

# Long Island Power Authority Long Island Solar Farm



May 10, 2012

LIPA's Long Island Solar Farm Project in Partnership with  
BNL Constructed and Operated by BP Solar

# Agenda

- LIPA's Solar Initiative to Date
- The Long Island Solar Farm Project Process
- A Few Words About Brookhaven National Laboratory as a Site
- The Physical Project
- Environmental Benefits
- How is this Project Bid – Something New for All of Us
- Research and Development Opportunities

# LIPA's Solar Initiatives

<b>Solar Pioneer (Residential) and Entrepreneur (Commercial and Not for Profit)</b>	
Total Installs	4,939
Total MW (DC)	38
Total MWh (AC)	46,174
<b>50 MW Utility Scale (As of April 2012)</b>	
Total MW Planned (DC)	54
Total MW Planned (AC)	49
Total MW Installed (DC)	43
Total MW Installed (AC)	37



# The Long Island Solar Farm Project



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# The Long Island Solar Farm Project

- Fall 2008                      Proposals Received
- December 17, 2009        BP Solar proposal selected
- February 8, 2010           PPA executed
- April 29, 2010              PPA Approved by NYS Regulators
- Fall 2010                      Clearing and Construction began
- December 2010              Solar Panel Installation began
- October 5, 2011 -  
October 31, 2011              SGF Testing Period
- November 1, 2011          Commercial Operation

# LIPA's 50 MW Solar RFP (2008)

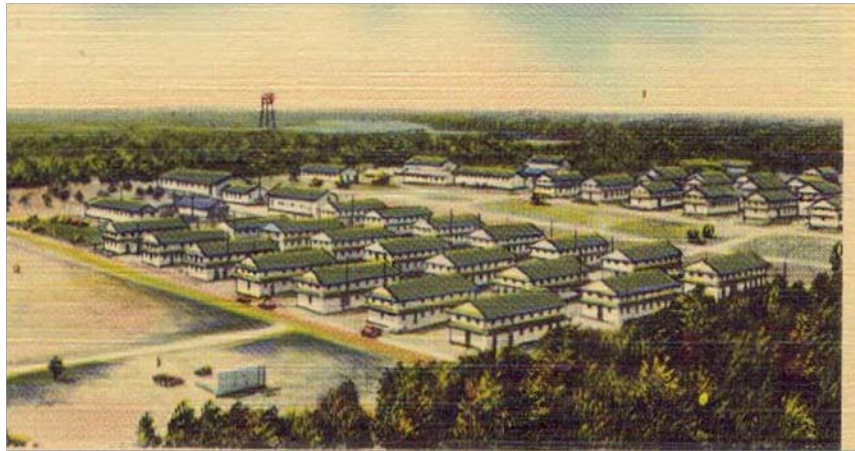
- LIPA sought to procure up to 50 MW of utility-scale solar generation:
  - ▶ Reduce our dependence on fossil fuels
  - ▶ Assist in the overall development of the solar industry on Long Island
  - ▶ Encourage economic development on Long Island in particular in the area of “green jobs”
  - ▶ Support then Governor David Paterson’s Renewable Energy Taskforce’s goal of 100 MW of renewable energy generation facilities in NYS
  - ▶ Strive to meet LIPA’s Renewable Portfolio Standard goals
  - ▶ Additional Benefits such as establishing a Research and Development Platform
- LIPA selected BP Solar’s 32 MW Long Island Solar Farm (LISF) Project and enXco’s 17 MW Eastern Long Island Solar Project (ELISP)

# The History of the Brookhaven National Laboratory as Camp Upton

- World War I Training Facility – Camp Upton (1917 to 1921)



- World War II Training Facility (1940 to 1947)



# The History of the Brookhaven National Laboratory

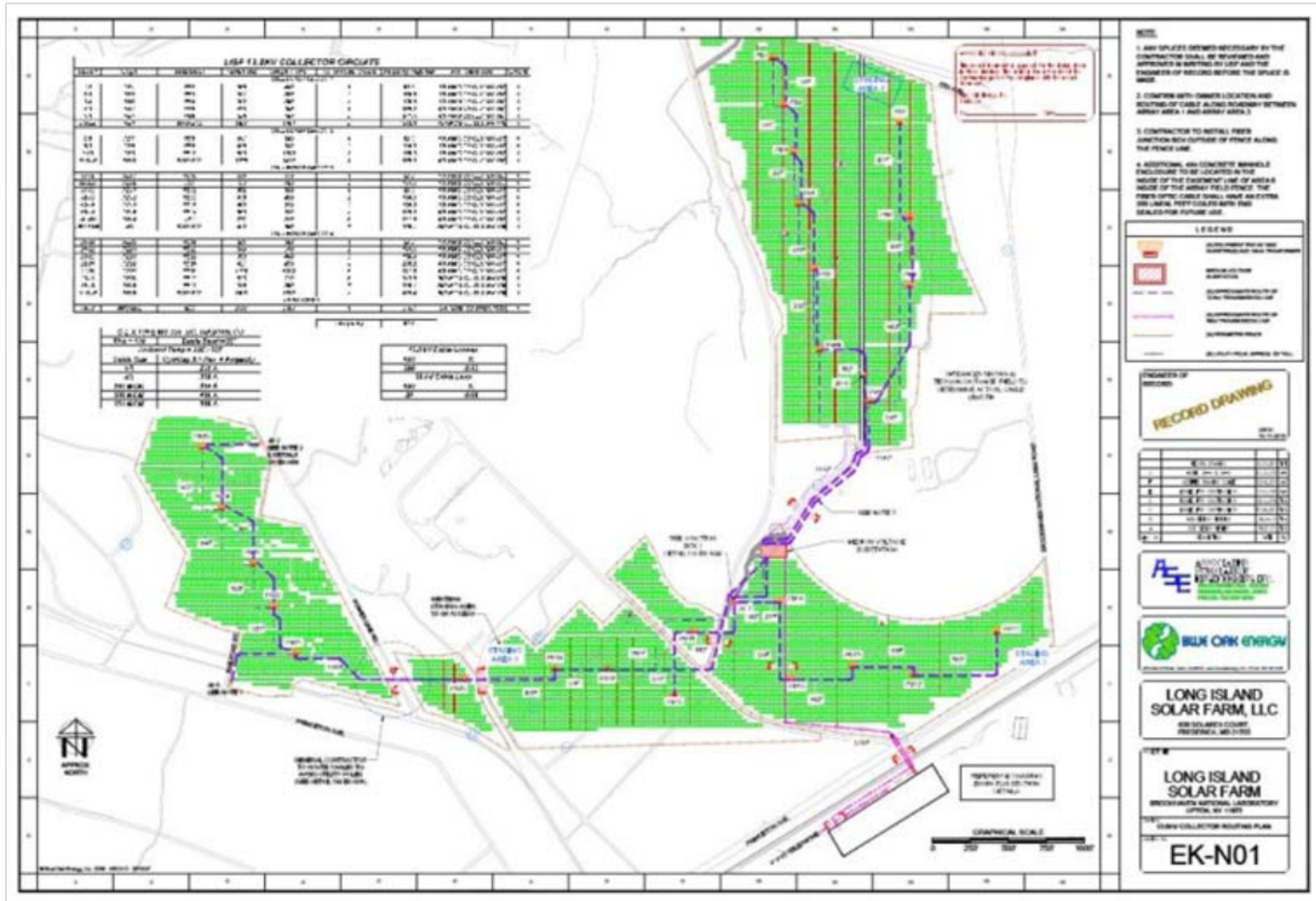
- Brookhaven National Laboratory Established on March 1, 1947
  - ▶ 5,000 Acres of land 1,000 acres of which occupied by the Lab's development.
  - ▶ The site was selected for its existing barracks which could be converted to laboratories, proximity to New York City and its educational institutions, and obviously for its sheer acreage.
  - ▶ This was the first national laboratory dedicated to the peaceful use of nuclear power.



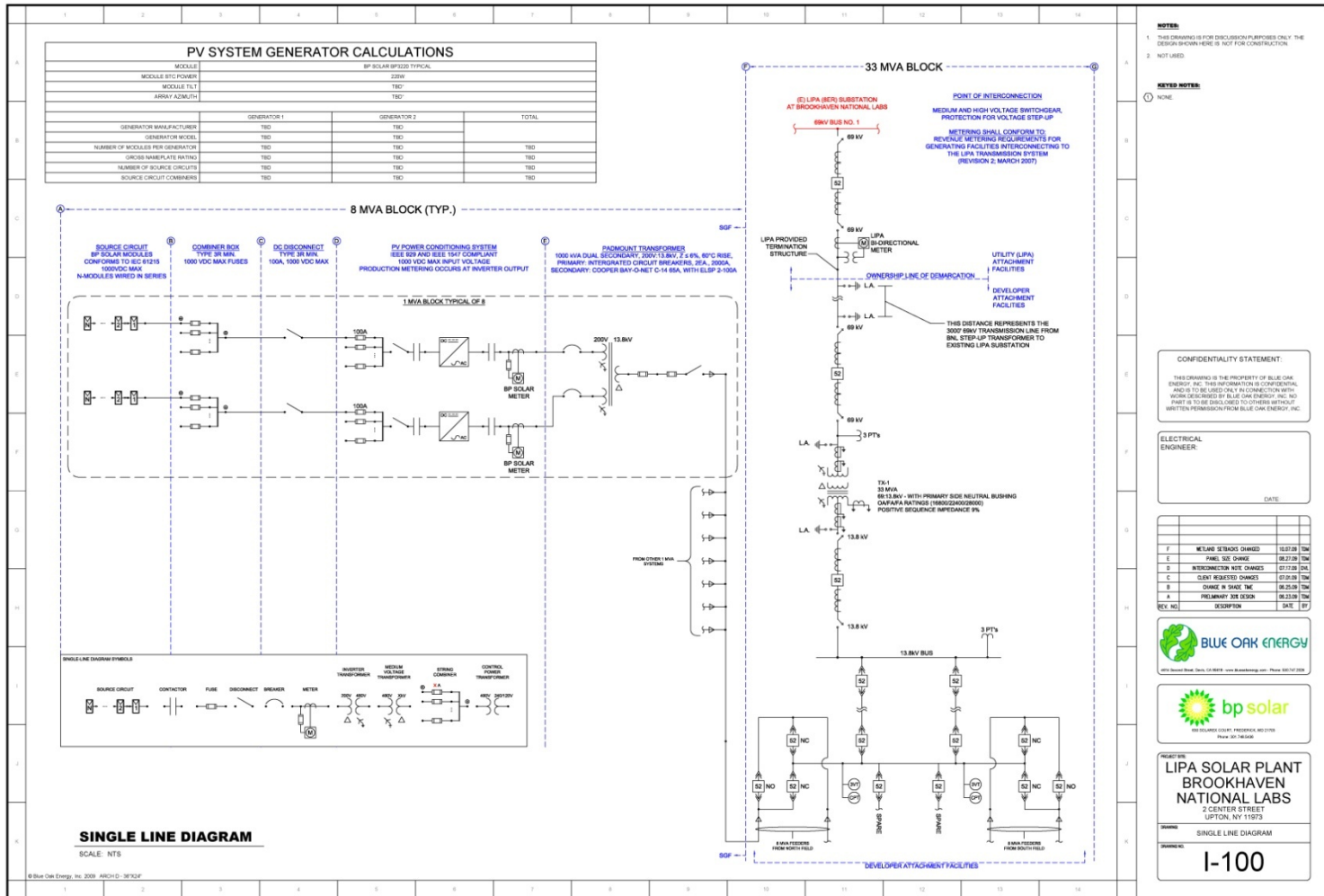
# Site Data

- 200 Acre Project Site
  - ▶ Site Divided into Six Easement Areas. Area 1 is involved with the BNL R&D Project.
- 44,000,000 kwh estimated annual energy output
- 164,312 Ground Mounted Fixed Panels
- 27 degree solar panel tilt, Array Azimuth: 180°
- Panel Type: BP Solar c-Si
- Panel Quantity: 164,312
- Racking Type: Solar Flex Rack
- Foundation: Screw Piles
- Inverter Type: SMA, 630 HE US
- System Size [DC]: 37 MWp
- System Size [AC]: 32 MVA
- DC Voltage: 1,000 V
- AC Voltage: 13.8kV
- Point of Common Coupling Voltage: 69 kV

# LISF Project Site Layout



# The LISF - the Basics



**NOTES:**

- THIS DRAWING IS FOR DISCUSSION PURPOSES ONLY. THE DESIGN SHOWN HERE IS NOT FOR CONSTRUCTION.
- NOT USED.

**KEYED NOTES:**

- NONE

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**ELECTRICAL ENGINEER:**

DATE:

REV	NO.	DESCRIPTION	DATE	BY
F	1	NEUTRAL SWITCH CHANGED	02/28/09	TRD
E	1	PANEL SIZING CHANGE	02/28/09	TRD
D	1	INTERCONNECTOR NOTE CHANGES	07/28/08	TRD
C	1	CLIENT REQUESTED CHANGES	07/28/08	TRD
B	1	CHANGE # 3482, INC.	06/25/08	TRD
A	1	PRELIMINARY 3/18 (2/20)	02/25/08	TRD



**PROJECT NO.:** LIPA SOLAR PLANT BROOKHAVEN NATIONAL LABS  
2 CENTER STREET  
LITCHFIELD, NY 11753

**DATE:** SINGLE LINE DIAGRAM

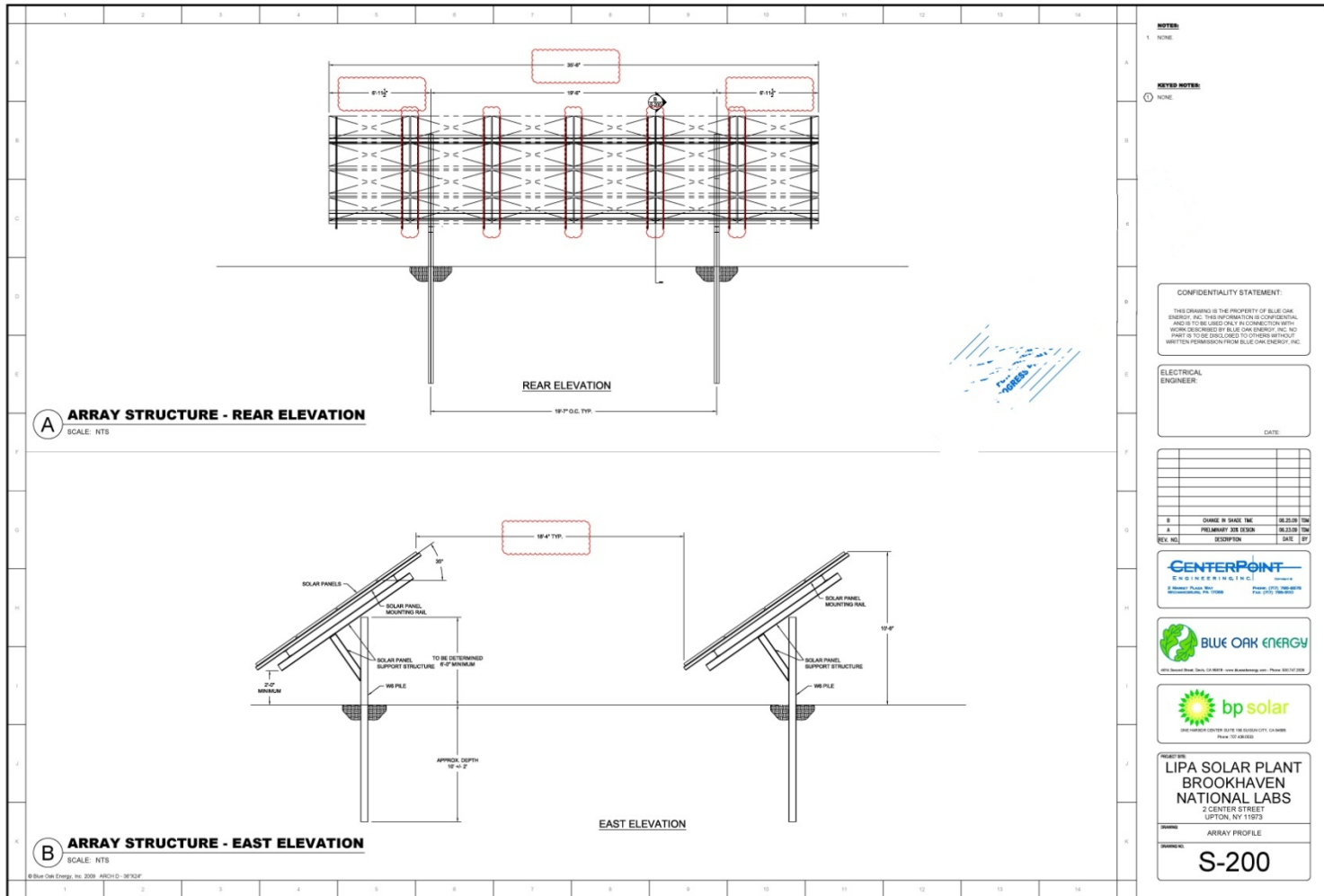
**DRAWING NO.:** I-100

# Environmental Benefits / Challenges

- Expected annual reductions in emissions:
  - ▶ 33 metric tons of NO<sub>x</sub> avoided
  - ▶ 30 metric tons of Ozone Season NO<sub>x</sub> avoided
  - ▶ 76 metric tons of SO<sub>2</sub> avoided
  - ▶ 30,000 metric tons of CO<sub>2</sub> avoided
    - CO<sub>2</sub> sequestration lost due to removal of trees totals an estimated 842 metric tons



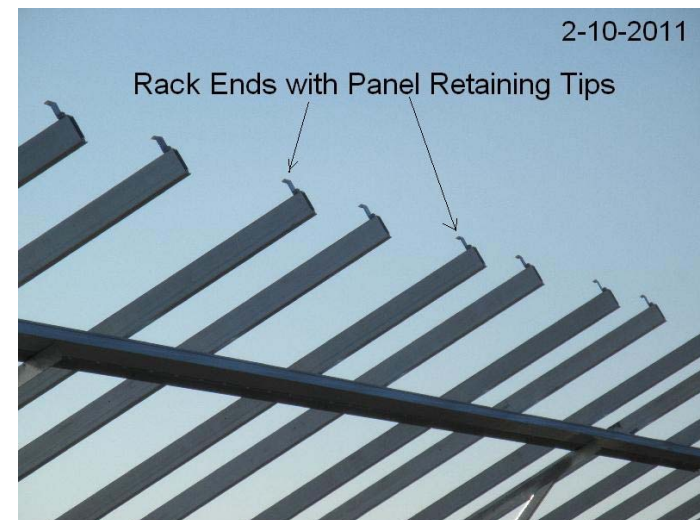
# Panel Construction Details



# Construction Details / Photos



# Construction Details / Photos (continued)





# Construction Details / Photos (continued)



The process of installing the vertical helical piles were completed in a few relatively non intrusive steps:

1<sup>st</sup>- Survey the field and mark where all helical piles were to be located.

2<sup>nd</sup>- Stage materials in an area to minimize traffic and to maximize LEEN thinking.

3<sup>rd</sup>- Using the bobcat tractor shown in the next photo, pick the helical pile up and bring to the exact location of installation and stand in a vertical position.



# Construction Details / Photos (continued)



4<sup>th</sup>- Track-hoe with torque adapter would take possession and gently auger to appropriate depth and torque requirement based on soils report and structural engineers calculation.

5<sup>th</sup>- Equipment would move to next pile and survey crew would validate pile is located in correct position, height and alignment. Final step- QA/QC team would randomly inspect to ensure consistency.

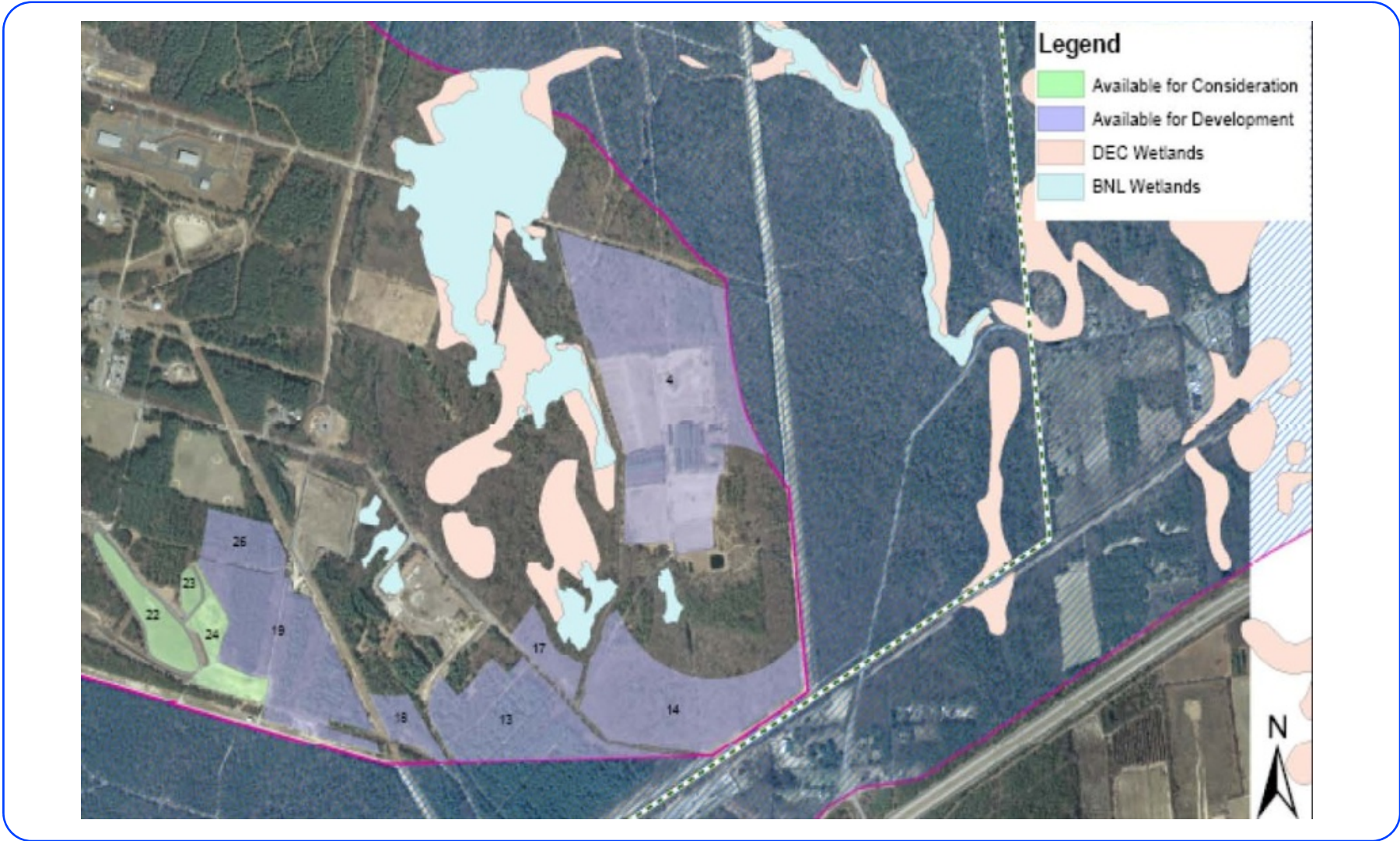
# Construction Challenges

- **Historical Uses of the Site**
  - ▶ Abandoned munitions – necessitated special excavation procedures
  - ▶ Site usage as a National Laboratory – avoidance of the tritium plume
- **Interconnection of the site to the LIPA Brookhaven 69 kV Substation**
  - ▶ Crossing of the LIRR – Special directional drilling permit required
- **Environmental considerations**
  - ▶ Avoidance of Wetlands
  - ▶ Avoidance of Core Pine Barrens Area
  - ▶ Consideration of migrating wildlife

# Steps Taken to Account for Environmental Sensitivities

- Portion of project area moved to avoid 14 acres of higher quality pine barrens habitat in Compatible Growth Area (CGA) of Pine Barrens
- Irregular layout designed to minimize environmental issues
- Project totally avoids development within Core Preservation Area (CPA)
- Avoids wetlands and tiger salamander habitat and improves a small tiger salamander pond
- Maximizes tiger salamander buffers (1,000 feet where 850 feet is BNL requirement)
- Native grasses planted
- Removes invasive plants and will manage for invasives preventing establishment and spread into Core Preservation Area (CPA)
- Will not impact groundwater - Total annual water use for maintenance less than 500,000 gallons - Native vegetation below arrays will filter precipitation as it infiltrates ground
- Project not expected to impact surface water – current flow patterns will be unchanged - Impervious surfaces increase by 10,890 sq. ft.
- Creates a deer-free area – enhancing habitat for other wildlife
- Fencing is wildlife friendly
- Construction activities timed to reduce disturbance to birds and wildlife

# BNL Wetlands Near to the LISF





# Benefits

- Predictive modeling of the weather effects on system performance
  - ▶ Characterize variability and capacity credit
  - ▶ Forecasting solar generation to address dispatchability issues
- National energy security and renewable energy research are crucial to DOE/BNL missions
- Development here will include a research array
  - ▶ Improve solar PV cell efficiency
  - ▶ Seek breakthroughs in battery storage
  - ▶ Advance other technologies
  - ▶ Impact on the grid under different operating conditions

# Working for the future - R&D Project Benefits

## ■ Performance in the Northeast US

- ▶ Characterize variability and capacity credit
- ▶ Role of storage to mitigate variability issues
- ▶ Forecasting solar resource and power generation to address dispatchability issues

## ■ Grid Integration

- ▶ Issues with grid control and stability
- ▶ Support for grid issues with voltage sag, VAR control
- ▶ Capacity credit for solar projects and DG

## ■ Environmental Impacts

- ▶ Impacts on local environment and ecology
- ▶ Life-cycle analysis

# Award Winning Project

- 2012 Winner of the “Readers Choice Award” as part of the 2012 Excellence in Renewable Energy Awards



# Calculation of Unforced Capacity (UCAP)

■  $UCAP = ProdF \times NC,$

where:

- ▶  $ProdF$  is the production factor used in the calculation of the amount of Unforced Capacity
- ▶  $NC$  is the nameplate capacity of Resource
- ▶  $E$  is the amount of energy delivered to the NYCA transmission system

■

$$ProdF_{gm} = \frac{\sum_{h \in CPPH_{gm}} E_{gh}}{\sum_{h \in CPPH_{gm}} NC_{gh}}$$



# Real Time Data



3/27/2012 7:00:00 AM	2	3/27/2012 9:05:00 AM	14295
3/27/2012 7:05:00 AM	2	3/27/2012 9:10:00 AM	15802
3/27/2012 7:10:00 AM	6	3/27/2012 9:15:00 AM	19023
3/27/2012 7:15:00 AM	21	3/27/2012 9:20:00 AM	19023
3/27/2012 7:20:00 AM	40	3/27/2012 9:25:00 AM	20736
3/27/2012 7:25:00 AM	65	3/27/2012 9:30:00 AM	22519
3/27/2012 7:30:00 AM	122	3/27/2012 9:35:00 AM	24367
3/27/2012 7:35:00 AM	274	3/27/2012 9:40:00 AM	26255
3/27/2012 7:40:00 AM	479	3/27/2012 9:45:00 AM	28190
3/27/2012 7:45:00 AM	736	3/27/2012 9:50:00 AM	30177
3/27/2012 7:50:00 AM	1046	3/27/2012 9:55:00 AM	32231
3/27/2012 7:55:00 AM	1412	3/27/2012 10:00:00 AM	34350
3/27/2012 8:00:00 AM	1843	3/27/2012 10:05:00 AM	36494
3/27/2012 8:05:00 AM	2341	3/27/2012 10:10:00 AM	38684
3/27/2012 8:10:00 AM	2905	3/27/2012 10:15:00 AM	40947
3/27/2012 8:15:00 AM	3549	3/27/2012 10:20:00 AM	43248
3/27/2012 8:20:00 AM	4272	3/27/2012 10:25:00 AM	45589
3/27/2012 8:25:00 AM	5072	3/27/2012 10:30:00 AM	47967
3/27/2012 8:30:00 AM	5947	3/27/2012 10:35:00 AM	50424
3/27/2012 8:35:00 AM	6897	3/27/2012 10:40:00 AM	52911
3/27/2012 8:40:00 AM	7923	3/27/2012 10:45:00 AM	55391
3/27/2012 8:45:00 AM	9034	3/27/2012 10:50:00 AM	57891
3/27/2012 8:50:00 AM	10226	3/27/2012 10:55:00 AM	60407
3/27/2012 8:55:00 AM	11505	3/27/2012 11:00:00 AM	62955
3/27/2012 9:00:00 AM	12862		

# Real Time Data



3/27/2012 11:05:00 AM	65474	3/27/2012 1:05:00 PM	126866
3/27/2012 11:10:00 AM	67997	3/27/2012 1:10:00 PM	129391
3/27/2012 11:15:00 AM	70533	3/27/2012 1:15:00 PM	131918
3/27/2012 11:20:00 AM	73097	3/27/2012 1:20:00 PM	134442
3/27/2012 11:25:00 AM	75621	3/27/2012 1:25:00 PM	136981
3/27/2012 11:30:00 AM	78149	3/27/2012 1:30:00 PM	139542
3/27/2012 11:35:00 AM	80673	3/27/2012 1:35:00 PM	142065
3/27/2012 11:40:00 AM	83236	3/27/2012 1:40:00 PM	144591
3/27/2012 11:45:00 AM	85779	3/27/2012 1:45:00 PM	147114
3/27/2012 11:50:00 AM	88307	3/27/2012 1:50:00 PM	149644
3/27/2012 11:55:00 AM	90832	3/27/2012 1:55:00 PM	152215
3/27/2012 12:00:00 PM	93392	3/27/2012 2:00:00 PM	154709
3/27/2012 12:05:00 PM	95969	3/27/2012 2:05:00 PM	157235
3/27/2012 12:10:00 PM	98545	3/27/2012 2:10:00 PM	159758
3/27/2012 12:15:00 PM	103697	3/27/2012 2:15:00 PM	162331
3/27/2012 12:20:00 PM	103697	3/27/2012 2:20:00 PM	164904
3/27/2012 12:25:00 PM	106273	3/27/2012 2:25:00 PM	167476
3/27/2012 12:30:00 PM	108850	3/27/2012 2:30:00 PM	170048
3/27/2012 12:35:00 PM	111426	3/27/2012 2:35:00 PM	172621
3/27/2012 12:40:00 PM	114002	3/27/2012 2:40:00 PM	175192
3/27/2012 12:45:00 PM	116577	3/27/2012 2:45:00 PM	177762
3/27/2012 12:50:00 PM	119154	3/27/2012 2:50:00 PM	180293
3/27/2012 12:55:00 PM	121730	3/27/2012 2:55:00 PM	182811
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# Real Time Data



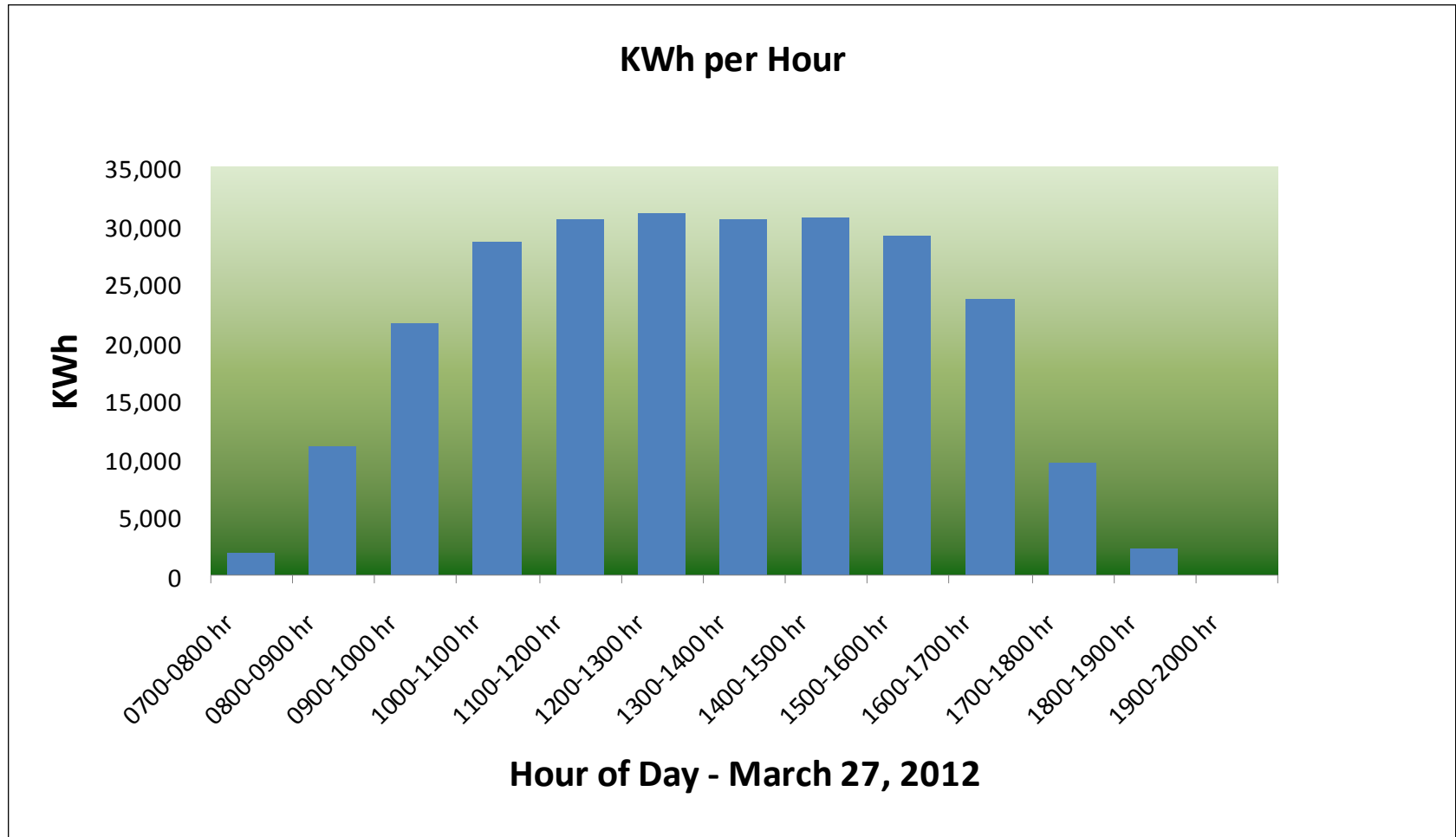
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3/27/2012 3:15:00 PM	192978	3/27/2012 5:15:00 PM	240498
3/27/2012 3:20:00 PM	195494	3/27/2012 5:20:00 PM	241675
3/27/2012 3:25:00 PM	197989	3/27/2012 5:25:00 PM	242778
3/27/2012 3:30:00 PM	200445	3/27/2012 5:30:00 PM	243772
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3/27/2012 3:40:00 PM	205262	3/27/2012 5:40:00 PM	245457
3/27/2012 3:45:00 PM	207609	3/27/2012 5:45:00 PM	246258
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3/27/2012 3:55:00 PM	212173	3/27/2012 5:55:00 PM	247229
3/27/2012 4:00:00 PM	214386	3/27/2012 6:00:00 PM	247585
3/27/2012 4:05:00 PM	216549	3/27/2012 6:05:00 PM	248023
3/27/2012 4:10:00 PM	218662	3/27/2012 6:10:00 PM	248195
3/27/2012 4:15:00 PM	220722	3/27/2012 6:15:00 PM	248485
3/27/2012 4:20:00 PM	222735	3/27/2012 6:20:00 PM	248808
3/27/2012 4:25:00 PM	224639	3/27/2012 6:25:00 PM	249104
3/27/2012 4:30:00 PM	226526	3/27/2012 6:30:00 PM	249352
3/27/2012 4:35:00 PM	228358	3/27/2012 6:35:00 PM	249558
3/27/2012 4:40:00 PM	230119	3/27/2012 6:40:00 PM	249716
3/27/2012 4:45:00 PM	231822	3/27/2012 6:45:00 PM	249826
3/27/2012 4:50:00 PM	233458	3/27/2012 6:50:00 PM	249882
3/27/2012 4:55:00 PM	235024	3/27/2012 6:55:00 PM	249904
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# Real Time Data

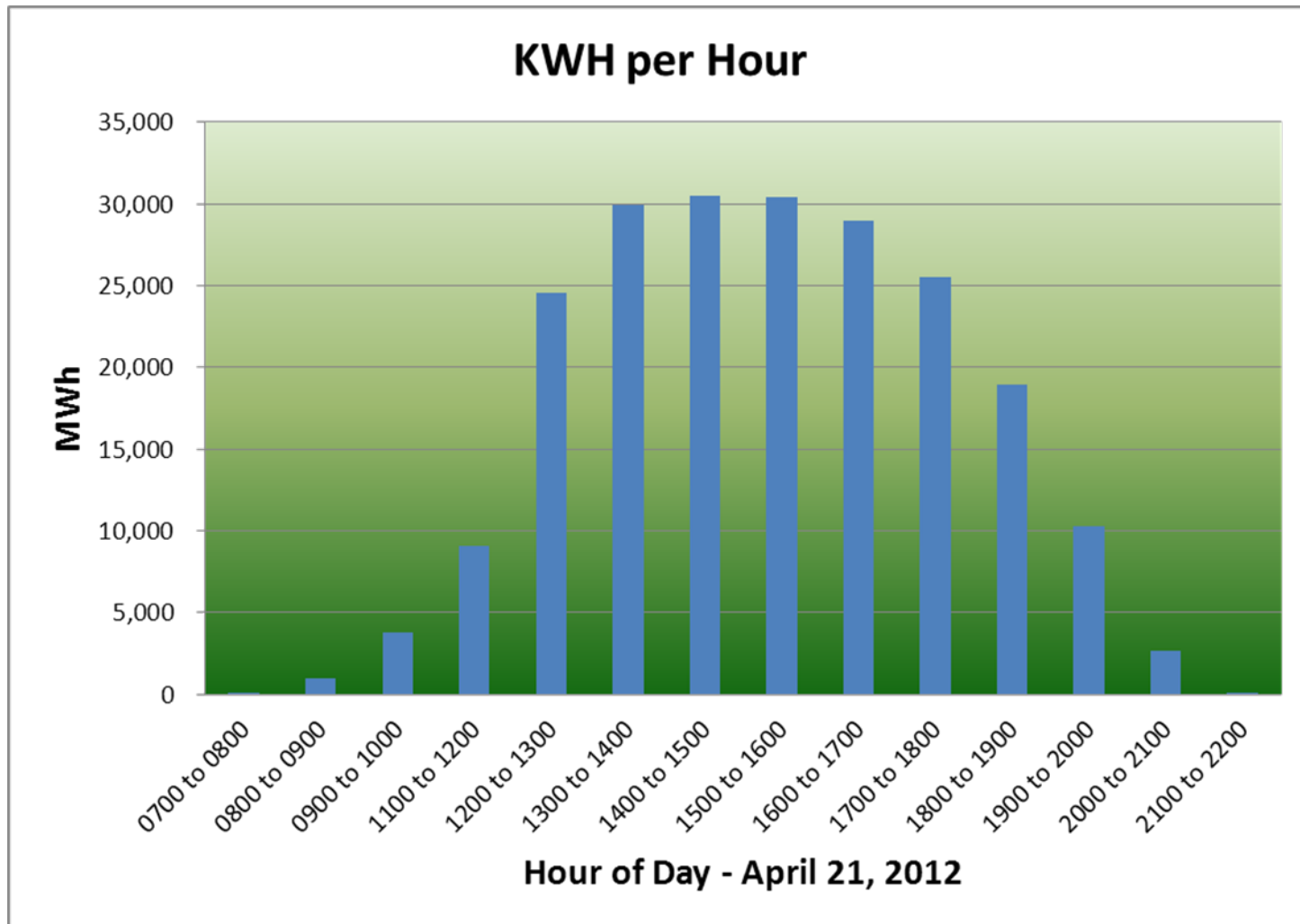
3/27/2012 7:05:00 PM	249916
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3/27/2012 7:35:00 PM	249923
3/27/2012 7:40:00 PM	249923
3/27/2012 7:45:00 PM	249923
3/27/2012 7:50:00 PM	249923
3/27/2012 7:55:00 PM	249923
3/27/2012 8:00:00 PM	249923



# How Did the LISF Perform Throughout the Day



# A Little Further into the 2012



# Monthly Generation to Date

Month	Actual MWh delivered	Monthly Capacity Factor	Original Modeled MWh
11-Dec	3,008	12.60%	2,096
12-Jan	3,435	14.40%	2,833
12-Feb	4,056	18.20%	4,868
12-Mar	4,837	20.30%	4,259

# Details of BNL R&D Data Collection

- A suite of advanced research instruments will be installed in the LISF plant
- BNL worked with BP Solar to incorporate instrumentation into the array
- Data obtained at high sample rates for research purposes
  - ▶ Solar Resource Data: sample rates up to 1 per second
  - ▶ Meteorological Data: sample rates up to 1 per second
  - ▶ Power Quality Data: sample rates up to 512 per cycle
  - ▶ All data is time synchronized



# Details of BNL R&D Data Collection

## ■ 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



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



Total Sky Imager



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

## ■ Electrical Performance Data

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



Power Quality Monitor

# The Next Step in R&D

- **BNL is exploring the development of a Northeast Solar Energy Research Center (NSERC)**
  - ▶ Supplement research using the LISF array
  - ▶ Dedicated research array for field testing
  - ▶ Laboratory space for standardized testing
- **NSERC Research would enable research in various other areas of interest to the solar industry**
  - ▶ Testing under actual Northeast conditions
  - ▶ Technology development test bed
- **BNL is working to obtain stakeholder input for the development of NSERC**
  - ▶ Identify key research issues
  - ▶ Discuss research and testing interests for NSERC
  - ▶ Determine capabilities to include