SDGE connected
A Sempra Energy utility

Enterprise Approach to OSIsoft PI System

Presented by **Subbu Sankaran**

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Agenda

- San Diego Gas & Electric®(SDG&E®) Overview
- OSIsoft PI System at SDG&E
- Smart Grid Projects
- Current State
- SDG&E Enterprise Strategy
- Key Reasons For Adopting Enterprise Approach
- Summary of EA Benefits

San Diego Gas & Electric

- Subsidiary of Sempra Energy
- Regulated public utility
- Provide safe and reliable energy service to 3.4 million consumers
  - 1.4 million electric meters
  - 800,000 natural gas meters
- 4,100 square mile service territory in San Diego and southern Orange Counties (25 cities)

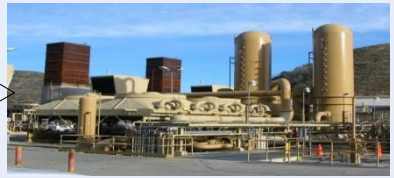
- 1,800 miles of electric transmission lines and 21,600 miles of electric distribution lines
- Two compressor stations, 160 miles of natural gas transmission pipelines, 8,100 miles of distribution pipelines and 6,200 miles of service lines
- 4,500 employees

San Diego Gas & Electric

GAS SYSTEM

PIPELINE

GAS T&D



GAS STORAGE

ELECTRICAL SYSTEM

GENERATION

SUBSTATIONS

T&D OPERATIONS

T & D CBM

IT Data Center

OSIsoft PI Systems at SDG&E

GAS SYSTEM

PIPELINE

GAS T&D

GAS STORAGE

ELECTRICAL SYSTEM

GENERATION

CBM

SUBSTATIONS

Transmission & Distribution

T&D OPERATIONS

T & D CBM

IT Data Center

OSIsoft PI Systems at SDG&E

2003 - T&D Operational Data (~ 260,000 tags)

Ability to integrate Transmission and Distribution data

2003 fire storm & activated in EOC, monitor EMS IT assets,T&D Planning, Engineering, Grid Operations, Distribution Operations, Substation

2005 - Generation (~ 30,000 tags)

Palomar, Miramar, Desert Star

Ability to monitor assets 24x7, operational efficiency, maintenance

2007 – CBM non-Operational Data (~ 150,000 Tags)

Monitor T&D substation assets, Reduce operational maintenance costs

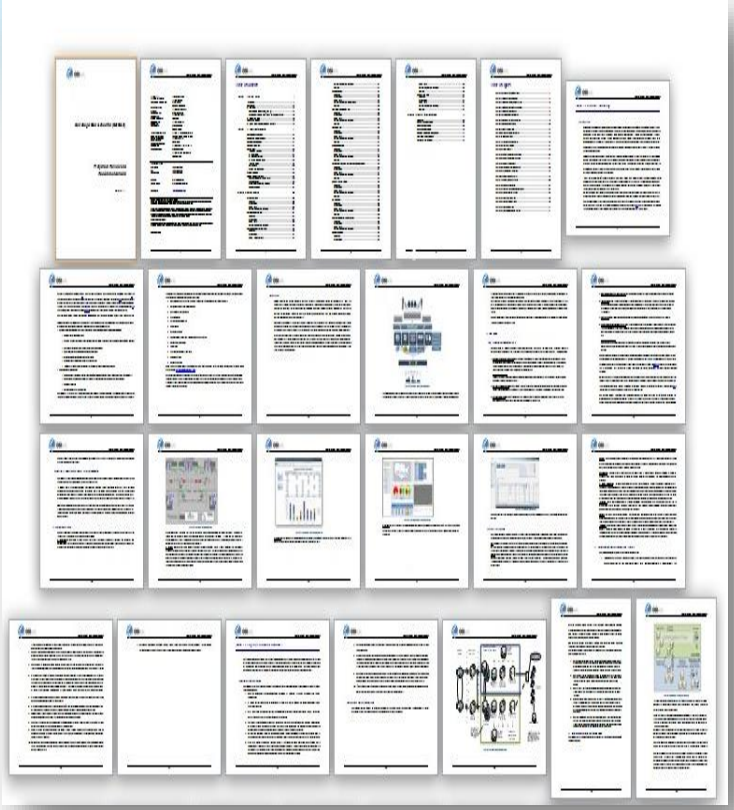
Event based notification, Dissolved gas analysis, LTC & Bushing monitoring

2011 – Enterprise Agreement (unlimited tags, EA Services)

Microgrid, Synchrophasors, PV integration, LPCN (On-Ramp) Interface, Cell Relay Monitoring, Gas Meter Events, Meter data (non-billing), EV's, Electric T&D, Asset Management, etc.

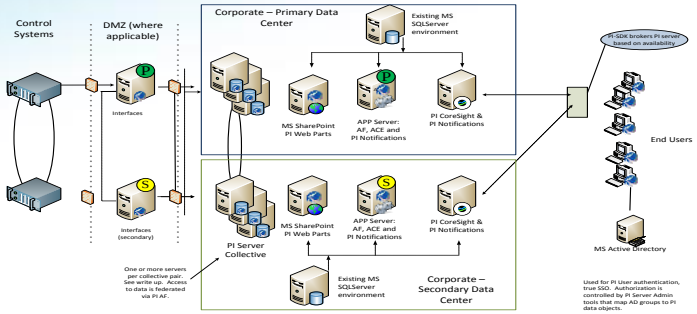
Smart Grid Projects Discovery Workshops

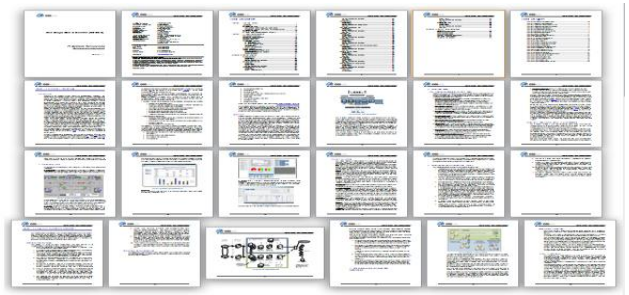
- Condition Based Mainteance (CBM)
- Borrego Springs Microgrid
- Synchrophasors
- Low Power Communication Network(OnRamp Wireless)
- Sustainable Communities and Substation PV
- Smart Meter Data Collection (Voltage Montioring)
- Weather Data Analysis
- Gas Meter Events Processing
- Advanced Energy Storage (AES)
- Dynamic Voltage Support
- EV Detection
- Dynamic Line Rating
- Distribution Phase Imbalance



PI System Review & Recommendations

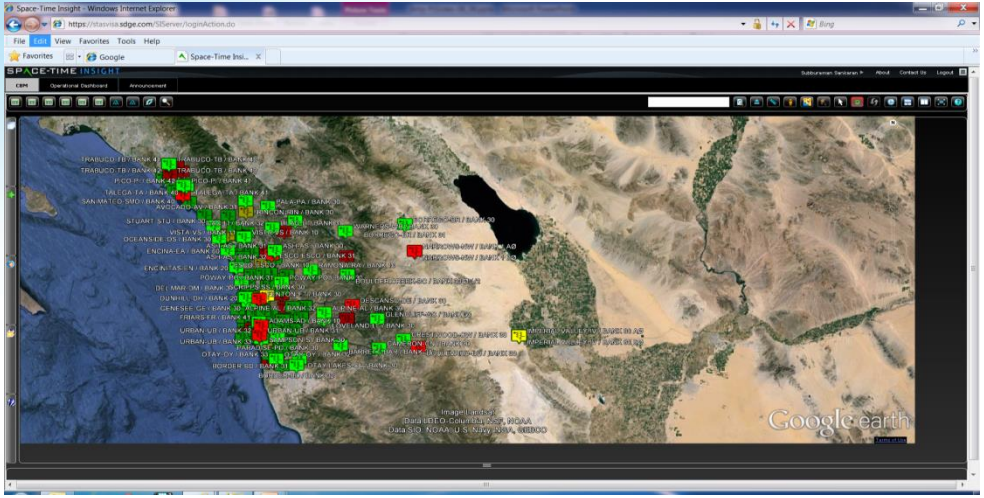
- Based on discovery workshops
- Summary of existing implementation & upcoming projects
- Provided basis for next generation, centralized architecture
- Provided insight into deployment options
- Provided guidance on internal CoE
- Recommendations on PI System use cases

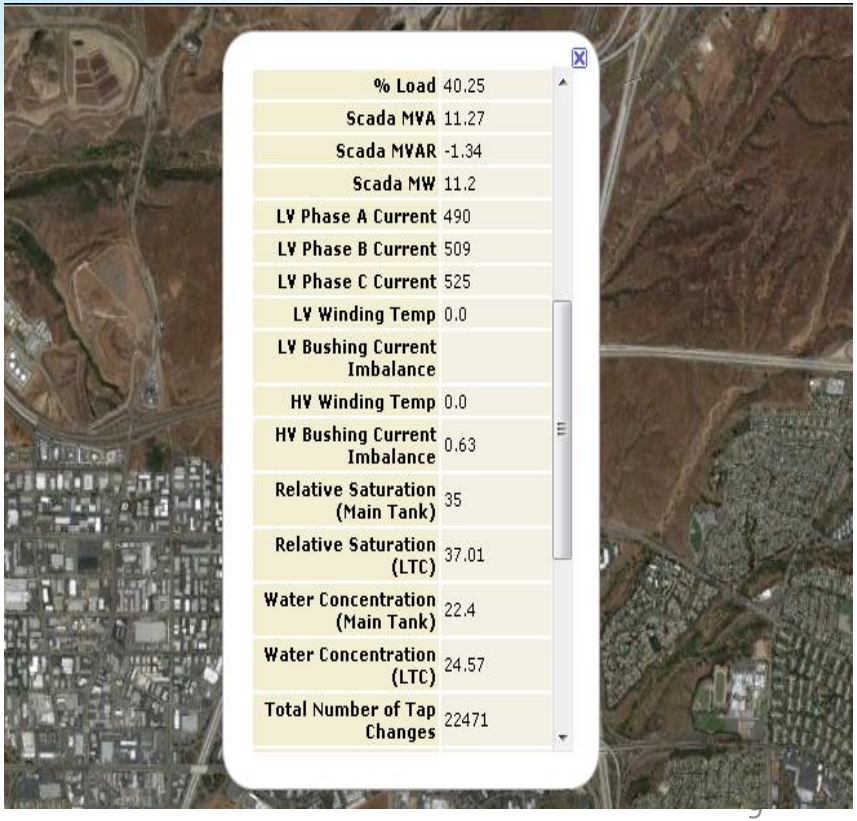




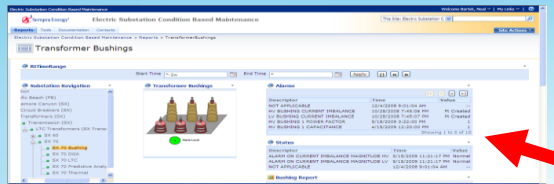
Condition Based Maintenance

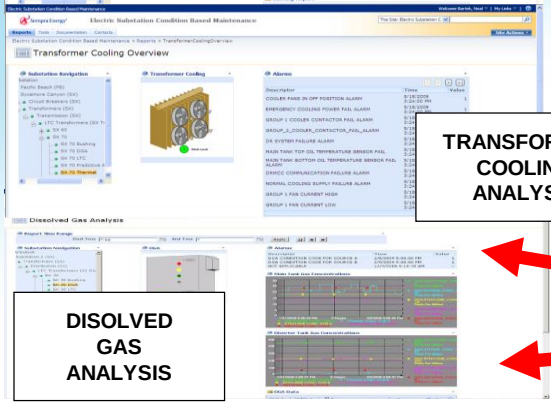
- Extend the useful life and make greater utilization of transmission and distribution substation assets
- Use technology to measure the perfomance and condition of equipment to make better maintenance decisions





Condition Based Maintenance

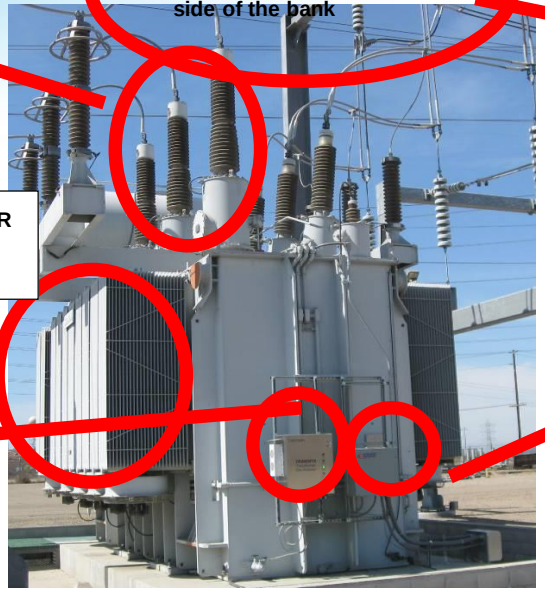


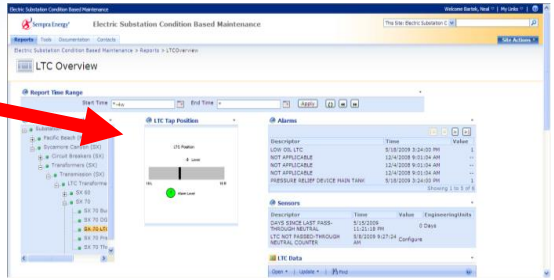


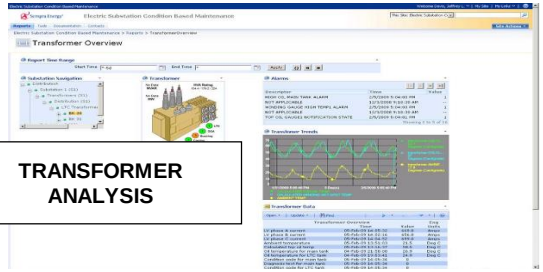
DISOLVED GAS ANALYSIS

TRANSFORMER COOLING ANALYSIS

LTC energy is measured at the control cabinet on the other side of the bank

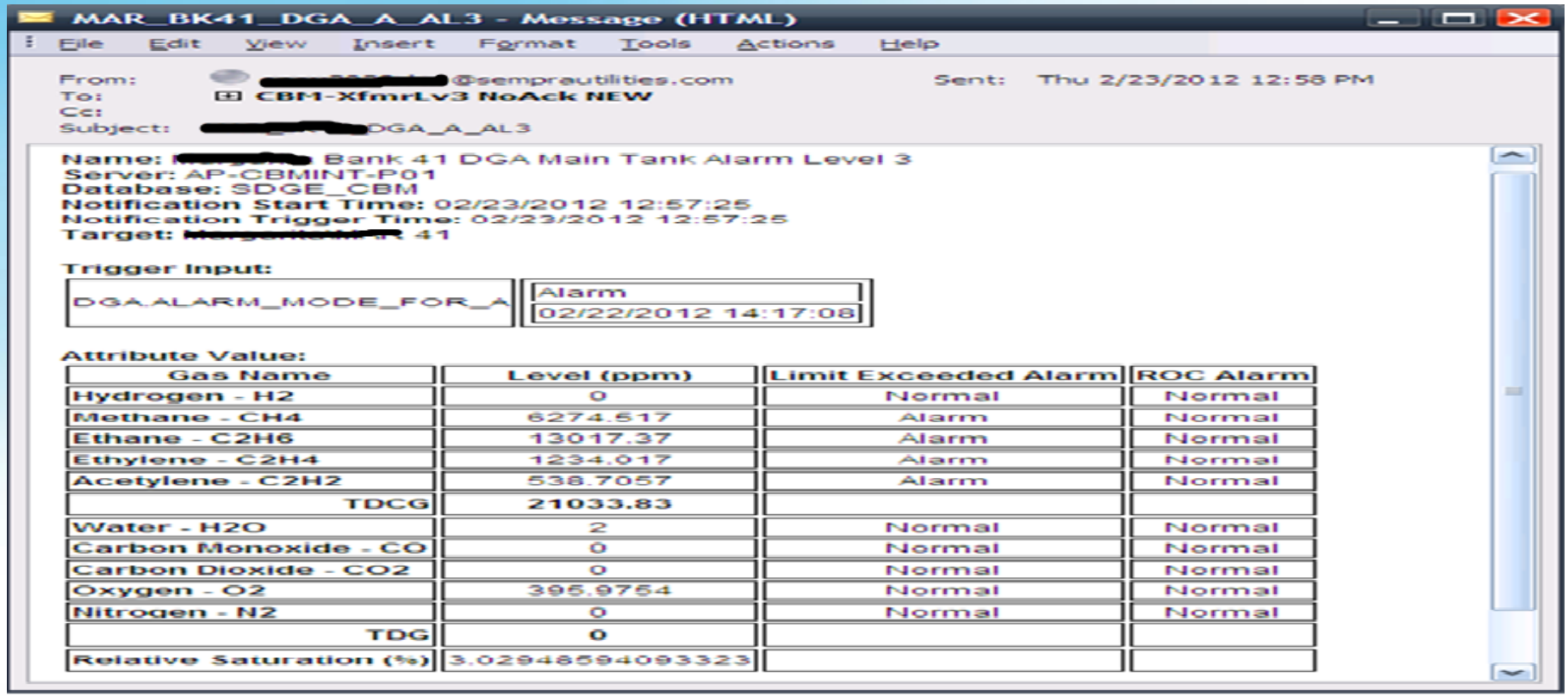






TRANSFORMER ANALYSIS

PI Notifications for CBM



MAR_BK41_DGA_A_AL3 - Message (HTML)

File Edit View Insert Format Tools Actions Help

From: [redacted]@semprautilities.com
To: CBM-XfmrLv3 NoAck NEW
Cc:
Subject: [redacted]DGA_A_AL3

Sent: Thu 2/23/2012 12:58 PM

Name: [redacted] Bank 41 DGA Main Tank Alarm Level 3
Server: AP-CBMINT-P01
Database: SDGE_CBM
Notification Start Time: 02/23/2012 12:57:25
Notification Trigger Time: 02/23/2012 12:57:25
Target: [redacted] 41

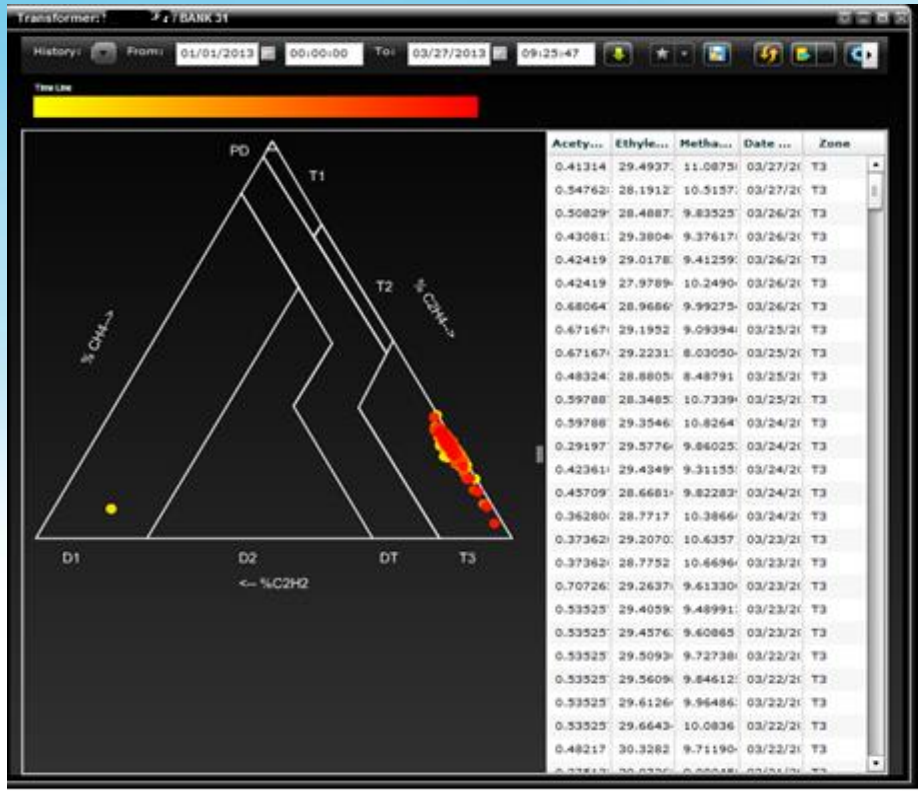
Trigger Input:

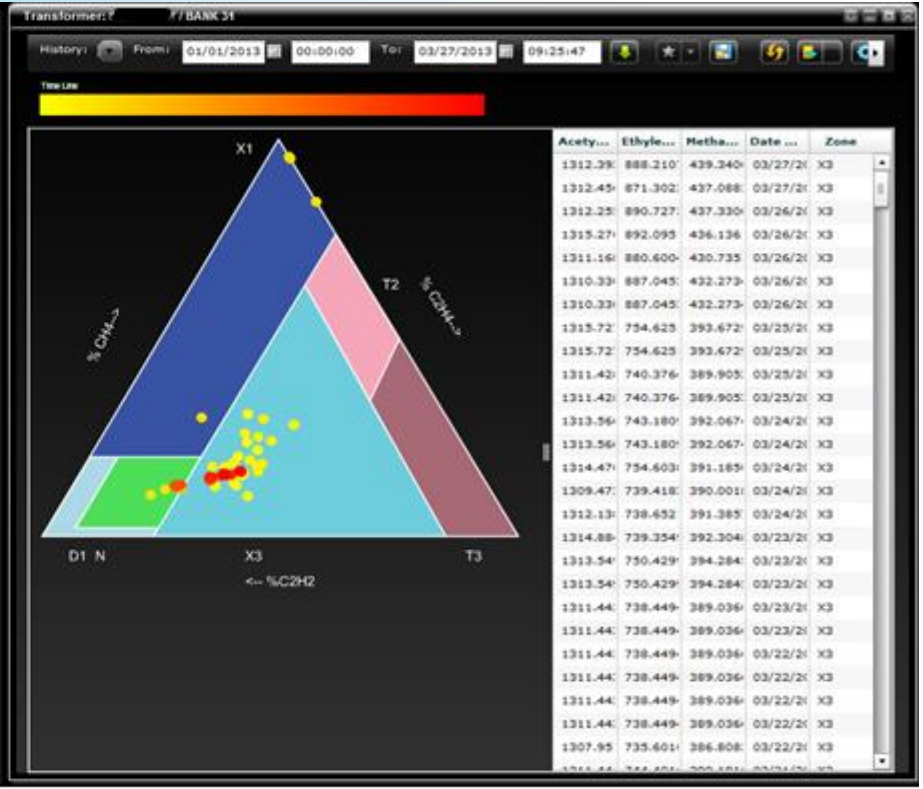
DGA.ALARM_MODE_FOR_A	Alarm
	02/22/2012 14:17:08

Attribute Value:

Gas Name	Level (ppm)	Limit Exceeded Alarm	ROC Alarm
Hydrogen - H2	0	Normal	Normal
Methane - CH4	6274.517	Alarm	Normal
Ethane - C2H6	13017.37	Alarm	Normal
Ethylene - C2H4	1234.017	Alarm	Normal
Acetylene - C2H2	538.7057	Alarm	Normal
TDCG	21033.83		
Water - H2O	2	Normal	Normal
Carbon Monoxide - CO	0	Normal	Normal
Carbon Dioxide - CO2	0	Normal	Normal
Oxygen - O2	395.9754	Normal	Normal
Nitrogen - N2	0	Normal	Normal
TDG	0		
Relative Saturation (%)	3.029485940933323		

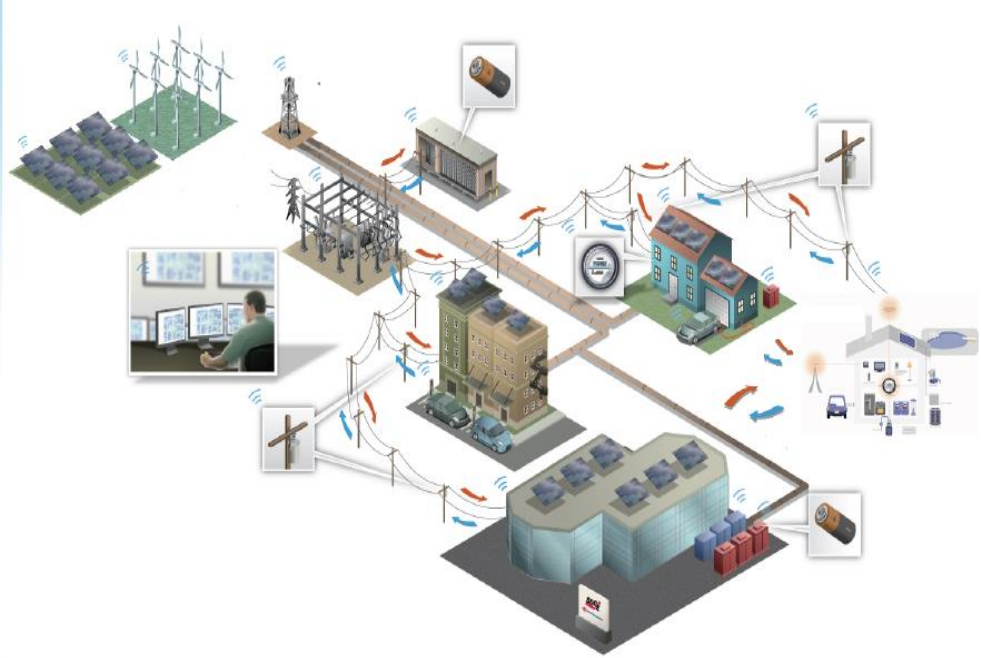
Condition Based Maintenance





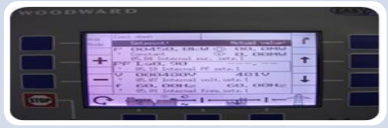
Borrego Springs Microgrid

- Integrate and leverage various generation and storage configurations.
- Reduce the peak load feeders and enhance system reliability.
- Enable customers to become more active participants in managing their energy usage.

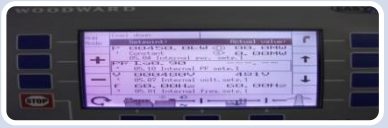


Borrego Springs Microgrid

- Each DER vendor provides its own control software
- No Automated controls or approval processes
- No Coordination with DMS
- No market participation
- No Optimization over multiple resource landscape

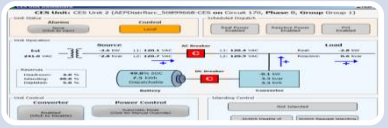


Woodward controls for generator 1



Woodward controls for generator 2

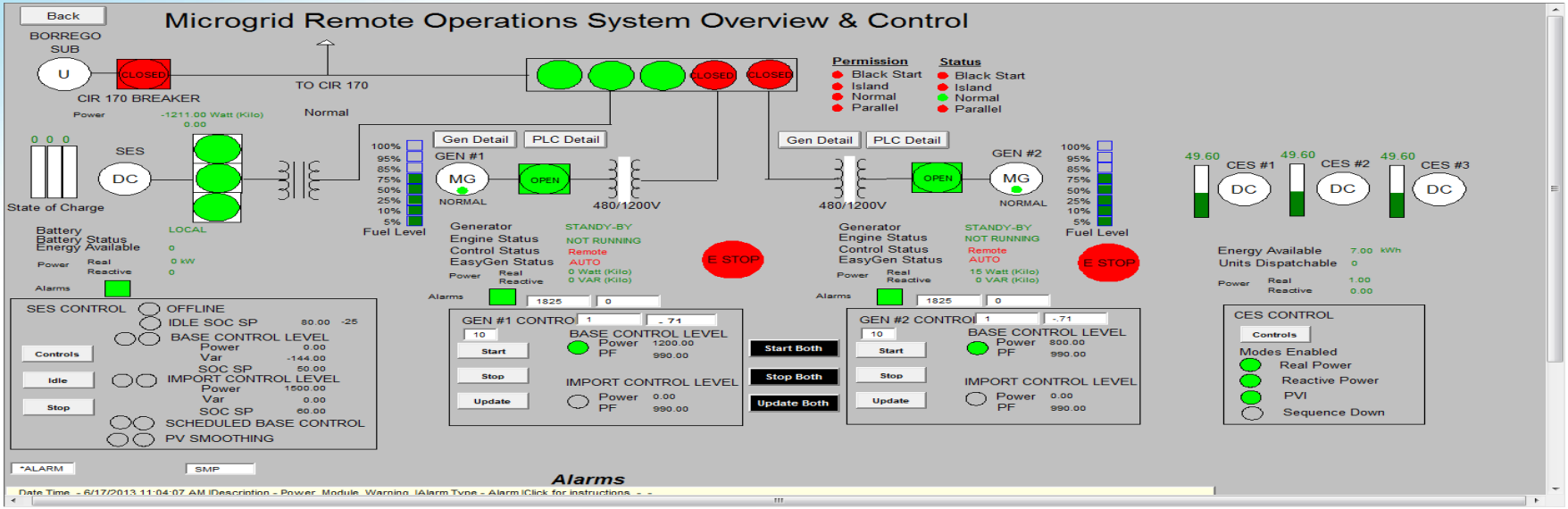
Saft SES unit



S&C CES units

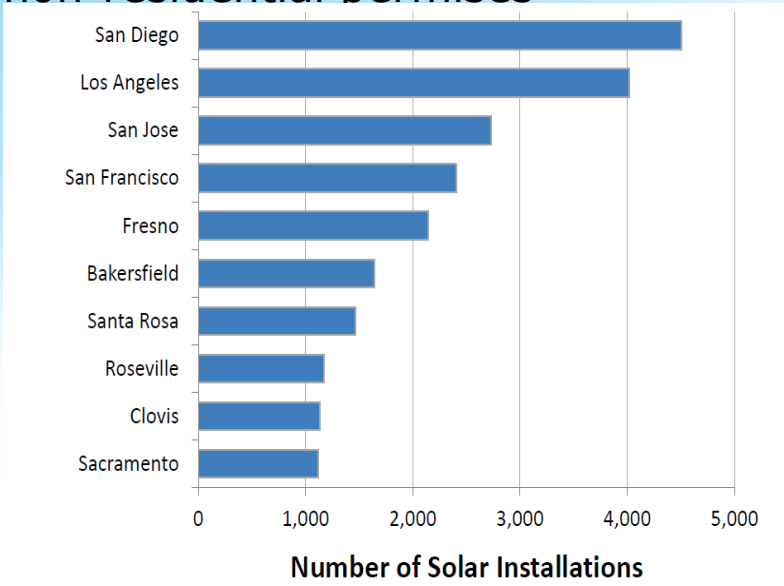
Borrego Springs Microgrid

- Centralized monitoring & control of multiple DER
- Integrates data from multiple sources (SCADA and various DER)
- Standardized controls across DER vendors
- PI Notifications used to monitor status of DER



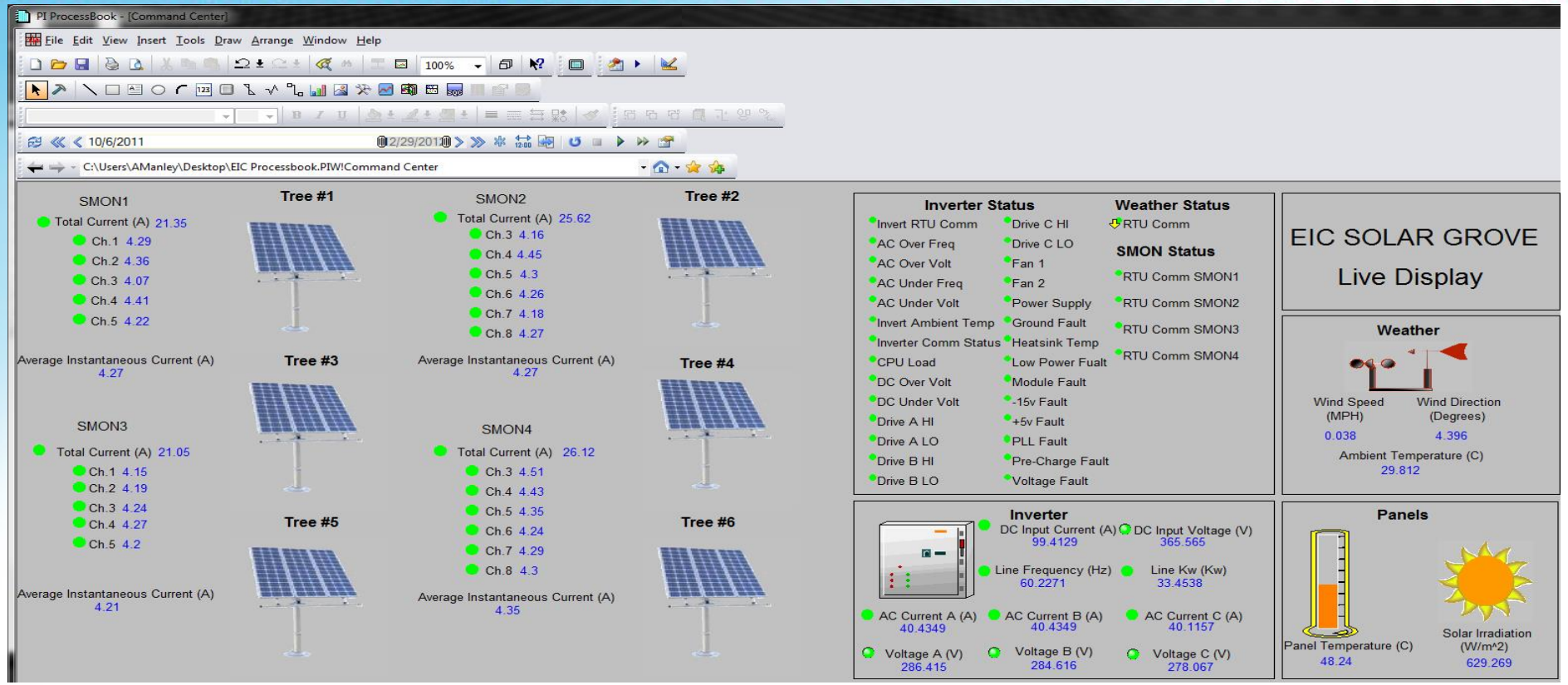
Renewables Integration

SDG&E customers continue to install significant quantities and capacities of solar photovoltic and other intermittent electric generation resources at residential and non-residential permises

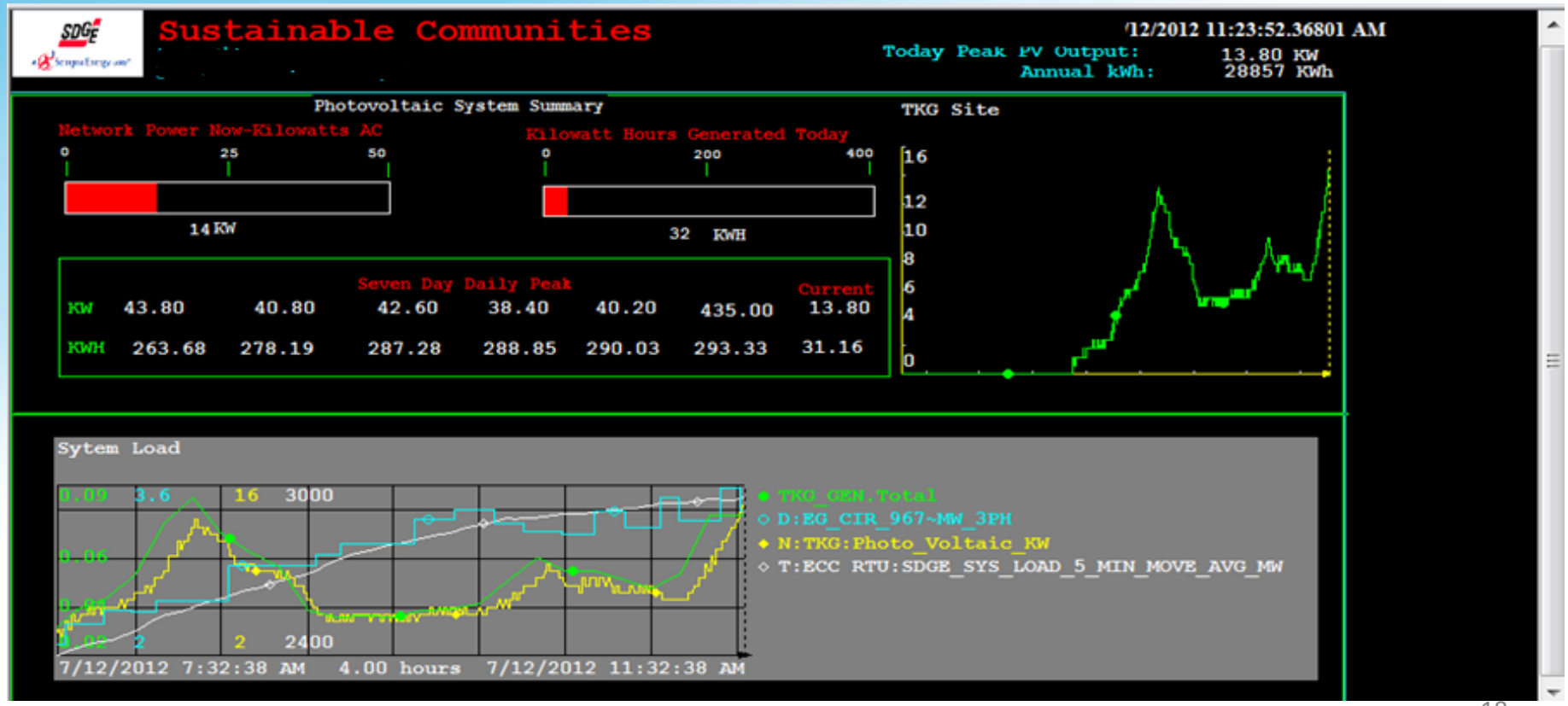


Source: California's Solar Cities 2012: Leaders in the Race Towards a Clean Energy Future; Environment California

Renewables Integration



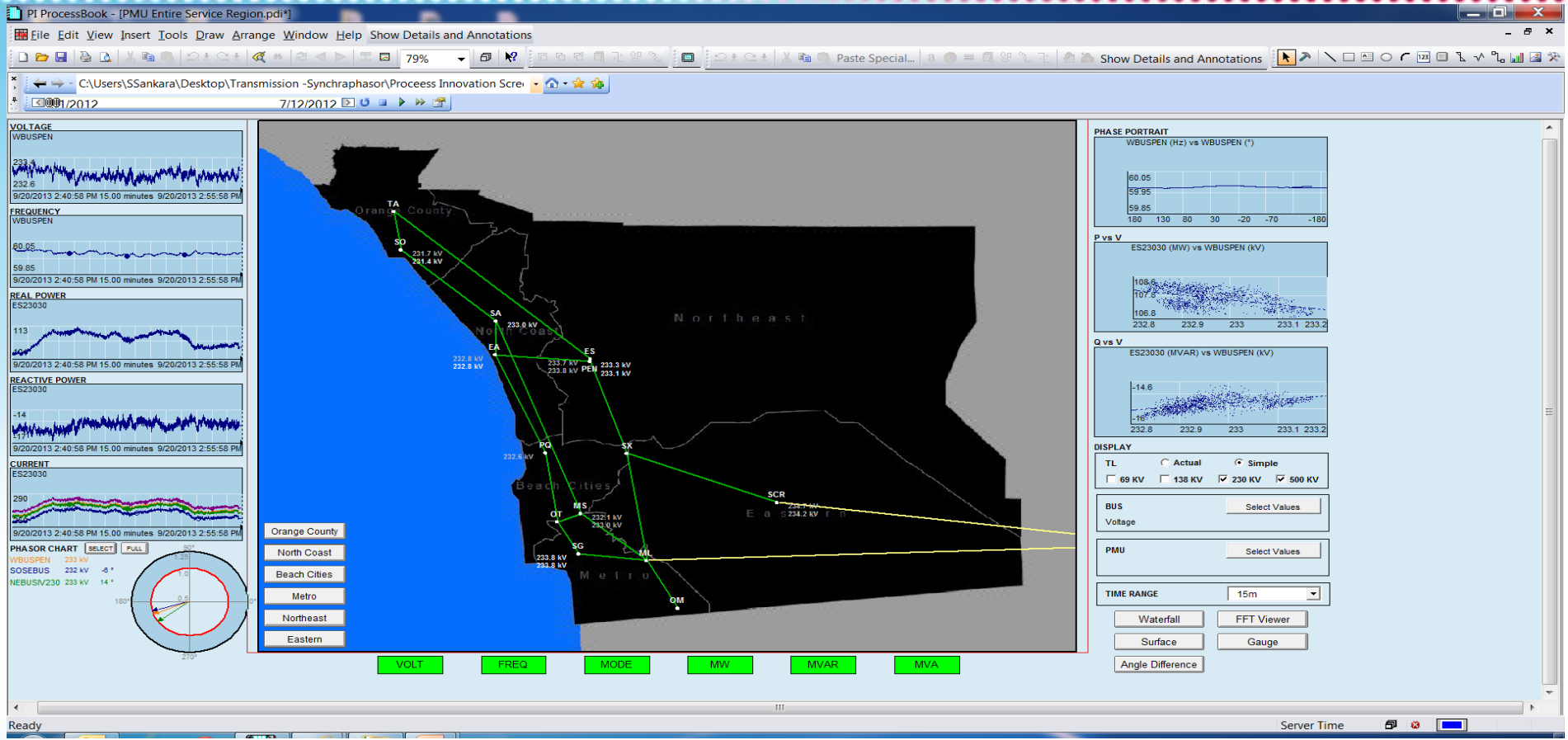
Renewables Integration



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
- CoE provided advice on use cases for Transmission, Distribution and Generation
- Used for condition assessment and generator modeling
- Potential for sharing data with WECC, CAISO, Universities and researchers for reliability and deeper analysis

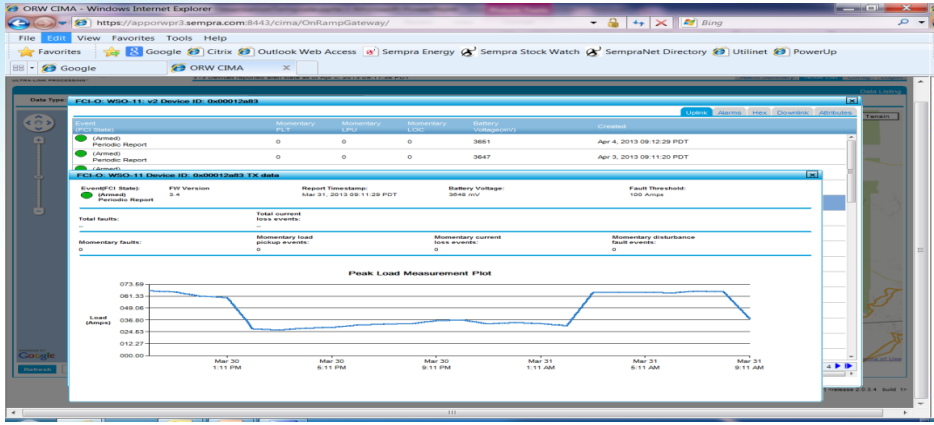
Synchrophasors

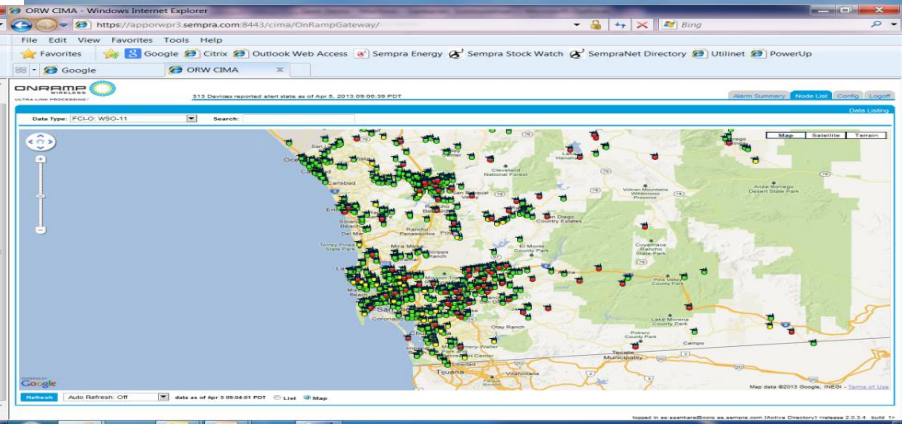


Low Power Communication Network

Acquiring additional data from smart grid wireless devices

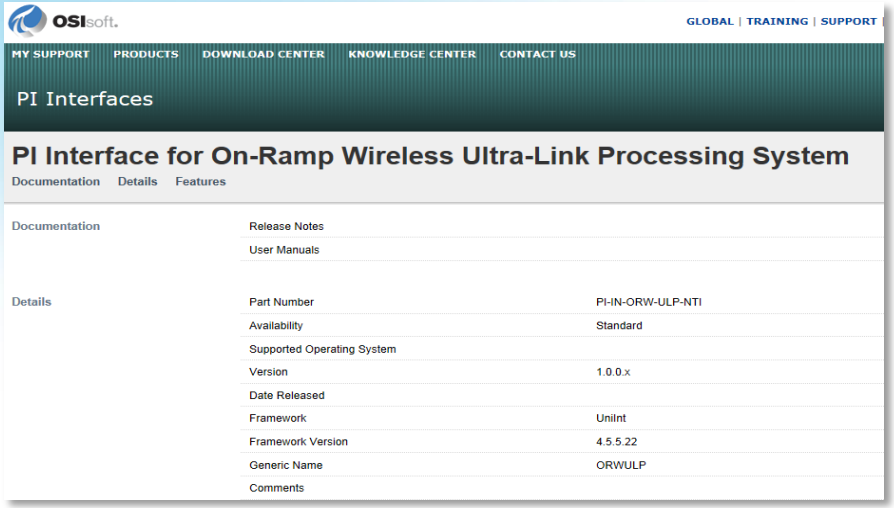
- Fault Circuit Indicators
- Aircraft warning light status
- Smart Transformers

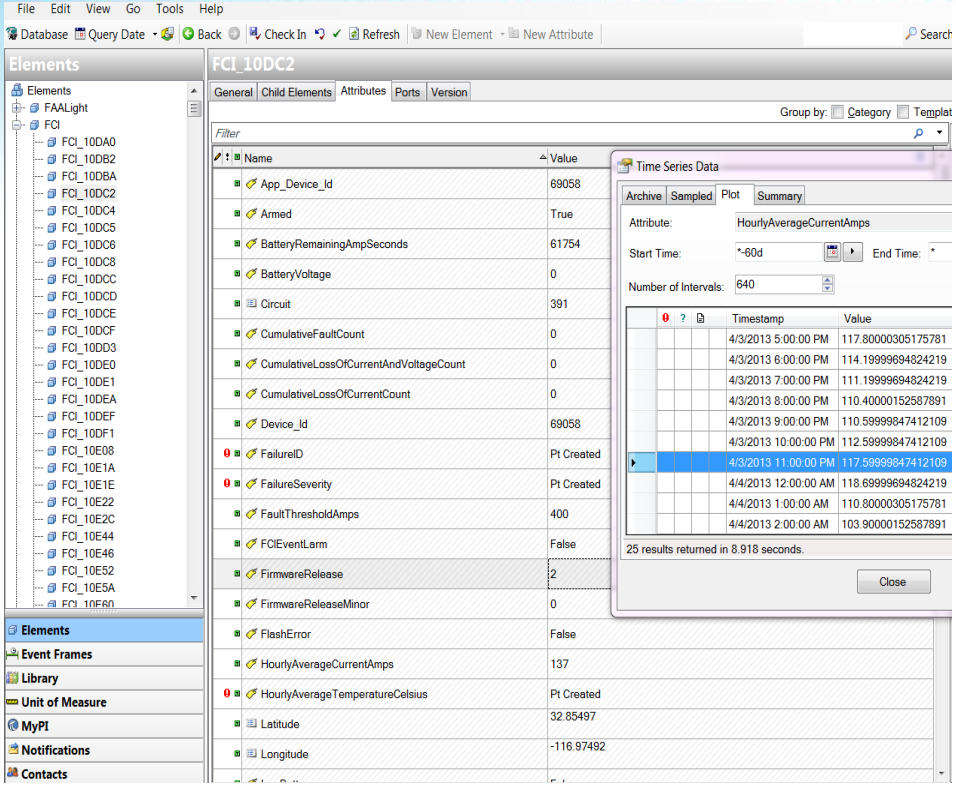




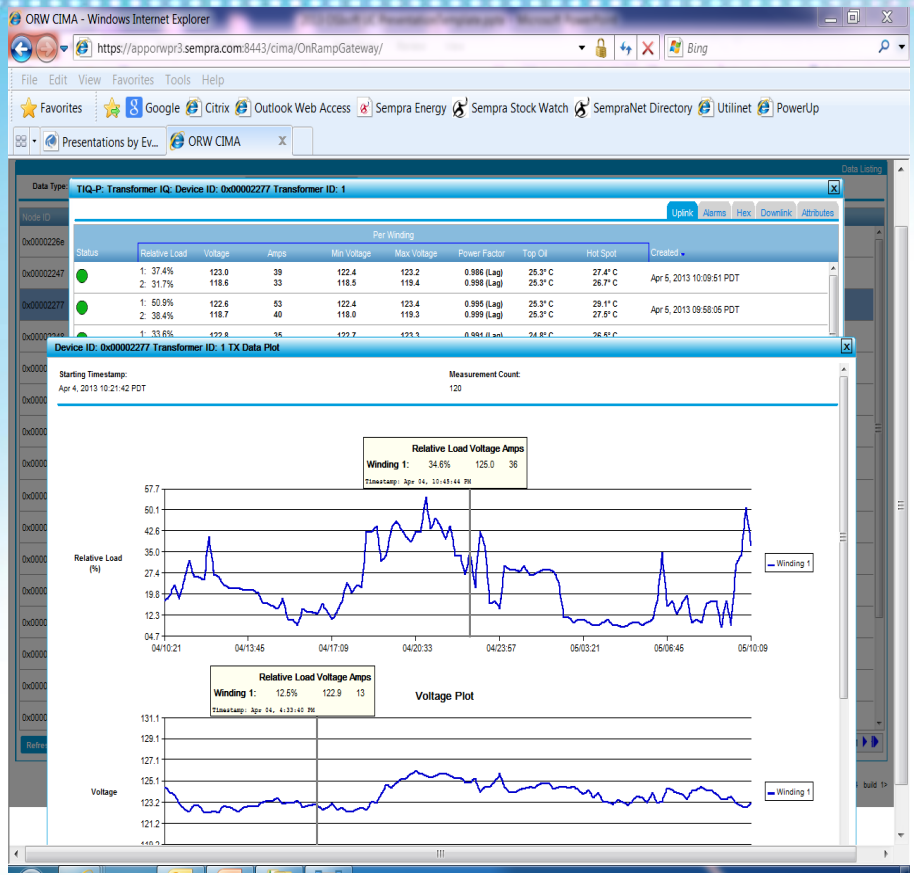
LPCN(OnRamp) Interface

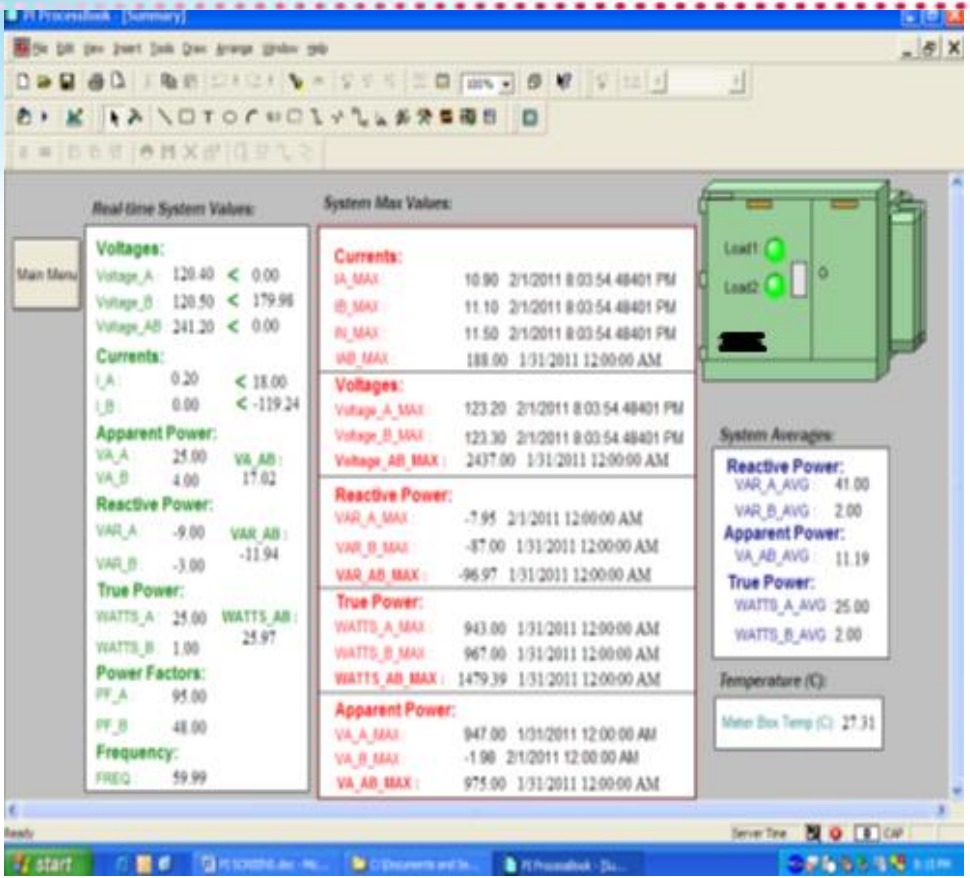
- OSIsoft developed interface and released as supported product to support this Initiatives
- Data can be combined with other operational data from EMS





LPCN -Smart Transformer





Gas Meter Event Processing

- Consume gas meter events for analysis
- Provide exceptions back to meter data management system
- Provided advice on implementation approach and sizing
- 900k meters, 6 events each, twice a day
- 5.4MM tags

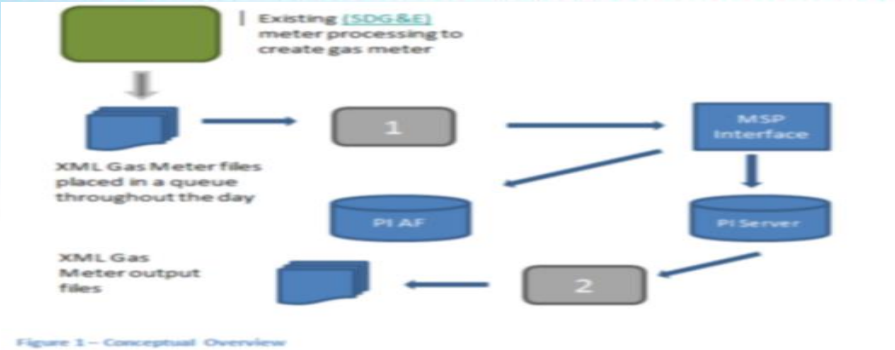


Figure 1 – Conceptual Overview

PI Server 2012 *Data Archive Sizing*

Please review and modify the values in yellow cells, sizing recommendations are shown in orange cells

PI Collective Size	2	members
Total Point Count	5,500,000	points
Average Point Sampling	43,500.00000	sec (0 Hz)
Data Retention Requirement	48	months
Measurement Data Type	int32	(32-bit precision)
Average Data Compression	90	% (10:1)
Estimated Snapshot Rate	126	events/sec
Estimated Event Size	7	bytes
Estimated Archiving Rate	13	events/sec

STORAGE		
Minimum Archive Size	10,750	MB
Recommended Archive Size	25	GB
Total Online Disk Space	200	GB
Estimated Archive Count	1	files/year
Estimated Archive Volume	0	MB/hour
(per PI Collective member)	0	GB/month

DISK I/O		
Minimum Disk Throughput	18	MB/sec
Minimum Disk Latency	10	IOPS*
Recommended Disk Throughput	20	MB/sec
Recommended Disk Latency	100	IOPS*

(*) See "KB Article #xxxxx" for details on how to evaluate IOPS

PI Interface Nodes	3	nodes
Active Client Applications	1	application
Average Query Interval	60	seconds
Average Query Range	8.0	hours
Average Points per Query	1,000	points
Estimated Query Rate	1	events/sec

PROCESSOR		
Minimum CPU Count	4	cores†
Recommended CPU Count	8	cores†

(†) Physical cores (not counting Hyper-Threading) or 100% allocated virtual cores

MEMORY		
Minimum RAM	32,250	MB
Recommended RAM	75	GB
Estimated Cache Capacity	163,880	hours
Estimated Cache Efficiency	100	%
Non-Cached Archive Reads	-	events/sec

NETWORK		
Minimum Bandwidth‡	10	Mbps
Recommended Bandwidth‡	100	Mbps

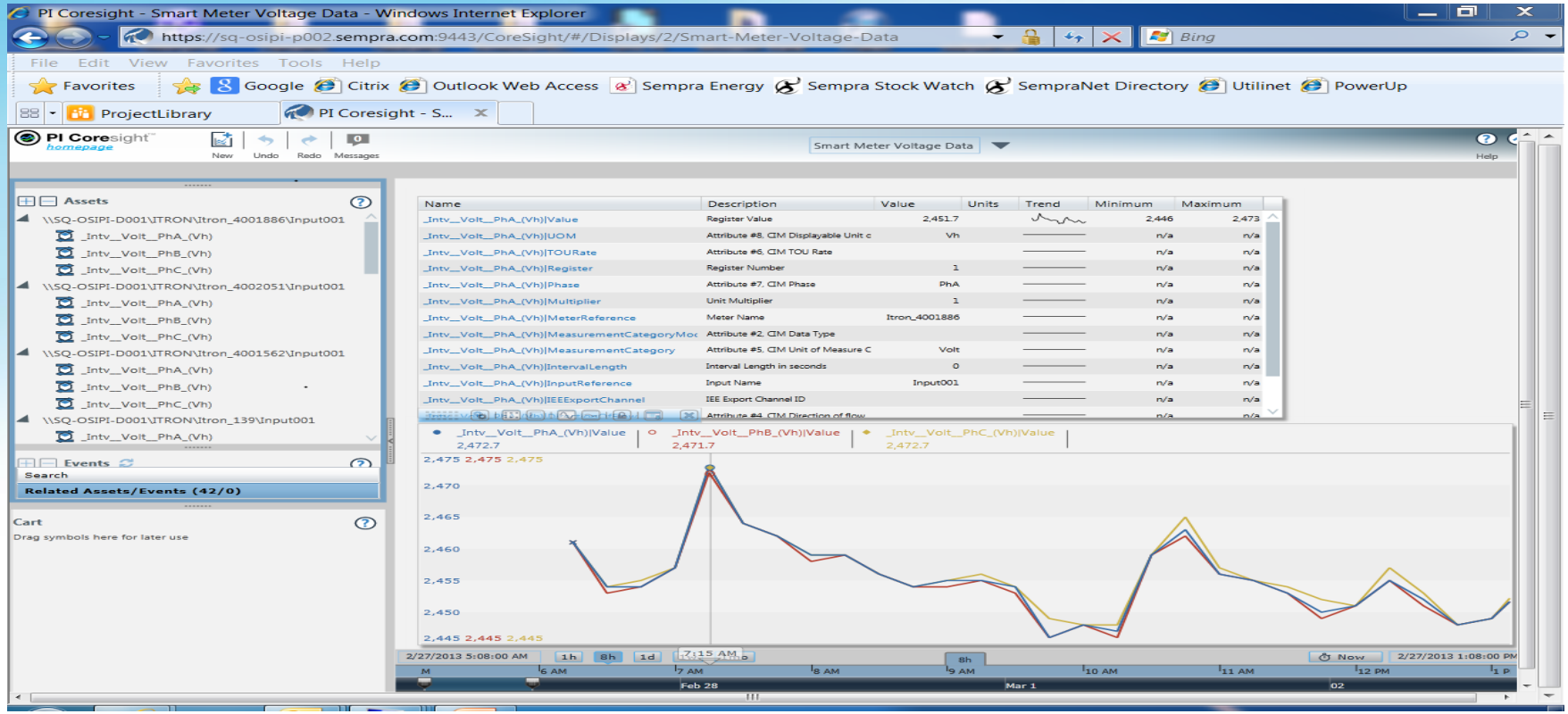
(‡) See "Buffer and Bandwidth Calculation" spreadsheet for latency considerations

Non-Billing Smart Meter Data Analytics

- New subscriber interface to head-end system
- Collect instantaneous voltage levels
- Analyze voltage against upstream data
- Targeting PV and older circuits customers first
- CoE Provided project advice, architecture, sizing, etc.
- Developing production interface to head-end system
- Supports auto-creation of PI AF elements

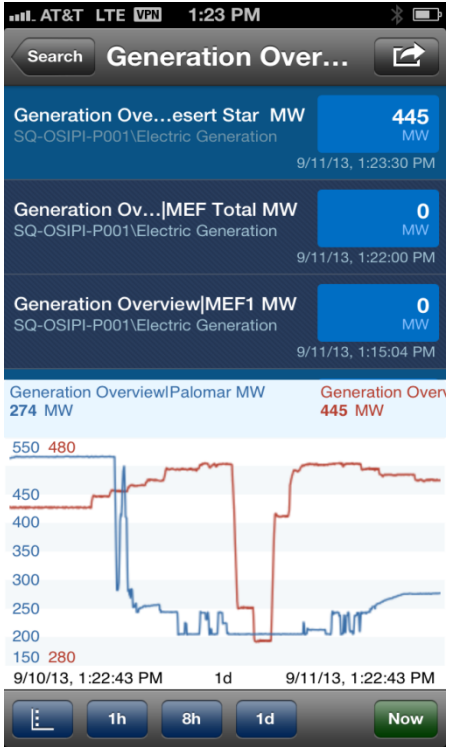
configuration Date	2/2/2011	2/2/2011	2/24/2011	2/2/2011	6/19/2012	9/6/2012
Voltage Monitor						
Enable Voltage Monitor	True	True	False	True	True	True
Phase Selection	Phase A	Phase A	Phase A	Phase A	Phases A, B, C	Auto Detect
Interval Length	60 minutes	60 minutes	5 minutes	15 minutes	15 minutes	15 minutes
VoltHour Low Threshold (per interval)	93	93	80	93	93	93
VoltHour High Threshold (per interval)	107	107	120	107	107	107
RMS Volt Low Threshold	192	192	192	192	80%	80%
RMS Volt High Threshold	288	288	288	288	120%	120%
Instantaneous Voltage High/Low Alarm Latency	N/A	N/A	N/A	N/A	N/A	0 seconds

Non-Billing Smart Meter Data Analytics

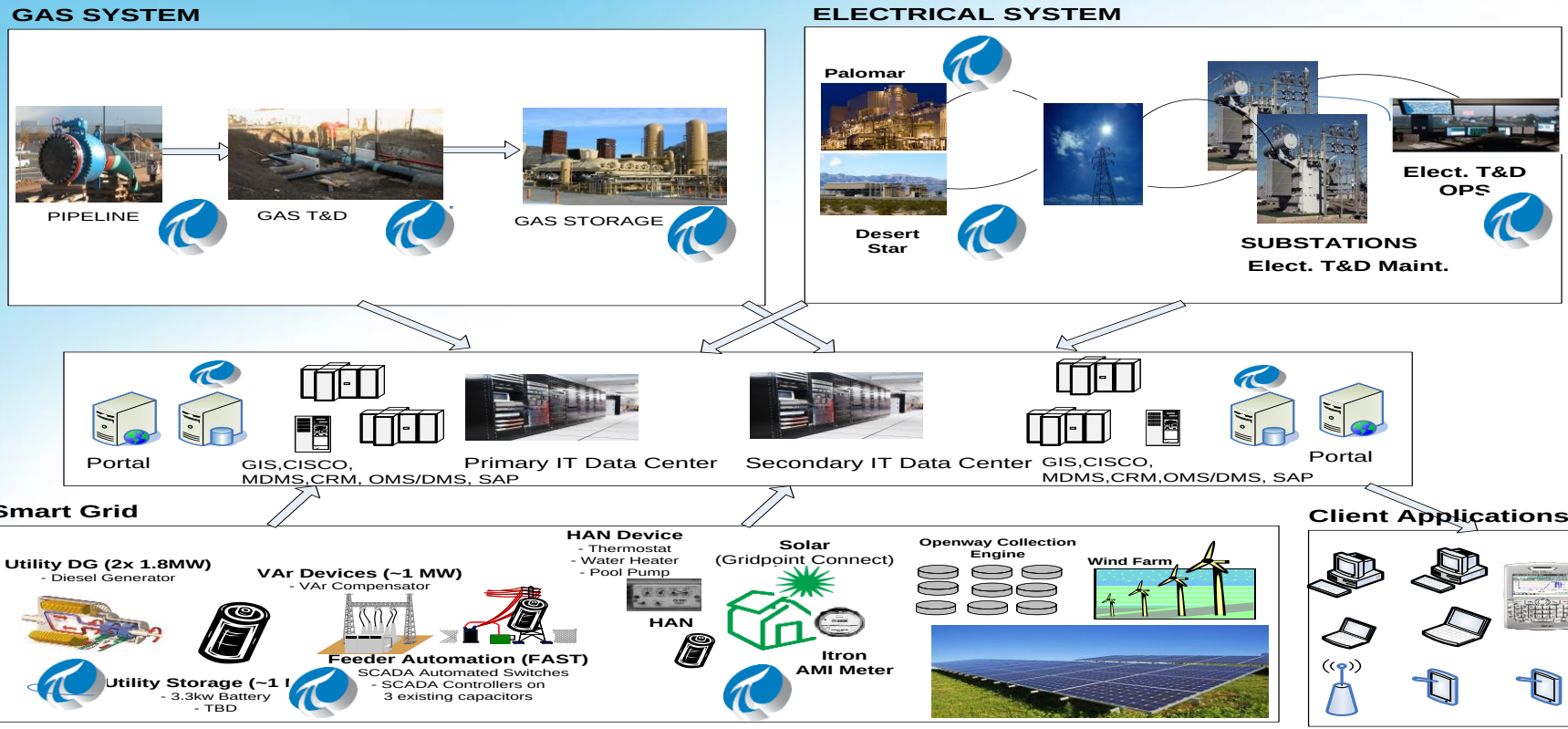


Mobility

- Provide KPI and executive summary displays (generation, system load, outages, load flows, etc.)



Current State



Key Reasons For Adopting Enterprise Approach

- **Vendor Management**
  - SDG&E has multiple instances of PI System installed across the business areas.
  - Procurement effort was an order of magnitude greater in the site-by-site approach.
  - Excessive time required to negotiate each new project
- **Internal Support**
  - Lack of ownership for applications & configuration management
- **Architecture**
  - Inconsistent infrastructure standards-Security,Redundancy,SoftwareTools and Upgrade
  - Application Integration was fragmented
- **Missed Opportunities**
  - Data was under utilized (silos)
  - Missed business application (SmartGrid)
  - Under utilized operational (PI System) and business data for real time decision making

SDG&E Enterprise Strategy

- **Vendor Management**
  - Managing the total cost of ownership while meeting growing business needs.
  - Leveraging OSIsoft's EA model
    - Support Enterprise wide licensing
    - PI System rollout/monitoring
    - Center of excellence
  - Improved relationship with OSIsoft to best leverage their platform to support all business needs.
    - OSIsoft's understanding of SDG&E Business
    - Facilitate broader communication
    - Understanding SDG&E technical issues
- **Smart Grid and Future Use Cases**
  - Position ourselves to maximize the use of an enterprise solution while minimizing the software licensing and infrastructure costs
  - Be innovative in the use of the Tsunami of data (Big Data) that the smart grid initiatives will bring to the enterprise

SDG&E Enterprise Strategy

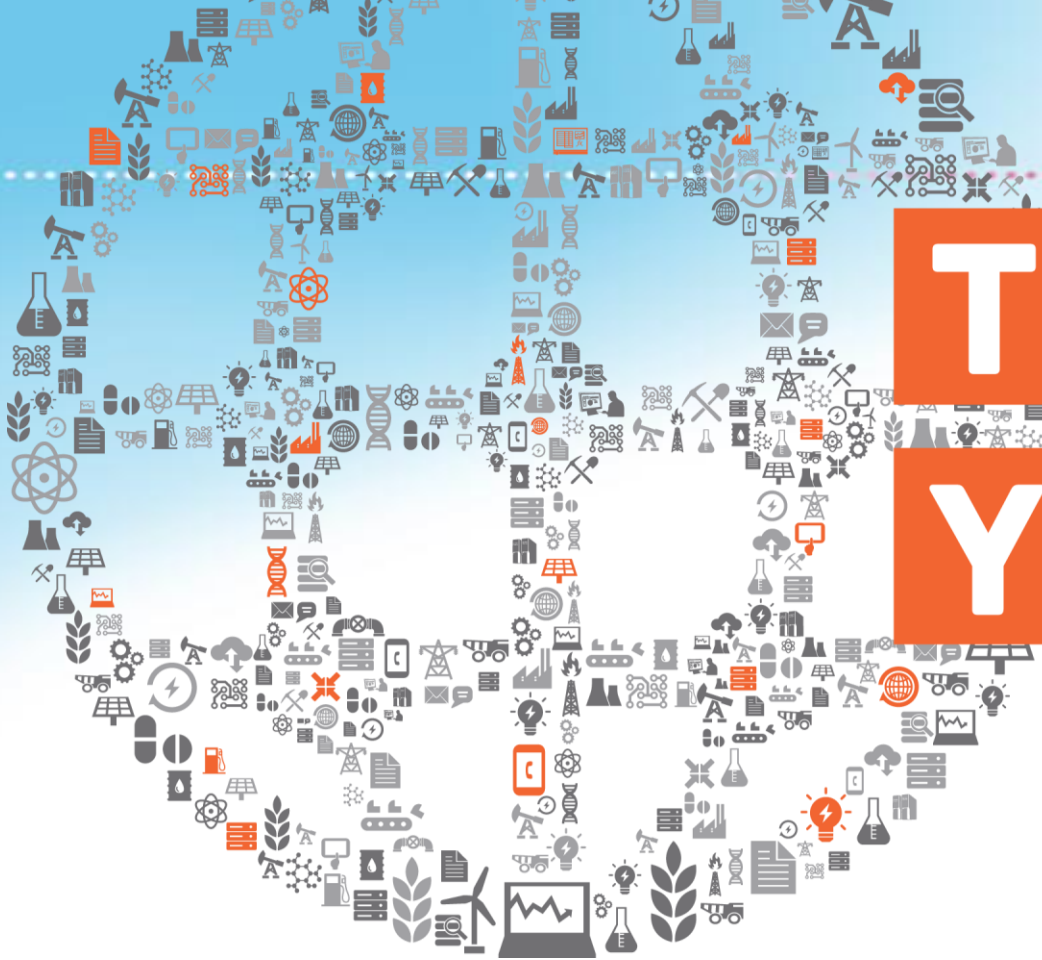
- **Smart Grid and Future Use Cases (cont.)**
  - Condition assessment
  - Closing the loop in analytics and operations
- **Managing the total cost of ownership (TCO) of the existing infrastructure, while meeting growing business needs by:**
  - Consolidated systems where practical
  - Centralize PI System application support and management of infrastructure (and make use of the OSIsoft provided Network Operations Center or NOC)
  - Self-service user access to the data for business intelligence and mobility
  - Consistent processes and procedures for rollout and migrations
  - Improved configuration management and maintenance
  - Reuse of existing catalog functions, analytics, displays and rules
  - Internal User group to share best practices in cross-functional group discussions for added value
  - Limit Data Replication

Success Criteria

- Manage total cost of ownership while meeting growing business needs
- Empower PI System users at SDG&E
- Support Smart Grid Initiatives and Future Use Cases

Summary of EA Benefits

- Strategic Expertise and Advice
- PI System Installs
- Interface Development
- PI System Monitoring
- PI System Promotion and Training Events
- Removed Project Constraints for Adoption
- Expanded Organizational Capabilities with one Toolset



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