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| PGRR Number | [121](https://www.ercot.com/mktrules/issues/PGRR121#summary) | PGRR Title | Related to NOGRR272, Advanced Grid Support Requirements for Inverter-Based ESRs |

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| Date | June 4, 2025 |

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| Submitter’s Information | |
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| Market Segment | Not Applicable |

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| Comments |

ERCOT submits these comments to:

(1) incorporate several revisions to Planning Guide Revision Request (PGRR) 121;

(2) highlight the urgency to adopt the advanced grid support requirements and   
 encourage stakeholders to move Nodal Operating Guide Revision Request   
 (NOGRR) 272, Advanced Grid Support Requirements for Inverter-Based ESRs, and   
 Planning Guide Revision Request (PGRR) 121, Related to NOGRR272, Advanced   
 Grid Support Requirements for Inverter-Based ESRs, forward for consideration at   
 the September 2025 Board of Directors meeting;

(3) describe the problems with the approach proposed in Nodal Protocol Revision   
 Request (NPRR)1278 and recommend that it not move forward; and

(4) propose to sponsor a future NPRR that would implement a one-time advanced grid   
 support (“AGS”) new technology incentive concept to encourage AGS adoption for   
 existing Inverter-Based Resources (IBRs). ERCOT is also open to working with   
 stakeholders on another future NPRR if circumstances change.

As of April 2025, a total of ~82 gigawatts (GW) of IBRs, including ~39 GW of wind Generation Resources (GRs), ~31 GW of solar GRs, and ~12 GW of battery Energy Storage Resources (ESRs), are operational and the highest instantaneous IBR penetration has reached to 76%. All of these connected IBRs are considered to be grid-following (“GFL”) IBRs, which are prone to stability issues especially in existing weak grids and the areas that will become weak as more GFL IBRs are integrated. An additional ~50 to 70 GW of IBRs are also projected to connect to the ERCOT Transmission Grid by 2028. ERCOT has worked with stakeholders to implement several improvements in recent years to address and mitigate existing stability challenges, including installing more synchronous condensers and sponsoring NOGRR245, Inverter-Based Resource (IBR) Ride-Through Requirements. Additional improvement options will be needed for further grid integration of IBRs and Loads. Widespread adoption of grid-forming (“GFM”) IBRs that provide AGS will significantly improve the stability of the grid in areas where they are installed. Therefore, adoption of NOGRR272 and PGRR121 is imperative to continue to support reliable grid operation and voltage/frequency response in both normal operations and during disturbances and to facilitate the continued integration of new Resources and Loads that are sensitive to grid voltage and frequency stability.

ERCOT provides several revisions to this PGRR:

* Section 6.2, “The performance of this test will be assessed when operating within the inverter current limit” in paragraph (5)(c)(iv)(D) and (5)(c)(iv)(E).

ERCOT has reviewed NPRR1278 and provides the following concerns with the proposed market service framework:

* **Consistent technical requirements**: The technical requirements described in NPRR1278 are generally consistent with those established in NOGRR272 and PGRR121.
* NOGRR272 and PGRR121 do not change the voltage support requirements for Resources and do not address the Public Utility Commission of Texas (PUCT) Blueprint requirement to create a service to compensate voltage support services.
* **Lack of defined services**: NPRR1278 mentioned the examples of other regions that have adopted AGS for ESRs. It should be noted that those examples, including National Energy System Operator in Great Britain, have different performance requirements compared with NOGRR272. Specific inertia and short-circuit contributions that are components of AGS in those regions typically require higher hardware specifications or require Resources to maintain headroom to meet the required performance requirements. NOGRR272 clarifies that ESRs are required to provide AGS when operating within their current limits. Specific service needs, such as inertia or short-circuit current contribution, would still need to be defined in NPRR1278 though. ERCOT has identified that the minimum inertia level must be maintained and will be monitoring the Real-Time inertia performance. Currently, ERCOT has not identified specific inertia or additional short-circuit current contribution needs from IBRs. In addition to the market service examples mentioned in NPRR1278, many regions in the US and globally are in the process of adopting AGS similar to that proposed, including MISO, Fingrid, and ENTSO-e.
* **Lack of details on how the proposed framework can be implemented**: NPRR1278 would require ERCOT to identify the need in advance on an annual basis both for the quantity and location of AGS and to procure sufficient AGS to meet the need through an annual Request for Proposal (RFP). Identification of stability needs depends on accurate models and specific grid conditions such as new generation, load, transmission, and outages. Therefore, identification of the annual need for AGS will require a significant technical assessment effort and may necessitate changes to existing interconnection processes to ensure that all required information is available well in advance of the technical assessment. Furthermore, given that grid conditions and stability challenges will vary, the identified stability needs will be limited to the information currently available at that time and cannot capture the potential stability issues arising from future integrations to the ERCOT System. To address both near-term and long-term stability challenges, it would be best to require all new Energy Storage Resources (ESRs) to provide AGS. It is not clear if it is practical to obtain a market service via an RFP to procure AGS from all new ESRs though.
* **Cost and resources:** NPRR1278 will require an ERCOT project to implement that will entail significant costs and time commitment.
* **Launch complications:** There are no existing ESRs with AGS capability available to bid into this service, so it is unclear how the initial round of this RFP would occur. It is also not clear what the performance requirement is if the service is no longer awarded to a Resource, which could further increase the challenges to and complexity of the technical assessment.

For these reasons, ERCOT recommends that NPRR1278 not move forward, at least in its current form.

ERCOT acknowledges the need for and benefit of incentivizing existing IBRs to adopt AGS. To better address this, ERCOT plans to propose a new concept that will provide a one-time incentive to existing IBRs. For example, if an IBR can implement AGS by a defined deadline, such as December 31, 2027, the Resource could receive this incentive based on its capacity, incentive price, and availability after 12 months of its AGS implementation. ERCOT plans to submit an NPRR with a more detailed implementation plan for this concept in summer 2025.

Finally, ERCOT encourages stakeholders to approve NOGRR272 and PGRR121 in time to be considered at the September meeting of the ERCOT Board of Directors. Although ERCOT does not consider NPRR1278, as written, to be needed at this time, if an ESR were to be required in the future to preserve headroom or State of Charge (SOC) for AGS, then ERCOT will work with stakeholders on an NPRR to provide an opportunity cost payment and will develop an NPRR for a future inertia service or similar service if such a service becomes necessary in the future.

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| Revised Cover Page Language |

None

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| Revised Proposed Guide Language |

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.

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| [PGRR101: Replace paragraph (4) above with the following upon system implementation of NPRR1133:]  (4) For Transmission Service Providers (TSPs) and owners of Direct Current Ties (DC Ties), dynamics data includes the data needed to represent the dynamic and transient capability of dynamic devices including but not limited to Load shedding relays, protective relays, FACTS devices (e.g., SVC, STATCOMs), DC Ties, variable-frequency transformers, automatically switched shunts, and transformers with automatic load tap changers. |

(5) The owner of a generator Facility or any 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 (5) of Section 5.5, Generator Commissioning and Continuing Operations. For existing Generation Resources and ESRs, these reports shall be provided as required in paragraph (6) 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 (13) 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 for Generation Resources, ESRs, or Transmission Elements that are not required to comply with Nodal Operating Guide Section 2.14, Advanced Grid Support Requirements for Inverter-Based ESRs, 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 profiles as described in Nodal Operating Guide Section 2.9.1, Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs), Type 2 WGRs, and Type 3 WGRs, 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.

(iv) For inverter-based Energy Storage Resources (ESRs) required to comply with Nodal Operating Guide Section 2.14, 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: The high and low voltage ride-through profiles as described in Nodal Operating Guide Section 2.9.1, shall be applied to the POI to demonstrate the Facility’s dynamic response.

(D) Frequency change and inertia response test: A frequency change increase and decrease shall be applied to the POI to demonstrate the Facility’s dynamic response.

(E) System strength test: The Facility shall be tested under multiple equivalent short circuit ratios, as described in the Dynamics Working Group Procedure Manual. This tests the robustness of the model to varying system conditions.

(F) Phase angle jump test: A step change is applied to the phase angle. This tests the capability to maintain the voltage phasor and resistance to angle change.

(G) Loss of synchronous machine test: This test confirms the performance of the Facility to maintain synchronism and voltage phasor after changes occur on the ERCOT System. This test is not intended to require the Facility to operate reliably without connecting to the ERCOT Transmission Grid.

(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 (voltage ride-through 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.