BNL's Grid and Micro-Grid Efforts and Capabilities

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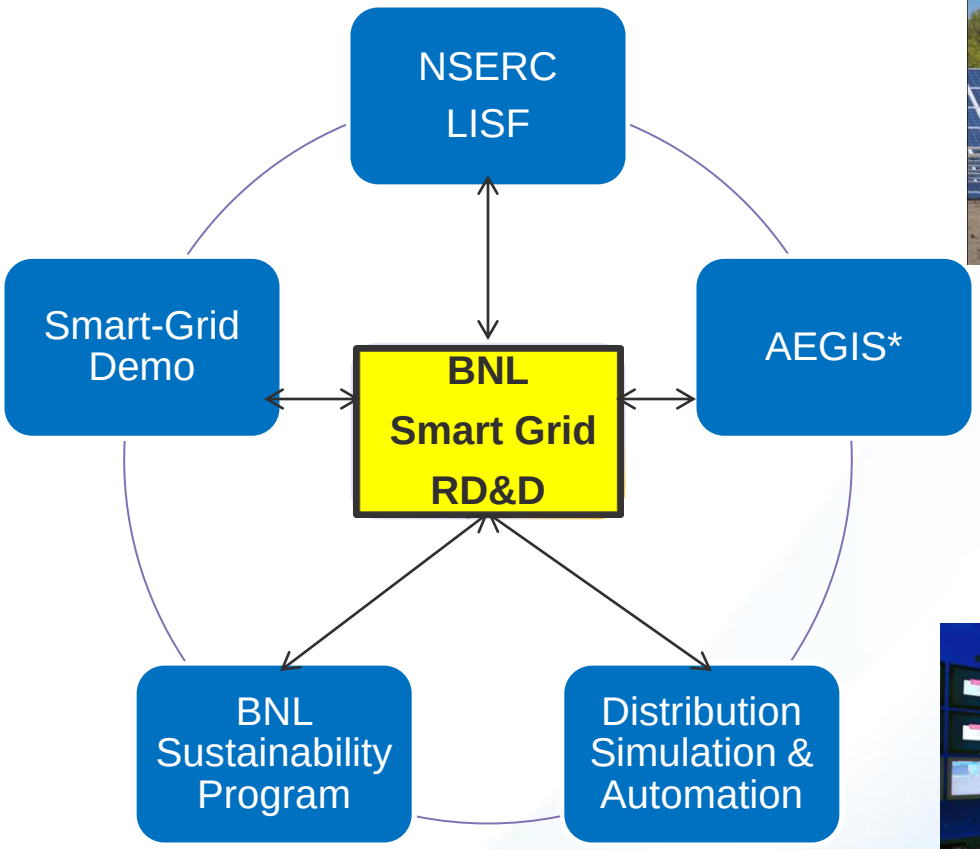
BROOKHAVEN NATIONAL LABORATORY
a passion for discovery

Office of Science
U.S. DEPARTMENT OF ENERGY

BNL's Energy Grid Research is focused on challenges of the design, management, and control of the electricity distribution layer in the northeast

- Tools for "smarter grid"
  - Advanced simulation and modeling
  - Distributed generation & integration of renewables & their impacts on control
  - Load shedding and automated demand response for high density urban areas
  - Grid-scale storage for frequency regulation and renewables integration
  - Advanced smart sensors for distribution (synchronized, fast, low-cost, smart) state measurement and control
  - Simulation-informed decisions on operations
  - Micro-grid design for resilience, reliability, improved efficiency

BNL has several inter-related Grid RD&D initiatives



BNL/Stony Brook Univ. partnership received $5million NYS grant to initiate development of SGRID^3 for which the Advanced Electric Grid Innovation and Support (AEGIS) Facility is the BNL component

BNL has established a number of collaborations and partnerships to enhance its capabilities

Category	Organizations	Research Interests
Industry	Orange & Rockland; LIPA Long Island Power Authority; GE; American Superconductor; EPRI Electric Power Research Institute; United Technologies Research Center; IBM	• Advanced power electronics and grid control schemes • Innovative smart grid technologies and integration of renewables
University	Stony Brook State University of New York; Farmingdale State College; Binghamton University State University of New York; Clarkson University; College of Nanoscale Science & Engineering University at Albany State University of New York; Syracuse; Virginia Tech Invent the Future; Rensselaer; CUNY The City University of New York; Columbia University	• Integration of renewables • Smart grid applications
State/Local Govt	nyserda Energy. Innovation. Solutions.; New York Power Authority; NYS SmartGrid Consortium; NYEPI New York Energy Policy Institute; NY BES+ New York Battery and Energy Storage Technology Consortium	• Integration of renewables • Smart grid applications • Grid storage • Policies for implementation of smart grid

The installation of smart sensors in the BNL distribution system enables using the site as a microgrid test bed

Micro-Grid Demonstration Project

- BNL has a 20 MW base load representative of a typical industrial complex; 13.8 kV primary distribution

- Use one (or more) circuits for the development of a micro-grid - including:
  - high penetration DG
  - advanced monitoring and simulation
  - micro-turbines and stationary generation
  - load demand management

BNL is collaborating with strategic industry partners on computer simulation-informed grid control

Orange & Rockland Utility (ORU) Project

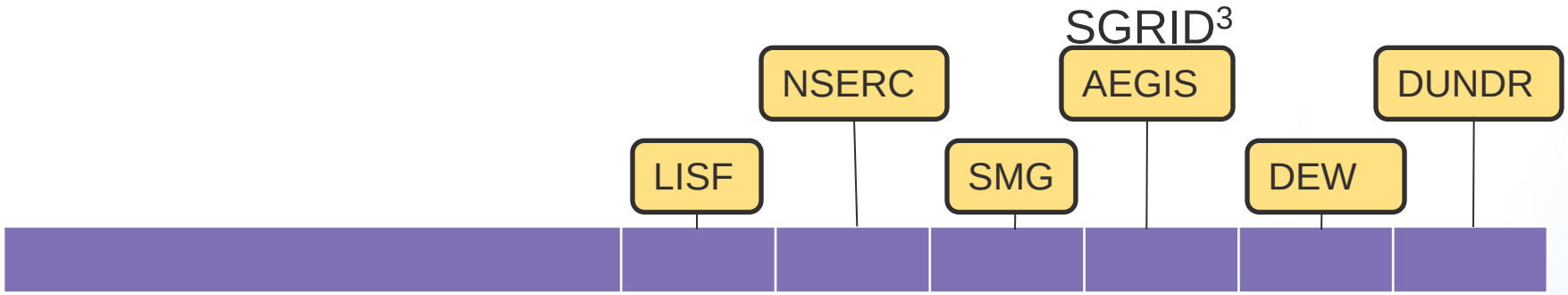
- Evaluation of advanced electrical system modeling software (DEW)
  - Developed by researchers at Virginia Tech
  - Paradigm shift in modeling/simulation
  - Based on advanced network analysis (e.g. graph trace analysis), local loop analysis, and advanced computational techniques (object-oriented, memory efficient techniques)
  - Much more computationally efficient than traditional approaches based on linear-algebra (e.g. OpenDSS)
- DEW can model transmission and/or distribution systems in real-time
  - Reliability, transient analysis, system planning, failure propagation, etc
  - City-scale simulations can be completed in sec timescales
- ORU is using this software to model their electrical distribution system and run simulations for improved grid control
- SET is working with ORU to help develop applications for DEW
  - Justify costs of system upgrades as part of rate cases
- Potential to use DEW for simulation informed grid control
  - Embed DEW in local smart grid sensors
  - Connects with BNL Smart Micro-grid Project

BNL is studying the impact of demand response in dense urban network environments

Dense Urban Network Demand Response (DUNDR) Project

- Demand Response is a concept whose time has come in many places
- During only 200 hours per year is the grid peak overloaded
- Usually in cold or hot periods
- Customers can help and in some locales receive $$$$$
- BNL's R&D looks to take high-rise historic buildings and combine tenants' efforts to lower the peak
- Technical and policy issues to deal with allow this to happen

BNL's RD&D agenda is well aligned with DOE research focus areas



	LISF	NSERC	SMG	AEGIS	DEW	DUNDR
DOE Office of Electricity Delivery and Energy Reliability Research Focus Areas [1]						
Visualization and Controls		●	●	●	●	●
Renewable and Systems Integration	●	●		●	●	
Energy Storage and Power Electronics		●			●	
DOE Office of Energy Efficiency and Renewable Energy Solar Energy Research Focus Areas [2]						
Distributed Grid Integration	●	●	●		●	
Transmission Grid Integration				●		
Solar Resource Assessment	●					
Technology Validation		●	●			

1. DOE/OE Strategic Plan, Transforming Electricity Delivery, September 2007 http://energy.gov/oe/downloads/transforming-electricity-delivery
2. DOE/EERE Solar Energy Technologies Program-Systems Integration Multi-year Plan FY2011-FY2016, December 2010.