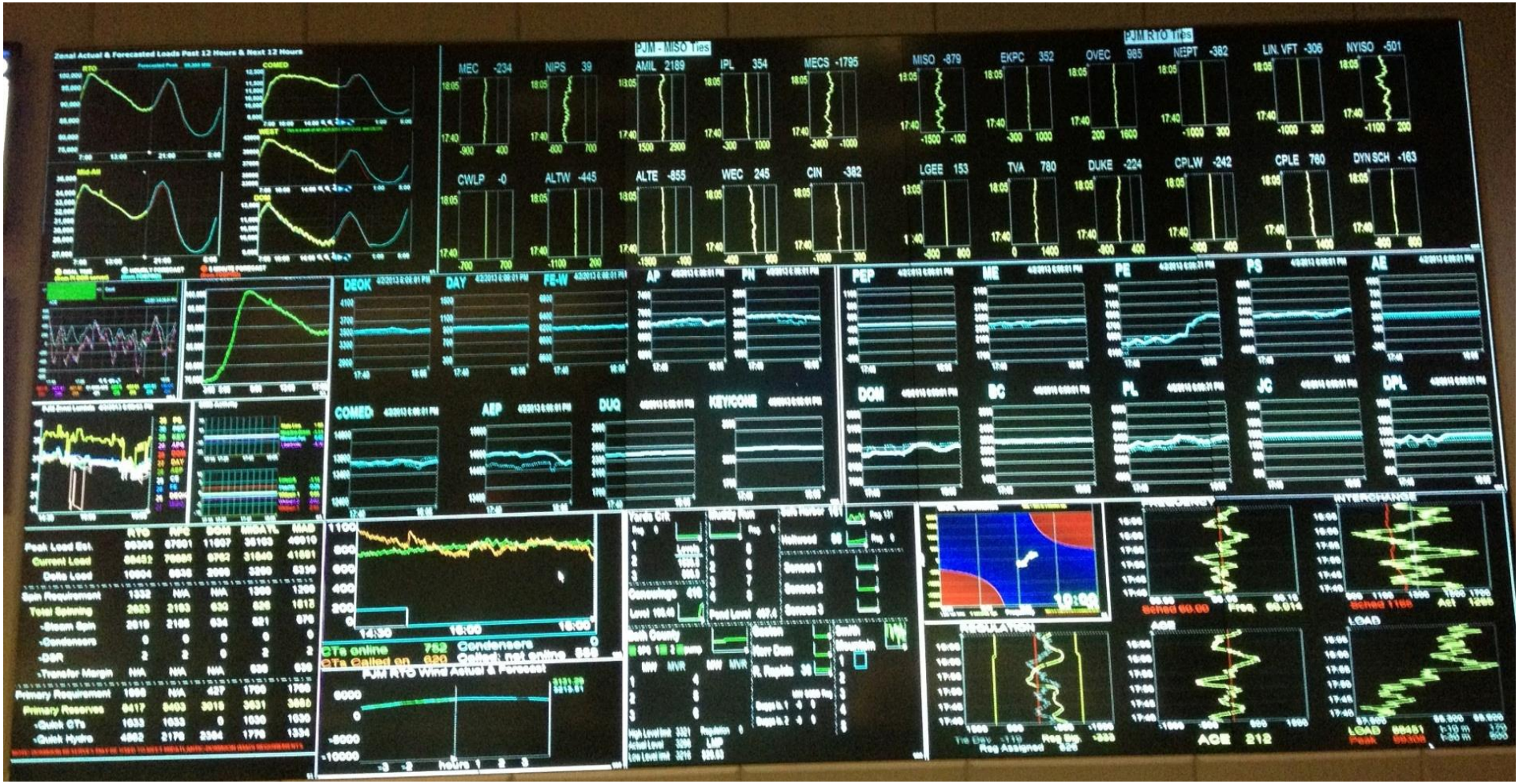


Transmission flow and voltages

Scheduled and Actual MW Flows between PJM and neighbors

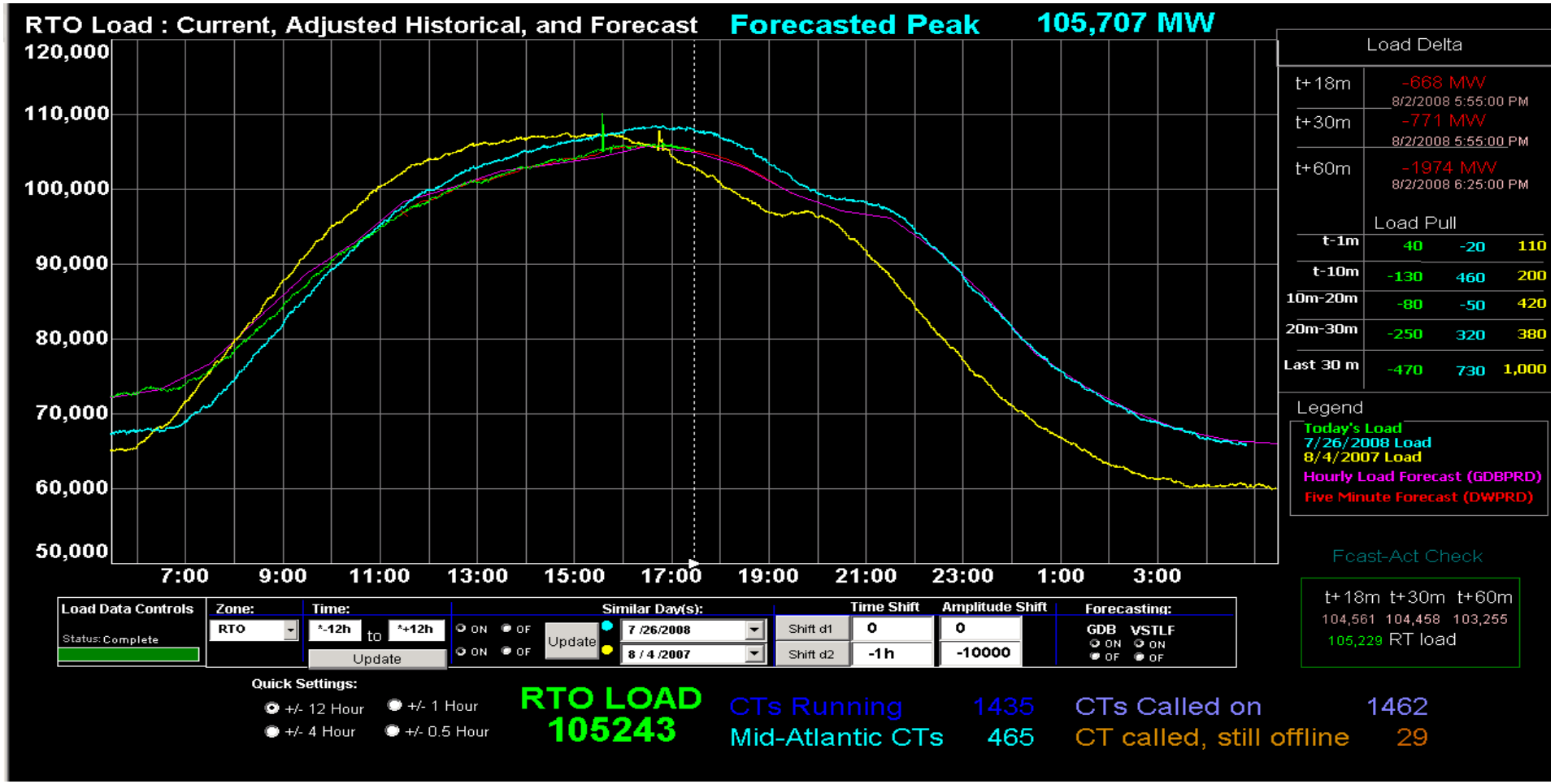


Generation Video Wall

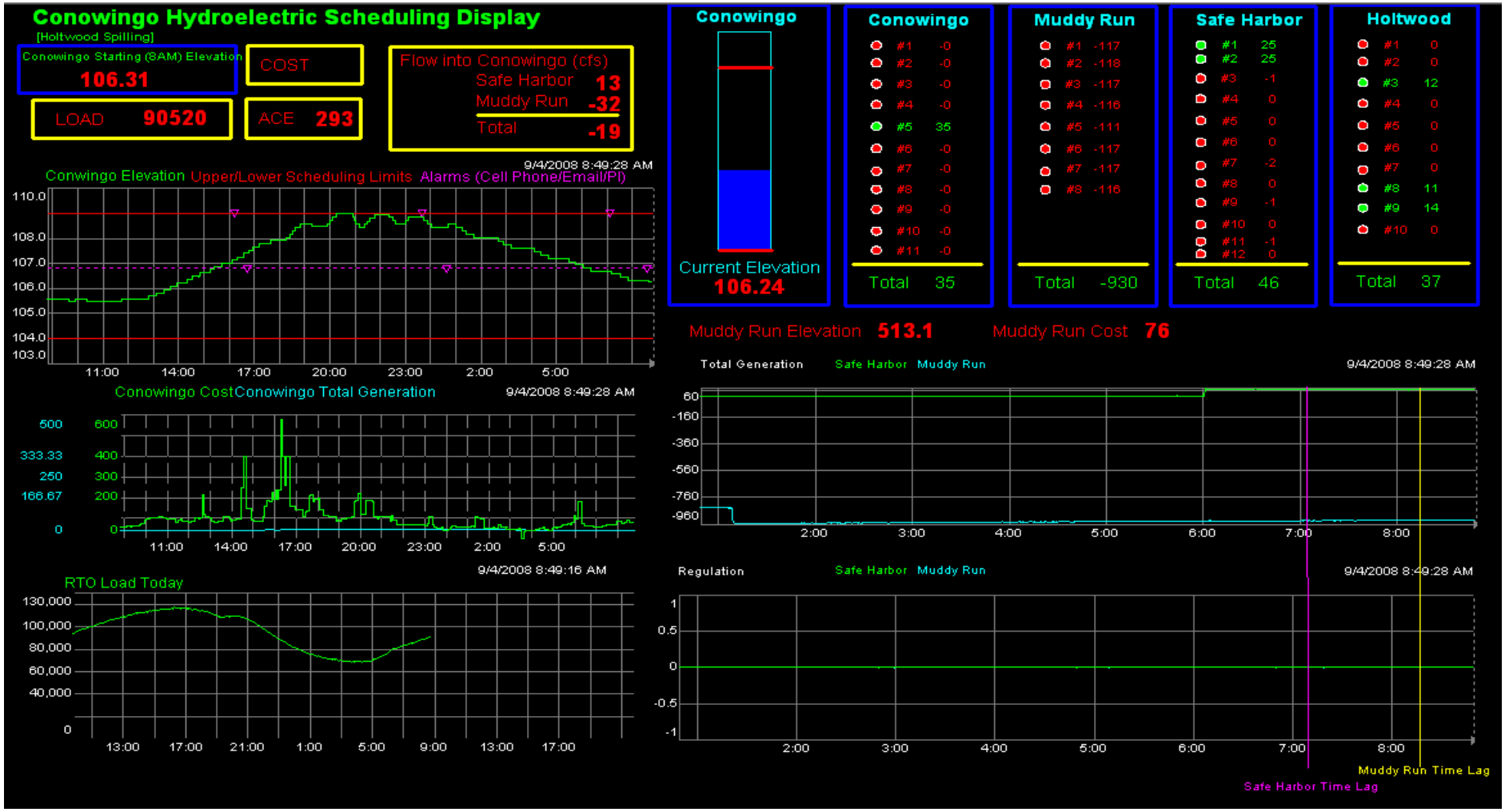


Desk Top Displays

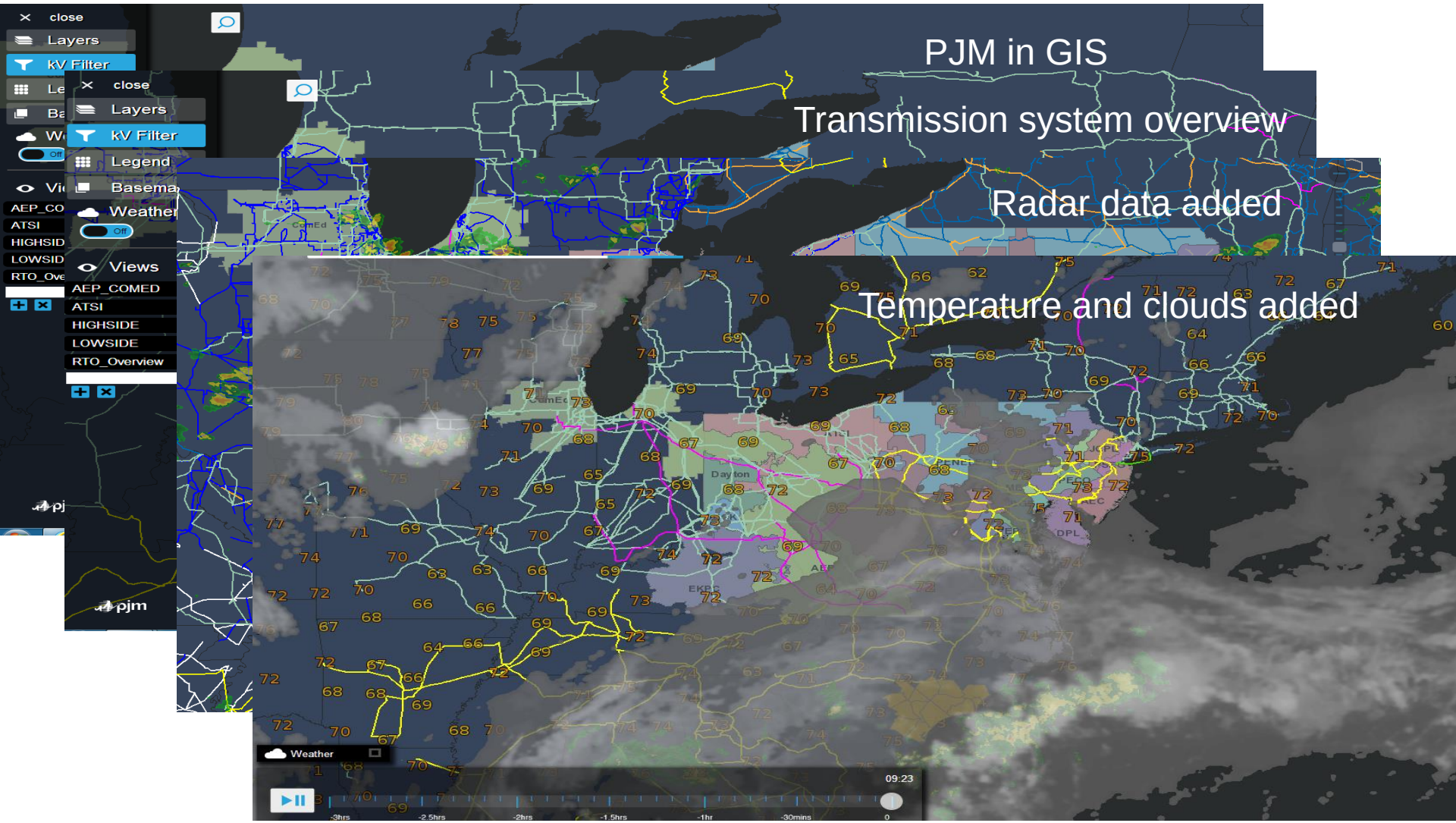
Load Picker Display



Hydro Monitoring



GIS with the PI System

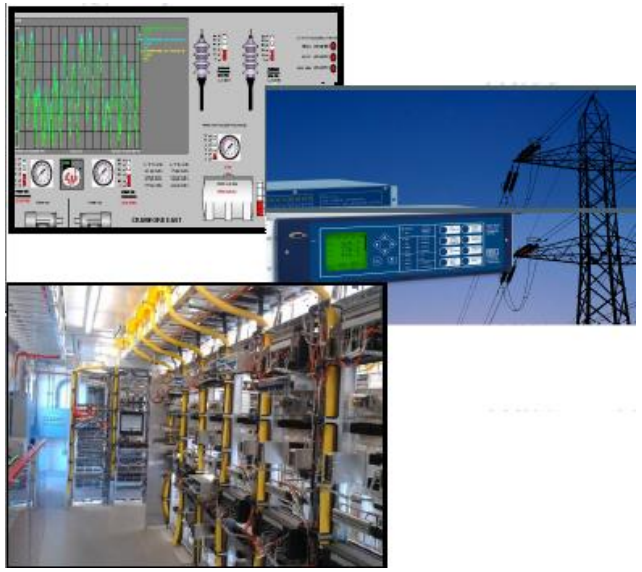


Trusting the Data: Analytics and Visualization

ComEd
An Exelon Company

ComEd's Experience of Smart Data Analytics and Visualization

As part of ComEd's grid modernization program, the Operations , Engineering and IT departments are working together to come up with new ideas and develop new tools to capture the benefits of the collected big data.



ComEd
An Exelon Company

Business Challenge

Challenge to deal with hundreds of assets for which information needs to be organized. A formidable task to monitor the data associated with hundreds of grid components in reasonable amount of time.

Solution

Detailed asset models for Substations to improve Data Visualization.

Automate and apply logical algorithms for monitoring hundreds of targeted pieces of equipment.

Results and Benefits

Engineers are certain that the vital equipment is being monitored around the clock.

Implements standardization across Substations within ComEd.

About ComEd

Electric Delivery Company	• Providing service to approximately 3.8 million customers across Northern Illinois
Manages	• 90,000 miles of power lines in an 11,400-square-miles territory
Investing	• Made capital investments of $1.4 billion in 2013 • Expects to invest an additional $5.7 billion over the next three years to further strengthen and modernize the system in Northern Illinois
Understands	• How important safe, reliable power is to customers, and is continuously looking for new ways to improve service

ComEd
An Exelon Company

Business Challenges

- What are the appropriate processing tools for visualization of smart grid applications?
- How to efficiently monitor field assets and enable data analytics to be more proactive in decision making?
- How to educate more users to embrace data mining techniques?

ComEd
An Exelon Company

Diverse users of the PI System

- Capacity Planning
- Relay and Protection Engineering
- Transmission System Operations
- Transmission and Substation Equipment Standards
- Distribution Dispatch Support, Operations
- Testing Groups
- Energy Acquisition
- IT Real Time
- Energy Infrastructure Modernization Act – IT
- Corporate Security

ComEd
An Exelon Company

Lets hear it from the customer

Leveraging PI System at PSE&G: Asset Health

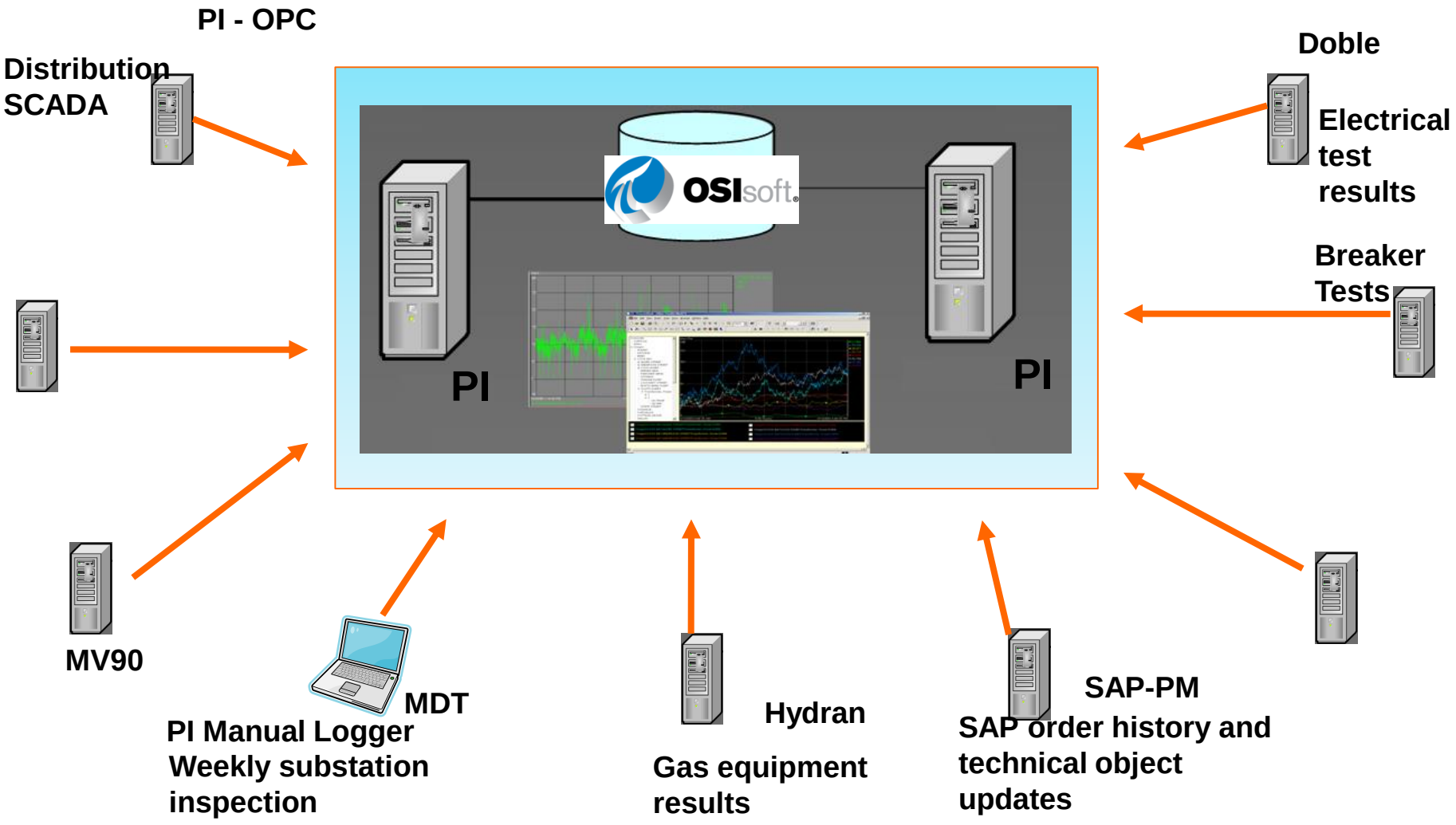
PSEG

T&D Critical Assets

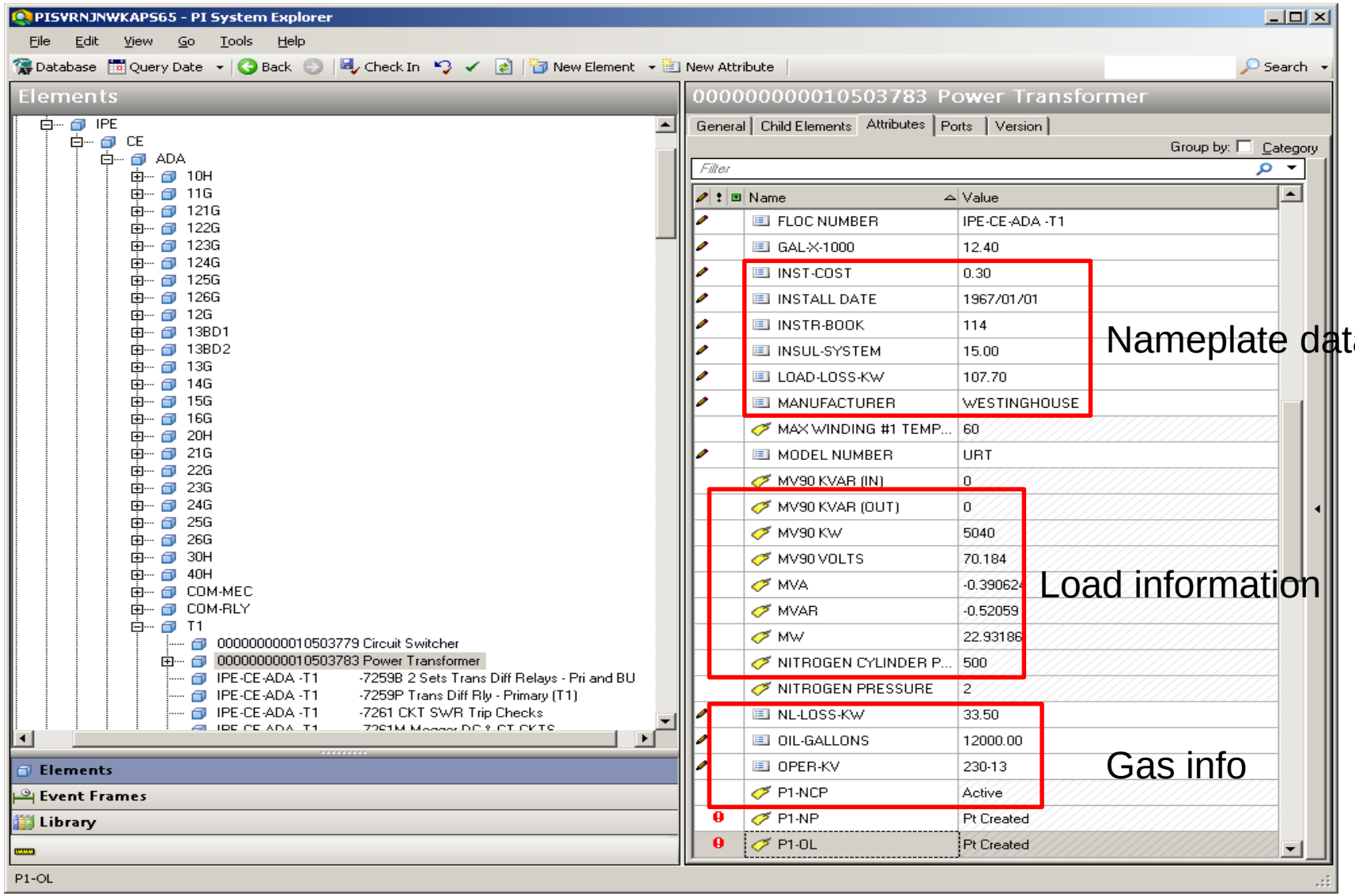
The challenge with driving value from asset data

- How to monitor and analyze large asset populations easily?
- How to combine data from scada, analyzers and EAM/ERP systems together?
- How to have a complex system which is user friendly at the same time?

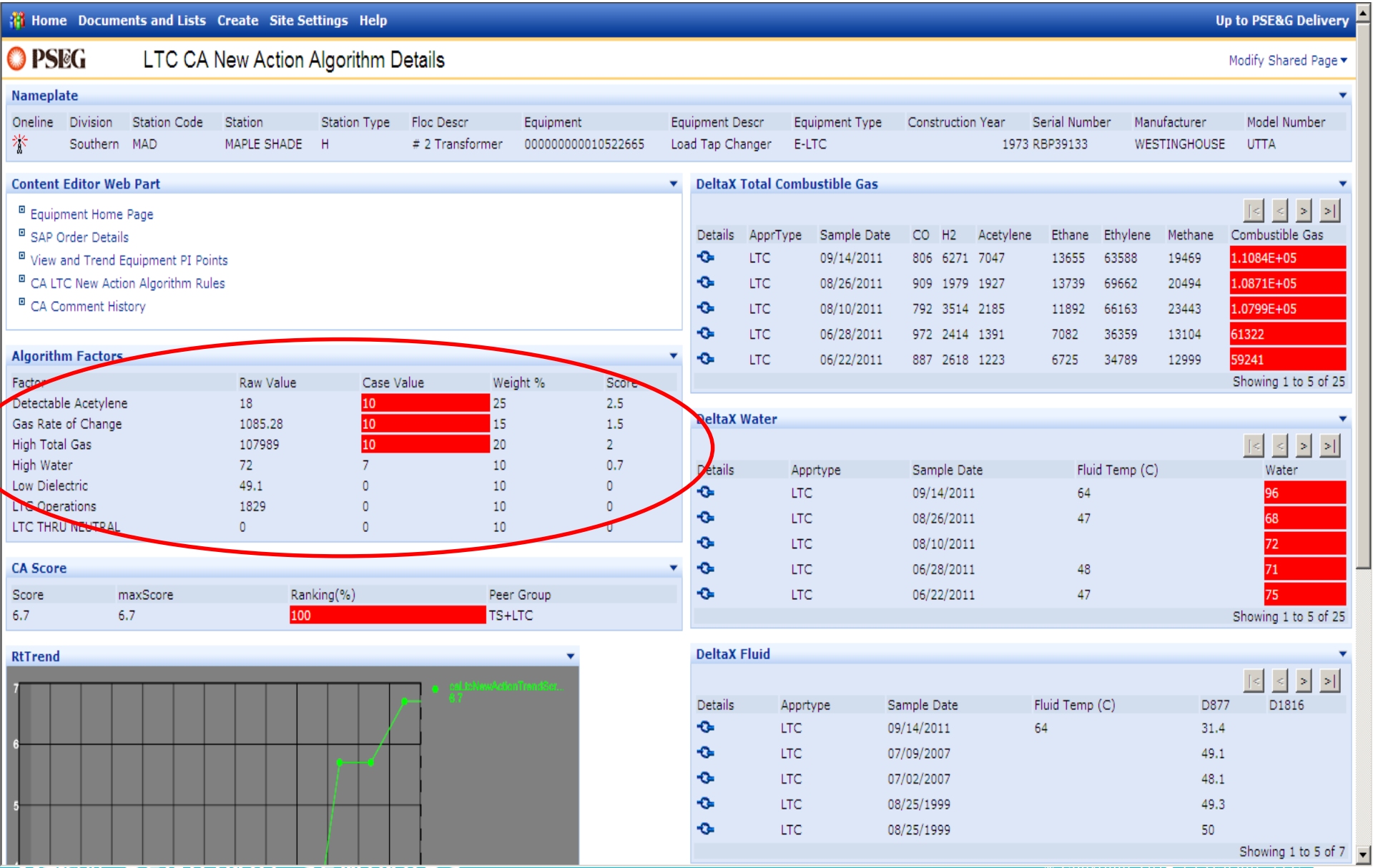
PSE&G CMMS
(Computerized Maintenance Management System)



Build Asset Model and Correlate Data



Algorithm Details



Home Documents and Lists Create Site Settings Help — Up to PSE&G Delivery

PSE&G — LTC CA New Action Algorithm Details — Modify Shared Page

Nameplate

Oneline	Division	Station Code	Station	Station Type	Floc Descr	Equipment	Equipment Descr	Equipment Type	Construction Year	Serial Number	Manufacturer	Model Number
	Southern	MAD	MAPLE SHADE	H	# 2 Transformer	000000000010522665	Load Tap Changer	E-LTC	1973	RBP39133	WESTINGHOUSE	UTTA

Content Editor Web Part

- Equipment Home Page
- SAP Order Details
- View and Trend Equipment PI Points
- CA LTC New Action Algorithm Rules
- CA Comment History

Algorithm Factors

Factor	Raw Value	Case Value	Weight %	Score
Detectable Acetylene	18	10	25	2.5
Gas Rate of Change	1085.28	10	15	1.5
High Total Gas	107989	10	20	2
High Water	72	7	10	0.7
Low Dielectric	49.1	0	10	0
LTC Operations	1829	0	10	0
LTC THRU NEUTRAL	0	0	10	0

CA Score

Score	maxScore	Ranking(%)	Peer Group
6.7	6.7	100	TS+LTC

RtTrend

DeltaX Total Combustible Gas

Details	ApprType	Sample Date	CO	H2	Acetylene	Ethane	Ethylene	Methane	Combustible Gas
	LTC	09/14/2011	806	6271	7047	13655	63588	19469	1.1084E+05
	LTC	08/26/2011	909	1979	1927	13739	69662	20494	1.0871E+05
	LTC	08/10/2011	792	3514	2185	11892	66163	23443	1.0799E+05
	LTC	06/28/2011	972	2414	1391	7082	36359	13104	61322
	LTC	06/22/2011	887	2618	1223	6725	34789	12999	59241

Showing 1 to 5 of 25

DeltaX Water

Details	Apprtype	Sample Date	Fluid Temp (C)	Water
	LTC	09/14/2011	64	96
	LTC	08/26/2011	47	68
	LTC	08/10/2011		72
	LTC	06/28/2011	48	71
	LTC	06/22/2011	47	75

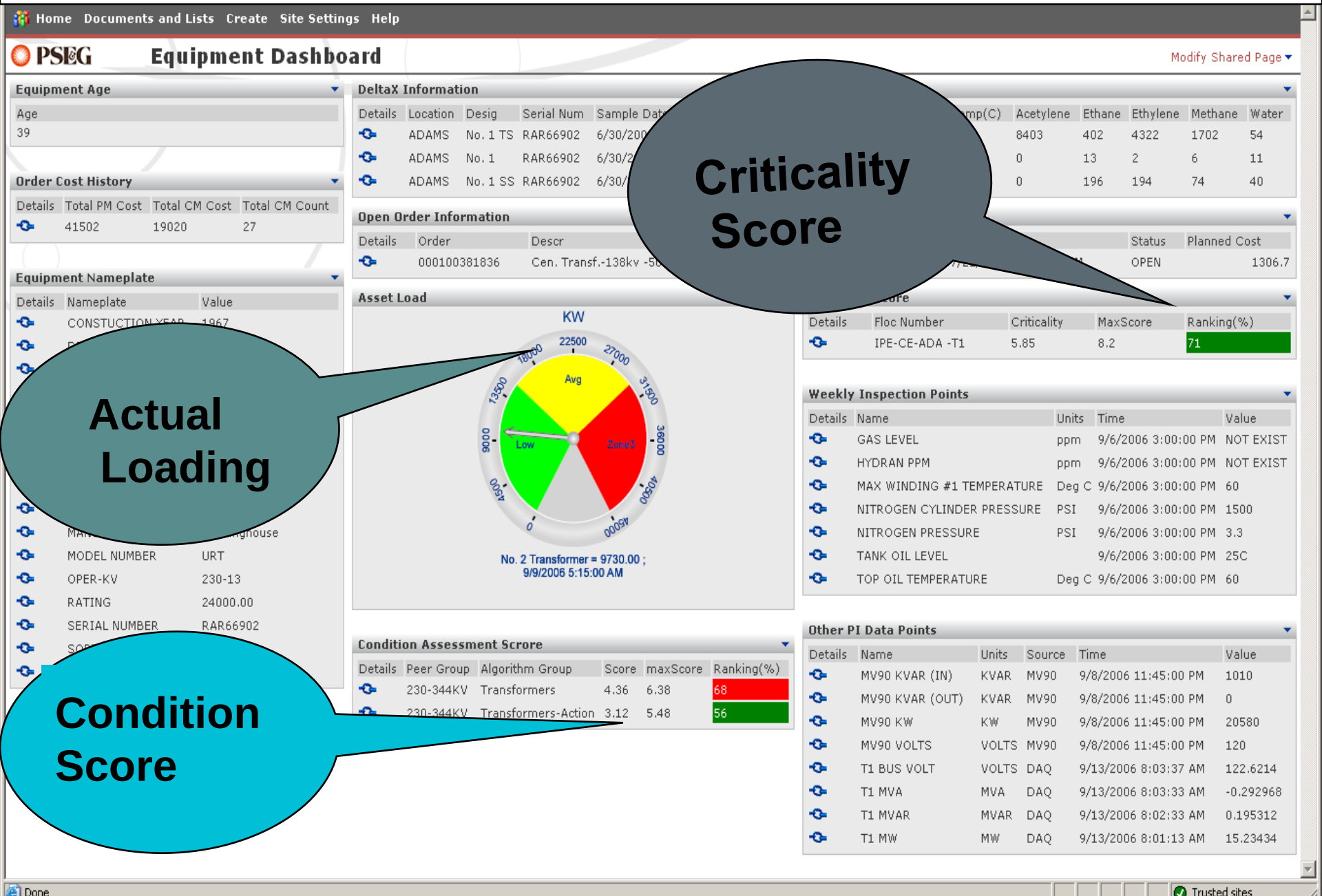
Showing 1 to 5 of 25

DeltaX Fluid

Details	Apprtype	Sample Date	Fluid Temp (C)	D877	D1816
	LTC	09/14/2011	64	31.4	
	LTC	07/09/2007		49.1	
	LTC	07/02/2007		48.1	
	LTC	08/25/1999		49.3	
	LTC	08/25/1999		50	

Showing 1 to 5 of 7

Dashboard


Home
Documents and Lists
Create
Site Settings
Help
PSEG
Equipment Dashboard
Modify Shared Page
Equipment Age
Age
39
Order Cost History
Details
Total PM Cost
Total CM Cost
Total CM Count
41502
19020
27
Equipment Nameplate
Details
Nameplate
Value
CONSTUCTION YEAR
1967
MODEL NUMBER
URT
OPER-KV
230-13
RATING
24000.00
SERIAL NUMBER
RAR66902
DeltaX Information
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Serial Num
Sample Dat
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Ethane
Ethylene
Methane
Water
ADAMS
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6/30/200
8403
402
4322
1702
54
ADAMS
No. 1
RAR66902
6/30/2
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13
2
6
11
ADAMS
No. 1 SS
RAR66902
6/30/
0
196
194
74
40
Open Order Information
Details
Order
Descr
Status
Planned Cost
000100381836
Cen. Transf.-138kv -5
OPEN
1306.7
Criticality Score
Details
Floc Number
Criticality
MaxScore
Ranking(%)
IPE-CE-ADA -T1
5.85
8.2
71
Asset Load
KW
22500
27000
31500
36000
40500
45000
4500
9000
13500
18000
Avg
Low
Zone3
No. 2 Transformer = 9730.00 ;
9/9/2006 5:15:00 AM
Actual Loading
Weekly Inspection Points
Details
Name
Units
Time
Value
GAS LEVEL
ppm
9/6/2006 3:00:00 PM
NOT EXIST
HYDRAN PPM
ppm
9/6/2006 3:00:00 PM
NOT EXIST
MAX WINDING #1 TEMPERATURE
Deg C
9/6/2006 3:00:00 PM
60
NITROGEN CYLINDER PRESSURE
PSI
9/6/2006 3:00:00 PM
1500
NITROGEN PRESSURE
PSI
9/6/2006 3:00:00 PM
3.3
TANK OIL LEVEL
9/6/2006 3:00:00 PM
25C
TOP OIL TEMPERATURE
Deg C
9/6/2006 3:00:00 PM
60
Condition Assessment Scrore
Details
Peer Group
Algorithm Group
Score
maxScore
Ranking(%)
230-344KV
Transformers
4.36
6.38
68
230-344KV
Transformers-Action
3.12
5.48
56
Condition Score
Other PI Data Points
Details
Name
Units
Source
Time
Value
MV90 KVAR (IN)
KVAR
MV90
9/8/2006 11:45:00 PM
1010
MV90 KVAR (OUT)
KVAR
MV90
9/8/2006 11:45:00 PM
0
MV90 KW
KW
MV90
9/8/2006 11:45:00 PM
20580
MV90 VOLTS
VOLTS
MV90
9/8/2006 11:45:00 PM
120
T1 BUS VOLT
VOLTS
DAQ
9/13/2006 8:03:37 AM
122.6214
T1 MVA
MVA
DAQ
9/13/2006 8:03:33 AM
-0.292968
T1 MVAR
MVAR
DAQ
9/13/2006 8:02:33 AM
0.195312
T1 MW
MW
DAQ
9/13/2006 8:01:13 AM
15.23434
Done
Trusted sites

Summary of Worst Performing LTCs

Home Documents and Lists Create Site Settings Help

PSEG LTC CA-Action New Summary Report

CA Records

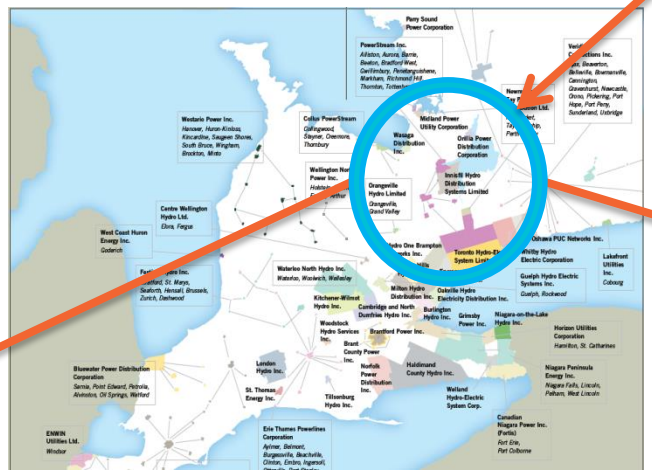
Details	Division	Floc	Floc Descr	Equipment	Equip Descr	Score	Person	Status	Manufacturer	Type	ApprType	Serial Number	Tim
	SO	IPE-SO-MAD -T2	# 2 Transformer	000000000010522665	Load Tap Changer	6.7	Mark Stoughton	Awaiting Maint.	WESTINGHOUSE	UTTA	LTC	RBP39133	Se
	ME	IPE-ME-SNW -1TRH	132-1 Transformer	000000000010510407	LTC/Selector and Transfer 13 Kv	5	Paul Morakinyo	No Action	WESTINGHOUSE	URT2	TS	7001829-13	Se
	ME	IPE-ME-SNW -1TRH	132-1 Transformer	000000000010510410	LTC/Selector and Transfer 26 Kv	5	Paul Morakinyo	Awaiting Maint.	WESTINGHOUSE	URT2	TS	7001829-26	Se
	ME	IPE-ME-SNW -3TRH	132-3 Transformer	000000000010510415	LTC/Selector and Transfer 13 Kv	5	Paul Morakinyo	No Action	WESTINGHOUSE	URT2	TS	6537551-13	Se
	ME	IPE-ME-SNW -3TRH	132-3 Transformer	000000000010510418	LTC/Selector and Transfer 26 Kv	5	Paul Morakinyo	Awaiting Maint.	WESTINGHOUSE	URT	TS	6537551-26	Se
	CE	IPE-CE-ADA -T1	# 1 Transformer	000000000010503781	Load Tap Changer (URT)	4.75	Shirish Patel	Awaiting Maint. Results	WESTINGHOUSE	URT	SS	RAR66902	Se
	CE	IPE-CE-SOS -T2	# 2 Transformer	000000000010503189	Load Tap Changer (URT)	4.6	Mark Stoughton	Awaiting Maint.	WESTINGHOUSE	URT	SS	6994649	Se
	CE	IPE-CE-ADA -T1	# 1 Transformer	000000000010503781	Load Tap Changer (URT)	4.3	Shirish Patel	Awaiting Maint. Results	WESTINGHOUSE	URT	TS	RAR66902	Se
	ME	IPE-ME-SNW -2TRH	132-2 Transformer	000000000010510413	LTC/Selector and Transfer 26 Kv	4.25	George	OK	WESTINGHOUSE	URT2	TS	6537553-26	Se
	CE	IPE-CE-SOS -T2	# 2 Transformer	000000000010503189	Load Tap Changer (URT)	4	Mark Stoughton	Awaiting Maint.	WESTINGHOUSE	URT	TS	6994649	Se
	CE	IPE-CE-BEN -T2	# 2 Transformer	000000000010503858	Load Tap Changer (URT)	4	Mark Stoughton	Awaiting Maint.	WESTINGHOUSE	URT	TS	RAR66905	Se
	CE	IPE-CE-GBK -T2	# 2 Transformer	000000000010504122	Load Tap Changer (TC 546)	4	NA		FEDERAL PACIFIC	TC546	LTC	502362	Se
	ME	IPE-ME-LAU -T1	# 1 Transformer	000000000010507675	Load Tap Changer-Main Tank	4	George Arthur	Awaiting Maint.	WESTINGHOUSE	UTT	LTC	UGP50682	Se
	ME	IPE-ME-SNW -2TRH	132-2 Transformer	000000000010510411	LTC/Selector and Transfer 13 Kv	4	Don Fallon	Pending Action	WESTINGHOUSE	URT2	TS	6537553-13	Se
	SO	IPE-SO-BEA -T1	# 1 Transformer	000000000010520910	Load Tap Changer	4	Geoge Arthur	Awaiting Maint.	FEDERAL PACIFIC	TC546	LTC	502222	Se
	SO	IPE-SO-LAW -T1	# 1 Transformer	000000000010522331	Load Tap Changer	4	NA		WESTINGHOUSE	UTTA	LTC	RBP39131	Se
	SO	IPE-SO-MAR -T4	# 4 Transformer	000000000010522900	Load Tap Changer	4	NA		GENERAL ELECTRIC	LRT65	LTC	F961854B	Se
	CE	IPE-CE-SBR -1TRH	220-2 Transformer	000000000010505100	Load Tap Changer 220-2 26Kv	3.5	Mark	Pending Action	MOLONEY	SRTMHD	TS	P670632	Se
	SO	IPE-SO-SLA -T1LTC	220-1 Transformer Tap Changer	000000000010526193	Load Tap Changer SEL 220-1	3.5	Angela Rothweiler	Awaiting Maint.	MOLONEY	SRTMHD	SS	P680443	Se
	CE	IPE-CE-GSE -1TRH	220-1 Transformer	000000000010501563	Load Tap Changer	3.25	Mark	Pending Action	WESTINGHOUSE	UTH	TS	7001753	Se
	SO	IPE-SO-LAW -T2	# 2 Transformer	000000000010522332	Load Tap Changer	3.25		No Action	FEDERAL PACIFIC	TC546	LTC	501092	Se
	SO	IPE-SO-MAR -T1	# 1 Transformer	000000000010522897	Load Tap Changer	3.25	NA	Awaiting Maint. Results	GENERAL ELECTRIC	LRT65	LTC	D596044	Se
	CE	IPE-CE-SPF -T1	# 1 Transformer	000000000010540523	Load Tap Changer (UTT-A)	3.25			WESTINGHOUSE	UTTA	LTC	UGP50673	Se
	CE	IPE-CE-SAL -4TRH	220-4 Transformer	000000000010502666	Load Tap Changer	3			PENNSYLVANIA	394	SS	C0407351	Se
	CE	IPE-CE-SBY -20TR	220-1 Transformer	000000000010502885	Load Tap Changer	3			GENERAL ELECTRIC	LR500	LTC	D572025	Se
	CE	IPE-CE-POH -T2	# 2 Transformer	000000000010504695	Load Tap Changer (UVT)	3	Don Fallon	2010 Replacment	WESTINGHOUSE	UVT	LTC	SLM54093	Se

CMMS Benefit Summary

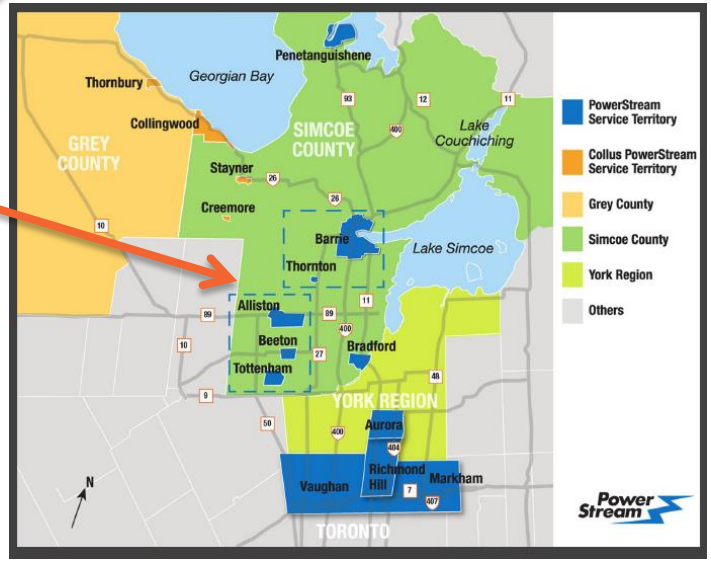
- More targeted capital expenditures with eventual overall reductions
- Incipient failures are reduced; corrective maintenance costs go down
- With a move to condition-based maintenance, calendar-based preventive maintenance is reduced
- Automation of condition-based notifications (emails, pages, maintenance notifications, etc.)
- Codification of organizational intelligence into condition-based algorithms
- Prioritization of maintenance, shorter downtimes, do the right work at the right time
- Improved visualization of asset health status
- Improved decision making capabilities

Leveraging PI System at PowerStream: Operations to Micro Grid

Where are They?



Powerstream Service Territory



Ontario
1,068,587 km2

Texas
696,200 km2

Powerstream Service Territory

- 806 km2
- 11 Municipalities
- Located just North of Toronto

PowerStream Fast Facts

- **2nd Largest Municipally owned Local Distribution Co. (LDC) in Ontario, Canada**
- **Serving 11 Communities through Central Ontario (Serving over 1 million residents)**
- **550 Employees**
- **343,000 Customers** : (Residential (89%) Commercial Ind. (11%))
- **Total Revenue:** **$788 Million**
- **Total Assets:** **$1,087.5 Million**
  - **Overhead Circuit Wires:** **2,500 km**
  - **Underground Cable:** **4,900 km**
  - **Transformer Stations (TS's):** **11**
  - **Municipal Substations (MS's):** **55**
  - **Distribution Transformers:** **43,000**
  - **Switchgears:** **1,800**
  - **Poles:** **40,000**
- **Peak Demand:** **1,972 MW**
- **Geographical Size of Service Territory:** **806 Sq. Km**
- **Distribution Voltages** **4kV, 8kV, 13.8kV, 27.6kV and 44kV**

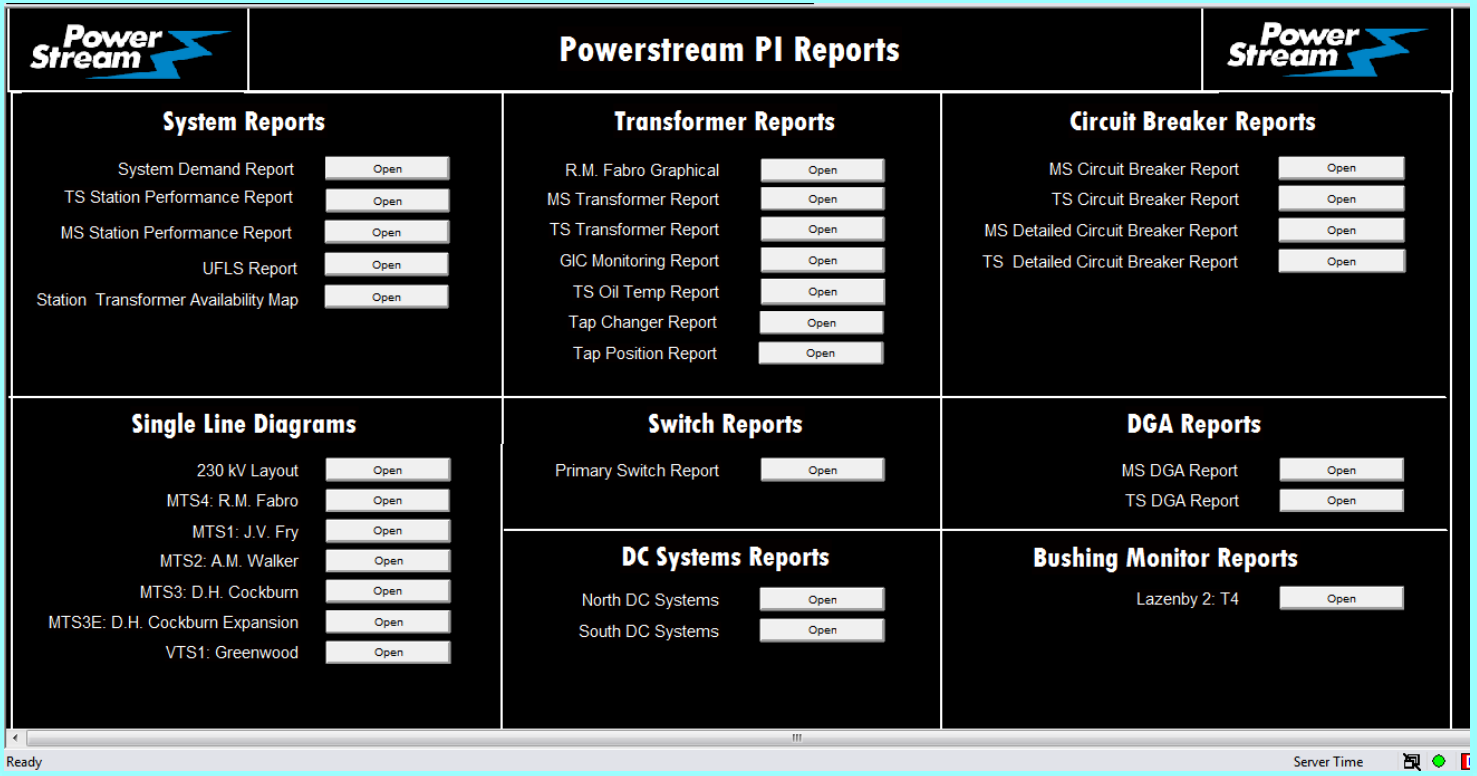
Background - PI System at Powerstream

- July 2012 Implementation – 5000 tags
- Purchased as part of Computerized Maintenance Management System (CMMS) implementation strategy
  - Migrate from Time Based Maintenance to Risk Based Condition Based Maintenance model
  - Integrate with CMMS to make SCADA data available
- Operational reports (PI ProcessBook, PI Coresight, PI DataLink, PI Web Parts)
- July 2013 Notifications
  - Equipment alarms, operations, peak load, oil temperatures, fire alarm, SF6 gas, building temp, battery /charger failure, etc

Leveraging PI System at Powerstream

- Asset Dashboard on Company Intranet
- Link to multiple databases/systems
  - SCADA, MicroGrid, CMMS
  - OMS (future), WMS/EAM (future), CIS (future)
- Expand Notifications / Alerting to stakeholders (email)
  - Offload low level SCADA alarms through PI System PI Notifications to field staff (awareness)
- Future - Mobile Dashboard (iPAD and SmartPhone)
- Future – Analytics

PI ProcessBook Reports Home Page



PI ProcessBook – TS Transformer Report

Equipment Attributes

Links:
- Weather report
- Radar Map Link

Pictures

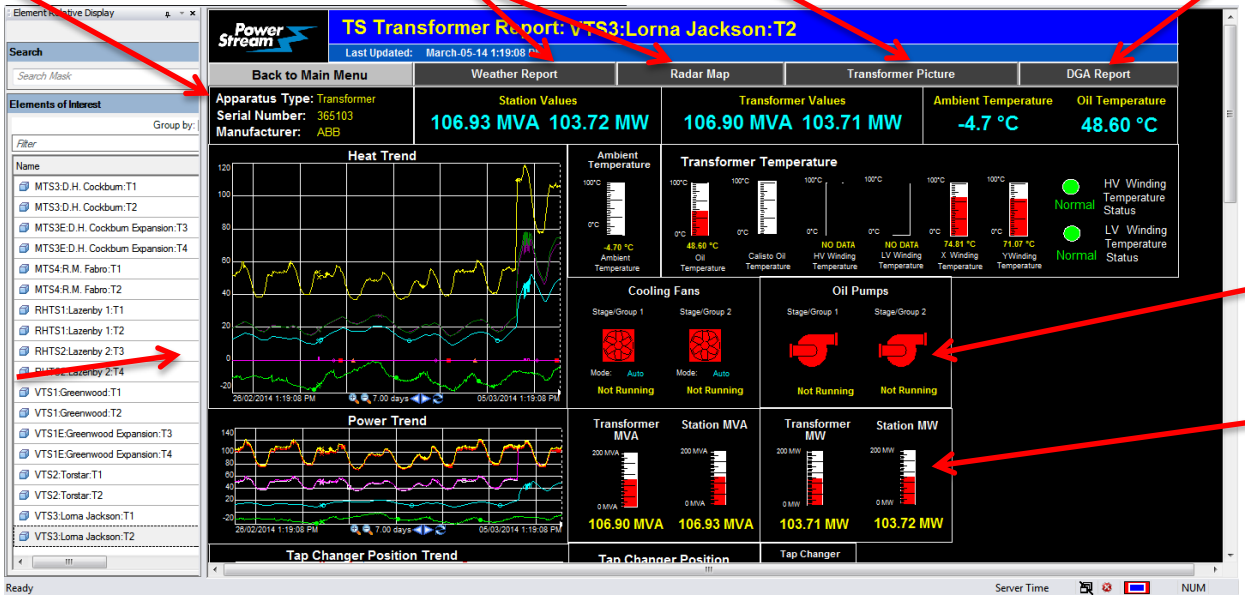
External Database/App

PI AF Elements

PI ProcessBook Trends

PI ProcessBook Symbol Animations

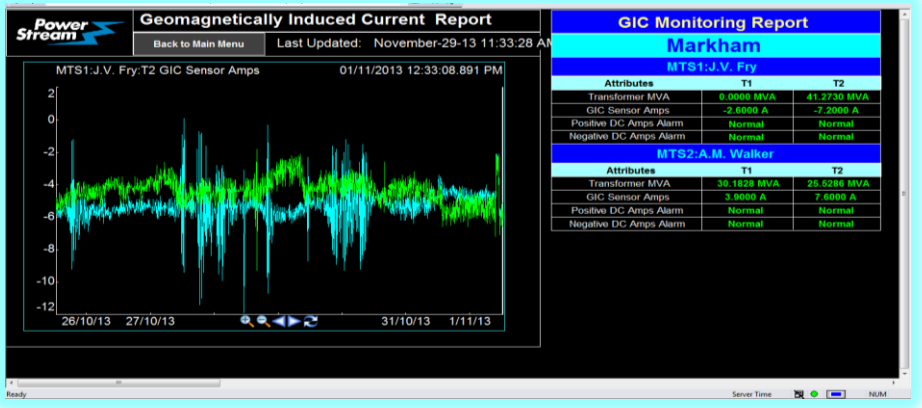
PI ProcessBook Gauges



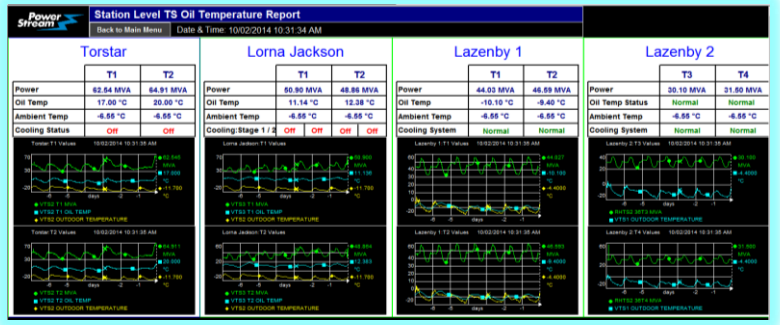
Template Report

PI ProcessBook Reports

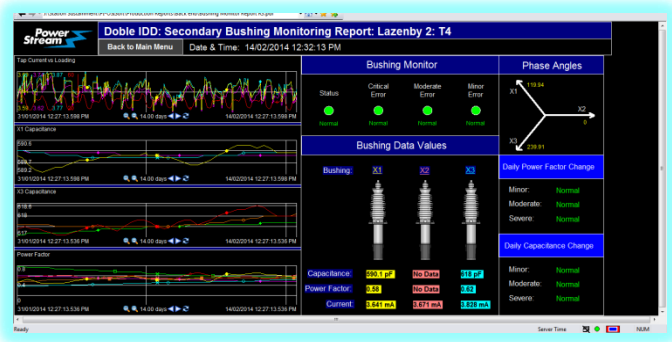
Geomagnetically Induced Current (GIC)



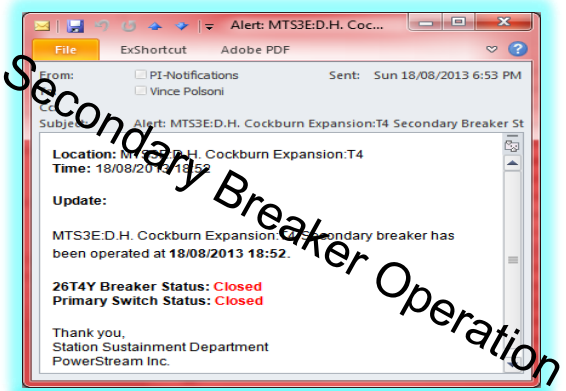
Transformer Oil Temperature

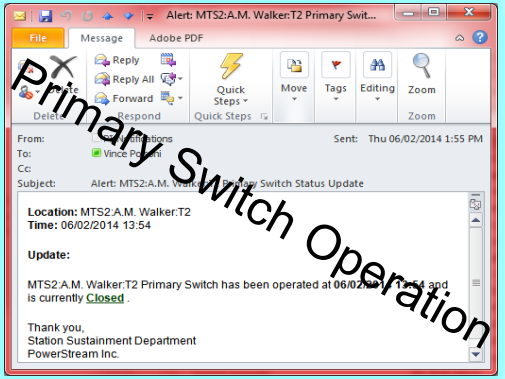


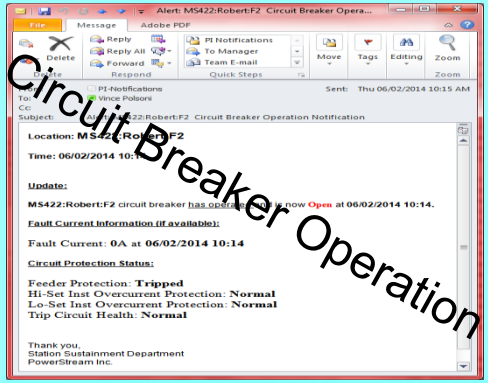
Transformer Secondary Bushing Monitoring

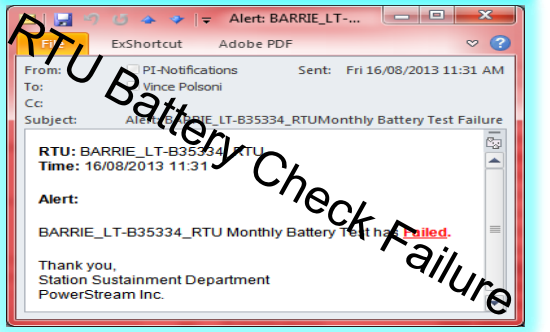


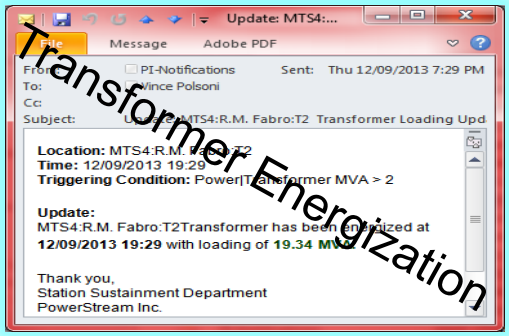
PI Notifications







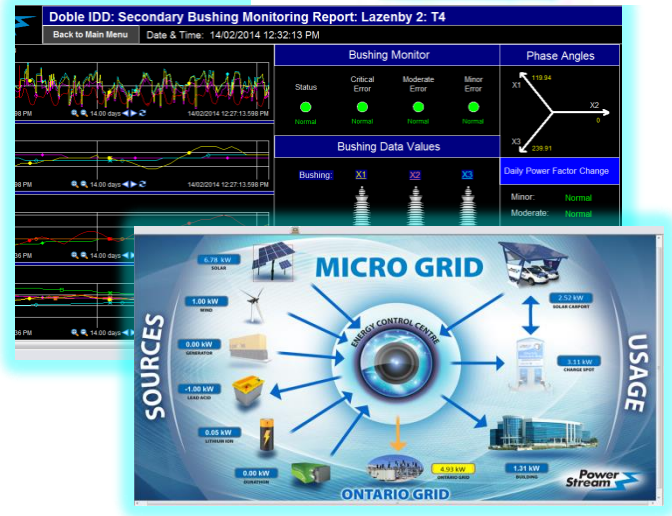




Summary

There is a constant pressure to do more with less; Improve reliability and availability. In order to achieve this, the same information needs to be made available in multiple systems.

Data turned into Information is the key to a successful transition of maintenance methodology.



Business Challenge

1. Provide and utilize Operational data outside of SCADA (Operations)
2. Present Micro Grid system architecture and data in an appealing, easy-to-understand format.

Solution

- SCADA to PI connectivity (Ops)
- Integrated PI System to CMMS (Ops)
- Micro Grid SCADA to PI for demonstration presentation

Results and Benefits

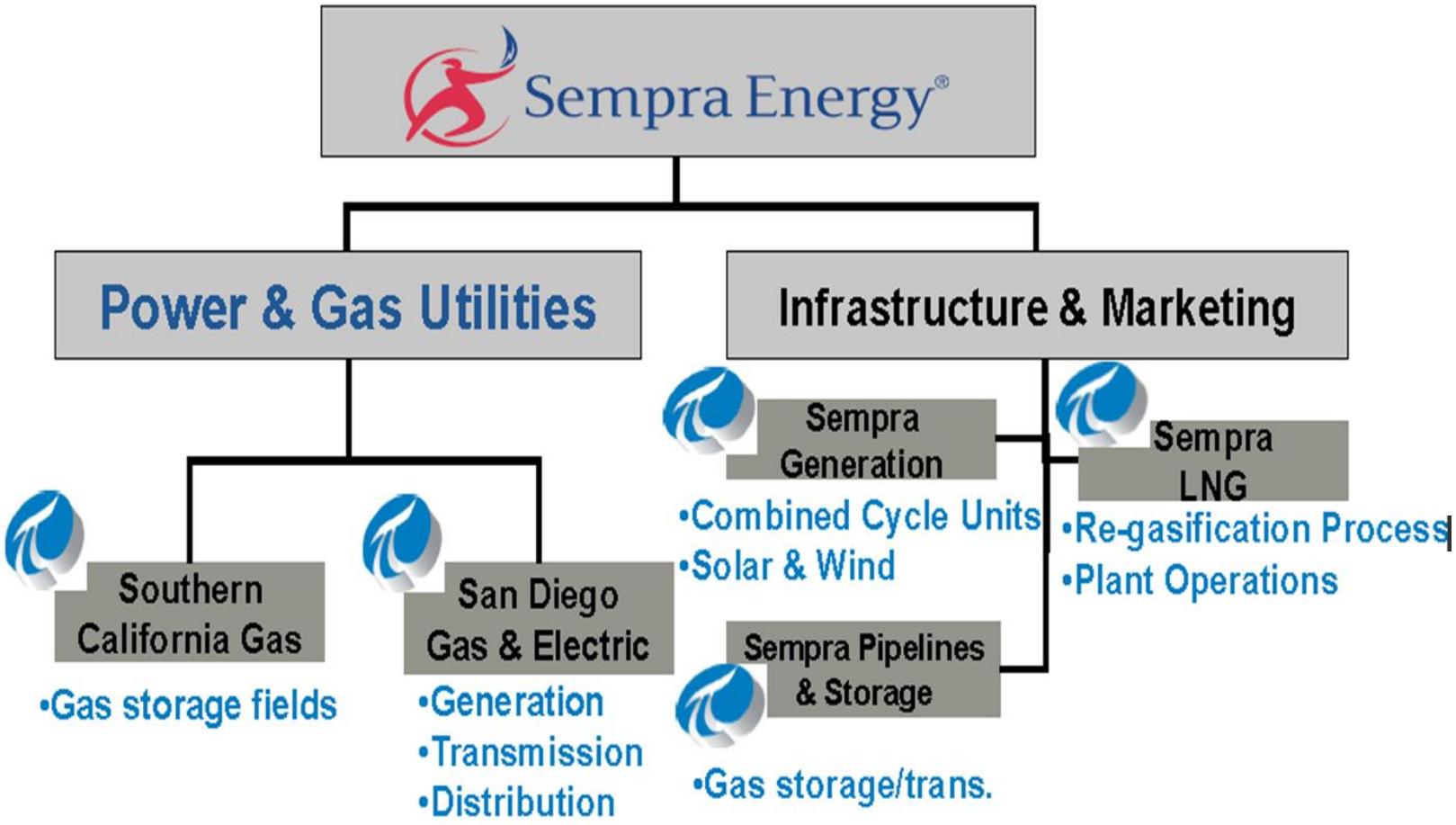
- Real-time information to those who need it (Ops)
- Increased equipment monitoring and alerting (Ops)
- Eye-pleasing and functional presentation of Micro Grid data

Lets hear it from the Customer

PI and SDG&E

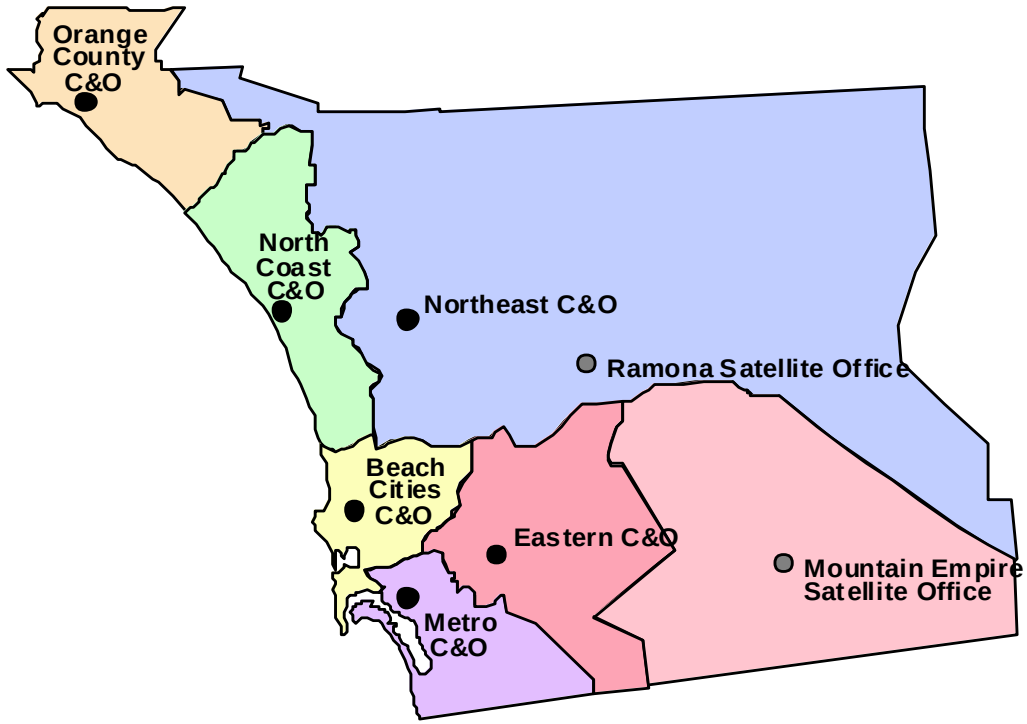
SDGE connected
A Sempra Energy utility

Sempra Energy – PI at a glance

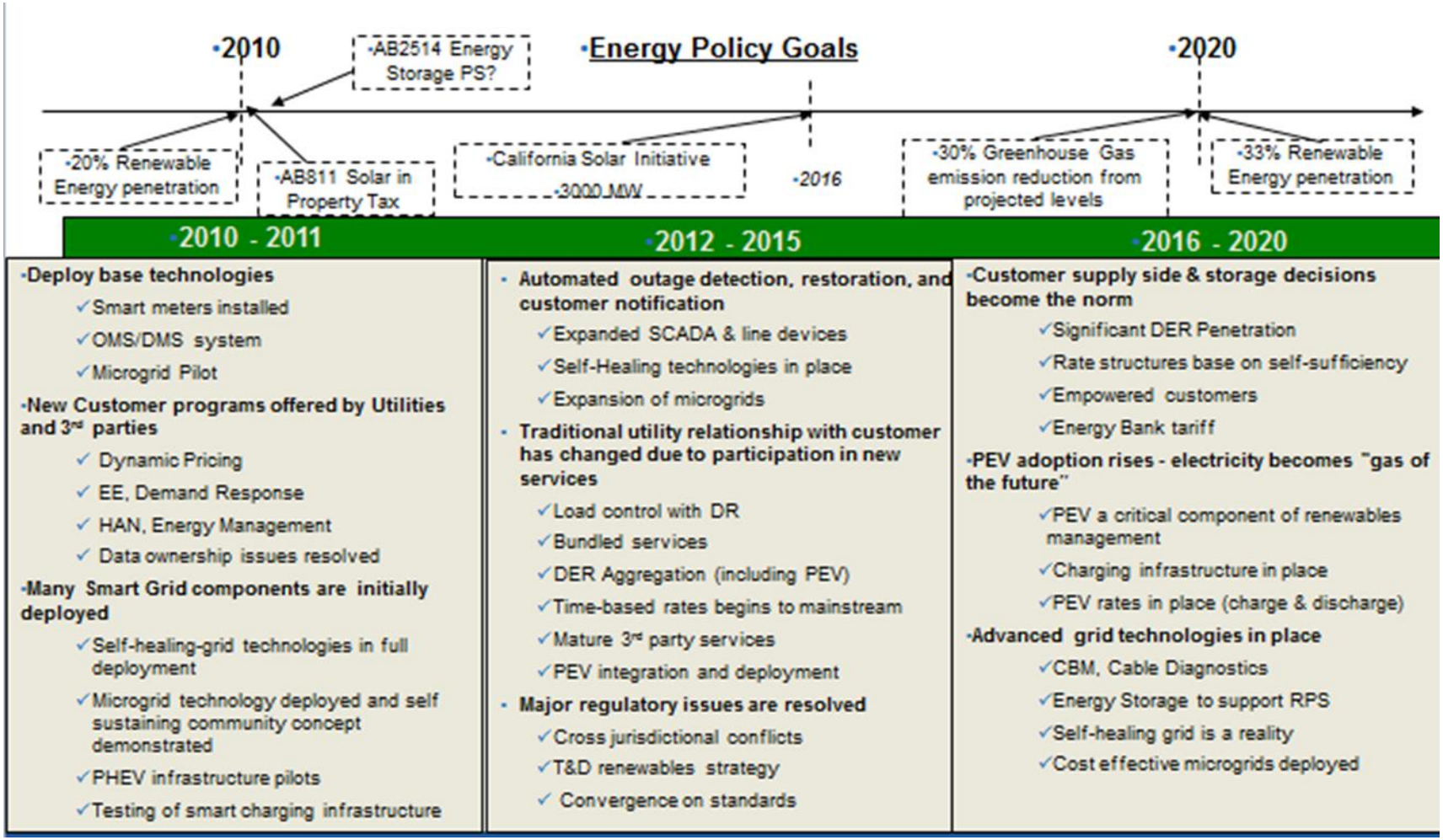


About SDG&E's Electric Distribution System

- Total of 175 Substations
- 1113 Distribution Circuits
- 9,954 Miles of UG Dist. Circuits
- 6,702 miles of OH Dist. Circuits
- 1,562 Field Sites on SCADA
- 81 Dist. Substations on SCADA



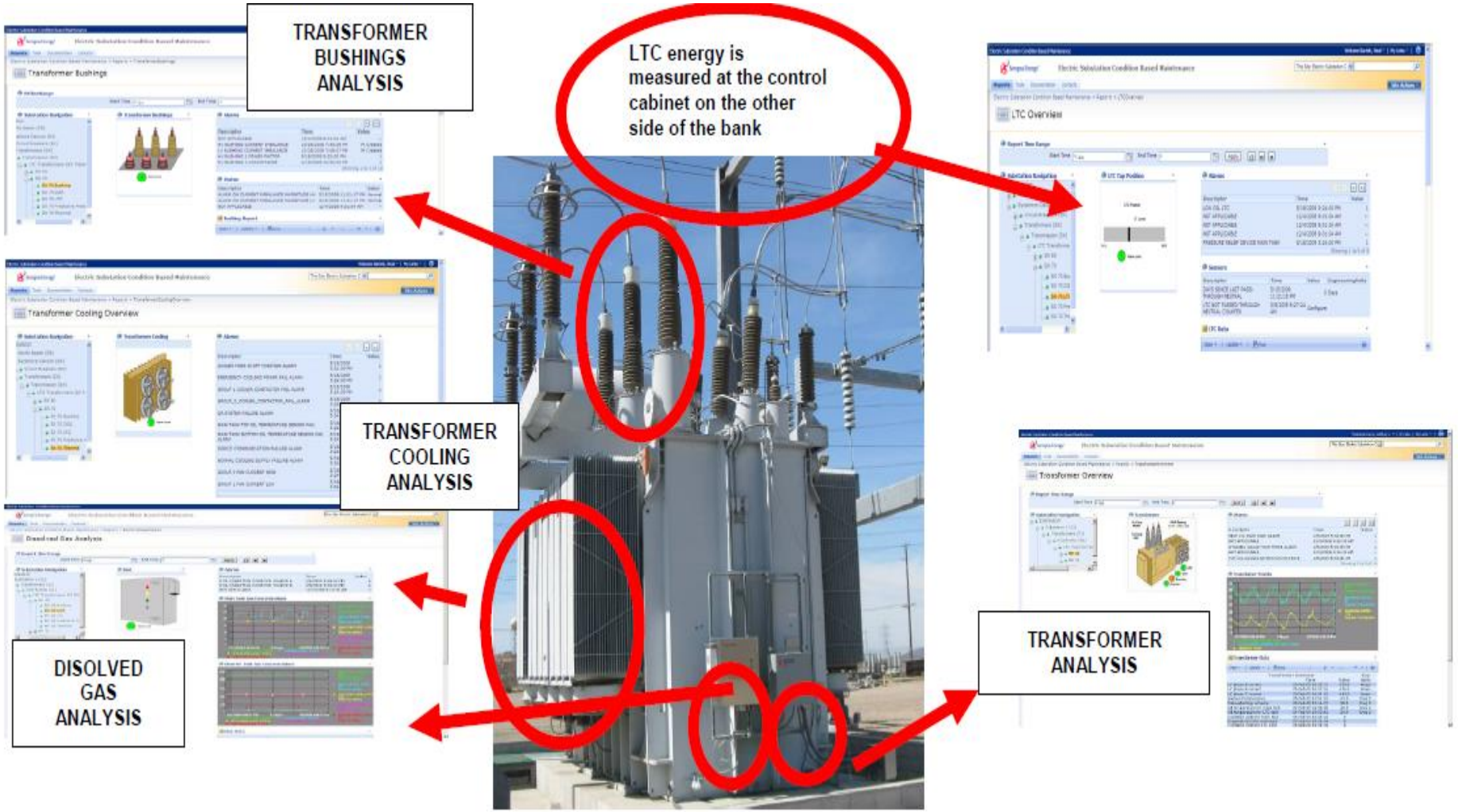
SDG&E – Smart Grid Road Map



SDG&E – PI System footprint

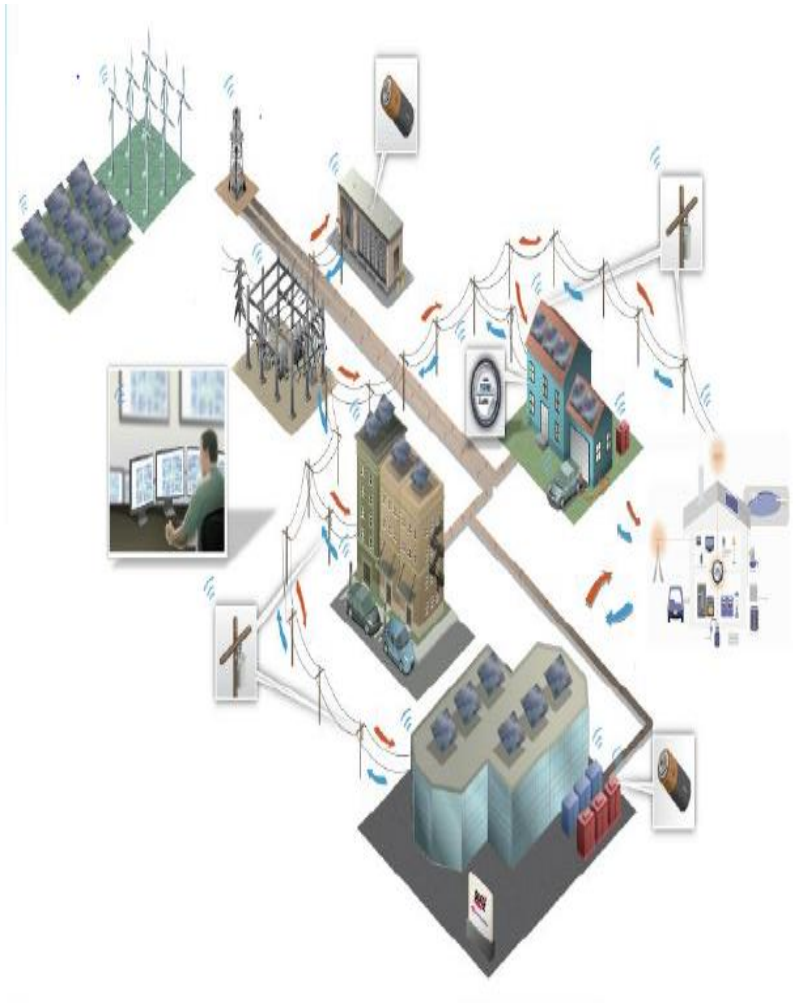
- Phase 1 – T&D Operational Data (- 260k tags)
  - Ability to integrate T&D data; 2003 fire storm & activated in EOC, monitor EMS IT assets, T&D planning, Engineering, Operations, Distribution Ops, Substations
- Phase 2 – Generation (- 30k tags)
  - Palomar, Miramar, Desert Star; Ability to monitor assets 24x7, operational efficiency, maintenance
- Phase 3 – CBM non-Operational data (- 150k tags)
  - Monitor T&D substation assets, reduce operational maintenance cost, Event based notification, Dissolved gas analysis, LTC & Bushing monitoring
- Phase 4 – Enterprise Agreement (Unlimited tags, EA Service)
  - MicroGrid, Synchrophasors, PV intgration, Cell relay monitoring, Gas meter events, meter data (non billing), EV, etc, Electric T&D and asset management

SDG&E – Smart Grid Pieces



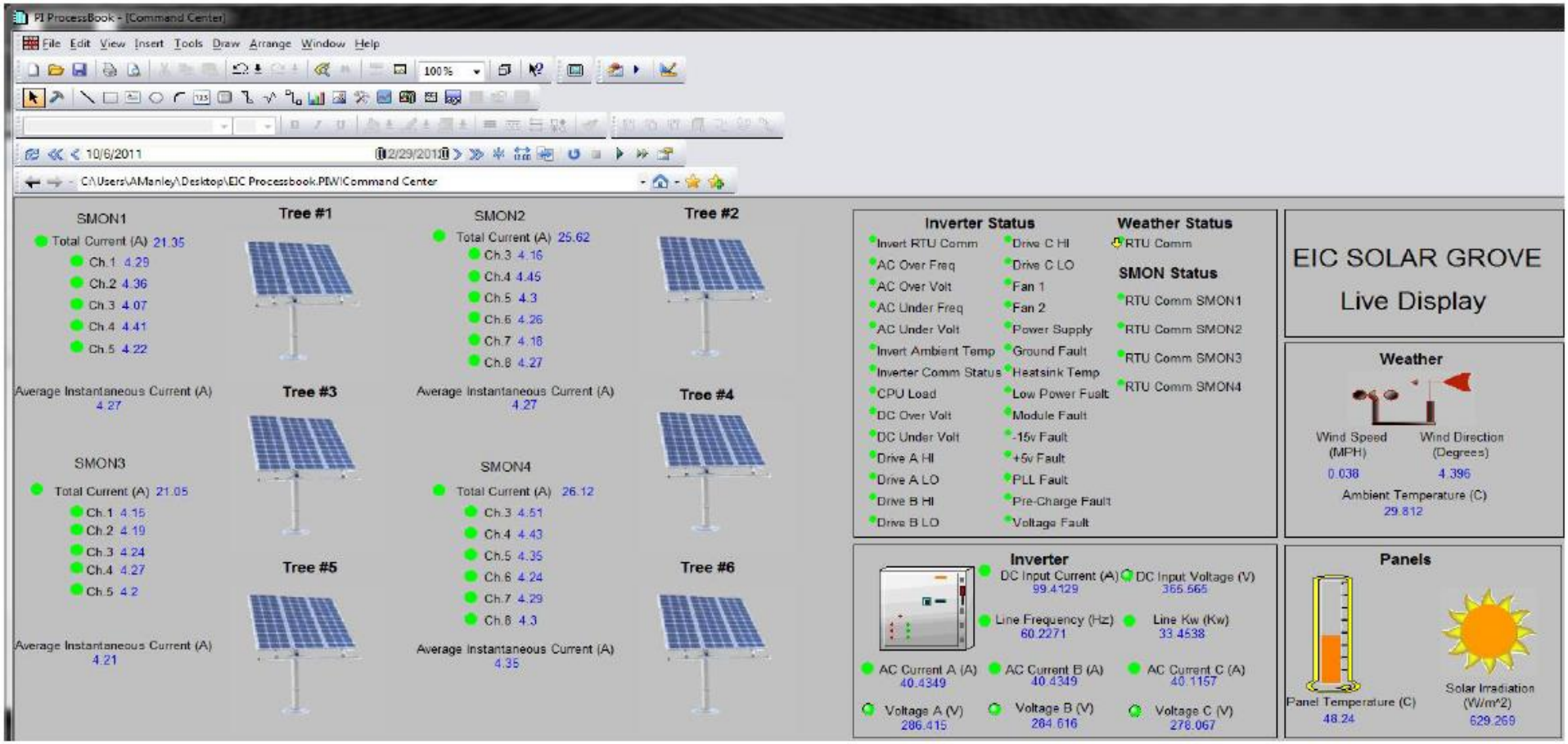
SDG&E – Smart Grid Pieces

- Borrego Springs Microgrid
  - Integrate and leverage various generation and storage configuration
  - Reduce the peak load feeders and enhance system reliability
  - Enable customers to become more active participants in managing their energy storage



SDG&E – Smart Grid Pieces

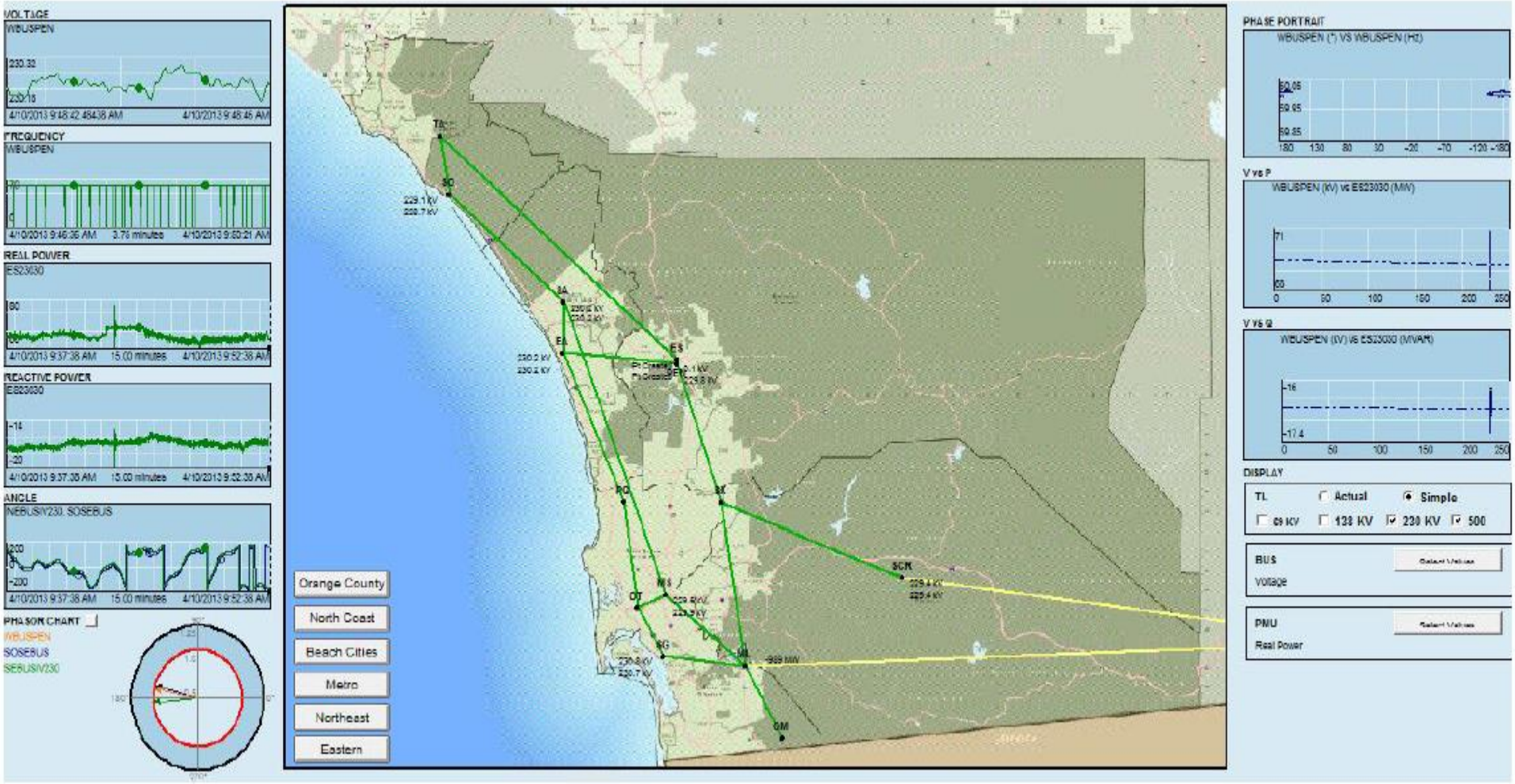
- Renewable integration



SDG&E – Smart Grid Pieces

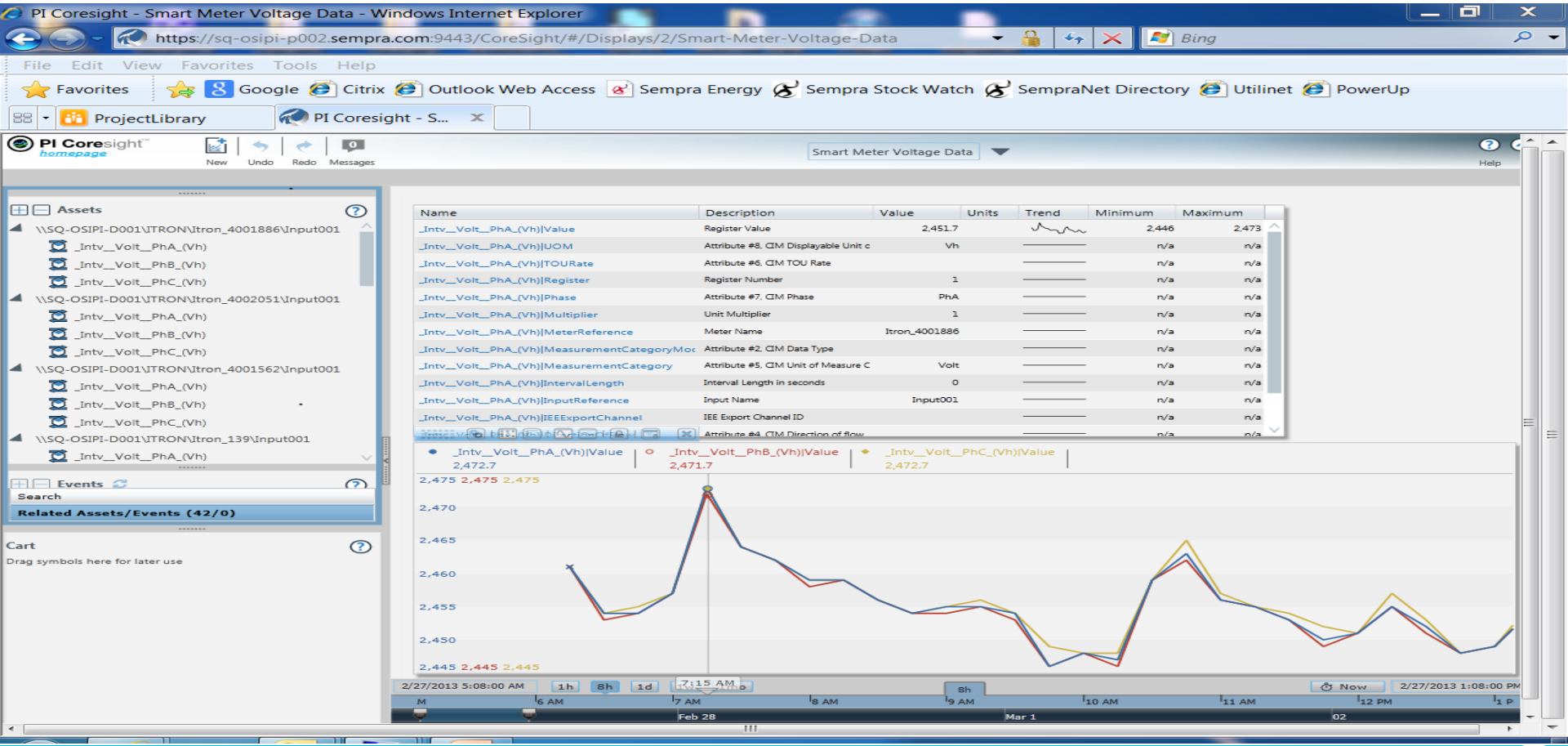
- Synchrophasors
  - The Synchrophasors provide near real-time synchronized state of the power system and disturbance data that can be analyzed to improve generator, transmission, and load modeling and to understand abnormal power system behavior in the power grid.
  - Synchrophasors system will provide the system operators and engineers the power system situational awareness and visualization tools. Wide Area Situational Awareness (WASA) and visualization will enable the operator to:
    - Monitor System Stress (Phase Angle Separation)
    - Monitor Critical Voltage support
    - Monitor Frequency and rate of change of frequency
    - Monitor Critical tie-line loadings and generation
    - Oscillation detection

SDG&E – Smart Grid Pieces



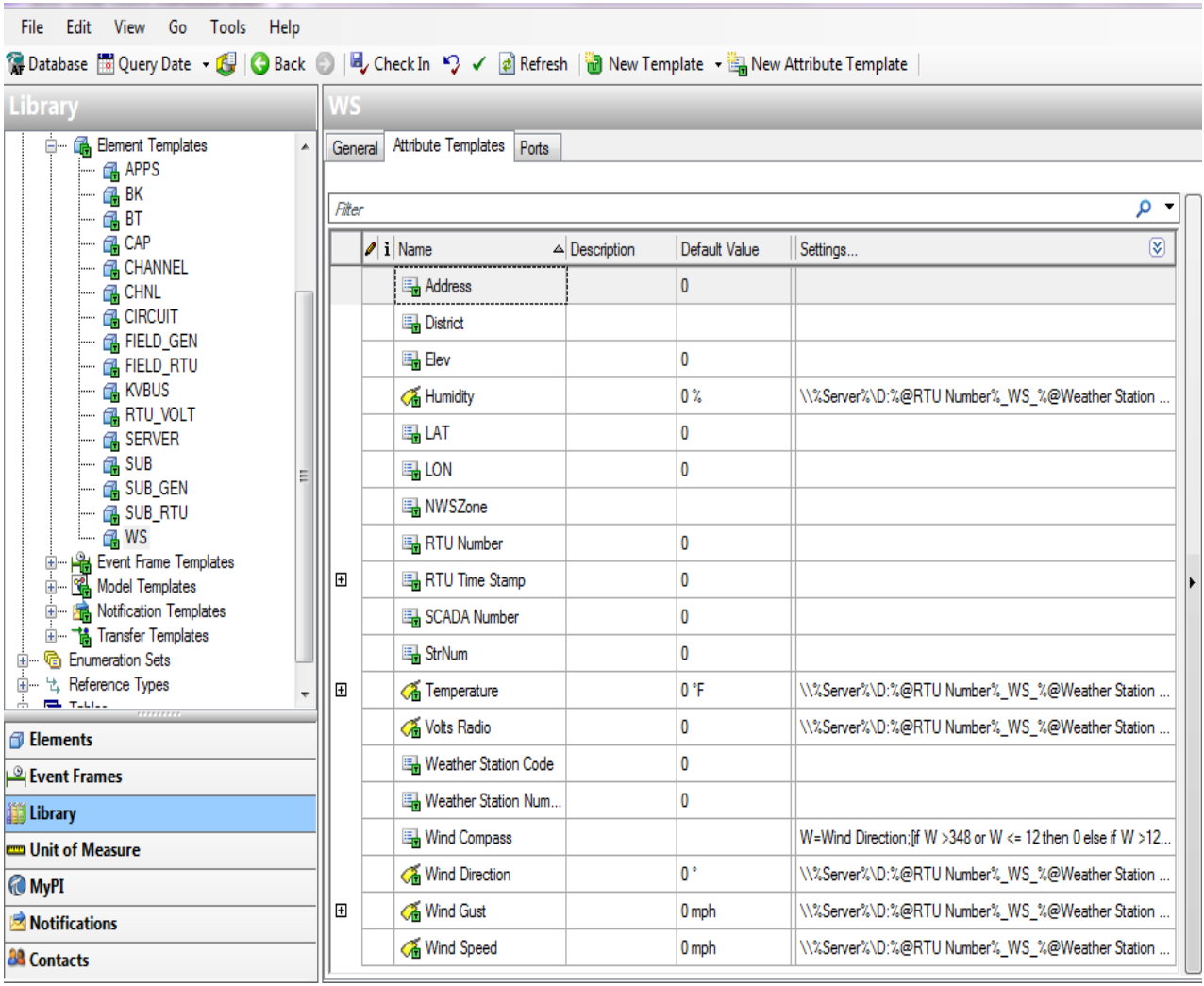
SDG&E – Smart Grid Pieces

- Non Billing Smart meter Data Analytics



Why PI AF and Element Templates

- We have data in PI System, Oracle, SQL, etc. databases
- Use PI AF as a single point of contact for getting data
- Template is the key element in PI AF.
- We use templates to create elements for PI Clients and PI Notifications.

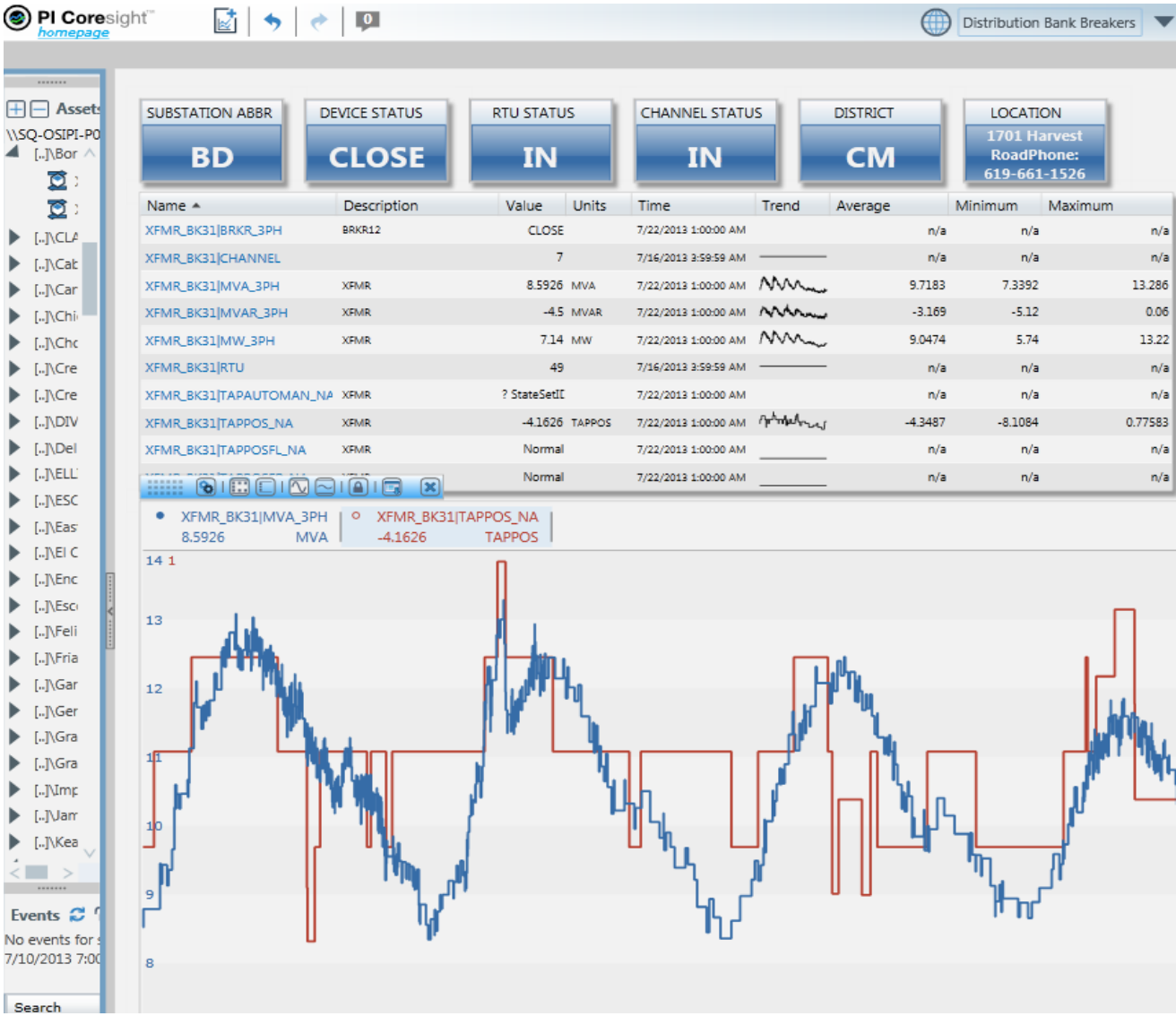


Distribution Circuit Breaker Monitoring

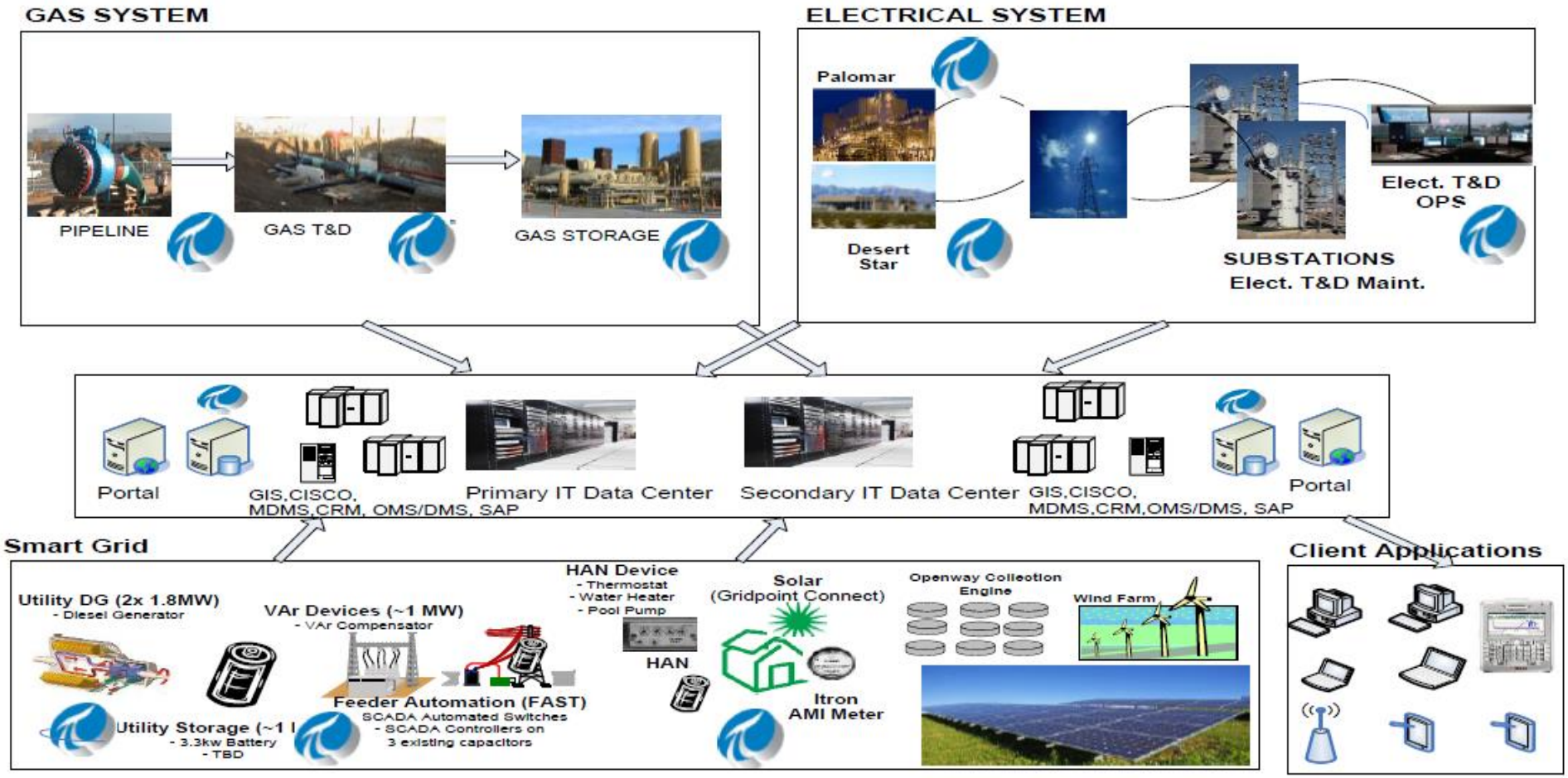
- Using PI ProcessBook to create a display similar to SCADA system
- PI AF and PI ProcessBook allow operators to select and monitor any circuit from the list, without remembering display number.

PI AF & PI Coresight for Sub bank Breakers

- PI AF and PI Coresight also allow us to monitor bank breakers from web browser or smart phones.
- Users just click the substation name on the left, then information will be displayed on the main window.



SDG&E – Smart Grid Data Infrastructures

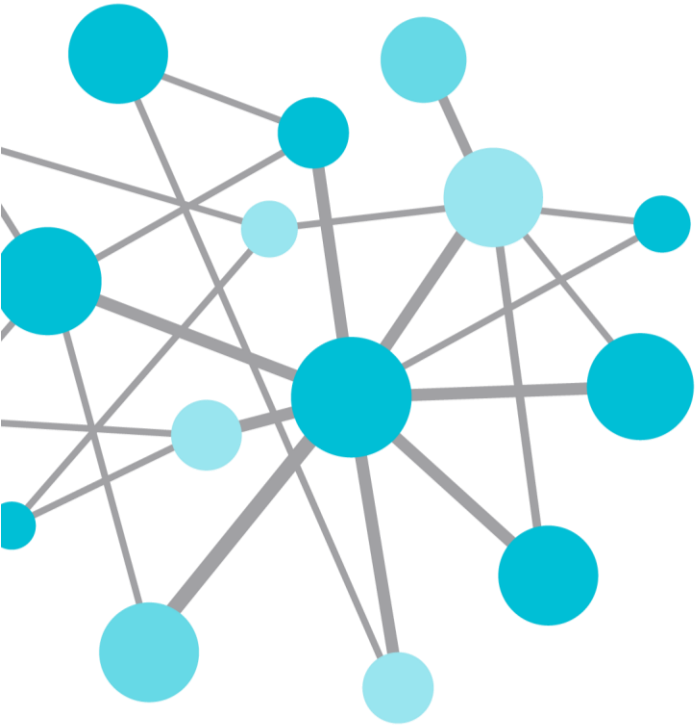


Kevin P Walsh

kwalsh@osisoft.com

Industry Principal

OSIsoft, LLC



THANK YOU

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