

Northeast Solar Energy Research Center at Brookhaven National Laboratory

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December 4, 2013



BROOKHAVEN
NATIONAL LABORATORY

a passion for discovery

 **Office of
Science**
U.S. DEPARTMENT OF ENERGY



A key motivation for pursuing solar energy research at BNL is access to the Long Island Solar Farm ...

- **32 MWac grid-connected solar photovoltaic plant being built at BNL**
 - Owned by Long Island Solar Farm, LLC (originally developed by BP Solar)
 - Purpose is to sell power to LIPA under a PPA
 - Commercial operation initiated Nov. 1, 2011
 - Largest PV plant in the eastern U.S.
- **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 from the array for research purposes
- **BNL installed research instruments to collect data for research purposes**
 - High-resolution, time synchronized data sets



LISF is complete and is generating power!

Commercial operation
November 1, 2011

The LISF is operational and generates up to 32MW of power for Long Island



BNL installed research instruments in the LISF

Collecting Time Synchronized, High Resolution (1sec.) Data Sets

■ Solar Resource Data

- Field Instruments: pyranometers 32 pairs @ 25 locations to measure direct and diffuse irradiance
- Base Station Instruments: Solar tracker, rotating shadowband radiometer for precision measurements



Rotating Shadowband Radiometer



Field Pyranometer

■ Meteorological Data

- Two Met Towers (85m & 10m)
 - Air Temp/Barometric Pressure
 - Wind speed and direction
- Array Field Instruments
 - Temperature (air , panel, soil)
 - Relative Humidity
- Total Sky Imagers – Cloud images



Power Quality Monitor



Pyrheliometer



Pyrgometer

■ Electrical Performance Data

- Power Quality: all inverters, collection substation
- Power Quality: Utility feeders to BNL
- String Level: DC currents and voltages



Sun tracker with sensors for global, diffuse and direct irradiance.



Total Sky Imager

BNL is also developing the Northeast Solar Energy Research Center (NSERC)

- Supplements LISF research
 - DOE owned facility on BNL campus
 - Available to support industry needs
- Comprised of two elements
 - Research array for field testing
 - Laboratories for standardized testing
- Resource for the Northeast
 - Field testing under actual northeast conditions
 - Technology development test bed
- Solar array connected to BNL electrical system
 - Help with BNL sustainability goals
 - Enable micro-grid test bed

NSERC Research Facility

- ✓ **Field Testing***
- ✓ **Grid Integration**
- ✓ **Solar PV**
- ✓ **Smart Grid Test Bed**
- ✓ **Energy Storage**
- ✓ **Smart Grid Inverters**
- ✓ **Solar Forecasting**
- ✓ **Reliability & Degradation**
- ✓ **Environmental Sustainability**

Overview of the research array final design...

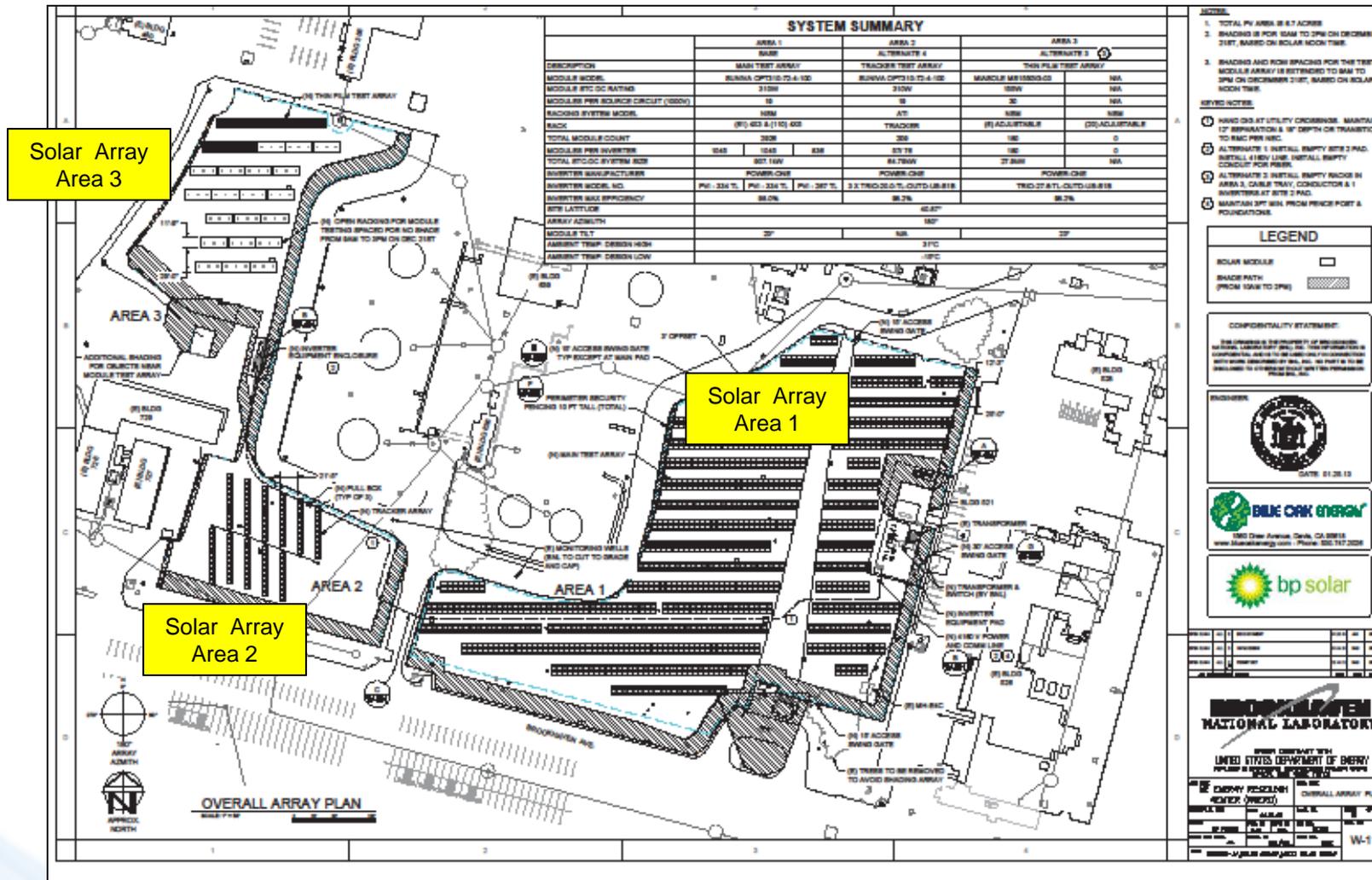
■ Nominal Specifications

- Power output: ~1MW-ac
- Reconfigurable architecture
 - 67kw blocks
 - Voltage 1000V
- Solar Modules – Suniva Crystalline silicon
 - ~16% efficiency
 - Buy American Compliant
- Racking: Northern States Metal
 - Fixed tilt (90%) /Single Axis trackers (10%)
- Inverters: Aurora Power One Modular
 - Capability for individual MPPT control of blocks

■ Special Features

- Inverter testing from utility-scale to string level and micro inverters
- Storage systems – separate test pad provided
- Microgrid – ring bus architecture included
- Solar module testing – empty racks for module testing

The design includes 3 separate test areas...



Area 1: ~907kw-dc for testing inverters, storage and micro-grids – and provide power to BNL
 Area 2: ~ 65kw-dc for testing modules on trackers
 Area 3: ~150kw-dc for testing new module designs and inverter topologies

Development of the solar research array is underway...

- Site selected for the research array
 - BNL main campus ~6.9 acres
- Construction initiated
 - Active Environmental – Piles
 - Roppelt Electric – array
- Schedule for Completion
 - Area 1 (518kw portion) by Jan. 2014
 - Areas 2 and 3 in future



Research Capabilities provided by NSERC

- Smart Grid Integration Studies
 - Research on strategies that improve communication and control
 - Techniques for integrating large numbers of systems into utility grids
 - Microgrid demonstrations with renewable energy generation
- Energy Storage Research
 - Value propositions for integrated grid-level storage
 - Evaluation of storage and control alternatives
 - Reduce intermittency, resource extension
 - Frequency regulation capability
- Field Testing of New Technologies
 - Evaluation and testing of new design concepts, such as inverters with capability for voltage regulation and VAR control
 - Comparison of performance for components and systems using different technologies
- Reliability and Degradation Studies
 - Long-term reliability and degradation studies under Northeast conditions
 - Standardized test conditions to evaluate component degradation
 - Post mortem testing and failure analyses

For further information...

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