Case Study – Improving System Performance Using Distribution Network Automation

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Westar Energy at a Glance

- Generation, transmission, and distribution
- 690,000 customers
- 11,000-square-mile service territory
- 725 substations
- 1,227 distribution circuits
Distribution Automation (DA) Objectives

- Increase system reliability
- Reduce outage restoration times
- Minimize distribution system losses
- Reduce loading during peak conditions
- Improve system operation
- Improve service to customers
SmartStar Lawrence DA Functionality

• Fault location, isolation, and service restoration (FLISR) on 15 distribution circuits (12.47 kV) from 5 substations

• Volt / VAR optimization on 24 circuits from same 5 substations
SmartStar DA Equipment

- 34 smart bidirectional reclosers
- 53 capacitor bank controls
- 87 3G and 4G LTE cellular modems
- Distribution automation controller (DAC)
- Ethernet security gateway
- 10 substation transformer LTC controls
- 39 nontelemetered switches
Why Cellular Communications?

- Deployment time minimized
- Cellular provider – system maintenance
- Loss of communications acceptable but not desirable
- Low total cost of ownership per asset
- Data availability and ownership
Why Cellular Communications?

- 3G 1st Generation
- 3G 2nd Generation
- LTE 1st Generation
- LTE 2nd Generation

Percent of Time Online:

- <99.90
- 99.91
- 99.92
- 99.93
- 99.94
- 99.95
- 99.96
- 99.97
- 99.98
- 99.99
- >99.99

Safety Features Disable Automation

- Hot-line tags
- Disabled reclosing
- DAC-identified loop
- Loss of communications
- System load shedding
- Tagged recloser (out of service or bypassed)
- Excluded circuit
Event Provides Success Story

- Fault occurs within customer switchgear
- Upstream recloser – substation breaker open and lock out
Event Provides Success Story

- Event caused by apparent miscoordination
- Event triggered review by DA group
- Event data collected by DA system for analysis
• First upstream recloser properly cleared switchgear fault
• Secondary fault upstream of recloser caused circuit to lock out
• Based on nature of fault, it appeared to be mid-span

Getting to Root Cause
Getting to Root Cause

- Long spans where magnetic forces may cause fault events were identified
- Field inspection revealed arcing and burn marks
- Spacers installed to prevent future faults
### Successful Reconfigurations

#### Customer Minutes Interrupted (CMI)

<table>
<thead>
<tr>
<th>Event Date</th>
<th>Circuit(s)</th>
<th>Total Possible CMI</th>
<th>Actual CMI</th>
<th>Saved CMI</th>
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<tbody>
<tr>
<td>11/10/2014</td>
<td>19TH 12-22 to 6TH 12-34</td>
<td>47,212</td>
<td>14,134</td>
<td>33,078</td>
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<td>11/24/2014</td>
<td>19TH 12-22 to 6TH 12-34</td>
<td>99,591</td>
<td>53,997</td>
<td>45,594</td>
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<td>08/19/2016</td>
<td>6TH 12-34 to LAWH 12-12</td>
<td>102,242</td>
<td>23,584</td>
<td>78,658</td>
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<td>12/07/2016</td>
<td>LAWH 12-24 to LAWH 12-26</td>
<td>59,641</td>
<td>5,589</td>
<td>54,052</td>
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<td>06/17/2017</td>
<td>LAWH 12-12 to LAWH 12-24</td>
<td>80,824</td>
<td>42,893</td>
<td>37,931</td>
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<td><strong>Total</strong></td>
<td></td>
<td><strong>249,313</strong></td>
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</table>
Automation Successes
VISION Application Identifies Fault Confidence Areas

4VAN012031 - Focus on this feeder
Asset ID -> T012G11243 - Device Profile
Asset Type -> Switch
Latitude -> 39.0567993102086
Longitude -> -95.633179283119
VAR Optimization
Control Modes

- Optimize voltage on feeder
- Optimize power factor (PF) on feeder
- Optimize PF on substation bus
- Demand response for peak load reduction
- Optimize VAR set point on primary side of transformer for transmission VAR support
VAR Optimization
Results for Feeder LAWH 12-22

VARs
Watts
VA

Magnitude

VAR Control Enabled

Date

Future Implementations

• Legacy recloser communications retrofitted with cellular communications
• Additional LTC and capacitor controls for volt / VAR optimization
• Advanced distribution management system
• Integrated augmented reality with controls
SmartStar DA Conclusions

• Centralized DAC provides powerful system that improves reliability and efficiency

• Application of industry-standard protocols allows existing and new controls to be used

• Ease of use and training are key to adoption by engineers and operators

• Secure communications to remote devices have several benefits
Questions?