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I N D I A

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WESTIN GARDEN CITY, MUMBAI

How a US-based Integrated Utility Uses the PI System to Support their End-to-End Energy Value Chain

Chris Crosby, Business Development Executive
OSIsoft

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Agenda

- Sempra overview
- Engagement timeline and awards
- Uses in 'regulated' operations
- Uses in 'unregulated' operations
- 'Future' applications
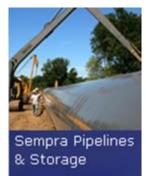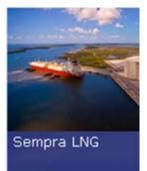- Value proposition
- Conclusion

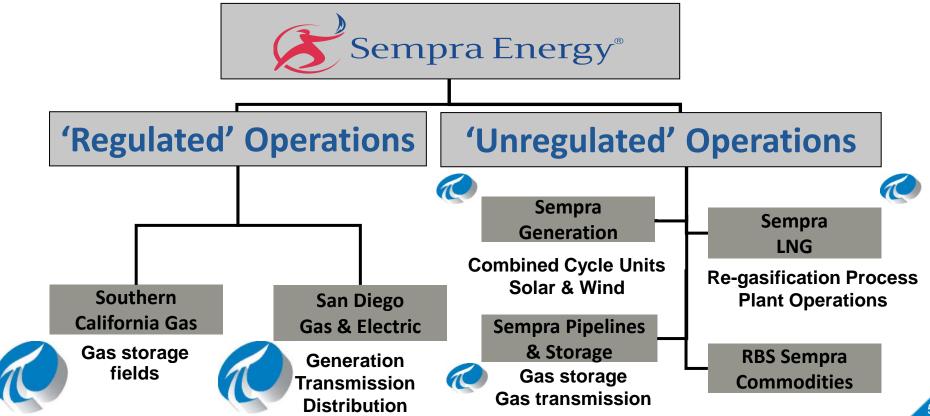# Sempra Energy

Sempra Energy®

'Regulated' Operations

'Unregulated' Operations

San Diego Gas & Electric®

Southern California Gas Co.

Sempra Generation

Sempra Pipelines & Storage

Sempra LNG

Sempra's Integrated Energy Business

New Supplies

Gas Transportation & Storage

Electric Generation

Gas & Elec. Transmission & Distribution

- ▶ Leading developer of LNG import facilities

- ▶ Rockies Express is the largest pipeline built in 20 years

- ▶ 150 Bcf of natural gas storage

- ▶ Thermal power plants and renewable

- ▶ Largest gas utility in the U.S.

- ▶ Serve 29 million consumers

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OSIsoft PI Deployment in Sempra

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                    Sempra Energy®

        ┌───────────────────┴───────────────────┐
'Regulated' Operations            'Unregulated' Operations

   ┌────────┴────────┐          ┌──────────────┴──────────────┐
                                Sempra
                                Generation              Sempra
                                                        LNG
                            Combined Cycle Units
Southern         San Diego   Solar & Wind        Re-gasification Process
California Gas    Gas & Electric                 Plant Operations
                            Sempra Pipelines
Gas storage                 & Storage
fields           Generation                     RBS Sempra
                 Transmission  Gas storage      Commodities
                 Distribution  Gas transmission
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Quotes: Mike Gallagher

"We turned all of our operators into **businessmen**." Vice-President Sempra Generation

"In every business I've been in where we put PI in…**we made money**." Senior Vice President, SoCalGas

Timeline

Unregulated 1998

- Sempra generation (Combined Cycle)
- Liquefied natural gas (LNG)
- SoCalGas gas storage (West)
- Merchant gas storage (Southwest)
- Sempra generation (Renewables - Wind and Solar)

SDGE - 2003

- Transmission
- Distribution
- Fossil Generation
- Substation Monitoring/CBM
- Enterprise Agreement
  - SDE&G; Option SoCalGas
  - August 2011
  - T&D
  - Combined cycle natural gas units; simple cycle natural gas peakers
- Smart meters/smart grid/microgrid (Pilot Current; Roll-out Future)

San Diego Gas & Electric (SDG&E)

NORTH COUNTY TIMES

NCTIMES.COM
This newspaper uses recycled paper.

Monday, August 2, 2010

SDG&E Honored as Most Intelligent Utility in USA
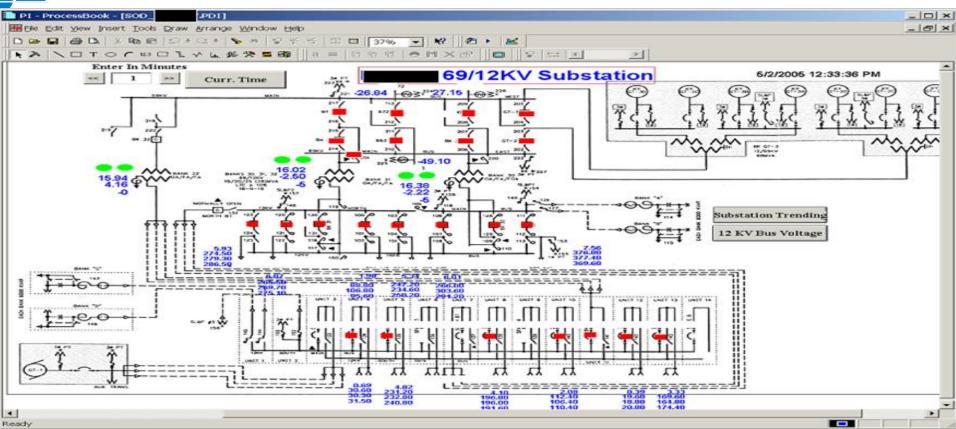
- For the second straight year, Sempra Energy's San Diego Gas & Electric (SDG&E) has taken top honors as the most intelligent utility in the United States, according to the annual ranking undertaken by Intelligent Utility magazine and IDC Energy Insights, released today.
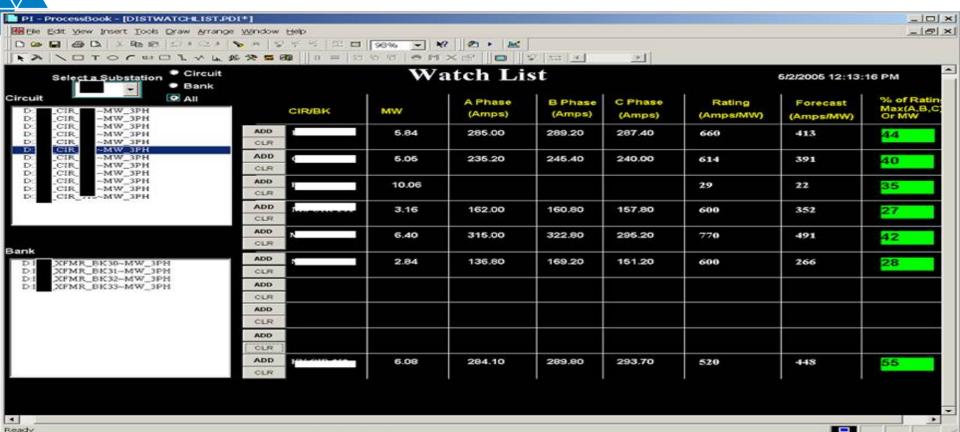
The San Diego Union-Tribune.

50¢ Final

November 18, 2010

SDG&E Awarded 2010 National Award For Outstanding Reliability

- San Diego Gas & Electric (SDG&E) was recognized by PA Consulting Group (PA) as the recipient of the ReliabilityOne™ 2010 National Award for Outstanding Reliability Performance. SDG&E was also the top winner of the ReliabilityOne™ award among Western U.S. electric utilities for the fifth year in a row.
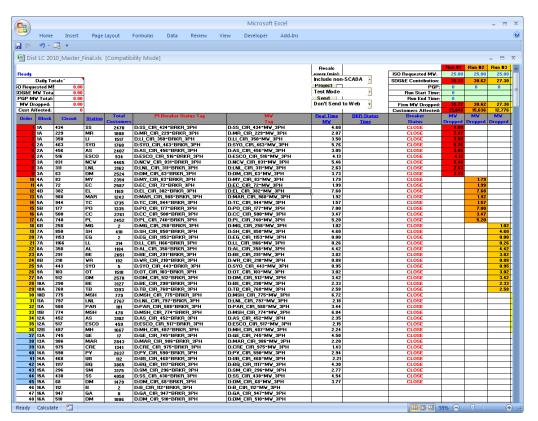
T&D System Operations – System Operating Diagram

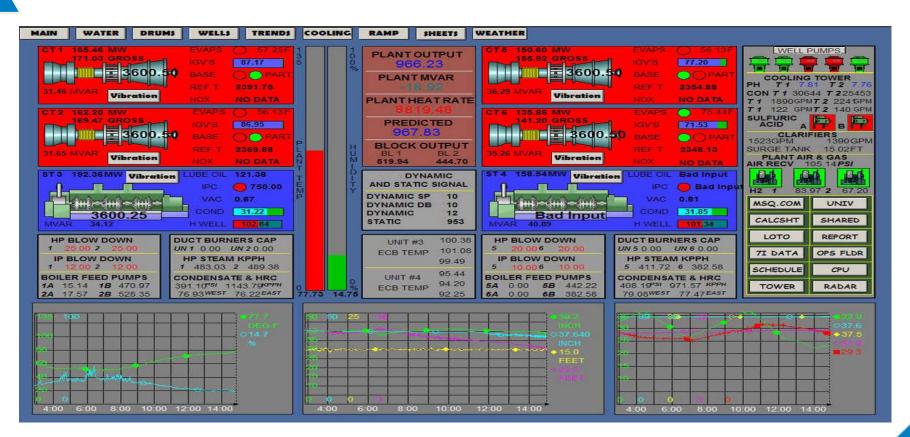# Distribution Planning – Potential Overload Watch List

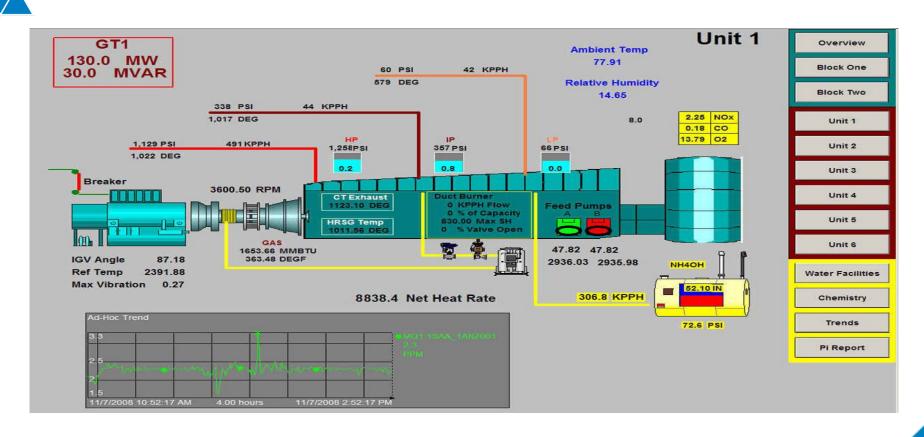# Emergency Operations Load Curtailment – Rolling Blackout

- **Enter total MW's required to be dropped**

- **Show circuit breakers status and MW load**

- **Automatically calculate how many breakers need to be opened and total customers are out**

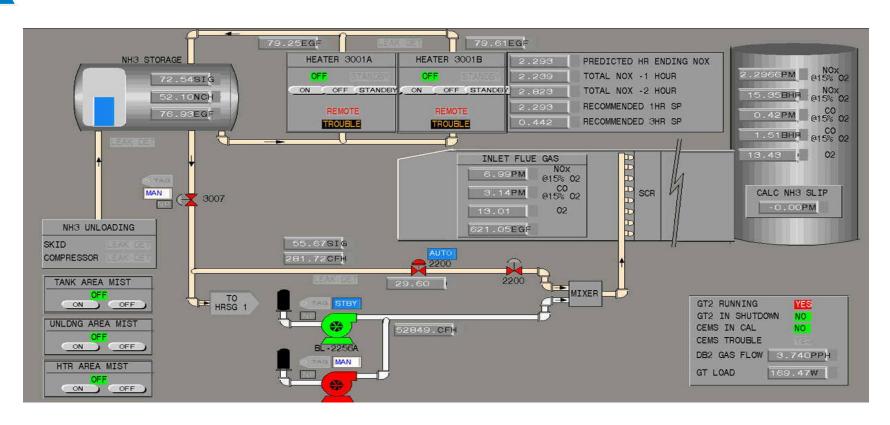- **Automatically publish to SDG&E public website and report to Utility Commission and Regulator**

CCGT Plant Operation

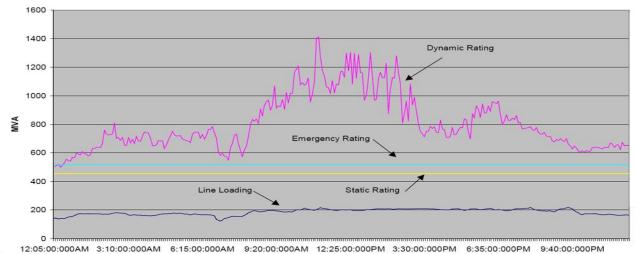# Gas Turbine Monitoring - Turbine Operations

Real Time Emission Monitoring – Predicted vs Actual
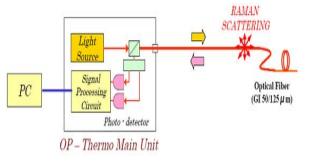
Electric Transmission Dynamic Rating

Overhead

- Ruling span concept
- Load Cells for measuring cable tension
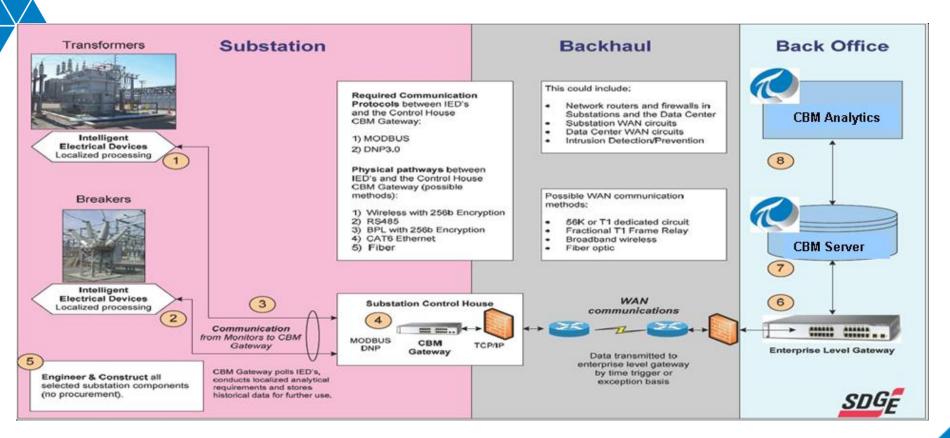- Cable Tension (CAT) Monitoring Unit
- Radio transmitter

230KV UG Cable

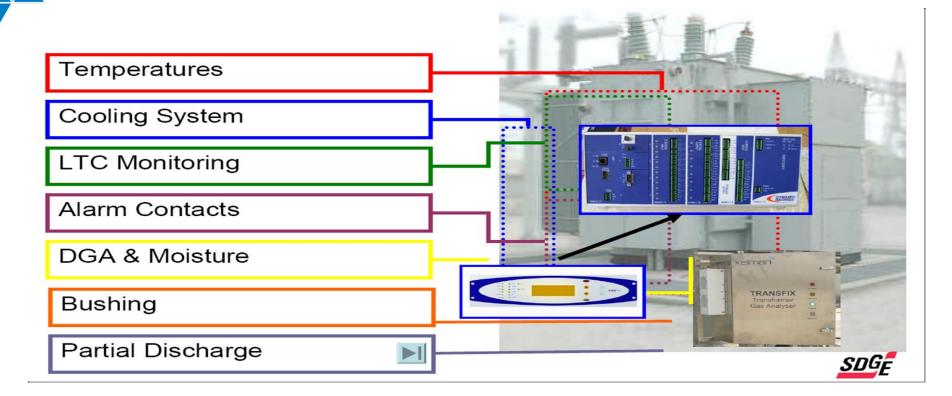- Fiber optic sensors
- Real-time modeling
- Dynamic rating

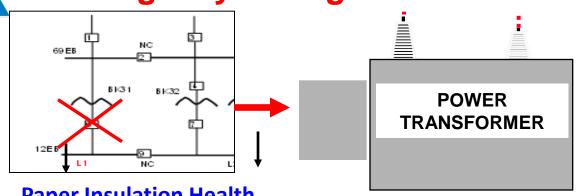# Substation Condition Based Maintenance

Condition Based Monitoring – PI Notifications Email Alert

From: ████████@semprautilities.com   Sent: Wed 1/21/2009 11:57 AM
To: CBM-XfmrLv4 Ack
Cc:
Subject: ██_BK71_THER_AlarmLevel4

Name: ████BK71_THER_AlarmLevel4
Description: ████████████ Bank 71 Thermal Alarm Level 4
Server: ██████NT-P01
Database: CBM2
Start Time: 1/21/2009 11:56:24 AM Pacific Standard Time (GMT-08:00:00)
Trigger Time: 1/21/2009 11:56:24 AM Pacific Standard Time (GMT-08:00:00)
Target: ██████T-P01\CBM2\SISCO Managed Models\SDGE_CBM\ClassView\thermal██1 Thermal
Value: Alarm 4
Priority: Normal

Link:
████ - BK71 - Thermal

Actions:
 Acknowledge
 Acknowledge with comment

Condition Based Monitoring – Transformers

Temperatures

Cooling System

LTC Monitoring

Alarm Contacts

DGA & Moisture

Bushing

Partial Discharge

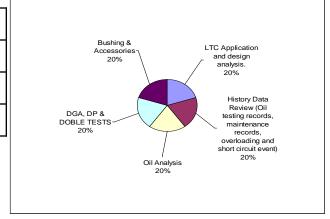# Operations Decision Support – Transformer at Emergency Rating?

TRANSFORMER Health Indices
 Insulation Power Factor
 LTC Application & Design
 Oil Conditions
 Bushing & Accessories
 Operating History & Conditions

Paper Insulation Health

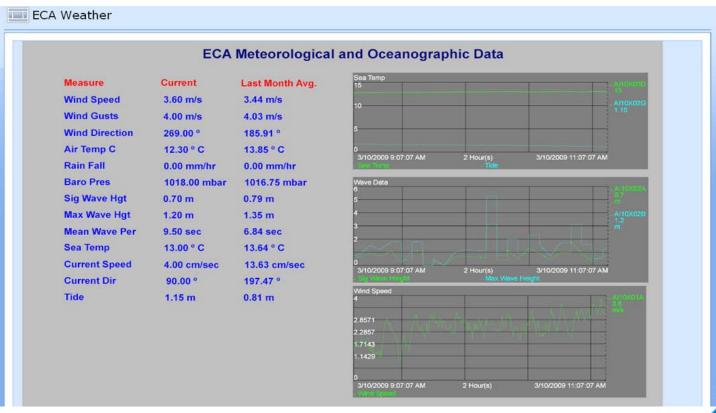| Location of Paper Sample	Degree of Polymerization (DP)
NLTC – Phase A	586
NLTC – Phase B	737
69kV Bushing C	688

New Insulation Paper: 1000 < DPv < 1300
Middle Aged Insulation Paper: DPv = 500
Old Age Insulation Paper: DPv < 251
Severely Degraded Insulation Paper: DPv < 151

LNG Terminal Application

► **Energía Costa Azul (ECA)**

Solar Generating Projects

El Dorado 10MW Solar PV

- 30 miles Southeast of Las Vegas
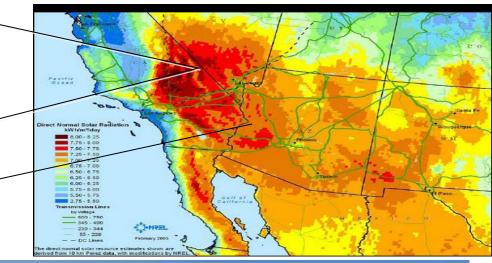- Technology: Thin Film Solar PV (CdTe)
- Expected Annual Yield: 23,000 MWh

Copper Mountain 48MW Solar PV (6/2010)

- 30 miles Southeast of Las Vegas

Mesquite Solar (up to 500MW Solar PV or Thermal : 2010 – 2014)
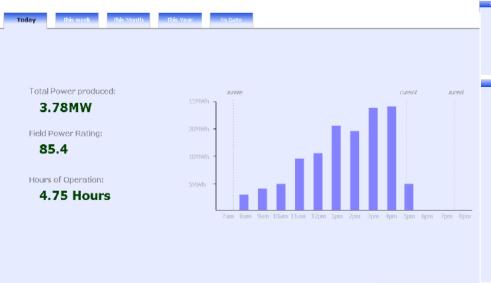
- Near Palo Verde in Arizona

Solar Field Monitoring

- Performance Monitoring
  - DC and AC Output
  - Inverter Operating Conditions
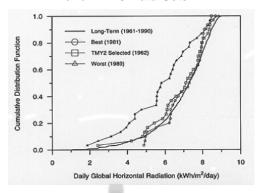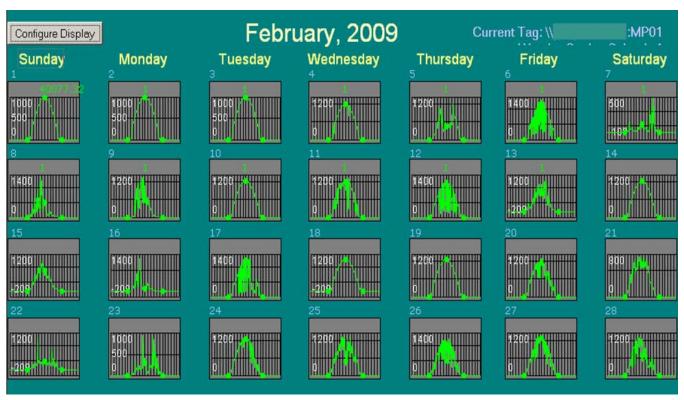- Weather Conditions

Solar Generation Applications - Irradiance Analysis (Historical, Predicted, and Actual)

National Renewable Energy Lab (NREL)
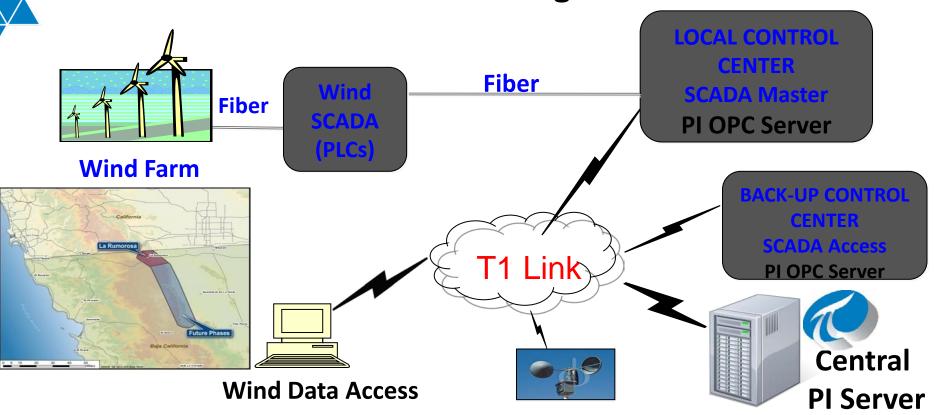
- Typical Meteorological Year (TMY)
- TMY2 and TMY3 Data Sets
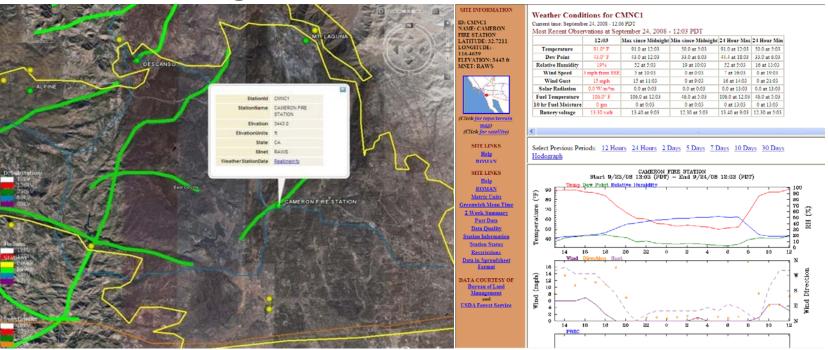
Statistical Modeling

Wind Generation Data Planning - Architecture

Wind Farm

Fiber

Wind SCADA (PLCs)

Fiber

LOCAL CONTROL CENTER
SCADA Master
PI OPC Server

T1 Link

BACK-UP CONTROL CENTER
SCADA Access
PI OPC Server

Wind Data Access

Central PI Server

Weather Intelligence

- **More than 90 pole mounted weather stations to support fire operations and Smart Grid vision**
- **Currently the 4th largest privately owned weather station network in US; the densest weather station network in the world**
- **Locations selected by SDG&E's Meteorologist, based on topography, field observations, and fire hazard**

Weather Station Network Project

- Real-time weather data every 10 minutes (wind direction, wind speed, wind gust, temperature, and relative humidity, etc.) to provide SDG&E with a better tool to maintain and operate the system safely

- Viewing winds in areas that have never been monitored to help to "harden" overhead electric system with larger conductors and steel poles to better withstand high winds

- Sharing data with the public, local universities and posting on the National Weather Service (NWS) Site and MesoWest

- San Diego First Responders (Fire Agencies) have been provided a mobile SDG&E weather station application and website to access to all SDG&E weather station data and maps
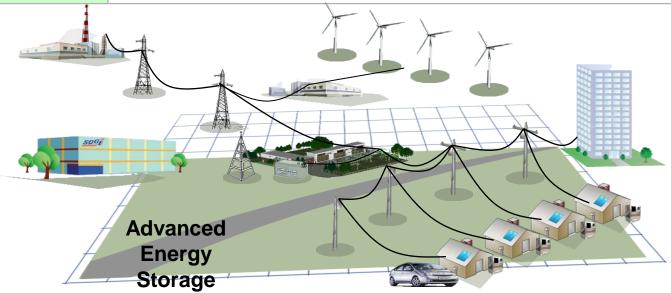
Opportunities For Future Applications in PI System

- More renewable energy development
- Electric vehicles planning
- Roof top solar and electric vehicles integration
- Roof top solar PV monitoring
- Smart meters
- Renewable and distributed systems integration (RDSI)
- Microgrid
- Energy market assessment & transaction
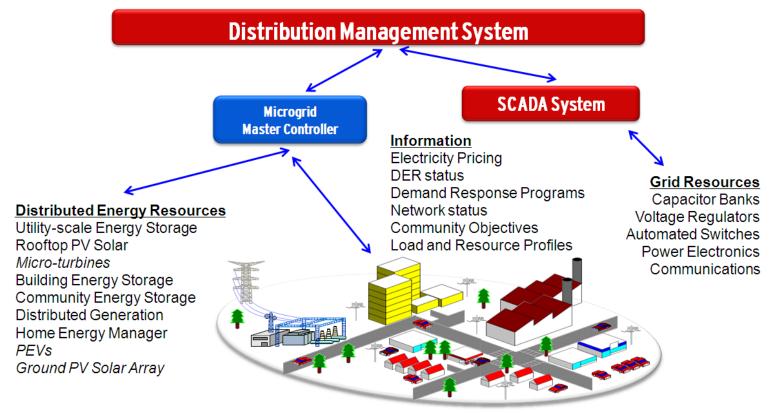- Create synergy across the integrated business

SDG&E RDSI Project

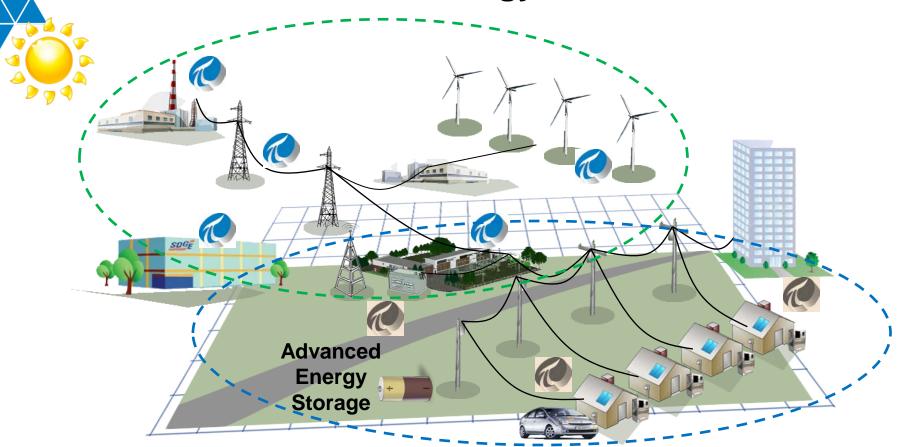| Budget:	$15.2M ($4.1M SDG&E, $7.5M DOE, $2.8M CEC, and $0.8M partners)
Benefits:	▪ Integrate and leverage various generation and storage configurations ▪ Reduce peak demand and enhance overall system reliability

Advanced Energy Storage

Microgrid Applications

Distribution Management System

Microgrid Master Controller

SCADA System

Information
Electricity Pricing
DER status
Demand Response Programs
Network status
Community Objectives
Load and Resource Profiles

Grid Resources
Capacitor Banks
Voltage Regulators
Automated Switches
Power Electronics
Communications

Distributed Energy Resources
Utility-scale Energy Storage
Rooftop PV Solar
Micro-turbines
Building Energy Storage
Community Energy Storage
Distributed Generation
Home Energy Manager
PEVs
Ground PV Solar Array

National Energy Technology Laboratory

PI System Value Proposition

- Improve real-time & historical data analysis & modeling
- Increase timely decision making capability
- Enable energy market assessment & transaction
- Improve abilities for new business development
- Extract value from capital investments
- Support innovation
- Optimize operations and maintenance costs
- Improve system performance and reliability
- Increase productivity
- Improve customer satisfaction
- Improves safety and environmental compliance
- Enable end-to-end integration

SDG&E's End-to-End Energy Value Chain
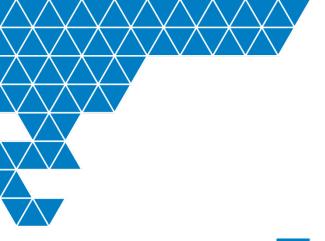

Advanced Energy Storage

Conclusion

- PI System delivers value out of the box and over time
- Customers can improve their businesses in silos
- PI System can deliver value in 'regulated' or 'unregulated' operations
- Acceleration of PI system expansion can occur with cooperation between operating units, IT and leadership
- Enterprise agreements can help customers accelerate end-to-end integration
  - Enterprise Project Manager and Account Manager
  - Access to Center of Excellence (Max VALUE from PI System)
  - PI System monitoring
  - Lose the "tag" constraint mentality and think "eat more PI"

Quotes: Patrick Lee, Vice-President Energy Supply, SDG&E

"Data is in silos today…Smart Grid will drive end-to-end data integration!"

"As you have seen in some of our applications using OSIsoft PI, I believe we have only scratched the surface in turning available data into valuable and relevant information. We will continue to expand our data collection, analysis, and modeling capabilities at Sempra Energy. **We believe a successful company must have the ability to make good judgment decisively.** This core capability is best augmented by a powerful data and information system. We believe OSIsoft PI is a key component of this data system."

Thank you