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| RRGRR Number | [022](http://www.ercot.com/mktrules/issues/RRGRR022) | RRGRR Title | Related to NPRR973, Add Definitions for Generator Step-Up and Main Power Transformer |
| Date of Decision | June 24, 2020 |
| Action | Recommended Approval |
| Timeline | Normal |
| Proposed Effective Date | Upon system implementation of Nodal Protocol Revision Request (NPRR) 973, Add Definitions for Generator Step-Up and Main Power Transformer |
| Priority and Rank Assigned | Not Applicable |
| Resource Registration Glossary Sections Requiring Revision  | Section 2, Resource Registration Glossary – ProtectionSection 2, Resource Registration Glossary – Transformer Data (as applicable) |
| Related Documents Requiring Revision/Related Revision Requests | NPRR973 Nodal Operating Guide Revision Request (NOGRR) 196, Related to NPRR973, Add Definitions for Generator Step-Up and Main Power Transformer Planning Guide Revision Request (PGRR) 074, Related to NPRR973, Add Definitions for Generator Step-Up and Main Power Transformer |
| Revision Description | This Resource Registration Glossary Revision Request (RRGRR) clarifies language by use of NPRR973-proposed defined terms Generation Step-Up (GSU) and Main Power Transformer (MPT). |
| Reason for Revision |  Addresses current operational issues. Meets Strategic goals (tied to the [ERCOT Strategic Plan](http://www.ercot.com/content/wcm/lists/144926/ERCOT_Strategic_Plan_2019-2023.pdf) or directed by the ERCOT Board). Market efficiencies or enhancements Administrative Regulatory requirements Other: (explain)*(please select all that apply)* |
| Business Case | For Wind-powered Generation Resources (WGRs), the transformer that steps up to transmission level voltage (with a high-side voltage greater than 60 kV) is referred to as the Main Power Transformer (MPT). The transformer that steps up from turbine level voltage (typically 600 – 700 V) to mid-voltage level (typically 34.5 kV) is referred to as the Generator Step-Up (GSU) transformer. NPRR973 proposes adding as defined terms Generator Step-Up and Main Power Transformer; these two terms are used in the Resource Registration Glossary. |
| ROS Decision | On 11/7/19, ROS voted unanimously to table RRGRR022 and refer the issue to the Planning Working Group (PLWG). All Market Segments were present for the vote.On 1/9/20, ROS voted unanimously to recommend approval of RRGRR022 as submitted. All Market Segments were present for the vote.On 2/6/20, ROS voted unanimously to endorse and forward to TAC the 1/9/20 ROS Report and Impact Analysis for RRGRR022. All Market Segments were present for the vote. |
| Summary of ROS Discussion | On 11/7/19, there was no discussion.On 1/9/20, there was no discussion.On 2/6/20, there was no discussion. |
| TAC Decision | On 6/24/20, TAC voted unanimously via roll call to recommend approval of RRGRR022 as recommended by ROS in the 2/6/20 ROS Report. All Market Segments were present for the vote. |
| Summary of TAC Discussion | On 6/24/20, there was no discussion. |
| ERCOT Opinion | ERCOT supports approval of RRGRR022. |

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| Phone Number | 512-248-6582 |
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| Market Segment | Not Applicable |

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| **Market Rules Staff Contact** |
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| **Comments Received** |
| Comment Author | **Comment Summary** |
| None |  |

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| Market Rules Notes |

Please note the baseline Protocol language in the following sections has been updated to reflect the incorporation of the following RRGRRs into the Resource Registration Glossary:

* RRGRR021, Dynamic Model Requirement for TSAT (incorporated 3/1/20)
	+ Section 2, Resource Registration Glossary – Protection

Please note that the following RRGRR(s) also proposes revisions to the following section(s):

* RRGRR023, Related to NPRR1002, BESTF-5 Energy Storage Resource Single Model Registration and Charging Restrictions in Emergency Conditions
	+ Section 2, Resource Registration Glossary – Protection
	+ Section 2, Resource Registration Glossary – Transformer Data (as applicable)
* RRGRR024, Related to NPRR1003, Elimination of References to Resource Asset Registration Form
	+ Section 2, Resource Registration Glossary – Protection
	+ Section 2, Resource Registration Glossary – Transformer Data (as applicable)

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| Proposed Guide Language Revision |

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| **RARF Tab** | **Wind** | **Solar Photovoltaic (PV)** | **Conventional Generation (Gen)** | **Combined Cycle (CC)** | **Load Resources** | **Distributed Generation** | **Notes** | **Field Name** | **Definition / Detailed Description** | **Screening Study (SS) (R, C, O, A)** | **Full Interconnect Study (FIS) (R, C, O, A)** | **Planning Model(R, C, O, A)**  | **Full Registration (R, C, O, A)**  |  |
|  **Protection** |
| Protection | X | X | X | X |  |  | List | Unit Name | Unit Code as provided on the Unit Info tab. |  | R | R | R |  |
| Protection | X |  |  | X |  |  | Automatic | SITE\_CODE | Site Code as provided on the General and Site Information tab. |  |  |  | A |  |
| Protection | X | X | X | X |  |  | Automatic | Resource Name (Unit Code/Mnemonic) | Concatenated mnemonic of Resource Site Code and Unit name (e.g. CBY\_CBYG1). |  |  | A | A |  |
| Protection | X | X | X | X |  |  | cycles | Breaker Interruption Time | Time taken (in cycles) between the breaker receiving the trip signal, and the breaker contacts opening to interrupt the flow of current. |  | R | R | R |  |
| Protection | X | X | X | X |  |  | p.u. | Instantaneous Undervoltage Trip | The per unit value (below nominal) of the undervoltage relay instantaneous set point. |  | O | O | O |  |
| Protection | X | X | X | X |  |  | p.u. | Undervoltage 1 | Enter the first level undervoltage relay set point in per unit. |  | C | C | C |  |
| Protection | X | X | X | X |  |  | sec | Time 1 | Enter the first level undervoltage time delay set point.  |  | C | C | C |  |
| Protection | X | X | X | X |  |  | p.u. | Undervoltage 2 | Enter the second level undervoltage relay set point in per unit. |  | C | C | C |  |
| Protection | X | X | X | X |  |  | sec | Time 2 | Enter the second level undervoltage time delay set point.  |  | C | C | C |  |
| Protection | X | X | X | X |  |  | p.u. | Undervoltage 3 | Enter the third level undervoltage relay set point in per unit. |  | C | C | C |  |
| Protection | X | X | X | X |  |  | sec | Time 3 | Enter the third level undervoltage time delay set point.  |  | C | C | C |  |
| Protection | X | X | X | X |  |  | p.u. | Undervoltage 4 | Enter the fourth level undervoltage relay set point in per unit. |  | C | C | C |  |
| Protection | X | X | X | X |  |  | sec | Time 4 | Enter the fourth level undervoltage time delay set point.  |  | C | C | C |  |
| Protection | X | X | X | X |  |  | p.u. | Instantaneous Overvoltage Trip | The per unit value (above nominal) of the overvoltage relay instantaneous set point. |  | O | O | O |  |
| Protection | X | X | X | X |  |  | p.u. | Overvoltage 1 | Enter the first level overvoltage relay set point in per unit. |  | C | C | C |  |
| Protection | X | X | X | X |  |  | sec | Time 1 | Enter the first level overvoltage relay time delay set point.  |  | C | C | C |  |
| Protection | X | X | X | X |  |  | p.u. | Overvoltage 2 | Enter the second level overvoltage relay set point in per unit. |  | C | C | C |  |
| Protection | X | X | X | X |  |  | sec | Time 2 | Enter the second level overvoltage relay time delay set point.  |  | C | C | C |  |
| Protection | X | X | X | X |  |  | p.u. | Overvoltage 3 | Enter the third level overvoltage relay set point in per unit. |  | C | C | C |  |
| Protection | X | X | X | X |  |  | sec | Time 3 | Enter the third level overvoltage relay time delay set point.  |  | C | C | C |  |
| Protection | X | X | X | X |  |  | p.u. | Overvoltage 4 | Enter the fourth level overvoltage relay set point in per unit. |  | C | C | C |  |
| Protection | X | X | X | X |  |  | sec | Time 4 | Enter the fourth level overvoltage relay time delay set point.  |  | C | C | C |  |
| Protection | X | X | X | X |  |  | Hz | Instantaneous Underfrequency Trip | The per unit value (below 60Hz) of the underfrequency relay instantaneous set point. |  | O | O | O |  |
| Protection | X | X | X | X |  |  | Hz | Underfrequency 1 | Enter the first level underfrequency relay set point in Hz. |  | C | C | C |  |
| Protection | X | X | X | X |  |  | sec | Time 1 | Enter the first level underfrequency relay time delay set point.  |  | C | C | C |  |
| Protection | X | X | X | X |  |  | Hz | Underfrequency 2 | Enter the second level underfrequency relay set point in Hz. |  | C | C | C |  |
| Protection | X | X | X | X |  |  | sec | Time 2 | Enter the second level underfrequency relay time delay set point.  |  | C | C | C |  |
| Protection | X | X | X | X |  |  | Hz | Underfrequency 3 | Enter the third level underfrequency relay set point in Hz. |  | C | C | C |  |
| Protection | X | X | X | X |  |  | sec | Time 3 | Enter the third level underfrequency relay time delay set point.  |  | C | C | C |  |
| Protection | X | X | X | X |  |  | Hz | Underfrequency 4 | Enter the fourth level underfrequency relay set point in Hz. |  | C | C | C |  |
| Protection | X | X | X | X |  |  | sec | Time 4 | Enter the fourth level underfrequency relay time delay set point.  |  | C | C | C |  |
| Protection | X | X | X | X |  |  | Hz | Instantaneous Overfrequency Trip | The per unit value (above 60Hz) of the overfrequency relay instantaneous set point. |  | O | O | O |  |
| Protection | X | X | X | X |  |  | Hz | Overfrequency 1 | Enter the first level overfrequency relay set point in Hz. |  | C | C | C |  |
| Protection | X | X | X | X |  |  | sec | Time 1 | Enter the first level overfrequency relay time delay set point.  |  | C | C | C |  |
| Protection | X | X | X | X |  |  | Hz | Overfrequency 2 | Enter the second level overfrequency relay set point in Hz. |  | C | C | C |  |
| Protection | X | X | X | X |  |  | sec | Time 2 | Enter the second level overfrequency relay time delay set point.  |  | C | C | C |  |
| Protection | X | X | X | X |  |  | Hz | Overfrequency 3 | Enter the third level overfrequency relay set point in Hz. |  | C | C | C |  |
| Protection | X | X | X | X |  |  | sec | Time 3 | Enter the third level overfrequency relay time delay set point.  |  | C | C | C |  |
| Protection | X | X | X | X |  |  | Hz | Overfrequency 4 | Enter the fourth level overfrequency relay set point in Hz. |  | C | C | C |  |
| Protection | X | X | X | X |  |  | sec | Time 4 | Enter the fourth level overfrequency relay time delay set point.  |  | C | C | C |  |
| Protection | X |  |  |  |  |  | Y/N | Does the resource have the manufacturer's technical document / Simulation Results / Test Results, etc. describing the turbine technology & VRT optIons purchased with turbine, if any | TURBINE VRT CAPABILITY: Ensure that VRT capability is included as part of the normal dynamic model data submitted. If yes, provide the following: (1) the PSS/E dynamic model including the settings, and (2) technical manufacturer's documents describing the VRT capabilities of the purchased packages. Models and documents are to be embedded in the RARF Dynamic Data tab or included in the zip file. |  | R | R | R |  |
| ***[RRGRR021: Replace the Protection field above with the following on August 1, 2020:]*** |
| Protection | X |  |  |  |  |  | Y/N | Does the resource have the manufacturer's technical document / Simulation Results / Test Results, etc. describing the turbine technology & VRT optIons purchased with turbine, if any | TURBINE VRT CAPABILITY: Ensure that VRT capability is included as part of the normal dynamic model data submitted. If yes, provide the following: (1) the PSS/E dynamic model including the settings, (2) the TSAT dynamic model including the settings, and (3) technical manufacturer's documents describing the VRT capabilities of the purchased packages. Models and documents are to be embedded in the RARF Dynamic Data tab or included in the zip file. |  | R | R | R |  |
| Protection | X |  |  |  |  |  | Y/N | Does the Resource use dynamic reactive devices (SVC/statcom, etc.) at the wind farm? - (note: capacitor/reactor banks used for conventional reactive support cannot be considered as dynamic reactive devices) - If yes, please provide supporting documentation. (manufacturer's technical document, PSS/E model etc.), submitted in the Dynamics Data Tab. | TURBINE VRT CAPABILITY: If yes, provide the following (1) the PSS/E dynamic model for the Dynamic Reactive Device (SVC, DVAR, STATCOM), including the settings, and (2) a manufacturer's technical document describing the dynamic device and model.Models and documents are to be embedded in the RARF Dynamic Data tab or included in the zip file. |  | R | R | R |  |
| ***[RRGRR021: Replace the Protection field above with the following on August 1, 2020:]*** |
| Protection | X |  |  |  |  |  | Y/N | Does the Resource use dynamic reactive devices (SVC/statcom, etc.) at the wind farm? - (note: capacitor/reactor banks used for conventional reactive support cannot be considered as dynamic reactive devices) - If yes, please provide supporting documentation. (manufacturer's technical document, PSS/E model, TSAT model etc.), submitted in the Dynamics Data Tab. | TURBINE VRT CAPABILITY: If yes, provide the following (1) the PSS/E dynamic model for the Dynamic Reactive Device (SVC, DVAR, STATCOM), including the settings, (2) the TSAT dynamic model for the Dynamic Reactive Device (SVC, DVAR, STATCOM), including the settings, and (3) a manufacturer's technical document describing the dynamic device and model. Models and documents are to be embedded in the RARF Dynamic Data tab or included in the zip file. |  | R | R | R |  |
| Protection | X |  |  |  |  |  | Y/N | Does the Resource have plant voltage protection? If yes, please provide supporting documentation. | TURBINE VRT CAPABILITY: Plant voltage protection is substation Main Power Transformer (MPT) and equipment protection, If yes, provide a technical description of the protection scheme and voltage settings. The documents are to be embedded in the RARF Dynamic Data tab or included in the zip file. |  | R | R | R |  |
| Protection | X |  |  |  |  |  | Y/N | Does The Resource Have Feeder Voltage Protection? If Yes, Please Provide Supporting Documentation. | TURBINE VRT CAPABILITY: Feeder voltage protection is protection on the feeder breakers, If yes, provide a technical description of the protection scheme and voltage settings. The documents are to be embedded in the RARF Dynamic Data tab or included in the zip file. |  | R | R | R |  |
| **Transformer Data (as applicable)** |
| Transformer Data | X | X | X | X |   |   | List | Description of Change | Select: description of change from drop down list: Add, Change or Delete |   |   |   | C |   |
| Transformer Data | X | X | X | X |   |   | enter all caps | Transformer Name | Transformer name must be 14 characters or less and contain no special characters other than an underscore "\_". |   |   | R | R |   |
| Transformer Data | X | X | X | X |   |   | enter all caps | ERCOT Station Name (Station Code or Station Mnemonic) | ERCOT Station Code/Mnemonic where the transformer is located. |   |   | R | R |   |
| Transformer Data | X | X | X | X |   |   | Automatic | Transformer Code | Concatenated code automatically provided |   |   | A | A |   |
| Transformer Data | X | X | X | X |   |   | Y/N | Transformer Test Report Attached? | Is the Transformer test report attached to this Resource Registration? Submit the Transformer Test Report as a zip file attached to the RARF submission. |   |   | R | R |   |
| Transformer Data | X | X | X | X |   |   | Y/N | Is This Transformer In a Master-follower Current Balancing Configuration? | Select Y or N whether this transformer is part of a master - following configuration |   |   | R | R |   |
| Transformer Data | X | X | X | X |   |   | enter all caps | Master Name(can Be Same As this transformer) | The registered name of the transformer designated as the master in a parallel transformer control system scheme.  |   |   |   | C |   |
| Transformer Data | X | X | X | X |   |   | enter all caps | Follower Name(can Be Same As this transformer) | The registered name of the transformer designated as the follower in a parallel transformer control system scheme.  |   |   |   | C |   |
| Transformer Data | X | X | X | X |   |   | Y/N | Main Power Transformer (MPT)? | Select Y or N whether this transformer is a Main Power Transformer (MPT) |   | R | R | R |   |
| Transformer Data | X | X | X | X |   |   |   | Zero Sequence Data Winding Connect code (1-5) | Enter zero sequence data winding connect code 1 - 5 as noted below. Transformer Connection Codes:Two Winding Transformers (in order of Voltage highest first)1 -- Wye-Wye Bank Both Neutrals Grounded2 -- Wye - Delta Bank Grounded Wye3 -- Delta - Wye Bank Grounded Wye4 -- Delta - Delta Bank; Wye-Delta Bank Ungrounded Wye; Delta-Wye Bank Ungrounded Wye; Wye-Wye Bank Either Wye Grounded5 -- Three Winding only (Test Reports needed for Code 5) |   | R | R | R |   |
| Transformer Data | X | X | X | X |   |   | p.u. | Zero Sequence Grounding Resistance For An Impedance Grounded Transformer in P.u. (100 MVA Base) | Zero Sequence Grounding Resistance For An Impedance Grounded Generator in p.u. (100 MVA Base) and the nominal system voltage (69, 138 or 345 kV) |   | R | R | R |   |
| Transformer Data | X | X | X | X |   |   | p.u. | Zero Sequence Grounding Reactance For An Impedance Grounded Transformer In P.u. (100 MVA Base) | Zero Sequence Grounding Reactance For An Impedance Grounded Transformer In P.u. (100 MVA Base) and the nominal system voltage (69, 138 or 345 kV) |   | R | R | R |   |
| Transformer Data | X | X | X | X |   |   | p.u. | Zero Sequence Resistance In p.u. (100 MVA Base) | Zero Sequence Resistance In p.u. (100 MVA Base) and the nominal system voltage (69, 138 or 345 kV) |   | R | R | R |   |
| Transformer Data | X | X | X | X |   |   | p.u. | Zero Sequence Reactance In P.u. (100 MVA Base) | Zero Sequence Reactance In P.u. (100 MVA Base) and the nominal system voltage (69, 138 or 345 kV) |   | R | R | R |   |
| Transformer Data | X | X | X | X |   |   | p.u. | Positive Sequence Resistance (100 MVA Base) | Positive Sequence Resistance (100 MVA Base) and the nominal system voltage (69, 138 or 345 kV) |   | R | R | R |   |
| Transformer Data | X | X | X | X |   |   | p.u. | Positive Sequence Reactance (100 MVA Base) | Positive Sequence Reactance (100 MVA Base) and the nominal system voltage (69, 138 or 345 kV) |   | R | R | R |   |
| Transformer Data | X | X | X | X |   |   | MVA | Normal Rating | The continuous MVA rating of the transformer, including substation terminal equipment in series with the transformer, at the applicable ambient temperature. The Transmission Element can operate at this rating indefinitely without damage, or violation of NESC clearances.  |   | R | R | R |   |
| Transformer Data | X | X | X | X |   |   | MVA | 2-hr Emergency Rating | The two-hour MVA rating of the transformer, including substation terminal equipment in series with the transformer, at the applicable ambient temperature. The Transmission Element can operate at this rating for two hours without violation of NESC clearances or equipment failure. |   | R | R | R |   |
| Transformer Data | X | X | X | X |   |   | MVA | 15-min Rating | The 15-minute MVA rating of the transformer, including substation terminal equipment in series with the transformer, at the applicable ambient temperature and with a step increase from a prior loading up to 90% of the Normal Rating. The transformer can operate at this rating for 15 minutes, assuming its pre-contingency loading up to 90% of the Normal Rating limit at the applicable ambient temperature, without violation of NESC clearances or equipment failure. This rating takes advantage of the time delay associated with heating of the transformer following a sudden increase in current.  |   | R | R | R |   |
| Transformer Data | X | X | X | X |   |   | MVA | Relay loadability limit | Enter the rating in MVA that would cause the circuit to trip within 15 minutes of exceeding that value. If no overload trip relay exists, enter "99999" |   |   | R | R |   |
| Transformer Data | X | X | X | X |   |   | enter all caps | Unit(s) Associated With This Transformer (Must be entered as SITECODE\_UNITNAME) | Enter the Unit(s) Associated With This Transformer (name must match unit names provided on the unit info tab) |   |   |   | C |   |
| Transformer Data | X | X | X | X |   |   | kV | High Side Voltage Level (no-Load) | Enter the voltage level of the high side for this transformer system nominal voltage (69, 138, 345 kV) |   |   | R | R |   |
| Transformer Data | X | X | X | X |   |   | # | High Side PTI Bus Number | Enter the PTI bus number for the high side of this transformer |   |   | O | O |   |
| Transformer Data | X | X | X | X |   |   | List | High Side Voltage Connection - Wye or Delta | Select whether this high side connection is a Wye or Delta connection |   | R | R | R |   |
| Transformer Data | X | X | X | X |   |   | Device 1 | High Side Voltage Connected Devices | Enter a device connected to the high side of this transformer |   |   |   | R |   |
| Transformer Data | X | X | X | X |   |   | kV | High Side Manufactured Nominal Voltage | Enter the high side manufactured nominal voltage for this transformer  |   | R | R | R |   |
| Transformer Data | X | X | X | X |   |   | kV | Low Side Voltage level (no-Load) | Enter the voltage level of the low side for this transformer  |   |   | R | R |   |
| Transformer Data | X | X | X | X |   |   | # | Low Side PTI Bus Number | Enter the PTI bus number for the low side of this transformer |   |   | O | O |   |
| Transformer Data | X | X | X | X |   |   | List | Low Side Voltage Connection - Wye or Delta | Select whether this low side connection is a Wye or Delta connection |   | R | R | R |   |
| Transformer Data | X | X | X | X |   |   | Device 1 | Low Side Voltage Connected Devices | Enter a device connected to the low side of this transformer |   |   |   | R |   |
| Transformer Data | X | X | X | X |   |   | kV | Low Side Manufactured Nominal Voltage | Enter the low side manufactured nominal voltage for this transformer |   | R | R | R |   |
| Transformer Data | X | X | X | X |   |   | Y/N | On-Load Voltage Regulation | Select Y or N whether this transformer will change tap settings automatically while online to control voltage. |   | R | R | R |   |
| Transformer Data | X | X | X | X |   |   | Y/N | Does Transformer have an On-Load Tap Changer? | Select Y or N whether this transformer has an On-Load Tap changer |   | R | R | R |   |
| Transformer Data | X | X | X | X |   |   | List | Location of On-Load Tap Changer - Primary (High) or Secondary (Low) side | If this transformer has an On-Load Tap changer, select whether it is on Primary (High) or Secondary (Low) side. |   | C | C | C |   |
| Transformer Data | X | X | X | X |   |   | kV | Base kV of Regulated Side | Base kV of Regulated Side |   |   | C | C |   |
| Transformer Data | X | X | X | X |   |   | kV | Target kV of Regulated Side | Target kV of Regulated Side |   |   | C | C |   |
| Transformer Data | X | X | X | X |   |   | % | Acceptable Deviation of Target Voltage | Acceptable Deviation from Target Voltage before tap change, in percent (enter 1% as 0.01). |   |   | C | C |   |
| Transformer Data | X | X | X | X |   |   |   | Comments | Enter any comments regarding this transformer data |   |   |   | O |   |
| Transformer Data | X | X | X | X |   |   | Ohms/Phase | DC Resistance of Winding 1 | Using manufacturer's data, enter the DC resistance of the Primary/high voltage winding (or for autotransformers, the series winding).  |   |   | R | R |   |
| Transformer Data | X | X | X | X |   |   | Ohms/Phase | DC Resistance of Winding 2 | Using manufacturer's data, enter the DC resistance of the Secondary/low voltage winding (or for autotransformers, the common winding). For physical three-winding transformers modeled as three 2-winding transformers, enter "99999"for each transformer row. |   |   | R | R |   |
| Transformer Data | X | X | X | X |   |   | Y/N | GIC Blocking device on Winding 1 | Answer Yes or No whether a Geomagnetic Induced Current blocking device exists on the Primary/high voltage winding (or for autotransformers, the series winding).  |   |   | R | R |   |
| Transformer Data | X | X | X | X |   |   | Y/N | GIC Blocking device on Winding 2 | Answer Yes or No whether a Geomagnetic Induced Current blocking device exists on the Secondary/low voltage winding, (or for autotransformers, the common winding). For physical three-winding transformers modeled as three 2-winding transformers, select "N" for each transformer row.  |   |   | R | R |   |
| Transformer Data | X | X | X | X |   |   | List | Vector Group Identifier | Manufacturer-supplied alphanumeric identifier specifying vector group based on transformer winding connections and grounding. For physical three-winding transformers modeled as three 2-winding transformers, enter the same Vector Group Identifier for each transformer row. |   |   | R | R |   |
| Transformer Data | X | X | X | X |   |   | List | Transformer Core Design Type | Manufacturer-supplied Transformer Core Design Type (Three Phase shell Form, Unknown, 3@Single Phase (separate cores), Three Phase 3-Legged Core Design, Three Phase 5-Legged Core Design, Three Phase 7-Legged Core Design). For physical three-winding transformers modeled as three 2-winding transformers, enter the same Transformer Core Design Type for each transformer row. |   |   | R | R |   |
| Transformer Data | X | X | X | X |   |   | Number | K Factor | Value supplied by transformer manufacturer. If data is unavailable from the manufacturer, enter 0. For physical three-winding transformers modeled as three 2-winding transformers, enter the same K Factor for each transformer row. |   |   | R | R |   |
| Transformer Data | X | X | X | X |   |   | Ohms  | Winding 1 Grounding DC Resistance  | Enter the Primary/high voltage winding Grounding DC Resistance in Ohms for any grounding device, (for a solidly grounded winding, enter 0, enter "99999" for ungrounded). |   |   | R | R |   |
| Transformer Data | X | X | X | X |   |   | Ohms  | Winding 2 Grounding DC Resistance  | Enter the Secondary/low voltage winding Grounding DC Resistance in Ohms for any grounding device, (for a solidly grounded winding, enter 0, enter "99999" for ungrounded). For physical three-winding transformers modeled as three 2-winding transformers, enter "99999" for each transformer row. |   |   | R | R |   |
| Transformer Data | X | X | X | X |   |   | List | Transformer Model  | Enter 0 except for a phase-shifting transformer, which should be entered as a 1. For physical three-winding transformers modeled as three 2-winding transformers, enter the same model for each transformer row. |   |   | R | R |   |
| Transformer Data | X | X | X | X |   |   | mm/dd/yyyy | Effective Date: | Date this transformer was added, removed or updated in the model |   |   |   | R |   |