Leveraging AVEVA™ PI System™ to Integrate D-SCADA with OMS

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Consolidated Edison Company of New York (ConEdison)

Enterprise Agreement signed in year 2020

- Electric Operations
  - Distribution
  - Transmission
- Gas Operations
- Steam Operations
Consolidated Edison Company of New York (ConEdison)

Energy for New York City and Westchester

- Longest-listed company on the New York Stock Exchange
- 200 years of legacy
- 3.62 Million Electric Customers
  - 2.5 Million Network
  - 1 Million Non-Network
- 36,000 Miles of Overhead Transmission & distribution lines
- 94,000 Miles of Underground Transmission & distribution lines
- Record System Peak Load: 13,321 MW
- 1.1 Million Gas Customers
- 4,300 miles of gas mains
- 1,700 Steam Customers
- 105 miles of Steam mains and lines
Expansive distribution system

Distribution Electric Control Center (Manhattan, Brooklyn & Queens, Bronx & Westchester, Staten Island)

- 65 Second Contingency Networks
  - Ability to operate on the loss of 2 sources
- 19 First Contingency Networks
  - Ability to operate on the loss of 2 sources
- 62 Substations
  - 2210 Distribution Feeders
  - 43,000 Network Transformers
  - 185 Autoloops
  - 217 4kV Unit Substations
  - 110 Step Down Feeders
- 266,573 manholes and service boxes
Distribution system overview

AutoLoop Systems @ ConEdison

- 2 Feeders connected by a normally open switch
- Multiple Automatically operated and SCADA operated sectionalizing switches

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Distribution system overview

4KV Grid System @ ConEdison

• Multiple interconnected Unit Substations
  • Each substation supplied by a different Distribution Feeder
  • Connected through distribution feeders with normally closed automatically and SCADA operated switched in between
• Supports overhead areas with over 676 feeders
SCADA System - screenshot
D-SCADA to OMS Integration Project

ConEd Success Story

**Challenge**
- Manually Open/Close SCADA device in OMS Viewer
- Manually adjust restore time
- Rely on OMS prediction rules for outage calls

**Solution**
- Leverage PI to create device Change of Status (COS) Analytics using Eventframes
- PI Notification web service function to call Webservice
- Leverage PI AF to create Device mapping between D-SCADA and OMS
- Leverage PI4BA for reporting

**Benefits**
- Automatically Open/Close SCADA device in OMS Viewer
- Automatically group customer calls and AMI last gasps
- Automatically capture accurate restoration time based on SCADA
- Automatically suppress AMI last gasps caused by SCADA operations
Distribution Electric AVEVA PI System

Quick Facts

- 1.5 Million PI tags
- Data from SCADA Master System
- 10 years of Data worth 6 TB (4 GB/Day)
- Highly available PI System with DR site
- PI AF High Availability via Load Balancer
- Analysis and Notification High Availability via Microsoft Windows Clustering
- PI Integrator for Business Analytics (100K Data Stream)
Outage Management System @ ConEd

Oracle Network Management System 2.3

D-SCADA TO OMS Integration
D-SCADA to OMS integration

High Level Overview

D-SCADA
GE XA/21

Raw Data from Field Devices

PI System

Device Mapping
Using PI AF

Device Change of Status (COS) Events
with OMS Specific Details

OMS
Oracle NMS 2.3
D-SCADA to OMS integration

Project Specific Details

• ~ 5000 Overhead Reclosers
• ~ 900 Feeder Breakers
• 30 Element Templates
• 15 Eventframe Templates
• 17K individual Analyses (Expression and Eventframes)
• 10K Notification Rules
• Tableau Dashboard for Reporting (using PI integrator for Business Analytics)
Asset structure – drill down

SCADA Device – OMS ALIAS from Mapping Table – RTU #2613
3011:22AB:P48355:GTTS:900000173

Device Phase Switch Position – Data feed from SCADA System
Element attribute – table lookup
## Eventframe & Notifications

### General Tab
- **Name**: SCADA to STAR - Hot Line Status

### Attributes Tab
- **RTU Communication**
- **SCADA to STAR - Millisecond Timestamp**
- **SCADA to STAR - Switch A Status**
- **SCADA to STAR - Switch B Status**
- **SCADA to STAR - Switch C Status**
- **Time Offline Calculator**
- **TRIP A Phase**
- **TRIP B Phase**
- **TRIP C Phase**

### Notification Rules Tab
- **SCADA to STAR - Hot Line Tag Notification**: Analysis = SCADA to STAR - Hot Line Status
- **SCADA to STAR - Switch A Status**: Analysis = SCADA to STAR - Switch A Status
- **SCADA to STAR - Switch B Status**: Analysis = SCADA to STAR - Switch B Status
- **SCADA to STAR - Switch C Status**: Analysis = SCADA to STAR - Switch C Status

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### Event Frame Template
- **Name**: Event Frame Template
- **Event Frame**: STS-OH-SW 3 Ph - Switch Position A
- **Generation Mode**: Explicit Trigger
- **Variables**
  - Start Trigger: `PreVal('Switch Position A', '1') <> TagVal('Switch Position A', '1') AND Not(bad)
  - End Trigger: `PreVal('Switch Position A', '1') <> TagVal('Switch Position A', '1') AND Not(bad)`
- **Scheduling**: Event-Triggered
- **Trigger on**: Any Input

### Subscriptions
- **Name**: SCADA to STAR - Switch A Status
- **Configuration**: STAR WebService Delivery Channel
- **Notify-Option**: Event start

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Attribute Mapping

PI Notification Web Service Configuration

- 18 Attribute Mapping between PI and OMS including Notification Send Time

- Transaction Success/Error Message back from Webservice into SQL Table thus closing out feedback loop

- Heartbeat Function –
  - Calculated SCADA Point toggling b/w 0 & 1 every minute
  - 3 heartbeat point for 3 regions (BQ, XW and SI)
  - Heartbeat Monitoring on OMS end – Alerts generated if heartbeat not received within 10 minutes
Example

• Step 1 – SCADA sends FVRS Device OPEN operation on the Loop resulting into Loop de-energized

• Step 2 – SCADA sends TVRS Device CLOSE operation on the Loop resulting into Loop re-energized
### SCADA OHSW Status Report

<table>
<thead>
<tr>
<th>Region</th>
<th>RTUID</th>
<th>Loop</th>
<th>Communication</th>
<th>Supply</th>
<th>STAR ALIAS</th>
<th>Location</th>
<th>Critical Status</th>
<th>Switch Position A</th>
<th>Switch Position B</th>
<th>Switch Position C</th>
<th>Alignment - STAR Vs PI</th>
<th>Nominal State</th>
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### Filters
- **Borough**
- **Nominal Vs Not Nominal Device**

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**Tableau Report using PI Integrator for BA**

Filter by Borough

Nominal Vs Not Nominal Device filter
D-SCADA to OMS integration project

Project Challenges & Lessons Learned

• Challenge -
  • Aging equipment, contacts losing connectivity – Resulted into Chattering of devices
    • More than 100 Operations in a week
    • Feeder breakers also had chattering issues

• Mitigation -
  • Implemented 2 Level of Chatter Filter using Expression Analytics
    • Overhead Reclosers – Max 6 events in an hour, max 12 events in 24 hours
    • Feeder Breakers – Analyze phase currents on every feeder trip/close, if Phase currents reduces/increases than true operations else ignore event

• Results -
  • Only valid Operations being sent to OMS
  • Increased accuracy & Better resiliency of overall system
Chatter filters

Chatter Filter using NumofChanges Function for Overhead Reclosers

Chatter Filter comparing Phase Currents for Feeder Breakers
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Questions?
Please wait for the microphone.
State your name and company.

Please remember to...
Navigate to this session in the mobile app to complete the survey.

Thank you!
“Arise, Awake and Stop not until the goal is reached”

Swami Vivekananda
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