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| PGRR Number | [075](http://www.ercot.com/mktrules/issues/PGRR075) | PGRR Title | Dynamic Model Quality Requirement |
| Date Posted | | October 22, 2019 | |
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| Requested Resolution | | Normal | |
| Planning Guide Sections Requiring Revision | | 5.7.1, All-Inclusive Generation Resource Data Requirements  6.2, Dynamics Model Development  6.2.1, Dynamics Data Requirements for Resources  6.2.2, Dynamics Data Requirements for Load Resources  6.2.4, Dynamics Data Screening and Maintenance  6.2.5, Dynamics Data Recorder (delete) | |
| Related Documents Requiring Revision/Related Revision Requests | | Dynamics Working Group Procedure Manual | |
| Revision Description | | This Planning Guide Revision Request (PGRR) adds a requirement for Resource Entities and Interconnecting Entities (IEs) to provide model quality test results that demonstrate appropriate performance for submitted dynamic models. Additional revisions are proposed to:   * Clarify that dynamic model data shall be provided using the appropriate dynamic model template; * Raise awareness of requirements associated with user written dynamic models (move from Dynamics Working Group Procedure Manual to Planning Guide); and * Make various miscellaneous language updates and corrections, including the elimination of Section 6.2.5, which has been superseded by North American Electric Reliability Corporation (NERC) Reliability Standard PRC-002-2, Disturbance Monitoring and Reporting Requirements, and Nodal Operating Guide Section 6.1.3, Phasor Measurement Recording Equipment Including Dynamic Disturbance Recording Equipment. | |
| 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: Improve dynamic model quality in alignment with 2019 Reliability and Operations Subcommittee (ROS) goals  *(please select all that apply)* | |
| Business Case | | This proposed revision is aligned with the 2019 ROS goal to continuously improve dynamic modeling processes. The expected benefits of the revision are to:   * Identify dynamic model issues as early as possible so that study delays can be avoided. * Reduce or eliminate iterations of model troubleshooting among Resource Entities, IEs, Transmission Service Providers (TSPs), vendors, and ERCOT. * Allow study engineers to focus on reliability studies instead of model issues. | |

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| Market Rules Notes |

Please note the following PGRR(s) also propose revisions to the following section(s):

* PGRR074, Related to NPRR973, Add Definitions for Generator Step-Up and Main Power Transformer
  + Section 5.7.1

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| Proposed Guide Language Revision |

5.7.1 All-Inclusive Generation Resource Data Requirements

(1) The Interconnecting Entity (IE) shall submit with its Generation Interconnection or Change Request (GINR) the most current actual facility information (generation, substation, and transmission/subtransmission if applicable) or best available expected performance data for the physical and electrical characteristics of all proposed facilities (in sufficient detail to provide a basis for modeling) up to the Point of Interconnection (POI) with a Transmission Service Provider (TSP).

(2) Failure to supply the required data may delay ERCOT processing of the interconnection application and studies and result in a GINR cancellation as described in Section 5.7.7, Cancellation of a Project Due to Failure to Comply with Requirements. Recommendations resulting from these studies that are based on outdated, false, or bad data may adversely affect the safety and reliability of the ERCOT System and can result in damage to generation or transmission equipment. The IE and subsequently, the Resource Entity associated with any approved All-Inclusive Generation Resource, must promptly submit any updates to ERCOT to ensure the long-term adequacy, reliability, and safety of the ERCOT System, as required by the Protocols, this Planning Guide, the Operating Guides, and North American Electric Reliability Corporation (NERC) Reliability Standards. Failure to comply may result in financial penalties.

(3) In an effort to produce the best available Security Screening Study and Full Interconnection Study (FIS), ERCOT suggests that IEs begin collecting all appropriate engineering and equipment data from manufacturers as soon as the IE selects its major equipment for the proposed project.

(4) While the duty to update data may require additional information, at a minimum, the IE shall submit the following data via the online Resource Integration and Ongoing Operations (RIOO) system at each step of the process:

(a) Application and Security Screening Study:

(i) Generation Entity Information Sheet; and

(ii) Generation Interconnection Screening Study Request Data.

(b) FIS:

(i) Updates to the above information (if necessary);

(ii) Applicable data required for interconnection studies as defined in the Resource Registration Glossary applicable to the resource type; and

(iii) The appropriate dynamic model for the proposed All-Inclusive Generation Resource and results of model quality tests and associated simulation files as described in paragraph (5)(b) of Section 6.2, Dynamics Model Development, which are subject to performance and usability verification by the lead TSP with approval from ERCOT through the FIS process. Dynamic model data shall be provided utilizing the appropriate dynamic model template to enable the TSP(s) and ERCOT to perform stability (transient and voltage) analyses. Paragraph (5) of Section 6.2, and the Dynamics Working Group Procedure Manual contains more detail and IE dynamics data requirements. Data submitted for transient stability models shall be compatible with ERCOT standard models (Siemens/PTI PSS/E and Powertech Labs Inc TSAT, VSAT and SSAT). If no compatible model exists, the IE shall work with a consultant or software vendor to develop and supply accurate/appropriate models along with other associated data. These models shall be incorporated into the standard model libraries of both software packages. It is recommended that generation owners and developers encourage manufacturers and software vendors to work together to develop and maintain these important models.

(c) Prior to start of construction:

(i) Any significant design changes in the generator(s) or main power transformer(s) of the proposed All-Inclusive Generation Resource shall be provided to ERCOT and the TSP to ensure compatibility with the existing transmission system.

(d) Prior to the Resource Commissioning Date:

(i) Registration and official Resource Registration data submittal pursuant to Section 6.8.2, Resource Registration Process;

(ii) Updates to Resource Registration data based on “as-built” or “as-tested” data in all cases; and

(iii) Proof of meeting ERCOT requirements (reactive, Voltage Ride-Through (VRT), dynamic models, Power System Stabilizer (PSS), Subsynchronous Resonance (SSR) models).

(e) During continuing operations:

(i) The IE shall provide ERCOT and the TSP with any equipment data changes which result from equipment replacement, repair, or adjustment. Unless otherwise required in the Protocols, this Planning Guide or the Operating Guides, the IE shall provide such data to ERCOT and the TSP no later than 60 days prior to the date of the actual change in equipment characteristics or during annual data update filings whichever occurs first. This requirement shall also apply to all future owners throughout the service life of the project/plant.

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| [PGRR069: Replace Section 5.7.1 above with the following upon system implementation of NPRR921:]  5.7.1 Generation Resource and Settlement Only Generator Data Requirements  (1) The Interconnecting Entity (IE) shall submit with its Generation Interconnection or Change Request (GINR) the most current actual facility information (generation, substation, and transmission/subtransmission if applicable) or best available expected performance data for the physical and electrical characteristics of all proposed facilities (in sufficient detail to provide a basis for modeling) up to the Point of Interconnection (POI) with a Transmission Service Provider (TSP).  (2) Failure to supply the required data may delay ERCOT processing of the interconnection application and studies and result in a GINR cancellation as described in Section 5.7.7, Cancellation of a Project Due to Failure to Comply with Planning Guide Requirements. Recommendations resulting from these studies that are based on outdated, false, or bad data may adversely affect the safety and reliability of the ERCOT System and can result in damage to generation or transmission equipment. The IE and subsequently, the Resource Entity associated with any approved Generation Resource or Settlement Only Generator (SOG), must promptly submit any updates to ERCOT to ensure the long-term adequacy, reliability, and safety of the ERCOT System, as required by the Protocols, this Planning Guide, the Operating Guides, and North American Electric Reliability Corporation (NERC) Reliability Standards. Failure to comply may result in financial penalties.  (3) In an effort to produce the best available Security Screening Study and Full Interconnection Study (FIS), ERCOT suggests that IEs begin collecting all appropriate engineering and equipment data from manufacturers as soon as the IE selects its major equipment for the proposed project.  (4) While the duty to update data may require additional information, at a minimum, the IE shall submit the following data via the online Resource Integration and Ongoing Operations (RIOO) system at each step of the process:  (a) Application and Security Screening Study:  (i) Generation Entity Information Sheet; and  (ii) Generation Interconnection Screening Study Request Data.  (b) FIS:  (i) Updates to the above information (if necessary);  (ii) Applicable data required for interconnection studies as defined in the Resource Registration Glossary applicable to the resource type; and  (iii) The appropriate dynamic model for the proposed Generation Resource or SOG and results of model quality tests and associated simulation files as described in paragraph (5)(b) of Section 6.2, Dynamics Model Development, are subject to performance and usability verification by the lead TSP with approval from ERCOT through the FIS process. Dynamic model data shall be provided utilizing the appropriate dynamic model template to enable the TSP(s) and ERCOT to perform stability (transient and voltage) analyses. Paragraph (5) of Section 6.2, and the Dynamics Working Group Procedure Manual contains more detail and IE dynamics data requirements. Data submitted for transient stability models shall be compatible with ERCOT standard models (Siemens/PTI PSS/E and Powertech Labs Inc TSAT, VSAT and SSAT). If no compatible model exists, the IE shall work with a consultant or software vendor to develop and supply accurate/appropriate models along with other associated data. These models shall be incorporated into the standard model libraries of both software packages. It is recommended that generation owners and developers encourage manufacturers and software vendors to work together to develop and maintain these important models.  (c) Prior to start of construction:  (i) Any significant design changes in the generator(s) or main power transformer(s) of the proposed Generation Resource or SOG shall be provided to ERCOT and the TSP to ensure compatibility with the existing transmission system.  (d) Prior to the Resource Commissioning Date:  (i) Registration and official Resource Registration data submittal pursuant to Section 6.8.2, Resource Registration Process;  (ii) Updates to Resource Registration data based on “as-built” or “as-tested” data in all cases; and  (iii) Proof of meeting ERCOT requirements (reactive, Voltage Ride-Through (VRT), dynamic models, Power System Stabilizer (PSS), Subsynchronous Resonance (SSR) models).  (e) During continuing operations:  (i) The IE shall provide ERCOT and the TSP with any equipment data changes which result from equipment replacement, repair, or adjustment. Unless otherwise required in the Protocols, this Planning Guide or the Operating Guides, the IE shall provide such data to ERCOT and the TSP no later than 60 days prior to the date of the actual change in equipment characteristics or during annual data update filings whichever occurs first. This requirement shall also apply to all future owners throughout the service life of the project/plant. |

6.2 Dynamics Model Development

(1) To adequately simulate dynamic and transient events in the ERCOT System, it is necessary to establish and maintain dynamics data and simulation-ready study cases representing the dynamic capability and frequency characteristics of machines and equipment connected to the ERCOT System.

(2) Dynamics data is the network data and mathematical models required in accordance with the Reliability and Operations Subcommittee (ROS)-approved Dynamics Working Group Procedure Manual for simulation of dynamic and transient events in the ERCOT System.

(3) For Resource Entities, dynamics data includes the data needed to represent the dynamic and transient response of Resource Entity-owned devices and/or Loads including but not limited to generating units, plants, and other equipment when connected to the ERCOT System including the data for any privately owned transmission system or collection system used to connect the Resource to the ERCOT System.

(4) For Transmission Service Providers (TSPs), dynamics data needed to represent the dynamic and transient capability of TSP-owned devices including but not limited to Load shedding relays, protective relays, FACTS devices (e.g., DVARS, SVC, STATCOM, SMES), Direct Current Ties (DC Ties), variable-frequency transformers, automatically switched shunts, and transformers with automatic load tap changers.

(5) The Facility owner shall provide appropriate dynamics data to ERCOT and the interconnecting TSP, including the data for a planned Facility. The dynamic data shall include the following:

(a) A model with parameters that accurately represent the dynamics of the device and that is compatible with the current version of the planning and operations model software as described in the Dynamics Working Group Procedure Manual. If a user written model is provided, the data shall also include the following:

(i) The user written model in dynamic linked library (DLL) file format;

(ii) A technical description of the model characteristics, including detailed control block diagrams, design logic, and descriptions for all model parameters and variables; and

(iii) A user manual to describe procedures and considerations for using the model in dynamic simulations, including steady state representation and limitations for model adequacy and usability in the software. The model shall allow the user to determine the allocation of the bus number and machine IDs without restriction; and

(b) Results of model quality tests and associated simulation files that demonstrate acceptable performance of the models in the software as described in the Dynamics Working Group Procedure Manual. The purpose of these tests is to ensure the quality of the provided dynamic data and models for use in numerous system studies. Therefore, the Facility owner shall also assess sufficient sensitivities, including but not limited to Voltage Set Point at the Point of Interconnection (POI), real power output, and Reactive Power output to ensure acceptable model performance over the entire range of operating conditions.

(i) All site-specific dynamic models required to represent the Facility shall be included in the model quality tests. These tests can be performed in a simple test system without requiring ERCOT System information.

(ii) For Intermittent Renewable Resource (IRR) equipment aggregated together to form an IRR in accordance with paragraph (12) of Protocol Section 3.10.7.2, Modeling of Resources and Transmission Loads, the dynamic model shall represent the aggregated IRR.

(iii) Results for the following model quality tests shall be provided to demonstrate acceptable model performance. Additional details about each test, including the set up and description of desirable response, are included in the Dynamics Working Group Procedure Manual.

(A) Flat start test: A no-disturbance test shall be performed to demonstrate appropriate model initialization and the Facility’s dynamic response under a no-disturbance condition.

(B) Small voltage disturbance test: A voltage step increase and decrease shall be applied to the POI to demonstrate the Facility’s dynamic response.

(C) Large voltage disturbance test:

(1) For IRRs and inverter-based Resources, the high and low Voltage Ride-Through (VRT) profiles as described in Nodal Operating Guide Section 2.9.1, Additional Voltage Ride-Through Requirements for Intermittent Renewable Resources, shall be applied to the POI to demonstrate the Facility’s dynamic response.

(2) For Resources other than IRRs and inverter-based Resources, a fault shall be applied to the POI to demonstrate the Facility’s dynamic response.

(D) Small frequency disturbance test: A frequency step increase and decrease shall be applied to the POI to demonstrate the Facility’s dynamic response.

(E) System strength test: The model for IRRs and inverter-based Resources shall be tested under a few equivalent short circuit ratios, as described in the Dynamics Working Group Procedure Manual. This tests the robustness of the model to varying system conditions.

(6) Dynamics data for a planned Facility will be updated by the Facility owner upon completion of the design for the Facility.

(7) Updated dynamics data for an existing Facility shall be provided to ERCOT when field tests, inspections, or other information demonstrates that the dynamics data should be changed to accurately represent the dynamic characteristics of the Facility.

(8) Dynamics Data is considered Protected Information pursuant to Protocol Section 1.3, Confidentiality.

(9) Dynamics data shall be provided with the legal authority to provide the information to all TSPs. If any of the information is considered Protected Information, the Facility owner shall indicate as such.

6.2.1 Dynamics Data Requirements for All-Inclusive Generation Resources

(1) A Resource Entity shall submit new or updated dynamics data in accordance with Section 5, Generation Resource Interconnection or Change Request. The Resource Entity shall provide all dynamics data as described in paragraph (5) of Section 6.2, and the Dynamics Working Group Procedure Manual.

(2) A Resource Entity is responsible for tuning and validating the parameters that go into their models to ensure that the models produce an accurate representation of a device’s capability and response. If ERCOT, the interconnecting TSP, or the Dynamics Working Group (DWG) identifies inappropriate or incomplete dynamics data, ERCOT, in its sole discretion, may reject the submitted dynamics data and will provide the Resource Entity an explanation for the rejection. The Resource Entity shall take action to resolve discrepancies and provide updated dynamics data to ERCOT and the interconnecting TSP within 30 days.

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| [PGRRXXX: Replace Section 6.2.1 above upon system implementation of NPRR921:]  6.2.1 Dynamics Data Requirements for Generation Resources and Settlement Only Generators  (1) A Resource Entity shall submit new or updated dynamics data in accordance with Section 5, Generation Resource Interconnection or Change Request. The Resource Entity shall provide all dynamics data as described in paragraph (5) of Section 6.2, and the Dynamics Working Group Procedure Manual.  (2) A Resource Entity is responsible for tuning and validating the parameters that go into their models to ensure that the models produce an accurate representation of a device’s capability and response. If ERCOT, the interconnecting TSP, or the Dynamics Working Group (DWG) identifies inappropriate or incomplete dynamics data, ERCOT, in its sole discretion, may reject the submitted dynamics data and will provide the Resource Entity an explanation for the rejection. The Resource Entity shall take action to resolve discrepancies and provide updated dynamics data to ERCOT and the interconnecting TSP within 30 days. |

6.2.2 Dynamics Data Requirements for Load Resources

(1) ERCOT shall provide the updated Load Resource relay models.

(2) Load Resource relay models shall be updated as described in the Dynamics Working Group Procedure Manual.

6.2.4 Dynamics Data Screening and Maintenance

(1) In order to maintain simulation-ready base cases and associated dynamics data files for use in dynamic simulations, ERCOT, in consultation with the DWG, shall perform dynamic simulations called flat-start simulations as described in the Dynamics Working Group Procedure Manual.

(2) The schedule for producing the flat start simulations will be reviewed annually and submitted to the ROS.

(3) Transmission owners shall review the completeness and applicability of dynamics data used in the flat start simulation for equipment connected to their system. The model should be appropriate for the equipment and the data shall be appropriate for the model.

(4) ERCOT shall contact the appropriate TSP or Resource Entity to resolve any dynamics data problems, incomplete or missing data, encountered while preparing the flat start simulation.

(5) Upon completion of each flat start simulation, ERCOT shall distribute an electronic copy of all files necessary to replicate the flat start simulation as described in the Dynamics Working Group Procedure Manual to the DWG.

(6) ERCOT and the DWG shall document assumptions made, data created, and data changed during the creation of a flat start simulation.

(7) ERCOT shall be responsible for storing all of the dynamics data and shall maintain a repository of dynamics data with tuned parameters and any submitted revisions.

(8) Within 30 days of receipt, ERCOT shall forward all dynamics data received to the TSP to which the dynamics device is connected.