R&D Culture & Focus

• Seek to lead the industry in R&D
• Centrally located research engineers and scientists
• Laboratories dispersed across operating assets
• Active collaboration with utilities, universities, vendors
• Heavily leveraged by external funding partners
• Research portfolio to provide hardened technology options
What We Do

Support the Transmission & Distribution Organizations by providing technology options to maintain industry-leading status

- Develop and Manage Strategic R&D Portfolio
- Manage Collaborative Relationships
- Respond to Technology Needs
Strategic Focus Areas

Southern Company’s Smart Grid Definition:

- A smart grid provides fast, **two-way communication** that enhances our ability to monitor and control our entire electric infrastructure in real time and respond quickly to existing and potential problems.
  - “two-way communication”
  - “to monitor and control”
  - “in real time”

- Robotics
- Unmanned Aerial Systems
- Power Flow Control
- Energy Storage
- Visualization
- Technology Commercialization
EPRI Program 180 – Distribution Systems

- Project Sets
  - A – Distribution Planning, Design, and Analysis
  - B – Distribution Inspection, Maintenance, Asset Planning
  - C – Cable Systems Management
  - D – Distribution Reliability Management
  - E – Risk Mitigation Strategies
  - F – Grid Modernization
  - G – Technologies Evaluation and Assessment
  - H – Technology Development
  - I – Distribution Systems Practices
  - J – Tech Transfer and Industry Coordination
EPRI Program 174 –
Integration of Distributed Energy Resources

• Project Sets

  – A – Modeling and Simulation
    • Analytics and Methods for Existing Grid Distribution Applications
    • Analytics and Methods for Future Grid Distribution Applications
  – B – Grid Support Functions and Connectivity
    • Inverter Advanced Functions and Grid Communication
    • Inverter Performance and System Safety Assessment
  – D – Business Impacts and Practices
    • Best Practices, Markets, and Use Cases
    • Economic Analysis of Business Impacts & Opportunities
  – E – Technology Transfer and Industry Coordination
    • Technology Transfer, Resources, Tools
Varentec ENGO Device

Primary Distribution Network
- LTC, Cap Bank, LVR, EOL sensor etc

Secondary-side assets provide control at grid edge

CONTROL OFF

CONTROL ON

ΔV = 7V
Varentec ENGO Device

- Edge of Network Grid Optimization (ENGO) device
- 0-10 kVAR static compensation device (1 kVAR increments)
- Pole-mounted units on secondary side of service transformer
- Given a voltage setpoint, the units work to maintain that voltage at their installation point
- Taken in aggregate the result is a much flatter voltage profile throughout the feeder
- NOT a replacement for all capacitors
Varentec ENGO Device

What is an ENGO device?

• A single ENGO unit is a voltage controlled, fast-switched capacitive device that can be switched in 1 kVAR increments from 0-10 kVAR.

• Unlike traditional switched capacitor banks, this device is installed single-phase on the secondary side of a distribution transformer.

Expected Benefits

• With a more disperse and dynamic approach to Volt/VAR control, the ENGO solution allows for better circuit performance in these areas:
  — Phase Balancing
  — Renewable Integration
  — CVR Load Reduction
  — FIDVR Response
  — Voltage Control

Project Objective

• To evaluate and demonstrate the ENGO technology as an alternative option for distribution Volt/VAR control.

Southern Company Evaluation

• Baseline performance evaluation of 91 units completed using a Georgia Power feeder.

• SCS R&TM working with Alabama Power Distribution has deployed 100 of the ENGO devices on one circuit for a full feeder demonstration.
Varentec ENGO Device

• Device benefits demonstrated on a feeder-level
• 700 device multi-feeder, multi-sub pilot project planned
• Full deployment on all applicable feeders from several electrically close substations

• Expect to demonstrate substation-level benefits:
  – Peak load control
  – Transmission VAR support
  – Dispatchable load
  – Equipment life extension
    • Voltage regulators
    • LTCs
MicroPMU Project

• Partnership with UC Berkeley & Lawrence Berkeley National Lab
• 10 distribution sized Phasor Measurement Units (PMUs) installed on Green Valley (Hoover, AL) feeder last year
• Units take time-synchronized measurements of voltage and current on each phase
• Potential applications:
  – Power system automation (smart grid)
  – Demand response mechanisms
  – Advanced fault detection
  – Power quality monitoring
  – Cyber security (project expansion)
CD-PAR
Compact Dynamic Phase Angle Regulators for Power Routing

Objective
Compact low-cost dynamic power flow controller

Lab Testing
NEETRAC
• Atlanta, GA

Field Testing
Georgia Power Company
• Milledgeville, GA
LTC Dial Indicator

- **Purpose:** To be able to remotely record readings from the LTCs of transformers at substations
- **Readings are captured through a device known as a SCADA System Gateway (SSG)**

![SSG Unit](image1.png)

![SSG Installed Near LTC](image2.png)
LTC Dial Indicator

- An accelerometer is placed on the LTC dial of the substation transformer
- Calibrations are done through the use of software connected to the SSG and the accelerometer and network connections are made to SCADA

Manual Calibration of SSG

Accelerometer Affixed to Dial
LTC Dial Indicator

- The focus of this effort is to be able to more efficiently make remote voltage changes at a wide swathe of substations by observing their LTC readings in SCADA.

Completed LTC Dial Indicator Assembly
Smart Inverter Project

- 1 MW PV facility in Athens, GA
- Multiple SMA string inverters
- SunPower plant controller
- Some grid support functions to be tested:
  - Power curtailment
  - Power factor control
  - Volt/VAR
  - Frequency/Watt
  - Volt/Watt
  - LV/HV ride-through