The Smart Grid Vision

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What Is A “Smart Grid?”

- There are dozens of national and international initiatives directed toward a “smarter” grid – and many are narrow, focused largely upon the interests of the sponsor.
- SCE takes an expansive, inclusive view of the Smart Grid.
  - In our view, an advanced grid that doesn’t better serve customers is Showmanship, not Smart!
- A true Smart Grid will integrate advanced intelligence from the customer to the generator - and everywhere in between.
What Is A “Smart Grid”? 

• A Smart Grid will be:
  – Largely self-healing
  – More flexible
  – More reliable
  – Safer

• A Smart Grid will integrate thousands of Intelligent Electronic Devices (IEDs) sending and analyzing millions of pieces of data per minute to produce actionable information -- and using that information to control the electric system
The Self-Healing Grid

- A self-healing Smart Grid will prevent large-scale regional outages by responding much more quickly than humans.
- The integrated and interconnected IEDs of the Smart Grid will:
  1. Identify
  2. Analyze
  3. Isolate
  4. Remediate
  5. Report
The Flexible Grid

- By adding much more sophisticated intelligence and control, the Smart Grid will allow:
  - Higher transmission transfer capacity
  - Integration of more renewable/intermittent resources
  - More efficient and effective maintenance practices
  - Faster restoration when outages are unavoidable
  - More customer choice and energy self-determination
The Reliable Grid

- The Smart Grid will improve reliability by:
  - Reconfiguring the system within cycles
  - Isolating unavoidable outages to smaller areas
  - Enabling repair crews to precisely identify and geographically target problems quickly and efficiently
The Safer Grid

• The Smart Grid will be safer for workers and the public by:
  – Detecting many problems before catastrophic failure
  – Replacing oil-filled equipment with solid dielectric (transformers) or vacuum-operated components (fault interrupters)
  – Preventing equipment overloads (e.g., fault current limiters)
  – Placing more failure-prone equipment above ground (e.g., BURDs)
  – Better equipping workers to avoid danger (e.g., PVD, acetylene detection)
Why Now?

• A unique time of convergence between
  – Electrical engineering (e.g., IEDs)
  – High-speed, high-bandwidth communications
  – High-power computing

• The Smart Grid will succeed through an innovative partnership between TDBU and IT

• We can now begin to deploy in the field what we have researched and refined in the lab for over a dozen years
An Overview of the Smart Grid
A Few Component Pieces...

- **Smarter Transmission**
  - Flexible AC Transmission Systems (FACTS) enable transmission to remain stable over large distances with diverse loads and resources
    - Static VAR Compensation – e.g., Devers SVC helped increase transfer capacity of AZ-CA transmission system by 505 MW. Even more effective when coupled with SPM, as in recent Rector SVC installation

- **Synchronized Phasor Measurement**
  - Enable advance identification and remediation of problems over the entire Western Grid
  - Allow use of dynamic nomograms to safely increase transfer capability without adding infrastructure
Components...

- Smarter Transmission (cont.)
  - Centralized Remedial Action Schema (C-RAS) will allow cost-effective and reliable integration of diverse generation without degrading transfer capacity
  - High-tech composite conductors will increase transfers without new towers and scarce rights-of-way
  - High Temperature Superconducting transformers and cables could revolutionize the T&D business – no losses, no heat!
  - Real-time wireless monitors will provide span-by-span information about sag, temperature and loading
Components...

- Smarter Substations
  - Real-time monitoring of equipment conditions will allow higher loading, targeted maintenance and fewer failures
  - Remote Transformer Dissolved Gas (DGA) Analysis
  - Faster load-rolling and circuit reconfiguration via interconnected “smart” relays and switches
Components...

- Smarter Distribution Circuits
  - *Avanti* is the first real-world test bed for many of the “best of breed” distribution technologies
Mobile Distributed Generation

Composite Poles

Shandin Substation

Fault Current Limiter

Static VAR Compensator

Vacuum Fault Interrupter

High Speed Data Network
Components...

• Smarter Worker Tools
  – The Lineman of the Future tools may include:
    • Wearable computers
    • Wireless communications with a central data base and live SMEs
    • Wireless video transmission
    • Heads-up displays
    • RFIDs
    • Video recognition and diagnostics
    • High-tech PPE (e.g., PVDs)
Our Development Philosophy

• SCE’s advanced engineering credo is “Adapt and Adopt.”
  – We take the best developed by others in the industry and adopt it once proven
  – We take the best from other industries and adapt it to our business
  – We intentionally do very little “creating”
    • Risky
    • Expensive
    • Long lead-times
  – Never technology just for technology’s sake
When Will the Grid be “Smart Enough”?

- Never!
- The Grid is now becoming a vast network of interconnected, special-purpose computers and sophisticated algorithms. It will never again be “just wires and transformers”
- The relentless progress of digital electronics technology will cause rapid change to our Grid just as it does to our computing environment!
- The $64,000 Question: How do we evolve our strategies to accommodate the imminent transition of the Grid from the “mechanical world” to the “digital world” of rapid obsolescence and Moore’s Law?