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

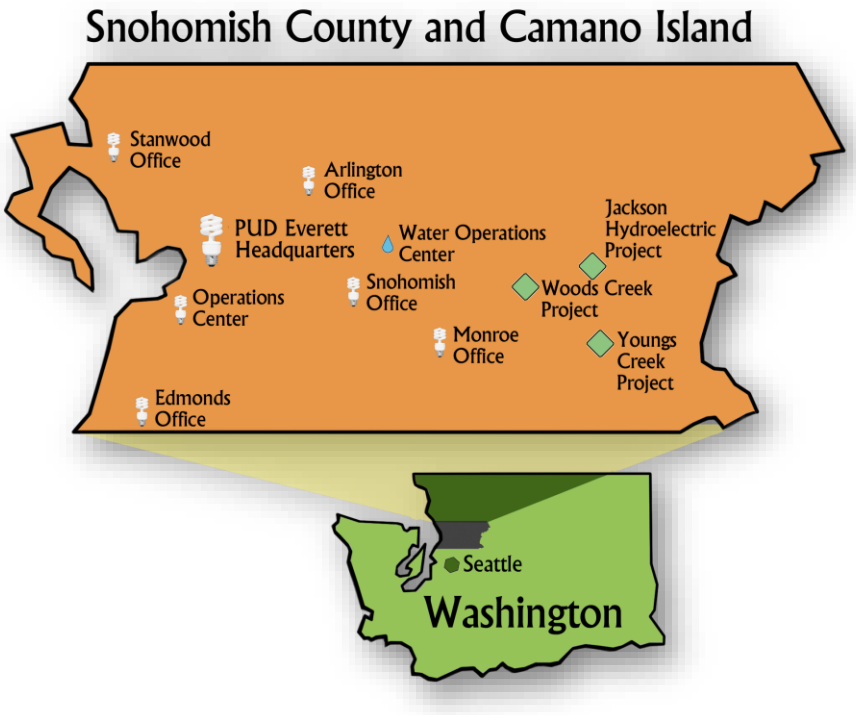
Generating Capacity: 164 MW

Residential Rates: 9.9¢ per kWh

# of Substations: 87

# of Circuits: 396

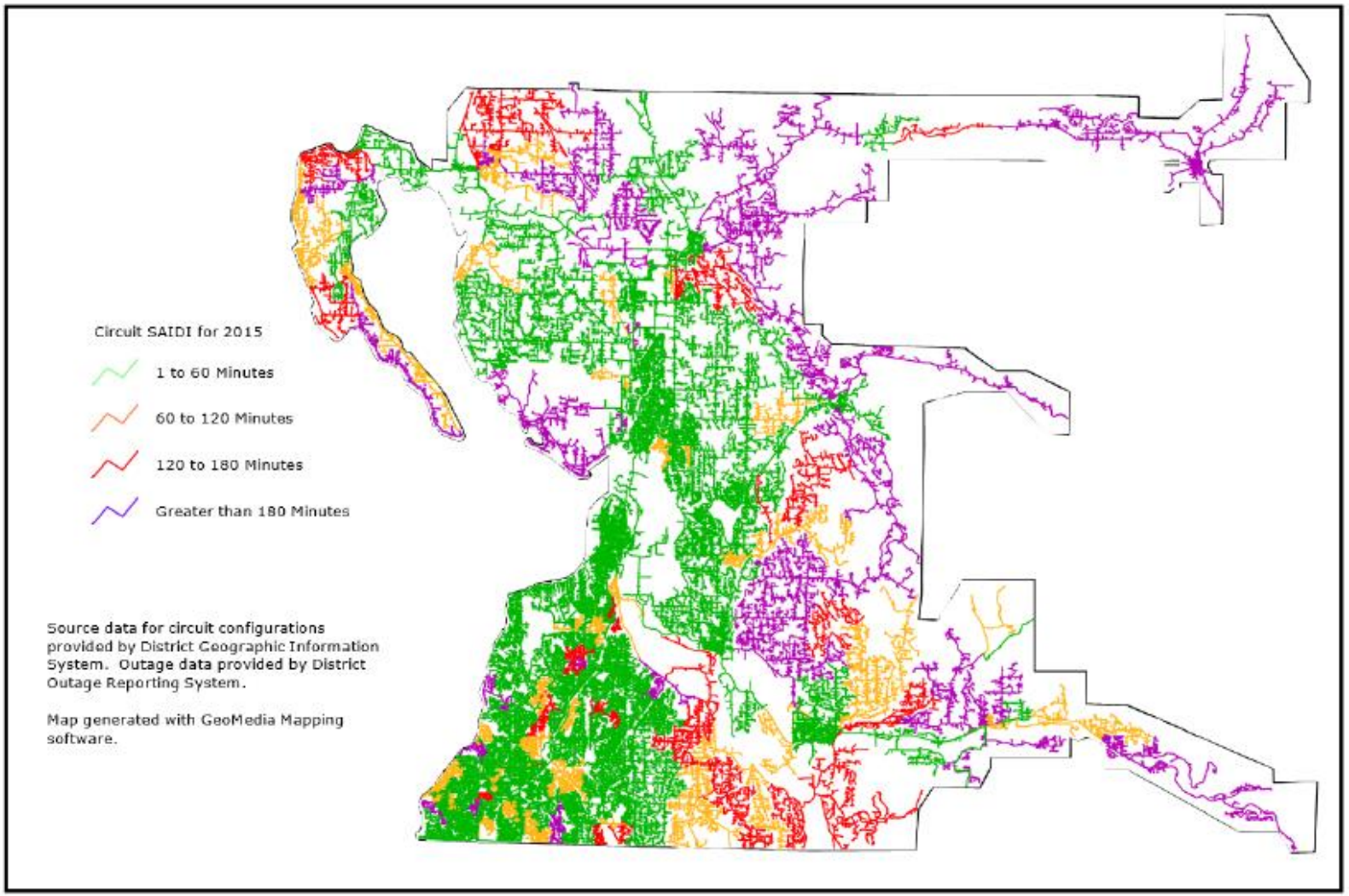
Resource Mix: 8% Renewables



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

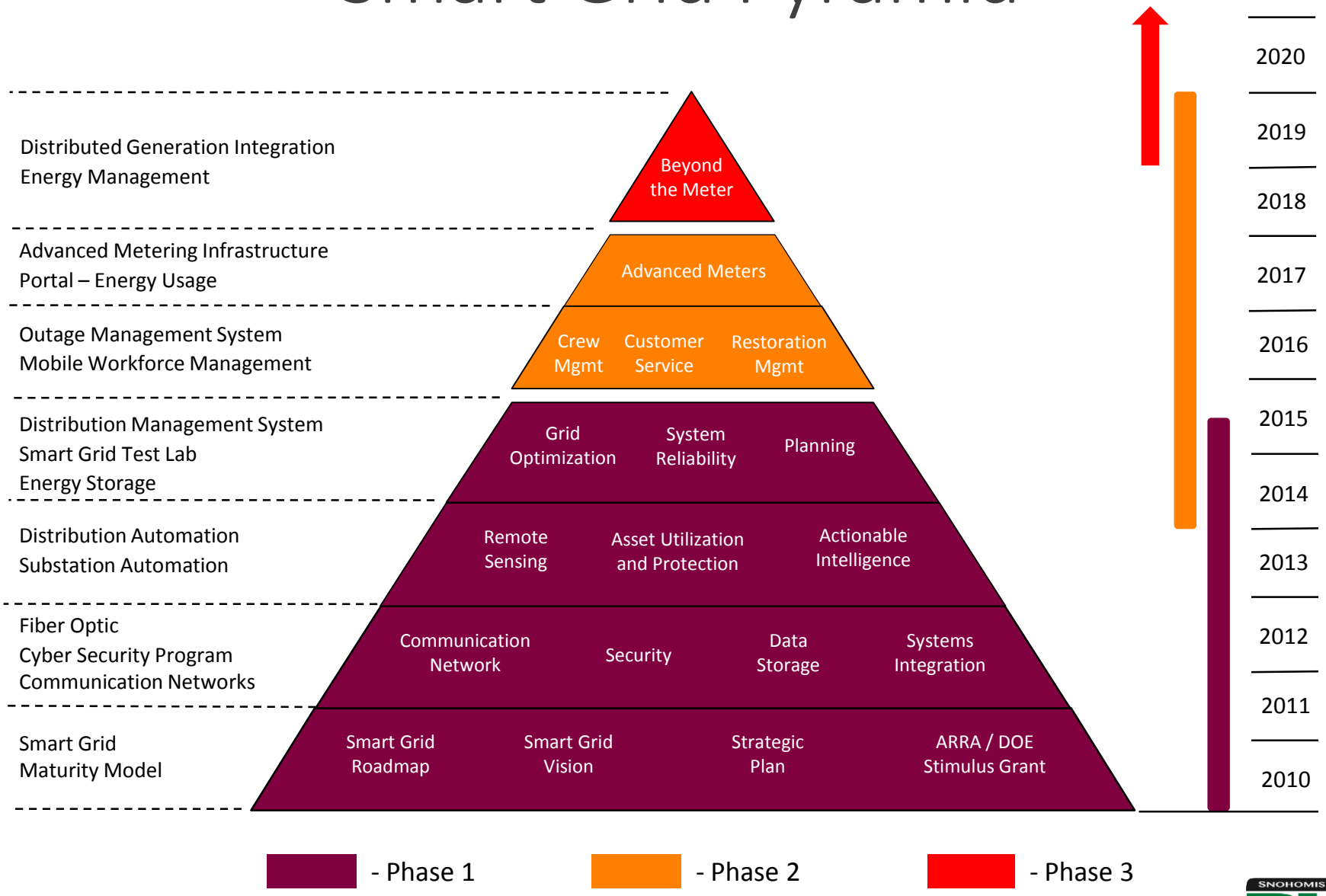
Circuit SAIDI for 2015



Storms

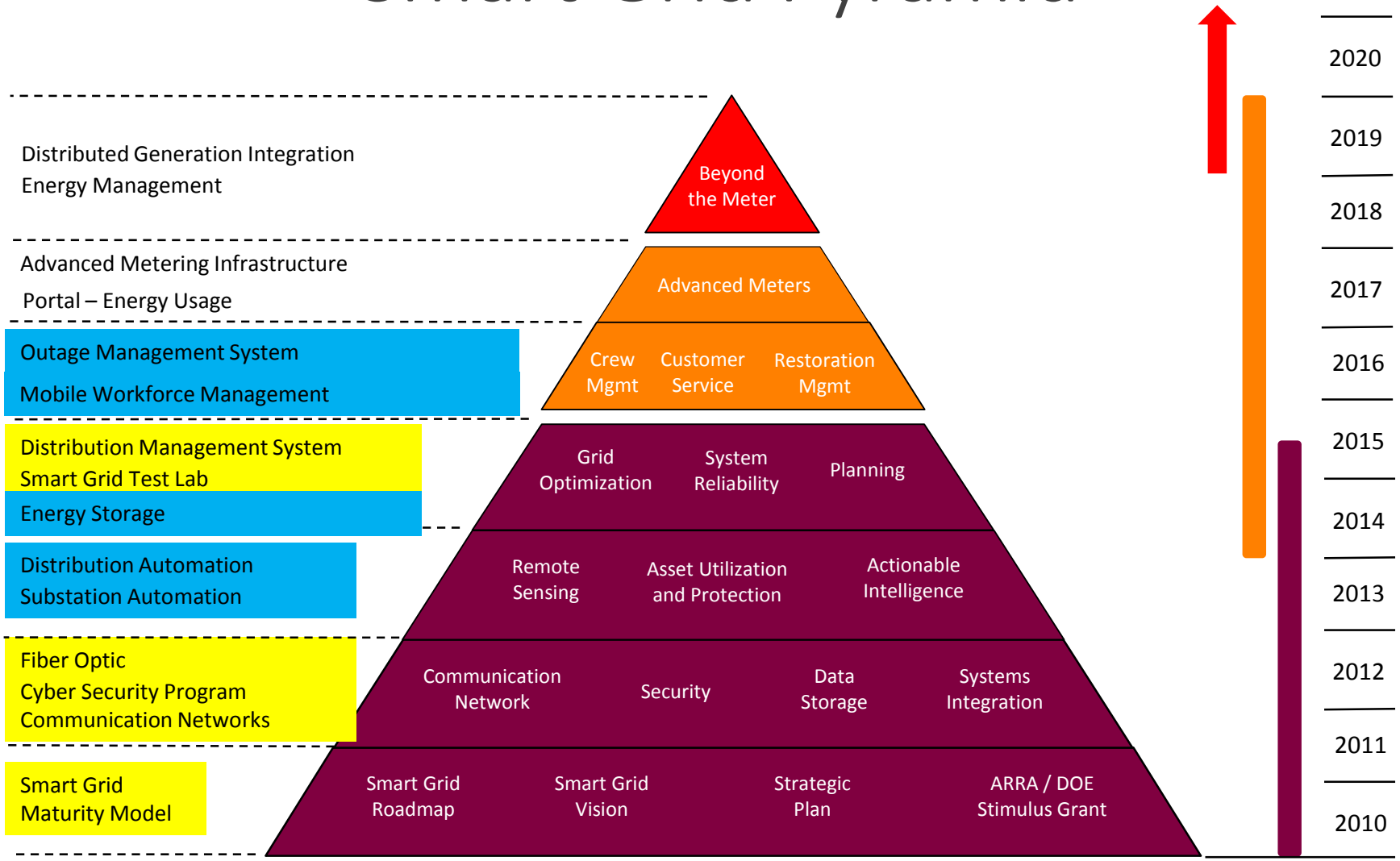
In 2015, the PUD experienced two of the largest storms in the history of the District.

Smart Grid Pyramid



- Completed
- In Progress

Smart Grid Pyramid



- Phase 1
- Phase 2
- Phase 3

SNOHOMISH COUNTY PUD PUBLIC UTILITY DISTRICT NO. 1

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

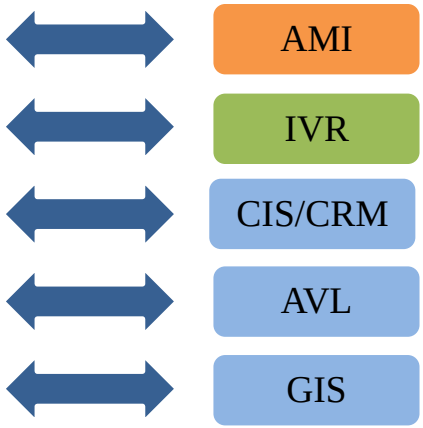
- Trouble Call Management
- Outage Analysis
- Outage Management
- Operations Management
- Switch Order Management
- Crew Management
- Interface to AMI

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



Supporting Systems

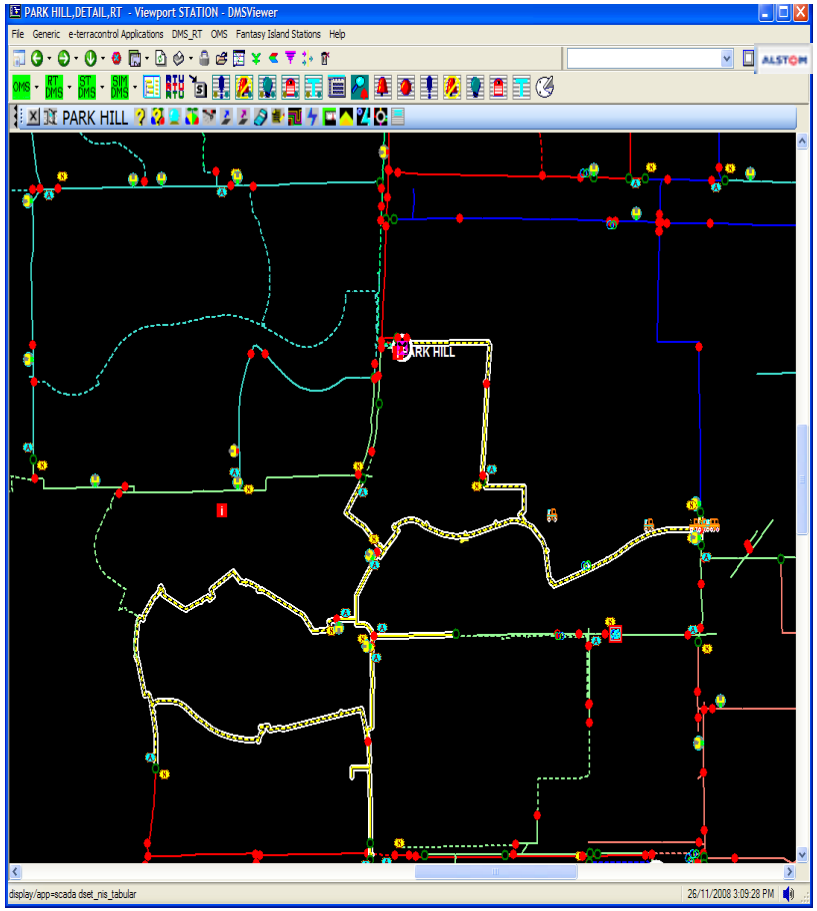
GE Grid Solutions

Adapted from ABB SG Presentation

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

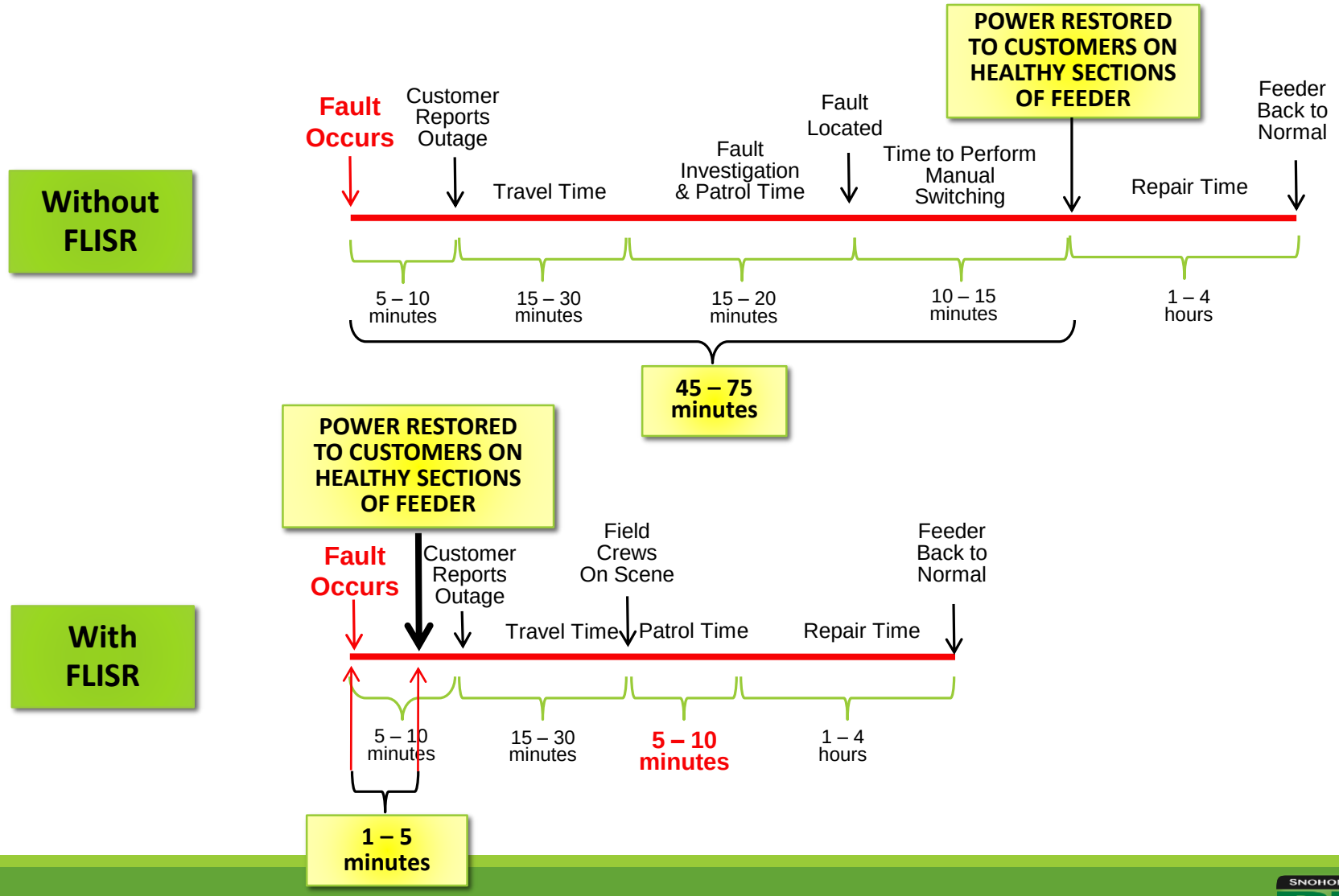
FLISR (Fault Location, Isolation and Service Restoration)
- Automatic switching of field devices based on faults

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)



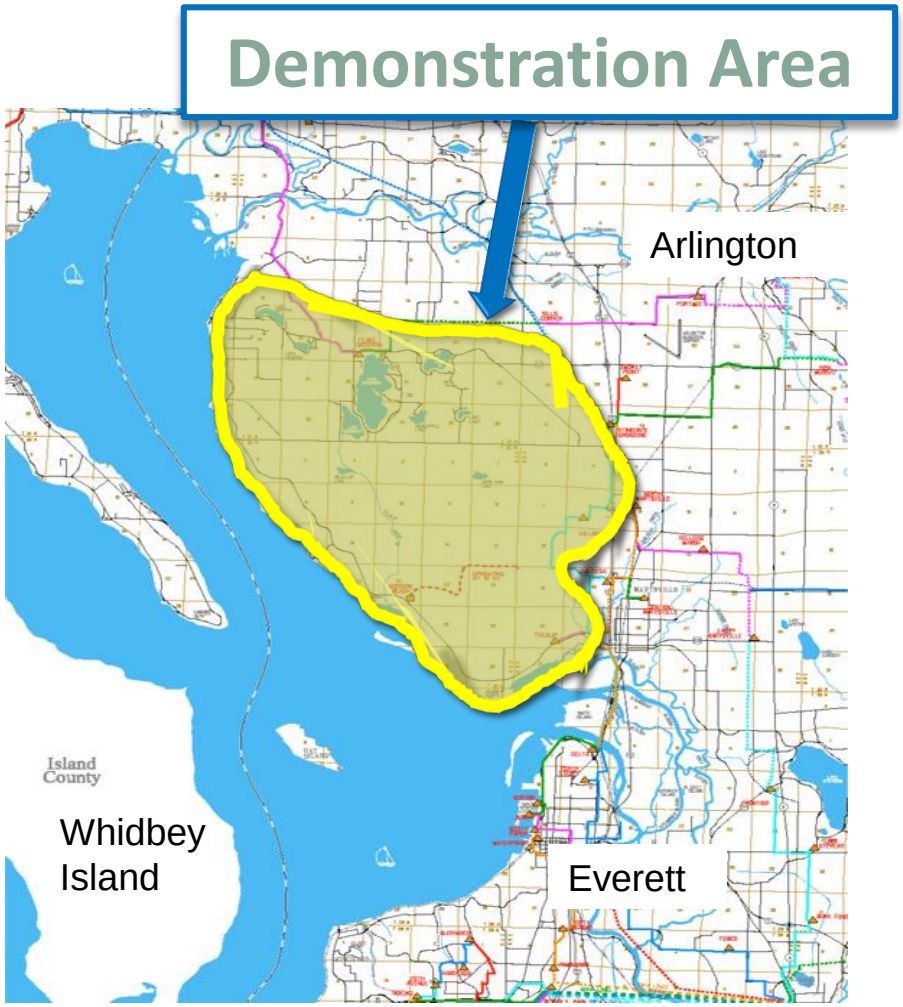
Distribution Automation (DA) Pilot Project

DA Demonstration Area
- 5 Substations & 10 Circuits
- 9,100 Customers

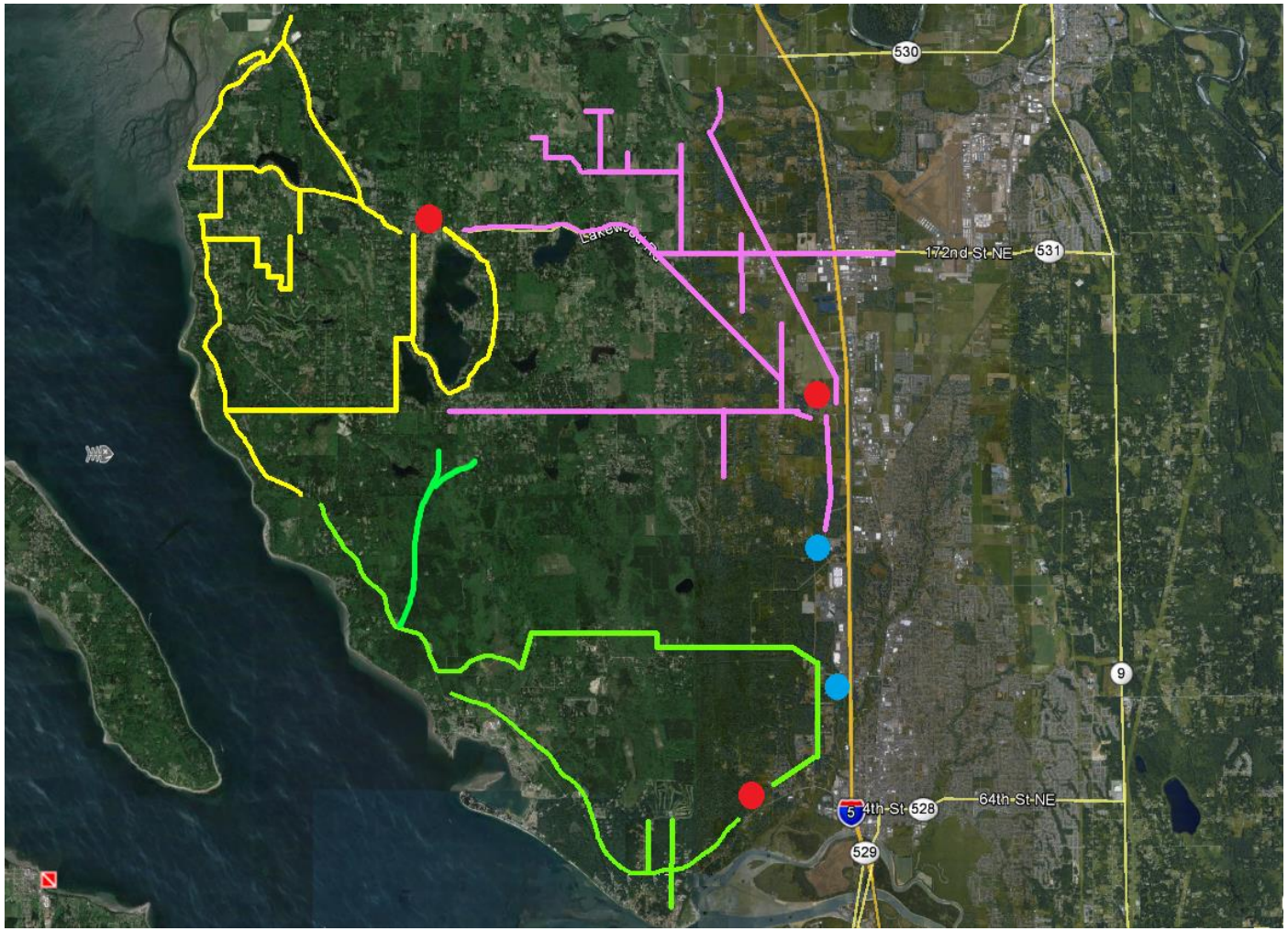
Automated Equipment
- Switches (8)
- Reclosers (26)
- Regulators (39)

Improve Reliability
- SAIDI 4-Yr Avg 90 min/yr

Project Budget - $3.8M

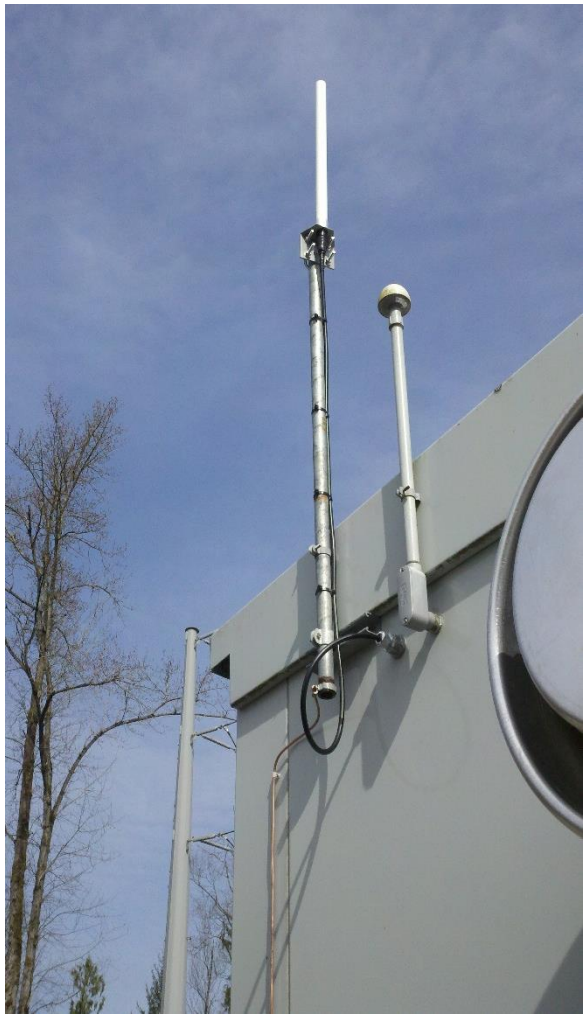


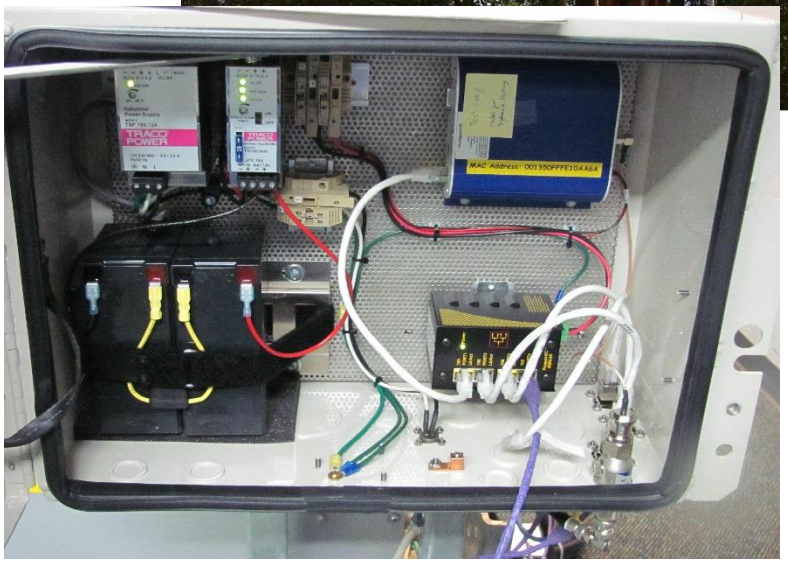
DA Pilot Project Area



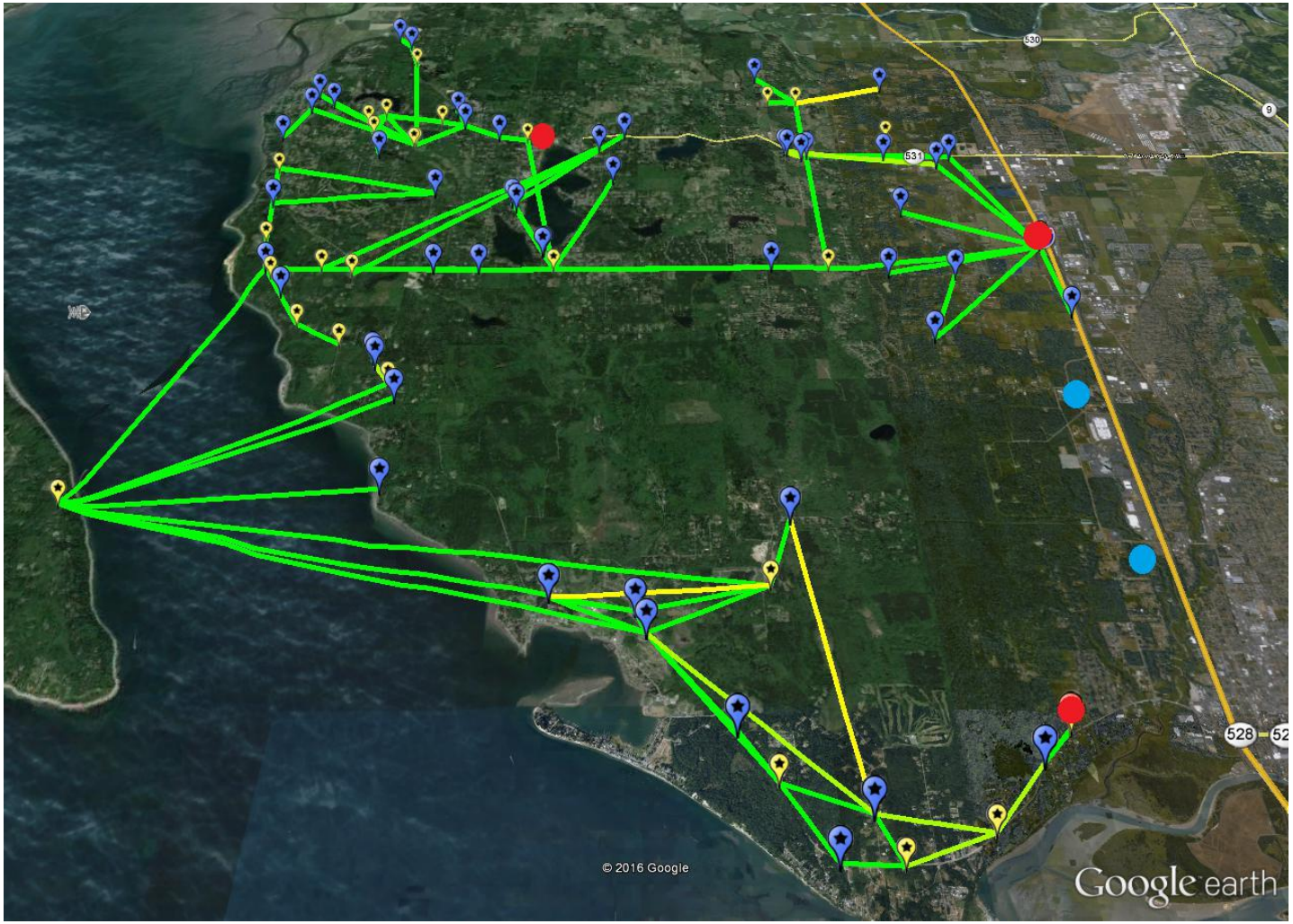
The Equipment

Control Hardware

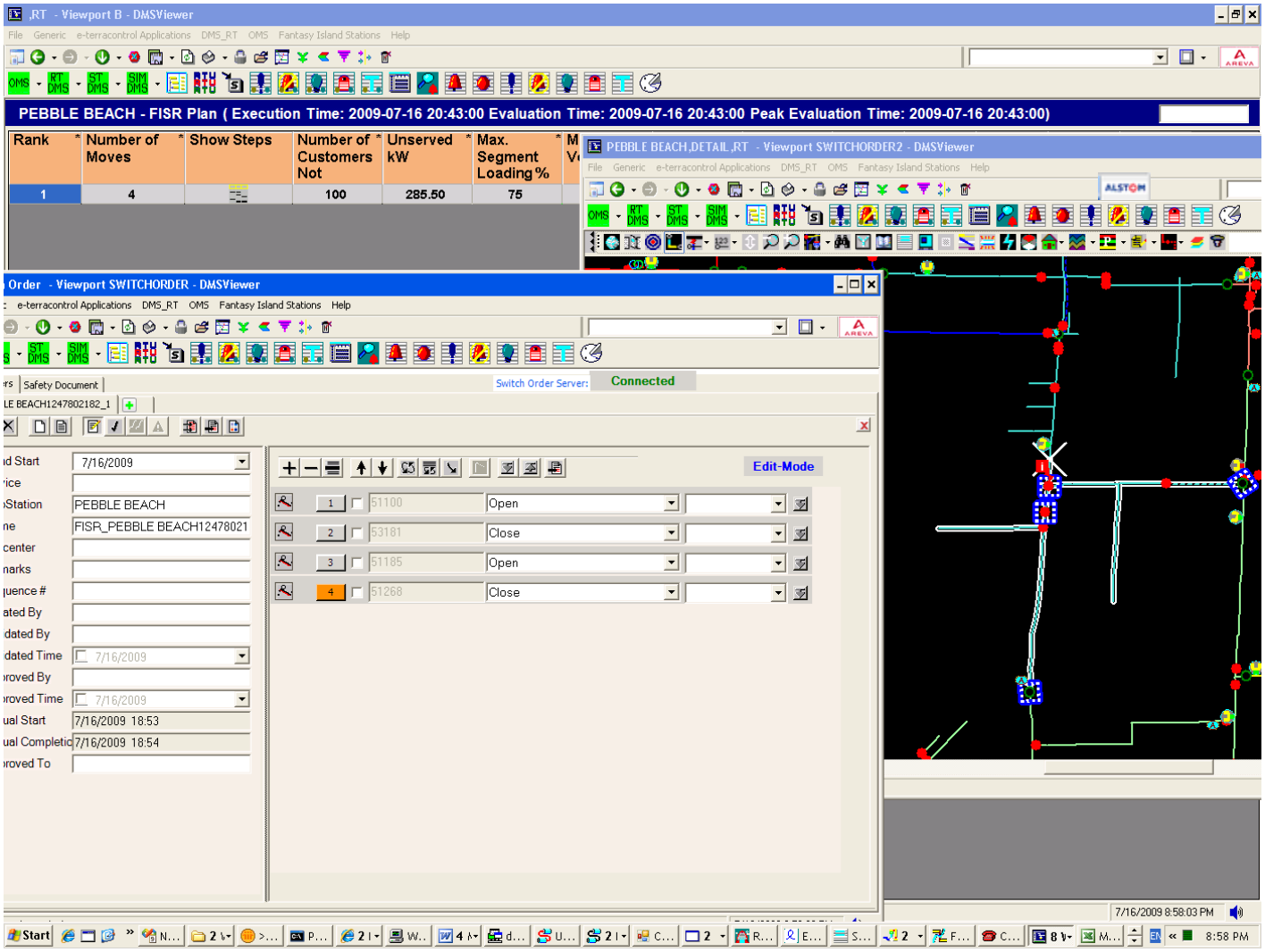




900 MHz Radio Connectivity

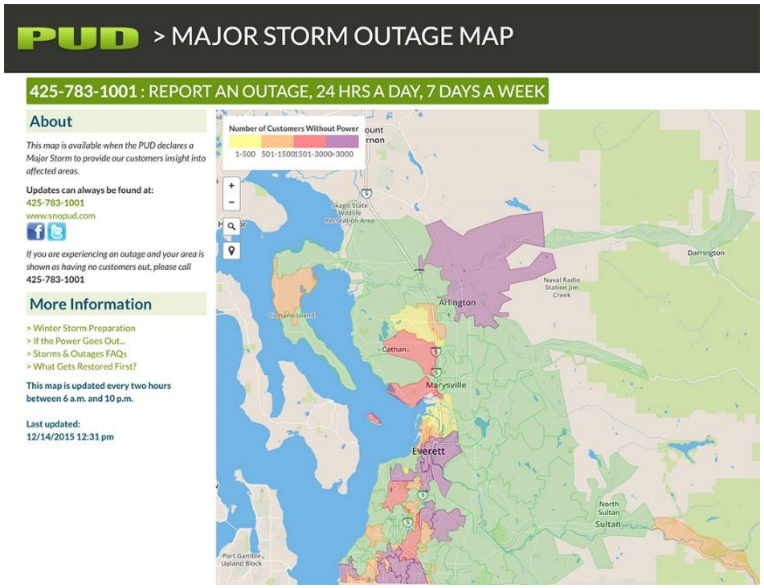


Switching Order Steps from FLISR Results



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.



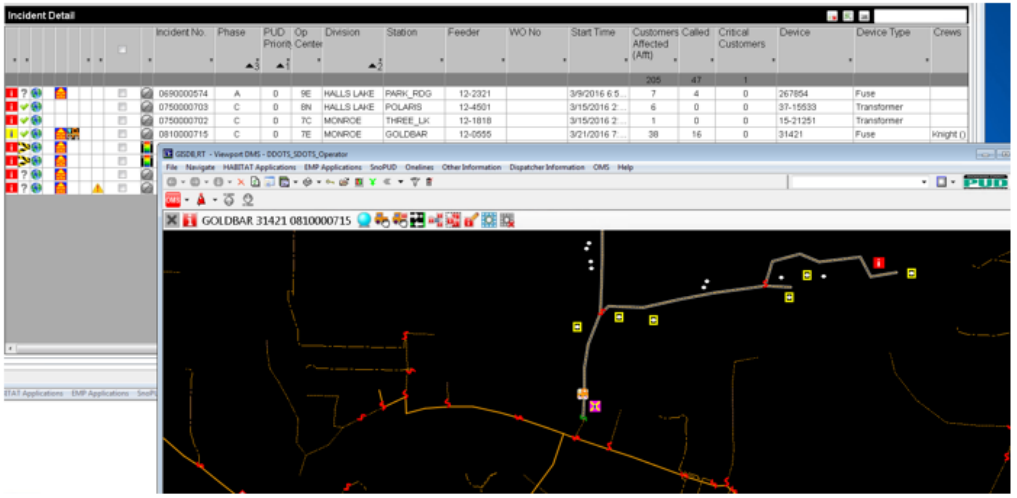
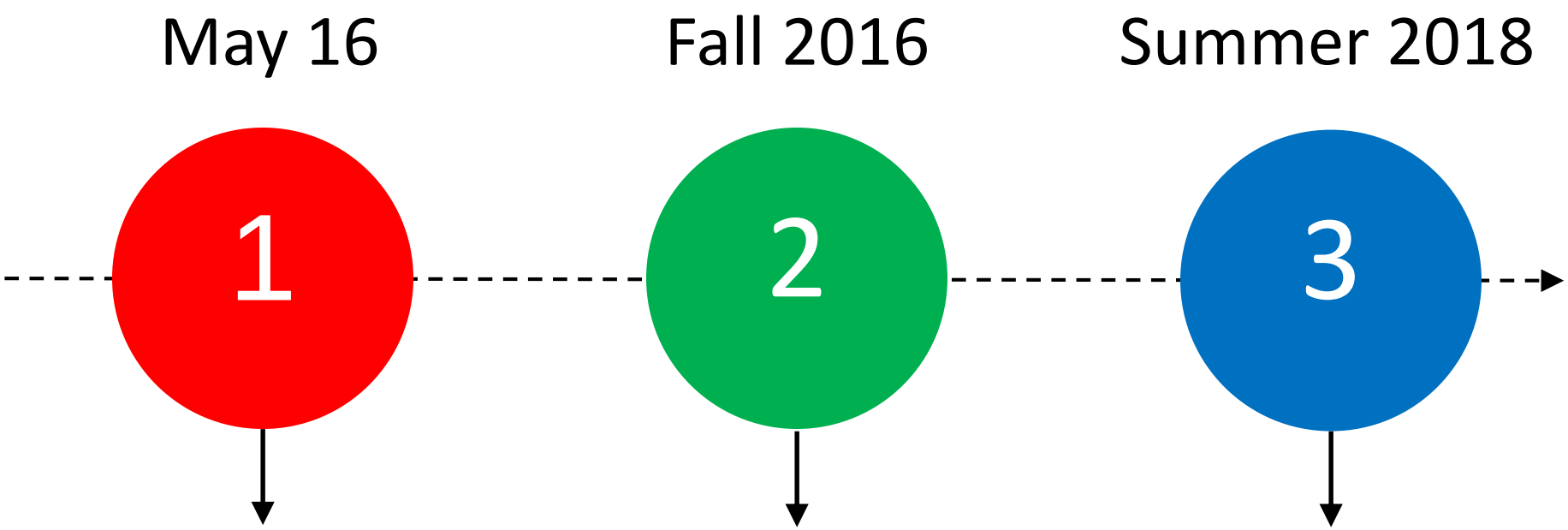


Figure 1-1: Outage Incident Tabular Data with Geographic View

OMS – A Three Phased Deployment

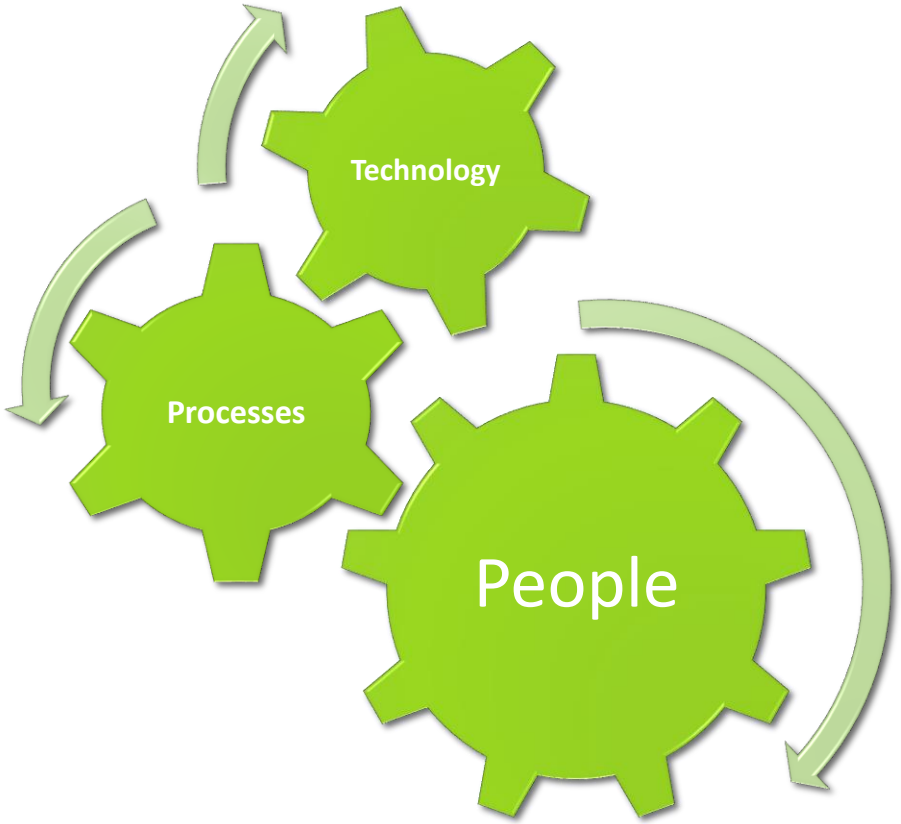


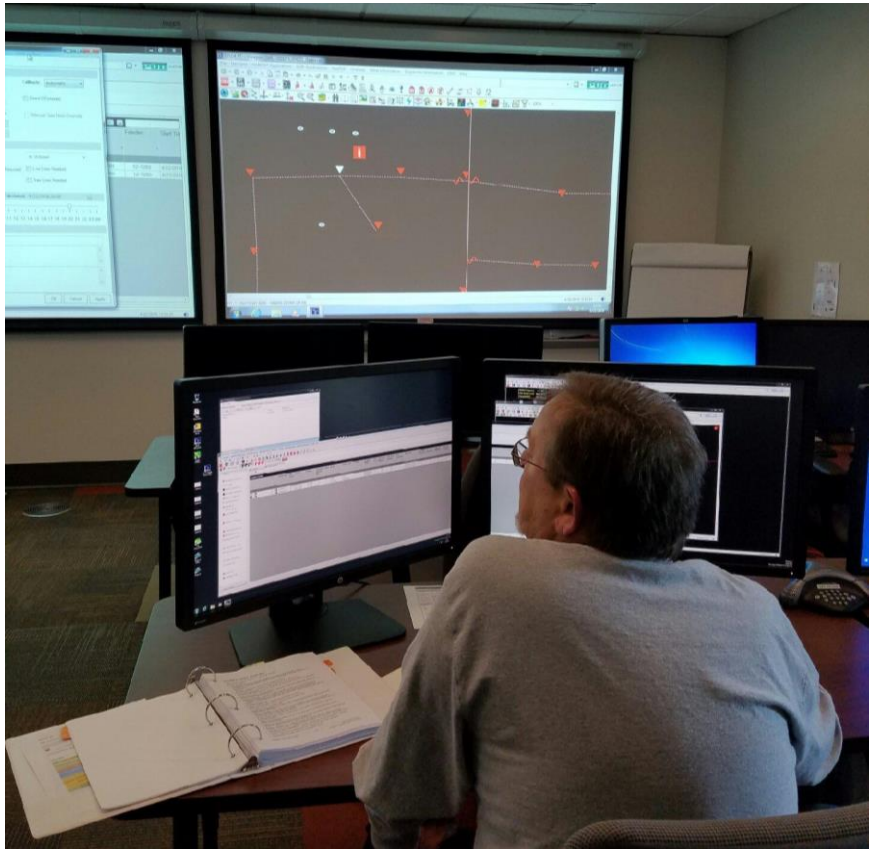
- **Deploy Outage Management System with Integration with CIS, AVL, IVR**
- **Business Process Re-Engineering**
- **Distribution Operator Training Simulator (DOTS)**

- **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**

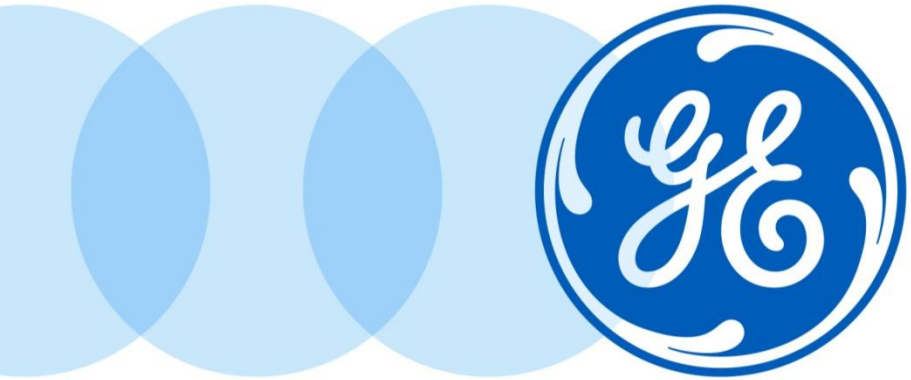
- **AMI Integration**
- **Meter on**
- **Meter last gasp**

Systems and Process Integration





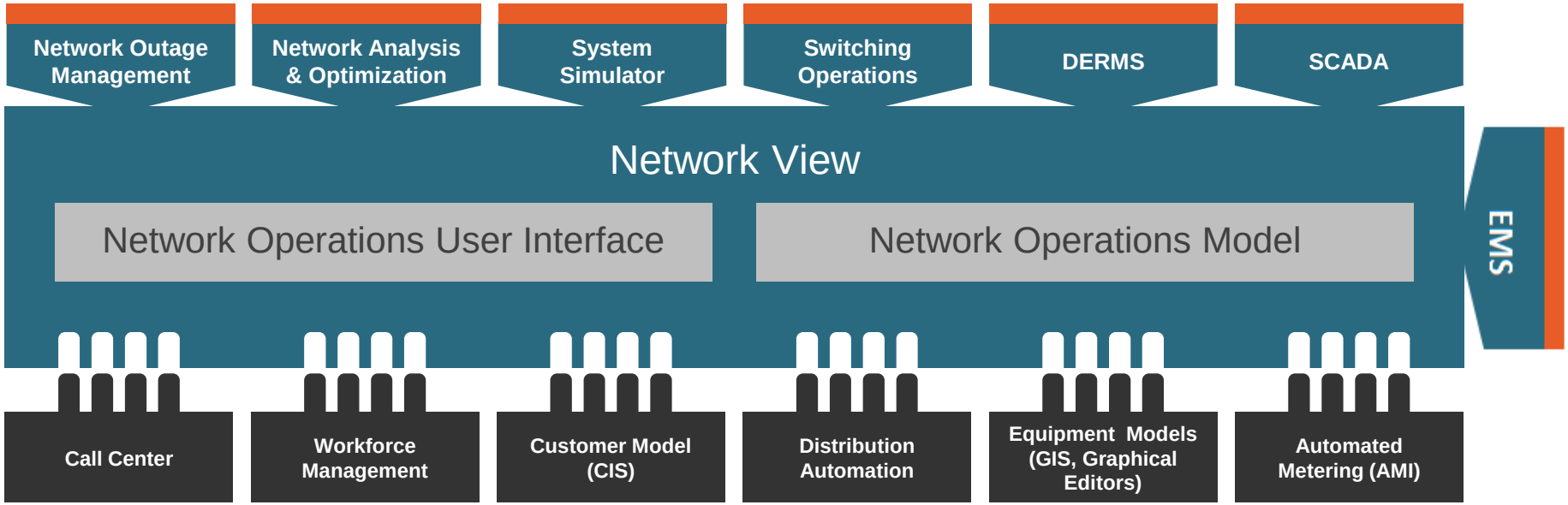
OMS Training Session utilizing DOTS Simulator



e-terra*distribution*

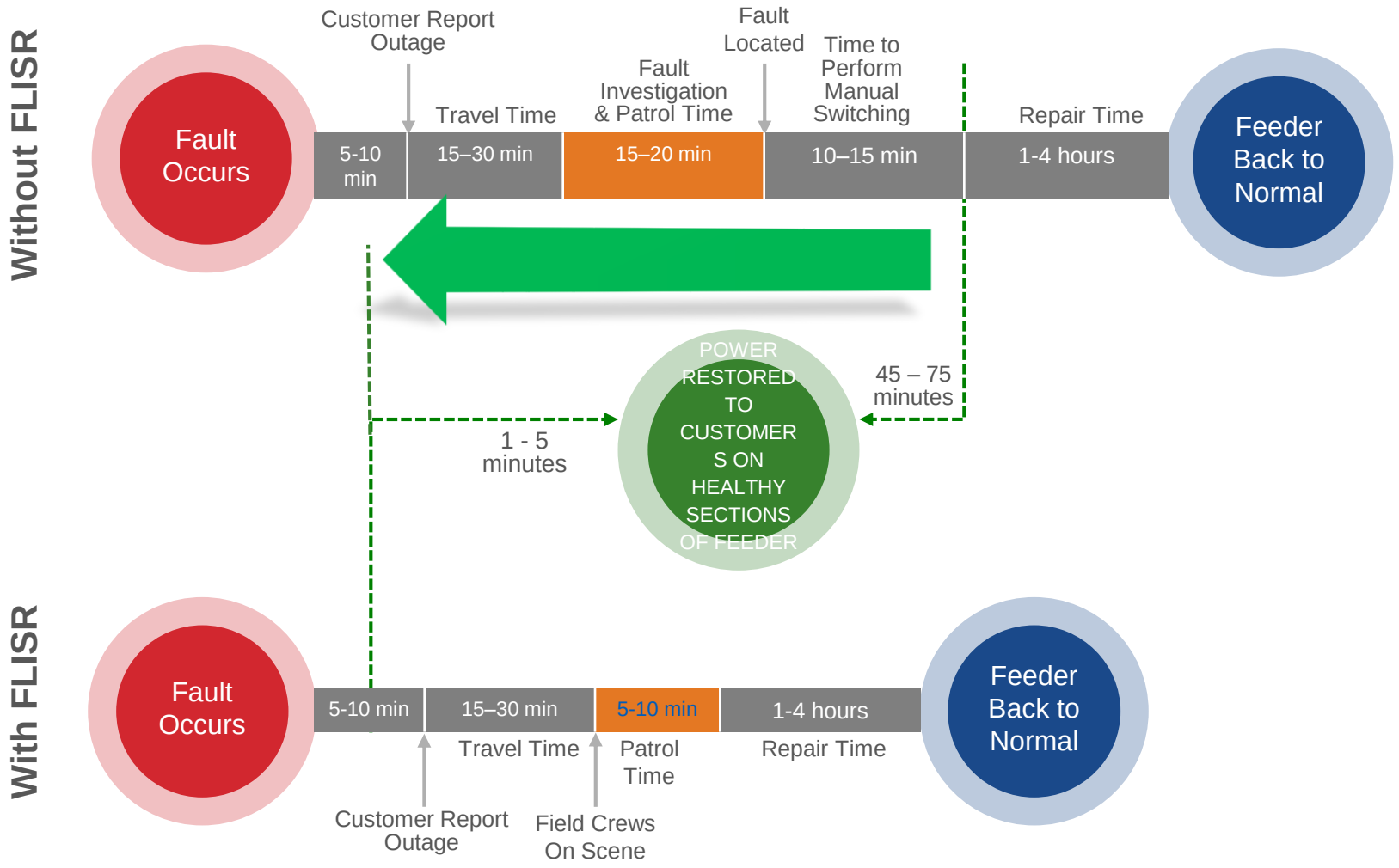
Imagination at work

Complete ADMS Functionality



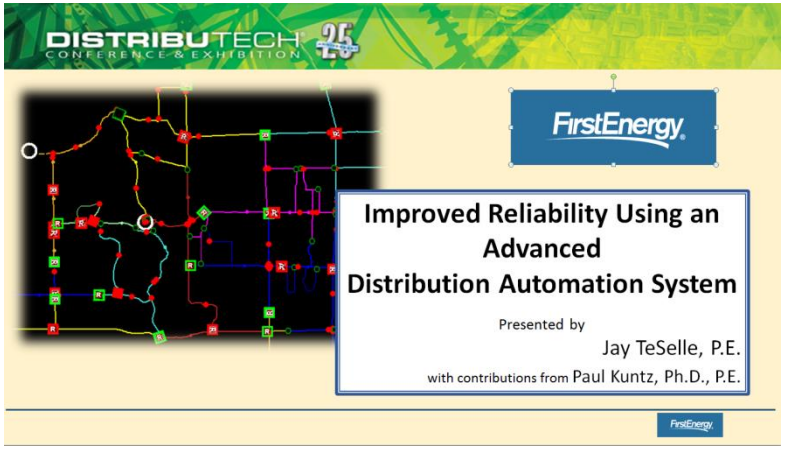
FLISR - Fault Location, Isolation, Service Restoration

Increase Customer Satisfaction, Lower Operating Cost

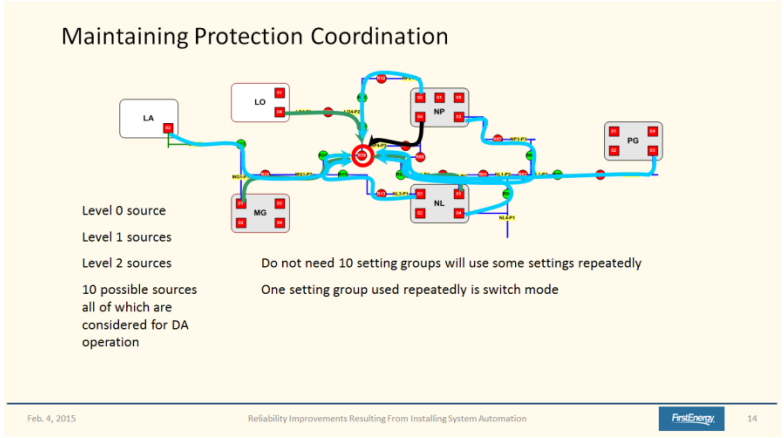


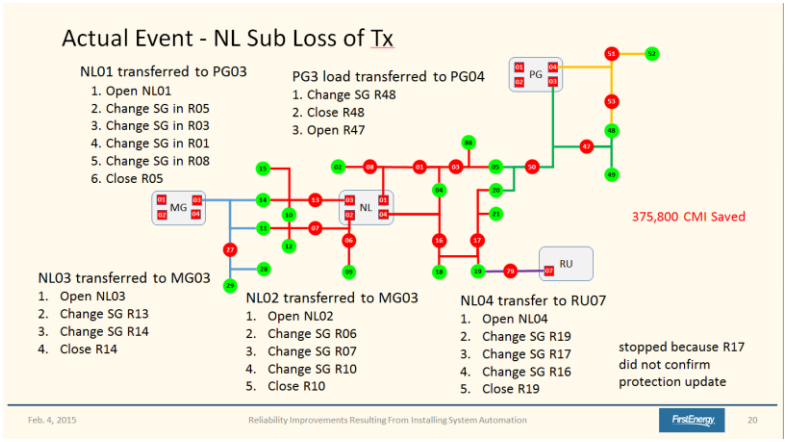
First Energy Experience with FLISR

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

DISTRIBUTECH 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

Benefits

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

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.

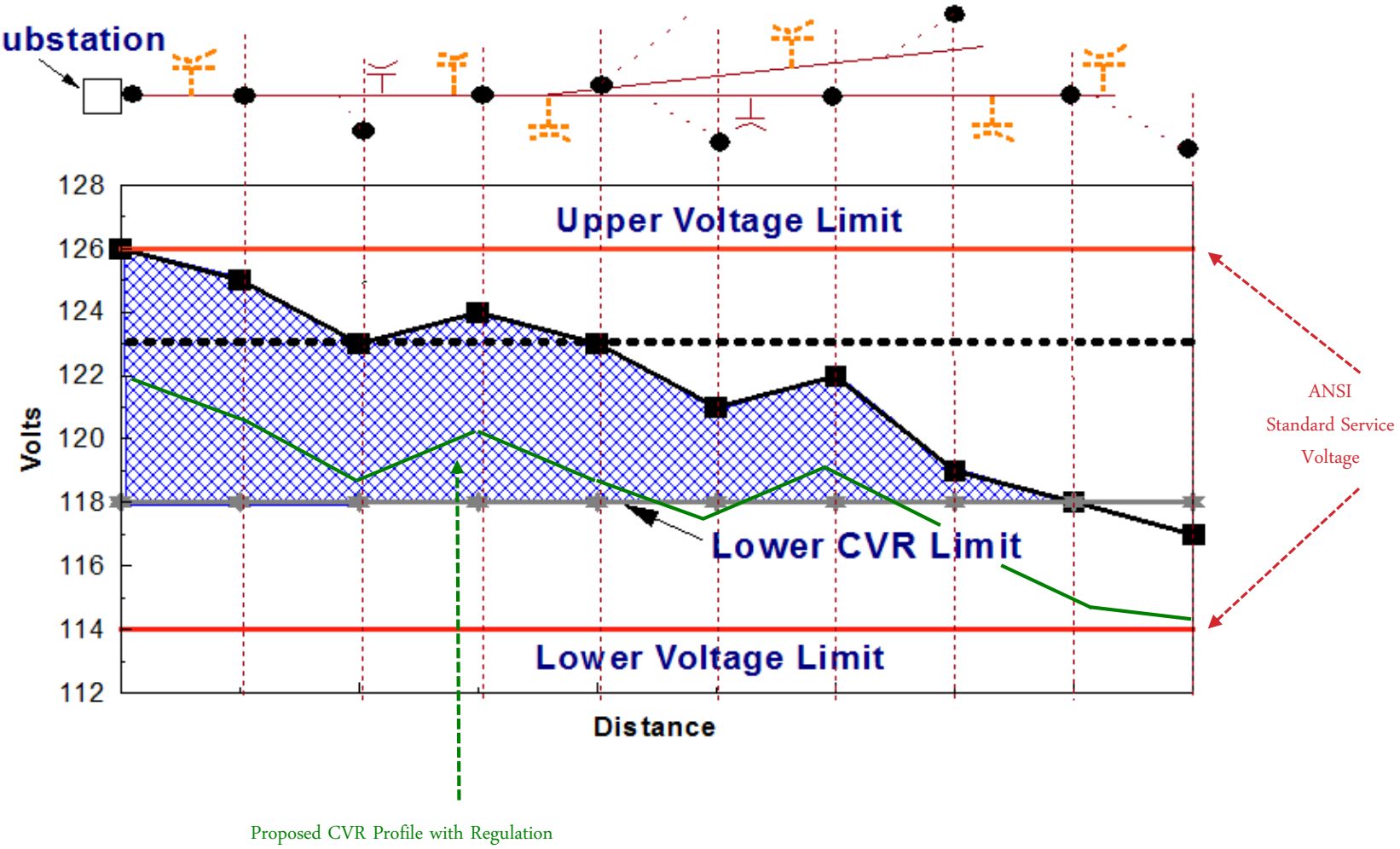
FPL

Momentary Investigation Maps

FPL

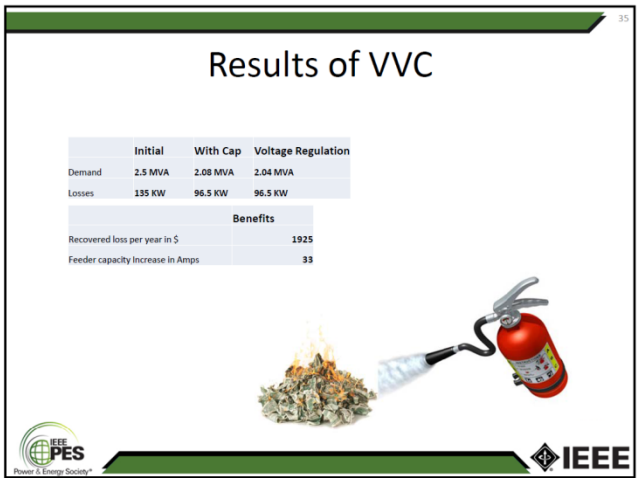
See tutorial regarding confidentiality disclosures. Delete if not needed.

VVC – Volt/VAR Control

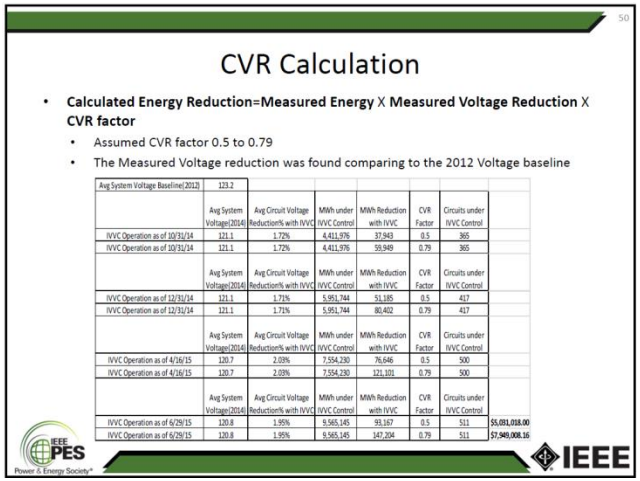


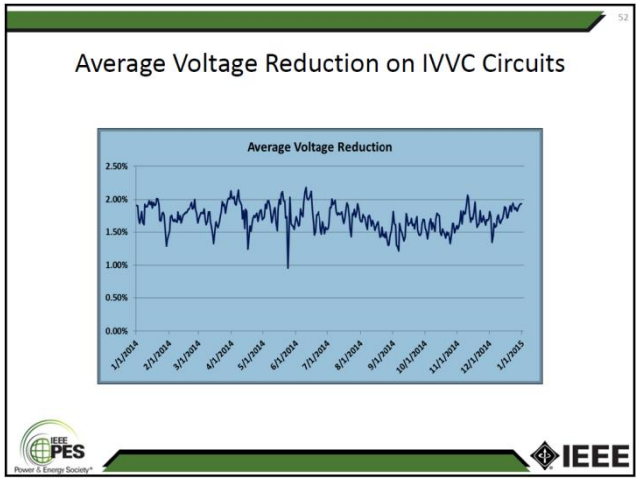
Duke Energy Experience with VVC

Presented at IEEE PES



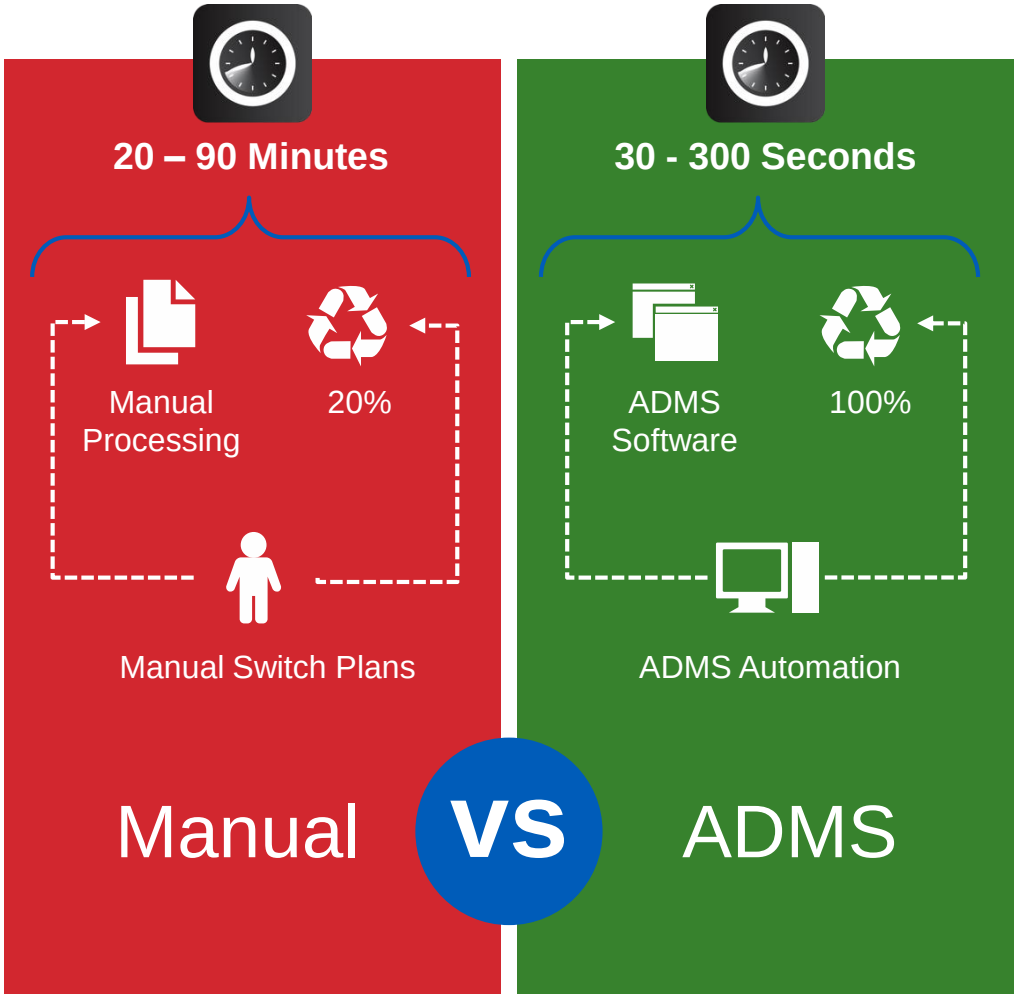
- In production on >500 Circuits (Ohio)
  - CVR Objective Function
- 1.95% Average Voltage Reduction
- $10k Annual Savings per Feeder @.50, $15.5k @.79 CVR Factor





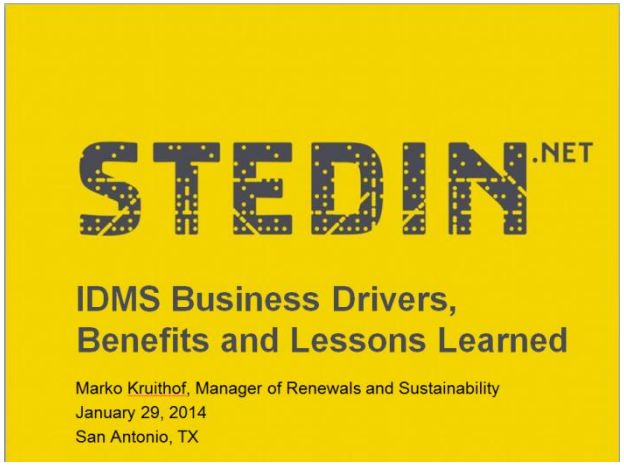
See tutorial regarding confidentiality disclosures. Delete if not needed.

Switch Order Development & Validation (SWO)



Stedin – SWO Benefits

Webcast Seminar



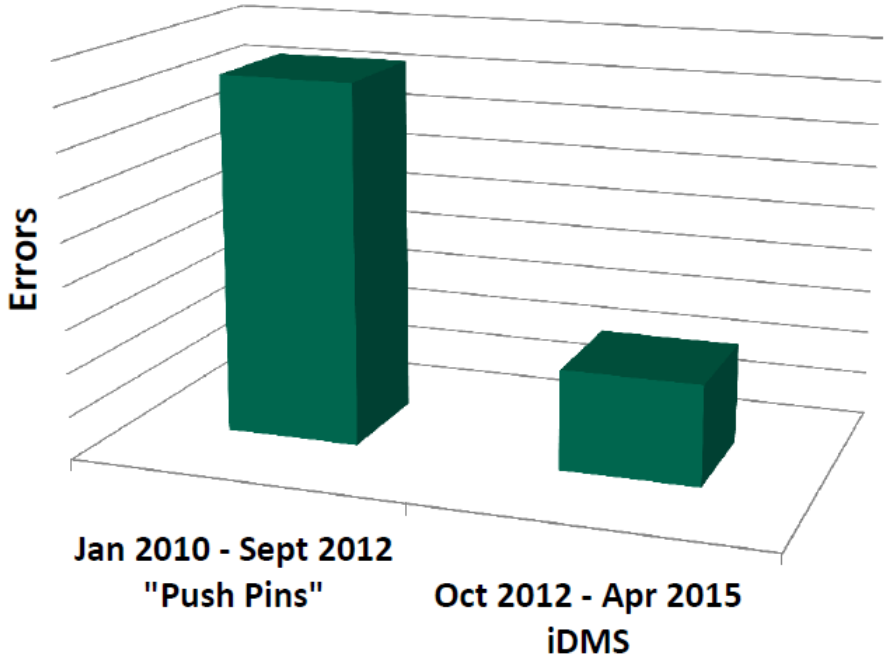
- 2 FTE Reduction for SWO Development
- Improved Communication
- Fewer Switching Mistakes
- Reduction in Outage Minutes
- Improved Safety
- Reduced Training Requirements

See tutorial regarding confidentiality disclosures. Delete if not needed.

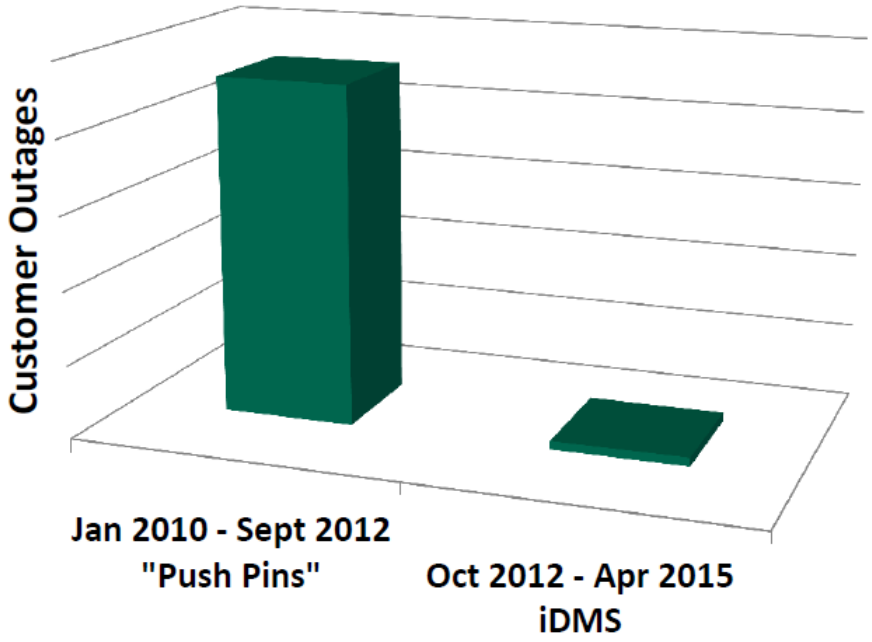
IDMS – Benefits Realized

Dramatic reduction in switching errors

MGE Average Annual Lost Load Switching Errors

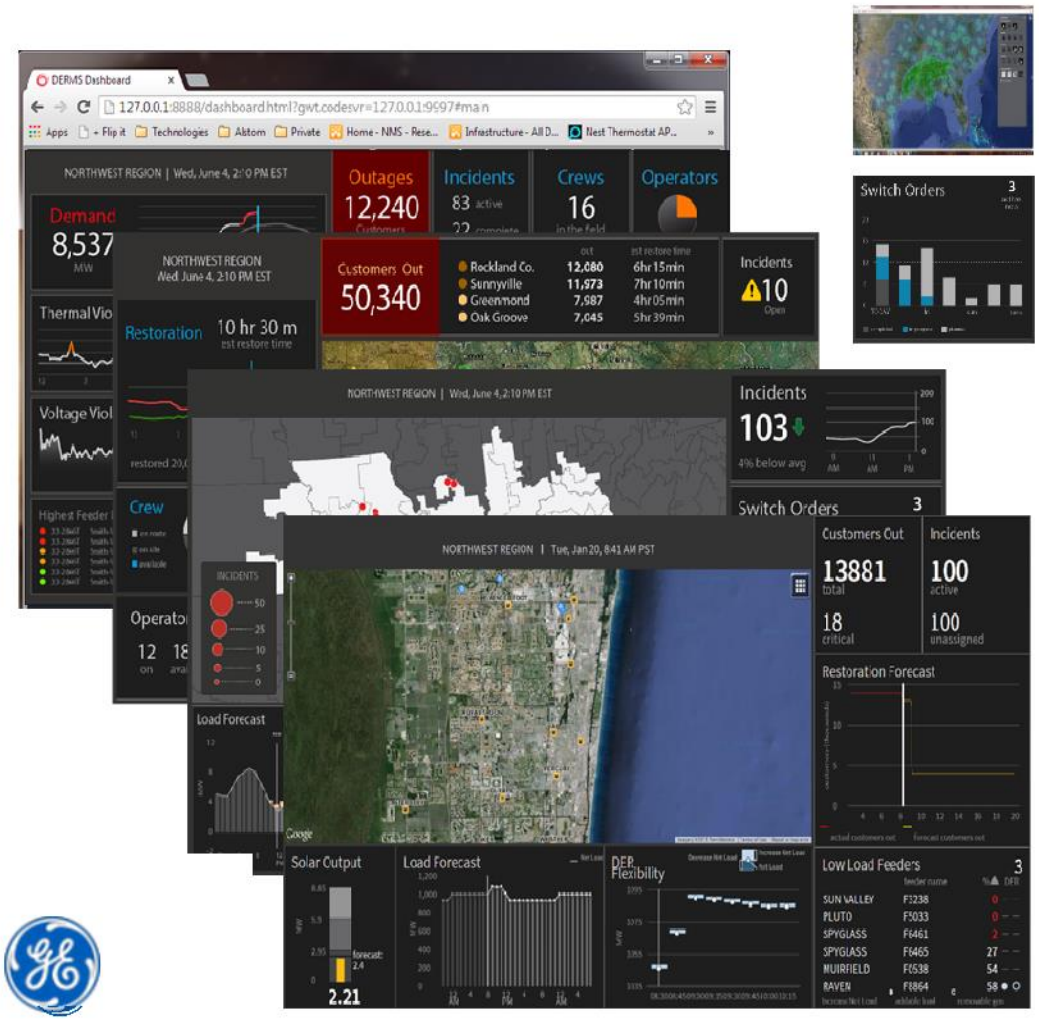


MGE Average Annual Switching Error Contribution to SAIFI



Grid IQ Insight

Analytics providing
real.actionable.insights



Flexible Form

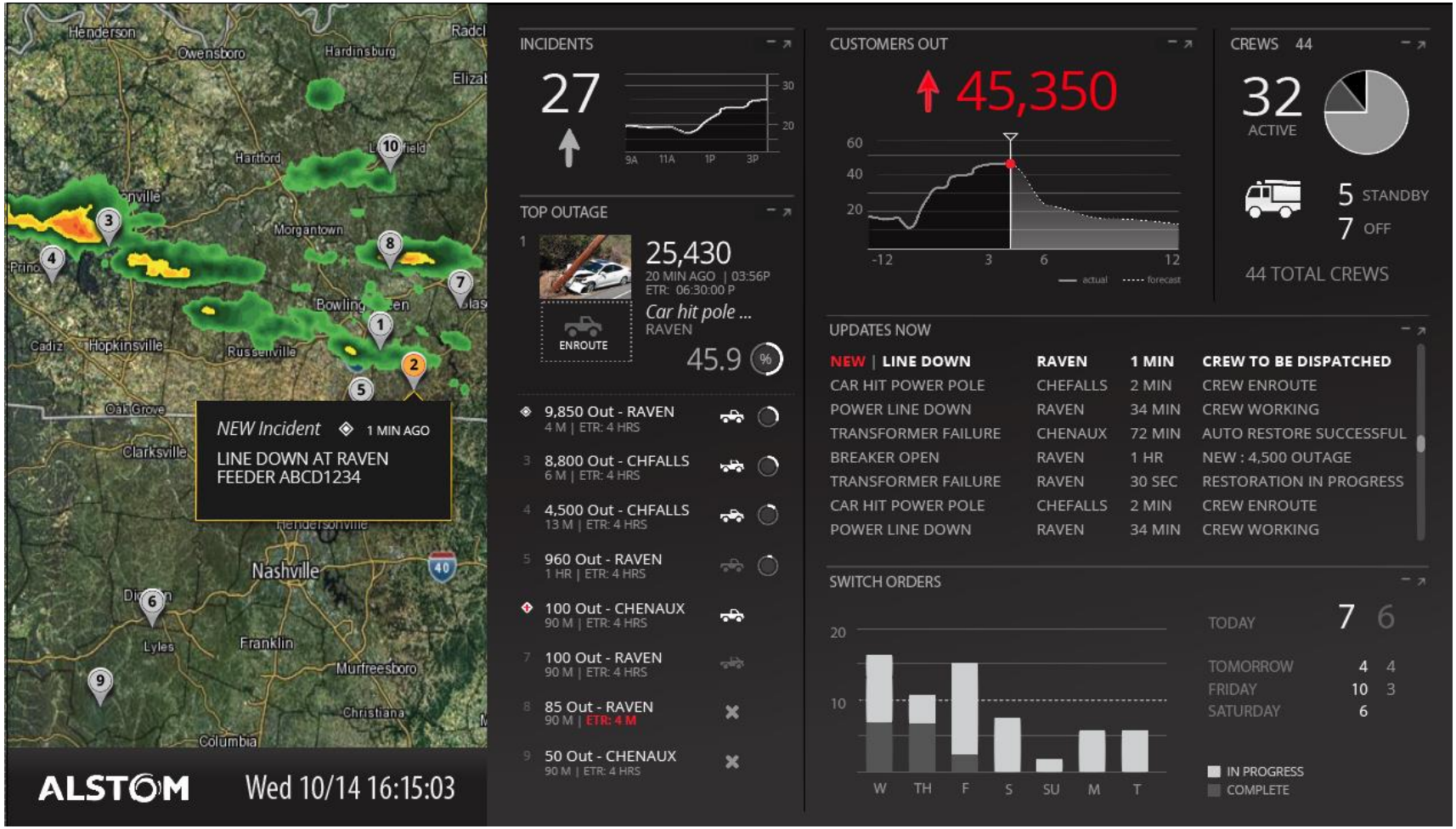
- Real-time Analytics
- Enterprise Dashboard
- Customer Outage Portal
- Aggregator Portal
- DERMS Workstation

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



See tutorial regarding confidentiality disclosures. Delete if not needed.

Q & A

Will Odell
Smart Grid Program Manager
Snohomish County PUD
whodell@snopud.com

Ethan Boardman
Director of Business Development IDMS
GE Grid Solutions
Ethan.Boardman@ge.com