Substation Transformer Backfeeding	Avangrid	Central Hudson Gas & Electric	Consolidated Edison	National Grid	Orange and Rockland
Common definition and criteria for neutral over-voltage protection.	Neutral over-voltage protection (commonly referred to as 3V0) is required where there is reverse power flow through substation power transformers from the distribution system as a result of having generation sources on the distribution system. This protection package is needed for substations comprised of delta-wye transformers that are radially fed or tapped from a single transmission source where Backfeeding is expected. Neutral overvoltage protection reduces prolonged over voltage from phase to ground faults on delta-wye connected transformers.				
Criteria and values to determine amount of allowable Backfeeding before neutral over-voltage protection is required (i.e. 3V0)	3V0 is rarely required; no specific threshold established	3V0 is rarely required; no specific threshold established	no specific threshold established	67% after N-1 contingency applied	3V0 is rarely required; no specific threshold established
What is the minimum daytime load time-frame used in your calculations?	10 AM – 6 PM	10 AM – 3 PM	11 AM - 2 PM	9 AM – 6 PM	8 AM – 3 PM
How is the minimum daytime load determined when actual transformer loading information is not available?	15% of the peak load	25% of peak load	30-40% peak load	25% of the peak load	Interval data available for all stations except: Summitville, Wurtsboro, and Pine Island, where toll grade readings allows calculations with <3% error.
What is the typical range of costs of 3V0 protection in your territory?	~ $225,000 - $400,000[123] 1. Some utilities have not executed field implementation to date. 2. Cost could run higher if a mobile transformer has to be installed to accommodate installation 3. 3V0 protection is at all Con Edison substations as part of normal substation design criteria. All Con Edison substations have multiple sources and thus must be protected against over-voltage conditions.				
What is the typical range of costs of an LTC or substation regulator upgrade in your territory?	$25,000 to $90,000	$15,000 - $125,000 LTC controller upgrades up to full regulator replacements	$10,000 – $150,000	$10,000 to $75,000 depending on age of transformer and style of controller.	$40,000 - $80,000
If there is a document which provides additional information on these requirements, please identify it here.	NYSEG/RGE Bulletin 86-01 REQUIREMENTS FOR THE INTERCONNECTION OF GENERATION, TRANSMISSION AND END-USER FACILITIES.	Central Hudson's existing Interconnection Protection Requirements document is located on Central Hudson's DG Website.	Con Edison's existing Interconnection Protection Requirements documents are located on Con Edison's DG Website. (EO-2115, EO-2022, etc.)	National Grid Electric service bulletin series and specifically ESB 756B	O&R is working on an external and internal document related to interconnections to be released in 2018 (internal) /2019 (external).

Monitoring and Control	Avangrid	Central Hudson Gas & Electric	Consolidated Edison	National Grid	Orange and Rockland
Describe any differences in monitoring and control requirements from those in the "Interim JU Monitoring and Control Criteria (September 1, 2017)"	N/A	N/A	DG interconnection applications connected directly connected to 4 kV and above and low voltage isolated network.	N/A	N/A
What is the typical range of costs for monitoring equipment for PV projects less than 50kW	At the current time, monitoring and control equipment is not required.				
What is the typical range of costs for monitoring and control equipment for PV projects 50kW to 500 kW	$35,000 based upon estimates (no field implementation), unless PCC recloser required	$21,000 - $25,000 based upon estimates (no field implementation), unless PCC recloser required	$25,000 -$100,000 for SCADA monitoring	$30,000 - $50,000 for above 300 to 500 kW for RTU only projects. PCC recloser would be required on under 5 kV circuits above 300 kW installations.	Monitoring will be enabled via Micatu sensors in 2019 at all large PV sites (>50kW).
What is the typical range of costs for monitoring and control equipment for PV projects greater than 500 kW	PCC Recloser with comm package and SCADA integration approximately $65,000	PCC Recloser with comm package and SCADA integration approximately $75,000	$25,000-$100,000 for SCADA monitoring. Additional costs could be required depending on additional technical issues and re-configurations upon CESIR evaluation.	PCC Recloser with comm package and SCADA integration approximately $110,000	Monitoring will be enabled via Micatu sensors in 2019 at all large PV sites (>50kW)* Control is via a recloser for projects typically 500kW and larger.
If there is a document which provides additional information on these requirements, please identify it here.	Interim JU Monitoring and Control Criteria (September 1, 2017)				

Anti-Islanding Mitigation	Avangrid	Central Hudson Gas & Electric	Consolidated Edison	National Grid	Orange and Rockland
Describe any differences in or additions to the anti-islanding protection requirements from those in the "Interim JU Anti-Islanding Criteria (February 9, 2017)" that are part of your standard procedure.	None	None	In addition to the JU document, the following anti-islanding schemes may be implemented: • Passive anti-islanding methods using local protective relays that measure and detect the deviation of frequency, rate of change in frequency, active and reactive power, and voltage from the normal operating range. • Special protective schemes that include synchrophasor comparison, etc. • Additional anti-islanding requirements for DG exporting via isolated networks.	None	None
If DTT protection is determined to be required, explain the different types of communications used and the reasoning for using each type.	Fiber or leased telecommunications line. Dedicated fiber is preferred however third party fiber path may also be an option.	Leased telecommunications line, fiber optic cable, or radio path.	Leased telecommunications line or fiber optic cable.	Leased telecommunications line, radio path (after analyzing feasibility)	Leased telecommunications line, radio path (after analyzing feasibility)
What is your typical range of costs for installing reclose blocking on one (1) mid-line recloser?	$1,000 - $75,000 Setting changes up to new recloser installations	$1,000 - $75,000 Setting changes up to new recloser installations	Costs are customized on a case by case basis	$1,000 - $75,000 Setting changes up to new recloser installations	$85,000 - $125,000
What is your typical range of costs for installing reclose blocking on a substation breaker?	N/A	$25,000 - $100,000 Single phase PT installations are typically lower in cost vs. three phase PT installations or full relay upgrades	Costs are customized on a case by case basis	N/A	N/A
What is your typical range of costs for installing direct transfer trip (DTT)?	$100k[1] up to ~ $200k - 300k[2] and could be as much as $700k - 1 million[3] 1. For wireless radio or in some cases fiber installations 2. Recurring cost of any leased telephone line not included 3. Reflecting the DTT installation for multiple contingency designed feeders in a network installations				
If there is a document which provides additional information on these requirements, please identify it here.	Interim JU Anti-Islanding (February 9, 2017)				

Effective Grounding	Avangrid	Central Hudson Gas & Electric	Consolidated Edison	National Grid	Orange and Rockland
For projects that require effective grounding evaluation, what calculations or software models are utilized to determine whether additional grounding mitigation methods are required? **OR** What criteria and values are used to determine whether the proposed system is in fact effectively grounded or if additional grounding mitigation is required.	ASPEN's One-liner software is utilized. EPS line/system configuration will dictate allowable transformer configurations and connections.	ASPEN's One-liner software is utilized as well as guidelines within IEEE C62.92.6 to determine if the system meets effective grounding requirements. EPS line/system configuration will dictate allowable transformer configurations and connections.	EPS line/system configuration will dictate allowable transformer configurations and connections.	ASPEN's One-liner software is utilized. EPS line/system configuration will dictate allowable transformer configurations and connections.	Fault analysis package in DEW software is utilized. EPS line/system configuration will dictate allowable transformer configurations and connections.

Effective Grounding continued	Avangrid	Central Hudson Gas & Electric	Consolidated Edison	National Grid	Orange and Rockland
The following questions are projects connecting to the grid using a Grounded Wye (Yg) Utility Side-Grounded Wye (Yg) Customer Side generator step-up transformer connecting to an effectively grounded system.					
What is the minimum system size where additional effective grounding mitigation methods will always be required?	N/A	N/A	N/A	500 kW	N/A
What is the minimum system size in which the system's effective grounding will be evaluated?	The need for effective grounding mitigation reviewed for all systems > 50 kW.	The need for effective grounding mitigation reviewed for all systems > 50 kW.	All system sizes require effective grounding mitigation methods EO-2115.	250 kW	50 kW
For this configuration, what mitigation methods are acceptable? (i.e. low side grounding banks, high side grounding banks or others)	See NYSEG/RGE Bulletin 86-01. NYSEG will evaluate on a case by case basis. Installation of a ground impedance may be required	Installation of a grounding transformer, such as wye-grounded delta or zig-zag configured transformers located on high or low voltage ratio side of the interconnecting transformer	Low side grounding banks, High side grounding banks or other delta-wye grounded auto transformer are all possible mitigation methods	Multiple options are available see ESB 756b for more detail on variations and requirements	•Wye-grounded to Wye-grounded (preferred) • Appropriately sizing the grounding or interconnection transformer to reduce fault current contribution • Addition of a properly sized neutral grounding reactor to the interconnecting or grounding transformer to reduce fault current contribution (under study now with our contractor)
Do you recommend the use of a particular document which provides a method of estimating the size of the grounding device in order to maintain system effective grounding? If so, please provide a title or link to said document.	Not at this time.	Central Hudson recommends the method established by Mike Ropp's document titled "Sizing of and Ground Potential Rise Calculations for Grounding Transformers for Photovoltaic Plants"	Not at this time.	Not at this time.	Not at this time.
If the developer's proposed grounding bank size is not acceptable, is the project placed on hold until a different size is resubmitted? What is your process for determining an acceptable bank size with a developer?	Impedance and fault current values are provided to the customer. The customer is expected to submit a size appropriate for their system, which also satisfies Avangrid's effective grounding requirements for the circuit. The project would not be put on hold at CESIR level, although projects progressing through construction would not be authorized to build that component until a satisfactory size has been agreed upon.	Central Hudson strives not to put the CESIR on hold unless developer response is significantly delayed. We will apply the additional 40 business days as needed. For acceptable bank size see above.	The CESIR will identify this requirement with subsequent discussion to agree on final solution before construction.	Ground bank proposals are part of utility requested information. If not provided industry assumptions are used and impedance and fault current values are provided to the customer. The customer is expected to submit a size appropriate for their system, which also satisfies National Grid's effective grounding requirements for the circuit. The project would not be put on hold at CESIR level, although projects progressing through construction would not be authorized to build that component until a satisfactory size has been agreed upon.	The project would not be put on hold at CESIR level, although projects progressing through construction would not be authorized to build that component until a satisfactory size has been agreed upon.

Effective Grounding continued	Avangrid	Central Hudson Gas & Electric	Consolidated Edison	National Grid	Orange and Rockland
The following questions are projects connecting to the grid using a Grounded Wye (Yg) Utility Side - Delta (▲) Customer Side generator step-up transformer connecting to an effectively grounded system.					
What is the minimum system size where a neutral impedance will always be required?	This is reviewed on a case by case basis.	This is reviewed on a case by case basis.	This is reviewed on a case by case basis.	500 kW and above, neutral impedance may be required an as this may change over time, all transformers of this type are required to be provided with an insulated neutral	This is reviewed on a case by case basis.
What is the minimum system size in which the requirement of a neutral impedance will be evaluated?	50 kW	50 kW	50 kW	250 kW	50 kW
What is the maximum fault current contribution of the system before a neutral impedance is required?	This value is modeled and reviewed on a case by case basis.				
By using this transformer configuration, are there any additional protection concerns (other than single-phase open protection) that must be addressed? If so, please identify the concern and provide technical background.	In addition to being effectively grounded while generating, the DER must not be a ground source when not generating in order to not desensitize protective relays.	In addition to being effectively grounded while generating, the DER must not be a ground source when not generating in order to not desensitize protective relays.	Upstream protection desensitizing and protection coordination impacts. Ground fault contribution from this configuration can impact protection response times.	Upstream protection desensitizing and protection coordination impacts. Ground fault contribution from this configuration can impact protection response times.	Upstream protection desensitizing and protection coordination impacts. Ground fault contribution from this configuration can impact protection response times.
What are some proven mitigation methods that have successfully addressed the protection concerns you mentioned above? (e.g. customer recloser, product listings, etc.)	Typical methods that have been approved for mitigation (depending on transformer configuration) include: • Appropriately sizing the transformer to reduce fault current contribution • Addition of a properly sized neutral resistor/reactor to the transformer to reduce fault current contribution •Disconnection on the high side of the transformer and/or the neutral of the transformer				
If there is a document which provides additional information on these requirements, please identify it here.	NYSEG/RGE Bulletin 86-01 REQUIREMENTS FOR THE INTERCONNECTION OF GENERATION, TRANSMISSION AND END-USER FACILITIES.	Central Hudson's existing Interconnection Protection Requirements document is located on Central Hudson's DG Website.	EO-2022 and EO-2115 are the two specifications needed to be reviewed with regards to the High Tension projects and DG projects	ESB 756b	O&R is working on an external and internal document related to interconnections to be released in 2018 (internal) /2019 (external).

Single-Phase Open Protection	Avangrid	Central Hudson Gas & Electric	Consolidated Edison	National Grid	Orange and Rockland
Do you require single-phase open protection?	At the current time, this situation has yet to be evaluated.	Yes	At the current time, this situation has yet to be evaluated.	At the current time, this situation has yet to be evaluated.	At the current time, this situation has yet to be evaluated.
What are some approved mitigation methods utilized to address these concerns? (i.e. negative sequence relaying w/ PCC recloser, etc.)	At the current time, this situation has yet to be evaluated.	The currently utilized method of mitigation for protecting against single phase loss and voltage backfeed is the installation of customer owned relay and breaker (typically an electronic recloser) that is installed on the high side of the interconnecting transformer and contains zero and negative sequence current and voltage detection to trip all three phases and disconnect the DER system upon loss of a single phase.	At the current time, this situation has yet to be evaluated.	At the current time, this situation has yet to be evaluated.	At the current time, this situation has yet to be evaluated.

Disclaimer: The statements and cost approximations provided in this document are for general reference only and may change on a project by project basis. The members of the Joint Utilities are not held to the values given or study procedures outlined in this document and, therefore, developers may see differences in individual projects.