Modernizing T&D on the Electric Grid

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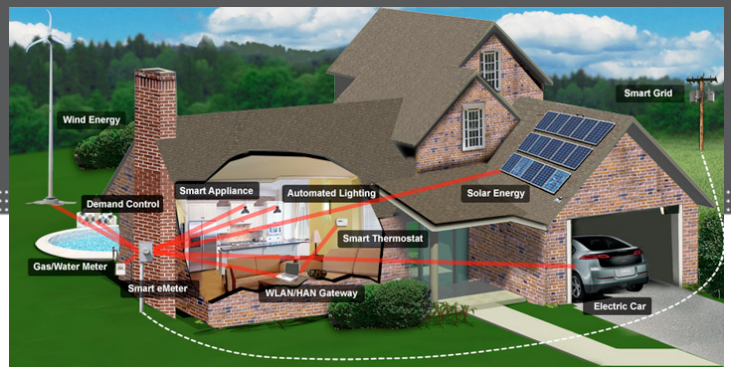
PSC Smart Grid Technical Conference

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

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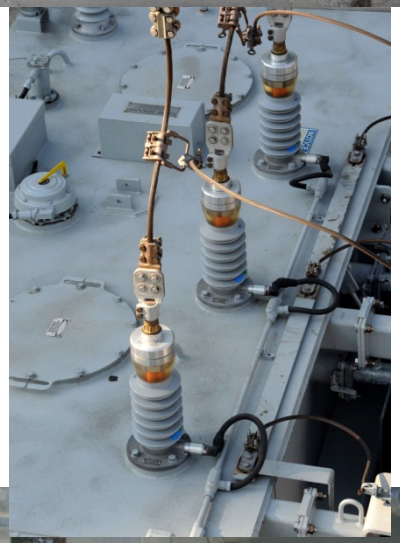
Smart Substation Technology

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

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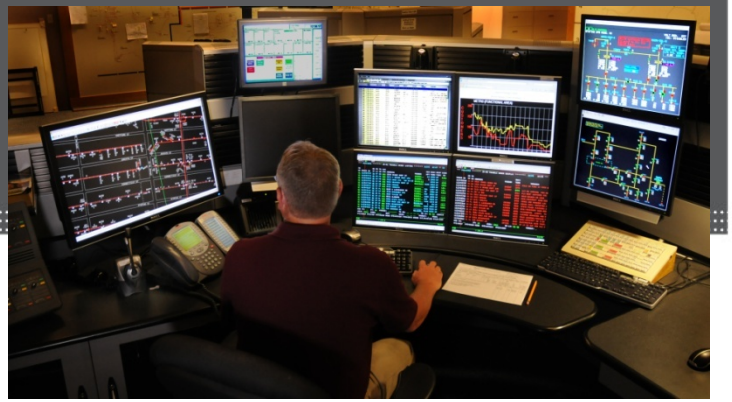
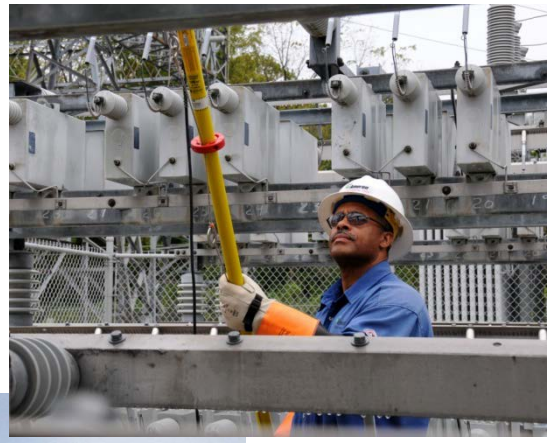
Smart Distribution Technology

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



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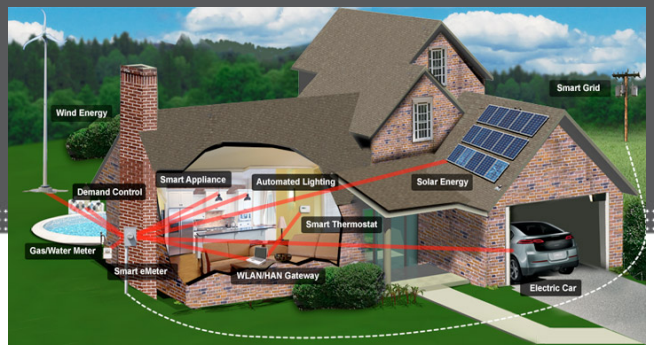
Technology Deployment Challenges

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

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