DATE: April 12, 2019

TO: Jason Pause, Electric Distribution Systems,
Office of Electric, Gas & Water
Department of Public Service
3 Empire State Plaza, Albany, NY 12223

FROM: Joint Utilities of New York – Interconnection Technical Working Group

RE: 3/27/19 ITWG Meeting Follow-Ups – JU Description of Appendix K Changes

Pursuant to your request, here is the response from the Joint Utilities of New York ("JU") regarding modifications to Appendix K of the New York State Standardized Interconnection Requirements (NYS SIR). Included herein are the descriptions of changes to Appendix K as well as a clean version of a revised Appendix K. Appendix K as referenced in this document has been discussed at several ITWG meetings and was reviewed by all parties of the ITWG prior to including within the SIR. It is worth noting that some items within Appendix K will become more critical as DER penetration increases and systems look to optimize their operations to increase hosting capacity. The response reflects the position of all of the utilities identified on this letterhead, although it does not necessarily apply to network systems.

Description of Changes to Appendix K

As an overall comment on the document, per December 13, 2018 Order Establishing Energy Storage Goal and Deployment Policy (Case 18-E-0310) the following bulleted items are required for reporting under National Energy Storage Metrics:

- General description of system: Storage technology type deployed
- The contractor with primary responsibility for the installation
- Interconnection approval date
- Rated power and capacity in kW and kWh
- Location and primary use case(s) for the energy storage system
- Facility type where the energy storage system is installed

1. Application Requirements:

Requirement 1.a.

Provide a general overview / description and associated scope of work for the proposed project. Is the new ESS project associated with a new or existing DG facility?

Modification: No Change proposed.

What is this information used for?

A general overview and scope for the project provides clarity to the scope and intent of the proposed project. This free form question allows the applicant to provide description of specific application or characteristics of the system that may lend to the utilities improved capabilities of project review which can lead to shorter review time and require less back and forth type communication for information clarification.

Requirement 1.b.

Identify whether this is a stand-alone or hybrid ESS proposal, or a change to the operating characteristics of an existing system. If hybrid, please select your hybrid configuration option:

1. Hybrid Option A - ESS is charged exclusively by the DG
2. Hybrid Option B - ESS will not export to the grid, only DG will.
3. Hybrid Option C - ESS may charge/discharge unrestricted, but grid consumption by ESS is netted out of grid exports
4. Hybrid Option D - ESS may charge/discharge unrestricted, but any consumption on the account is netted out of grid exports
5. N/A - not Value Stack

Modification: Added hybrid option selections in alignment with the recent storage order.

What is this information used for?

This is required to understand the applicants proposed system configuration to ensure metering and control schemes are designed to meet tariff and billing requirements based on proposed operating characteristics. The data facilitates modeling the charging and discharging impacts to the ESS and may prevent costly upgrades by narrowing the scope of the applicant's project and intent.

Requirement 1.c.
Indicate whether the ES and DG system inverter(s)/converter(s) are DC-coupled or AC-coupled.

1. AC Coupled Systems
    i. DG inverter rating (kW)
    ii. Storage inverter rating (kW)
    iii. Storage capacity (kWh)
2. DC Coupled Systems
    i. DG system size (kW)
    ii. Storage system size (kW)
    iii. Storage capacity (kWh)
    iv. PV + ESS inverter rating (kW)

Modification: Relocated previous requirement "m" and consolidated information asked elsewhere within the document.

What is this information used for?

Data requests for kW values are needed to perform the study.

The kWh values are necessary to understand the duration of the charge and discharge cycles. Furthermore, this is part of the operating characteristics necessary to review to understand how charge and discharge times may interface with existing load, generation and energy storage systems on the feeder and substation. It may also improve planning and forecasting to improve future hosting capacity. Finally, kW and kWh values for all energy storage systems are required for reporting purposes per Case 18-E-0310.

Requirement 1.d. (previous g)
Provide specification data/rating sheets for both the AC and/or DC components including the manufacturer, model, and nameplate ratings (kW) of the inverter(s)/converters(s) and controllers for the energy storage and/or DG system, and capacity, of ESS unit(s) (kWh).

Modification: Edited to require both AC and DC components. Merged ESS data request with this and deleted previous item f requesting such.

What is this information used for?

Data sheets allow for confirmation of information and may provide additional useful information which may improve the ability to understand features, functions or performance.

Requirement 1.e. (previous c)
Indicate the type of energy storage (ES) technology to be used. For example, NaS, dry cell, PB-acid, Li-ion, vanadium flow, etc.

Modification: No Change proposed.

What is this information used for?

This information helps determine the system capabilities and potential further restrictions or hazards.

Requirement 1.f. (previous d)
~~Indicate how the ESS will be charged and/or act as a load: (1) electrical grid only, (2) unrestricted charging from electrical grid and/or DG system, (3) restricted charging from electrical grid and/or DG systems, or (4) charging from DG only.~~

Modification: Recommended for removal as this is covered in requirement 1.b and elsewhere.

Requirement 1.g.
Submit control schemes, electrical configurations and sufficient detail for the utility to review and confirm acceptance of proposal.

Modification: Recommend moving requirement 1.g. into requirement 2.i.

What is this information used for?

Rationale provided under updated 2.i.

Requirement 1.h.
If the intended use case for the ESS includes behind-the-meter backup services, please provide a description and documentation illustrating how the entire system disconnects from utility during an outage (e.g. mechanical or electronic, coordination, etc.).

Modification: No Change proposed.

What is this information used for?

Data used to evaluate generation transfer to determine approved use case as backup generation or other as well as to ensure applicable standards requirements for functionality and safety of the system.

Requirement 1.i.
~~Indicate any impacts of ambient temperatures on charging and discharging capabilities, specifically noting any restrictions on available capacity as a function of temperature and listed on the system facility's nameplate.~~

Modification: Recommended for removal as this is covered in requirement 1.b and elsewhere.

Requirement 1.j.
Provide details on cycling (anticipated maximum cycles before replacement), depth of discharge restrictions, and overall expected lifetime regarding the energy storage components.

Modification: No Change proposed.

What is this information used for?

This data impacts modeling the charging and discharging impacts of the ESS. The frequency of charge/discharge cycles and the depth of discharge limitations are important considerations for voltage regulation issues. This information is also helpful in separating the maximum battery life from the expected, or average battery life based on the projects intended operations. Additionally, understanding the life expectancy of the battery enables utilities to perform more accurate planning studies as well as operate the distribution system.

Requirement 1.k.
Provide proposed inverter(s) power factor operating range and whether inverter(s) are single quadrant, two-quadrant, or four-quadrant operation.

Modification: No Change proposed.

What is this information used for?

This data impacts modeling the charging and discharging impacts of the ESS, potential meter scheme requirements. Additionally, understanding inverter power factor operating ranges provides utilities with the ability to use these features as lower cost mitigation options during impact studies.

~~**Requirement 1.l.**~~

~~Identify if inverter analytical models are available for use in the utility's power flow analysis program, and if there are any restrictions on their use.~~

~~**Modification:** New request for inverter analytical models developed for use in standard power flow and fault analysis software if available.~~

~~*What is this information used for?*~~

~~This data impacts modeling the charging and discharging impacts of the ESS.~~

Requirement 1.m.
Provide details on whether the inverter(s)/converter(s) have any intrinsic grid support functions, such as autonomous or interactive voltage and frequency support. If they do, please describe these functions and default settings.

Modification: Recommend merging as a subset to follow up on requirement 1.n.

Requirement 1.n.
Indicate whether the interconnected inverters inverter(s)/converter(s) is/are compliant to the latest versions of the following additional standards. If partially compliant to subsections of the latest standards, please list those subsections:

1. IEEE 1547-2018
2. UL 1741 and its supplement SA
3. SunSpec Common Smart Inverter Profile (CSIP) v2.103-15-2018

Where not classified as compliant with any of the above, provide details on whether the inverter(s)/converter(s) have any intrinsic grid support functions, such as autonomous or interactive voltage and frequency support. If they do, please describe these functions and default settings.

Modification: Updated IEEE reference to reflect current applicable addition. Added CSIP requirement for standards gap coverage.

What is this information used for?

This data will ease the review process for projects compliant with IEEE 1547-2018 and UL-1741. It also allows for better understanding of equipment capabilities for potential future planning use cases or project needs. The CSIP requirements are relevant and harmonizes UL 1741 SA as well as parts of IEEE 1547-2018. Eventually, this will be absorbed into IEEE 1547, but will take years. In the interim it is important to know if systems are certified under CSIP 2.1.

Requirement 1.o.

~~Detail any integrated protection that is included in the interconnected inverter(s)/converters. For example, describing over/under-voltage/current frequency behavior and reconnection behavior would comply, such as solid-state transfer switching or other.~~

Modification: Recommended for removal of this requirement as a protection question as non-type-tested functions in inverter equipment would not be recognized for protective function requirements. The word “protection” is replaced with “control schemes” and merged with the requirement 2.f.

Previous requirement 1.n.

Requirement “n” main statement, sub sections 1, 2, and 3 recommended for deletion. These segment items describe the requirement for inverters to be certified and reference the “PSC list”. Suitable practice has been established and elsewhere in the SIR this is covered.

2. System Operating Characteristics:

Previous requirement a

Modification: Moved this request to Application Requirements segment

Requirement 2.a. (previous b)
List the system's maximum net export and import in kW AC, including any equipment loads (i.e. HVAC)

Modification: Added the requirement to disclose any equipment loads such as heating or cooling. Also, some editorial changes.

What is this information used for?

This information is required to determine and study the ancillary load level that can occur at any time and to set up metering and control schemes to accommodate the load.

Requirement 2.b. (previous c)
Indicate desired ramp rates in kW/second during charging and discharging (worst case will be assumed if not provided). Please attach a charge and discharge data/curve.

Modification: Edited language to request this setting from the applicant as well as performance data. Added a unit value for this information. Added statement that the worse-case performance setting of the ESS will be utilized if other value not proposed.

What is this information used for?

Gaining desired or intended settings allows for more realistic modeling and approximation. Without this information or ability to define such information, worse case impacts would be assumed. For example, some inverters/converters may not be symmetric; requesting if the charger/inverter ramp rates are symmetric or not will impact the modeling assumptions used, and if not provided, worst case impacts would be assumed.

Requirement 2.c.
Is the ESS symmetrical or asymmetrical (e.g. charge magnitude equivalent to discharge magnitude)? Please also specify the full range of power factor capabilities in the context of the expected 2-quadrant or 4-quadrant operation.

Modification: This is a new request. This requires detail information on the charge and discharge performance as well as the real and reactive power operational capabilities of the ESS.

What is this information used for?

Gaining desired or intended settings allows for more realistic modeling and approximation. Without this information or ability to define such information, worse case impacts would be assumed. Understanding if the system is 2-quadrant or 4-quandrant is important if systems intend to provide grid support services. Furthermore, if systems are certifying that they have a 4-quadrant system, it will be critical to know the "exclusion areas" where the system cannot perform, otherwise worst case impacts would be assumed.

Requirement 2.d. (previous d)
Indicate the maximum frequency of change in operating modes (i.e. charging to discharging and vice-versa) that will be allowed based upon control system configurations and associated maximum potential change in power magnitude expressed in equipment limitations such as times per second, minute, hour, or day and kW or % of kW as applicable.

Modification: Edited language to clarify intent. Operational characteristics such as rate of charging and discharging events and maximum power swings are of interest to the utility when modeling these systems.

What is this information used for?

Gaining desired or intended settings allows for more realistic modeling and approximation. Without this information or ability to define such information, worst case impacts would be assumed. The modelling assumptions are also highly dependent on use case. For example, frequency response (FR) participation could require systems charging/discharging rapidly and swinging between generation and demand in a matter of seconds. Another mode, if approved to help mitigate generation impacts, could require the charger/inverter to perform generation smoothing of intermittent PV or wind generation.

Requirement 2.e. (previous e)
Indicate any specific operational limitations that will be imposed (e.g. will not charge between 2-7pm on weekdays). Charge/discharge at any time (24-hour) will be assumed if not provided.

Modification: Added statement that worse case period will be utilized absent any operational limitations.

What is this information used for?

Gaining desired or intended settings allows for more realistic modeling and approximation. Without this information or ability to define such information, worst case impacts would be assumed.

Requirement 2.f.
Provide a summary of protection and control scheme functionality and provide details of any integrated protection of control schematics and default settings within controllers.

Modification: No Change proposed.

What is this information used for?

Gaining desired or intended settings allows for more realistic modeling and approximation. Without this information or ability to define such information, worst case impacts would be assumed.

Requirement 2.g.

Is the system expected to participate in multiple use cases as part of dual-participation or a non-wires alternative agreement? If so, will the inverter be capable of directly supporting simultaneous modes as well as receiving "ad-hoc" commands?

Modification: New request for description of systems with intent on participating in multiple use cases or programs.

What is this information used for?

The JU recommended updating the language in this screen to improve clarity. The JU suggest the following:

"Is the system expected to participate in multiple use cases as part of dual-participation or as part of multiple NWAs? If so, will the inverter be capable of directly supporting simultaneous modes as well as receiving "ad-hoc" commands?"

With respect to the screen, gaining desired or intended settings allows for more realistic modeling and approximation. Without this information or ability to define such information, worse case impacts would be assumed, and appropriate technical requirements or metering schemes cannot be established.

As an example, an ESS may have programmed a Volt-VAR curve that runs 100% of the time. Most likely this Volt-VAR capability would use the inverter terminals as the measurement setpoint for control. At some point an external system may want to use the ESS for capacity offset for peak shaving. We need to know if an external signal can come in and assign the ESS to alter its operations, while it uses the default volt/VAR curve, or if these "modes" are completely exclusive. Depending on the configuration, an expert system may need to manage the ESS mode before various use cases can be performed.

~~**Requirement 2.h.**~~

~~List any available inverter ride-through capabilities on grid-island and island-grid transfers. Provide system description and design where multiple components are required or equipment data sheets for manufactured units identifying transfer method of unit (i.e. open, closed, static).~~

~~**Modification**: New request for identification of ride though capabilities and transfer capabilities.~~

~~*What is this information used for?*~~

~~The Joint Utilities recommend deleting this item.~~

Requirement 2.i. (previous part g)
Submit control schemes, electrical configurations, and sufficient detail for the utility to review and confirm acceptance of proposal. Detail any integrated control scheme(s) that are included in the interconnected inverter(s)/converters. For example, describing over/under-voltage/current frequency behavior and reconnection behavior would comply, such as solid-state transfer switching or other. Provide descriptions of any software functionality that enables intelligent charging and discharging of the ESS using interconnected DG, such as PV. For example, if the ESS can be charged only through the DG input, or if the ESS can be switched to be charged from the line input, provide those details in a sequence of operations. ~~Provide details on grounding of the interconnected energy storage and/or DG system to meet utility effective grounding requirements.~~

Modification: Clarified the need for control scheme submissions in addition to descriptions for review. Merged information from previous requirement 1.o. Recommend removal of the effective grounding component as this would be required through other utility standard practices dependent on system configurations, required to be displayed in the design package submission, and is not exclusive to ESS applications.

What is this information used for?

If this information is not provided, the study may be placed on hold, delaying interconnection.

Requirement 2.j.
Provide short circuit current capabilities and harmonic output from the hybrid project or stand-alone storage system.

Modification: No Change proposed.

What is this information used for?

This information is used for system impact modeling and verifying harmonic compliance according to IEEE 519.

Requirement 2.k.
Provide details on standard communication hardware interfaces that are available, e.g., TCP/IP, serial, etc.

Modification: No Change proposed.

What is this information used for?

This information is used to advance knowledge on potential communication protocols for monitoring and control or future use.

Requirement 2.l.
Provide details on standard communication protocols that are available, e.g., MODBUS, DNP-3, 2030.5, etc.

Modification: No Change proposed.

What is this information used for?

This information is used to advance knowledge on potential communication protocols for monitoring and control or future use.

Requirement 2.m. (previous k)

Provide details on standard communication data models that are available, e.g., 61850-90-7, SunSpec, MESA, 2030.5, OpenADR, etc

Modification: Added additional data model information.

What is this information used for?

This information is used to advance knowledge on potential communication protocols for monitoring and control or future use.

3. Market Participation:

Modified question "3.a." for added clarity.
Will the system operate in the NYISO markets? If yes, please specify which anticipated NYISO market(s).

What is this information used for?

Providing this information allows for proper review on the physical installation requirements and allows for proper metering scheme and SCADA reporting requirements. Not disclosing this information could result in significant project delays and inappropriate design requirements placed upon the applicant that could result in inability to participate in the desired market.

Expanded question "b" to gain further information to assist in modeling and performance evaluation of ESS based on expected performance and/or event triggers.

Will the system be compensated under a utility tariff(s)? If yes, please specify. Identify any associated use case stacking i.e. parallel standby, net meter, VDER, import only, export only, peak shaving, generator firming, demand response, PQ injection, Microgrid, reactive power control etc.

What is this information used for?

Providing this information allows for the technical review to be performed, allows for proper review on the physical installation requirements and allows for proper metering scheme requirements. Without selecting this information, a project may not be processed in a manner that includes all possibilities or desired customer revenue outcomes. This could result in significant project delays and inappropriate design requirements placed upon the applicant.

APPENDIX K

Energy Storage System (ESS) Application Requirements /
System Operating Characteristics / Market Participation

1. Application Requirements:

a. Provide a general overview / description and associated scope of work for the proposed project. Is the new ESS project associated with a new or existing DG facility?

b. Identify whether this is a stand-alone or hybrid ESS proposal, or a change to the operating characteristics of an existing system. If hybrid, please select your hybrid configuration option:

1. Hybrid Option A - ESS is charged exclusively by the DG
2. Hybrid Option B - ESS will not export to the grid, only DG will.
3. Hybrid Option C - ESS may charge/discharge unrestricted, but grid consumption by ESS is netted out of grid exports
4. Hybrid Option D - ESS may charge/discharge unrestricted, but any consumption on the account is netted out of grid exports
5. N/A - not Value Stack

c. Indicate whether the ES and DG system inverter(s)/converter(s) are DC-coupled or AC-coupled.

1. AC Coupled Systems
   i. DG inverter rating (kW)
   ii. Storage inverter rating (kW)
   iii. Storage capacity (kWh)
2. DC Coupled Systems
   i. DG system size (kW)
   ii. Storage system size (kW)
   iii. Storage capacity (kWh)
   iv. PV + ESS inverter rating (kW)

d. Provide specification data/rating sheets for both the AC and/or DC components including the manufacturer, model, and nameplate ratings (kW) of the inverter(s)/converters(s) and controllers for the energy storage and/or DG system, and capacity, of ESS unit(s) (kWh).

e. Indicate the type of energy storage (ES) technology to be used. For example, NaS, dry cell, PB-acid, Li-ion, vanadium flow, etc. ~~Provide data on operating and/or non-operating state of charge indicating energy level requirements relative to the capacity of the battery unit in percent capacity.~~

~~f. Indicate how the ESS will be charged and/or act as a load: (1) electrical grid only, (2) unrestricted charging from electrical grid and/or DG system, (3) restricted charging from electrical grid and/or DG systems, or (4) charging from DG only.~~

g. Submit control schemes, electrical configurations and sufficient detail for the utility to review and confirm acceptance of proposal.

h. If the intended use case for the ESS includes behind-the-meter backup services, please provide a description and documentation illustrating how the entire system disconnects from utility during an outage (e.g. mechanical or electronic, coordination, etc.).

~~i. Indicate any impacts of ambient temperatures on charging and discharging capabilities, specifically noting any restrictions on available capacity as a function of temperature and listed on the system facility's nameplate.~~

j. Provide details on cycling (anticipated maximum cycles before replacement), depth of discharge restrictions, and overall expected lifetime regarding the energy storage components.

k. Provide proposed inverter(s) power factor operating range and whether inverter(s) are single quadrant, two-quadrant, or four-quadrant operation.

~~l. Identify if inverter analytical models are available for use in the utility's power flow analysis program, and if there are any restrictions on their use.~~

m. Provide details on whether the inverter(s)/converter(s) have any intrinsic grid support functions, such as autonomous or interactive voltage and frequency support. If they do, please describe these functions and default settings.

n. Indicate whether the interconnected inverters inverter(s)/converter(s) is/are compliant to the latest versions of the following additional standards. If partially compliant to subsections of the latest standards, please list those subsections:

1. IEEE 1547-2018
2. UL 1741 and its supplement SA
3. SunSpec Common Smart Inverter Profile (CSIP) v2.103-15-2018

~~o. Detail any additional integrated protection that is included in the interconnected inverter(s)/converters, outside of standard UL 1741 requirements. For example, describing over/under-voltage/current frequency behavior and reconnection behavior would comply, such as solid-state transfer switching or other.~~

2. System Operating Characteristics:

a. List the system's maximum net export and import in kW AC, including any equipment loads (i.e. HVAC)

b. Indicate desired ramp rates in kW/second during charging and discharging (worst case will be assumed if not provided). Please attach a charge and discharge data/curve.

c. Is the ESS symmetrical or asymmetrical (e.g. charge magnitude equivalent to discharge magnitude)? Please also specify the full range of power factor capabilities in the context of the expected 2-quadrant or 4-quadrant operation.

d. Indicate the maximum frequency of change in operating modes (i.e. charging to discharging and vice-versa) that will be allowed based upon control system configurations and associated maximum potential change in power magnitude expressed in equipment limitations such as times per second, minute, hour, or day and kW or % of kW as applicable.

e. Indicate any specific operational limitations that will be imposed (e.g. will not charge between 2-7pm on weekdays). Charge/discharge at any time (24-hour) will be assumed if not provided.

f. Provide a summary of protection and control scheme functionality and provide details of any integrated protection of control schematics and default settings within controllers.

g. Is the system expected to participate in multiple use cases as part of dual-participation or another NWA? If so, will the inverter be capable of directly supporting simultaneous modes as well as receiving "ad-hoc" commands?

h. ~~List any available inverter ride-through capabilities on grid-island and island-grid transfers. Provide system description and design where multiple components are required or equipment data sheets for manufactured units identifying transfer method of unit (i.e. open, closed, static).~~

i. Submit control schemes, electrical configurations, and sufficient detail for the utility to review and confirm acceptance of proposal. Detail any integrated control scheme(s) that are included in the interconnected inverter(s)/converters. For example, describing over/under-voltage/current frequency behavior and reconnection behavior would comply, such as solid-state transfer switching or other. Provide descriptions of any software functionality that enables intelligent charging and discharging of the ESS using interconnected DG, such as PV. For example, if the ESS can be charged only through the DG input, or if the ESS can be switched to be charged from the line input, provide those details in a sequence of operations. ~~Provide details on grounding of the interconnected energy storage and/or DG system to meet utility effective grounding requirements.~~

j. Provide short circuit current capabilities and harmonic output from the hybrid project or stand-alone storage system.

k. Provide details on standard communication hardware interfaces that are available, e.g., TCP/IP, serial, etc.

l. Provide details on standard communication protocols that are available, e.g., MODBUS, DNP-3, 2030.5, etc.

m. Provide details on standard communication data models that are available, e.g., 61850-90-7, SunSpec, MESA, 2030.5, OpenADR, etc.

3. Market Participation:

a. Will the system operate in the NYISO markets? If yes, please specify which anticipated NYISO market(s).

b. Will the system be compensated under a utility tariff(s)? If yes, please specify. Identify any associated use case stacking i.e. parallel standby, net meter, VDER, import only, export only, peak shaving, generator firming, demand response, PQ injection, Microgrid, reactive power control etc.

Note: The market participation information is non-binding; however, the operating characteristics as defined above will be used for technical study.