# DUKE ENERGY OHIO SMART GRID / GRID MODERNIZATION

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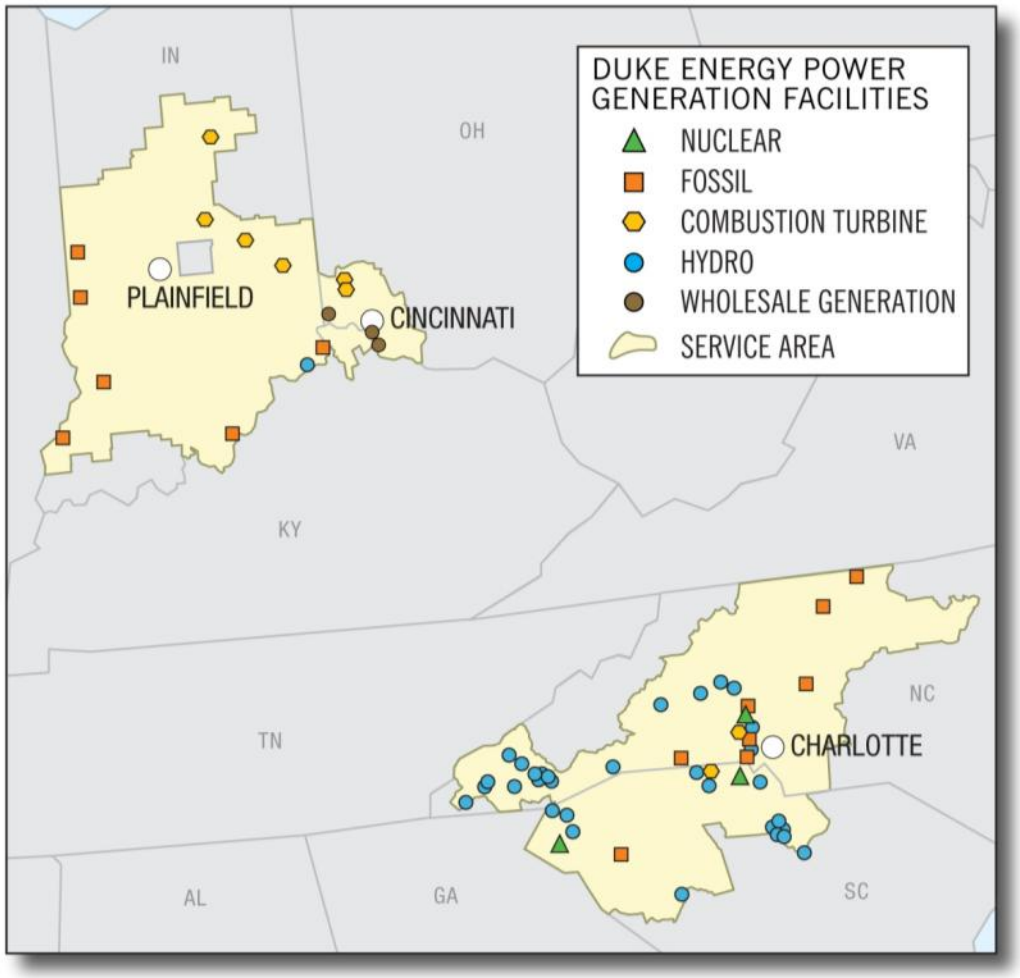
GM, Smart Grid Field Deployment
May 24, 2012

# FACTS ABOUT DUKE ENERGY

- 150+ years of service
- 4 million customers
- Fortune 500
- $50 billion in assets
- Stock dividends for 80+ years
- Traded on NYSE as DUK
- Dow Jones Sustainability Index

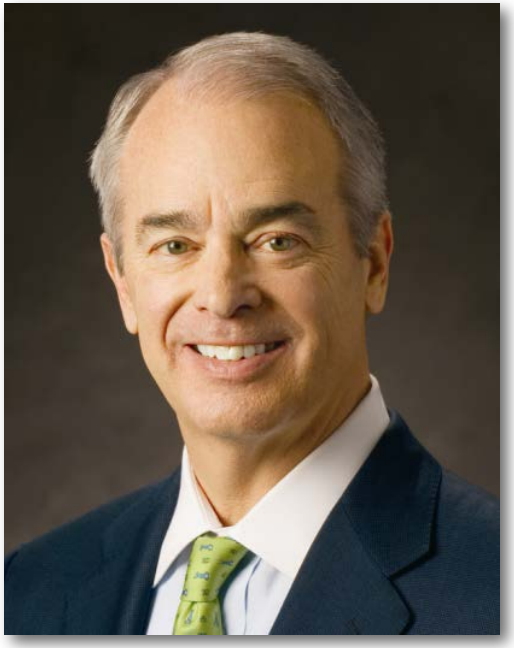
# U.S. FRANCHISED ELECTRIC AND GAS

- 5 states: North Carolina, South Carolina, Indiana, Ohio and Kentucky
- 47,000 square miles of service area
- 28,000 MW of regulated generating capacity
- 4.0 million retail electric customers
- 500,000 retail gas customers



# OUR SMART ENERGY CHALLENGE

- Operate in the most cost effective, reliable, safe and environmentally friendly way
- Adapt to the new energy paradigm, one where grid modernization will enable the next generation of energy efficiency and customer interaction.

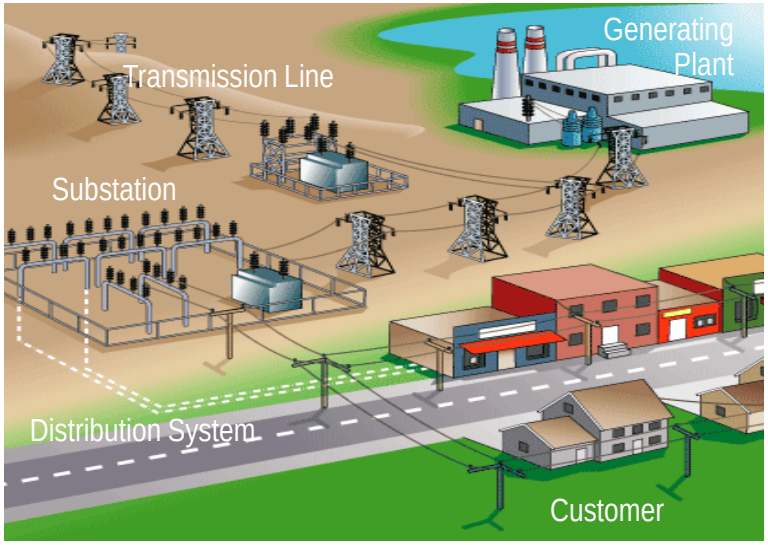


*"Our business in the 21st century is as an (energy) optimizer not just of the grid, but an optimizer of energy use at every residential home, and every business. Optimizing all the way from the device to the generating plant."*

Jim Rogers
Chairman, President and CEO

# DUKE ENERGY VISION AND GRID MODERNIZATION OBJECTIVES

## Duke Energy Vision

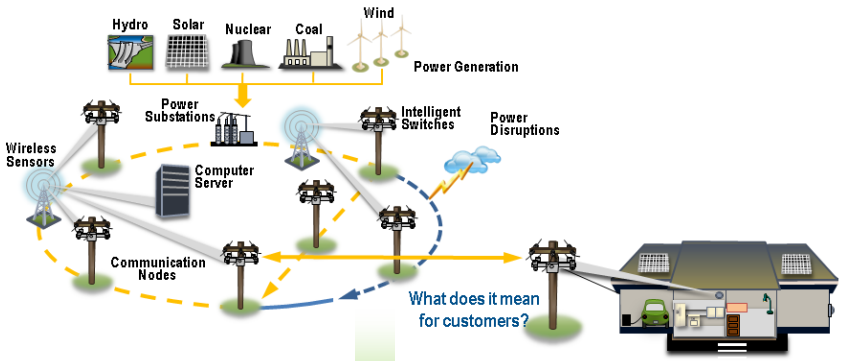



- Build new, more efficient generation and retire older, coal-fired units
- Modernize our grid by replacing less efficient analog technology with advanced digital technology
- Make energy efficiency the “fifth fuel” by implementing our save-a-watt model in each of our jurisdictions

## Grid Modernization Objectives

- Improve distribution system operational efficiency and reliability
- Facilitate expansion of energy efficiency & customer demand response
- Prepare for integration of higher levels of on-site renewable generation
- Enable an improved overall energy experience for customers by providing more information and options to help reduce wasted energy and save money.

# Value Proposition




## MODERNIZATION PROGRAM ELEMENTS

- Advanced Meter Infrastructure
- Distribution Automation
- Enabling Technologies/Systems
- Communication Network

## System Modernization

### SYSTEM BENEFITS

Enhanced system operations & reliability through:

- Outage assessment & reduction
- System voltage control
- Self-healing circuits
- Remote on/off
- Elimination of manual reads
- Integration of renewables

## Extending "Beyond the Meter"

### CUSTOMER BENEFITS

- Improved reliability
- Improved convenience
- Daily usage information
- New pricing options
- Flexible billing & payment options
- New products & services

# Architecture Tenets

## *Interoperable*

The architecture will be capable of integrating solutions from different vendors seamlessly into multi-vendor solutions.

## *Open*

The architecture will enable the easy integration of applications or products.

## *Secure*

Security will be build into the design of the architecture and its components, in such a way that future systems can sustain known or future forms of cyber attacks.

## *Scalable*

The architecture will be configurable to meet the needs of small and large users alike, using a common set of components and products.

## *Expandable*

The architecture will be able to be expanded vertically and horizontally, to accommodate future end users needs, without a wholesale replacement of its hardware or software components.

## *Flexible*

The architecture will enable the easy addition or replacement of its components, without a wholesale replacement of the system.

## *Maintainable*

The architecture will minimize the costs associated with routine maintenance of the applications and data. In particular, it will provide the capability to maintain displays and data concurrently, and will provide a single access point for each component

## *Usable*

The architecture will promote situation awareness by leveraging advanced user interface concepts, and provide users with a common look-and-feel, regardless of the number or origin of underlying applications.

## *Independent*

The architecture will be independent of underlying third-party technologies and products. This will include as a minimum the Operating System, the Database Management System and the Middleware.

## *Accessible*

It will be possible for developers to access data and services from existing applications, relying solely on existing documentation and minimum amount of training.

## *Enables Business Continuity*

The architecture will make provision for the mechanisms necessary to support end users specific disaster scenarios and associated requirements, up to the physical loss of all facilities in a given geographic area.

## *Standardized*

The architecture will promote a high level of standardization and interchangeability of its components, and will adhere to applicable Standards.

# ADVANCED METERING INFRASTRUCTURE (AMI)

# Advanced Metering Infrastructure (AMI)

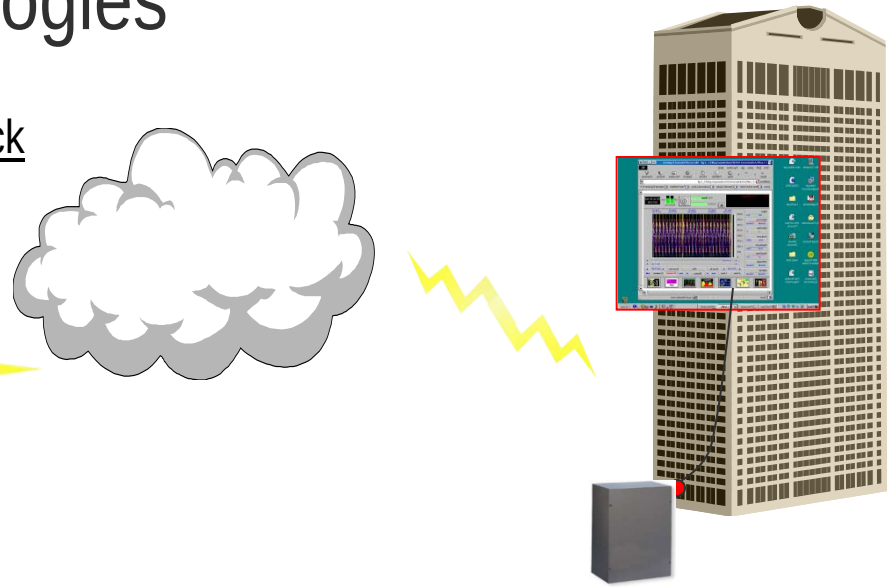
An advanced metering infrastructure is a metering system utilizing advanced two-way communications to electric/gas meters. The two-way communication allows for obtaining remote meter reads as well as the capability to perform certain remote operations. The AMI allows remote off-cycle meter reading as well as remote connection/disconnection of service.

## Duke Energy Ohio AMI Field Equipment

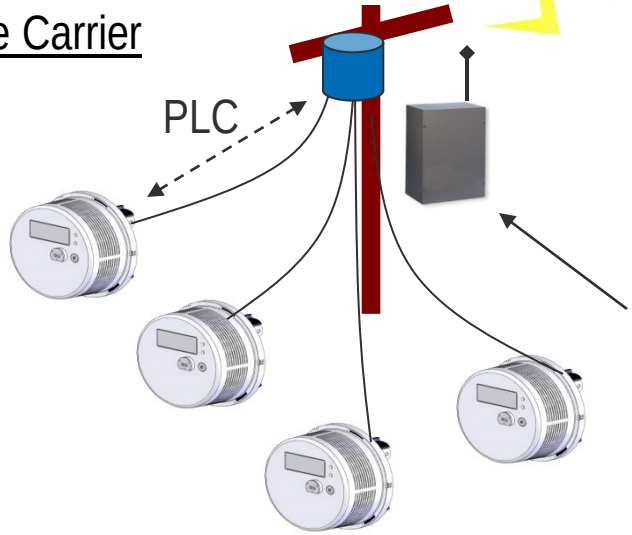
- Mass Market Customers (residential & small commercial)
  - Electric Meter
    - Manufactured by Echelon
    - Power Line Carrier (PLC) Technology to Communications Node
    - Remote Disconnect Capability
  - Gas Meter
    - Manufactured by Badger
    - Radio Frequency (RF) Technology to Communications Node
  - Communications Node
    - Manufactured by Ambient
    - Digital Cellular to Back Office Systems
    - Located at every Line Transformer
- Large Customers (large residential, commercial & industrial)
  - Meter and Communications Technology Currently Under Review

# Smart Meter / Network Technologies

WAN: Digital Cellular (back haul)



LAN: Echelon Meter & Data Collector – Power Line Carrier (PLC)




Back Office Systems

Comm. Box – (Ambient)
- Echelon Electric Data Collector
- Digital Cell Modem
- Badger Gas Data Collector

HAN: Home Area Network (TBD)

# ECHELON ELECTRIC “SMART” METER

These smart meters send metering data from the meter back to the Ambient Communications Node via Power Line Carrier (PLC) technology. These smart meters have internal disconnect/reconnect capabilities.

# AMBIENT COMMUNICATIONS NODE

These communication boxes send metering data (gas & electric) back to our systems.

# AMBIENT COMMUNICATIONS NODE (CONT.)

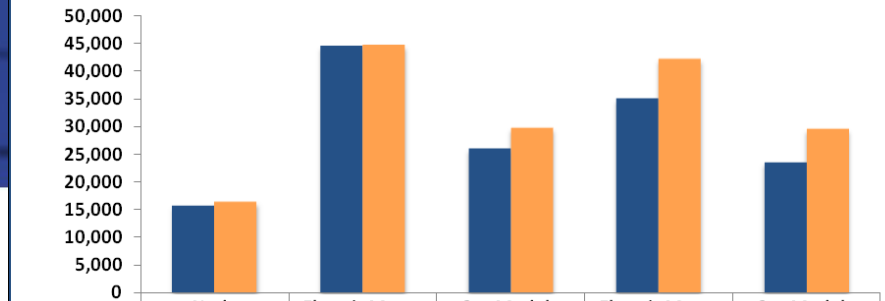
These communication boxes send metering data (gas & electric) back to our systems.


# AMI Field Deployment

| Overall AMI Metrics | | | | | |
|---|---|---|---|---|---|
| Metric | OH | KY | NC | SC | Cumulative |
| Installed Electric | 365,232 | 38,586 | 14,498 | 2,359 | 420,675 |
| Certified Electric | 333,758 | 38,243 | 14,471 | 2,349 | 388,821 |
| Installed Gas | 256,056 | 27,119 | N/A | N/A | 283,175 |
| Certified Gas | 233,341 | 26,821 | N/A | N/A | 260,162 |
| Comm Nodes | 86,130 | N/A | 2,387 | 1,296 | 89,813 |

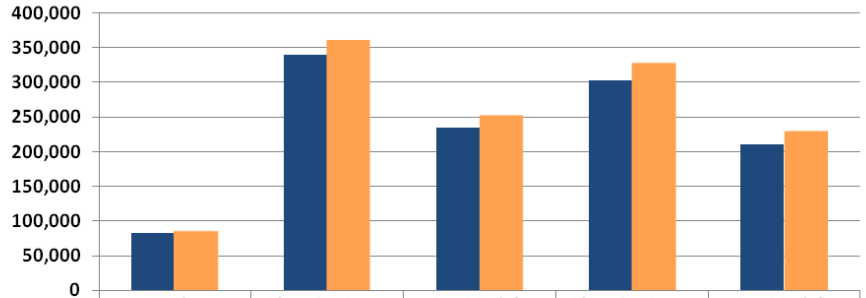
*Note: KY meter data represents TWACS AMI system*

**Ohio AMI Deployment Status YTD**
*(through 4/22/2012)*




| | Node Installation | Electric Meter Installation | Gas Module Installation | Electric Meter Certification | Gas Module Certification |
|---|---|---|---|---|---|
| PLAN | 15,500 | 44,375 | 25,885 | 34,870 | 23,465 |
| ACTUAL | 16,252 | 44,535 | 29,648 | 42,091 | 29,399 |

**Ohio AMI Program to Date Deployment Progress**
*(through 3/31/2012)*




| | Node Installation | Electric Meter Installation | Gas Module Installation | Electric Meter Certification | Gas Module Certification |
|---|---|---|---|---|---|
| PLAN | 82,855 | 339,430 | 234,310 | 302,215 | 210,375 |
| ACTUAL | 84,386 | 358,371 | 250,816 | 326,065 | 227,607 |

*Total Ohio AMI Deployment Plan (mass market customers)*

- *620,000 Electric Meters*
- *450,000 Gas Meters*
- *135,000 Communications Nodes*

*Weekly Pace in Ohio since 1/1/2011 has been*

- *4000 Electric Meters*
- *2500 Gas Meters*
- *1000 Communications Nodes*

# THE “KEY ROOM”

# DISTRIBUTION AUTOMATION (DA)

# Distribution Automation (DA)

## Smart Grid Distribution System

- Automates distribution system functions and components to manage voltage, VAR flow, load, capture fault events, enhance outage response, improve reliability, etc
- Monitors and documents system performance for voltage regulation and fault detection and locating
- Use real time data to analyzes system performance and feed the Smart Grid Optimization function

## Substation Components

ITF = Inside the Fence

- Substation RTUs & Communications
- Voltage Regulators/LTC Controls
- Circuit Breakers
- Digital Microprocessor based Relays

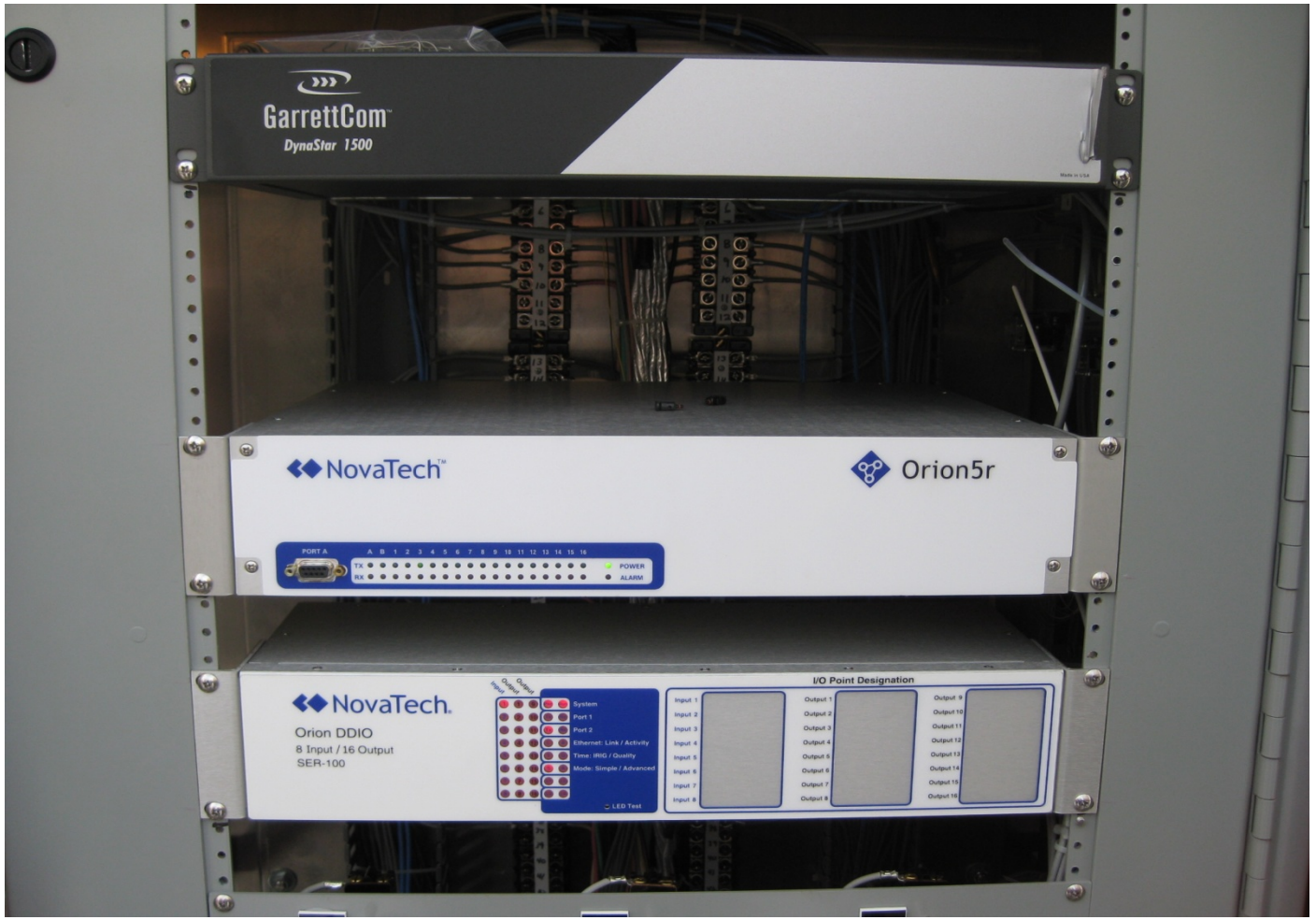
## Distribution Line Components

OTF = Outside the Fence

- Capacitor Bank Controls
- Electronic Recloser
- Self-Healing Teams
- Line Sensors
- Increased Sectionalization

# COMMUNICATIONS TO SUBSTATIONS/ RTUS

Serves as communication ‘pipe’ and ‘gateway’ into substation



# AUTOMATED CIRCUIT BREAKERS AND RELAYS

Allows remote operation of breakers (open, close, block, un-block, e-tag) and remote data acquisition (status, loading, fault current, voltage, PF, relay settings)

# DIGITAL RELAY

# AUTOMATED STATION VOLTAGE REGULATION ( VOLTAGE REGULATORS AND LTCS)

Enables integrated volt / var control, energy efficiency and reduces demand / generation need via Voltage Reduction Strategy, remote diagnostics (high / low voltage)

# AUTOMATED CAPACITOR BANKS

Enables integrated volt / var control, energy efficiency and reduces demand / generation need via Voltage Reduction Strategy, remote diagnostics (high / low voltage)

# AUTOMATED ELECTRONIC RECLOSERS

Allows remote operation of El. Rec. (open, close, block, un-block, e-tag), remote data acquisition (status, loading, fault current, voltage, PF)

# AUTOMATED LINE VOLTAGE REGULATORS

Enables integrated volt / var control, energy efficiency and reduces demand / generation need via Voltage Reduction Strategy , remote diagnostics (high / low voltage)

# SELF HEALING – AUTOMATED SWITCHES

Enables auto-reconfiguration and enhances reliability


# LINE SENSORS

Line sensors communicate what is happening on the lines, allowing the use of more accurate system data for system operations and planning.

# DA Field Deployment (Ohio)

| 5 Year Ohio Plan<br>++++++++++++++++++<br>Units per Year | 2009 Units (actual) | 2010 Units (actual) | 2011 Units (actual) | 2012 Units (plan) | 2013 Units (plan) | Total Units Planned |
|---|---|---|---|---|---|---|
| Substation Comms - New | 5 | 10 | 10 | 10 | 13 | 48 |
| Substation Comms - Analog to Digital | 5 | 1 | 1 | 3 | 5 | 15 |
| Circuit Breakers | 11 | 15 | 23 | 17 | 13 | 79 |
| Relays | 71 | 73 | 80 | 78 | 73 | 375 |
| Substation Regulators | 0 | 121 | 149 | 139 | 129 | 538 |
| Capacitor Banks | 0 | 17 | 536 | 861 | 640 | 2054 |
| Electronic Reclosers (SCADA) | 30 | 50 | 46 | 0 | 0 | 126 |
| Sectionalization | 96 | 105 | 72 | 89 | 88 | 450 |
| Self-Healing switches | 3 | 7 | 7 | 7 | 6 | 30 |
| Line Sensors | 0 | 0 | 200 | 1700 | 1300 | 3200 |
| Total Devices | | | | | | **6915** |

*Work in approximately 150 distributions substations and on approximately 600 distribution circuits*

# Thank You!

Don Schneider

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