**Generating Facility Name:**       IC-      Revision Date:

**Interconnection Service Amount (Maximum Net Export Capability at POI):**       MW

Gross Solar PV Capability (at PV Inverter Terminals): 0.00 MVA (= Item 6.a \* Item 6.b)

Gross ESR Capability (at ESR Inverter Terminals): 0.00 MVA (= Item 14.a \* Item 14.b)

Total Gross Generating Facility Capacity: 0.00 MVA (=Gross Solar PV Capability + Gross ESR Capability)

1. **Simplified One-Line Diagram.** This should be similar to Figure below. If it is different, please mark the difference on the diagram below.



* 1. Electric Storage Resource (ESR)?:   
     *If Generating Facility design contains ESR system, complete the Electric Storage Resource Data Attachment at the end of this form.*

1. **Generator Interconnection Tie Line.**

*Provide either absolute or per unit impedance values.*

* 1. Point of Interconnection (utility substation/line name):
  2. Line voltage:       kV, line rating at 95°F ambient:       MVA, line length:
  3. R1 =       ohm or       pu on 100 MVA and line kV base (positive sequence)
  4. X1 =       ohm or       pu on 100 MVA and line kV base (positive sequence)
  5. B1 =       μF or       pu on 100 MVA and line kV base (positive sequence)
  6. R0 =       ohm or       pu on 100 MVA and line kV base (zero sequence)
  7. X0 =       ohm or       pu on 100 MVA and line kV base (zero sequence)
  8. B0 =       μF or       pu on 100 MVA and line kV base (zero sequence)

1. **Main Transformer.** Number of main transformers:        
   *Provide data for either two-winding or three-winding transformer as appropriate.*

**Two-Winding Main Transformer Data (as applicable)**

* 1. Rating at 95°F ambient (OA/FA/FA):       /       /       MVA
  2. Nominal Voltage for each winding (Low/High):       /       kV
  3. Winding Connections (Low/High): /
  4. Available tap positions:       /       /       /       /       kV **or**       %       # of taps.
  5. Positive sequence impedance Z1:       %,       X/R on self-cooled (OA) MVA rating above.
  6. Zero sequence impedance Z0:       %,       X/R on self-cooled (OA) MVA rating above.
  7. For pad mount transformer, construction:

**Three-Winding Main Transformer Data (as applicable)**

* 1. GSU connection and winding (attach diagram and mark to reference this form).

|  | **H Winding Data** | **X Winding Data** | **Y Winding Data** |
| --- | --- | --- | --- |
| Full load ratings at 95°F ambient (i.e. OA/FA/FA) | /     /      MVA | /     /      MVA | /     /      MVA |
| Rated winding voltage base | kV  connected | kV  connected | kV  connected |
| Tap positions available | /       /       /       /       kV | /       /       /       /       kV | /       /       /       /       kV |
| Present Tap Setting  (if applicable) | kV | kV | kV |
| Neutral solidly grounded? (or) Neutral Grounding Resistor (if applicable) | Ohms | Ohms | Ohms |
| BIL rating | kV | kV | kV |

**Three-Winding Main Transformer Impedance Data (as applicable)**

|  | **H-X Winding Data** | **H-Y Winding Data** | **X-Y Winding Data** |
| --- | --- | --- | --- |
| Transformer base for impedances provided | MVA | MVA | MVA |
| Positive sequence impedance Z1 | %       X/R | %       X/R | %       X/R |
| Zero sequence impedance Z0 | %       X/R | %       X/R | %       X/R |

**Rapid Voltage Change (RVC) Induced by Main Transformer[[1]](#footnote-1)**

* 1. Provide RVC mitigation strategy on main transformer energization:

Main Transformer to be energized from the high side with a switching device that is equipped with pre-insertion resistors or point of wave control (**required** if valid main transformer energization data cannot be provided, or if deficiency is identified).

1. Device:
2. Manufacturer:

Main Transformer Energization Data:

1. Air core inductance:       pu (From H winding side on       MVA Base)
2. No-load test results:

i. Rated Voltage of Winding at which current is determined:       kV

ii. Current at 90% / 100% / 110% of rated voltage:       /       /       A

iii. Losses at 90% / 100% / 110% of rated voltage:       /       /       W

1. **PV Collector System Equivalent Model**.

*Provide either absolute or per unit impedance values.*

* 1. Collector system voltage =       kV
  2. Collector system equivalent model rating at 95°F ambient =       MVA
  3. R1 =       ohm or       pu on 100 MVA and line kV base (positive sequence)
  4. X1 =       ohm or       pu on 100 MVA and line kV base (positive sequence)
  5. B1 =       μF or       pu on 100 MVA and line kV base (positive sequence)
  6. R0 =       ohm or       pu on 100 MVA and line kV base (zero sequence)
  7. X0 =       ohm or       pu on 100 MVA and line kV base (zero sequence)
  8. B0 =       μF or       pu on 100 MVA and line kV base (zero sequence)

1. **PV Inverter Step-Up Transformers.** Number of inverter transformers:        
   *Provide data for either two-winding or three-winding transformer as appropriate*

**Two-Winding Inverter Step-Up Transformer Data (as applicable):**

* 1. Nameplate Rating (at 95°F ambient):       MVA
  2. Maximum Rating (if applicable):       MVA
  3. Nominal Voltage for each winding (Low/High):       /       kV
  4. Winding Connections (Low/High): /
  5. Available taps:       /       /       /       /       kV **or**       %       # of taps.
  6. Positive sequence impedance (Z1)       %,       X/R on MVA rating above.
  7. Zero sequence impedance (Z0)       %,       X/R on MVA rating above.

**Three-Winding Inverter Step-Up Transformer Data (as applicable)**

* 1. GSU connection and winding (attach diagram and mark to reference this form).

|  | **H Winding Data** | **X Winding Data** | **Y Winding Data** |
| --- | --- | --- | --- |
| Full load ratings at 95°F ambient (i.e. OA/FA/FA) | /     /      MVA | /     /      MVA | /     /      MVA |
| Rated winding voltage base | kV  connected | kV  connected | kV  connected |
| Tap positions available | /       /       /       /       kV | /       /       /       /       kV | /       /       /       /       kV |
| Present Tap Setting  (if applicable) | kV | kV | kV |
| Neutral solidly grounded? (or) Neutral Grounding Resistor (if applicable) | Ohms | Ohms | Ohms |
| BIL rating | kV | kV | kV |

**Three-Winding Inverter Step-Up Transformer Impedance Data (as applicable)**

|  | **H-X Winding Data** | **H-Y Winding Data** | **X-Y Winding Data** |
| --- | --- | --- | --- |
| Transformer base for impedances provided | MVA | MVA | MVA |
| Positive sequence impedance Z1 | %       X/R | %       X/R | %       X/R |
| Zero sequence impedance Z0 | %       X/R | %       X/R | %       X/R |

1. **PV Inverter Data.** 
   1. Number of Inverters:
   2. Inverter maximum capability at 95°F/35°C or higher:       kW/       kVA
   3. Describe inverter reactive capability at maximum capability listed above:
   4. Inverter short circuit ratio limit:
   5. Inverter Manufacturer and Model #:
   6. Provide with this form the inverter specification sheet with reactive capability curve.  **Attached**
   7. Type of photovoltaic system:
2. **Plant Reactive Power Compensation** (beyond the inverters built-in reactive capability)**.**
   1. Type of reactive compensation device(s):
   2. Individual fixed shunt reactive device type:
      * Number and size of each:      ×      MVA
   3. Dynamic reactive control device (e.g., SVC, STATCOM):
   4. Control range at rated MW output:       Mvar (lead and lag)
   5. Control mode (e.g., voltage, power factor, reactive power):
   6. Regulation point:
   7. Describe the overall reactive power control strategy:
3. **PV Dynamic Modeling Data.**

*Ensure DC connected ESR are considered for this section.*

* 1. Provide with this form 2nd generation generic dynamic models for the PV inverter, and any additional dynamic reactive control devices. **Generic** **Models** **Attached** 
     + Include plant volt/var control function model and active power/frequency control function model.
     + Use of model REEC\_B is not allowed.
     + All the associated files, including source code for user-written models, for dynamic modeling should be in PSS/E version 33 or higher, and must be shareable on an interconnection-wide basis to support use in the interconnection-wide cases.[[2]](#footnote-2)
     + Model parameters must be set for the inverter to operate per Southern Companies’ Interconnection Requirements for Inverter-Based Generation [[3]](#footnote-3), including:
       1. Voltage response and ride-thru settings.
       2. Frequency response and ride thru settings.
       3. Control mode (voltage control for POI >100 kV, power factor control for POI < 100 kV).
       4. Q-Priority enabled.
       5. Any plant-level real power limits.
  2. In addition, if the standard model does not accurately represent the equipment’s dynamic response, user-written models should be submitted along with the standard model. The user-written models must include the model characteristics, including block diagrams, values and names for all model parameters and a list of all state variables.

**User-Written** **Models** **Attached**

1. **PV Three-Phase Modeling Data.**

*Ensure DC connected ESR are considered for this section.*

* 1. Provide with this form a three-phase model for the entire solar facility, and any additional dynamic reactive control devices.[[4]](#footnote-4) **Attached**  **Provide at NTP**

1. **Short Circuit Contribution of the Generating Facility at the Point of Interconnection.**

*Include any electric storage.*

* 1. Maximum three phase surge current /sub-transient current (reached within 0 -1 cycles):       Amps
  2. Symmetrical three phase short-circuit current (reached after 3 cycles) :       Amps

1. **Harmonic Distortion of the plant at Point of Interconnection.** [[5]](#footnote-5)

*Include any energy storage.*

* 1. Total Harmonic Current Distortion:       %
  2. Provide with this data form the individual harmonic currents through 50th harmonic, in % of fundamental current rating. **Attached**

1. **Data Revisions.**
   1. If submitting revised data, record the date and a summary of the sections that have been updated:

**Electric Storage Resource (ESR) Data Attachment**

1. **ESR Data.** 
   1. ESR Configuration (see diagrams below):
   2. Gross Capability (Peak Power/Maximum Energy):       kW/       kWh
   3. Charging Capability (Peak Power/Maximum Energy):       kW/       kWh
   4. Charging Strategy: [[6]](#footnote-6)





1. **ESR Inverter Data.**

*Complete if ESR is AC connected (separate inverters from PV arrays).*

* 1. Number of Inverters:
  2. Inverter maximum capability at 95°F/35°C or higher:       kW/       kVA
  3. Describe inverter reactive capability at maximum kW listed above:
  4. Inverter short circuit ratio limit:
  5. Inverter Manufacturer and Model #:
  6. Provide with this form the inverter specification sheet with reactive capability curve.  **Attached**

1. **ESR Inverter Dynamic Modeling Data.**

*Complete if ESR is AC connected. For DC connected ESR, ensure sections 8 & 9 consider DC connected ESR.*

* 1. Provide with this form 2nd generation generic dynamic models for the ESR inverter, and any additional dynamic reactive control devices. **Generic** **Models** **Attached** 
     + Include plant volt/var control function model and active power/frequency control function model.
     + Use of model REEC\_B is not allowed.
     + All the associated files, including source code for user-written models, for dynamic modeling should be in PSS/E version 33, and must be shareable on an interconnection-wide basis to support use in the interconnection-wide cases.[[7]](#footnote-7)
     + Model parameters must be set for the inverter to operate per Southern Companies’ Interconnection Requirements for Inverter-Based Generation.[[8]](#footnote-8)
  2. In addition, if the standard model does not accurately represent the equipment’s dynamic response, user-written models should be submitted along with the standard model. The user-written models must include the model characteristics, including block diagrams, values and names for all model parameters and a list of all state variables.

**User-Written** **Models** **Attached**

1. **Three Phase Modeling Data.**

*Complete if ESR is AC connected. For DC connected ESR, ensure sections 8 & 9 consider DC connected ESR.*

* 1. Provide with this form a three-phase model for the for the ESR inverter and any additional dynamic reactive control devices.[[9]](#footnote-9) **Attached**  **Provide at NTP**

1. **ESR Inverter Step-Up Transformers.** Number of inverter transformers:        
   *Complete if ESR inverters are connected to separate step-up transformers from PV inverters.*

*Provide data for either two-winding or three-winding transformer as appropriate.*

**Two-Winding Inverter Step-Up Transformer Data (as applicable):**

* 1. Nameplate Rating (at 95°F ambient):       MVA
  2. Maximum Rating (if applicable):       MVA
  3. Nominal Voltage for each winding (Low/High):       /       kV
  4. Winding Connections (Low/High): /
  5. Available taps:       /       /       /       /       kV **or**       %       # of taps.
  6. Positive sequence impedance (Z1)       %,       X/R on MVA rating above.
  7. Zero sequence impedance (Z0)       %,       X/R on MVA rating above.

**Three-Winding Inverter Step-Up Transformer Data (as applicable)**

* 1. GSU connection and winding (attach diagram and mark to reference this form).

|  | **H Winding Data** | **X Winding Data** | **Y Winding Data** |
| --- | --- | --- | --- |
| Full load ratings at 95°F ambient (i.e. OA/FA/FA) | /     /      MVA | /     /      MVA | /     /      MVA |
| Rated winding voltage base | kV  connected | kV  connected | kV  connected |
| Tap positions available | /       /       /       /       kV | /       /       /       /       kV | /       /       /       /       kV |
| Present Tap Setting  (if applicable) | kV | kV | kV |
| Neutral solidly grounded? (or) Neutral Grounding Resistor (if applicable) | Ohms | Ohms | Ohms |
| BIL rating | kV | kV | kV |

**Three-Winding Inverter Step-Up Transformer Impedance Data (as applicable)**

|  | **H-X Winding Data** | **H-Y Winding Data** | **X-Y Winding Data** |
| --- | --- | --- | --- |
| Transformer base for impedances provided | MVA | MVA | MVA |
| Positive sequence impedance Z1 | %       X/R | %       X/R | %       X/R |
| Zero sequence impedance Z0 | %       X/R | %       X/R | %       X/R |

1. **ESR Collector System Equivalent Model**.

*Complete if ESR inverters are connected directly to low-side of main transformer.*

*Provide either absolute or per unit impedance values.*

1. Collector system voltage =       kV
2. Collector system equivalent model rating at 95°F ambient =       MVA
3. R1 =       ohm or       pu on 100 MVA and line kV base (positive sequence)
4. X1 =       ohm or       pu on 100 MVA and line kV base (positive sequence)
5. B1 =       μF or       pu on 100 MVA and line kV base (positive sequence)
6. R0 =       ohm or       pu on 100 MVA and line kV base (zero sequence)
7. X0 =       ohm or       pu on 100 MVA and line kV base (zero sequence)
8. B0 =       μF or       pu on 100 MVA and line kV base (zero sequence)
9. **ESR Main Transformer (if applicable).** Number of ESR main transformers:        
   *Complete if ESR inverters are connected to a separate main transformer from PV inverters.   
   Provide data for either two-winding or three-winding transformer as appropriate.*

**Two-Winding ESR Main Transformer Data (as applicable)**

1. Rating at 95°F ambient (OA/FA/FA):       /       /       MVA
2. Nominal Voltage for each winding (Low/High):       /       kV
3. Winding Connections (Low/High): /
4. Available tap positions:       /       /       /       /       kV **or**       %       # of taps.
5. Positive sequence impedance Z1:       %,       X/R on self-cooled (OA) MVA rating above.
6. Zero sequence impedance Z0:       %,       X/R on self-cooled (OA) MVA rating above.
7. For pad mount transformer, construction:

**Three-Winding ESR Main Transformer Data (as applicable)**

1. GSU connection and winding (attach diagram and mark to reference this form).

|  | **H Winding Data** | **X Winding Data** | **Y Winding Data** |
| --- | --- | --- | --- |
| Full load ratings at 95°F ambient (i.e. OA/FA/FA) | /     /      MVA | /     /      MVA | /     /      MVA |
| Rated winding voltage base | kV  connected | kV  connected | kV  connected |
| Tap positions available | /       /       /       /       kV | /       /       /       /       kV | /       /       /       /       kV |
| Present Tap Setting  (if applicable) | kV | kV | kV |
| Neutral solidly grounded? (or) Neutral Grounding Resistor (if applicable) | Ohms | Ohms | Ohms |
| BIL rating | kV | kV | kV |

**Three-Winding ESR Main Transformer Impedance Data (as applicable)**

|  | **H-X Winding Data** | **H-Y Winding Data** | **X-Y Winding Data** |
| --- | --- | --- | --- |
| Transformer base for impedances provided | MVA | MVA | MVA |
| Positive sequence impedance Z1 | %       X/R | %       X/R | %       X/R |
| Zero sequence impedance Z0 | %       X/R | %       X/R | %       X/R |

**Rapid Voltage Change (RVC) Induced by ESR Main Transformer[[10]](#footnote-10)**

1. Provide RVC mitigation strategy on main transformer energization:

ESR Main Transformer to be energized from the high side with a switching device that is equipped with pre-insertion resistors or point of wave control (**required** if valid main transformer energization data cannot be provided, or if deficiency is identified).

1) Device:

1. Manufacturer:

ESR Main Transformer Energization Data:

3) Air core inductance:       pu (From H winding side on       MVA Base)

4) No-load test results:

i. Rated Voltage of Winding at which current is determined:       kV

ii. Current at 90% / 100% / 110% of rated voltage:       /       /       A

iii. Losses at 90% / 100% / 110% of rated voltage:       /       /       W

1. The Generating Facility will be required to comply with the RVC limits set forth in the Southern Companies’ Power Quality Policy prior to being approved for Commercial Operation. Southern Companies’ Power Quality Policy can be found in the Generator Interconnection folder on Southern Companies OASIS website at https://www.oasis.oati.com/SOCO. [↑](#footnote-ref-1)
2. As required by NERC Reliability Standard MOD-032-1. [↑](#footnote-ref-2)
3. Southern Companies’ Interconnection Requirements for Inverter-Based Generation document can be found in the Generator Interconnection folder on Southern Companies OASIS website at https://www.oasis.oati.com/SOCO. [↑](#footnote-ref-3)
4. A three-phase model (in PSCAD format) is not required for the Interconnection studies but will be required prior to Notice to Proceed under a Generator Interconnection Agreement. [↑](#footnote-ref-4)
5. Harmonic values should represent the total harmonics present at the POI, including all customer equipment, such as all inverters, cap banks, transformers, etc. If data for the harmonics produced by individual inverters is provided, that data will be screened during the Interconnection Studies; however, the Generating Facility will be required to comply with Southern Companies’ Power Quality Policy prior to being approved for Commercial Operation. Southern Companies’ Power Quality Policy can be found in the Generator Interconnection folder on Southern Companies OASIS website at https://www.oasis.oati.com/SOCO. [↑](#footnote-ref-5)
6. Grid charging is not evaluated as a part of the Southern Companies interconnection process. [↑](#footnote-ref-6)
7. As required by NERC Reliability Standard MOD-32-1. [↑](#footnote-ref-7)
8. Southern Companies’ Interconnection Requirements for Inverter-Based Generation document can be found in the Generator Interconnection folder on Southern Companies OASIS website at https://www.oasis.oati.com/SOCO. [↑](#footnote-ref-8)
9. A three-phase model (in EMTP-RV format) is not required for the Interconnection studies but will be required prior to Notice to Proceed under a Generator Interconnection Agreement. [↑](#footnote-ref-9)
10. The Generating Facility will be required to comply with the RVC limits set forth in the Southern Companies’ Power Quality Policy prior to being approved for Commercial Operation. Southern Companies’ Power Quality Policy can be found in the Generator Interconnection folder on Southern Companies OASIS website at https://www.oasis.oati.com/SOCO. [↑](#footnote-ref-10)