Grid Modernization – Bringing New Technology to the Industry

Art Anderson
NREL Grid Integration Program Manager
Grid Integration – New Technology

Utility Environments

- Power Networks
- Communication Networks
  - Transmission
  - Distribution
  - Control Systems
  - Outage Management
Utility Communication Networks

Field Area Networks
- Fiber
- Cellular
- Legacy Network Solutions

Residential & Commercial Networks
- Cellular
- WiFi
- Radio Frequency Mesh
  - Meter Networks
  - Home Energy Management

Utility Infrastructure

Example: California Utility:
- 70,000 square miles
- 5.2 million Electric Customers
- 1,008,186 Transformers
- 6,833 MW of Generation
- 18,616 miles of electric transmission
- 120,000 miles of electric distribution circuits
Innovation to Production

Grid Integration - Establish a Path

Solutions Rarely go from Design to Production
  o Too Many Moving Parts

• Products need to be evaluated in a test environment
  o Power Solution Characteristics
  o Communication Capability
  o Utility Requirements

• Evaluate Business Processes and Systems
  o Transmission Systems
  o Distribution Systems
    – SCADA
    – Outage Management
Electric System Integration Facility

- Designated by DOE March 2013
- Federally sponsored facility available for external use
  1. Open to all potential users
  2. Allocation of resources determined by merit review
  3. User fees are not charged for non-proprietary work if results are published in open literature
  4. Full cost recovery is required for proprietary work
  5. Facility provides resources sufficient for users to conduct work safely and efficiently
  6. Facility supports a formal users organization
  7. Facility is governed by a steering committee made up of DOE, NREL, Industry, Academia, and Users
  8. Facility does not compete with any available private sector capability
ESIF – Integrated Distribution Capability

Small Commercial
Multi Inverter
Cyber Security
Commercial PV
Commercial Systems
Home Energy Management

Feeder Level Technology

ESIF Level 2

DMS Control Room
PV Simulation
Grid Simulation
Industrial Demand
Solar Thermal Calibration
Environmental Characterization

Distributed Energy Resources
Solar Farm Large Inverter Testing
Distributed Energy Resource Management
Microgrids Large Commercial Loads

NATIONAL RENEWABLE ENERGY LABORATORY
ESIF – On Site Integration

Low Voltage Test Yard

Medium Voltage Test Yard

Commercial Feeder

Diesel Gensets

Flywheels

Vehicle to Grid Integration

Generation Substation and Distribution
High Performance Computing

Grid Integration – Show solutions at utility scale

HPC for Advanced Manufacturing

• The *High Performance Computing for Manufacturing (HPC4MFG)*
  The HPC tools can provide simulation capability to provide new understanding of energy and materials efficiency in manufacturing processes, particularly for energy intensive and energy dependent applications.

• The *Next Generation Electric Machines (NGEM)*
  This program connects AMO investments in power electronics with the large scale electric motors used in manufacturing, providing a technical pathway to cost-effective energy efficiency in a range of applications.
Thank you
Art.Anderson1@nrel.gov
www.nrel.gov/ESIF