Brookhaven National Laboratory Renewable Energy Research and Grid Centers

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BROOKHAVEN NATIONAL LABORATORY

a passion for discovery

Office of Science
U.S. DEPARTMENT OF ENERGY

Outline

- BNL's strategic plans for energy research
  - Solar Energy
  - Smart Grids
- Solar energy related research
  - Status of the 32MWp LISF array
  - Development of the Northeast Solar Energy Research Center (NSERC)
- Smarter Electric Grid Research, Innovation, Development, Demonstration, Deployment Center – SGRID^3
  - Development of AEGIS (Advanced Electric Grid Innovation and Support Center) at BNL

Renewable energy research: a key motivation is the construction of the LISF solar plant on site

- **32 MWac grid-connected solar photovoltaic plant being built at BNL**
  - Owned by Long Island Solar Farm, LLC
  - Purpose is to sell power to LIPA under a PPA
- **Located on 195 acres on BNL campus under an easement from DOE**
  - Consideration (in-kind funds) provided to DOE
  - BNL can instrument and collect data (met, solar resource, power quality) from the array for research purposes (currently funded by EERE)

LISF is complete and is generating power!

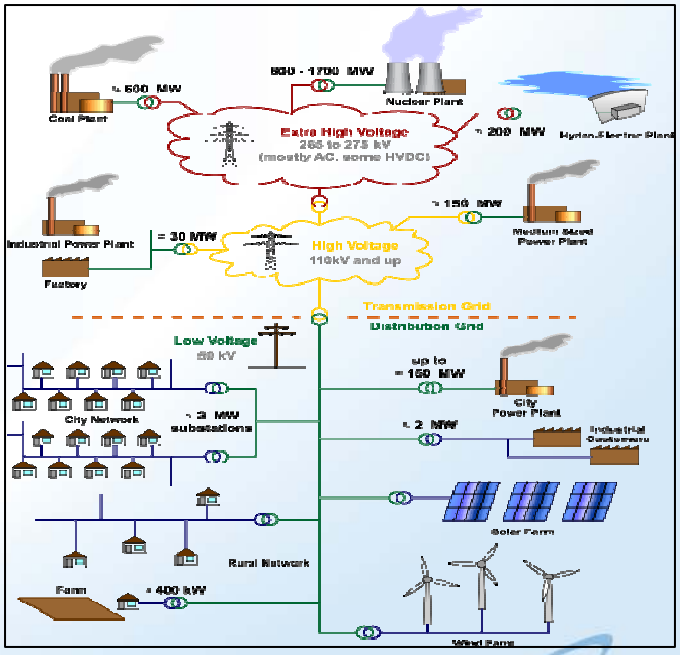
Commercial operation November 2011

Aerial view from south of completed LISF – October 2011

Research agenda of renewable energy

- **Solar Variability**
  - Characterize solar variability for plants in the northeast
  - Forecasting the solar resource – Min/Hours/Day ahead
    - Leverage BNL core capability in cloud physics
    - Leverage access to NOAA facility on site
  - Predicting solar plant power output
    - Tie forecasting models to electrical models
    - Capacity credit for solar PV plants

- **Grid Integration**
  - Impact of solar variability on grid management
    - Different penetration levels
  - Impact of distributed generation on the grid
    - Grid control, power quality, reliability
  - The role of storage
  - The role of advanced grid-tied inverter technologies
    - Inverters with DVAR, voltage regulation



- **Environmental Impacts**
  - Impact of utility-scale solar PV plants on local environment and ecology

BNL is developing a separate solar research facility: Northeast Solar Energy Research Center (NSERC)

- NSERC Research will supplement research capabilities offered by the LISF and enable research in various other areas of interest to the solar industry
  - Dedicated research array for field testing
  - Laboratory space for standardized testing
  - Technology development test bed
  - Testing in Northeast conditions

- BNL held a workshop to obtain stakeholder input for the development of NSERC – March 2011
  - BP Solar, GE, AMSC, Direct Grid, LIPA, EPRI, SEPA, SBU…
  - **Unanimous agreement that such a facility is needed!**

NSERC would include a dedicated research array for field testing of solar system technologies and laboratories…

- Solar PV Array Size
  - 700kW to 1MW connected to BNL electrical distribution system
  - Different PV technologies
- Configuration
  - Re-configurable to simulate different operating scenarios
  - Fixed tilt with capability for Trackers
- BOP Equipment
  - Capability for running macro and micro inverters and including storage
- Research instrumentation
  - Similar to LISF (met, solar resource, power quality)
  - High Sample Rates – 1 sec data
- Research laboratories to support solar energy research projects

Conceptual design is underway!
Array scheduled to be operational by summer 2012

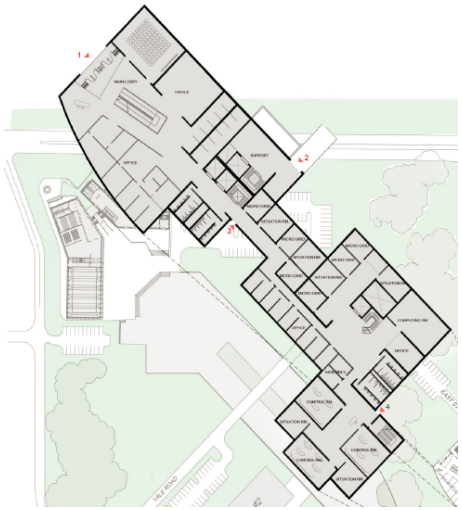
Smarter Electric Grid Research, Innovation, Development, Demonstration, Deployment Center – SGRID^3

- SGRID^3 Goals
  - Lower the cost of electric power by 5-10%
  - Improve the quality and reliability of electric power
  - Ensure the security of the Smart Grid and implement the biggest energy technology revolution in 100 years
  - Develop capabilities to advance future utility investments in the electrical transmission and distribution systems in New York State
- SGRID^3 is a unique facility filling an unmet need to:
  - Create a development, demonstration, and deployment infrastructure for new grid technologies, including renewables

SGRID^3 Vision

AEGIS Center

- Enable grid-performance info collection and modeling to optimize transmission/distribution



- **Foster invention, development, testing, deployment of SGIC (Smart Grid Information Clearinghouse) technologies**

NYS Smart Grid Innovation Center

- Stakeholders can develop and demonstrate grid technologies

- **Model technologies with grid performance info from AEGIS**

Research Focus Areas

- Transmission
  - Integration of PMU data
  - High Tc superconducting transmission
  - Energy Storage
    - Peak management
    - Load leveling
    - Renewables integration
- Distribution
  - Improving efficiencies
    - Sensors for the distribution side
  - Improving knowledge of system
    - Emergency recovery improvement

Brookhaven Smart Micro-Grid Demonstration

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

- BNL has a 20 MW base load representative of a typical industrial complex; 13.8 kV primary distribution
- An active collaboration is in place for placing a network of new generation grid sensors in the BNL distribution system
- NSERC includes renewable generation on the BNL grid.
- Beyond solar, there may be options for wind and CHP installations as well.
- Manage deployment of capacitor banks in real time in response to micro-grid state

Status of the AEGIS Center

- Received funding through Governor Cuomo's Regional Economic Development Councils
- Working on conceptual design …