Company Owned Solar - Phase II

MA TSRG Regular Meeting – 9/17/14

Justin Woodard PE

Introduction - Phase I Solar

- Received pre-approval from Department of Public Utilities (DPU) in 2009 as authorized by the Green Communities Act in 2008.
- Five separate sites for a total of approximately five megawatts of solar generation.
  - Dorchester 1250kW
  - Everett 605kW
  - Haverhill 1016 kW
  - Revere 750 kW
  - Sutton 983 kW
- Environmental Remediation – Solar on limited use land

Introduction - Phase I Solar

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- Currently National Grid owns 5 MW's of Solar (Phase I)
  - Additional Site Information : https://www.nationalgridus.com/masselectric/solar/

Waltham – 225 kW

Sutton – 983 kW

Everett – 605 kW

Revere – 750 kW

Dorchester – 1250 kW

Haverhill – 1016 kW

Company's Solar Phase II Proposal

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- On 12/31/2013 National Grid submitted plans to the Massachusetts Department of Public Utilities (DPU) for approval to build, own and operate an additional 20 megawatts (MW) of new solar generation with advanced inverter functionality within targeted towns in the state
- Integrate vs. Interconnect
- On June 28, 2014 the DPU responded with a favorable order

Why is National Grid doing Phase II ?

- Since 2009, National Grid has interconnected over 200 MW of third party-owned solar generation facilities within its service territory.
- National Grid is looking to interconnect a greater number of projects with higher benefits to customers, developers and the electric distribution system, especially given the Commonwealth's goal of 1,600 MW of solar by 2020, set by Governor Deval Patrick.
- National Grid's goal is to use these sites, to further solar development in the commonwealth through advanced technologies.
- Installing solar generation in pre-selected areas will enable the company to experiment with new tools and unlock technical challenges. National Grid will share findings with the entire energy community, assisting toward the Commonwealth's clean energy goals.

Pre-Selected Towns

The Pre-Selected Cities and Town were selected for one of three reasons:

- Areas with High PV Penetration
- Lightly Loaded Feeders
- Heavily Loaded Feeders

- Example application on selected feeder
  - Capacity relief
  - Voltage regulation
  - Coordination

Pre-Selected Towns

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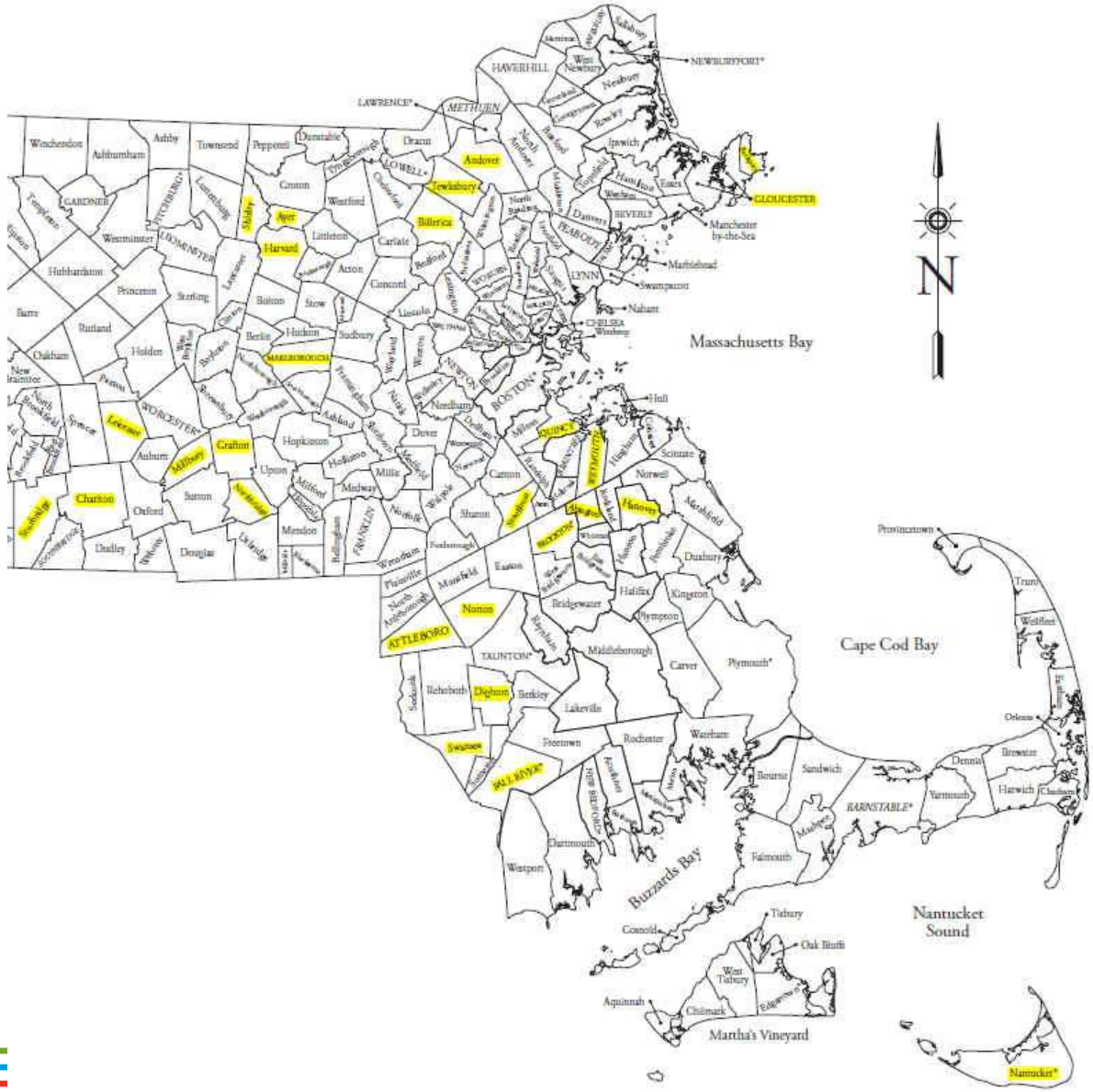
Abington
Andover
Attleboro
Ayer
Billerica
Brockton
Charlton
Dighton
Fall River
Grafton
Gloucester
Hanover
Harvard
Leicester
Marlborough
Millbury
Nantucket
Northbridge
Norton
Quincy
Rockport
Shirley
Stoughton
Sturbridge
Swansea
Tewksbury
Weymouth



Advanced Functionalities

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Functionality	Modes	Description
Active Power Control	Real Power Curtailment	Ability to limit the active power production of the PV site to a value below its potential
Active Power Control	Ramp Rate Control	Ability to limit the rate of change in magnitude of active power supplied
Reactive Power Control	Fixed Power Factor: Pffixed	Ability to maintain a power factor at the PV site's PCC by changing reactive power injection
Reactive Power Control	Fixed Reactive Set-point: Qfixed	Ability to inject a fixed amount of reactive power (percentage of nameplate) at the PCC
Reactive Power Control	Power factor compensation - Power factor/active power characteristic curve PF(P)	Ability to establish a Power Factor level at the PCC based on actual Active Power production
Reactive Power Control	Voltage Compensation - Reactive power/voltage characteristic curve Q(U)	Ability to inject Reactive Power at the PCC based on actual Voltage level
Reactive Power Control	Voltage Regulation – closed loop regulation of the voltage Ramp Rate Control	Ability to establish a Voltage level at the PCC by injecting Reactive Power. Ability to limit the rate of change in magnitude of reactive power supplied
Frequency Droop Response	Real Power Curtailment	Ability to curtail Active Power during higher than normal frequency at the PCC
Low Voltage Ride Through ("LVRT") & High Voltage Ride Through ("HVRT")	Ride Through or Modulated Power Output	Ability to configure the tripping of the PV site during Under and Over Voltage events at the PCC (beyond what UL1741 specifies)
Frequency Ride Through ("FRT")	Ride Through or Modulated Power Output	Ability to configure the tripping of the PV site during Under and Over Frequency events at the PCC (beyond what UL1741 specifies)

Advanced technologies

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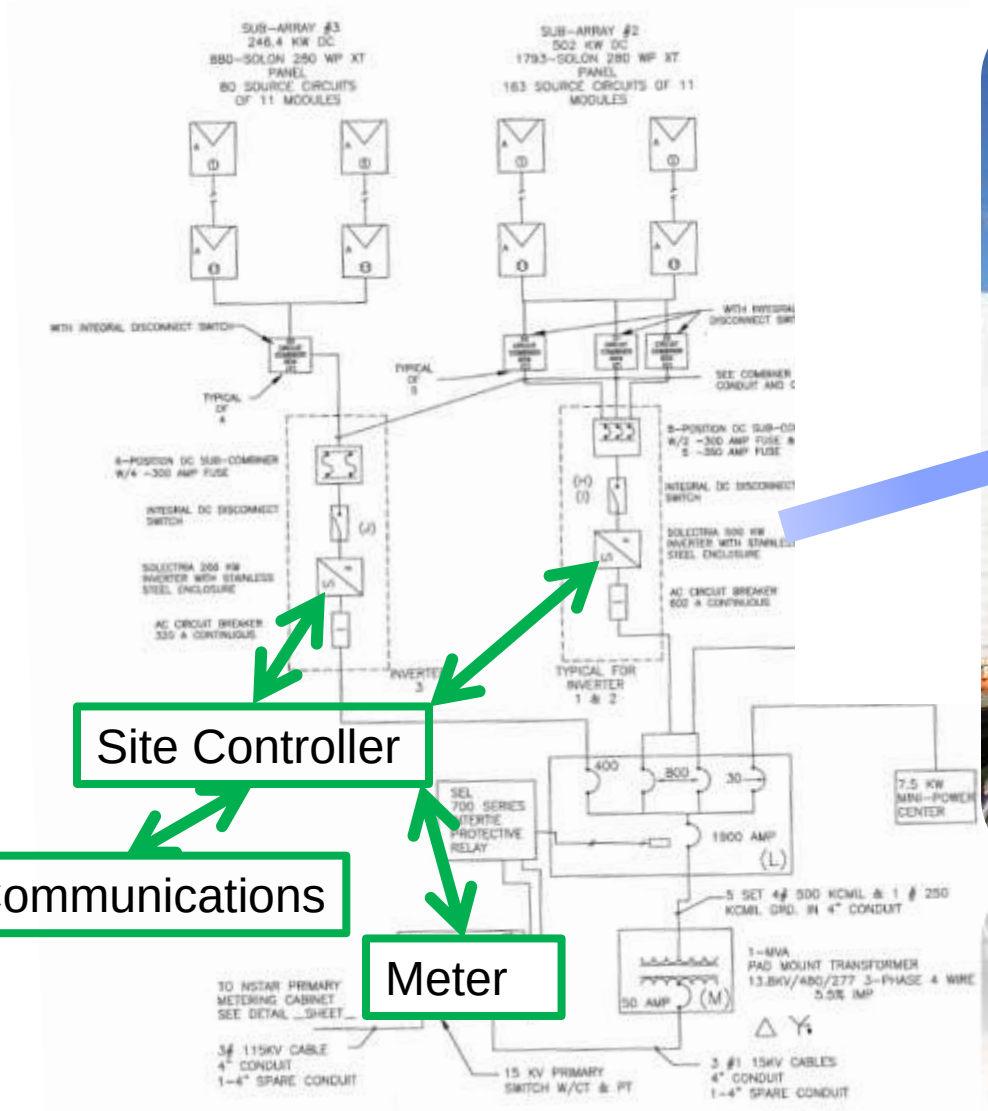

TSRG Involvement

- National Grid will be drafting the testing protocols, we would like to ask the TSRG to review and recommend any improvements for maximizing the potential benefits
- National Grid would like to present the results of the Company's analysis performed under its Solar Phase II program to the TSRG and other Massachusetts electric distribution companies at a future meeting of the TSRG.

Questions

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