

Modernizing T&D on the Electric Grid

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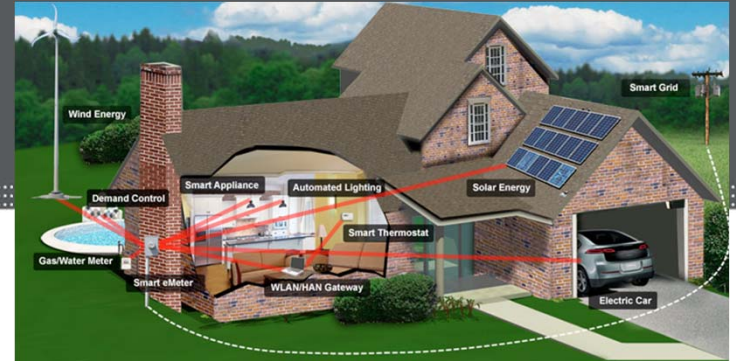
PSC Smart Grid Technical Conference



What is the Smart Grid?

What Smart Grid means to Ameren

“Transform Ameren’s grid to create a secure, reliable and more efficient infrastructure enabling customers’ use of “energy smart” technologies”



- Ameren is achieving this vision by doing the following:
 - Improving **service reliability**
 - Improving **operating efficiency, asset optimization**, and the degree to which we **integrate our systems**
 - Broadening **stakeholder awareness** of Smart Grid concepts in general and Ameren’s plans in particular
 - Preparing the grid for emerging **customer-owned technologies** – electric vehicles, smart appliances, distributed generation
- As a concept, Smart Grid represents more of a “direction” than a “destination”



Smart Substation Technology

What's Standard – What's New – and Why It's Done

Ameren's standard substation technology deployments

- **Microprocessor Relaying – 15 years**
 - More reliable than legacy technology, reduced maintenance, fewer failure points
- **Supervisory Control/Data Acquisition – 40 years**
 - Identification of overloads, reduced operational margins, enhanced outage response
- **Automatic Supply Line Transfer – 40+ years**
 - Fewer extended outages, shorter outage durations
- **Transformer Temperature Control – 20 years**
 - Cooler operating temperatures during high load, ability to predict unstable temperatures
- **Automatic Voltage Control – 40 years**
 - System stability, improved customer power quality

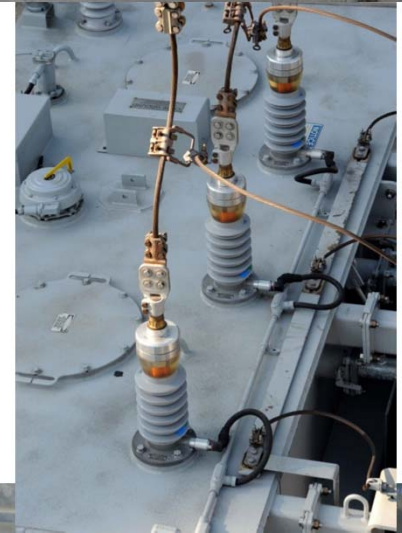


Smart Substation Technology

What's Standard – What's New – and Why It's Done

Ameren's new substation technology deployments

- ***Moisture and dissolved gas monitors***
 - Transformer operating life extensions, reductions in unforeseen transformer failures
- ***Transformer winding temperature sensors***
 - Allows for tighter operating margins
- ***Transformer bushing monitors***
 - Ability to predict bushing failures before they occur, avoidance of collateral damage
- ***Control battery monitors***
 - Reduced maintenance, eliminates unforeseen battery failures
- ***Dynamic rating analyzers***
 - Enhanced load management during heavy transmission interchange activity



Smart Distribution Technology

What's Standard – What's New – and Why It's Done

Ameren's standard distribution system applications

- ***Radio-controlled line capacitors – 25 years***
 - System voltage stability, reductions in line losses, improved customer power quality
- ***Outage management system – 15 years***
 - More efficient daily outage and emergency response, improved workforce management and tracking
- ***Smart line switching and restoration – 20 years***
 - Reductions in average customer outage frequency and duration
- ***Distribution network model/mapping – 20 years***
 - Greater worker safety, more effective daily distribution system management, basis for engineering analysis and planning



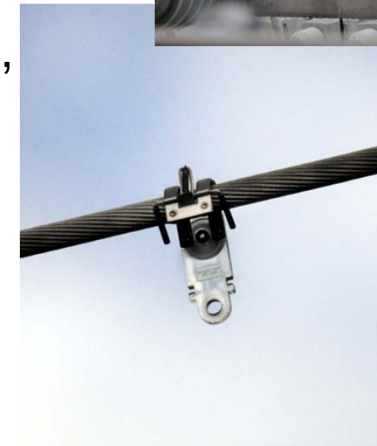
Smart Distribution Technology

What's Standard – What's New – and Why It's Done

Ameren's new distribution system applications

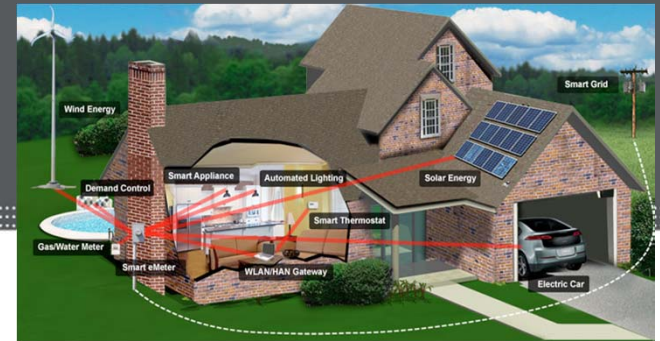


- ***Advanced Distribution Management***
 - Improved daily system management, common platform allows for full integration of distribution applications formerly separate and distinct
- ***Faulted Circuit Indication***
 - Reductions in patrol times by First Responders
- ***Centralized Line Switching Automation***
 - Minimizes customers affected by single outage, circuit model dynamically updated
- ***Volt-VAR Optimization***
 - Maximum energy efficiency at feeder level, minimization of losses, improved power quality
- ***Distribution Switching Orders***
 - Enhanced workforce management and safety



Technology Deployment Challenges

The “Speed of Value” for Stakeholders



- Technology ***maintenance and management***
 - Digital and communications technology “turns over” in under ten years
 - Upgrades can be forced by obsolescence, lack of vendor support
 - Maintenance of the technology can be worse than the maintenance it’s meant to replace
 - Data analytics and storage becomes a major concern early
- Making ***prudent and opportunistic*** investment choices
 - Navigation through many communications, standards, and security options
 - What, how, and when to deploy – and when to stop
- Challenging ***business cases***
 - Imagination always outpaces reality – “we can” doesn’t mean “we should”
 - Weighing the benefits against the “total cost of ownership”
 - Ameren Missouri has researched many technologies that we’ve decided not to pursue at this time – smart metering, energy storage
 - Moving at the “speed of value” for all stakeholders is critical

