Enterprise Approach to OSIsoft PI System

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San Diego Gas & Electric®
Agenda

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

ELECTRICAL SYSTEM

GENERATION

Transmission & Distribution

SUBSTATIONS

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 Operations

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, etc., Electric T&D, Asset Management
Key Reasons For Adopting Enterprise Approach

• Vendor Management
  ▪ SDG&E has multiple instances of PI 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, Software Tools and Upgrade
  ▪ Application Integration was fragmented

• Missed Opportunities
  ▪ Data was under utilized (silos)
    ▪ Missed business application (SmartGrid)
  ▪ Under utilized operational (PI) 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 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
  – Condition assessment
SDG&E Enterprise Strategy

• Smart Grid and Future Use Cases (cont.)
  – Be innovative in the use of the Tsunami of data (Big Data) that the smart grid initiatives will bring to the enterprise
  – 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 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
Vendor Management Process For EA

- CoE Value Realization Plan
- EA Negotiation & Approval
- EA Staffing & Customer Contact
- Rollout Review Meeting
- Rollout Planning
- Team Introduction and Kickoff Meeting
- Install Sites
- Ongoing Access to CoE & Product Roadmap
- Celebrate Success
Discovery Workshops

• Condition Based Maintenance (CBM)
• Gas Meter Events Processing
• Synchrophasors
• Low Power Communication Network (OnRamp Wireless)
• Sustainable Communities and Substation PV
• Smart Meter Data Collection (Cell Relay health)
• Weather Data Analysis
• Borrego Springs Microgrid
• 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 use cases
Condition Based Maintenance

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

LTC energy is measured at the control cabinet on the other side of the bank.
PI Notifications for CBM
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

Microgrid Remote Operations System Overview & Control

BORREGO SUB

CIR 170 BREAKER

TO CIR 170

SEL

REMOTE

SES

DC

Power

88.20 Watt (Kilo)

0.00

30.39

Fuel Level

100%

95%

85%

75%

50%

25%

10%

5%

Generator

Engine Status

EasyGen Status

Control Status

STANDBY

NOT RUNNING

REMOTE AUTO

0 Watt (Kilo)

0 VAR (Kilo)

0 Watt (Kilo)

0 VAR (Kilo)

STANDBY

NOT RUNNING

REMOTE AUTO

0 Watt (Kilo)

0 VAR (Kilo)

0 Watt (Kilo)

0 VAR (Kilo)

Battery

Battery Status

Energy Available

Power

Real Reactive

Alarms

GES CONTROL

OFFLINE

IDLE SOC SP

59.68 - 25

BASE CONTROL LEVEL

Power

150.00

Var

0.00

SOC SP

53.00

IMPORT CONTROL LEVEL

Power

180.00

Var

0.00

SOC SP

60.00

SCHEDULED BASE CONTROL

PV SMOOTHING

GEN #1 CONTROL

BASE CONTROL LEVEL

Power

0.00

PF

0.00

IMPORT CONTROL LEVEL

Power

0.00

PF

0.00

GEN #2 CONTROL

BASE CONTROL LEVEL

Power

800.00

PF

950.00

IMPORT CONTROL LEVEL

Power

0.00

PF

0.00

Permission

Black Start

Island

Normal

Parallel

Status

Black Start

Island

Normal

Parallel

State of Charge

Power

Real Reactive

Alarms

GES CONTROL

State of Charge

Power

Real Reactive

Alarms

DC
Renewables Integration

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

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 initiative.
- 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

![Gas Meter Event Processing Diagram](Image)

- **Data Archive Sizing**
  - PI Server 2012
  - Data Archive Sizing
  - PI Collective Size = 3,000 GB
  - Total Event Count = 4,000,000,000
  - Event Count per Day = 300,000,000
  - Event Count per Hour = 1,250,000
  - Event Count per Minute = 20,000
  - Event Count per Second = 333
  - Total Archive Size = 3.6 TB
  - Archive Size per Event = 10 KB
  - Archive Size per Hour = 10 GB
  - Archive Size per Day = 250 GB
  - Archive Size per Month = 7.5 TB

- **PI Interface Nodes**
  - PI Interface Nodes = 3
  - PI Interface Count = 3
  - PI Interface Data Rate = 1,000 MB/s
  - PI Interface Bandwidth = 500 MB/s
  - PI Interface Latency = 100 ms

- **XML Gas Meter Files**
  - XML Gas Meter Files placed in a queue throughout the day

- **XML Gas Meter File Output**
  - MSP Interface

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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 AF elements
Non-Billing Smart Meter Data Analytics
Cell Relay

- Initial assessment phase
- Provided architecture recommendations
- Setup proof of concept in smart meter lab
- Continue to support project evaluation, architecture and design
- Currently in funding evaluation
Mobility

- Provide executive summary displays (generation, system load, outages, load flows, etc.)
- Based on PI Coresight displays
- Assisting with prototype
- Plan for beta version of ProcessBook displays
Current State

GAS SYSTEM

PIPELINE
GAS T&D
GAS STORAGE

ELECTRICAL SYSTEM

Palomar
Desert Star
Elect. T&D Ops

SUBSTATIONS
Elect. T&D Maint.

Portal
GIS, CISCO, MDMS, CRM, OMS/DMS, SAP
Primary IT Data Center
Secondary IT Data Center
GIS, CISCO, MDMS, CRM, OMS/DMS, SAP
Portal

Smart Grid

Utility DG (2x 1.8MW)
- Diesel Generator
Utility Storage (~1 MW)
- 3.3kvar Battery
- TBD

VAr Devices (~1 MW)
- VAr Compensator

HAN Device
- Thermostat
- Water Heater
- Pool Pump

Solar
(Gridpoint Connect)

Openway Collection
Engine

Wind Farm

Itron
AMI Meter

HAN

VAr Devices
SCADA Controllers on 3 existing capacitors

Feeders Automation (FAST)

Client Applications

Utility DG

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Summary of EA Benefits

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

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