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So What *IS* The Smart Grid Anyway?

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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 Smart Electronic Devices (SEDs) 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 SEDs 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
  - Better equipping workers to avoid danger

Why Now?

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

- 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
      - SVCs help increase transfer capacity of transmission systems
    - Synchronous Phasor Measurement
      - Enable advance identification and remediation of problems over the entire grid
      - Allow use of dynamic nomograms to safely increase transfer capability without adding infrastructure

Components…

- Smarter Transmission (cont.)
  - Centralized Remedial Action Schema $(C\text{-}RAS)_W$ ill 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 energy business – no losses, no heat!
  - Real-time wireless monitors will provide span-by-span information about sag, temperature and loading

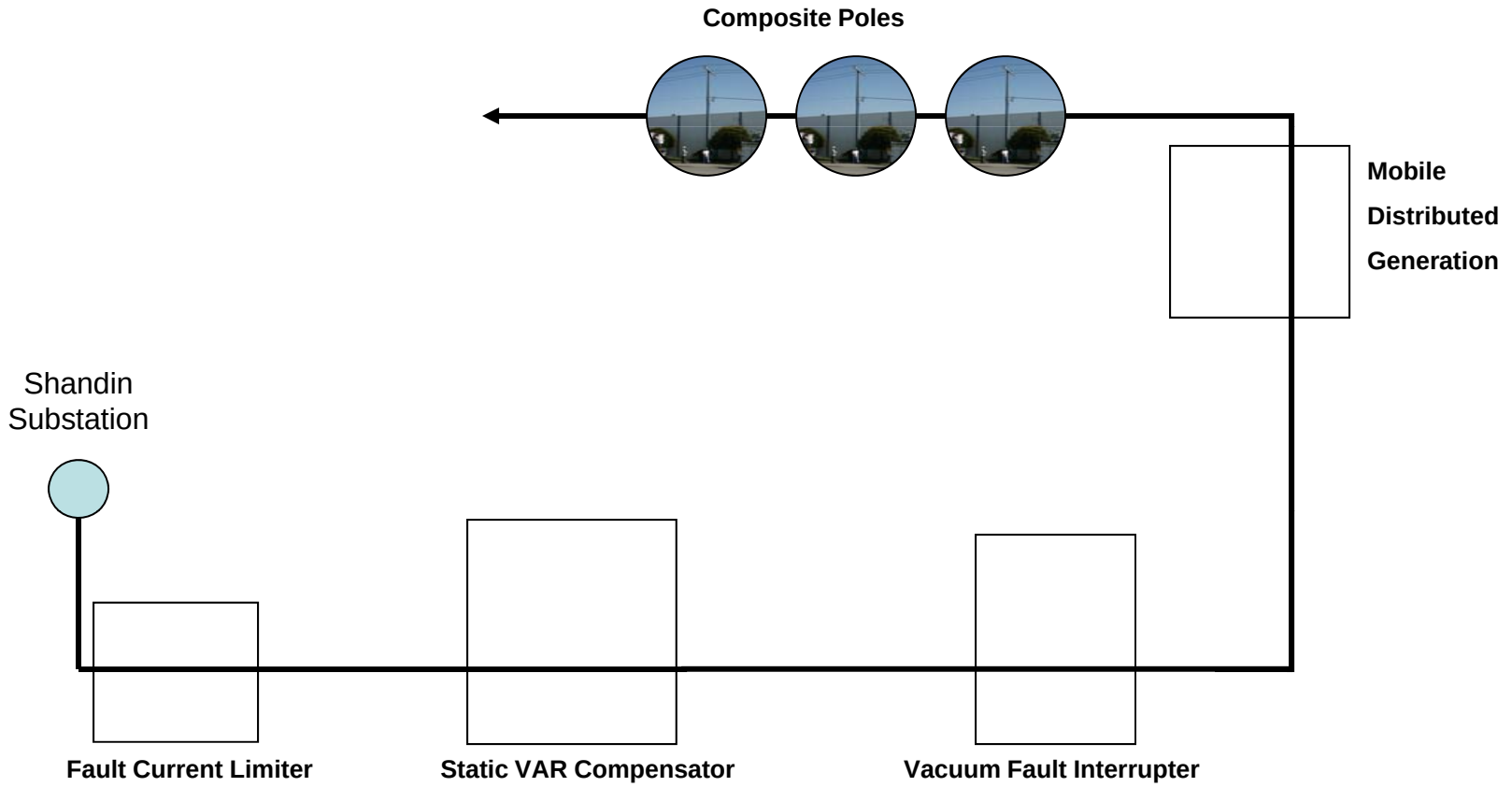
Components…

- Smarter Substations
  - Real-time monitoring of equipment conditions will allow higher loading, targeted maintenance and fewer failures
    - Remote Transformer Dissolved Gas Analysis (DGA)
  - 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

Distribution Circuit of the Future



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?