Solar and Storage Industries Perspectives on Storage

NY Interconnection Technical Working Group

9/27/17

Overall Approach – Aggregating Nameplate Technical History in NY and Future Applicability to Solar + Storage

Precedent for Use of Nameplate Capacity

- It is the view of the solar and storage industries that the existing NY Public Service Commission rulings concerning the use of nameplate capacity are unlikely to present a substantive barrier for adopting the use of operating characteristics for studying non-NEM solar plus storage and storage projects going forward

Indication of PSC Willingness to Revisit Issue

- "Moreover, while the eligibility of storage paired with generation for Value Stack compensation has been approved, it is clear that a number of issues remain that need to be addressed before Value Stack compensation for projects that include storage can be effectively implemented. These include establishing the appropriate mechanisms in the SIR for the treatment of such projects in the interconnection process, defining necessary technical performance and protection requirements, and **determining the appropriate method for identifying the nameplate capacity of a system that combines generation and storage for interconnection and compensation purposes.**"

Indication of PSC Willingness to Revisit Issue

- "Staff is therefore directed to work with NYSERDA, utilities, developers, and other interested stakeholders, through the Interconnection Policy Working Group, the Interconnection Technical Working Group, and other forums to develop a proposal for integrating storage into the interconnection process, which should include consideration of the technical and procedural issues raised by the utilities' compensation options. Staff shall file proposed changes to the SIR and related recommendations by December 20, 2017 for public review and comment followed by Commission consideration." (p. 40-41)

  CASE 15-E-0751 - In the Matter of the Value of Distributed Energy Resources, *Order on Phase One Value of Distributed Energy Resources Implementation Proposals, Cost Mitigation Issues, and Related Matters,* Issued and Effective: September 14, 2017

Precedent for Use of Nameplate Capacity

The underlying case of Boxler included three lines of reasoning for use of nameplate versus operational capacity:

1. The actual output of the facility might exceed the then current NEM limit of 500 kW for farm systems
2. The fault current of the system would be determined by the full nameplate capacity
3. The system will not be adequately monitored and able to report compliance with operating limits versus nameplate capacity compared to large (80 MW) facilities

Precedent for Use of Nameplate Capacity: Ability to Exceed Operating Characteristics

- "Boxler is incorrect in contending that its facility cannot generate 570 kW; the generator will produce the output that is indicated on its nameplate if driven with sufficient energy. The other components of the generator facility are capable of producing the requisite energy. Unlike the 570 kW nameplate rating of the generator, the 500 kW estimated rating of the gas turbine engine driving Boxler's generator is only approximate. Like any gas-fired turbine, that engine is capable of exceeding its estimated rating under certain circumstances, and Boxler's waste digester is capable of producing enough fuel to push the turbine's output well over 500 kW." (p. 9)

Precedent for Use of Nameplate Capacity: Fault Current Contribution

- "Moreover, because a generator will contribute its full fault current to the electric system in the event of an electrical fault, the nameplate rating is a vital factor in determining the impact the generating facility has on the safety and reliability of the overall electric system. For this reason, each CESIR properly depends upon an electrical fault current calculation using the nameplate value of the generator itself in order to fully understand the potential impacts on the electrical system. " (p. 9)

  CASE 09-E-0608 – Complaint of Boxler Dairy Farm Regarding the Costs of Interconnecting a Net Metered Farm Waste Generator. *"Order Denying Complaint and Making Other Findings",* (Issued and Effective April 16, 2010)

Precedent for Use of Nameplate Capacity: Validation and Verification

- "If a new affiliate of NRG Energy, Inc. makes a legally binding commitment in the required air emissions permit and certificate of public convenience and necessity that the generating unit will not be operated at a total net generating capacity of 80 MW or more (including a commitment to install all practicable measures for recording compliance with such output limitation and reporting of monitoring data to the New York State Department of Public Service at regular intervals), the generating facility so constructed will not be a major electric generating facility under Article X of the Public Service Law."(p. 9-10)

  CASE 01-F-0222 – Petition of NRG Energy, Inc. for a Declaratory Ruling That the 79.9 MW Stand-Alone Simple Cycle Gas Turbine Peaking Unit Proposed to be Installed by NRG Energy, Inc. Will Not Constitute a Major Electric Generating Facility Under Article X of the New York Public Service Law. *"Declaratory Ruling Concerning Facility Proposed By an Affiliate of Existing Facility Owner"*, (Issued and Effective June 20, 2001)

Precedent for Use of Nameplate Capacity: VDER vs NEM

- “PSL §66-j expressly limits the facilities eligible for net metering to a size of no more than 500 kW. Allowing Boxler to install a generator sized at 570 kW does not comply with the statute. Moreover, treating a 570 kW machine as if it were sized at 500 kW could adversely affect the reliability of the electric system. Therefore, Boxler cannot obtain net metering under PSL §66-j if it installs a 570 kW generator.” (p. 11)

CASE 09-E-0608 – Complaint of Boxler Dairy Farm Regarding the Costs of Interconnecting a Net Metered Farm Waste Generator. *“Order Denying Complaint and Making Other Findings”,* (Issued and Effective April 16, 2010)

Rationale for a Different Approach Here

- Solar + Storage and Storage Only are different technologies that can easily be limited to the planned maximum output.
- The fault current issue can be straightforwardly dealt with (see next slide)
- Projects will now be under VDER and not NEM
- Larger facilities today and most going forward will be monitored by the utility as well as the operator
- Thus, an operating characteristics approach instead of nameplate aggregation can and should be used.

Addressing Fault Current in Short Circuit Studies

- During faulted conditions, a generating facility may contribute its full short circuit capability for a short time, regardless of relaying or control schemes that limited steady state power flow.
- During the interconnection process, the applicant should be required to submit the "Maximum Fault Current," which may correspond to the aggregate nameplates of the generating units.
- Utilities should use the Maximum Fault Current for short circuit studies, while using the net export for load flow studies.
- For solar-plus-storage, both resources are inverter-interfaced, so Max Fault Current will likely be limited to ~1.25-1.4pu.
- Additional overcurrent schemes may be used to interrupt fault current if short circuit studies result in significant upgrades (e.g. instantaneous relaying)

Precedent in Other Jurisdictions

- In addition to the above analysis, there is also significant precedent in other jurisdictions that interconnection rules should be based on DER and storage operating characteristics instead of aggregated nameplates

- Examples include CA, HI, CO, NV and FERC

Operating Characteristics

California and Hawaii study the maximum level of power that may be exported.

2.7 The maximum level of power that may be exported by the Generating Facility to PG&E's Electric System is expected to be:

2.7.1 Eligible Generator(s):

biomass	_____kW	digester gas	_____kW
solar thermal	_____kW	municipal solid waste	_____kW
photovoltaic	_____kW	landfill gas	_____kW
wind	_____kW	ocean wave	_____kW
geothermal	_____kW	ocean thermal	_____kW
fuel cell	_____kW	tidal current	_____kW
small hydroelectric generation _____kW		Storage/Batteries _____amp hours _____ inverter kWh	

2.7.2 Non-Eligible Generator(s): _____ kW

2.7.3 **Total maximum level of power** that may be exported by the Generating Facility: _____ kW

PG&E Generation Facility Interconnection Agreement

Section 2, Generator Qualifications

Is the generator a Qualifying Facility as defined under Subpart B, Section 201 of the Federal Energy Regulatory Commission's regulations per the Public Utility Regulatory Policies Act of 1978, or the PUC's Standards for Small Power Production and Cogeneration (Hawaii Administrative Rules Title 6, Chapter 74)? ☐ Yes ☐ No

Is Generator powered from a Nonfossil Fuel Source? ☐ Yes ☐ No

Type of Qualifying Facility or Nonfossil Fuel Source (if applicable): ☐ Solar ☐ Wind ☐ Hydro ☐ Biomass ☐ Geothermal

Other generator energy source: ☐ Diesel ☐ Other Fuel Oil ☐ Other: _____

PV Array DC Rated Output: _____ kW PV Array AC Rated Output: _____ kW (CEC-CSI)[2]

Maximum Site Load without Generation: _____ kW Maximum Generator Capability: _____ kW

Minimum Site Load without Generation: _____ kW Maximum Export: _____ kW

HECO Interconnection Application

Operating Characteristics

Xcel Energy does not simply aggregate nameplates

"Less than full nameplate will be considered if the added source is limited by programing or onsite."

"Interconnections are reviewed based on the combined nameplate ratings of the sources that can actually be simultaneously supplied to the grid, such as two inverters. The ongoing operation capacity portion of the review is based on the actual simultaneous performance AC ratings. If the contribution of the energy storage to the total contribution is limited by programing or by some other on-site limiting element, the reduced ongoing capacity will be used."

Guidance No. 2 for Interconnection of Energy Storage Systems Operated in Front of a Production Meter and Paired with Onsite Renewable Generation Connected Under a Net Metering Tariff. Xcel Energy. January 25th, 2017.

Operating Characteristics

NV Energy does not plan to simply aggregate nameplates

"**Net Nameplate Rating:** The gross generating capacity of a Generating Unit or the total of the gross generating capacity of the Generating Units comprising a Generating Facility as designated by the manufacturer(s) of the Generating Unit(s) minus the consumption of electrical power of the Generating Unit(s). *Where the gross generating capacity of a Generating Unit or Units is limited (e.g., through the use of a control system, power relay(s), or other similar device settings or adjustments), the Net Nameplate Rating shall be the maximum specified by the Applicant in the Application.* The Net Nameplate Rating will subsequently be contained in the net metering agreement or Interconnection and Operating Agreement." (Emphasis Added.)

Rule 15 Advice Letter to the Public Utilities Commission of Nevada. NV Energy. June 9th, 2017.

Operating Characteristics

FERC allows to not simply aggregate nameplates

"Under section 4.10.3 adopted herein, the Transmission Provider is to measure the capacity of a Small Generating Facility based on the capacity specified in the interconnection request, which may be less than the maximum capacity that a device is capable of injecting into the Transmission Provider's system, provided that the Transmission Provider agrees, with such agreement not to be unreasonably withheld, that the manner in which the Interconnection Customer proposes to limit the maximum capacity that its facility is capable of injecting into the Transmission Provider's system will not adversely affect the safety and reliability of the Transmission Provider's system. For example, an Interconnection Customer with a combined resource may propose a control system, power relays, or both for the purpose of limiting its maximum injection amount into the Transmission Provider's system." (Emphasis Added.)

Page 125 of Order 792 in Docket RM13-2-000 issued on November 22, 2013.

Resulting Recommendation

- As will talk about in "Solutions Controlling System Export, Functionality & Operations" section later, we thus propose an operating characteristics approach along the following lines:

  - For large stand-alone projects (i.e > 100kW max export): Integrated control scheme + utility grade directional relay
  - For BTM and smaller projects (i.e. < 100kW max export): Integrated control scheme only*

*NOTE: Additional considerations may be necessary for:
- Projects with low max export and high aggregate generator rating
- Projects that deploy load-following schemes

Understanding the Role of Use Cases - Analysis and Exploration of Their Reduction to Few Study Components and Rules

Use Cases to Date

- In the July 18, 2017 NY IPWG meeting, the JU shared three categories of use cases for storage:
  - Where storage with or without solar exists with building load
  - Where storage+solar is standalone
  - Where storage only is standalone

- Within each category, they provided several examples of the different ways the the technologies could be planned to be used.

- As illustrated on the next slides, all of these examples break down to just a few key study parameters - max export/non-export, max load/non-load, ramp rate, and fault current

Reduction to Key Study Parameters

Use Cases With Building Load

Example Use Cases Presented	Max Export/Non-Export	Max Load/Non-Load	Ramp Rate	Fault Current
Behind the meter storage coupled with DG system and storage charged with DG and net generation no higher than DG application	Max Export Studied	Non-Load	Max set by operating characteristics	Only parameter studied as aggregate of equipment nameplates
Behind the meter storage coupled with DG system and storage not limited to being charged by DG	Max Export Studied	Max Load Studied	Max set by operating characteristics	Only parameter studied as aggregate of equipment nameplates
Behind the meter stand alone with no increase in demand (off peak charging) and no net generation (or controls included so no export)	Non-Export	Max Load Studied	Max set by operating characteristics	Only parameter studied as aggregate of equipment nameplates
Behind the meter stand alone with increase in demand or net generator (export)	Max Export Studied	Max Load Studied	Max set by operating characteristics	Only parameter studied as aggregate of equipment nameplates

Reduction to Key Study Parameters

Standalone Storage and DER

Example Use Cases Presented	Max Export/Non-Export	Max Load/Non-Load	Ramp Rate	Fault Current
Never acts a load (charged exclusively from the DG system) and net generation no higher than DG application	Max Export Studied	Non-Load	Max set by operating characteristics	Only parameter studied as aggregate of equipment nameplates
Storage system does or can act as a load (charged by the distribution system) - Only charged during non-peak hours and no limitation on charging	Max Export Studied	Max Load Studied	Max set by operating characteristics	Only parameter studied as aggregate of equipment nameplates

Reduction to Key Study Parameters

Standalone Storage

Example Use Cases Presented	Max Export/Non-Export	Max Load/Non-Load	Ramp Rate	Fault Current
System not coupled with existing customer load or DG system. System acts as both a load and a generator as seen by the distribution system	Max Export Studied	Max Load Studied	Max set by operating characteristics	Only parameter studied as aggregate of equipment nameplates
Commercial installation with small load and large storage system. Potential for large export due to storage. Can effectively be viewed as a stand alone system.	Max Export Studied	Max Load Studied	Max set by operating characteristics	Only parameter studied as aggregate of equipment nameplates

Solutions for Controlling System Export, Functionality & Operations

Proposed Solution

- As introduced above, we propose an operating characteristics approach along the following lines:

Export

- For large stand-alone projects (i.e > 100kW max export): Integrated control scheme + utility grade directional relay
- For BTM and smaller projects (i.e. < 100kW max export): Integrated control scheme only*

*NOTE: Additional considerations may be necessary for:
- Projects with low max export and high aggregate generator rating
- Projects that deploy load-following schemes

- For the BTM and smaller projects solution, there are several states mentioned above where integrated control schemes are relied on for a wide-range of project sizes. We are open to different approaches for ensuring these schemes adhering to certain standards or other backstops.

Load

- The system acting as a load should be controlled just like max export and studied at that planned level