Interconnection Request Submission Job Aid

DATE: JANUARY 12, 2022

ISO-NE PUBLIC

Introduction/Disclaimer

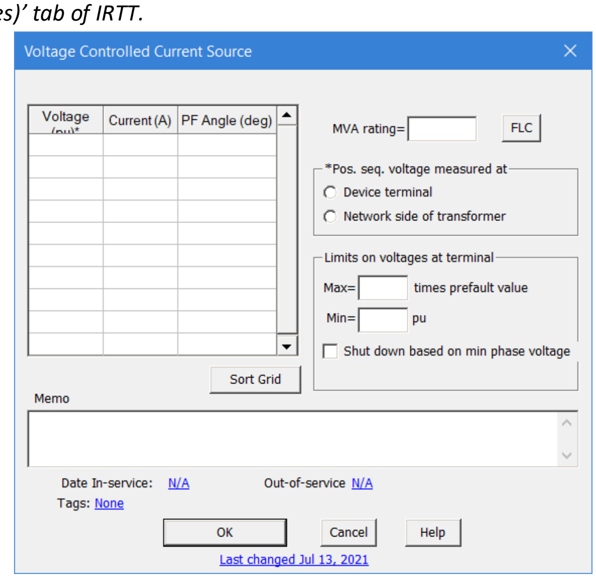
This document was written to clarify what ISO New England is looking for in submissions of Interconnection requests into the Interconnection Request Tracking Tool (IRTT). This document has screenshots of IRTT and other software necessary to submit these necessary files. If you have additional questions on the tools themselves, see the applicable user guides. In case of any discrepancy with this web guide, the ISO Tariff and applicable operating procedures and planning procedures govern.

Contents

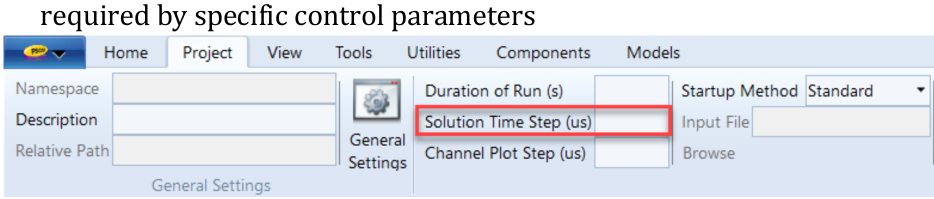
Interconnection Request File Upload Checklist

The following is a list of files that should be submitted to support an Interconnection Request (IR).
**Note: All of the data shown below may not need to be submitted for each IR.*

1. Siemens PSSE Files:
    - Steady State Modeling (.idv/.raw) – text file including project model and a connection to a real bus in the ISO-NE network
    - Dynamic Data Modeling (.dyr/.snp) – including generator/exciter/governor models (where applicable) and protection models
2. Short-circuit data (.olr/.chf) for use in ASPEN
    - Including project model with all Positive- and Zero-Sequence Impedance information – consistent with Collection System Detail Impedance Sheet
    - If an ASPEN file cannot be provided, please provide the information/data needed to construct an ASPEN model on our end, including:
        - Generator Voltage-Current relationship information for use in ASPEN Voltage-Controlled Current Source (VSC) model –shown below:
          **Note: The largest value in the Current (A) Column below should align with Max Design Fault Contribution Current from '[Small Generating Facility Characteristic Data](#) (for Inverter-based Machines)' tab of IRTT.*



        - GSU Transformer Zero-Sequence Impedance values
        - Branch & Equivalent Collector Zero-Sequence Impedance values aligning with the Collection System Detail Impedance Sheet
3. PSCAD Files (.pscx/.pswx) must be capable of the following:
    - Compatible with Intel Fortran 12 or later
    - Run at a minimum time step of 20 microseconds, or no less than 10 microseconds if required by specific control parameters



- Initialize as quickly as possible (e.g. < 1-3 seconds) to user supplied terminal conditions.
- Support multiple instances of the model in the same simulation.
- Support the PSCAD "snapshot" feature.
- Support the PSCAD "multiple run" feature.

4. PSSE-PSCAD Benchmarking Report
   - Consistent with [Planning Procedure 05-6] Requirements (seen below)

3.4.1 Detailed Instructions for the conduct of benchmarking analysis to confirm acceptable performance of the PSS/E model in comparison to the PSCAD model

PSS/E Simulation

1. The project shall be modeled at full output per the project's Interconnection Request.
2. Sufficient data channels shall be included in the snapshot file for reporting purposes. Example channel data would include bus voltages within the project and around the project's POI, line and transformer flows (both real and reactive), and LVRT status signal. Channel selection shall enable PSCAD modeling results to be directly compared against the PSS/E results.
3. Two fault simulations, each using a 6 cycle clearing time, at a bus close to the point of interconnection, for both pre-project (without the project modeled in-service) and post-project (with the project modeled in-service) :
   a. With all lines in service
   b. With one line close to the point of interconnection out of service.
4. Plot scales shall be set appropriately for the reviewers to discern the entirety of the plotted signals, without clipping. Multiple signals may be plotted together in the same plot, as long as the signals are discernible from one another—otherwise, some of those signals should be separated out into multiple plot diagrams.

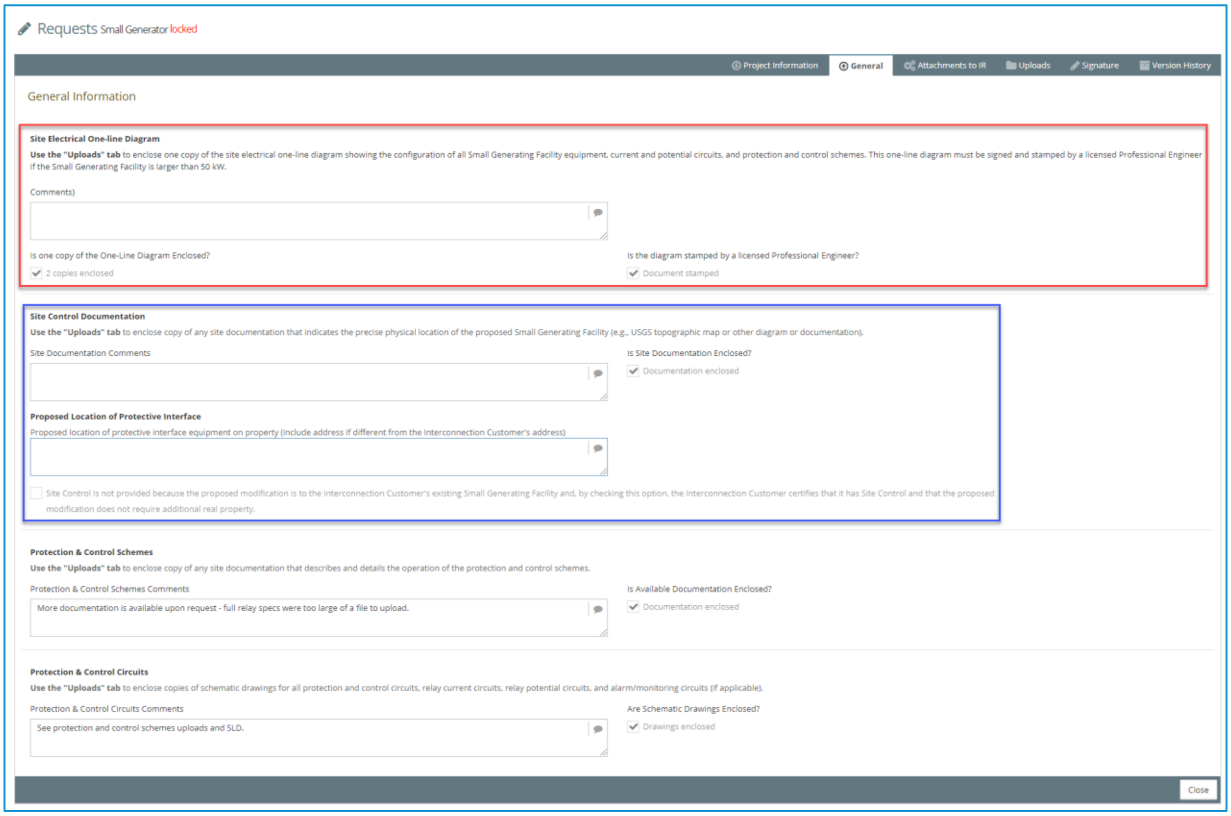
PSCAD Simulation

1. PSCAD simulation shall be performed under as similar conditions as possible to the PSS/E simulations discussed above, for the best possible comparison.
2. The Project and its associated auxiliary equipment shall be modeled with comparable parameters between the PSS/E and PSCAD modeling, with each model's parameters detailed in the summary report.
3. The PSCAD transmission system case model shall be created from the PSS/E case model, with sufficient buses included after forming the system equivalent to allow simulation of the line outage and fault conditions modeled in the PSS/E simulations discussed above.
4. Steady-state line outage scenarios shall be created similar to those in the PSS/E simulation. For each scenario, a short description of the SCMVA values resulting from the fault conditions considered shall be provided.
5. The PSCAD model shall initialize properly and that the same power flow and voltage conditions shall be observed between the PSCAD and PSS/E models.
6. Output channels shall be set up to capture similar data to that of the PSS/E simulations
7. Fault simulations using the same modeling as those for PSS/E shall be run
8. Comparison plot sets modeling the same data channels from PSS/E and PSCAD shall be developed.

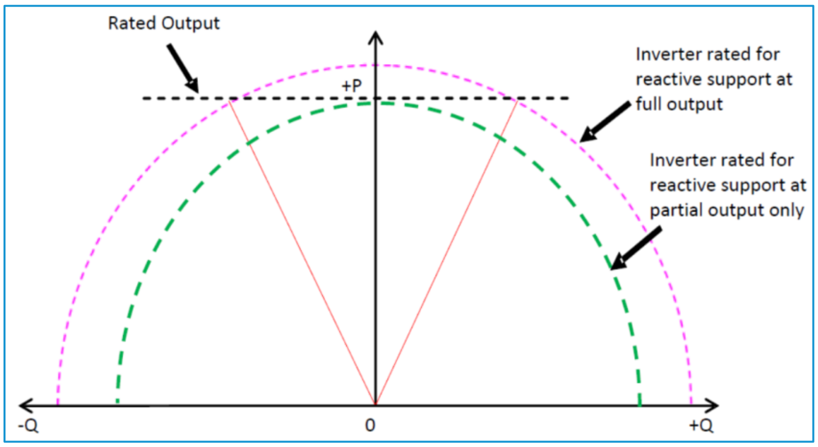
Evaluation of Results

1. Comparison plots shall show similar results between PSS/E and PSCAD. If any significant differences are shown between the traces, sufficient explanation shall be included about why these differences should be considered acceptable.

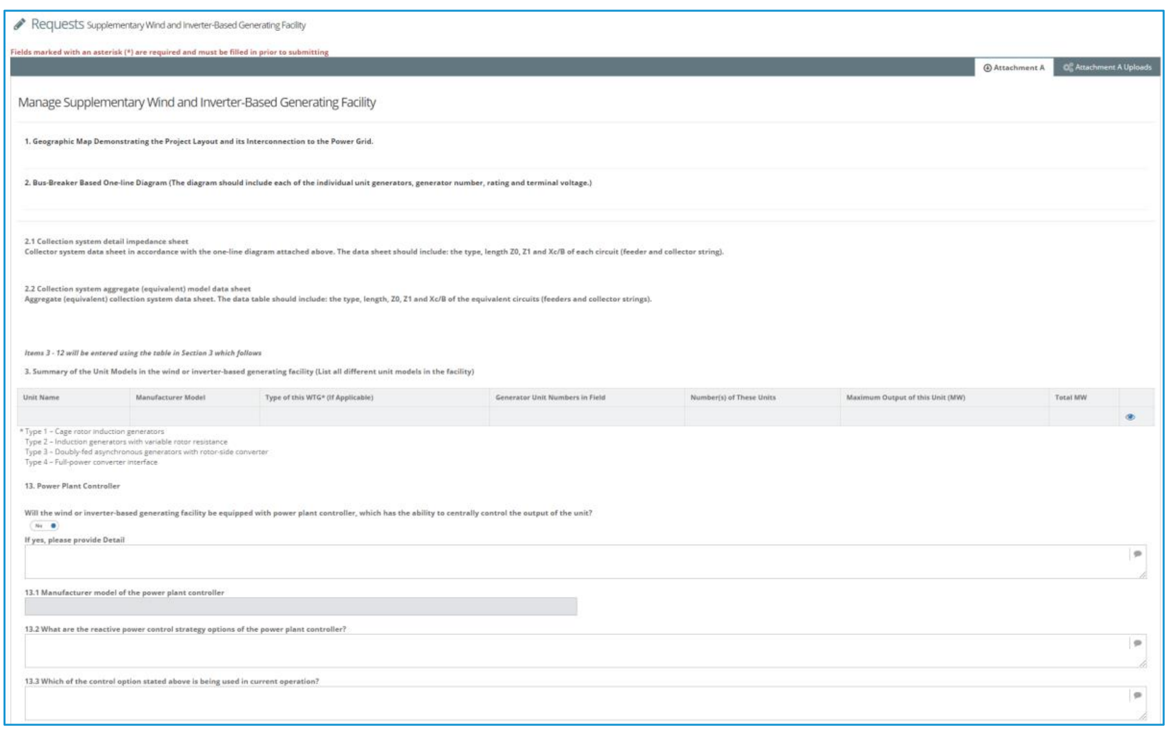
5. Project One-line (red box below)
    - State the Point of Interconnection (POI), and if the project is sectionalizing a line with a new substation, state the distance from both of the terminal stations
    - All inverters/generators must be shown
    - Must be stamped by a Professional Engineer if Interconnection Agreement is larger than 50 kW
6. Site Control Document (Geographical Map – blue box below)



7. PQ Curve ("D" Curve) showing Reactive Power Capability of Generator/Inverter (example shown below). Units with voltage control are required to be capable of a composite power delivery at their maximum rated power output (maximum MW) at the Point of Interconnection (or at the high side of the station transformer in the case of a wind generating facility) at both the power factor of 0.95 leading and 0.95 lagging. The power factor evaluation shall be conducted with the new Generating Facility or Eligible ETU modeled at unity terminal voltage and maximum rated power output. *Note: The PQ Curve is usually provided in inverter/generator model documentation.*



8. Collection System Detail Impedance Sheet (Item 2.2 Below)
    - The data table should include the Type, Length, Zero-Sequence Impedance, Positive Sequence Impedance, Reactance, and Charging of each section of the Detailed Model (Feeder & Collector Strings), as well as the Equivalent Model



Requests Supplementary Wind and Inverter-Based Generating Facility

Fields marked with an asterisk (*) are required and must be filled in prior to submitting

Attachment A | Attachment A Uploads

Manage Supplementary Wind and Inverter-Based Generating Facility

1. Geographic Map Demonstrating the Project Layout and its Interconnection to the Power Grid.

2. Bus-Breaker Based One-line Diagram (The diagram should include each of the individual unit generators, generator number, rating and terminal voltage.)

2.1 Collection system detail impedance sheet
Collector system data sheet in accordance with the one-line diagram attached above. The data sheet should include: the type, length Z0, Z1 and Xc/B of each circuit (feeder and collector string).

2.2 Collection system aggregate (equivalent) model data sheet
Aggregate (equivalent) collection system data sheet. The data table should include: the type, length, Z0, Z1 and Xc/B of the equivalent circuits (feeders and collector strings).

Items 3 - 12 will be entered using the table in Section 3 which follows

3. Summary of the Unit Models in the wind or inverter-based generating facility (List all different unit models in the facility)

Unit Name	Manufacturer Model	Type of this WTG* (If Applicable)	Generator Unit Numbers in Field	Number(s) of These Units	Maximum Output of this Unit (MW)	Total MW	

* Type 1 – Cage rotor induction generators
Type 2 – Induction generators with variable rotor resistance
Type 3 – Doubly-fed asynchronous generators with rotor-side converter
Type 4 – Full-power converter interface

13. Power Plant Controller

Will the wind or inverter-based generating facility be equipped with power plant controller, which has the ability to centrally control the output of the unit?

No

If yes, please provide Detail

13.1 Manufacturer model of the power plant controller

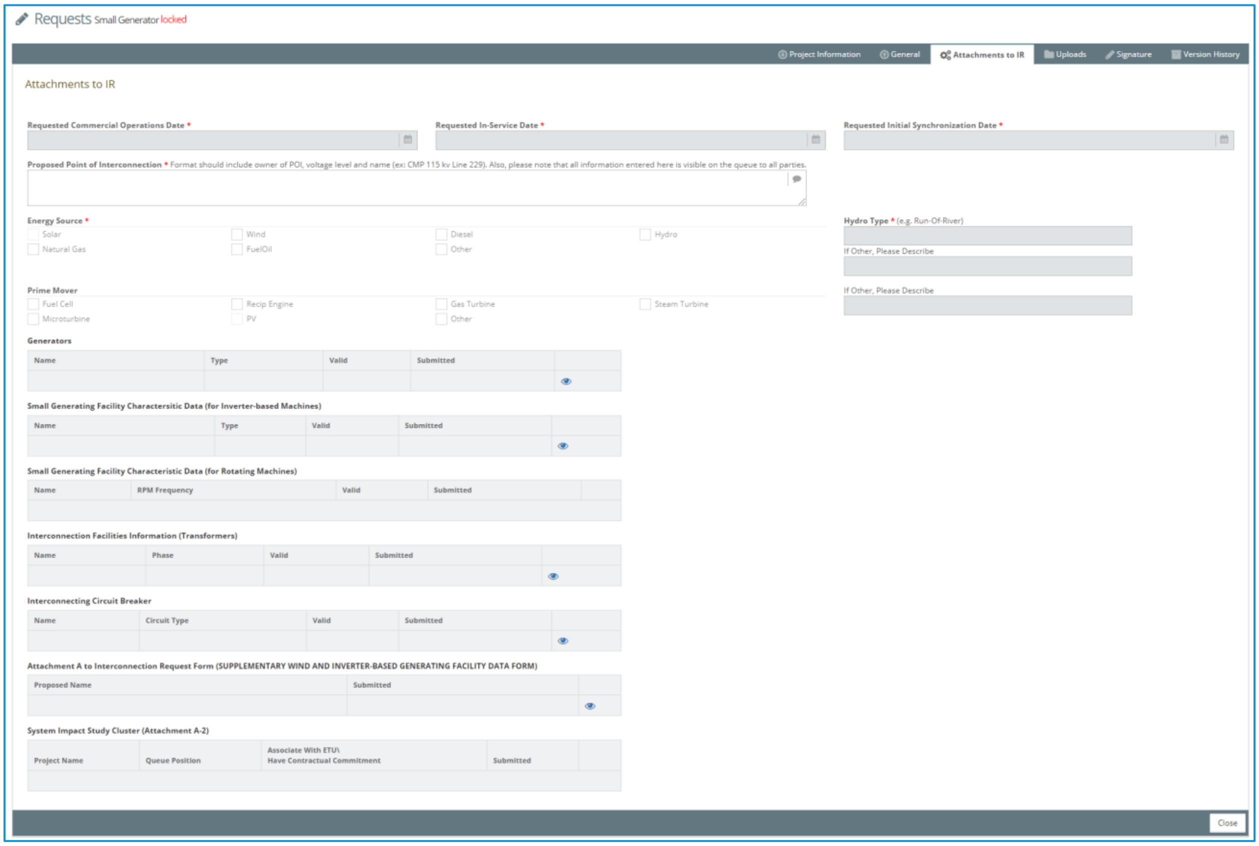
13.2 What are the reactive power control strategy options of the power plant controller?

13.3 Which of the control option stated above is being used in current operation?

Section 1 IRTT Entries

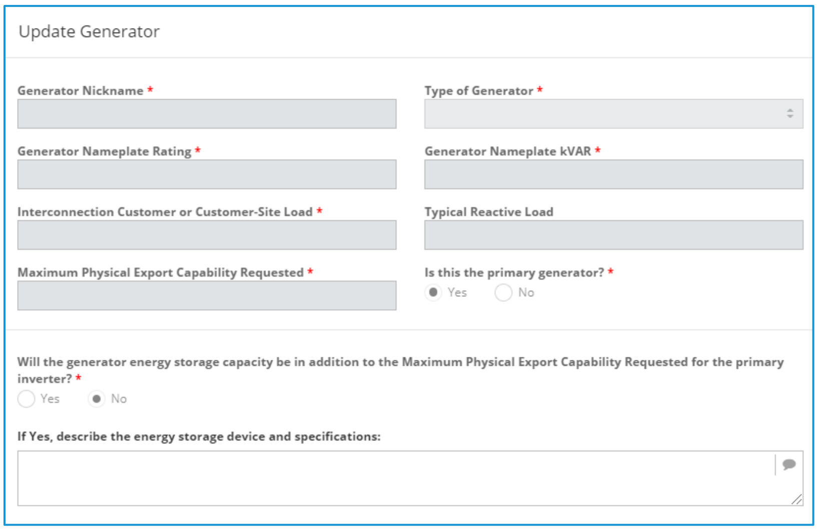
The following pages provide information needed to submit data into the Attachments to IR Tab shown below. Within this tab there are multiple section that need to filled in. To expand each table click on the eye icon to the right of each table. The expanded tables are shown on the pages to follow.

Attachments to IR Tab:



1.1 Generators:

- **Generator Nameplate Rating** and **Generator Nameplate kVAR** should be based on a primary (largest) generator/inverter, not the entire aggregated project. Additional details about other generator/inverters on the site will be requested in Attachment A to Interconnection Request Form.
- **Interconnection Customer or Customer-Site Load** is meant to represent any Station Service Load associated with the project facility


Update Generator

Generator Nickname *

Type of Generator *

Generator Nameplate Rating *

Generator Nameplate kVAR *

Interconnection Customer or Customer-Site Load *

Typical Reactive Load

Maximum Physical Export Capability Requested *

Is this the primary generator? *

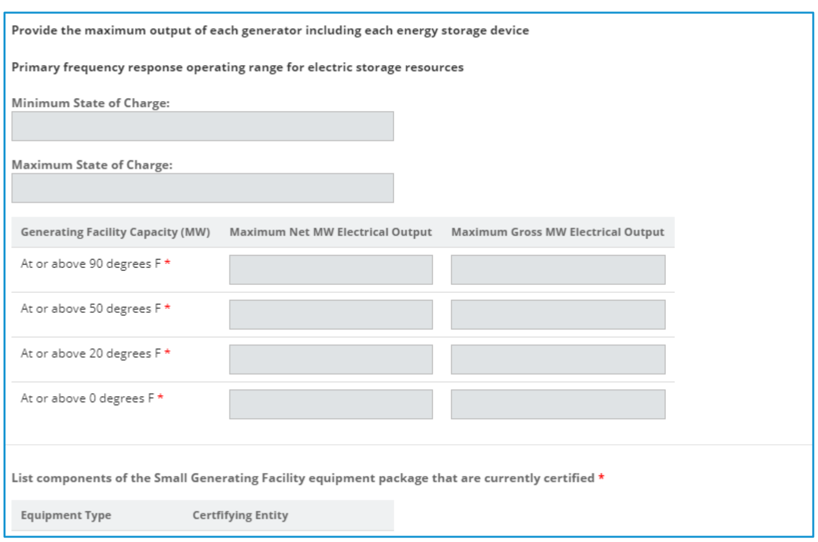
Yes No

Will the generator energy storage capacity be in addition to the Maximum Physical Export Capability Requested for the primary inverter? *

Yes No

If Yes, describe the energy storage device and specifications:

- **Minimum and Maximum State of Charge** is meant to represent the percentage of the total nameplate MWh that the Energy Storage System (if applicable) can charge


Provide the maximum output of each generator including each energy storage device

Primary frequency response operating range for electric storage resources

Minimum State of Charge:

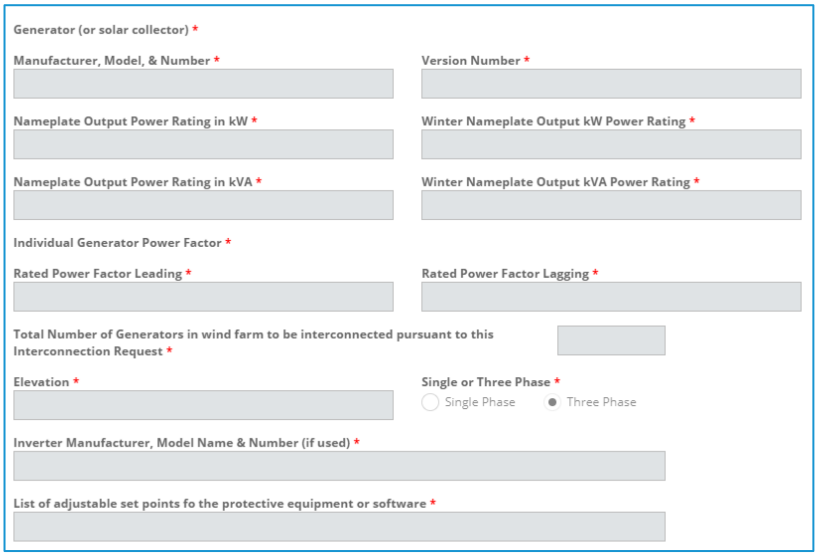
Maximum State of Charge:

Generating Facility Capacity (MW)	Maximum Net MW Electrical Output	Maximum Gross MW Electrical Output
At or above 90 degrees F *		
At or above 50 degrees F *		
At or above 20 degrees F *		
At or above 0 degrees F *		

List components of the Small Generating Facility equipment package that are currently certified *

Equipment Type	Certifying Entity

- **Nameplate Output Power Ratings** below need to be based on a primary (largest) generator/inverter, not the entire aggregated project.



Generator (or solar collector) *

Manufacturer, Model, & Number *

Version Number *

Nameplate Output Power Rating in kW *

Winter Nameplate Output kW Power Rating *

Nameplate Output Power Rating in kVA *

Winter Nameplate Output kVA Power Rating *

Individual Generator Power Factor *

Rated Power Factor Leading *

Rated Power Factor Lagging *

Total Number of Generators in wind farm to be interconnected pursuant to this Interconnection Request *

Elevation *

Single or Three Phase *

Single Phase

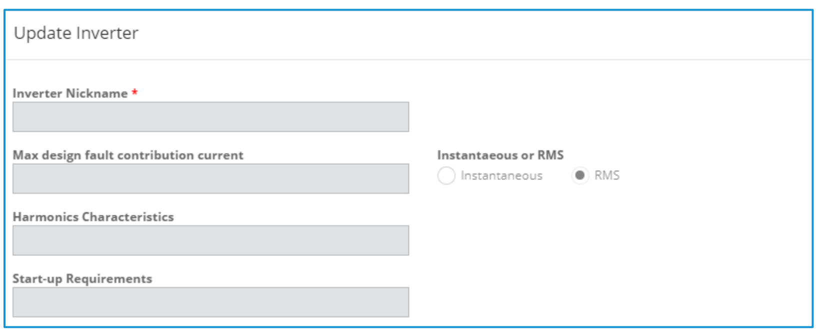
Three Phase

Inverter Manufacturer, Model Name & Number (if used) *

List of adjustable set points fo the protective equipment or software *

1.2 Small Generating Facility Characteristic Data (for Inverter-based Machines)

- **Max Design Fault Contribution Current** should align with the ASPEN generator model.



Update Inverter

Inverter Nickname *

Max design fault contribution current

Instantaeous or RMS

Instantaneous

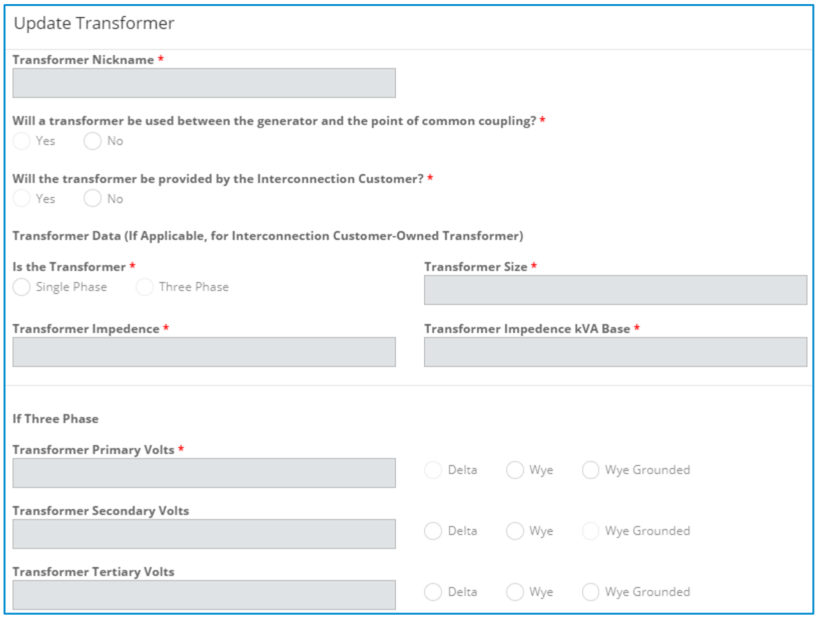
RMS

Harmonics Characteristics

Start-up Requirements

1.3 Interconnection Facilities Information (Transformers)

For Transformer entries below, please base values on individual Generator-Step-Up Transformers (if there are multiple).


Update Transformer

Transformer Nickname *

Will a transformer be used between the generator and the point of common coupling? *

Yes No

Will the transformer be provided by the Interconnection Customer? *

Yes No

Transformer Data (If Applicable, for Interconnection Customer-Owned Transformer)

Is the Transformer * Single Phase Three Phase

Transformer Size *

Transformer Impedence *

Transformer Impedence kVA Base *

If Three Phase

Transformer Primary Volts * Delta Wye Wye Grounded

Transformer Secondary Volts Delta Wye Wye Grounded

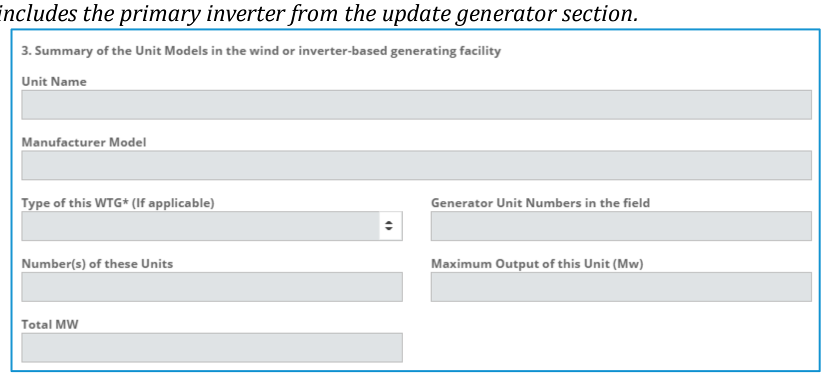
Transformer Tertiary Volts Delta Wye Wye Grounded

1.4 Attachment A to Interconnection Request Form

(Supplementary Wind & Inverter-Based Generating Facility Data Form)

- Filled in, Section 3 below, on a per-inverter basis for each unique type of inverter.

  Note: This includes the primary inverter from the update generator section.


3. Summary of the Unit Models in the wind or inverter-based generating facility

Unit Name

Manufacturer Model

Type of this WTG* (If applicable)

Generator Unit Numbers in the field

Number(s) of these Units

Maximum Output of this Unit (Mw)

Total MW

- **Leading/Lagging Reactive Power Limits** below should align with the PSSE model
- For the question, **On which bus the minimum SCR is required by manufacturer** provide a *specific PSSE bus number*

Unit Manufacturer Model

Terminal Voltage

Rating of Each Unit (MVA)

Maximum Gross Electrical Output (MW)

Minimum Gross Electrical Output(MW)

Lagging Reactive Power Limit at Rated Real Power Output (MVAR)

Leading Reactive Power Limit at Rated Real Power Output (MVAR)

Lagging Reactive Power Limit at Zero Real Power Output (MVAR)

Leading Reactive Power Limit at Zero Real Power Output (MVAR)

Station Service Load(MW, MVAR)

Minimum short circuit ratio(SCR) requirement by manufacturer

On which bus the minimum SCR is required by manufacturer

What voltage level the minimum SCR is required by manufacturer

Positive sequence Xsource

Zero sequence Xsource

5. Unit GSU

Nameplate rating(MVA)

Total number of the GSUs

Voltages, generator side/system side

Winding connections, low voltage/high voltage

Available tap positions on high voltage side

Available tap positions on low voltage side

Will the GSU operate as an LTC?

No

Desired voltage control range if LTC

Tap adjustment time (Tap switching delay + switching time) if LTC

Desired tap position if applicable

Impedance, Z1, X/R ratio

Impedance, Z0, X/R ratio

6. Low Voltage Ride Through (LVRT) ***(Specify the Manufacturer Model of this Unit)***

Does each Unit have LVRT capability?

If yes, please provide:

6.1 Unit LVRT mode activation and release condition

When operating at maximum real power, what is the Unit terminal voltage for LVRT mode activation?

When operating at maximum real power, what is the Unit terminal voltage for releasing LVRT mode after it is activated?

If there is different LVRT activation and release logic, please state here

6.2 A Wind or other inverter-based generating facility technical manual from the manufacturer including description of LVRT functionality

Attach an Inverter-Based Generating Facility Technical Manual from the manufacturer. Attachments can be added on the upload tab.

6.3 Does the wind or other inverter-based generating facility technical manual attached above include a reactive power capability curve?

If no, attach the file and specify the name of the attachment here:

Attach a Manufacturer Technical Manual without Reactive Power Capability Curve. Attachments can be added on the upload tab.

1.5 Sections 7-10 (Voltage and Frequency Protection Settings)

Note: See next section "Attachment A-1 Protection Settings" for a guide to the appropriate settings.
ISO-SRD Settings are shown below

7. Low Voltage Protection (considering LVRT functionality) *

(Specify the Manufacturer Model of this Unit)

*Add more rows in the table as needed

Low Voltage Setting (pu)	Relay Pickup Time (Seconds)
0.5	1.1
0.88	2

8. High Voltage Protection - (Specify the Manufacturer Model of this Unit)

*Add more rows in the table as needed

High Voltage Setting (pu)	Relay Pickup Time (Seconds)
1.1	2
1.2	0.16

9. Low Frequency Protection - Specify the Manufacturer Model of this Unit)

*Add more rows in the table as needed

Low Frequency Setting (Hz)	Relay Pickup Time (Seconds)
58.5	300
56.5	0.16

10. High Frequency Protection - (Specify the Manufacturer Model of this Unit)

*Add more rows in the table as needed

High Frequency Setting (Hz)	Relay Pickup Time (Seconds)
61.2	300
62	0.16

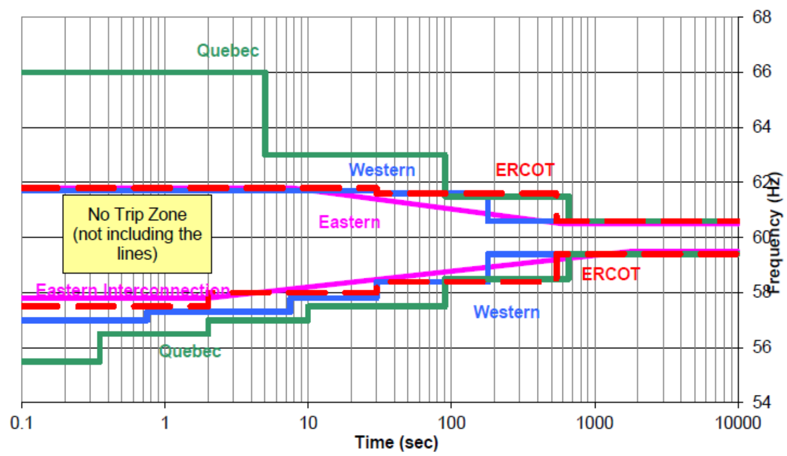
Section 2 Attachment A-1 Protection Settings

For any Generators connecting to the Bulk Electric System[1] (BES), or to Subtransmission that is not considered Distribution, the unit(s) should have Voltage and Frequency Protection Settings that Comply with Standard PRC-024-2 (https://www.nerc.com/pa/Stand/Reliability Standards/PRC-024-2.pdf). Generators that are interconnecting at the distribution level should comply withthe ISO-NE Inverter Source Requirement Document (ISO-NE SRD) Protection Settings.

2.1 PRC-024-2 Frequency Protection Settings:

PRC-024 — Attachment 1

OFF NOMINAL FREQUENCY CAPABILITY CURVE



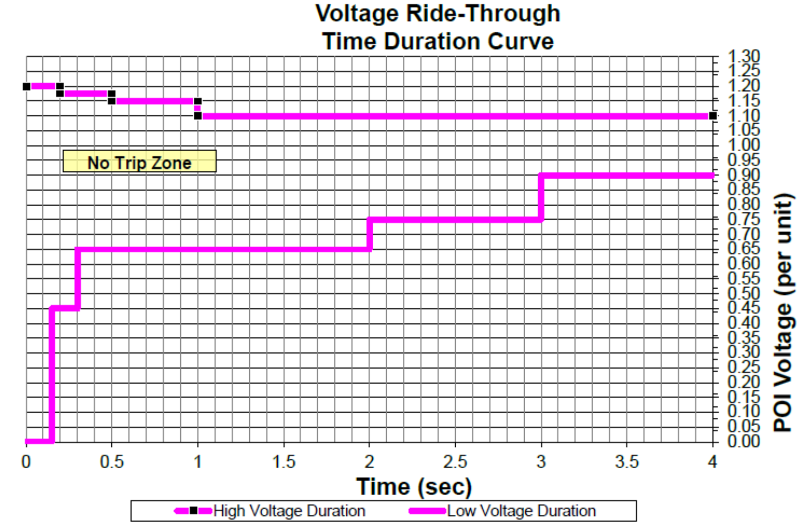
Curve Data Points:

Eastern Interconnection

High Frequency Duration		Low Frequency Duration	
Frequency (Hz)	Time (Sec)	Frequency (Hz)	Time (sec)
≥61.8	Instantaneous trip	≤57.8	Instantaneous trip
≥60.5	$10^{(90.935-1.45713*f)}$	≤59.5	$10^{(1.7373*f-100.116)}$
<60.5	Continuous operation	> 59.5	Continuous operation

[1] Bulk Electric System (BES) Definition via FERC: All Transmission Elements operated at 100 kV or higher and Real Power and Reactive Power resources connected at 100 kV or higher. This does not include facilities used in the local distribution of electric energy.

2.2 PRC-024-2 Voltage Protection Settings:



Ride Through Duration:

High Voltage Ride Through Duration		Low Voltage Ride Through Duration	
Voltage (pu)	Time (sec)	Voltage (pu)	Time (sec)
≥1.200	Instantaneous trip	<0.45	0.15
≥1.175	0.20	<0.65	0.30
≥1.15	0.50	<0.75	2.00
≥1.10	1.00	<0.90	3.00

2.3 ISO-SRD Frequency Protection Settings:

Table II: Inverters' Frequency Trip Settings

Shall Trip Function	Required Settings		Comparison to IEEE Std 1547-2018 (2^{nd} ed.) default settings and ranges of allowable settings for Category I, Category II, and Category III		
	Frequency (Hz)	Clearing Time(s)	Frequency	Clearing Time(s)	Within ranges of allowable settings?
OF2	62.0	0.16	Identical	Identical	Yes
OF1	61.2	300.0	Identical	Identical	Yes
UF1	58.5	300.0	Identical	Identical	Yes
UF2	56.5	0.16	Identical	Identical	Yes

2.4 ISO-SRD Voltage Protection Settings:

Table I: Inverters' Voltage Trip Settings

Shall Trip – IEEE Std 1547-2018 (2nd ed.) Category II					
Shall Trip Function	Required Settings		Comparison to IEEE Std 1547-2018 (2nd ed.) default settings and ranges of allowable settings for Category II		
	Voltage (p.u. of nominal voltage)	Clearing Time(s)	Voltage	Clearing Time(s)	Within ranges of allowable settings?
OV2	1.20	0.16	Identical	Identical	Yes
OV1	1.10	2.0	Identical	Identical	Yes
UV1	0.88	2.0	Higher (default is 0.70 p.u.)	Much shorter (default is 10 s)	Yes
UV2	0.50	1.1	Slightly higher (default is 0.45 p.u.)	Much longer (default is 0.16 s)	Yes

11. Unit Reactive Power Control (Specify the Manufacturer Model of this Unit)

11.1 What are the options for the Unit reactive power control (check all available)?

- ☐ Control the voltage at the Unit terminal
- ☐ Control constant power factor at the Unit terminal
- ☐ Control constant power factor at the low side of the station main transformer
- ☐ Control constant power factor at the high side of the station main transformer
- ☐ Control voltage at the low side of the station main transformer
- ☐ Control voltage at the high side of the station main transformer
- ☐ Other options. Please describe if select others

11.2 In all the control options selected above, please list the options in which the Unit is able to control its terminal voltage to prevent low/high voltage tripping.

11.3 What is the desired control mode from the selected options above? Specify the control plan in this mode. For example: control voltage at which bus to what schedule.

Please provide the park controller technical manual from the manufacturer

Attach a Park Control Technical Manual. Attachments can be added on the upload tab.

14. Station Transformer

Transformer Name

Nameplate ratings (MVA)

Total number of the main transformer(s)

Voltage, High/Low/Tertiary (kV)

Winding connections, High/Low Tertiary

Available tap positions on high voltage side

Available tap positions on low voltage side

Will the transformer operate as a LTC?

No

Desired voltage control range if LTC

Tap adjustment time (Tap switching delay + switching time) if LTC

Desired tap position if applicable

Tap adjustment time (Tap switching delay + switching time)

Impedance Z_1, X/R ratio

$Z_{1H\text{-}L}$	X/R
$Z_{1H\text{-}T}$	X/R
$Z_{1T\text{-}L}$	X/R

Impedance Z_0, X/R ratio

$Z_{0H\text{-}L}$	X/R
$Z_{0H\text{-}T}$	X/R
$Z_{0T\text{-}L}$	X/R

15. Dynamic Simulation Model for the Power Plant Controller(s) (if applicable)
(All model files provided under this section should be compatible with Siemens PTI's PSS/E version currently in use at ISO New England)

Attach a Dynamic Simulation Model for the Power Plant Controller(s). Attachments can be added on the upload tab.

15.1 A compiled PSS/E dynamic model for the power plant controller(s) (a *.LIB or *.OBJ file)

Attach a Compiled PSS/E dynamic model. Attachments can be added on the upload tab.

15.2 A dynamic data file with appropriate parameters and settings for the power plant controller(s) (typically a *.DYR file).
Please set the parameters in accordance with the currently used control mode.

Attach a Dynamic Data File for Power Plant Controller(s) File. Attachments can be added on the upload tab.

15.3 PSS/E model user manual for the power plant controller(s)

Attach a PSS/E Model User Manual. Attachments can be added on the upload tab.

16. Capacitors and Reactors

Please provide necessary modeling data for all the capacitors and reactors belong to the facility, including: size, basic electrical parameters, connecting bus, switched or fixed, etc.

Modeling Data for All Capacitors and Reactors for Facility

Attach a Modeling Data for All Capacitors and Reactors. Attachments can be added on the upload tab.

17. Dynamic Device(s)
(All model files provided under this section 17 should be compatible with Siemens PTI's PSS/E version currently in use at ISO New England)

17.1 Provide necessary modeling data file for all the dynamic devices belong to the facility.

Attach a Dynamic Device Modeling Data File. Attachments can be added on the upload tab.

17.2 A dynamic data file containing the parameters for the units (typically a *.DYR file).
Set the parameters in accordance with the desired control mode.

Attach a Dynamic Data File for Parameters for the Units. Attachments can be added on the upload tab.

18. Collection System/Transformer Tap-Setting Design
Collection system/transformer tap-setting design calculations, consistent with the requirements in the ISO New England Planning Procedures, that identify the calculations to support the proposed tap settings for the unit step-up transformers and the station step-up transformers.

Attach a Collection System/Transformer Tap-Setting Design. Attachments can be added on the upload tab.

19. Additional Information

Are there any special features available to be implemented to the wind or inverter-based generating facility? Such as weak grid interconnection solutions, etc. Specify the available features here

Technical manual for each of the features listed above as object (display as icons)

Attach a Additional Information Tech Manual. Attachments can be added on the upload tab.

20. PSCAD Model and Documentation for the wind or inverter-based generating facility, the Power Plant Controller(s) and Other Dynamic Devices for the wind or inverter-based generating facility.
ISO will determine how much PSCAD work is needed from the wind or inverter-based generating facility based on its interconnection system conditions.

Attach a PSCAD Model and Documentation. Attachments can be added on the upload tab.