

## GIC data – RARF v 5.4:

- **Helpful references:**
  - Planning Geomagnetic Disturbance Task Force – Key Documents
    - [GIC System Model Procedure Manual ROS Approved July 7 2016](#)
    - [GIC Application Guide 2013 - Approved](#)
  - PDCWG Meeting – May 10, 2017 - GIC System Model Data Workshop presentations
    - [01 04 GIC System Model Workshop Material OU 05102017](#)
    - [02 Transformer Resistance Workshop Presentation 05162017](#)
    - [03 AEPs Ground Grid Resistance Measurement Procedure 05102017](#)
  - RARF Glossary - Resource Registration Glossary Library
    - <http://www.ercot.com/mktrules/guides/resourcereg/library>
    - Click on “By Section”
  
- **If the Resource Entity has questions about the RARF v 5.4 data fields, how can assistance be obtained?**
  - The above cited references will provide much helpful information.
  - This FAQ may help with some questions.
  - For questions about your specific site or the statements in this FAQ, please contact your ERCOT Account Manager for assistance.
  
- **Does the Resource Entity need to verify all the pre-populated entries in the RARF v 5.4 packages (released by ERCOT on or about 5/10/2017) for existing sites?**
  - Yes, best efforts have been made to pre-populate the new RARF v 5.4 forms, however, please verify that all entries are correct and current.
  
- **Is an entry required in every field in RARF v 5.4?**
  - An entry must be made for all required data fields. Please refer to the RARF Glossary for which fields are required for your Generation Resource’s technology type.
  
- **Do all previously embedded documents and models need to be re-embedded on the RARF v 5.4 forms?**
  - Yes, the pre-population process was not capable of embedding documents and models that were previously embedded.
  
- **What is “EPPRE” as used in the GIC System Model Procedure Manual?**
  - “EPPRE” - ERCOT-prescribed process applicable to Resource Entities that defines the method of data submittal for Resource Entities” - RARF v 5.4.
  
- **What GIC data is required for “Non-Modeled Generator” sites?**
  - “Non-Modeled Generator” sites are required to provide the same GIC data that all Generation Resource sites must provide. RARF v 5.4 GIC data for all modeled stations, transmission lines, series devices, GSUs, main power transformers and shunt devices are required. Please refer to PGRR046 and RRGR009 for details about data requirements

(Planning Guide Section 6.11 (1) (c).) Also, refer to the GIC System Model Procedure Manual at the above referenced link.

- **Are PTI Bus Numbers required fields in RARF v 5.4?**
  - PTI Bus Numbers are only required in the Unit Info tab for the Point of Interconnection bus number and on the Line Data tab for the TSP bus number connecting a Resource Entity-owned line to a TSP bus.
- **What is the meaning of the RARF validation error message “Do Substations exist?”**
  - The Resource Entity (RE) needs to enter data on the RARF Transmission Form – Station tab. One row must be completed on the Station tab for each transmission voltage level.
  - If there is only one Resource Entity-owned station or if the Resource Entity doesn’t own the station, then the Resource Entity still needs to complete row 9. Cell B9 - ERCOT Station Code or Mnemonic would be the same as B5 - Resource Site Code, cell C9 - Station Long Name would be the same as the General Site ESIID Information form - General and Site Information tab – row 16. Cells F9 – L9 must also be entered.
  - Station Grounding Resistance (column F) - is the DC Station Grounding Resistance for the ground grid to which the transmission voltage grounded-wye transformer windings and grounded-wye reactors are connected. It is suggested that the Resource Entity refer to AEP’s presentation at the May 10, 2017 PDCWG - GIC System Model Data Workshop as referenced above.
  - Special case A - In any case where the Resource Entity station/equipment is adjacent to the TSP station/equipment, it is important that the Resource Entity coordinates with the TSP to discuss the ground grids and determine if they are shared/connected. In cases where there is a shared/connected ground grid with a TSP, and if the Resource Entity confirms with the TSP that the TSP has provided a non-zero DC “Station Grounding Resistance” for the station in its GIC data file provided to ERCOT, the Resource Entity may enter “0” (zero) on the RARF for DC “Station Grounding Resistance”. If the Resource Entity can’t confirm that the TSP has provided the DC “Station Grounding Resistance” to ERCOT in its GIC data file, then the Resource Entity must provide a non-zero DC “Station Grounding Resistance” for the station. Coordination with the TSP is needed to be sure that the GIC - DC “Station Grounding Resistance” is provided for the station to ERCOT.
  - Special case B - In any case where the Resource Entity GSUs or main power transformers are all delta connected (no grounded-wye) on the transmission voltage transformer windings and there are no grounded-wye reactors on the transmission voltage, if the Resource Entity doesn’t have a value for DC “Station Grounding Resistance”, then the RE may enter “0” (zero) on the RARF for DC “Station Grounding Resistance”. If there are any grounded-wye transformer windings or reactors on the transmission voltage, the Resource Entity must enter a non-zero DC “Station Grounding Resistance”.

- **On the Line Data tab in the RARF Transmission Form – what needs to be entered in the DC Resistance field?**
  - Option 1 - enter Ohms per phase for the line - temperature adjusted to 50 or 75 degrees C.
  - Option 2 - enter “0” (zero) on the RARF to elect to use the AC Resistance converted to Ohms per phase by the GIC program.
- **What should be entered for capacitor banks on the RARF - Capacitor and Reactor Data tab for Coil DC Resistance and Grounding DC Resistance?**
  - The value of “99999” can be entered for capacitor banks for both Coil DC Resistance and Grounding DC Resistance. (It may be necessary to use a work-around as follows – open a blank worksheet – enter “99999” in any cell – copy – paste special value into the Coil DC Resistance and Grounding DC Resistance fields.)
- **For reactor banks what should be entered on the RARF - Capacitor and Reactor Data tab for Coil DC Resistance and Grounding DC Resistance?**
  - Enter Ohms per phase from a test report for the Coil DC Resistance adjusted to 75 degrees C.
  - Enter zero or near zero value for Grounding DC Resistance for solidly grounded-wye connected reactor banks. For ungrounded-wye or delta, enter “99999”. (It may be necessary to use a work-around as follows – open a blank worksheet – enter “99999” in any cell – copy – paste special value into the Grounding DC Resistance fields.)
- **For transformer GIC data - what are Winding 1 and Winding 2?**
  - In the RARF Transformer Data tab – Winding 1 is the high voltage winding and Winding 2 is the low voltage winding. For autotransformers – Winding 1 is the series winding and Winding 2 is the common winding.
- **For transformer GIC data – DC Resistance of Winding 1 – how do I use the resistance values in the transformer test report to calculate the RARF value?**
  - Refer to [02 Transformer Resistance Workshop Presentation 05162017](#) for details of calculating the required RARF values including temperature adjustment to 75 degrees C.
- **For transformer GIC data – DC Resistance of Winding 2 – how do I use the resistance values in the transformer test report to calculate the RARF value?**
  - Refer to [02 Transformer Resistance Workshop Presentation 05162017](#) for details of calculating the required RARF values including temperature adjustment to 75 degrees C
  - Special Case – For a physical 3-winding transformer that has been entered in the RARF as three 2-winding transformers (for example, a GSU with one high voltage winding and two low voltage windings) – Winding 2 is entered as 1 KV in the RARF - Low Side Voltage Level (no-load) and Low Side Manufactured Nominal Voltage fields – enter “99999” for both DC Resistance of Winding 2 and Winding 2 Grounding DC Resistance. (It may be necessary to use a work-around as follows – open a blank worksheet – enter “99999” in any cell – copy – paste special value.)
- **What needs to be entered for GIC Blocking device on Winding 1?**
  - Select “Y” or “N”. Answer Yes or No whether a Geomagnetic Induced Current blocking device exists on the high voltage winding (or for autotransformers, the series winding).

- **What needs to be entered for GIC Blocking device on Winding 2?**
  - Select “Y” or “N”. Answer Yes or No whether a Geomagnetic Induced Current blocking device exists on the low voltage winding, (or for autotransformers, the common winding).
- **How is the transformer Vector Group Identifier determined?**
  - Determine from the manufacturer the alphanumeric identifier specifying vector group based on transformer winding connections and grounding. Select from a drop-down list of Vector Group Identifiers for 2-winding, 3-winding and autotransformers. (For “YNdd” transformers it may be necessary to use a work-around as follows – open a blank worksheet – enter “YNdd” in any cell – copy – paste special value.)
  - Special Case - For physical three-winding transformers modeled as three 2-winding transformers, enter the same Vector Group Identifier in each of the 3 rows.
- **How is the Transformer Core Design Type determined?**
  - Determine from the manufacturer the Transformer Core Design Type. Select from a drop-down list -1=Three Phase Shell Form, 0=Unknown core design, 1=3@Single Phase (separate cores), 3=Three Phase 3-Legged Core Design, 5=Three Phase 5-Legged Core Design, 7=Three Phase 7-Legged Core Design. (For a “-1=Three Phase shell Form” transformer it may be necessary to use a work-around as follows – open a blank worksheet – enter “-1=Three Phase shell Form” in any cell – copy – paste special value.)
  - Special Case - For physical three-winding transformers modeled as three 2-winding transformers, enter the same Transformer Core Design Type in each of the 3 rows.
- **How is the Transformer K Factor determined?**
  - The K Factor may be supplied by transformer manufacturer. If data is unavailable from the manufacturer, enter “0” (zero) which will result in a default value of K Factor being used based on voltage and Transformer Core Design. In requesting the K Factor from the manufacturer, it is suggested that the Resource Entity provide the manufacturer [Section 3.3 of the GIC System Model Procedure Manual ROS Approved July 7 2016](#).
  - Special Case - For physical three-winding transformers modeled as three 2-winding transformers, enter the same transformer K Factor in each of the 3 rows.
- **What value needs to be entered for Transformer - Winding 1 Grounding DC Resistance?**
  - Enter the Winding 1 Grounding DC Resistance in Ohms for any grounding device - for a solidly grounded winding enter “0” (zero) or near zero, enter "99999" for ungrounded-wye or delta and enter the DC resistance for any grounding reactor for a grounded-wye transformer winding. (To enter “99999” it may be necessary to use a work-around as follows – open a blank worksheet – enter “99999” in any cell – copy – paste special value.)
- **What value needs to be entered for Transformer - Winding 2 Grounding DC Resistance?**
  - Enter the Winding 2 Grounding DC Resistance in Ohms for any grounding device - for a solidly grounded-wye winding enter “0” (zero) or near zero, enter "99999" for ungrounded-wye or delta windings and enter the DC resistance for any grounding reactor for a grounded-wye transformer winding. (To enter “99999” it may be

necessary to use a work-around as follows – open a blank worksheet – enter “99999” in any cell – copy – paste special value.)

- Special Case – For a physical 3-winding transformer that has been entered in the RARF as three 2-winding transformers (for example, a GSU with one high voltage winding and two low voltage windings) – Winding 2 is entered as 1 KV in the RARF - Low Side Voltage Level (no-load) and Low Side Manufactured Nominal Voltage fields – enter “99999” for Winding 2 Grounding DC Resistance. (It may be necessary to use a work-around as follows – open a blank worksheet – enter “99999” in any cell – copy – paste special value.)
- **What value needs to be entered for Transformer - Model?**
  - Enter “0” except for a phase-shifting transformer, which should be entered as a “1”.
  - Special Case - For physical three-winding transformers modeled as three 2-winding transformers, enter the same Transformer Model in each of the 3 rows.
- **On the Series Device Data tab in the RARF Transmission Form – what needs to be entered in the DC Resistance field?**
  - Option 1 - enter Ohms per phase for the Series Device - temperature adjusted to 50 or 75 degrees C.
  - Option 2 - enter “0” (zero) on the RARF to elect to use the AC Resistance converted to Ohms per phase by the GIC program.
- **Is it required to submit the transformer test report for each GSU or main power transformer?**
  - Yes, it is required.

#### Non-GIC data - RARF v 5.4:

- **Why would there be an Error message for missing data for a device that I have previously marked “Delete” in column A on a tab in the Transmission Form?**
  - The RARF validation rules are run on all rows in the RARF even if marked as “Delete” in column A. After a RARF has been loaded into the Network Operations Model on its Model Ready Date (MRD), the Resource Entity needs to clear the contents of rows in any tabs on the Transmission Form that were previously marked “Delete” and then move all data on subsequent rows up in order to not leave any blank rows.
- **What files need to be embedded in the RARF v 5.4?**
  - Embedded files include, but are not limited to, the following - station one-lines, transformer test reports, collector system models and one-lines, dynamic models and data, PSCAD models and data and inverter efficiency curves.
- **How are files embedded in the appropriate RARF tabs?**
  - Refer to Section 3.2 of the Resource Registration Guide v 5.4 021517 located in the RARF package which is found at the below link.
  - [Resource Asset Registration Forms](#)  
Package of files necessary to register a Resource
- **Where can the list of RARF v 5.4 validation rules be found?**
  - [Resource Asset Registration Forms](#)

- **What is needed on the RARF Transmission Form – Station tab for Normal Voltage Limit - Max p.u. above 60 kV, Normal Voltage Limit - Min p.u. Base above 60 kV, Emergency Voltage Limit - Max p.u. above 60 kV, Emergency Voltage Limit -Min p.u. Base above 60 kV?**
  - These fields are for Resource Entity-owned equipment and facilities. The Resource Entity must enter at least row 9 on the Station tab even if it does not own the station.
  - For each transmission level voltage, provide the Resource Entity-defined normal high voltage limit. If the Resource Entity does not have a unique voltage limit, may enter 1.05 as a default.
  - For each transmission level voltage, provide the Resource Entity-defined normal low voltage limit. If the Resource Entity does not have a unique voltage limit, may enter 0.95 as a default.
  - For each transmission level voltage, provide the Resource Entity-defined emergency high voltage limit. If the Resource Entity does not have a unique voltage limit, may enter 1.10 as a default.
  - For each transmission level voltage, provide the Resource Entity-defined emergency low voltage limit. If the Resource Entity does not have a unique voltage limit, may enter 0.90 as a default.
  
- **What is entered for Relay Loadability Limit (MVA) on the Line Temperature tab in the Transmission Form?**
  - For each line on the RARF Line Data tab - enter the MVA loading that would cause the circuit to trip within 15 minutes of exceeding that value (Resource Entity-owned relays only). If there is no Resource Entity-owned relay set to trip the line due to loading – enter “99999”. (To enter “99999” it may be necessary to use a work-around as follows – open a blank worksheet – enter “99999” in any cell – copy – paste special value.)
  - If the Resource Entity has no data on the Line Data tab because it doesn’t own any lines, then no entries are needed on the Line Temperature tab.
  
- **What is entered for Relay Loadability Limit (MVA) on the Transformer Data tab in the Transmission Form?**
  - For each transformer on the Transformer Data tab enter the MVA loading that would cause the transformer to trip within 15 minutes of exceeding that value (Resource Entity-owned relays only). If there is no Resource Entity-owned relay set to trip the transformer due to loading – enter “99999”. (To enter “99999” it may be necessary to use a work-around as follows – open a blank worksheet – enter “99999” in any cell – copy – paste special value.)
  - Special Case - If the Resource Entity has no data on the Transformer Data tab because it doesn’t model any transformers, then no entries are needed on the Transformer Data tab.
  
- **Under what circumstances is an entry in the Most Limiting Series Element tab required?**
  - The Resource Entity needs to enter on their RARF the most limiting Resource Entity-owned device that is in series with a non-Resource Entity-owned line (or series device). An entry is only made for cases where there is a Resource Entity-owned device in the series path from station to station with a non-Resource Entity-owned line (or

- series device) that may limit the ratings of that path. The Resource Entity does NOT need to provide any TSP data, TSP line ratings or TSP equipment ratings. The only TSP information that the Resource Entity would need to enter on the RARF is the TSP-owned line name/code in the field “Device Restricted by the MLSE”.
- In regard to Resource Entity-owned transformers (GSUs or main power transformers), the RARF already contains the ratings of the Resource Entity-owned transformers with their ratings, so there would not be an entry for Resource Entity-owned transformers on the Most Limiting Series Element tab.
  - A typical case where there would be an entry in the “Most Limiting Series Element” (MLSE) tab is where the POI is at the Resource Entity-owned station because the TSP owns the line(s) that terminates at the Resource Entity-owned station. In that case the Resource Entity could own breakers, switches, wave traps, jumpers or CTs that could be a “Most Limiting Series Element Device” that is in the series path with a TSP-owned line from the Resource Entity-owned station to the TSP-owned station.
  - Example A: The Resource Entity owns “SWITCH1” that connects in series with a TSP-owned line and “SWITCH1” is the most limiting Resource Entity-owned device in that series path. The Resource Entity would enter “SWITCH1” on the Most Limiting Series Element tab as the “Most Limiting Series Element Device” and indicate that the “Device restricted by the MLSE” is the TSP-owned line (entered as the modeled name/code of the TSP-owned line). The Resource Entity would enter the ratings of “SWITCH1” in the “Normal Rating”, “2-hr Emergency Rating” and “15-min Rating” fields on the Most Limiting Series Element tab.
  - Example B: The TSP owns a line to the Resource Entity-owned station and connects between two Resource Entity-owned breakers (“BKR1” and “BKR2”). If “BKR1” and “BKR2” are “normally closed” and are the most limiting series element devices owned by the Resource Entity in series with the TSP-owned line, then the “Most Limiting Series Element Device” would be “BKR1, BKR2” and the “Device Restricted by the MLSE” is the TSP line. The Resource Entity would enter the sum of “BKR1” and “BKR2” ratings in the “Normal Rating”, “2-hr Emergency Rating” and “15-min Rating” fields on the Most Limiting Series Element tab.
  - Example C: The Resource Entity owns the line from its Resource Entity-owned station to the TSP-owned station (POI). In this case there would be no entry on the Most Limiting Series Element tab in the RARF. The RARF would already have the Resource Entity-owned line on the Line Data tab, with its associated ratings on the Line Temperature tab which would include the most limiting Resource Entity-owned device in the path.
- **In the RARF – Gen Form – Reactive Capability – GEN tab, my data was in row 11, but why was there data in rows 12 – 16 not associated with my Generation Resource?**
    - During RARF v 5.4 testing a set of test values were inadvertently left in the RARF template for the Gen Form – Reactive Capability – GEN tab. Please clear contents for all cells containing the test data. This test data issue did not occur for the Combined Cycle Form or Renewable Form.

- **In the RARF Protection tab in the Gen Form, Combined Cycle Form and Renewable Form has the order of entering the pairs of setting/time delay changed in RARF v 5.4?**
  - Yes. Please take note of the validation rules for these Protection tab settings.
  - The order of entry of the pairs for Over-voltage settings is such that Time1>Time2>Time3>Time4.
  - Note that the Under-voltage settings need to be in the order – Time4>Time3>Time2>Time1.
  - The order of entry of the pairs for Under-frequency settings is such that Under-frequency 4 setting < Under-frequency 3 setting < Under-frequency 2 setting < Under-frequency 1 setting.
  - Note that the Over-frequency settings need to be in the order Over-frequency 4 > Over-frequency 3 > Over-frequency 2 > Over-frequency 1).
- **On the Renewable Form – Wind Turbine Details tab, is column AF - Continuous Rating MVA for the wind turbine generator or for the Turbine Step-up Transformer?**
  - Column AF - Continuous Rating MVA is for the Turbine Step-up Transformer. The currently posted RARF v 5.4 has been corrected to group column AF with the other Turbine Step-up Transformer Data fields.
- **On the Renewable Form – Panel Details tab, is the “MW Rating for this Model of Panel” – KW need to be entered as MW or KW?**
  - The heading of the field is being modified to “KW Rating for this Model of Panel” – KW, please enter the KW rating of the panel.
- **On the Renewable Form – Inverter Details tab, why is the Inverter Model required to be numeric?**
  - The Inverter Model field is being changed to allow All Caps text like the Panel Model.
- **On the Renewable Form – Panel Details tab, what is the Plane of Array - Azimuth?**
  - For a Tracking Type of Fixed/None or Single Axis – enter the degrees of rotation of the panel face using true north as a reference, where “90” degrees means that the panel is facing east and 180 degrees means that the panel is facing south. As a default, enter “0” (zero) degrees if panel is facing directly up (vertical).
  - For a Tracking Type of Double axis – enter “0” (zero).
- **On the Renewable Form – Panel Details tab, what is the Plane of Array - Tilt?**
  - For a Tracking Type of Fixed/None or Single Axis – enter the angle in degrees from horizontal ground level to panel face, where “0” (zero) degrees means that the panel is facing directly up (vertical).
  - For a Tracking Type of Double axis – enter “0” (zero).