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| PGRR Number | [102](https://www.ercot.com/mktrules/issues/PGRR102) | PGRR Title | Dynamic Operation Model Improvement |
| Date of Decision | January 24, 2023 |
| Action | Recommended Approval |
| Timeline  | Normal |
| Proposed Effective Date | April 1, 2023 |
| Priority and Rank Assigned | Not applicable  |
| Planning Guide Sections Requiring Revision  | 5.5, Generator Commissioning and Continuing Operations6.2, Dynamics Model Development |
| 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 operations dynamic model quality test results that demonstrate appropriate performance for submitted operations dynamic models, and makes non-substantive clarifying changes. |
| 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) Improves dynamic mode quality in alignment with Reliability and Operations Subcommittee (ROS) goals.*(please select all that apply)* |
| Business Case | This PGRR is aligned with PGRR075, Dynamic Model Quality Requirement, and PGRR085, Dynamic Model Improvements, to continuously improve dynamic modeling processes. The expected benefits of these revisions are to provide clarification and to ensure:* High quality and accurate models in operations dynamic assessment; and
* Consistency of simulations across planning and operations software platforms.
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| ROS Decision | On 11/7/22, ROS voted unanimously to recommend approval of PGRR102 as submitted. All Market Segments participated in the vote.On 12/1/22, ROS voted unanimously to endorse and forward to TAC the 11/7/22 ROS Report and 10/21/22 Impact Analysis for PGRR102. All Market Segments participated in the vote. |
| Summary of ROS Discussion | On 11/7/22, ERCOT Staff presented PGRR102. Participants commented that model quality testing is needed for the Transient Security Assessment Tool (TSAT).On 12/1/22, participants reviewed the 10/21/22 Impact Analysis for PGRR102.  |
| TAC Decision | On 1/24/23, TAC voted unanimously to recommend approval of PGRR102 as recommended by ROS in the 12/1/22 ROS Report. All Market Segments participated in the vote.  |
| Summary of TAC Discussion | On 1/24/23, TAC reviewed the ERCOT Opinion, ERCOT Market Impact Statement, and Independent Market Monitor (IMM) Opinion for PGRR102. |

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| **Opinions** |
| **Credit Review** | Not applicable |
| **Independent Market Monitor Opinion** | IMM has no opinion on PGRR102. |
| **ERCOT Opinion** |  ERCOT supports approval of PGRR102. |
| **ERCOT Market Impact Statement** |  ERCOT Staff has reviewed PGRR102 and believes the market impact for PGRR102 improves the dynamic modeling processes that will result in high quality and accurate models in operations dynamic assessment, and consistency of simulations across planning and operations software platforms. |

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| Market Segment | Not Applicable |

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| Comments Received |
| **Comment Author** | **Comment Summary** |
| None |  |

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| Proposed Guide Language Revision |

5.5 Generator Commissioning and Continuing Operations

(1) Each Interconnecting Entity (IE) shall meet the conditions established by ERCOT before proceeding to Initial Energization, Initial Synchronization, and commercial operations. These conditions may require proof of meeting applicable ERCOT requirements, which may include, but are not limited to, reactive capability, Voltage Ride-Through (VRT) standards, dynamic model template submission, Automatic Voltage Regulator (AVR), Primary Frequency Response (PFR), Power System Stabilizer (PSS), Subsynchronous Resonance (SSR) models, and telemetry.

(2) No later than 30 days following the Resource Commissioning Date, the IE shall submit updates to the resource dynamic planning and operations models based on “as-built” or “as-tested” data and provide a plant verification report as required by paragraph (5)(b) of Section 6.2, Dynamics Model Development. Pursuant to paragraph (5)(c) of Section 6.2, the IE shall include model updates with model quality tests.

(3) During continuing operations:

(a) Pursuant to paragraph (5)(c) of Section 6.2, the Resource Entity shall include model updates with model quality tests.

(b) The Resource Entity shall provide ERCOT with a plant verification report as required by paragraph (5)(b) of Section 6.2 at the following times:

(i) No later than 30 days after implementing a settings change as required by paragraph (7) of Section 6.2;

(ii) No earlier than 12 months and no later than 24 months following the later of the Resource Commissioning Date or March 1, 2021; and

(iii) A minimum of every ten years.

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., SVC, STATCOMs), Direct Current Ties (DC Ties), variable-frequency transformers, automatically switched shunts, and transformers with automatic load tap changers.

(5) The owner of the generator Facility or dynamic device shall provide appropriate dynamics data to ERCOT, including the data for a planned Facility, in accordance with the Dynamics Working Group Procedure Manual. 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:

(i) A model manual containing a technical description of the model characteristics, including descriptions for all model parameters and variables, a list of which parameters are commonly tuned for site-specific settings, and a description of procedures and considerations for using the model in dynamic simulations, including steady state representation and limitations for model adequacy and usability in the planning and operations model software; and

(ii) The user-written model shall allow the user to determine the allocation of machine identifiers (bus numbers, bus names, machine IDs etc.) without restriction.

(b) Verification reports that support the model data based on documented field settings shall be provided as specified in the Dynamics Working Group Procedure Manual for Generation Resources, Energy Storage Resources (ESRs), and for Transmission Elements represented by a dynamic model. The reports shall demonstrate that the model parameters which are commonly tuned match site-specific settings implemented in the field. For new Generation Resources and ESRs, these reports shall be provided as required in paragraph (2) of Section 5.5, Generator Commissioning and Continuing Operations. For existing Generation Resources and ESRs, these reports shall be provided as required in paragraph (3) of Section 5.5. For Transmission Elements represented by a dynamic model, these reports shall be provided no later than two years following energization of new equipment and updated a minimum of every ten years.

(c) Results of model quality tests and associated simulation files that demonstrate acceptable performance of the models in the planning model and operations software as described in the Dynamics Working Group Procedure Manual. The Facility owner shall provide updated information whenever it provides a new or updated dynamic model to ERCOT representing a Generation Resource, ESR, or Transmission Element. These tests ensure the quality of the provided dynamic data and models for use in numerous system studies and consistency across planning and operations software platforms. 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. The Facility owner shall provide an explanation if model responses do not match.

(i) Facility owners shall include all site-specific dynamic models representing the Facility in the model quality tests. Facility owners can perform the tests 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, ESRs, and inverter-based transmission equipment, 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, ESRs, and inverter-based equipment, 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.

(d) Inverter-Based Resources (IBRs) shall provide results of the unit model validation to demonstrate that the PSCAD model, as described in the Dynamics Working Group Procedure Manual, accurately represents the dynamic responses of all inverter-based dynamic devices within the Facility. This validation is not intended to be site-specific; rather it is intended to be a hardware type test, where models representing different inverter hardware are benchmarked for accuracy. Validation results for a specific model of inverter can be submitted for multiple uses of that model of inverter.

(i) The validation results shall be included when submitting a PSCAD model to ERCOT.

(ii) Results for the following unit model validation tests shall be provided to demonstrate model accuracy. Additional details about each test are included in the Dynamics Working Group Procedure Manual.

 (A) Step change in voltage;

 (B) Large voltage disturbance (VRT tests);

 (C) System strength test;

 (D) Phase angle jump test; and

 (E) Subsynchronous test.

(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.