



SDG&E PI-based Substation Real-Time Condition Based Maintenance System

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- San Diego Gas & Electric Company

Empowering Business in Real Time
PI Infrastructure for the Enterprise

Agenda

- Sempra Utilities OpEx 20/20
- Smart Grid & CBM
- CBM Business Case
- CBM Project Scope
- CBM System Components
- How PI is used in CBM
- PI CBM Examples
- CBM Benefits

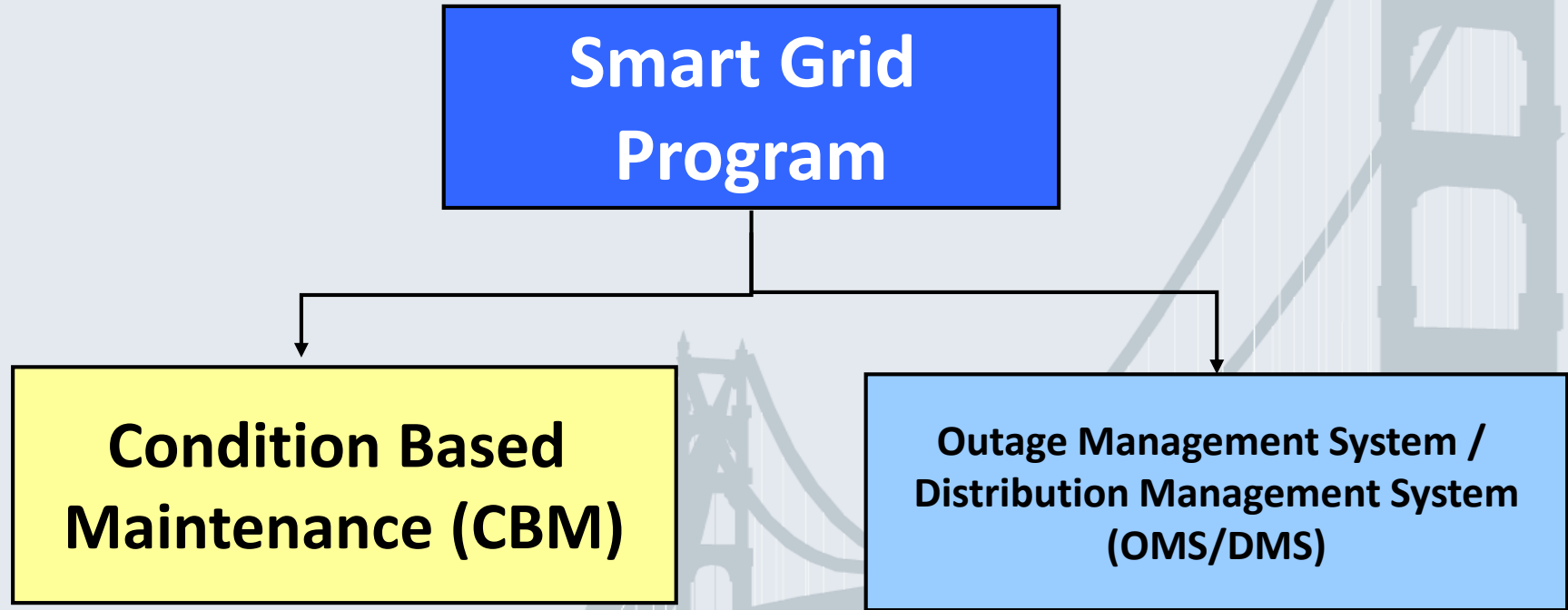
Sempra Utilities OpEx 20/20

- In 2006, a team of employees developed a roadmap to prepare company for future success. The plan includes a renovation of the systems that support our operations. These initiative were named:



- The program's technology and process improvements will enable our utilities to *continue* to deliver our commitment of **Op**erational **Ex**cellence.
- **20/20** symbolizes a clear, sharp vision guiding our efforts.

OpEx 20/20: Smart Grid Program



What is CBM?

*Use technology (HW/SW) to measure the condition and performance of equipment to **make better maintenance decisions***

CBM

Diagnostics detect potential problems before they occur

- Optimizing equipment utilization based on predictive history, etc.
- Equipment can be repaired before failure

Sensors will provide diagnostic information to facilitate capacity and reliability maintenance.

Start 2008, Go-live 2008

CBM Business Case

- What does CBM do for SDG&E?
 - Improve asset utilization
 - Provide actionable data to support decisions
 - Allows capital expenditures to be deferred
 - Shift from time-based to Condition Based Maintenance should reduce overall maintenance activity
 - Proactive “As-Needed” maintenance (less time based)
 - Improve efficiency of maintenance activities
 - Reduction in time required to complete maintenance on equipment through better knowledge of equipment condition
 - Reduction in unplanned maintenance work
 - Reduction in cost to collect condition data by manual means
 - Reduction of field equipment inspections

Project Scope: Phase 1

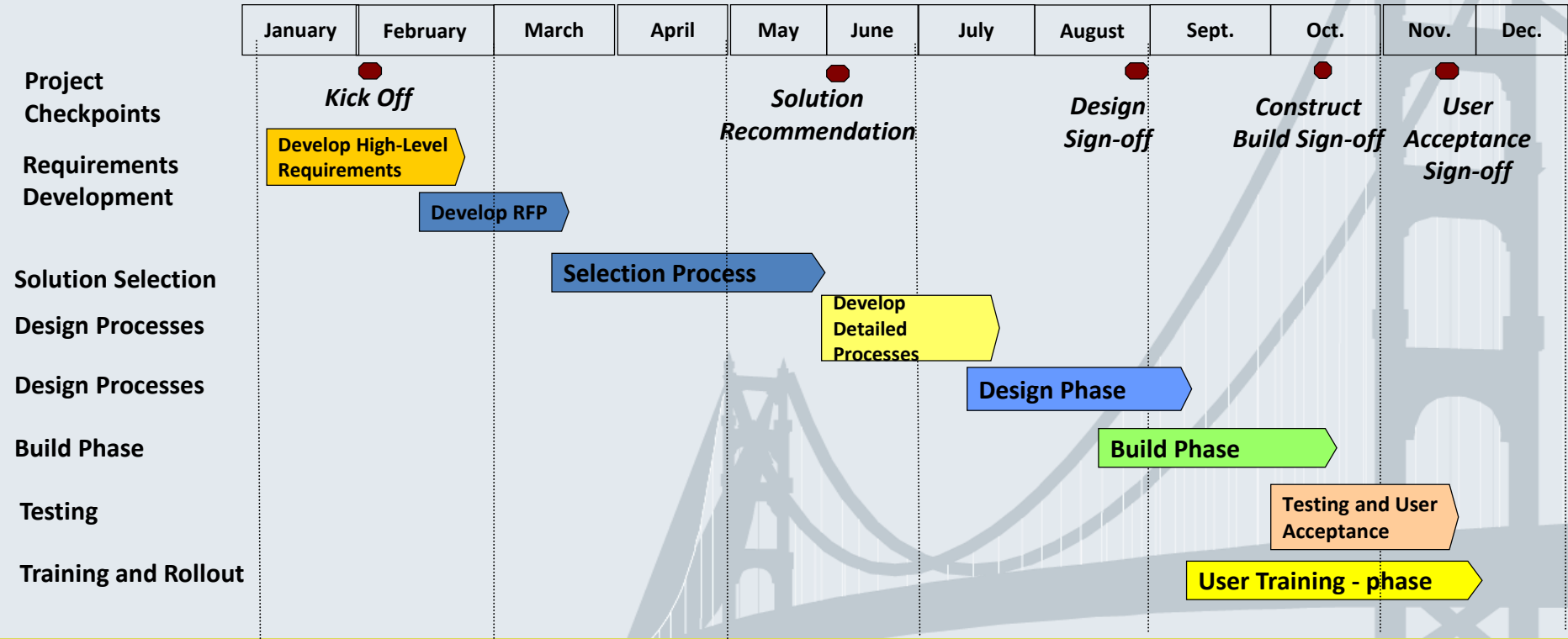
Implement CBM for two substations by October 2008

- Implement sensors and data collection at 2 substations (1 Distribution & 1 Transmission)
 - Distribution Substation
 - 2 transformers
 - Transmission Substation
 - 3 transformers
 - 24 gas breakers
- Implement back office data collection infrastructure, notification mechanisms and initial data analytics

Project Scope: Phase 2

- **Implement CBM for remaining 123 substations**
 - 102 Distribution Substations over 7 years
 - 226 Distribution Transformers
 - 194 Gas Circuit Breakers
 - 21 Transmission Substations over 5 years
 - 49 Transmission Transformers
 - 26 Distribution Transformers
 - 185 Gas Circuit Breakers
- **Integrate with enterprise systems and evolve/refine analytics**

CBM Implementation Phase 1 Timeline



System Requirements



System Features

- **Technical Requirements**
 - Product Flexibility, Scalability and Manageability
- **Functional Requirements**
 - How the product meets the needs of our business
- **Strategic Plans**
 - Roadmap for the future
- **Implementation Plan**
 - Capability to meet the schedule and project plan
- **Support Supplied**
 - Support structure and availability

CBM Vision Diagram



Transformers



Intelligent Electrical Devices
Localized processing

1

Breakers



Intelligent Electrical Devices
Localized processing

2

Substation

Required Communication Protocols between IED's and the Control House CBM Gateway:

- 1) MODBUS
- 2) DNP3.0

Physical pathways between IED's and the Control House CBM Gateway (possible methods):

- 1) Wireless with 256b Encryption
- 2) RS485
- 3) BPL with 256b Encryption
- 4) CAT6 Ethernet
- 5) Fiber

Substation Control House



Communication from Monitors to CBM Gateway

CBM Gateway polls IED's, conducts localized analytical requirements and stores historical data for further use.

Backhaul

This could include:

- Network routers and firewalls in Substations and the Data Center
- Substation WAN circuits
- Data Center WAN circuits
- Intrusion Detection/Prevention

Possible WAN communication methods:

- 56K or T1 dedicated circuit
- Fractional T1 Frame Relay
- Broadband wireless
- Fiber optic

WAN communications

Data transmitted to enterprise level gateway by time trigger or exception basis

Back Office



CBM Analytics

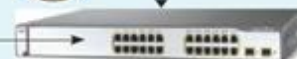
8



CBM Server

7

6



Enterprise Level Gateway

SDGE

A Semptra Energy utility®

What does CBM monitor on Distribution Transformers?



- Oil Temperature
 - Top Oil
 - Bottom Oil
- Winding Hot Spot Temperature (Calculated)
- LV Load Current
- Ambient Temperature
- Eight gas DGA
- Cooling System Manager / Monitor
- HV Bushing Power Factor
- LV Bushing Power Factor
- LTC Position Indication & Operations Counter
- LTC Motor Energy
- Conservator Integrity
- Provide Break-Out of Miscellaneous Bank Alarms

- Detect Loss of Cooling Fans/Pumps
- Detect Failed Control Contactor for Cooling Fans/Pumps
- Collect Data on Run Hours for Fans/Pumps

What does CBM monitor on Distribution Transformers?



- Detect Loss of Cooling Fans/Pumps
- Detect Failed Control Contactor for Cooling Fans/Pumps
- Collect Data on Run Hours for Fans/Pumps

- Oil Temperature
- Top Oil
 - LTC
 - Main Tank / LTC Differential
- Winding Hot Spot Temperature (Calculated)
- LV Load Current
- Ambient Temperature
- Hydrogen / Moisture Monitor
- Cooling System Manager / Monitor
- LTC Position Indication & Operations Counter
- LTC Motor Energy Monitor
- HV Bushing Power Factor Monitor
- On-line Main Tank 3 gas DGA
- On-line LTC Tank DGA Monitor
- LTC Vacuum bottle integrity
- Nitrogen Pressure

What does CBM monitor on Transmission Gas Breakers?



- Gas Pressure / Density
- Ambient Temperature
- Air Compressor / Hydraulic Motor Hour Meter (optional-not in use)

What is a Substation Gateway?

- Controls and monitors communication from multiple Sensors and Intelligent electronic devices over multiple protocols
 - Uses dead banding to minimize bandwidth requirements
- Manage, maintain and configure your substation equipment remotely
- Upgrade Substations without Having to Replace RTUs
 - Integrate existing and legacy RTUs, IEDs, PLCs, as well as multiple control centers
 - Add new network technologies and protocols without sacrificing data or legacy devices
- Prepare for NERC CIP compliance with the Gateway's security features

What is an Enterprise Gateway?

- Controls and monitors communication from multiple substation gateways – similar to a SCADA approach
- Centralizes Security
 - Active Directory Authentication for all 125 substation gateways
 - Encryption with the substation gateway
- Remotely manages firmware/configuration to IEDs or gateways
- Maps the data points/tags automatically to the PI System
- Interfaces with the PI System

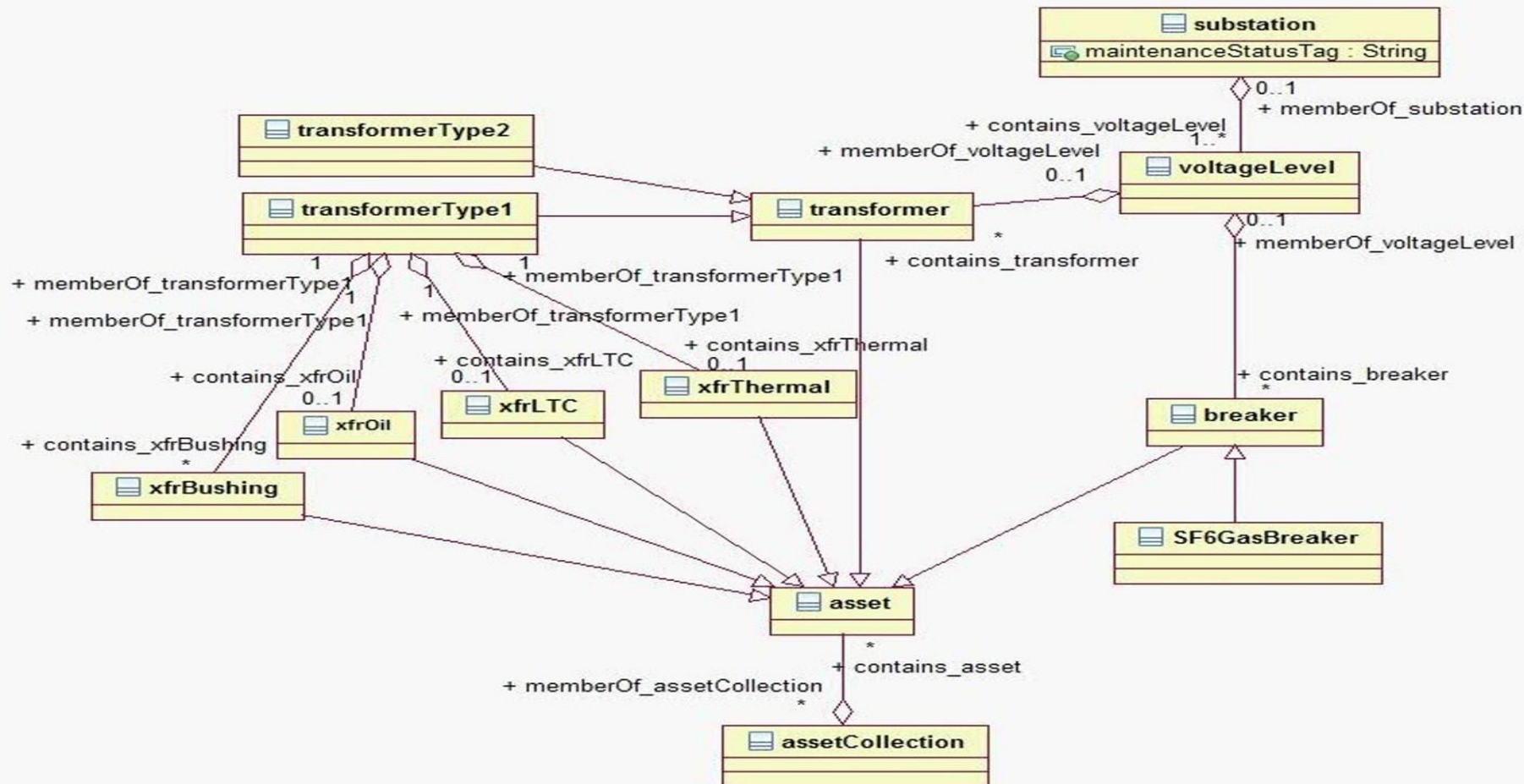
How CBM PI System is used

- Collects and stores time-series data
- Controls communication from Enterprise Gateway to PI
- Provides Analytics (ACE) and Visualizations (WebParts)
- Visualizes graphing, trending and analytics
- Maps data points automatically from Enterprise Gateway
- Integrates with T&D Operations PI System
- Integrates with Legacy applications (Phase 2)
- Sends PI Notifications and Acknowledgement
- Serves as a CBM Model server

How PI Is Used for a CIM Model Server

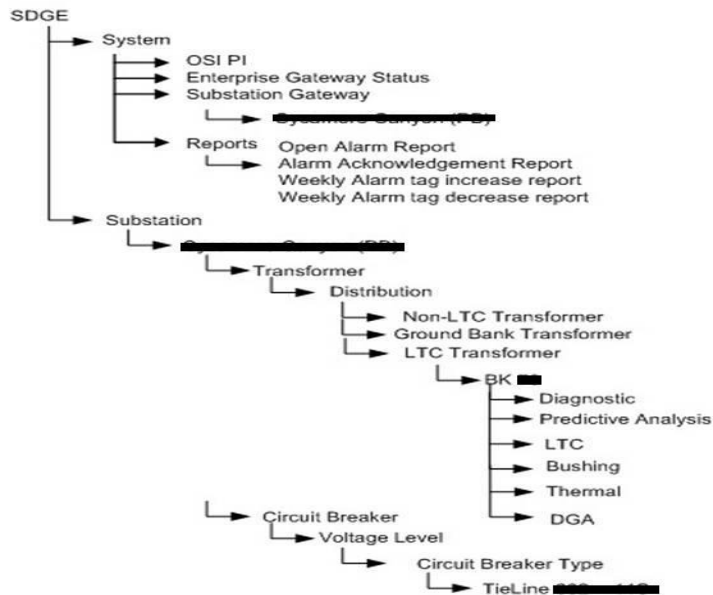
- Utilize PI capability to create a structure (model) for PI tags and
 - Module Database
 - Analysis Framework
- The structure allows tag data to be put into a meaningful context
- In Phase 1, the model is quite simple - a subset of the IEC 61970 Common Information Model
- Phase 2 includes a more complete model to allow CBM data to be accessed within a variety of contexts

SDG&E CBM CIM Asset Model



CBM Modeling (PI MDB)

- Once the model is loaded into PI, users access tags using a hierarchical tree based on the model



Properties Checklist

Substation Name
Substation Abbreviation
Voltage Class=Trans or Dist
CB Type = gas/oil,air/vacuum
CB Tieline = TL [redacted]

If no information assigned to a navigation branch,
no navigation branch is displayed

- Transformer Overview
- Transformer Diagnostic
- What-if
- LTC Overview
- Bushing Health Status
- Cooling
- DGA Summary
- Gas Circuit Breaker Summary

CBM Modeling (PI AF)

CBM - PI System Explorer

File Edit View Go Help

Database Query Date Back Check In New Element Search

Elements

- Elements
 - SISCO Managed Models
 - Layers
 - SDGE_CBM
 - Layers
 - ClassView
 - breakerAssets
 - breakerType
 - bushing
 - CBMSystem
 - DGA
 - distributionTransmission
 - LTC
 - LTCTransformer
 - predictiveAnalysis
 - report
 - SF6GasBreaker
 - Substation
 - systemReports
 - systemStatus
 - thermal
 - transformerAssets
 - transformerType
 - voltageLevel
 - InstanceView

Elements

CBM Group by: ☐ Category ☐ Template

Search

| Name | Description | Category | Type | Template |
|---------------------|-------------------|----------------|------|-----------------------------------|
| SISCO Managed Mo... | | | None | SISCO Model Template |
| SDGE_CBM | Created from R... | | None | SDGE_CBM |
| ClassView | | | None | |
| breakerAssets | | SDGE_CBM; S... | None | SDGE_CBM:breakerAssets |
| breakerType | | SDGE_CBM; S... | None | SDGE_CBM:breakerType |
| bushing | | SDGE_CBM; S... | None | SDGE_CBM:bushing |
| CBMSystem | | SDGE_CBM; S... | None | SDGE_CBM:CBMSystem |
| DGA | | SDGE_CBM; S... | None | SDGE_CBM:DGA |
| distributionTran... | | SDGE_CBM; S... | None | SDGE_CBM:distributionTransmission |
| LTC | | SDGE_CBM; S... | None | SDGE_CBM:LTC |
| LTCTransformer | | SDGE_CBM; S... | None | SDGE_CBM:LTCTransformer |
| predictiveAnalysis | | SDGE_CBM; S... | None | SDGE_CBM:predictiveAnalysis |
| report | | SDGE_CBM; S... | None | SDGE_CBM:report |
| SF6GasBreaker | | SDGE_CBM; S... | None | SDGE_CBM:SF6GasBreaker |
| Substation | | SDGE_CBM; S... | None | SDGE_CBM:Substation |
| systemReports | | SDGE_CBM; S... | None | SDGE_CBM:systemReports |
| systemStatus | | SDGE_CBM; S... | None | SDGE_CBM:systemStatus |
| thermal | | SDGE_CBM; S... | None | SDGE_CBM:thermal |
| transformerAssets | | SDGE_CBM; S... | None | SDGE_CBM:transformerAssets |
| transformerType | | SDGE_CBM; S... | None | SDGE_CBM:transformerType |
| voltageLevel | | SDGE_CBM; S... | None | SDGE_CBM:voltageLevel |
| InstanceView | | | None | |

Elements

Transfers

Library

Unit of Measure

MyPI

Notifications

Contacts

ClassView Modified: 10/28/2008 3:09:05 PM. Version: 1/1/1970 12:00:00 AM, Revision 1

Benefits of the Model-Driven Approach

- Creates an open environment for CBM application development
 - Users can easily develop custom applications
- Model enables the creation of navigation trees
 - Navigate to data instead needing to remember the tag names
- Builds a model-aware application development
 - PI Based CBM applications can focus on specific problem areas such as a particular asset type or operating history

PI Notifications

CBM - PI System Explorer

File Tools View Go Help

Database Query Date Back Check In Apply Template

Notifications

New

SX_BK60_LTC_AlarmLevel3
SX_BK60_LTC_AlarmLevel4
SX_BK60_Main Tank Buchholz Relay_AlarmLevel4
SX_BK60_Main Tank COPS Membrane Failure_AlarmLe
SX_BK60_Pressure Relief Device Main Tank_AlarmLev
SX_BK60_THER_AlarmLevel3
SX_BK60_THER_AlarmLevel4
SX_BK60_Top Oil Gauge High Temp 1_AlarmLevel3
SX_BK60_Top_Oil_Temp_AlarmLevel3
SX_BK60_Top_Oil_Temp_AlarmLevel4
SX_BK60_Winding Gauge High Temp 1_AlarmLevel3
SX_BK70_BUSH_AlarmLevel3
SX_BK70_BUSH_AlarmLevel4
SX_BK70_Calculated Winding Hot Spot_AlarmLevel3
SX_BK70_Calculated Winding Hot Spot_AlarmLevel4
SX_BK70_DGA_AlarmLevel3
SX_BK70_DGA_AlarmLevel4
SX_BK70_DGA_CommFail_AlarmLevel2
SX_BK70_DR_CommFail_AlarmLevel2
SX_BK70_Low Oil Main Tank_AlarmLevel3
SX_BK70_LTC_AlarmLevel3
SX_BK70_LTC_AlarmLevel4
SX_BK70_Main Tank Buchholz Relay_AlarmLevel4
SX_BK70_Main Tank COPS Membrane Failure_AlarmLe
SX_BK70_Pressure Relief Device Main Tank_AlarmLev

Elements

Transfers

Library

Unit of Measure

MyPI

Notifications

Contacts

SX_BK60_LTC_AlarmLevel4

Overview Trigger Content Subscriptions History

Target: \\VAP-CBMINT-S01\CBM\SISCO Managed Models\SDGE_CBM\ClassView\LTC\SX 60 L

Select A Target...

Conditions

New Condition

| Rule | Configuration | Time True | Result ... | Priority |
|------------|-----------------------|-----------|------------|----------|
| Comparison | LTC.LTC_GROUP_ALM = 4 | 0 | Alarm 4 | Normal |

Time Rule: Natural

Options

☒ Notify only on change in status

Resend Interval: 0 Seconds


Non Repetition Interval: 0 Seconds

Start CBM - PI System Expl...

8:08 AM

CBM PI Email Notifications



From:  opex2020cbm@semprautilities.com
To: CBM-XfmrLv4 Ack
Cc:
Subject: SX_BK71_THER_AlarmLevel4

Sent: Wed 1/21/2009 11:57 AM

Name: SX_BK71_THER_AlarmLevel4
Description: [REDACTED] Bank 71 Thermal Alarm Level 4
Server: AP-CBMINT-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: AP-CBMINT-P01\CBM2\SISCO Managed Models\SDGE_CBMClassView\thermal\SX 71 Thermal
Value: Alarm 4
Priority: Normal

Link:
[SX - BK71 - Thermal](#)

Actions:
[Acknowledge](#)
[Acknowledge with comment](#)

PI ACE

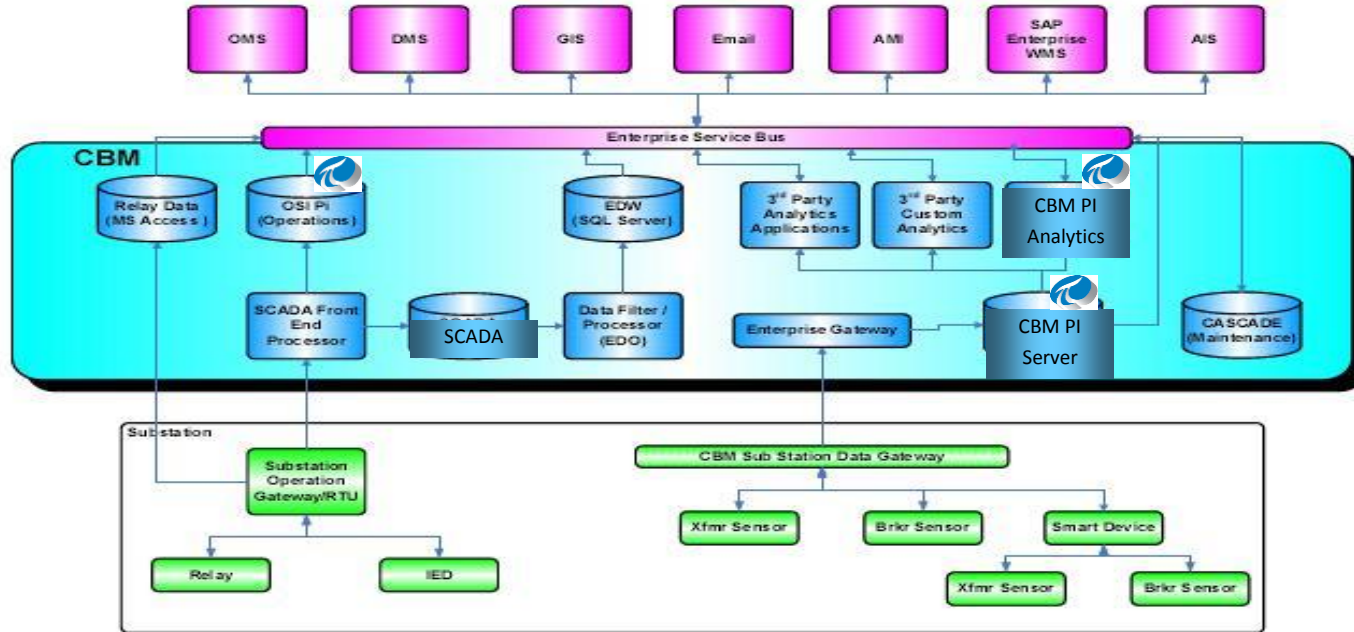
| Name | Status/Value | Since | Schedule | Output Tags |
|------------------------------|--------------|-----------------------|----------------|-------------|
| Current Status | On | 2/13/2009 10:24:30 AM | | |
| Scheduler Location | AP-CBMINT... | | | |
| Scheduler Owner | SYSTEM | | | |
| Scheduler Version | 2.x | | | |
| Context Summary | | | | |
| AP-CBMPI-S01\AlarmSummar... | On | 2/13/2009 10:24:38 AM | Clock (600, 0) | 0 |
| AP-CBMPI-S01\E1000_Alarm... | On | 2/26/2009 10:28:12 AM | Clock (120, 0) | 0 |
| AP-CBMPI-S01\PIPostProces... | On | 2/13/2009 10:24:38 AM | Clock (300, 0) | 0 |
| AP-CBMPI-S01\PIPreProcess... | On | 2/13/2009 10:24:38 AM | Clock (300, 0) | 0 |
| AP-CBMPI-S01\PIWeeklyPro... | On | 2/13/2009 10:24:39 AM | Clock (600, 0) | 0 |

- Background ACE Jobs
 - Alarm Tags Generation
 - Transformer Oil Analysis
 - Alarm Summary
 - Alarm Increase Reports
 - Alarm Decrease Reports

CBM Future Integration



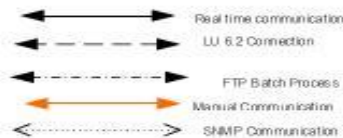
CBM TO-BE SYSTEM CONTEXT & DATA FLOW



Systems Color Coding & Major Functional Areas



LEGEND



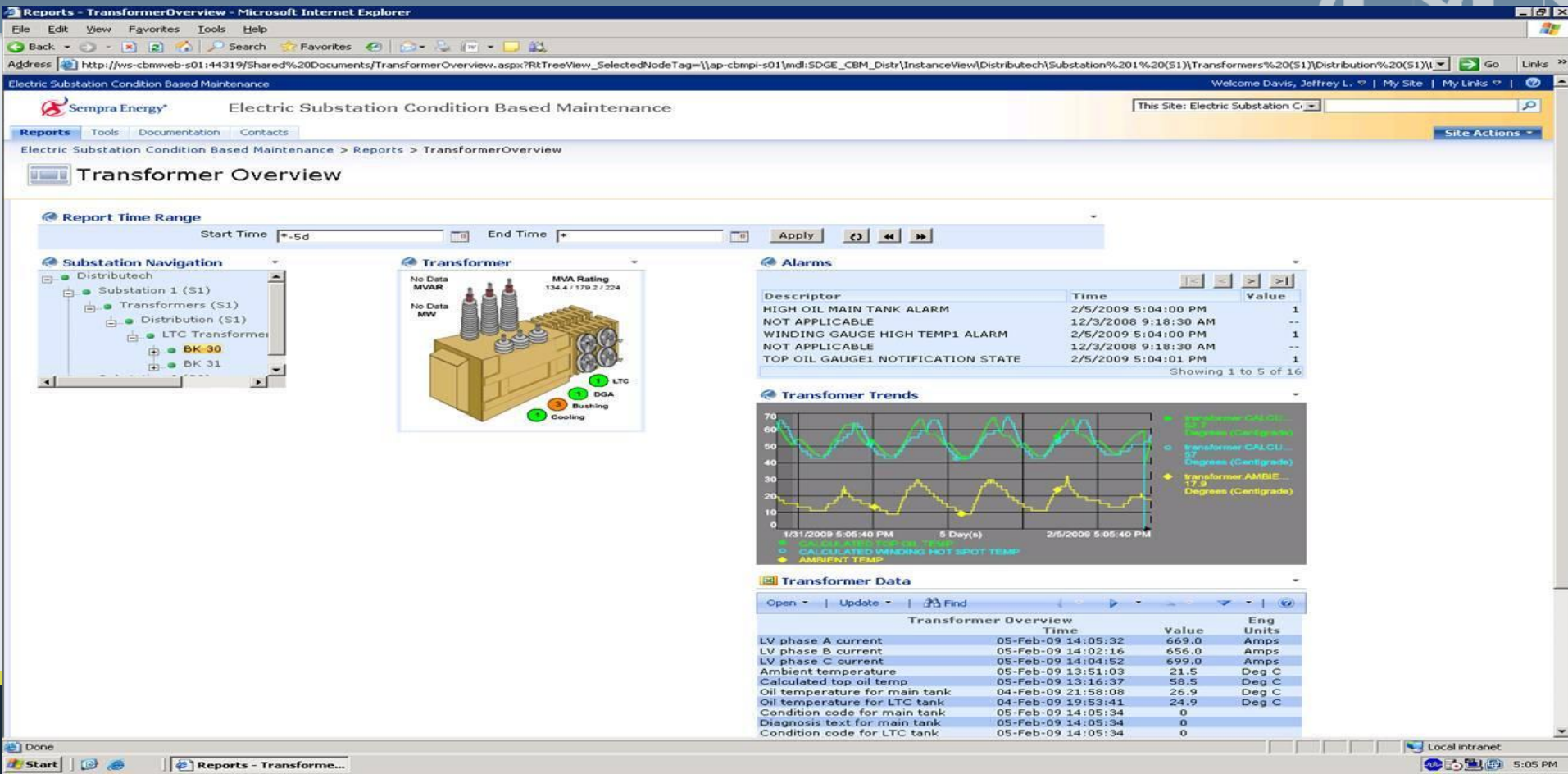
EDW - Engineering Data Warehouse
AIS - Asset Information System
RTU - Remote Terminal Unit
IED - Intelligent Electronic Device
OMS - Outage Management System
CBM - Condition Based Maintenance
EDO - Electric Distribution Operators

Glossary

PI Implementation Examples



Transformer Overview



Bushings

Reports - TransformerBushings - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Search Favorites

Address http://ws-cbmweb-s01:44319/Shared%20Documents/TransformerBushings.aspx?RtTreeView_SelectedNodeTag={\ap-cbmip-s01\mdl:SDGE_CBM_Distr\InstanceView\Distribution\Substation%201%20(S1)\Transformers%20(S1)\Distribution%20(S1)\L... Go Links

Electric Substation Condition Based Maintenance

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This Site: Electric Substation C... Site Actions

Reports Tools Documentation Contacts

Electric Substation Condition Based Maintenance > Reports > TransformerBushings

Transformer Bushings

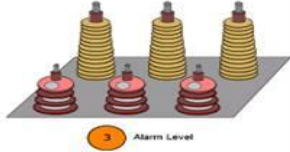
RtTimeRange

Start Time -5d End Time Apply

Substation Navigation

- Substation 1 (S1)
 - Transformers (S1)
 - Distribution (S1)
 - LTC Transformers (S1 D)
 - BK 30
 - BK 30 Bushing
 - BK 30 DGA
 - BK 30 LTC
 - BK 30 Predictive f
 - BK 30 Thermal
 - BK 31

Transformer Bushings



Alarm Level

Alarms

| Descriptor | Time | Value |
|------------------------------|----------------------|----------|
| NOT APPLICABLE | 12/3/2008 9:18:30 AM | -- |
| HV BUSHING CURRENT IMBALANCE | 12/3/2008 8:27:15 AM | Shutdown |
| NOT APPLICABLE | 12/3/2008 9:18:30 AM | -- |
| HV BUSHING 1 POWER FACTOR | 2/5/2009 5:06:00 PM | 1 |
| HV BUSHING 1 CAPACITANCE | 2/5/2009 5:06:00 PM | 1 |

Showing 1 to 5 of 15

Status

| Descriptor | Time | Value |
|---|----------------------|--------|
| ALARM ON CURRENT IMBALANCE MAGNITUDE HV | 2/5/2009 2:52:21 PM | Normal |
| NOT APPLICABLE | 12/3/2008 9:18:30 AM | -- |
| NOT APPLICABLE | 12/3/2008 9:18:30 AM | -- |

Excel Web Access - Bushing Report

Open Update Find

| Bushing Data | Time | Value | Eng Units |
|--------------------------------|--------------------|-------|-----------|
| HV bushing 1 capacitance | 05-Feb-09 14:52:21 | 0 | pF |
| HV bushing 1 power factor | 05-Feb-09 14:52:21 | 0 | % |
| HV bushing 2 capacitance | 05-Feb-09 14:52:21 | 0 | pF |
| HV bushing 2 power factor | 05-Feb-09 14:52:21 | 0 | % |
| HV bushing 3 capacitance | 05-Feb-09 14:52:21 | 0 | pF |
| HV bushing 3 power factor | 05-Feb-09 14:52:21 | 0 | % |
| HV bushing 3 current imbalance | 05-Feb-09 14:52:21 | 0 | % |
| HV bushing vector imbalance | 05-Feb-09 14:52:21 | 0 | Deg |
| HV bushing vector temp dep | 05-Feb-09 14:52:21 | 0 | % |
| LV bushing 1 capacitance | 05-Feb-09 17:07:07 | -- | pF |
| LV bushing 1 power factor | 05-Feb-09 17:07:07 | -- | % |
| LV bushing 2 capacitance | 05-Feb-09 17:07:07 | -- | pF |
| LV bushing 2 power factor | 05-Feb-09 17:07:07 | -- | % |
| LV bushing 3 capacitance | 05-Feb-09 17:07:07 | -- | pF |
| LV bushing 3 power factor | 05-Feb-09 17:07:07 | -- | % |
| LV bushing vector imbalance | 05-Feb-09 17:07:07 | -- | Deg |

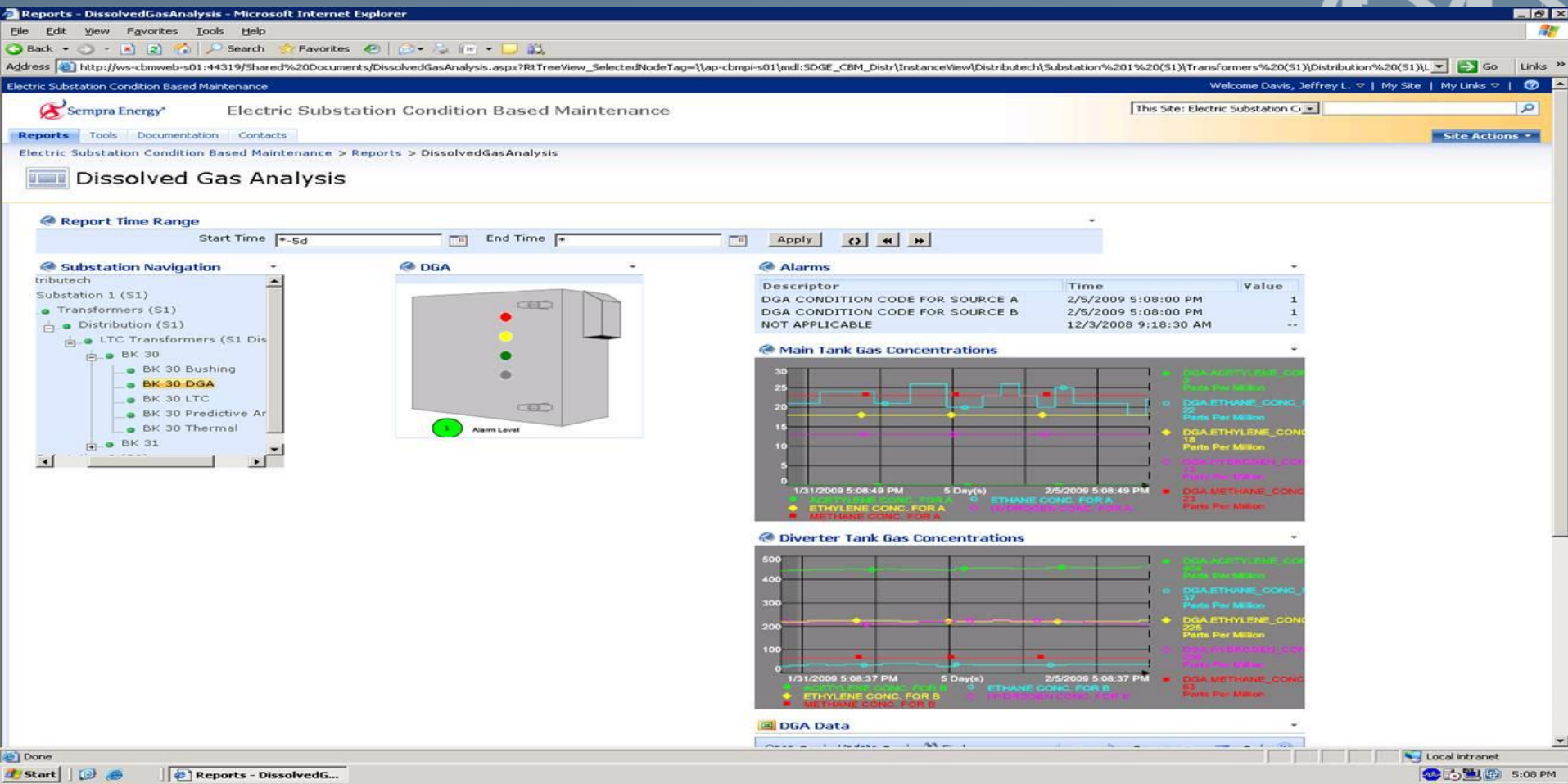
Done

Start Reports - Transforme...

Local intranet

5:07 PM

Dissolved Gas Analysis



LTC Overview

Reports - LTCOverview - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Search Favorites

Address [http://ws-cbmweb-s01:44319/Shared%20Documents/LTCOverview.aspx?RtTreeView_SelectedNodeTag={\ap-cbmip-s01\ndi:SDGE_CBM_Distr\InstanceView\Distribution\Substation%20\(S1\)\Transformers%20\(S1\)\Distribution%20\(S1\)\LTC%20](http://ws-cbmweb-s01:44319/Shared%20Documents/LTCOverview.aspx?RtTreeView_SelectedNodeTag={\ap-cbmip-s01\ndi:SDGE_CBM_Distr\InstanceView\Distribution\Substation%20(S1)\Transformers%20(S1)\Distribution%20(S1)\LTC%20) Go Links

Electric Substation Condition Based Maintenance

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Reports Tools Documentation Contacts

Electric Substation Condition Based Maintenance > Reports > LTCOverview

LTC Overview

Report Time Range

Start Time End Time Apply

Substation Navigation

ributech

Substation 1 (S1)

- Transformers (S1)
- Distribution (S1)
- LTC Transformers (S1 Dis)
- BK 30
 - BK 30 Bushing
 - BK 30 DGA
 - BK 30 LTC**
 - BK 30 Predictive An
 - BK 30 Thermal
- BK 31

LTC Tap Position

LTC Position

16 L 16 R

3 Lower

Alarm Level

Alarms

| Descriptor | Time | Value |
|--|----------------------|-------|
| NOT APPLICABLE | 12/3/2008 9:18:30 AM | -- |
| LTC HIGH TEMP ALARM | 2/5/2009 5:08:00 PM | 1 |
| LTC TANK TEMPERATURE SENSOR FAIL ALARM | 2/5/2009 5:08:00 PM | 1 |
| PRESSURE RELIEF DEVICE LTC ALARM | 2/5/2009 5:08:00 PM | 1 |
| PRESSURE RELIEF DEVICE MAIN TANK | 2/5/2009 5:08:00 PM | 1 |

Showing 1 to 5 of 6

Sensors

| Descriptor | Time | Value | EngineeringUnits |
|------------------------------|------------|--------|------------------|
| DAYS SINCE LAST PASS-THROUGH | 2/5/2009 | 0 | Days |
| NEUTRAL | 2:52:20 PM | | |
| LTC NOT PASSED-THROUGH | 2/5/2009 | | |
| NEUTRAL COUNTER ALARM | 2:52:21 PM | Normal | |

LTC Data

Open | Update | Find

| Number of Tap Operations | | | |
|--------------------------|-------|-----|-------|
| | Start | End | Total |
| Tap R 16 | 0 | 0 | 0 |
| Tap R 15 | 0 | 0 | 0 |
| Tap R 14 | 0 | 0 | 0 |
| Tap R 13 | 0 | 0 | 0 |
| Tap R 12 | 0 | 0 | 0 |
| Tap R 11 | 0 | 0 | 0 |
| Tap R 10 | 0 | 0 | 0 |
| Tap R 9 | 0 | 0 | 0 |
| Tap R 8 | 0 | 0 | 0 |
| Tap R 7 | 3 | 0 | -3 |
| Tap R 6 | 29 | 6 | -23 |
| Tap R 5 | 57 | 15 | -42 |
| Tap R 4 | 89 | 20 | -69 |
| Tap R 3 | 123 | 30 | -93 |
| Tap R 2 | 194 | 68 | -126 |

Thermal/Cooling

Reports - TransformerCoolingOverview - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address http://ws-cbmweb-s01:44319/Shared%20Documents/TransformerCoolingOverview.aspx?RtTreeView_SelectedNodeTag={\ap-cbmipi-s01\mdl:SDGE_CBM_Distr\InstanceView\ Distributech\Substation%201%20(S1)\Transformers%20(S1)\Distribution%20(S1)\LTC Transformer%20(S1)\BK 30\BK 30 The

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Site Actions

Reports Tools Documentation Contacts

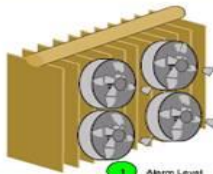
Electric Substation Condition Based Maintenance > Reports > TransformerCoolingOverview

Tranformer Cooling Overview

Substation Navigation

- Distributech
 - Substation 1 (S1)
 - Transformers (S1)
 - Distribution (S1)
 - LTC Transformer
 - BK 30
 - BK 30 Bus
 - BK 30 DG
 - BK 30 LTC
 - BK 30 Pre
 - BK 30 The**
 - BK 31

Transformer Cooling



Alarm Level

Alarms

| Descriptor | Time | Value |
|--|----------------------|-------|
| NOT APPLICABLE | 12/3/2008 9:18:30 AM | -- |
| NOT APPLICABLE | 12/3/2008 9:18:30 AM | -- |
| GROUP 1 COOLER CONTACTOR FAIL ALARM | 2/5/2009 5:10:00 PM | 1 |
| GROUP 2 COOLER CONTACTOR FAIL ALARM | 2/5/2009 5:10:00 PM | 1 |
| DR SYSTEM FAILURE ALARM | 2/5/2009 5:10:00 PM | 1 |
| MAIN TANK TOP OIL TEMPERATURE SENSOR FAIL | 2/5/2009 5:10:00 PM | 1 |
| MAIN TANK BOTTOM OIL TEMPERATURE SENSOR FAIL ALARM | 2/5/2009 5:10:00 PM | 1 |
| DRMCC COMMUNICATION FAILURE ALARM | 1/25/2009 4:20:00 AM | 1 |
| NOT APPLICABLE | 12/3/2008 9:18:30 AM | -- |
| GROUP 1 FAN CURRENT HIGH | 2/5/2009 5:10:00 PM | 1 |
| GROUP 1 FAN CURRENT LOW | 2/5/2009 5:10:00 PM | 1 |

Showing 1 to 11 of 15

Status

| Descriptor | Time | Value |
|-----------------|----------------------|-------|
| NOT APPLICABLE | 12/3/2008 9:18:30 AM | -- |
| GROUP 1 FANS ON | 2/5/2009 2:52:21 PM | On |
| GROUP 2 FANS ON | 2/5/2009 2:52:21 PM | On |
| NOT APPLICABLE | 12/3/2008 9:18:30 AM | -- |

Sensors

| Descriptor | Time | Value | EngineeringUnits |
|-------------------------|----------------------|-----------|------------------|
| GROUP 2 FAN CURRENT | 2/5/2009 2:52:20 PM | 0 AMPS | |
| GROUP 1 FAN CURRENT | 2/5/2009 2:52:20 PM | 0 AMPS | |
| GROUP 1 RUN HOURS (FAN) | 2/5/2009 2:52:34 PM | 475 Hours | |
| NOT APPLICABLE | 12/3/2008 9:18:30 AM | -- | |

Done

Start

Reports - Transforme...

Local intranet

5:11 PM

SF6 Gas Circuit Breakers

Reports - TransmissionSF6GasCircuitBreakers - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Search Favorites Home

Address http://ws-cbmweb-s01:44319/Shared%20Documents/TransmissionSF6GasCircuitBreakers.aspx?RtTreeView_SelectedNodeTag={\ap-cbmpl-s01\ndl:SDGE_CBM_Distr\InstanceView\ Distributech\Substation%20%20(S2)\Circuit%20Breakers%20(S2)\1\ Go Links

Electric Substation Condition Based Maintenance

Welcome Davis, Jeffrey L. My Site My Links

Sempra Energy

Electric Substation Condition Based Maintenance

This Site: Electric Substation C

Reports Tools Documentation Contacts

Site Actions

Electric Substation Condition Based Maintenance > Reports > TransmissionSF6GasCircuitBreakers

Transmission SF6 Gas Circuit Breakers

Report Time Range

Start Time -5d

End Time

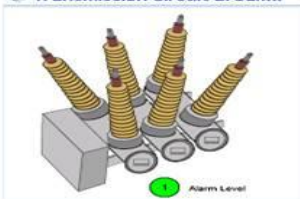
Apply

Previous Next

Substation Navigation

- Distributech
 - Substation 1 (S1)
 - Substation 2 (S2)
 - Circuit Breakers (S2)
 - 138 Voltage Level
 - Gas Breakers (1)
 - 92S
 - 32T
 - 33T
 - 230 Voltage Level
 - 69 Voltage Level

Transmission Circuit Break...



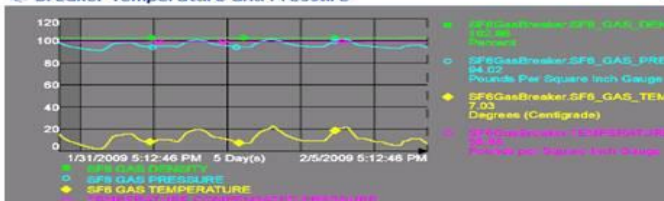
Alarms

| Descriptor | Time | Value |
|-----------------------------|----------------------|-------|
| SM6-0 COMMUNICATION FAILURE | 1/25/2009 4:20:00 AM | 1 |
| GCB GROUP ALARM | 2/5/2009 5:12:27 PM | 1 |
| LOW GAS ALARM 1 | 2/5/2009 5:12:00 PM | 1 |
| LOW GAS ALARM 2 | 2/5/2009 5:12:00 PM | 1 |
| TROUBLE ALARM | 2/5/2009 5:12:00 PM | 1 |

Sensors

| Descriptor | Time | Value | EngineeringUnits |
|----------------------------------|---------------------|--------|------------------------------|
| SF6 GAS DENSITY | 2/5/2009 9:10:37 AM | 102.86 | Percent |
| SF6 GAS PRESSURE | 2/5/2009 4:38:37 PM | 94.02 | Pounds Per Square Inch Gauge |
| SF6 GAS TEMPERATURE | 2/5/2009 4:47:21 PM | 7.03 | Degrees (Centigrade) |
| TEMPERATURE COMPENSATED PRESSURE | 2/5/2009 9:10:37 AM | 98.98 | Pounds per Square Inch Gauge |

Breaker Temperature and Pressure



Done

Start Reports - Transmissi...

Local intranet

5:12 PM

Summary

- SDG&E Real-Time CBM Project is the first-of-its-kind in the industry – end-to-end from substation sensors to backoffice analytics and visualization
- CBM moves SDG&E one step closer to meeting its objectives:
 - Increase asset utilization
 - Do the right maintenance, on the right piece of equipment, and at the right time
 - Leverage technology to make business processes more efficient