

Northwest Energy Systems Symposium

Deploying integrated systems to improve resilience,
reliability and flexibility for Snohomish County PUD
Customers



WILL ODELL
ETHAN BOARDMAN



April 28, 2016

Agenda

Background

Smart Grid Benefits

Smart Grid Strategy

DMS, DA and OMS Projects

Systems and Process Integration

Expected Benefits

Company Profile: Snohomish County PUD

Total Electric Customers: 332,000

2015 Energy Sales: 8,812,294 MWh

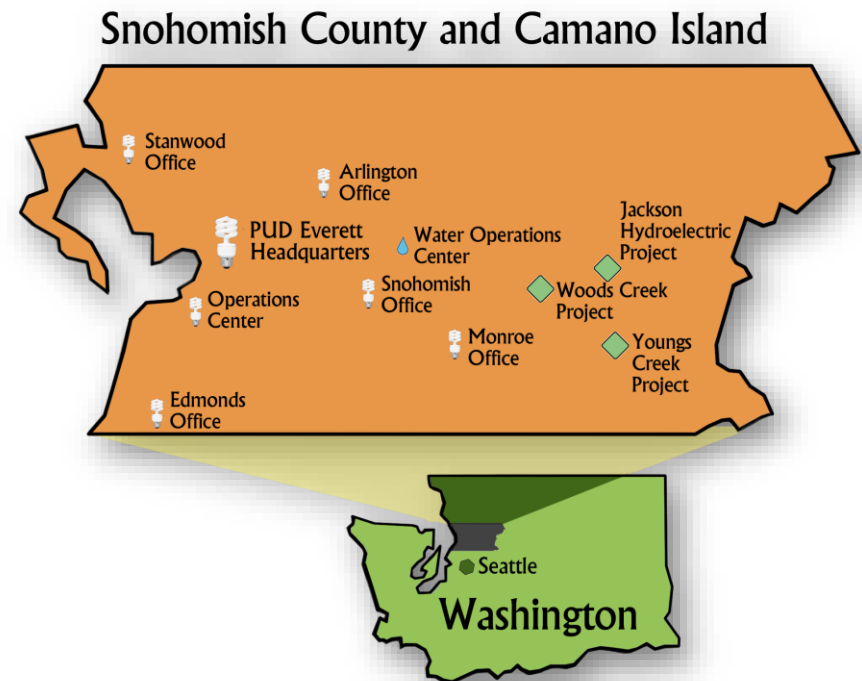
Generating Capacity: 164 MW

Residential Rates: 9.9¢ per kWh

of Substations: 87

of Circuits: 396

Resource Mix: 8% Renewables

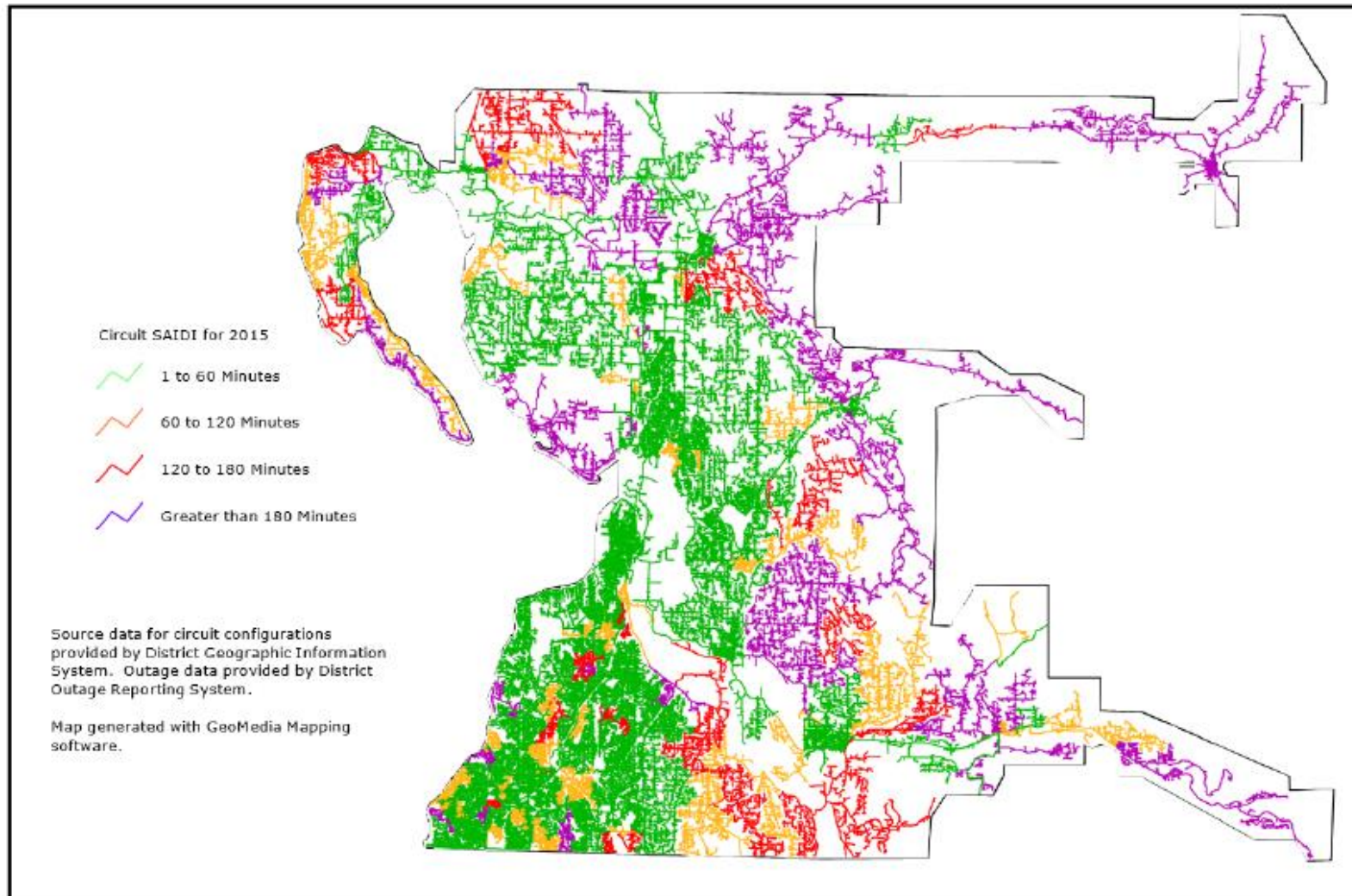


Expected Smart Grid Benefits

- ❖ Improved power reliability
- ❖ Improved safety
- ❖ Improved energy efficiencies
- ❖ Reduced environmental impact
- ❖ Increased energy conservation
- ❖ Integration of renewables
- ❖ Integration of distributed generation
- ❖ Customer choices
- ❖ Direct financial



Circuit SAIDI for 2015

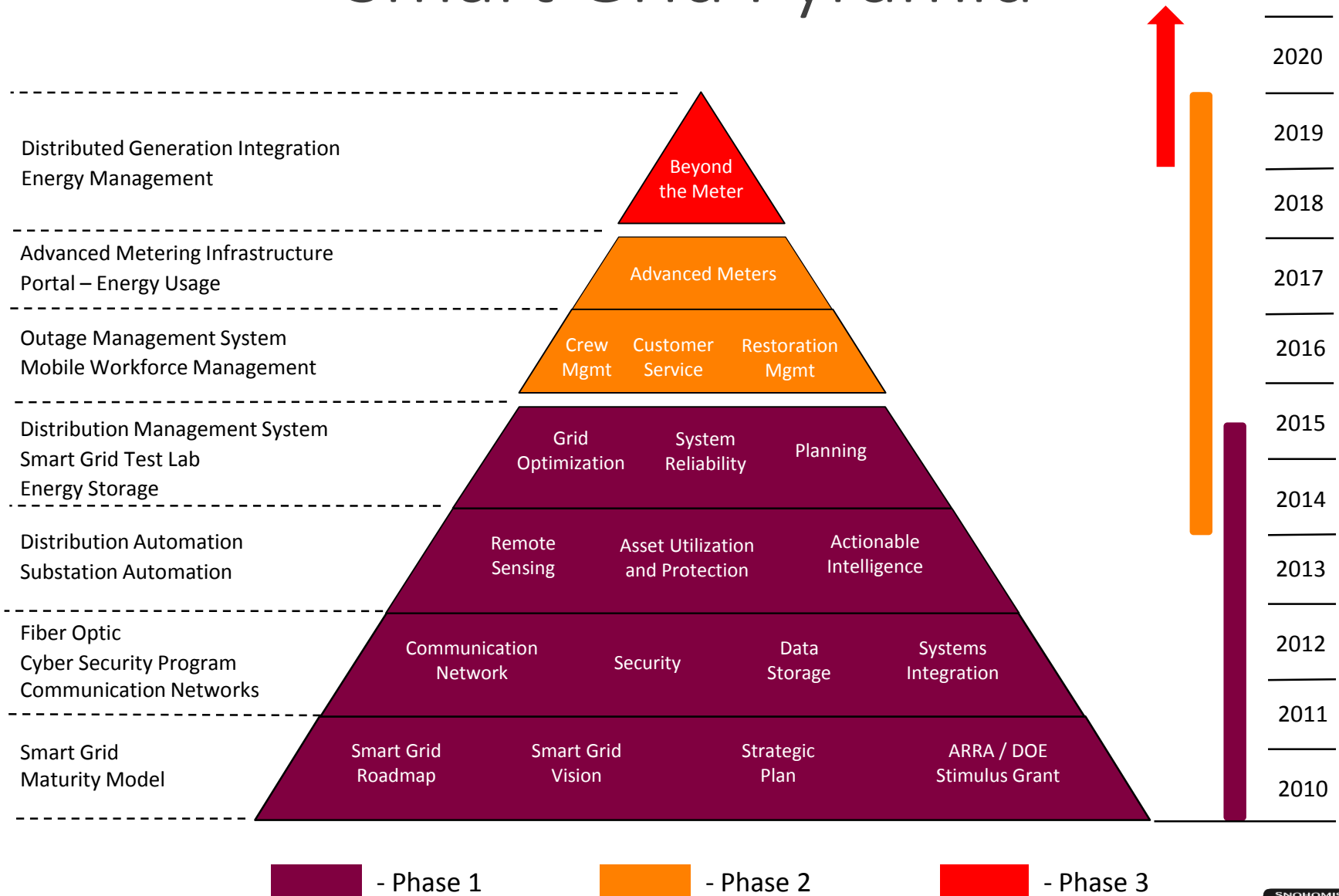


Storms

In 2015, the PUD experienced two of the largest storms in the history of the District.

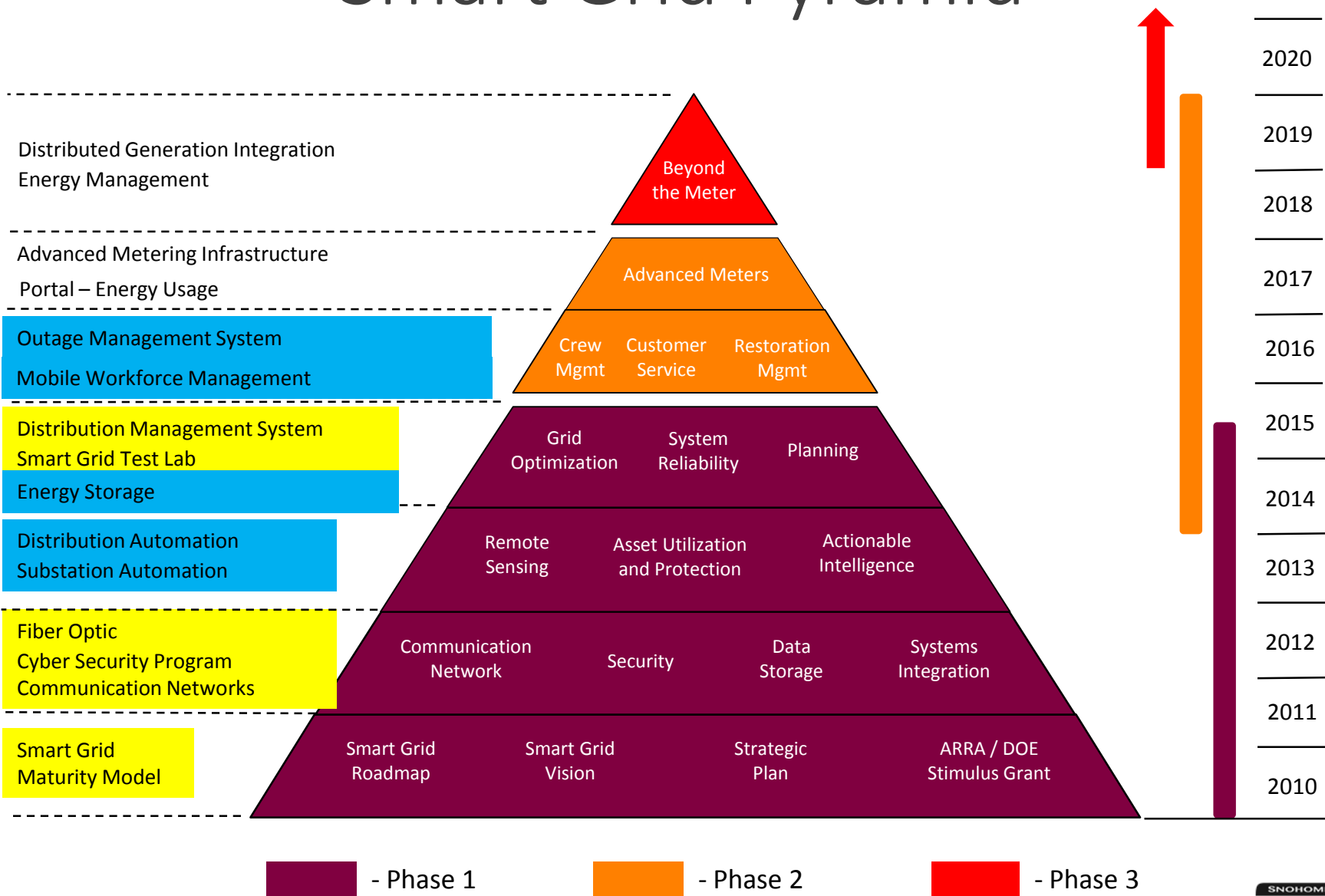


Smart Grid Pyramid



- Completed
- In Progress

Smart Grid Pyramid



Distribution Grid Management

Dashboards, Queries,
Outage Reports, KPIs

Multi-channel Communications to
Customers, Employees, Partners

Operational Business Intelligence/Analytics - T & D Systems

Enterprise Asset
Management

Mobile Workforce
Management

DERMS / DR
Management

Distribution Management
Systems Applications

- Fault Detection and Location
- Automated Restoration Switching
- Overload Reduction Switching
- Volt/VAr Optimization
- State Estimation
- Unbalanced 3-Phase Load Flow

Outage Management Systems
Applications

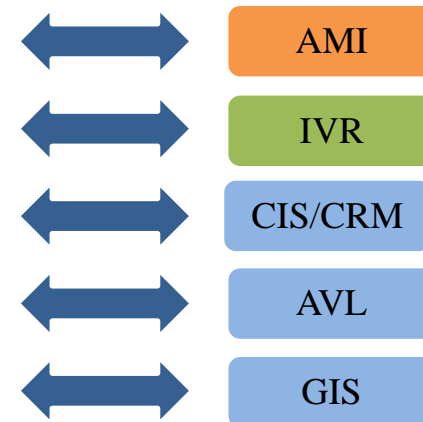
- Trouble Call Management
- Outage Analysis
- Outage Management
- Operations Management
- Switch Order Management
- Crew Management
- Interface to AMI

As Operated - Network Model

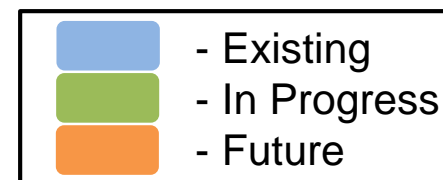
Supervisory Control and Data Acquisition

Communications - Microwave, Fiber, Wireless Networks

- Field Devices – Remote Terminal Unit, Sensors
- Distribution Automation Equipment – Reclosers, Switches, Regulators, Load Tap Changers
- Substation Automation Systems– Digital Relays, Gateways
- Distributed Energy Resources – Storage, Distributed Generation, Load Control



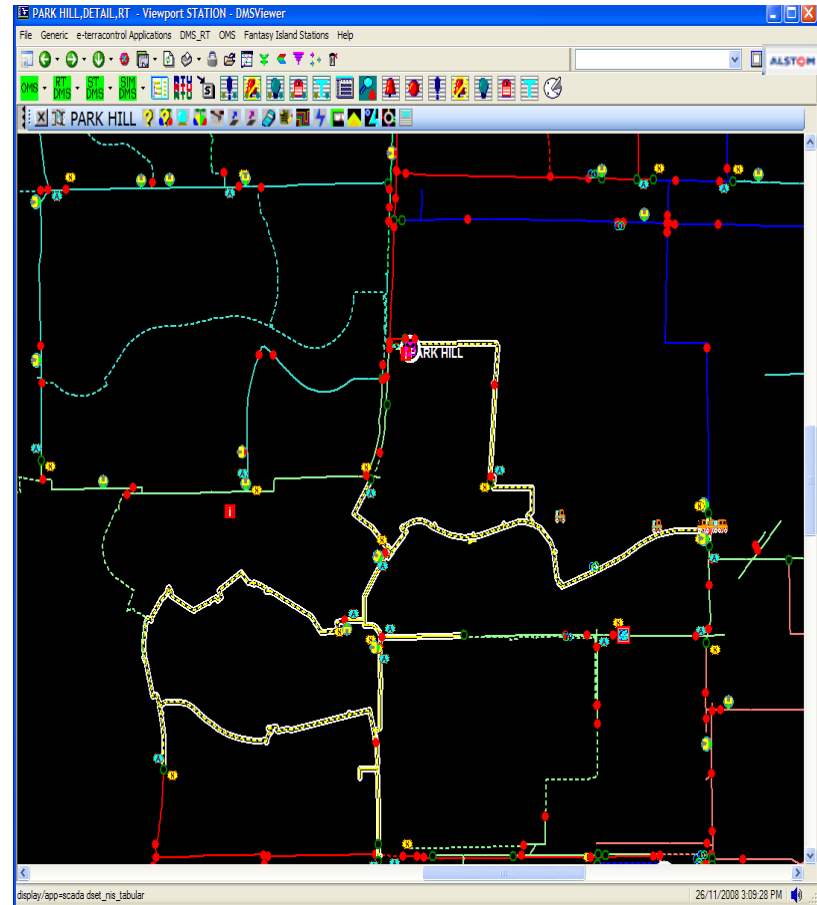
GE Grid Solutions



Distribution Management System (DMS)

IT system capable of collecting, organizing, displaying and analyzing real-time or near real-time electric distribution system information.

Interfaces with other operations applications such as geographic information systems (GIS), outage management systems (OMS), and customer information systems (CIS) to create an integrated view of distribution operations.



Distribution Management System Functionality

Visualization

- Overview and management of all aspects of the Distribution grid

Powerflow

- Calculated voltage and flow for each device, identification of violations

Switching

- Planned and Emergency, Tagging

Suggested Switching

- Automatically generated Switch Plans based on Operator request

FLISR (Fault Location, Isolation and Service Restoration)

- Automatic switching of field devices based on faults

Fault Location Analysis

- Fault location prediction

Feeder Load Management

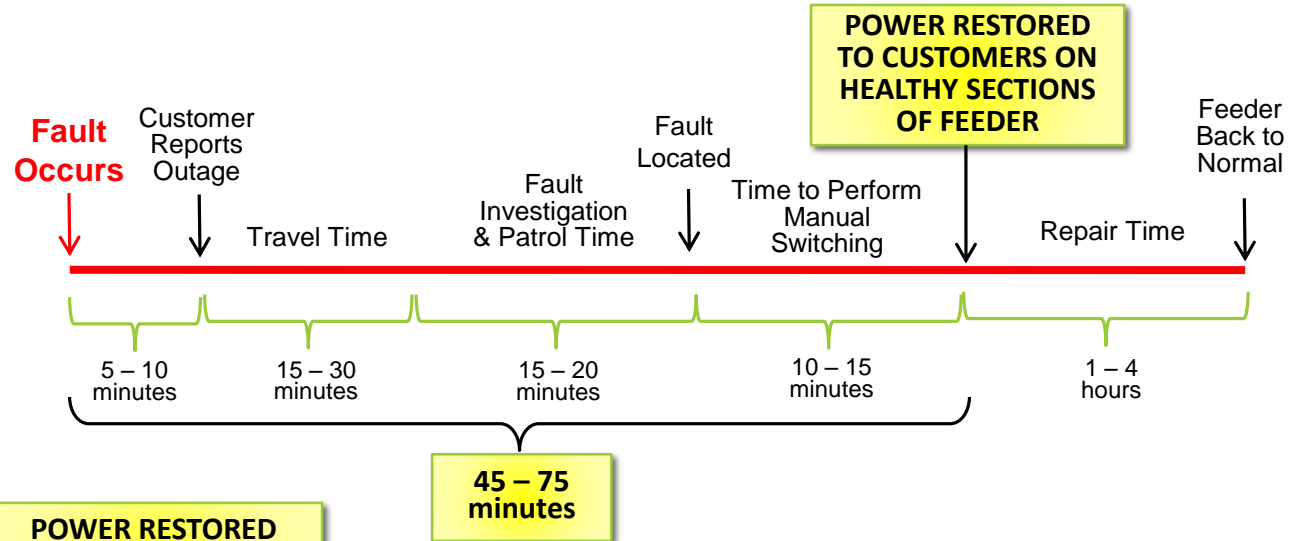
- Predictive Powerflow

Volt/VAr Optimization

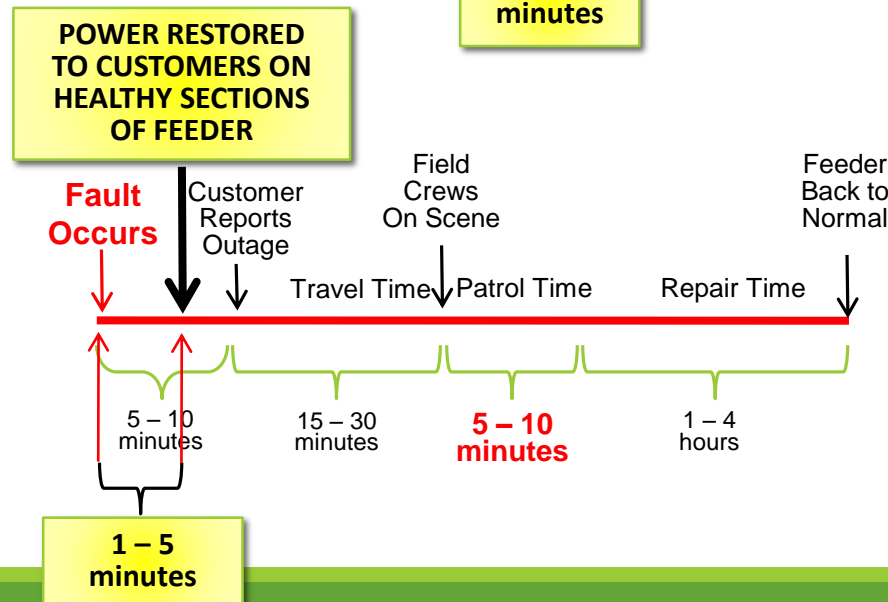
- Set of action plans based on loss minimization

Fault Location Isolation Service Restoration (FLISR)

Without FLISR



With FLISR



Distribution Automation (DA) Pilot Project

DA Demonstration Area

- 5 Substations & 10 Circuits
- 9,100 Customers

Automated Equipment

- Switches (8)
- Reclosers (26)
- Regulators (39)

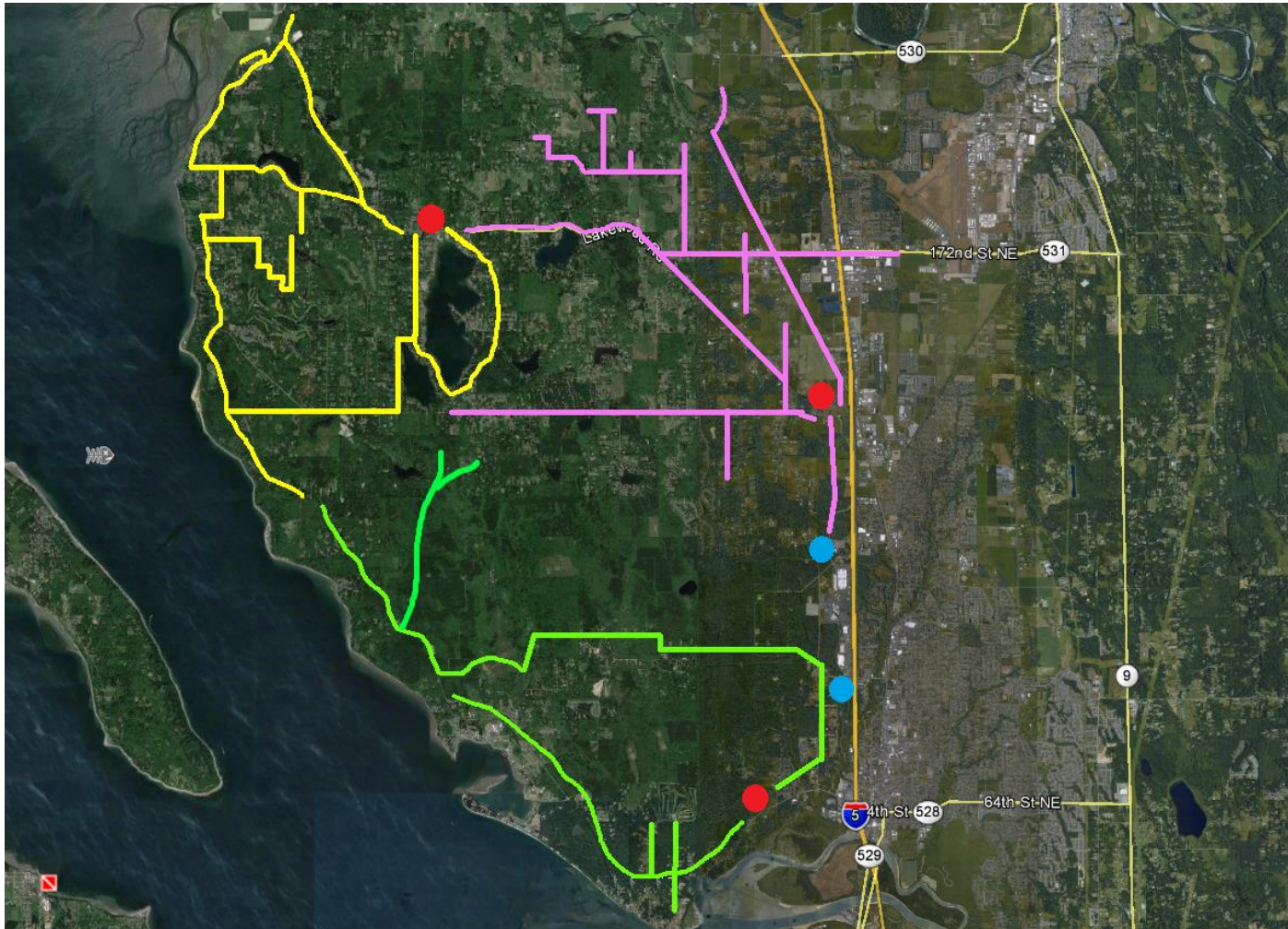
Improve Reliability

- SAIDI 4-Yr Avg 90 min/yr

Project Budget - \$3.8M



DA Pilot Project Area



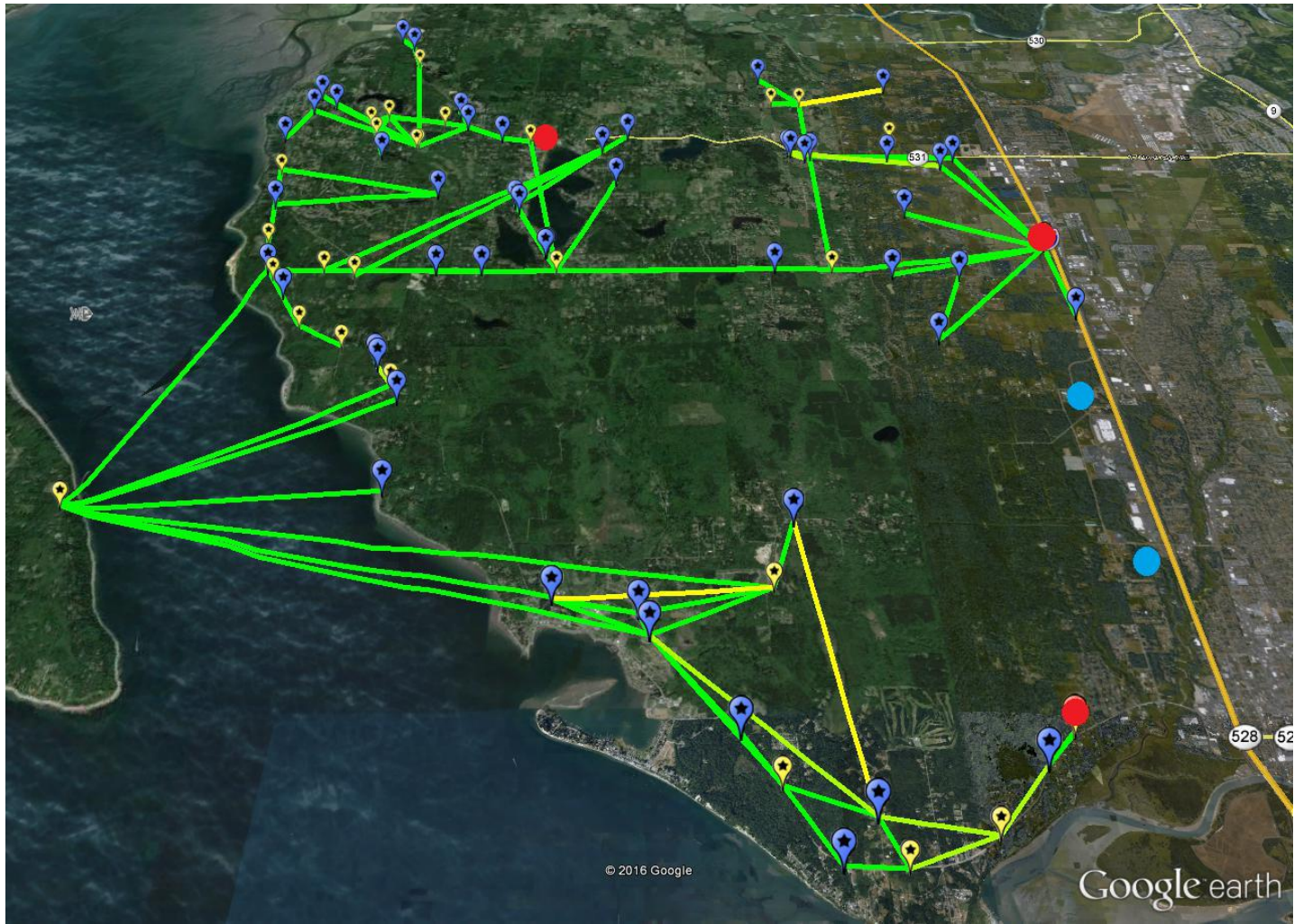
The Equipment



Control Hardware



900 MHz Radio Connectivity



Switching Order Steps from FLISR Results

PEBBLE BEACH - FISR Plan (Execution Time: 2009-07-16 20:43:00 Evaluation Time: 2009-07-16 20:43:00 Peak Evaluation Time: 2009-07-16 20:43:00)

Rank	Number of Moves	Show Steps	Number of Customers Not	Unservd kW	Max. Segment Loading %
1	4		100	285.50	75

Order - Viewport SWITCHORDER2 - DMSViewer

rs | Safety Document | Switch Order Server: **Connected**

id Start: 7/16/2009
rice: PEBBLE BEACH
Station: FISR_PEBBLE BEACH12478021
ne: center
marks: jence #
sted By: dated By: 7/16/2009
roved By: roved Time: 7/16/2009
ual Start: 7/16/2009 18:53
ual Completio: 7/16/2009 18:54
roved To:

Step	Device	Action
1	51100	Open
2	53181	Close
3	51185	Open
4	51268	Close

The right side of the interface displays a network diagram with various components and connections. The bottom status bar shows the date and time: 7/16/2009 8:58:03 PM.

Outage Management System (OMS)

Our OMS is part of a utility network management software suite that models network topology for safe, efficient field operations related to outage restoration.

PUD > MAJOR STORM OUTAGE MAP

425-783-1001 : REPORT AN OUTAGE, 24 HRS A DAY, 7 DAYS A WEEK

About

This map is available when the PUD declares a Major Storm to provide our customers insight into affected areas.

Updates can always be found at:
425-783-1001
www.sno.pud.com

If you are experiencing an outage and your area is shown as having no customers out, please call 425-783-1001

More Information

- > Winter Storm Preparation
- > If the Power Goes Out...
- > Storms & Outages FAQs
- > What Gets Restored First?

This map is updated every two hours between 6 a.m. and 10 p.m.

Last updated:
12/14/2015 12:31 pm

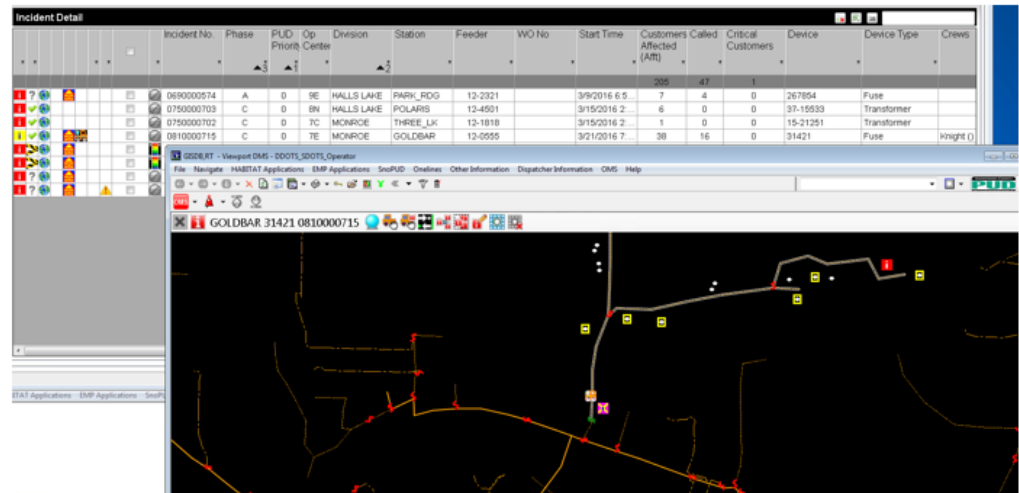
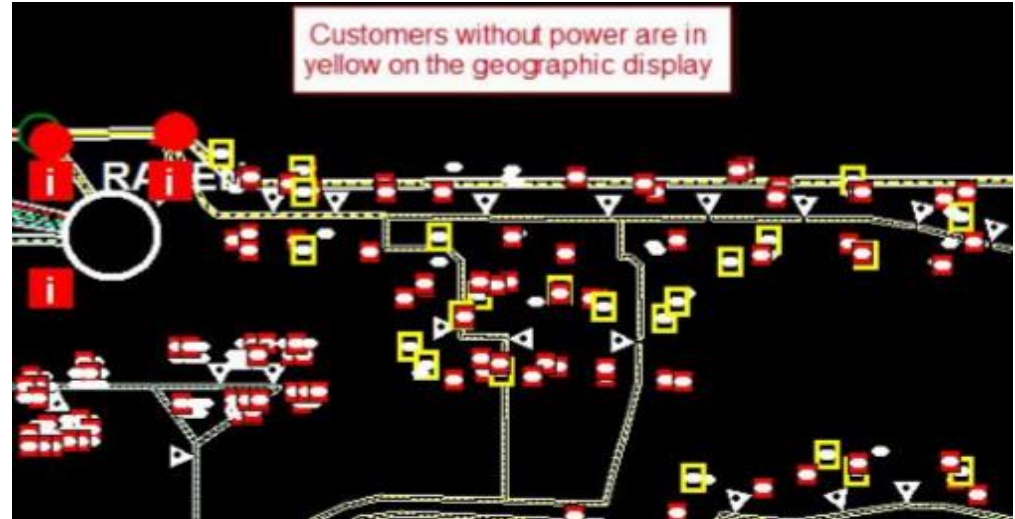
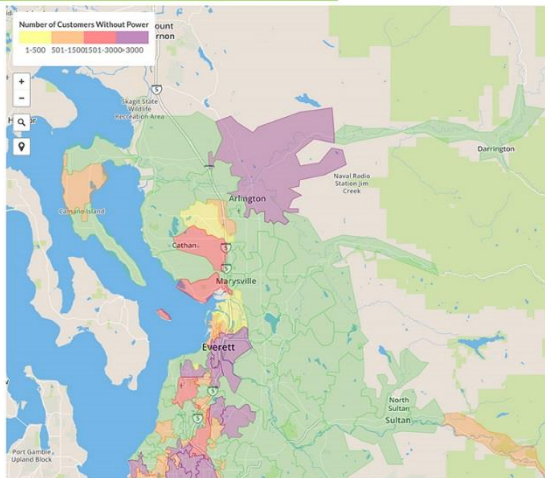


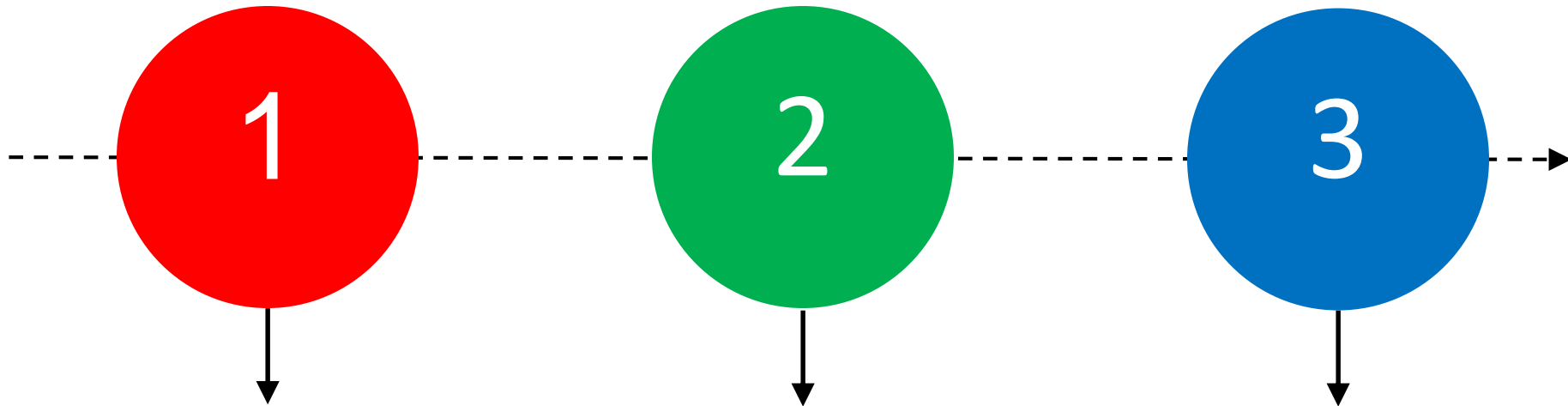
Figure 1-1: Outage Incident Tabular Data with Geographic View

OMS – A Three Phased Deployment

May 16

Fall 2016

Summer 2018

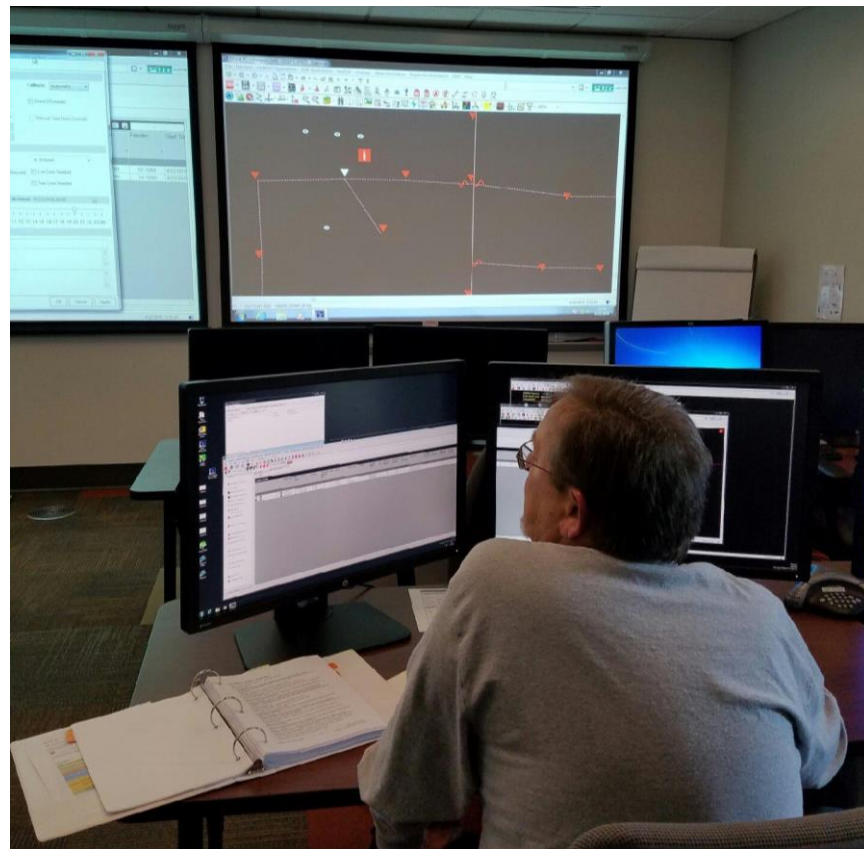
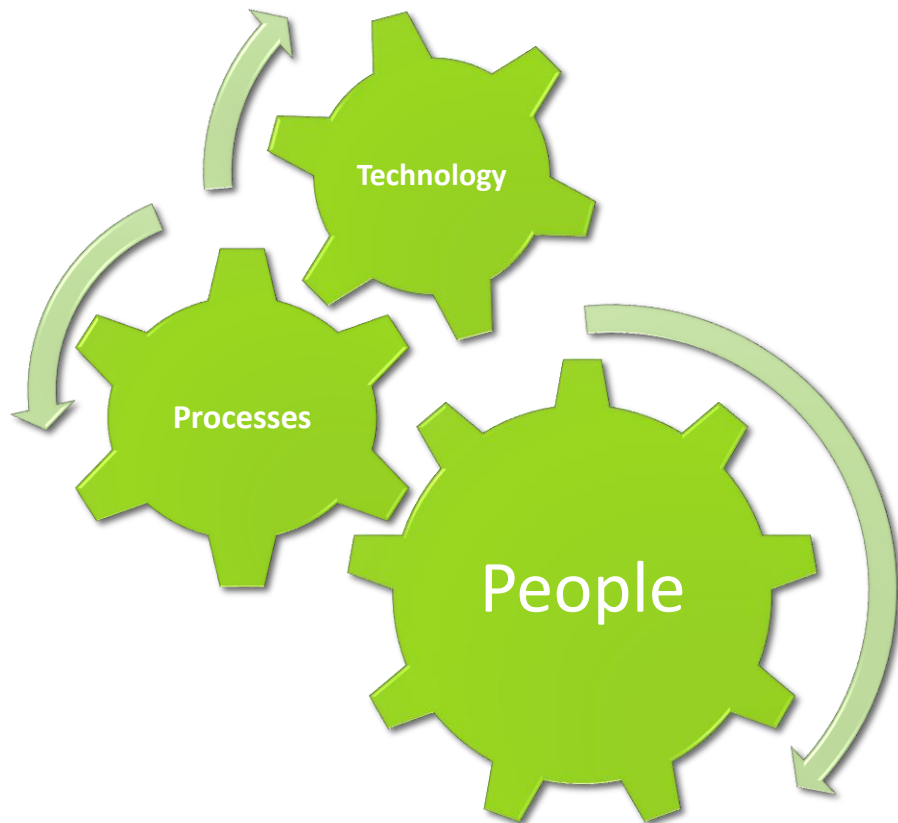


- Deploy Outage Management System with Integration with CIS, AVL, IVR
- Business Process Re-Engineering
- Distribution Operator Training Simulator (DOTS)

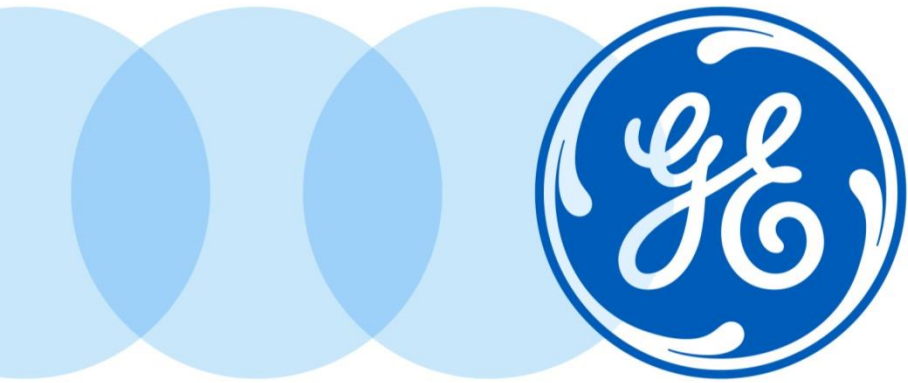
- Mobile functionality (ONE Program SAP functionality via ClickSoft)
- Common mobile platform for OMS, MWM, GIS
- Customer-facing outage communication (ONE Program Multi-Channel)
- Internal dashboards and KPIs

- AMI Integration
- Meter on
- Meter last gasp

Systems and Process Integration



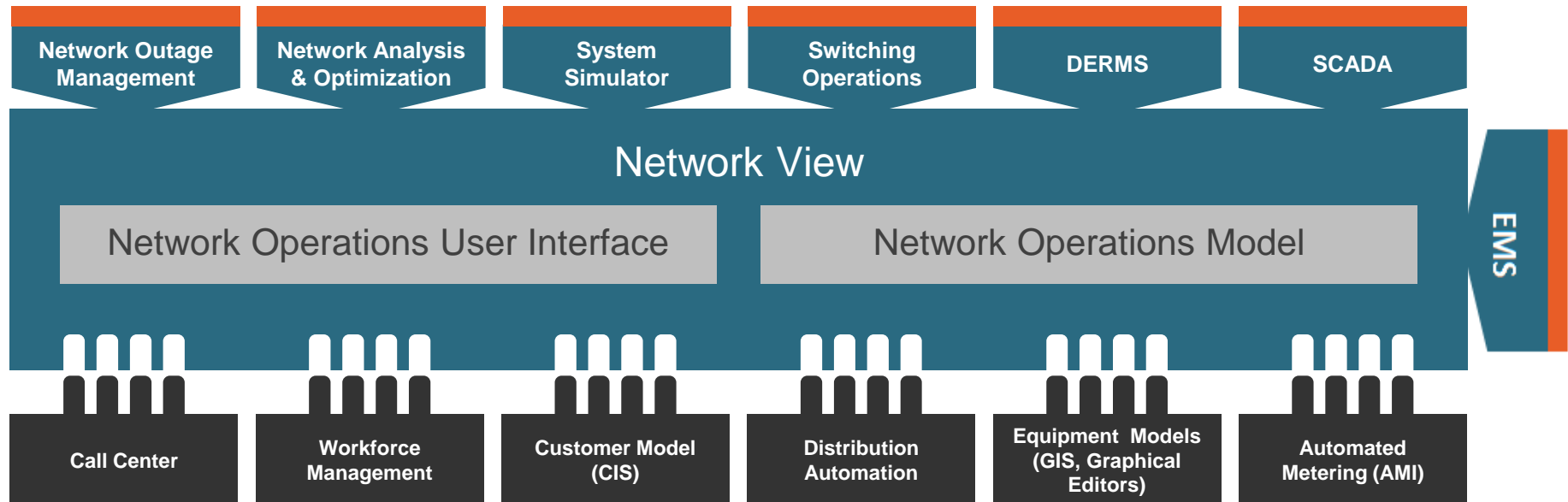
OMS Training Session utilizing DOTS Simulator



e-terra*distribution*

Imagination at work

Complete ADMS Functionality

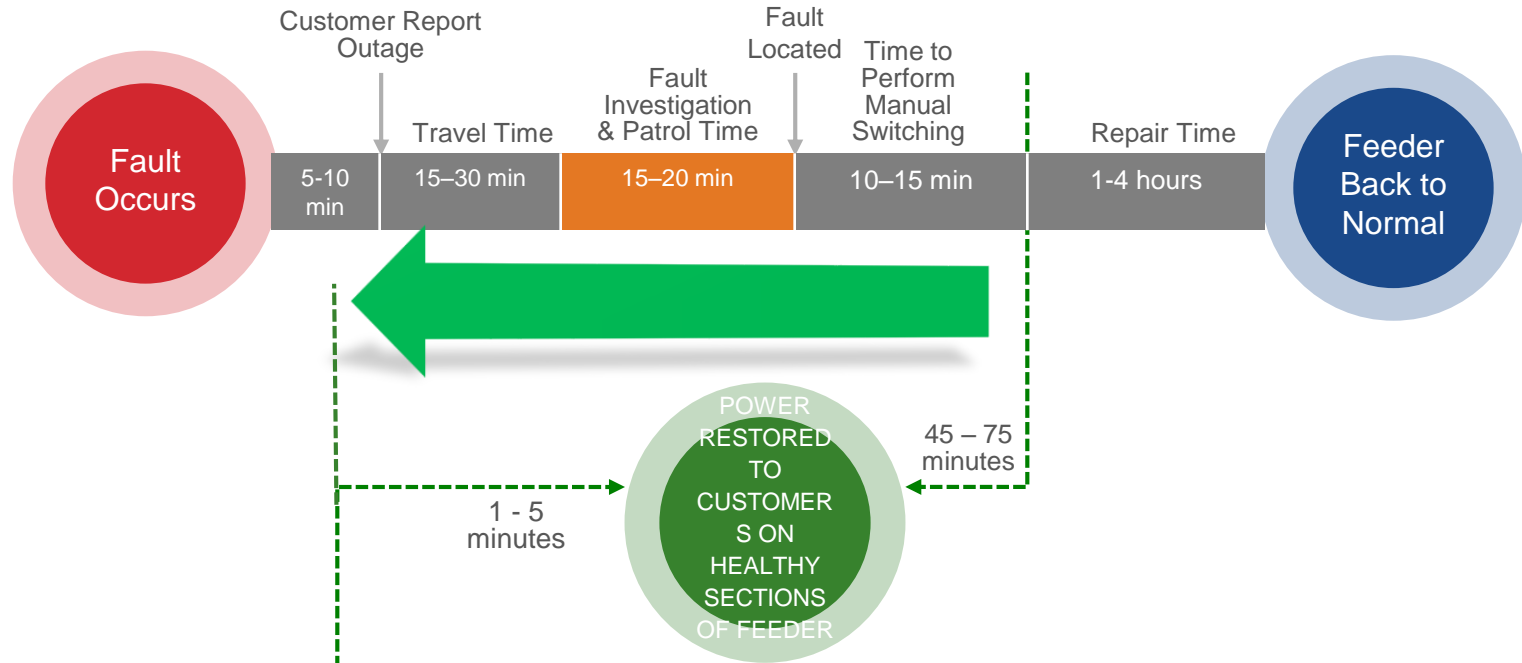


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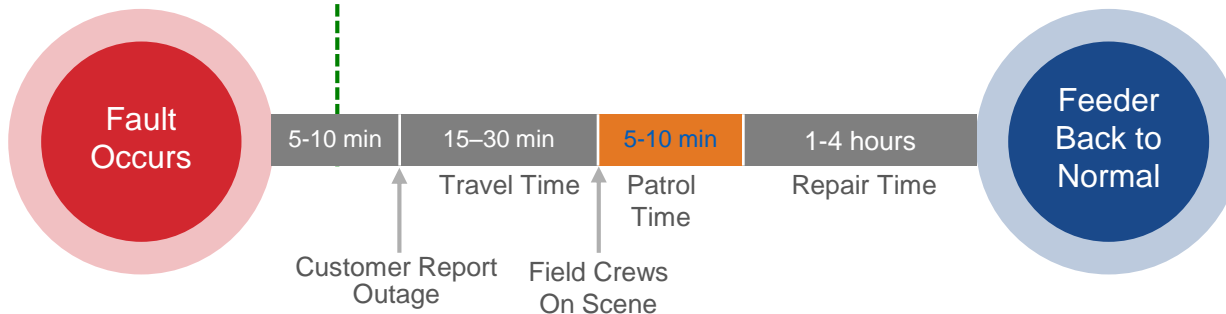
FLISR - Fault Location, Isolation, Service Restoration

Increase Customer Satisfaction, Lower Operating Cost

Without FLISR



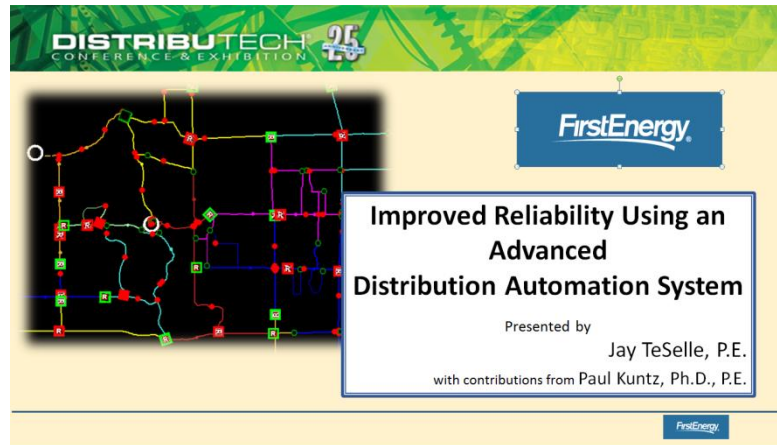
With FLISR



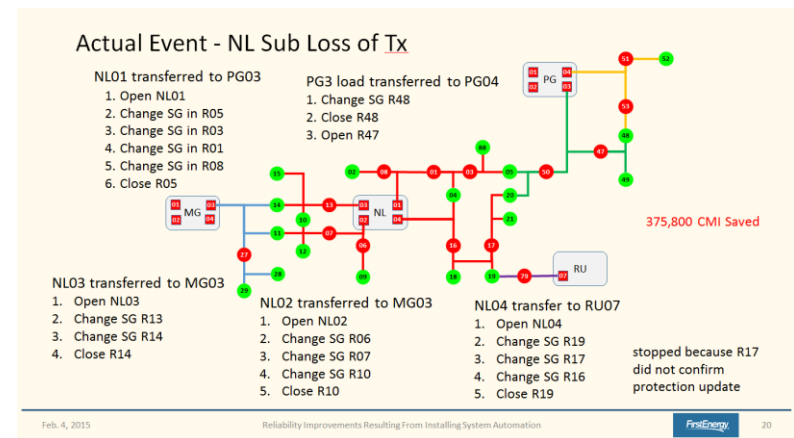
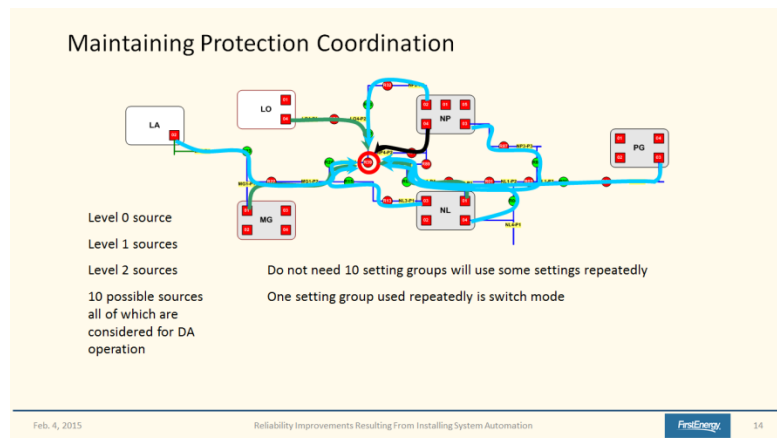
See tutorial regarding confidentiality disclosures. Delete if not needed.

First Energy Experience with FLISR

Presented at Distributech, 2015



- 1 Month
- 8 Events
- 2,164,209 CMI Prevented
- Protection Coordination Maintained
- Sustained Fault, LoV, OL Triggers



See tutorial regarding confidentiality disclosures. Delete if not needed.

FPL Experience with Fault Location

Presented at Distributech, 2014

<http://distributech.com>

DISTRIBUTETECH
CONFERENCE & EXHIBITION

**Distribution Feeder Performance
Analysis Utilizing Distribution
Management System Fault Location
Data at Florida Power & Light**

Jerry Gray – FPL
Ethan Boardman – Alstom Grid
John Sell – Alstom Grid
January 28th 2014

Powered & Protected by: **PowerGrid** | Official Application of **PowerGrid** | Supporting **Electric** | **Utility** | **WaterWorld** | **Media** | **Renewable** | **Smart** | **CPS**

Fault Location Operations Improvements

- Restoration
- Momentary Investigations

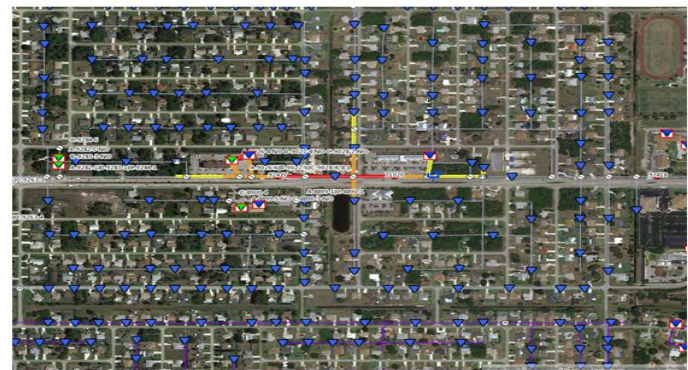
The DMS system at FPL has the ability to accurately determine the fault location in distribution feeders using the system impedance model and fault current magnitudes from protective devices.



Benefits

- Eliminate/Reduce switching into faults
- Reduce damage to facilities due to fault current exposure
- Reduce resource requirements
- Reduce Outage Duration

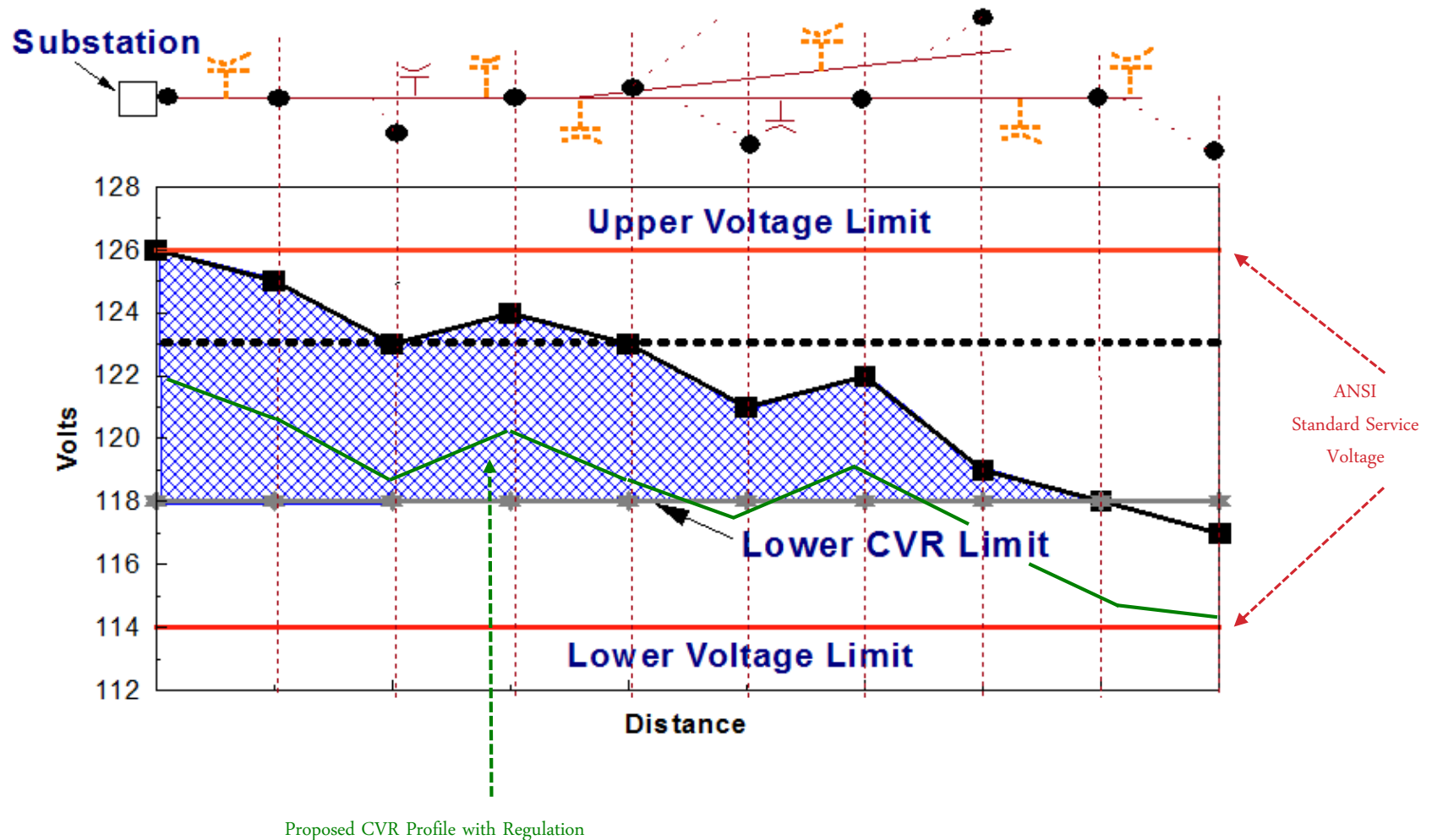
Momentary Investigation Maps



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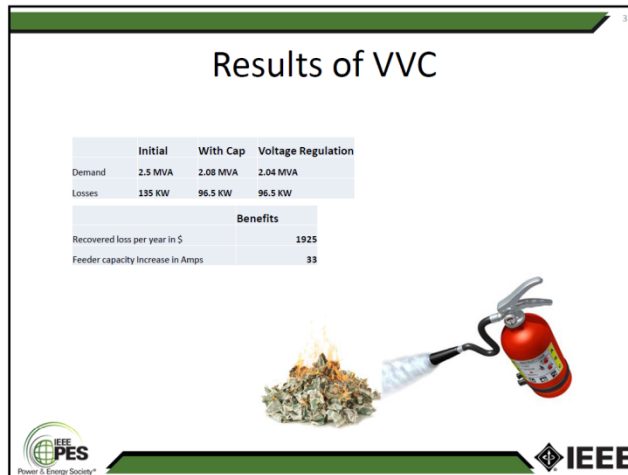
VVC – Volt/VAR Control



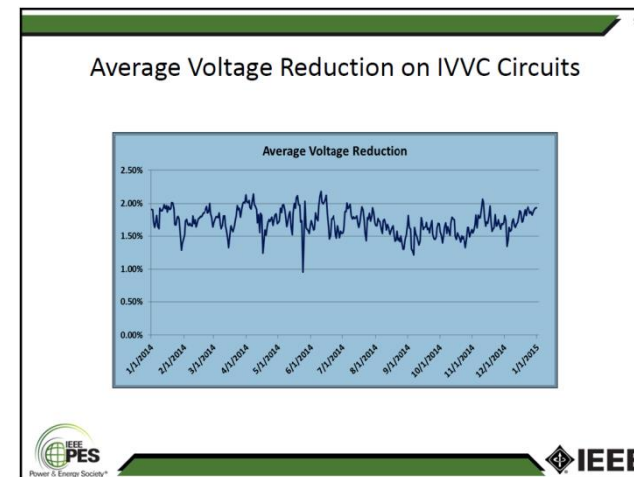
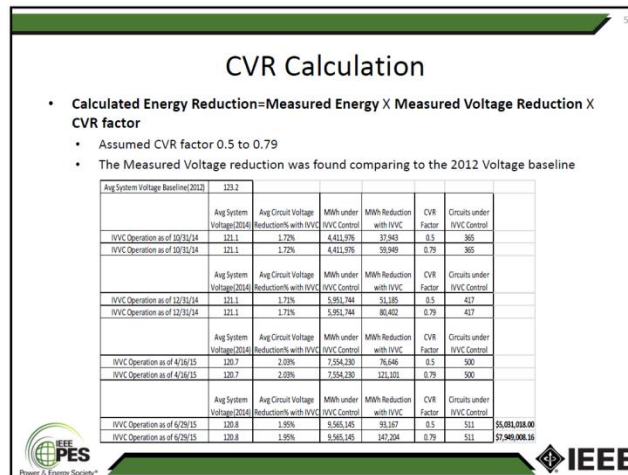
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Duke Energy Experience with VVC

Presented at IEEE PES



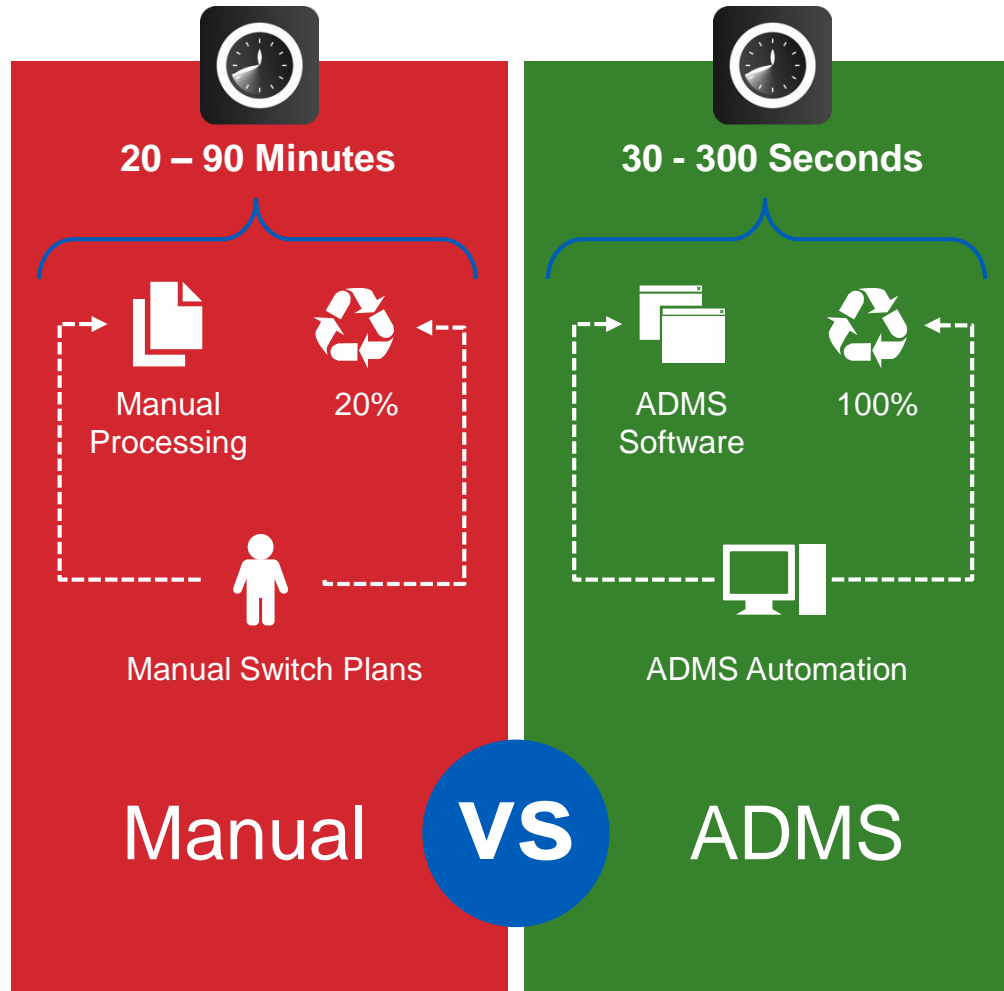
- In production on >500 Circuits (Ohio)
 - CVR Objective Function
- 1.95% Average Voltage Reduction
- \$10k Annual Savings per Feeder @ .50, \$15.5k @ .79 CVR Factor



See tutorial regarding confidentiality disclosures. Delete if not needed.




Switch Order Development & Validation (SWO)



See tutorial regarding confidentiality disclosures. Delete if not needed.

Stedin – SWO Benefits

Webcast Seminar



**IDMS Business Drivers,
Benefits and Lessons Learned**

Marko Kruijthof, Manager of Renewals and Sustainability
January 29, 2014
San Antonio, TX

- 2 FTE Reduction for SWO Development
- Improved Communication
- Fewer Switching Mistakes
- Reduction in Outage Minutes
- Improved Safety
- Reduced Training Requirements



IDMS BUSINESS DRIVERS

INCREASE CUSTOMER SATISFACTION
Reduce Customer Minutes Lost (CML)
Real-time information
Predictable and transparent

IMPROVE OPERATIONAL EFFICIENCY
Automatic switch plans
Reduce operational costs
Increase FTR and safety
Leverage single user interface with Alstom EMS

FOUNDATION FOR GRID MODERNIZATION
Use of smart distribution automation technologies
Use smart distribution field devices
Innovation and transition toward sustainability

STEDIN^{NET}



BUSINESS BENEFITS

ACHIEVED OBJECTIVES
Dynamic view of MV grid
Automatic generation of switch orders
SWO first time right
Reduce customer minutes lost
Ready for smart grid activities
Load flow calculations
Information to stakeholders (internal and external)
Improved efficiency and effectiveness of the grid

STEDIN^{NET}

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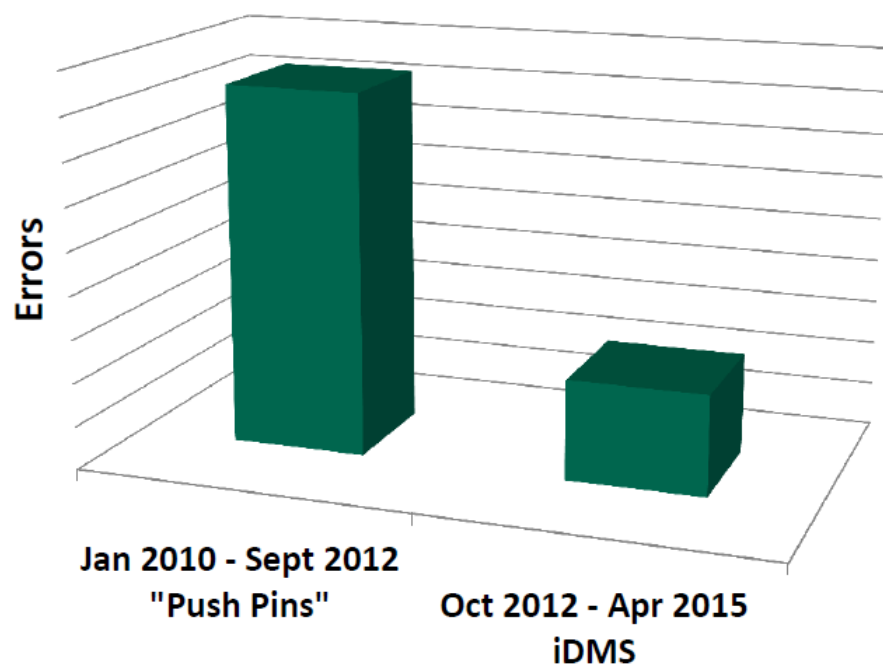


IDMS – Benefits Realized

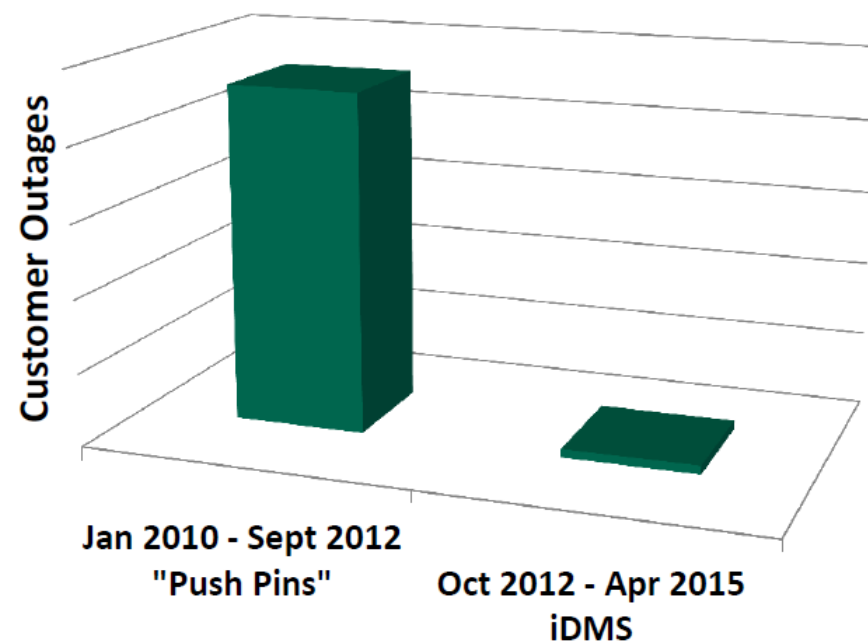
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Dramatic reduction in switching errors

MGE Average Annual Lost Load Switching Errors



MGE Average Annual Switching Error Contribution to SAIFI



Grid IQ Insight

Analytics providing
real.actionable.insights



Flexible Form

- Real-time Analytics
- Enterprise Dashboard
- Customer Outage Portal
- Aggregator Portal
- DERMS Workstation

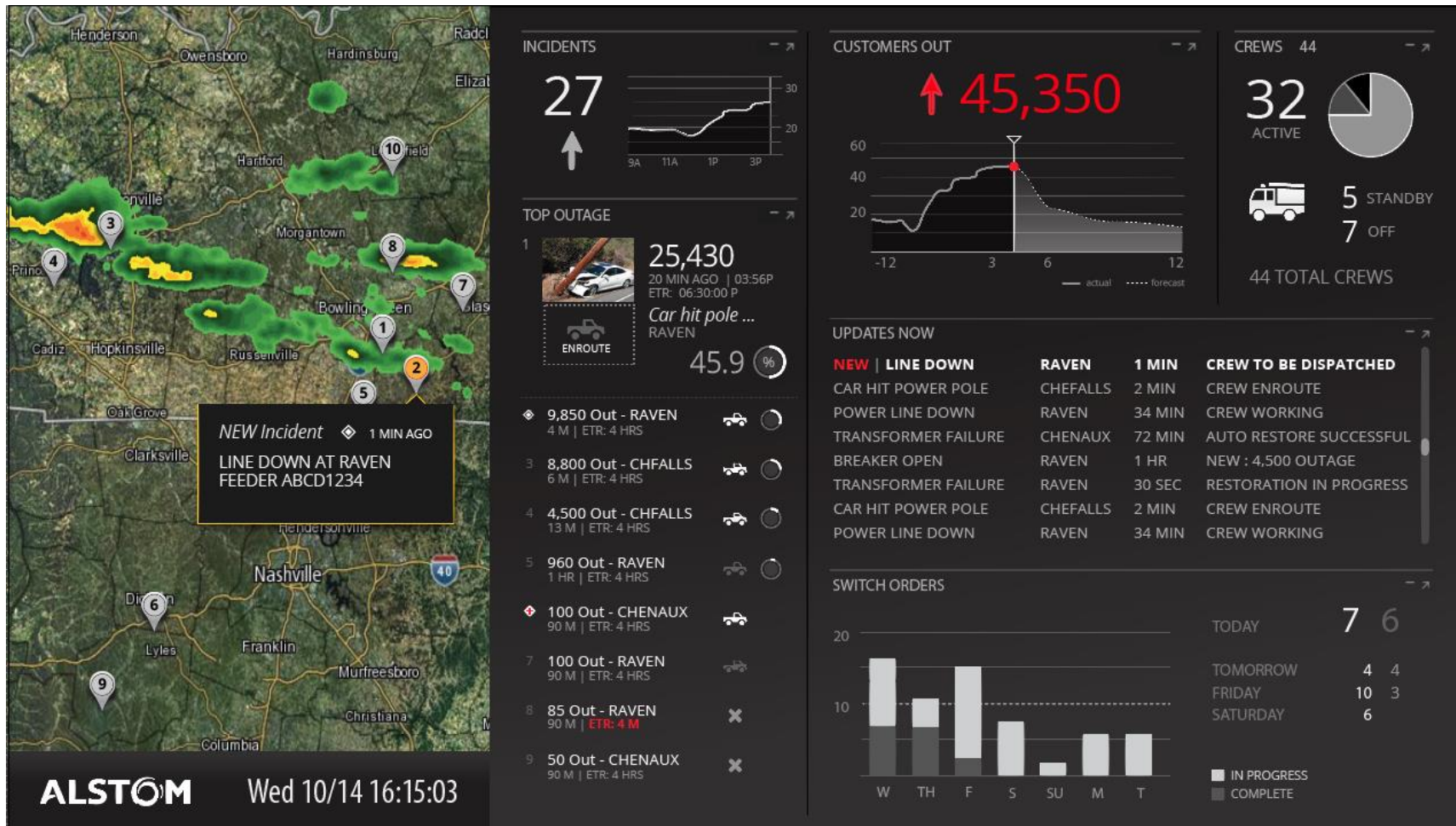
Integrated Solutions

- Geospatial & Mobile
- Outage Management & Storm Response
- Advanced Distribution Management
- Distributed Resource Management
- Energy & Distribution Management

An application
development framework
for **integrated data
analytics**



Example Dashboard: OMS Focus



Q & A

Will Odell

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Ethan Boardman

Director of Business Development IDMS
GE Grid Solutions
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