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| NOGRR Number | [272](https://www.ercot.com/mktrules/issues/NOGRR272) | NOGRR Title | Advanced Grid Support Requirements for Inverter-Based ESRs |

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| Date | July 8, 2025 |

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| Market Segment | Independent Generators |

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| Comments |

**Executive Summary**

* **Nodal Operating Guide Revision Request (NOGRR) 272 is unworkable and unclear**. It creates unclear performance obligations, imposes costs on Energy Storage Resources (ESRs) without compensation, and isn’t technology-neutral. ERCOT should instead pursue a market-based “Advanced Grid Support” (AGS) approach like Nodal Protocol Revision Request (NPRR) 1278, Establishing Advanced Grid Support Service as an Ancillary Service.
* **ERCOT must implement AGS in phases**. Clearly define capability, publish enforceable compliance metrics, give developers time to comply, include a calibration period, and create a path to compensation.
* **ESRs already support reliability**. Storage provides fast frequency response, State of Charge (SOC) management, and ride-through—none of which NOGRR272 acknowledges. Don’t punish what’s already working.
* **Strip out hidden inertia obligations**. Language in paragraph (5)(c)(iv)(D) of Section 6.2, Dynamic Model Development, in Planning Guide Revision Request (PGRR) 121, Related to NOGRR272, Advanced Grid Support Requirements for Inverter-Based ESRs, effectively mandates unpaid inertia services. This contradicts ERCOT’s own statements and should be removed.

**Comments**

Plus Power appreciates the opportunity to submit additional comments on NOGRR272, which proposes to mandate AGS requirements for inverter-based ESRs in ERCOT. We share ERCOT’s objective of enhancing grid reliability and support thoughtful improvements to system stability through advanced inverter technologies.

However, we oppose the NOGRR as written as the current proposal lacks a realistic and structured implementation framework, lacks clear compliance definitions, imposes performance obligations and compliance liability, does not compensate ESRs, and fails to provide sufficient transition time. As written when considering alone the potential iterations of modeling and adjustments which have significant costs to ESRs specifically, NOGRR272 is not technology-neutral and thus harms all future ESRs.

Plus Power continues to recommend that ERCOT reject NOGGRR272 and instead focus on the development of a technology-neutral service ancillary service as proposed in NPRR1278. As previously stated, not only will NPRR1278 accomplish the same goal as NOGRR272, it will incent a broader pool of Generation Resources that can provide this service which can enhance the reliability benefit based on location. A new AGS Ancillary Service, similar to Black Start Ancillary Service can be driven by studies to optimally select and contract AGS capable resources, ensure performance, and avoid much more costly dynamic reactive resources such as “Static Volt-Ampere Reactive (VAr) Compensators” (SVCs), “Synchronous Compensators” (STATCOMs), and “Synchronous Condensers”. This will optimize reliability while minimizing costs for consumers as a whole in a competitive and technology-neutral market structure that encourages investment versus discouraging a specific technology (ESRs) from interconnecting in ERCOT in the future.

If ERCOT continues to pursue approval of NOGRR272, Plus Power respectfully recommends that ERCOT adopt a clear, five-step approach for any AGS obligation, rather than moving forward with obtuse requirements imbedded in the Dynamics Working Group (DWG) Procedure Manual that introduce compliance risks and financial burdens without compensation.

Step One would start by establishing the technical capability requirements in a transparent and well-defined manner. For instance, terms such as “constant or near-constant” voltage phasor must be translated into quantifiable parameters, with specific timeframes such as “sub-transient” and “transient” explicitly defined. The proposal should clarify what constitutes sufficient capability, and whether the expectation is for the ESR to merely possess capability, or if there is a performance requirement in addition to having grid forming capability. Without explicit definitions and more clarity, an ESR will not be able to ensure that it has the capability to provide AGS, much less provide AGS, that complies with ERCOT requirements. Guide language in Section 2.14 needs comprehensive, detailed language similar to the language provided in the Appendix below that addresses specific, numerical requirements for performance.

Step Two would involve the creation and publication in Guide language of clear compliance metrics and testing protocols. An example of requirement Guide language based on requirements “Mid-Continent Independent System Operator” (MISO) adopted after consideration of the same proposal ERCOT filed at the outset as NOGRR272 is attached in the Appendix hereto for reference. As currently written, the language in NOGRR272 leaves significant ambiguity around enforcement—particularly in how performance will be monitored and how compliance will be assessed. Without defined measurement methods or clear pass/fail criteria, developers are left to navigate vague standards that could have material consequences for project financing and operations. Although ERCOT has stated that “Original Equipment Manufacturers” (OEMs) have represented that their equipment has the capability to provide AGS, in the absence of clarity regarding ERCOT’s requirements, it is unclear how any OEM can warrant that their current equipment can actually meet the as yet undefined ERCOT-specific requirements. ERCOT must provide a formal structure outlining how it will evaluate an ESR's ability to meet the AGS requirements before it can reasonably impose penalties or reliability compliance obligations. Also, it should be clear that model quality tests only test a small subset of potential operating conditions. While good measures of indicating general capability, model quality tests are not performance requirements. This ambiguous language may very well lead to performance that doesn’t meet “expectations” and iterations of model adjustments that go through the Planning Guide Revision Request (PGRR) 109, Dynamic Model Review Process Improvement for Inverter-Based Resource (IBR) Modification, process each with a significant cost impact. While Plus Power appreciates ERCOT’s public comments of its intent to work with ESRs, ESRs are bound to comply with written rules that the Public Utility Council of Texas (PUCT) deems mandatory and enforceable. This acknowledgement of potential iterations highlights the fact that the cost to ESRs to model each adjustment and go through approval and implement such adjustments (often to numerous inverters) is simply being ignored or minimized.

In Step Three, ERCOT would provide the industry adequate lead time to bring on the capability and adjust to any potential performance requirements. Battery storage developers typically lock in equipment specifications and procurement decisions as far as 18-24 months in advance of commercial operations. Therefore, we reiterate our recommendation that any new requirements should apply only to ESRs with Standard Generation Interconnection Agreements (SGIAs) executed no earlier than six months after the PUCT approval of NOGRR272 or April 1, 2026, at the earliest. This proposal is offered in the spirit of compromise as it assumes that OEMs have been paying attention to ERCOT’s proposal and already have taken steps to improve their equipment. However, as noted above in Step Two, in the absence of clarity regarding ERCOT’s requirements, it is unclear how any OEM can warrant today that their current equipment can actually meet ERCOT’s currently undefined specific requirements. As a result, retroactively applying new standards that have not yet been defined could force developers to reopen contract terms, procure alternate equipment, or potentially delay projects—outcomes that would undermine the very reliability goals this NOGRR seeks to achieve.

Step Four would involve ERCOT recognizing in the Guide language there will be a transition time needed to implement performance requirements. ERCOT should establish a transitional “compliance lite” period—a phase during which performance is monitored but not penalized. This would provide both ERCOT and ESR operators with valuable data and would allow ESR operators to refine and tune system performance prior to the imposition of enforcement actions.

Finally, in Step Five, ERCOT should create a mechanism for compensation for AGS services. While we recognize that ERCOT has raised concerns with NPRR1278 and its market-based approach to AGS procurement, the underlying principle remains sound: services that benefit the overall system should be compensated, especially when they come with a significant ongoing cost, offset other system costs for customers, and are advanced services beyond those traditionally established. ERCOT has acknowledged that capability and performance are not cost-free. Requiring them without compensation imposes unfair financial burdens on one class of resources for the benefit of the system as a whole. Plus Power recommends ERCOT consider an approach similar to Black Start Services (BSSs) where AGS capable resources can bid their capabilities and through studies, ERCOT can select optimal contracted resources for reasonable periods (e.g., 2 - 5 years). This will not only help optimize the reliability benefit vs impact to Market Participants, but will also ensure that grid forming capabilities are implemented in areas of the system appropriate for such technology. For example, if grid forming services are implemented in a part of the system with high system strength, these services could create adverse impacts and undermine system reliability or require coordination with other resource controls in the area to avoid unintended consequences. This thoughtful, study-based approach would thus proactively avoid issues instead of the wait-and-see-and-adjust approach of NOGRR272.

Finally, we believe it is important for ERCOT to recognize the contributions ESRs are already making to grid reliability. Storage facilities routinely perform frequency and voltage ride-through, respond rapidly to changing grid conditions, and manage SOC in ways that maintain headroom for reliability events. ESRs remain online and connected at all times - not on outage - and expend energy to provide significant levels of Primary Frequency Response, often before other generators due to their very fast response time. Many of these features are already embedded in today’s operations, are improving reliability of the ERCOT Grid, and any new compliance framework should build upon —rather than overlook— these existing reliability benefits.

Plus Power reiterates that we support ERCOT’s desire to address incorporating new AGS capabilities as part of the grid’s transformation. However, we oppose the requirement-only approach of NOGRR272 when a viable, efficient, technology-neutral approach exists that improves reliability beyond NOGRR272. The only reason for NOGRR272 to have urgency is if NPRR1278 or a similar market approach is not seriously considered. If ESRs still choose to develop in ERCOT with the additional headwind of NOGRR272 with no renumeration, they will not reach commercial operations for 24 to 30 months from now. It would be in ERCOT’s best interest to invest in a solution that would bring the technology most advantageous for system reliability on sooner rather than later.

We respectfully urge ERCOT to revise NOGRR272 to incorporate this phased approach—one that begins with clear capability definitions, specifies compliance requirements, allows for meaningful lead time, introduces a structured compliance calibration period, and ultimately integrates AGS into either a market product or a reliability obligation with appropriate compensation. This framework will better serve both grid reliability and market integrity, while ensuring the continued viability and investment certainty for ESRs.

We welcome further engagement with ERCOT Staff and stakeholders and remain committed to supporting Texas in its transition toward a more stable and modern electric grid.

**Appendix**

**2.14 Advanced Grid Support Requirements for Inverter-Based Resources (IBRs)**

(1) VOLTAGE SOURCE CAPABILITY REQUIREMENTS

(A) GFM IBRs shall provide autonomous, near-instantaneous frequency and voltage support by maintaining a nearly constant internal voltage phasor in the sub-transient time frame, within the inverter’s current limits and the resource’s energy limitations. ERCOT’s IBR requirements do not impose requirements for fault current capability extending beyond equipment ratings. All requirements and recommendations within this document assume that current limits are not exceeded. For readability, this limitation is not repeated for each requirement.

(I) The voltage phasor of a GFM IBRs shall be controlled to maintain synchronism with other generation and electric storage resources on the power system.

(II) The GFM IBRs should start to naturally react no more than XX milliseconds, achieving full response in less than XX milliseconds depending on the nature of the event.

(a) The term “react” used here is considered synonymous with the IEEE 2800-2022 definition of reaction time, which points to a measurable change in the direction of the control effort.

(b) “Full response” is viewed by ERCOT as analogous to IEEE 2800-2022 step response defined term.

(III) The GFM IBRs should improve system strength by resisting voltage magnitude changes in the subtransient time frame by modulating appropriate levels of reactive and/or active power, enhancing stable operation during and following power system disturbances. The GFM IBR should resist sudden changes in positive sequence voltage phase angle by modulating appropriate levels of reactive and/or active power.

(IV) The GFM IBRs should provide frequency support in the sub-transient timeframe by appropriately modulating active power in response to frequency excursions.

(2) REQUIREMENTS TO INTEGRATE GRID FIRMING INVERTERS WITH IEEE 2800-2022

(A) GFM IBRs shall be exempt from the following IEEE 2800-2022 subclauses: 4.7 (prioritization of IBR responses), 7.2.2.3.4 (current injection during voltage ride-through mode), and 7.2.2.3.5 (performance specifications).

(B) GFM IBRs shall be exempt from only voltage ride-through performance requirements, and associated normative language, within subclause 7.2.2.3.2 (low-and high-voltage ride-through capability). Further, the GFM shall not alter voltage source characteristics to meet reactive current priority mode requirements within subclause 7.2.2.3.2 and is exempted from this subclause should that be the implication of conformity.

(I) Reactive current priority is generally preferred performance during voltage ride-through, however, this requirement states that strict reactive current priority is not required if it alters basic GFM operation. GFM controls generally provide very fast reactive and active response to resist system changes, and it is not possible to constrain this to one mode or the other during fault/transient periods.

(C) For IEEE 2800-2022 subclause 7.2.2.6, for requirements applicable upon the applicable voltage returning to the continuous operating region after IBR performing ride-through, the GFM active power recover shall occur immediately with the rate of recovery not control-constrained by a default active power recovery rate of 1 second.

(3) OSCILLATION DAMPING

(A) Oscillation Damping: A GFM IBRs should be capable of providing positive damping for oscillations in the power system. In addition, the GFM IBRs should provide adequate damping of active power and reactive power responses following a disturbance on the power system. The GFM IBRs should present positive resistance to the grid within a frequency range of common grid electrical resonances and system disturbances, including from 0-300 Hz.

(I) The GFM IBRs should be designed and configured so as not to interact and affect the operation, performance, or capability of other facilities or equipment connected to the electrical system.

(II) Prioritization of responses: The GFM IBRs should be allowed to prioritize self-protection, preventing exceedances of capability limits, above other responses. When the GFM IBR is not constrained by capability limits, it should retain the required voltage source characteristics to support system stability.

(III) Operation on limits: Whenever a GFM IBR must temporarily constrain its voltage source (e.g., operating at short-duration current rating limits during voltage ride-through), these constraints should not degrade performance due to factors such as a mode transition. The GFM IBRs should be designed to ensure a smooth transition between the operating states.

(IV) Negative sequence current: GFM IBRs should provide negative sequence current when in the continuous operation region.

(V) Voltage balancing: GFM IBR’s voltage source behavior should act to reduce the level of unbalanced voltage conditions caused by disturbances, which could be achieved by the inverter emulating a balanced voltage source which naturally injects positive and negative sequence currents depending upon the nature of the voltage disturbance applied. The GFM resource should also ensure its internally generated voltage remains balanced during all near nominal operating conditions (e.g., 0.9–1.1. p.u. voltage range). The GFM should not actively oppose or prevent the flow of negative sequence current for small levels of voltage unbalance.

(VI) Configurability for controls tuning: Independent of the natural frequency response of the GFM control, the GFM IBR should have tunable secondary or outer-loop frequency controls, including response time, droop gain, and deadband. Similarly, The GFM IBR should have tunable voltage controls, including fast reactive current response times, droop gain, and deadband. The GFM IBR should be capable of being tuned so that following a disturbance its output is adequately damped. Actual damping characteristics for GFM IBRs will need to be determined and tuned based on network characteristics, and to enhance overall system stability.

(VII) Transient overvoltage: The GFM IBR should be designed to reduce the risk of transient over voltage levels arising following clearance of the fault.

(VIII) Power sharing: The GFM IBR should autonomously share power with other generation and storage resources according to well established frequency droop principals

(4) MODELING QUALITY REQUIRMENTS

(A) Model quality is important given the model-based performance verification method proposed for adoption. The model must be accurate, verified, and properly parameterized for simulation results useful for demonstrating conformity with required performance. PSCAD models should conform with the latest version of Electranix’s PSCAD Requirements consistent with BPM-015 r28 requirements.

(B) The model quality recommendations outlined in NERC’s EMT Reliability Guideline may also be reviewed as an additional reference. At minimum, the following conditions should be met to ensure model quality:

(I) OEM validated models and validation testing with minimum tests including the basic performance verification included in Electranix’s PSCAD model requirements.

(II) Verification from inverter OEM(s) and/or Interconnection Customer that provided models match planned configuration and settings.

(III) Verification from plant controller OEM(s) and/or Interconnection Customer that models provided match planned configuration and settings.

(IV) Verification from the Interconnection Customer, or third-party technical services provider, that the aggregate model representation of the IBR plant is accurate and matches planned configuration and settings. ERCOT recognizes that general IBR data and model validation is a topic NERC is addressing in response to FERC Order 901, with a filing required by November 4, 2025.

(5) DATA REQUIREMENTS AND DOCUMENTATION

(A) Given ERCOT’s current EMT tool is XXXXX, the GFM IBR model and conformity tests shall be performed using XXXX Version X.

(B) To facilitate ERCOT’s review of the GFM IBR capabilities, the Interconnection Customer shall submit information outlined in XXXX Requirements, Attachment 1, including:

(I) A completed test procedure check list using ERCOT-provided template.

(II) Simulation test result plots (voltage and reactive power; frequency and active power) for each test in the ERCOT-provided template.

(III) The XXX test set-ups (e.g., .pscx files, library files) with OEM model included and parametrization as configured during tests.

(IV) Model documentation for both inverter and power plant control describing functionality and operation of resource and model

(6) COMPLIANCE ASSESSMENT PROCEDURES

(A) GENERAL The simulation tests described below are ERCOT’s proposed method of demonstrating conformity with ERCOT’s GFM BESS capability and performance requirements.

(B) Table 3 summarizes the purpose for each of the four tests.

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| TEST | PURPOSE |
| Loss of Last Synchronous Machine (LLSM) | General grid-forming capabilities and performance following the loss of the last synchronous generator on the test system given various initial BESS dispatch conditions, including charging and discharging |
| Assess Rate of Change of Frequency (ROCOF) | Assess control stability and active power responses for increases and decreases in frequency |
| Phase Jump | Assess active power responses for voltage phase angle changes |
| Short Circuit Ratio (SCR) | Assess control stability in weak grid conditions before and after faults are applied |

(C) While the tests are expected to definitively determine GFM IBR capability, they are not intended to validate control stability performance under all potential grid conditions. Since the stability of control responses can in part be dependent on electrical system characteristics (e.g., weak grid) and interactions with other system components, the tests have substantial but not full coverage in evaluating GFM IBR control performance under a reasonable set of system conditions. In addition, the tests contain extreme conditions not anticipated on the grid for the purpose of exercising and understanding GFM IBR responses.

(D) An ESR that interconnects to the ERCOT Transmission Grid pursuant to a Standard Generation Interconnection Agreement (SGIA) executed before October 1, 2025 and that has paid the required financial security in full to the Transmission Service Provider (TSP) before October 1, 2025, is not required to comply with the requirements of this Section.

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| Revised Cover Page Language |

None

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| Revised Proposed Guide Language |

None