ELECTRIC POWER RESEARCH INSTITUTE

U.S. DEPARTMENT OF ENERGY

AMI Beyond Meter Reading

Moderators: Gale Horst EPRI / Debbie Haught DOE

Speakers: Dave Herlong – Florida Power & Light

Ruth Kiselewich – Baltimore Gas and Electric Co.

Jayme Holland – Central Maine

Sara Kaplan – Iowa Association of Municipal Utilities

Joe Schatz – Southern Company

The Smart Grid Experience: Applying Results, Reaching Beyond

Tuesday 28-October-2014 3:30pm

Session: AMI Beyond Meter Reading

Applying Results:

Successes

Surprises

Reaching Beyond

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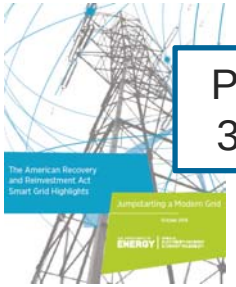
Leveraging AMI data in Operations

Dave Herlong, Smart Grid Operations Manager, Power Delivery

October 27-29, 2014
Charlotte, NC

Dave Herlong
Smart Grid Operations Manager, FPL

- Dave Herlong is manager of smart grid operations at Florida Power & Light Company and is responsible for making useful operation of smart grid data and devices in FPL's Power Delivery organization.
- Previously, he served as manager of distribution operations and was responsible for the overall engineering, maintenance, restoration and safe operation of the distribution network.
- Mr. Herlong earned his BS in Industrial & Systems Engineering from the University of Florida and is a graduate of the United States Marine Corps Officer Candidate School, former United Way loaned executive and certified Six Sigma black belt.



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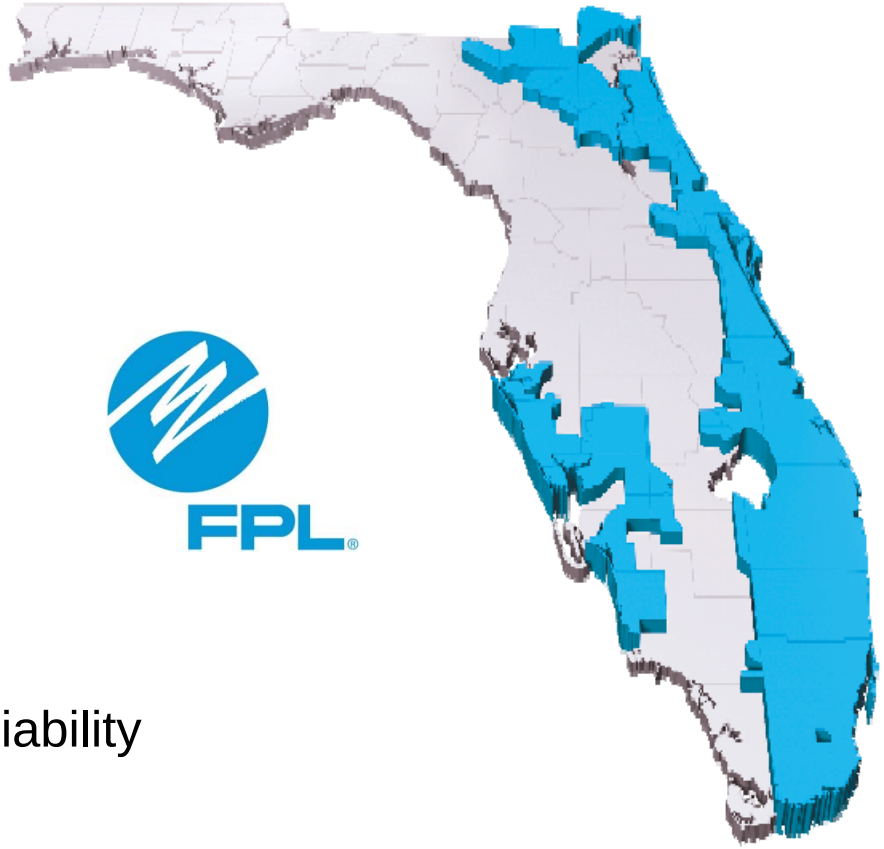
FPL & Smart Grid Overview

- Rate-regulated, vertically integrated
  - 4.7MM customers
  - 1.1MM poles
  - 800,000 transformers
  - 67,000 distribution line-miles
  - 600 substations
- Deployment goals
  - 4.6MM smart meters
  - 11,500 other intelligent devices
  - Expansive grid awareness
- Current & future initiatives
  - Continue data mining to improve reliability
  - Revamp grid architecture
  - Revolutionize how we serve customers



A Paradigm Change in Grid Awareness

Power Generation | **Transmission & Substation** | **Distribution**

Digital Monitoring Yesterday

Distribution Automation

Smart Meters

Digital Monitoring Today

Representative Successes … to Date

- Proactive outage ticket creation
  - Uses FPL-developed software
  - 40,000 automatically created outage tickets representing 500,000 customers
  - ***Result:*** *faster service restoration – often before customers call*
- Restoration Spatial View
  - Uses data & telemetry
  - Puts entire view on iPads in field
  - ***Result:*** *identifying embedded outages, fewer truck rolls*
- Automated feeder switch technology
  - Identifies fault locations
  - Reroutes power, mitigates outage impacts
  - ***Result:*** *fewer outages by over 400,000, faster restoration by about 5 million minutes*

Managing the Unexpected

- Network chatter volume and latency for restoration messaging
- Single-premise outage accuracy still a challenge
- Better-than-expected field use and acceptance
- Influx of additional features requested
- Automated switch commission process
- Need for a more comprehensive network strategy
- Evolve ownership and maintenance of distribution automation and network devices

Grid & Customer Analytics Driving Our Future

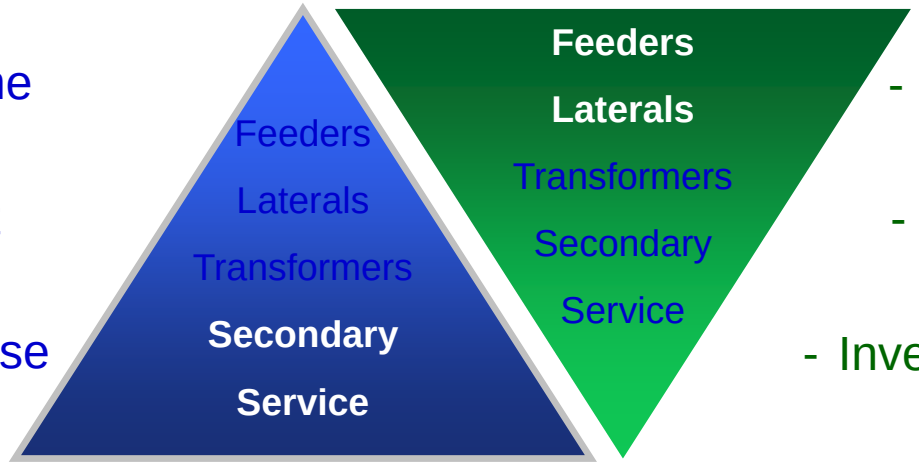
Expand the scale and scope of FPL's growing digital footprint:

- Add more automated, self-healing technologies to mitigate outages
- Expand digital connections for all feeders and substations
- Target more smart sensors for real-time, predictive diagnostics
- Drive more business solutions leveraging data mining / applied analytics

- Interruption volume

- Restoration cost

- Restoration Expense



- Customer volume

- Investment Cost

- Investment in prevention

Questions / Discussion

Dave Herlong

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BGE's Dynamic Pricing & Behavioral Programs

Ruth Kiselewich, Director, Demand Side Management Programs

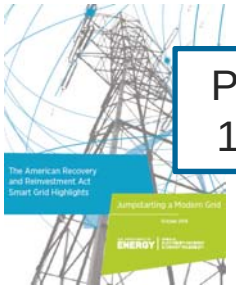
BGE
An Exelon Company

October 27-29, 2014
Charlotte, NC

Ruth Kiselewich
BGE's Director DSM Programs

- Leads planning, development, implementation, marketing and regulatory affairs for
  - All BGE energy efficiency programs
  - BGE's demand response program, PeakRewards℠
  - Smart grid enabled programs: Smart Energy Manager®, a behavioral program, and Smart Energy Rewards®, a dynamic pricing program
- Awards including Platts Energy Efficiency Program of the Year – Energy Supplier and 2 ENERGY STAR® Partner of the Year Sustained Excellence Awards
- B.A./M.A. from the Johns Hopkins University and an M.B.A. from Baltimore's Loyola University

BGE
An Exelon Company



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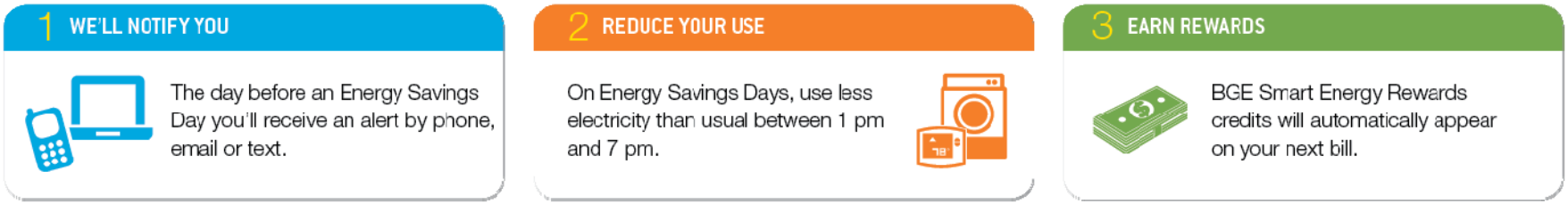
BGE Smart Energy Rewards® (SER): Peak Time Rebate Program

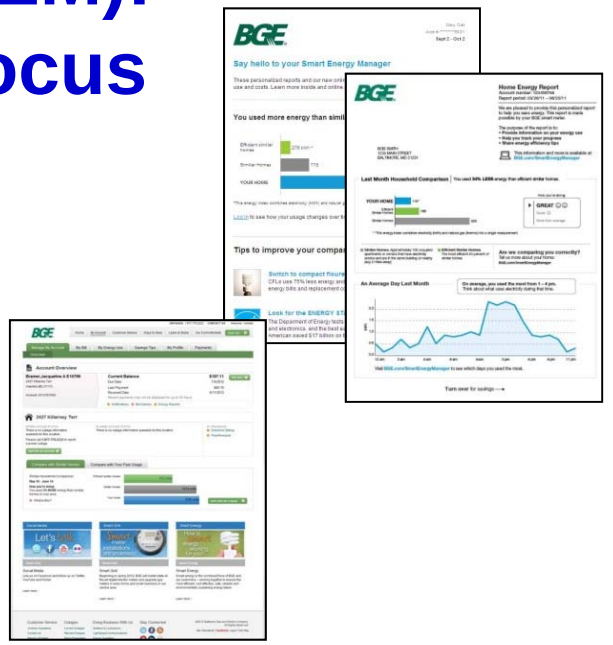
BGE SMARTENERGY rewards℠
a BGE SMARTENERGY savers program®

- Behavioral demand response program
- Default tariff that is applicable to all residential customers with a smart meter
- Customers earn bill credits for reducing electric consumption on approximately 5-10 peak event days each summer called Energy Savings Days
- BGE's Peak Time Rebate Program launched July 8, 2013

How it Works: 3 Simple Steps



BGE Smart Energy Manager® (SEM): Behavioral With Conservation Focus



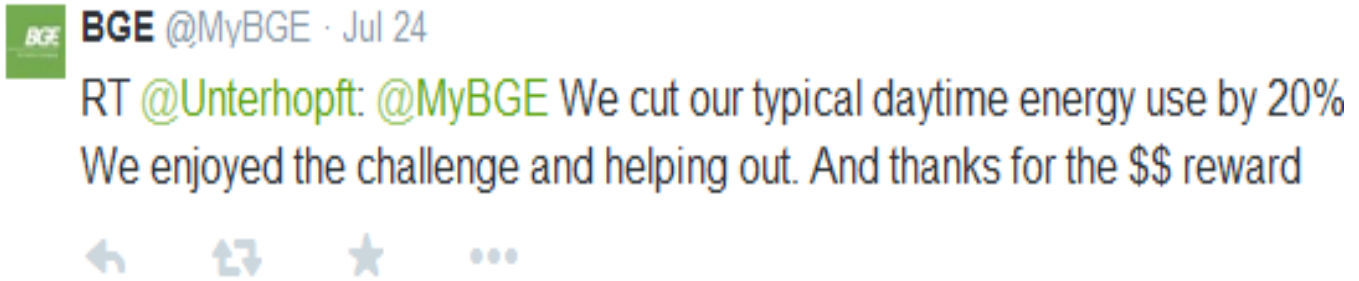
- Track, analyze usage and cost data
- Estimate bills
- Unusual usage alerts
- Compare to “like” customers
- Personalized usage and savings tips
- Printed and electronic home energy reports
- Access to interval usage data
- Launched October 2012

Successes

- In 2013
  - Four Energy Savings Days with $9.08 average credit paid
  - 75% to 93% of customers earned a rebate
- In 2014: 2 Energy Savings Days, 76% average participation

More Successes

- BGE Smart Energy Manager
  - Over 2.7 million Home Energy Reports sent to customers
  - Nearly 300,000 customers enrolled in web-based energy management tool
  - 23,016 MWh reduced = $2.8 million in bill savings
- High customer satisfaction
  - “I’ll see your $13.25 and raise you $12.75…we saved $26.00 yesterday! Pretty good deal!”



Surprises

Surprise 1:

Benefit of outbound calls to obtain contact preferences

Surprise 2:

Having to deal with smart meter opt outs

Surprise 3:

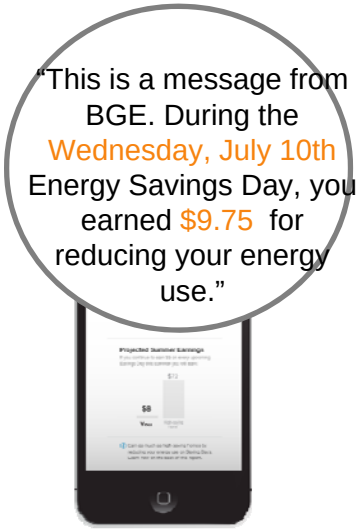
Slower implementation impacted mass communications

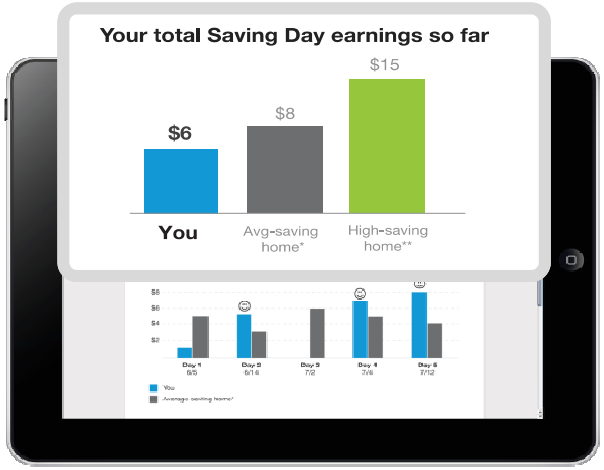
Surprise 4:

Weather

Reaching Beyond

- Effective marketing to build awareness and engagement
- Sending event communications to 1 million customers
- Ensuring visible feedback shows the customer benefits





Questions / Discussion

Ruth.C.Kiselewich@bge.com

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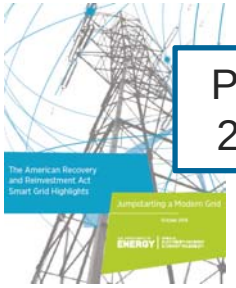
Optimization of assets, policy and process to achieve operational efficiencies, improve reliability and customer benefit

Jayme Holland, Manager of Projects and Programs
Central Maine Power

October 27-29, 2014
Charlotte, NC

BIO – Jayme Holland

- Manager of Projects and Programs – AMI enabled programs
- With Central Maine Power/Iberdrola USA since January 2013
- Implemented
  - Energy Manager
  - Green Button
  - Online Price Comparison tool
- Projects in progress:
  - Energy Manager for Business
  - Net Energy Billing
  - AMI Optimization Group Coordinator



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Iberdrola USA Smart Grid Strategic Principle

Optimization of assets, policy and process to achieve operational efficiencies, improve reliability and customer benefit

- Foundational Assets:
- Two way communications network across the service territory
- Faster, better data from all components of the network
- Centralized control/monitoring capability

Project Objectives and Features

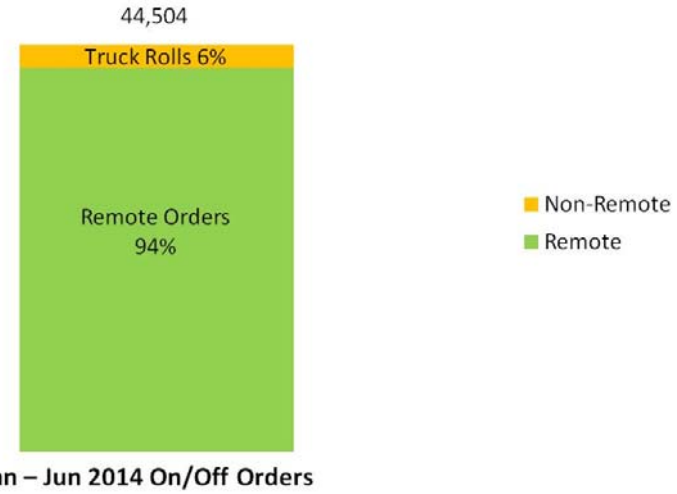
System Development Phases	Functionality
Phase 1 Meter to Bill Capable	- Ability to batch meter install service orders - Ability to bill from automated meter reads
Phase 2 Customer Service Enhancements	- Meter Asset Management Upgrade - Implement Customer Service rep web portal - Settlement Upgrade - Ability to support automated disconnect/reconnect - Ability to support on-demand reads, pings, and tenant changes from AMI read data
Phase 3 Demand Response Enhancements	- *Information Research Study* - Deploy full new outage management - Settlement on 100% of customer usage - Implement enhanced customer web portal - Support dynamic rates

Project Objectives and Features

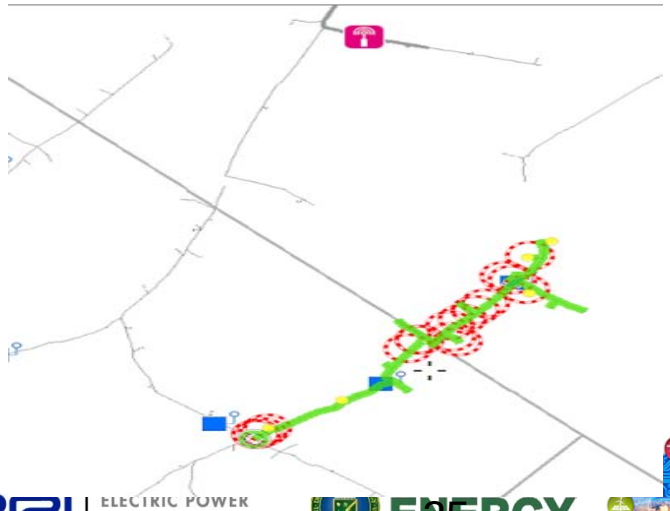
- Installed more than 600k meters to CMP's residential, commercial and industrial customers
- Deployed more than 6k network devices to provide 100% network coverage across CMP's service area The AMI system provides a wireless communications network that covers CMP's entire service territory to reach more than 600k customer endpoints and provide a platform for CMP's Smart Grid initiatives
- Upgraded or installed more than 10 new IT systems to support increased data volumes and new functionality
- Initiated a consumer research study to evaluate response to a variety of AMI-enabled programs and devices
- Support future Smart Grid initiatives including power quality monitoring and distribution automation

AMI Results: Smart (and Efficient) Company

Operation	Results/Impact	Company Benefit
Service: Remote orders	Up to 2K / day	Reduced truck rolls
Outage: Meter events + prediction	Event-driven	Faster preparation + response
Outage: Order clearing	As needed	Faster preparation + response
Reliability: Automated reclosers	21 devices	Reduced restoration miles, time
Reliability: Automated substations	12 devices	Reduced restoration miles, time
Revenue: Unconfigured meters	600 identified	All usage billed



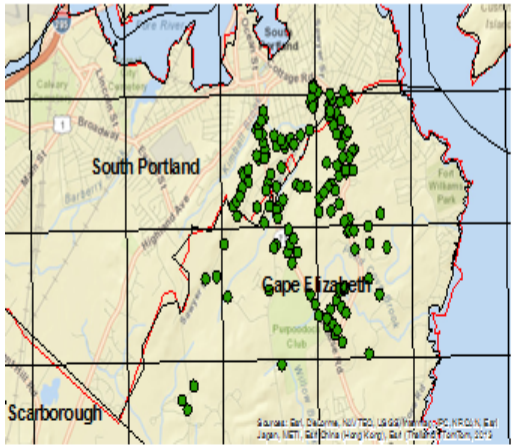
Percent of Orders Completed Remotely



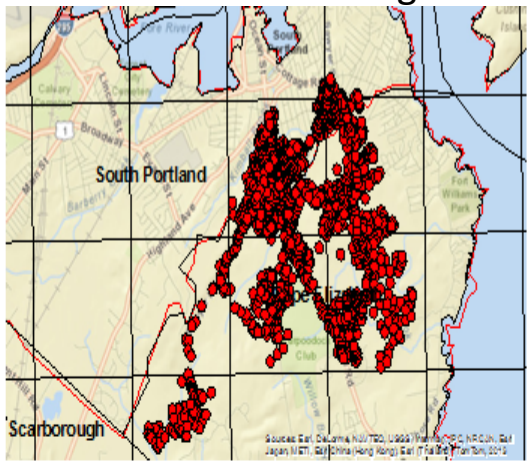
Meter off events in Smart Map

AMI Results: Event Data Adds Value to Outage Assessment

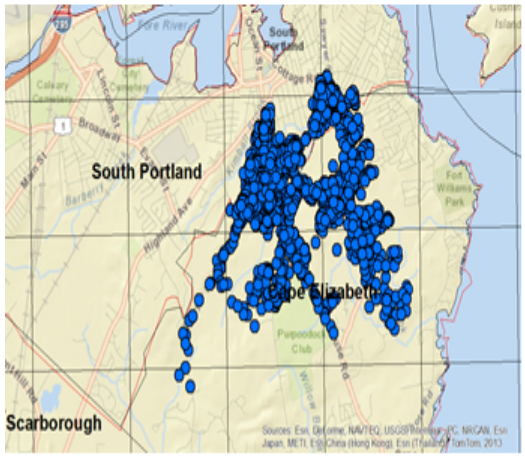
Phone Calls



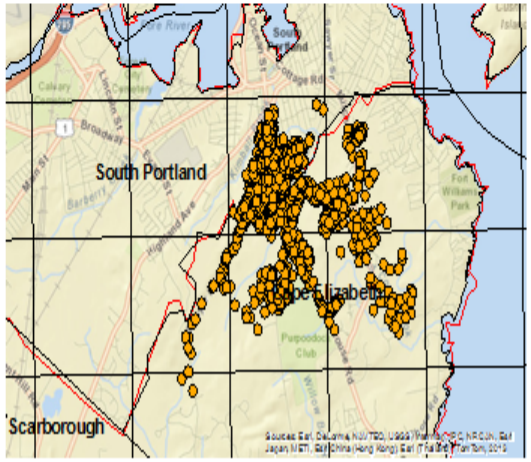
Predicted Outage



AMI Outage Events



AMI Restoration Events

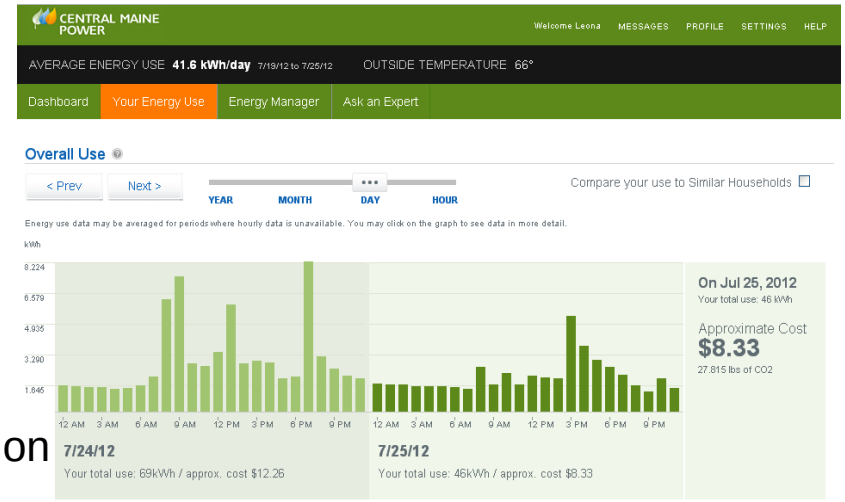


Outage Name	Cape Elizabeth
Outage Start	3/28/13 11:05
Outage End	3/28/13 11:41
Predicted Customers Out	1,880
Duration In Minutes	36
Phone Calls Received	148
Avg Phone Call Minutes before Outage Start	3
AMI Outage Notifications	1,493
Avg Outage Notification Minutes before Outage Start	13
AMI Outage Restoration Notifications	1,048
AMI message time advantage over phone calls	10

- Outage predicted 3 minutes after calls were received
- AMI events received 13 minutes before outage was predicted
- AMI events: 7 times more data points to support prediction

AMI Results: Customer Benefit

- Significantly reduced estimated bills
- Remote on/off:
  - Reconnect in 7 minutes
  - Automated after-hours reconnect
  - Schedule service orders by the hour
- Outage:
  - Better communications and faster restoration
  - Meter ping
  - Outage alerts
- Energy Management:
  - Energy Manager
  - Green Button
  - Price Comparison
  - Bill Alerts



Hourly Usage in Energy Manager

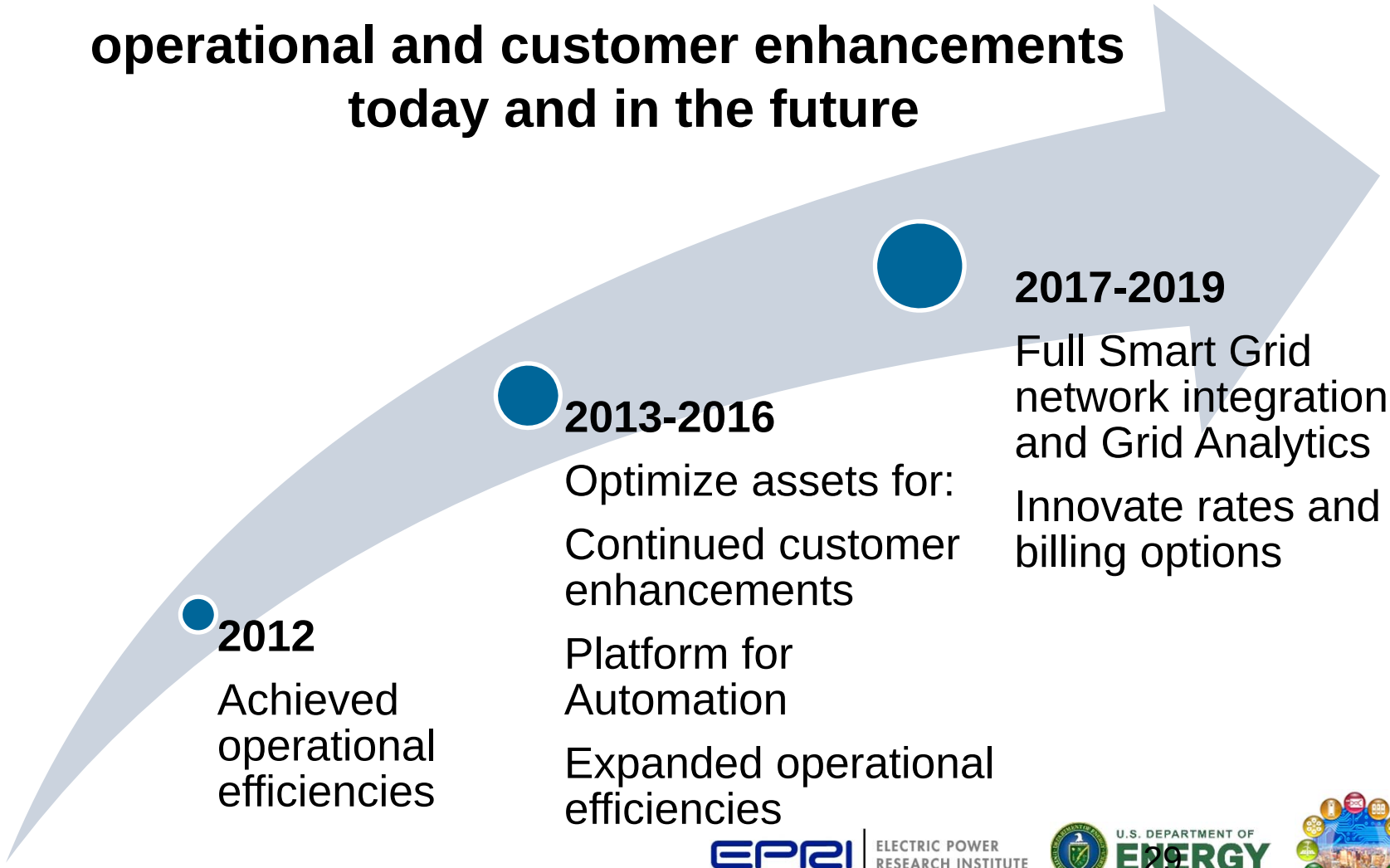
Reaching Beyond – Lessons Learned

- Continue leveraging investment
- Using lessons learned in Maine and applying that knowledge in other Iberdrola USA companies
  - Take a more global view of the network and consider optimizing the best collection of outage information up front
  - Make customer benefits available earlier through a portal that provides information even before hourly reads are available

Reaching Beyond – Next Steps

CMP's AMI platform supports

operational and customer enhancements today and in the future



Reaching Beyond – Next Steps

Enhancement	Company Benefit	Customer Benefit
Complete ultra-remote capabilities	Remote meter readings Remote service orders	Accurate bills Faster service
Implement bill alerts	Enhanced collections	Debt management
Compete system automation	Reduced restoration costs	Shorter outages
Automate trouble order clearing	Reduced restoration costs	Shorter outages
Enhance outage prediction with meter events	Reduced restoration costs	Shorter outages
Implement outage alerts	Customer satisfaction	Outage management
Launch Energy Manager for Business	Customer satisfaction	Energy management

Questions / Discussion

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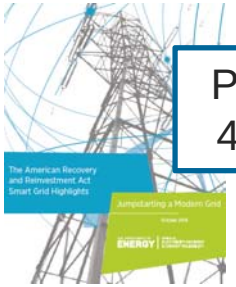
Buying Power with Small Players: A Joint Action Model for Smart Grid Technologies

Sara R. Kaplan, PE
Iowa Association of Municipal Utilities

October 27-29, 2014
Charlotte, NC

Sara Kaplan
IAMU Engineer

- Engineer at Iowa Association of Municipal Utilities
  - Provides technical assistance to electric and gas utilities, along with water utilities
  - Serves as Smart Grid Project Manager at IAMU
    - Manages 2Degrees2Save Program, along with AMI for eight different utilities in Iowa and Kansas
- BS in Environmental Engineering from MIT
- MS in Environmental Engineering from Manhattan College
- Licensed PE in Iowa and NY



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Project Description

- IAMU membership: 136 electric utilities, 51 gas utilities, 545 water utilities, 28 telecommunication utilities
- 75% members serve less than 1500 meters
- Received SGIG in 2010 – AMI/demand response project includes eight utilities in Iowa and Kansas
  - 7 utilities have either programmable communicating thermostats or load control switches
  - 4 utilities have AMI systems; 2 pilot projects and 2 full systems
  - 3 are implementing time of use rates

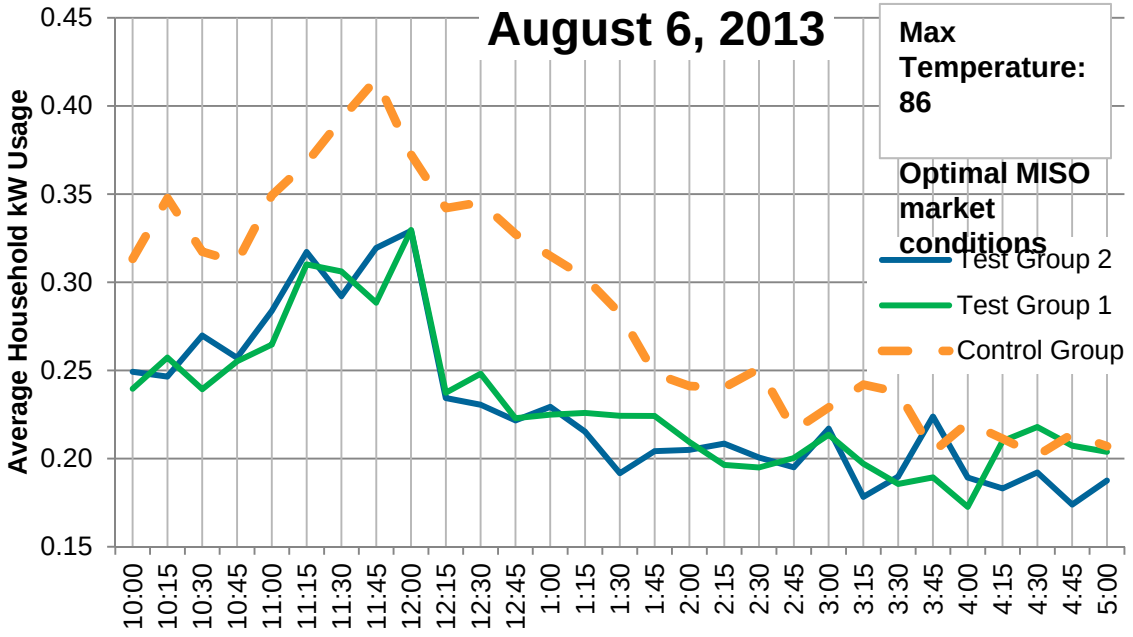
- Joint demand response platform
- Utilizes programmable communicating thermostats to be raised two degrees under peak conditions on weekdays
- Provides a customer portal for adjusting thermostat remotely
- Utilizes load control switches to cycle air conditioning units and water heaters
- Currently, uses paging technology for communication. Zigbee technology delay at inception of project

Surprises Related to the Project

- Initial project focused on demand response aspects of project.
  - Many power suppliers were hostile to demand response programs by utility
- Less “Big Brother” attitude than anticipated
- Early success with AMI, and challenges with demand response equipment led to expansion of project.
- AMI integration, especially between water and electric meters took longer than anticipated
- DOE was extremely supportive and willing to work with us to ensure successful outcomes

Project Successes

- Consumer-owned utility
  - Not much, if any, resistance by customers
- Better ability to deal with high bill complaints
- Ability to provide better customer service with outage management and new technologies
- Verified DR reduction



Challenges:

- Obtaining technology that is compatible with water and electric and gas systems
- Defective Products and product delays
  - Demand response technology, Zigbee
- Rapid development of technology
  - Demand response products are being replaced by other technology like the Nest thermostat, or improvements of earlier versions.

Reaching Beyond

- Utilities plan to offer new services to customers, including time of use rates, customer web portal, and other options for demand response.
- Utilities may expand demand response as a means to hedge market conditions, and may bid into market.
- Joint Action allows smaller utilities to participate in grid modernization technologies with cost effective prices
- AMI/demand response projects may present your utility with an opportunity for customer education and customer access.
- Work with your neighborhood associations!

Questions / Discussion

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Capacitor Bank Monitoring Using AMI Infrastructure

Joe Schatz, Manager of Transmission and Distribution Research
Southern Company

October 27-29, 2014
Charlotte, NC

Joe Schatz:
Southern Company

- Manager of Transmission and Distribution Research
  - Includes activities in:
    - Power Flow Control
    - Visualization
    - Analytics
    - Unmanned Aircraft Systems
- MSEE and BEE from Auburn University.

Joe Schatz

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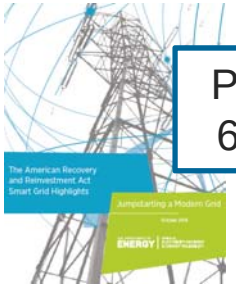

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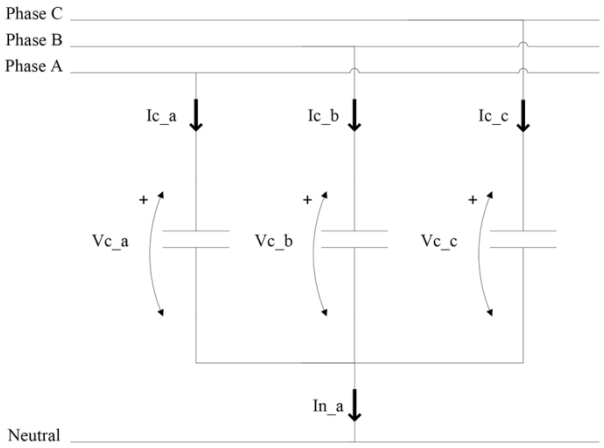
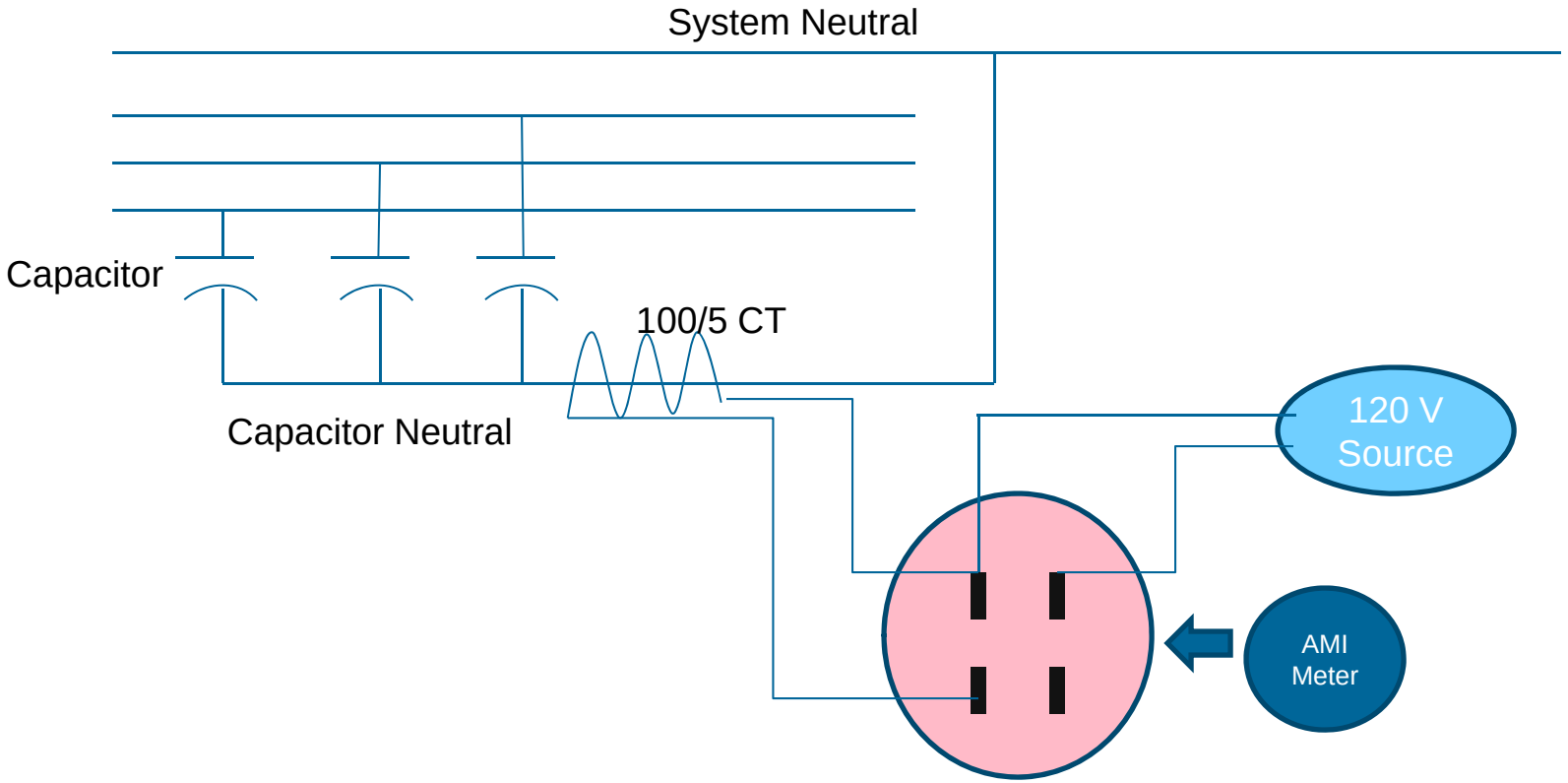
Capacitor Bank Monitoring Using AMI Infrastructure

- SGIG funded project to improve energy efficiency
- Replaces annual inspection program
  - Long practice of monitoring capacitor neutral current to determine capacitor health
  - Establishes year round monitoring of capacitor health
- Adapts standard AMI meter for capacitor neutral current metrology and data retrieval
- Data analysis will be manual until enough data is collected to establish exception rules

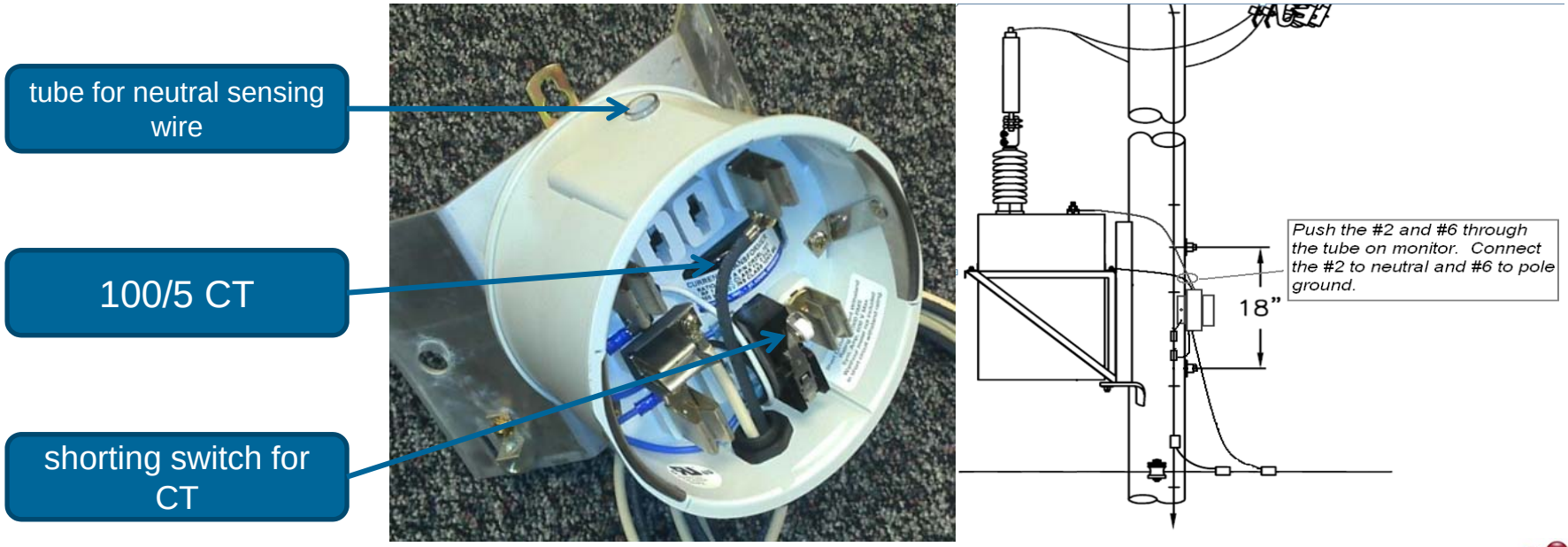


AMI Capacitor Monitor Schematic



AMI Capacitor Bank Monitor

- AMI monitors can be used on all Fixed or Switched Capacitor Banks.
- The internal CT reads the current on the neutral bus of the CAP bank.
  - Capacitor monitor has a built in 100:5 amp CT. This CT will be shorted by an internal switch when meter is removed.
- The adapter base has a ¾" plastic tube running inside the enclosure that goes thru the 100/5 amp ct.
- The AMI meter stores the hourly reading and transmits the data daily to a database.



AMI Capacitor Monitor

- Monitors installed:

  GPC 6,000 & APC about 3000
- Monitor info entered into the MDMS after installation
- Initial assessment found that approximately 15% of capacitor banks had issues within the first year of install
- Finding problems not noticed with a visual inspection
  - Oil switches
  - Fuse melted and primary switch didn't open
  - Improper fuse sizes

Daily Report Examples

	Amps	Amps	kVar	Type
	190	31.7	600	Fixed
	120	20.0	600	Switched
	330	55.0	1200	Switched

HQ	SUBSTATION	CIRCUIT	SwNum	MeterID	FLDADDRESS	Amps	A		
DUBLIN	DEXTER	N3332	112	5792454	215 MT-CARMEL RD UNIT G-CAP	19			
SAVANNAH	GRANGE ROAD	1303603	VWB11	5792570	880 DORSET RD UNIT G-CAP	120	20.0	600	Switched
AUGUSTA	ALEXANDER DRIVE	N3182	25702	5791794	2720 MAYO RD UNIT G-CAP	330	55.0	1200	Switched
AUGUSTA	BERCKMAN ROAD	N0362	19018	5793441	2675 OAKLAND DR UNIT G-CAP	210	35.0	1200	Switched
AUGUSTA	BERCKMAN ROAD	N0362	750807	5793457	322 BERCKMAN RD UNIT G-CAP	410	68.3	1200	Switched
AUGUSTA	BEAVER DRIVE	N4472	750806	5795237	3040 BRANSFORD RD UNIT G-CAP	130	21.7	1200	Switched
ATLANTA	GRADY	Q1668	108235	5789473	510 BOULEVARD SE UNIT G-CAP	240	40.0	1200	Switched
ATLANTA	NORTHSIDE DRIVE	K1422	92310	5789801	1391 HOWELL-MILL RD NW UNIT G-CAP	240	40.0	1200	Fixed
ATLANTA	VIRGINIA AVENUE	V6722	1200	5789819	553 COURTLAND ST NE UNIT G-CAP	160	26.7	1200	Switched
ATLANTA	DAVIS STREET	A0652	111566	5789855	460 LUCKIE ST NW UNIT G-CAP	230	38.3	1200	Fixed

15 Amp Threshold

meterid	repid	cap_bank	feeder	division	district	substation	opv	kvar	Last Sample Time	KVA Threshold	KVA Actual	Status
5827254	47546997	CE0162	20082	Eastern	Talladega	Talladega CS	4	150	1/4/2012 1:59	0.063	0.14	Over Threshold
5199426	45702008	C34	34906	Western	Tuscaloosa	Cedar Cove DS	12.47	600	6/3/2011 9:13	0.083	0	Dead/Disconnected Meter
5826311	47050351	HAA544	29716	Southeast	Valley	Langdale	12.47	600	1/4/2012 1:59	0.083	0.19	Over Threshold
5826478	47590966	C124	34616	Western	Haleyville	Weston	12.47	900	9/13/2011 8:30	0.125	0	Dead/Disconnected Meter
5826451	47577993	HAA158	32706	Southern	Montgomery	Hope Hull	13.2	150	1/1/1900 0:00	0.02	0	Dead/Disconnected Meter
5826742	47715249	HAA174	32706	Southern	Central	Hope Hull	12.47	900	1/4/2012 2:59	0.125	0.128	Over Threshold
5826767	47716135	CB0043	448224	Birmingham	Metro Central	EIGHTEENTH ST	13.2	900	12/9/2011 10:17	0.079	0	Dead/Disconnected Meter
5826759	47715028	C16	23908	Western	South	Demopolis	12.47	150	1/1/1900 0:00	0.021	0	Dead/Disconnected Meter
5826285	47050381	CSE177	29146	Southeast	Ozark	West Ozark	12.47	300	1/4/2012 3:00	0.042	0.098	Over Threshold

Lessons Learned

- Changed from using neutral current alarm to actual amp or KVA reading
- Readings reset after daily data is sent
- Reading varies based on:
  - Line voltage at the capacitor bank
  - Manufacturing KVAR tolerance of capacitor
- Use meter data to help determine threshold accuracy
  - Dynamic threshold based on local voltage
  - Neutral current reading

Questions / Discussion

Together…Shaping the Future of Electricity