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| NOGRR Number | [245](https://www.ercot.com/mktrules/issues/NOGRR245) | NOGRR Title | Inverter-Based Resource (IBR) Ride-Through Requirements |

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| Date | September 5, 2023 |

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| Comments |

Southern Power Company (“Southern Power”) appreciates the opportunity to comment on Nodal Operating Guide Revision Request (“NOGRR”) 245 and to work constructively with ERCOT staff and stakeholders to identify and implement practical solutions for grid disturbance events and their undesirable effects. While Southern Power appreciates ERCOT’s willingness to extend compliance deadlines in their latest comments filed on August 18, 2023, the existing framework fails to address essential concerns expressed by Southern Power and other stakeholders in previously submitted written comments. Southern Power supports a bifurcated approach of implementing new frequency and voltage ride-through requirements that distinguishes new facilities from those with existing Standard Generation Interconnection Agreements (“SGIAs”). Specifically, NOGRR245 should be updated so that Inverter-Based Resources (“IBRs”) with SGIAs executed on or after June 1, 2026 (“New IBRs”), must immediately comply with the new, more robust standard. IBRs with SGIAs executed before June 1, 2026 (“Existing IBRs”), should be provided with more narrowly tailored solutions that consider the unique challenges and constraints facing different subsets of Existing IBRs.

The combination of ERCOT’s proposed new, unfettered discretion to restrict IBR operations and the lack of clear ride-through testing standards will force certain IBR owners to make an untenable decision: (1) make significant (and unprecedented) capital investments to retrofit a facility without any proven or generally accepted testing method to demonstrate equipment compliance or (2) elect to not make retrofits and be subject to ERCOT’s broad discretion to restrict or flatly prevent facility operations. Before implementing a policy that may result in retiring or suspending operations of a significant volume of IBR resource capacity and thus jeopardize system reliability, ERCOT should perform a study identifying the expected IBR megawatts (“MW”) unable to comply with NOGRR245’s requirements and study the effects of retiring and/or suspending that capacity on resource adequacy and market clearing prices that ultimately are borne by retail customers. As proven during recent record setting load days and as publicly acknowledged by ERCOT and the Public Utility Commission of Texas (“PUCT”) in various venues, the ERCOT system relies on IBRs to meet growing electricity demand. Furthermore, ERCOT’s resource adequacy risk may further increase due to operational and financial impacts of the Environmental Protection Agency’s Cross-State Air Pollution Rule (“EPA CSAPR”)[[1]](#footnote-2) and other rules currently being considered and/or promulgated by the EPA on fossil-fuel resources.[[2]](#footnote-3) It is imprudent for ERCOT to implement NOGRR245 without thorough analysis and reporting of the potential resource adequacy risk that NOGRR245 poses. The PUCT, the ERCOT Board, and others with a vested interest in ensuring that ERCOT has adequate generating capacity should demand transparency on this issue.

In addition to the critical resource adequacy issues noted above, Southern Power recommends that the following factors be considered in the development of an IBR performance standard in the ERCOT region:

* Existing IBRs should be (1) required to maximize their ride-through capabilities and (2) allowed to seek an exemption for the specific requirements for which there are not technically feasible or commercially reasonable solutions and provide supporting documentation showing relevant equipment limitations. Additionally, every year thereafter, such resources with an exemption should either implement an identified retrofit to improve capabilities or attest that there is not a technically feasible or commercially reasonable solution available to address the exempted capability.
* The retroactive application and compliance timelines proposed in NOGRR245 are inconsistent with the Institute of Electrical and Electronics Engineers Standard for Interconnection and Interoperability of IBRs Interconnecting with Associated Transmission Electric Power Systems (“IEEE 2800-2022”) standard, the current approaches taken in other planning regions, and technical guidance provided by original equipment manufacturers (“OEMs”), which all support prospective implementation of ride-through standards.
* Regulatory and financial certainty is critical for entities to make investment decisions and to deploy hundreds of millions to billions of dollars to develop, own, and operate generation resources. NOGRR245 may force Existing IBRs to incur uneconomic and/or unproven retrofits or cease operations. Inserting new after-the-fact requirements would have a chilling effect on future generation investments of all types, further driving a resource adequacy deficiency in an already strained environment.
* In addition to improving IBR performance, a holistic approach concurrently evaluating transmission solutions that improve system resiliency and mitigate the impact of grid disturbance events will produce more cost-effective and durable results.
1. **NOGRR245 Should Implement Technically Achievable Requirements, Considering Capabilities/Limitations of Existing Resources.**

Southern Power acknowledges the need for a more robust IBR performance standard, including adequate facility testing followed by modeling/studies efforts, to improve technical capabilities of IBR equipment and to mitigate the impact of grid disturbance events. In fact, Southern Power and its affiliates have been actively participating in the development of the IEEE 2800-2022 standard that the preponderance of the United States appears likely to adopt. Such a performance standard should implement technically achievable requirements and consider the capabilities of Existing IBRs. Southern Power supports the adoption of IEEE 2800-2022 to New IBRs; however, it is important that a reasonable transition timeline is implemented to allow OEMs sufficient notice to test and design equipment accordingly. Currently, NOGRR245 proposes that IBRs with SGIAs executed on or after June 1, 2023, must immediately comply with the new ride-through requirements. Southern Power is concerned that some OEMs may not have fully compliant equipment for a few years and that some Interconnecting Entities may have already procured equipment that does not have full capabilities to meet all the proposed ride-through requirements.[[3]](#footnote-4) Southern Power recommends updating NOGRR245 so that New IBRs with SGIAs executed on or after June 1, 2026,[[4]](#footnote-5) must immediately comply with the proposed requirements.

Through Southern Power’s operational experience and extensive discussions with OEMs,[[5]](#footnote-6) it has identified various design limitations that will cause Existing IBRs to face significant challenges in meeting NOGRR245’s proposed requirements, if possible at all.[[6]](#footnote-7) OEMs reported that existing equipment cannot meet certain NOGRR245 requirements and additional time was needed to evaluate equipment capabilities and the viability and timing of potential retrofit solutions. Ultimately, the feasibility of Existing IBRs to meet the proposed requirements will vary by technology type and make/model of the specific equipment. Comments filed by OEMs voice concern with the ability to meet the proposed compliance timelines, question if retrofits will even be possible for certain Existing IBRs, and support the need for a good cause exemption process. No OEM has filed public comments indicating identification of technically feasible retrofit solutions that would allow all its legacy equipment to timely comply with the ride-through requirements proposed by NOGRR245.

* General Electric Vernova (“GE”) filed comments on May 3, 2023, and July 31, 2023, reiterating the complexity of needed technical studies and the inability to support the proposed compliance timelines.[[7]](#footnote-8)
* Siemens Gamesa Renewable Energy (“SGRE”) filed comments on June 6, 2023, objecting to the retroactive application of an IBR performance standard and highlighting the need for an industry defined testing and verification procedure. Furthermore, SGRE comments “designing new solutions for relatively old populations could prove to be a significant challenge **(if even possible)** considering the degree of obsolescence of many individual components, software, and available tools or other required support or resources.”[[8]](#footnote-9)
* Vestas filed comments on June 22, 2023, stating that certain legacy equipment will be unable to meet or will face difficulties meeting the proposed ride-through requirements. Vestas also opposes the retroactive application of the standard and supports incorporating a good cause exemption process for legacy equipment.[[9]](#footnote-10)

Accordingly, Southern Power recommends that NOGRR245 be updated (1) to require Existing IBRs to maximize their ride-through capabilities and (2) to allow Existing IBRs to seek an exemption for specific requirements for which there are not technically feasible or commercially reasonable solutions available. Southern Power also believes that additional time would be beneficial in finalizing and completing the capability and compliance report due June 1, 2024, and recommends updating the due date of that report to August 1, 2025. Additionally, every year thereafter, Existing IBRs with an exemption should either identify a plan to implement retrofits that would improve capabilities to meet the ride-through requirements or attest that there is not a technically feasible or commercially reasonable solution available to address the exempted capability.

1. **NOGRR245 Presents Untenable Risk and Uncertainty for Existing IBRs and Will Create a Chilling Effect for All Generation Investment.**

In addition to the technical uncertainty noted above, ERCOT’s undefined discretion to restrict operations, the lack of generally accepted testing standards, and the imposition of potentially cost-prohibitive retrofits cumulatively present untenable risk for Existing IBRs and will create a chilling effect for all generation investment. First, Southern Power is concerned that ERCOT’s proposed discretion to restrict operations of non-compliant IBRs is too undefined and could potentially be applied in an inconsistent and discriminatory fashion given the lack of criteria. Specifically, NOGRR245 contains no details relating to (1) the criteria assessing the need for and scope of restricted operations, (2) the obligation to seek a narrowly tailored and time bound restriction if appropriate, (3) whether an IBR has a reasonable cure period to address the identified deficiency, and (4) the appeal process for an affected IBR. Southern Power recommends striking ERCOT’s unfettered authority to restrict operations, and to the extent ERCOT deems such authority necessary, that policy should be developed in a separate revision request with appropriate criteria and guardrails. Southern Power believes that non-compliance with NOGRR245 can be managed like other non-compliance with ERCOT Protocols and Guides, via a referral to the Electric Reliability Monitor and potentially to the PUCT for review and enforcement.

Next, ERCOT proposes that all IBRs verify compliance with NOGRR245 requirements even though there is no generally accepted testing procedure to demonstrate compliance. IEEE P2800.2 is developing new testing and verification procedures to demonstrate compliance with IEEE 2800-2022, but that process is ongoing and currently the targeted publication of IEEE P2800.2 is Q1-Q2 of 2025.[[10]](#footnote-11) This testing procedure will likely focus on new equipment because IEEE 2800-2022 recommended that the standard be applied to IBR facilities for which interconnection requests are submitted after the date by which IEEE 2800-2022 is enforced. It is unreasonable to require assets to verify compliance with a standard they were not designed to meet and for which there is no proven testing procedure.

At this time, it is difficult to estimate the potential costs of retrofits which have not been developed yet, but costs are likely to be significant for changes requiring hardware and equipment changes.[[11]](#footnote-12) Repowering facilities (i.e., installing new inverters and necessary balance of plant equipment) would be even more extensive and costly. Southern Power is not opposed to Existing IBRs taking actions that are both technically feasible and commercially reasonable to improve ride-through performance, but it is unjust and unreasonable to substantially change regulatory requirements that impose extensive physical facility changes that are cost prohibitive and/or commercially unproven. The cumulative impact of the proposed policy exposes an unknown capacity amount of Existing IBRs to early retirement risk and will have a chilling effect on new investment in ERCOT.[[12]](#footnote-13) The decision to invest hundreds of millions, if not billions, in a new generation resource requires confidence in the predictability of revenue streams and expenses for the life of the plant and in the operational life of the plant. NOGRR245 would throw that predictability asunder, especially for IBRs; but also for thermal units because a future Binding Document might seek comparably costly or impossible retrofits for them.

It is critical that ERCOT recognize that it competes with other regions for investment in new resource capacity of all technology types. Other Regional Transmission Organizations (“RTOs”) appear on track to adopt and implement IEEE 2800-2022, which has clearer and more predictable treatment of legacy IBRs than NOGRR245 and therefore creates less regulatory risk than the NOGRR. Given the clear Legislative and Gubernatorial instruction to seek new investment in resource capacity in ERCOT, NOGRR245 should be scoped to minimize regulatory risk for entities willing to invest in resources in ERCOT.

1. **NOGRR245 Creates Future Resource Adequacy Risk for the ERCOT System.**

Southern Power agrees with ERCOT’s goal to mitigate reliability risk by improving IBR ride-through performance during system disturbances. However, Southern Power remains deeply concerned that the net impact of this proposed policy will be to increase resource adequacy risk to the ERCOT System through the premature retirement of legacy solar, wind, and battery energy storage resources that are unable to meet the new requirements. Due to the uncertainty—or impossibility—of meeting the new standards, Existing IBRs will be at risk of limited or completely restricted operations and may choose retirement instead of investing in potentially cost-prohibitive and/or commercially unproven technologies.

ERCOT still has not provided an estimate of how much resource capacity will be at risk of early retirement or disconnection should NOGRR245 be approved. It is entirely possible that NOGRR245’s adverse impacts on resource adequacy may far exceed any purported benefit from a voltage ride-through or frequency ride-through perspective. At this point, no analysis on this issue has been presented. Southern Power supports the concept of a study proposed in Avangrid’s comments dated June 7, 2023, to determine (a) which existing IBRs cannot or may not comply with ride-through requirements, and (b) model the ERCOT System without the IBRs that cannot or may not comply with those requirements.

Moreover, the ERCOT System continues to experience record-breaking peak loads this summer and expects to see substantial growth in the foreseeable future, with summer peak loads forecasted to exceed 90 GW by Summer 2032.[[13]](#footnote-14) The recent performance of wind and solar resources underscores the critical contribution that IBRs make in meeting peak demand while keeping costs reasonable for consumers. In the highest 50 peak demand hours from June 1, 2023, through August 29, 2023, wind and solar resources generated an average of 21.5 GW and served an average of 26% of total system load. Removal of a potentially significant and currently unknown amount of IBR capacity would further stress ERCOT’s ability to maintain system reliability.

Table 1: IBR Performance during Highest 50 Load Hours between June 1, 2023, and August 29, 2023

|  |  |  |
| --- | --- | --- |
|  | Average | Percentage Load Served by Wind + Solar |
| Top Rank Load Hours | Load (MW) | Wind (MW) | Solar (MW) | Wind + Solar (MW) | Average | Minimum | Maximum |
| 10 | 84,992 | 10,713 | 11,795 | 22,508 | 26% | 23% | 31% |
| 20 | 84,814 | 10,711 | 11,479 | 22,190 | 26% | 19% | 31% |
| 30 | 84,660 | 11,201 | 11,155 | 22,356 | 26% | 19% | 31% |
| 40 | 84,485 | 10,658 | 11,358 | 22,017 | 26% | 19% | 31% |
| 50 | 84,319 | 10,245 | 11,278 | 21,523 | 26% | 18% | 31% |

Meanwhile, the ERCOT System will potentially be exposed to additional resource adequacy risk through the introduction of proposed rulemakings at the EPA that will likely affect thermal resources.[[14]](#footnote-15) The proposed Texas Regional Haze Federal Implementation Plan (“Regional Haze FIP”) alone creates burdensome requirements for nine ERCOT coal units comprising 6.6 GW of capacity.[[15]](#footnote-16) On August 8, 2023, ERCOT, along with other RTOs submitted comments (“Joint RTO Comments”) expressing concern that the EPA’s proposed greenhouse gas emissions rule has the potential to materially and adversely impact electric reliability:

“As a threshold matter, the Joint ISOs/RTOs [including ERCOT] are concerned that the Proposed Rule could result in material, adverse impacts to the reliability of the power grid. These reliability concerns primarily arise from the possibility that the significant technological advances in low-greenhouse gas (GHG) hydrogen production, transport and generation, as well as in carbon capture and storage (CCS) that are identified as Best System of Emissions Reduction (BSER) under the Proposed Rule may not occur as anticipated, or may not occur at the pace anticipated by the EPA. If the technology and associated infrastructure fail to timely materialize, then the future supply of compliant generation—given forced retirements of non-compliant generation—would be far below what is needed to serve power demand, increasing the likelihood of significant power shortages.”[[16]](#footnote-17)

The potential impact of NOGRR245 cannot be viewed in a vacuum but must be assessed in light of other regulatory changes that may put further financial and operational stress on thermal resources. Importantly, as evidenced by the Joint RTO Comments, ERCOT recognizes the reality that grid reliability risk will increase if affected generation facilities do not have commercially and operationally viable solutions to meet the proposed compliance timelines:

“However, key requirements in the Proposed Rule are premised on EPA’s assumption that either (1) the development of new technologies will allow new, low GHG resources to substitute for the resources presently providing these necessary reliability attributes or grid services or (2) the retrofitting of fossil-based resources with either CCS or hydrogen co-firing to control carbon dioxide (CO2) emissions will be economically feasible within the timeframes specified for compliance in the Proposed Rule. Although the Joint ISOs/RTOs have been and will continue to be supportive of new technologies, we believe that the Proposed Rule’s BSER determination overstates the commercial viability of CCS and hydrogen co-firing today and ignores the cost and practicalities of developing new supporting infrastructure within the time frames projected. Without firm proof of the commercial and operational viability of these technologies, proceeding with these requirements could place the reliability of the electric grid in jeopardy. In short, hope is not an acceptable strategy.”[[17]](#footnote-18)

It is hypocritical and discriminatory[[18]](#footnote-19) for ERCOT to account for the commercial and operational viability of technologies when assessing the impact of greenhouse gas emission limit rules on thermal resources, but to ignore such reality when creating an IBR ride-through standard. Hope should not be a strategy for NOGRR245 that would similarly impose retrofits without firm proof of their commercial and operational viability.

1. **IEEE 2800-2022, ERCOT Precedent, PUCT Substantive Rules, PURA, and FERC/NERC’s Initial Approach All Suggest that an IBR Performance Standard Should Account for Existing IBRs’ Limitations.**

The IEEE 2800-2022 standard, upon which NOGRR245 is based, recognizes that the standard may be limited to IBR facilities for which interconnection requests are submitted after the date by which IEEE 2800-2022 is enforced and that legacy IBRs may have limitations in meeting the performance requirements.[[19]](#footnote-20) NOGRR245 ignores this reality identified by the technical experts who drafted IEEE 2800-2022 and instead proposes to force Existing IBRs to make potentially infeasible and/or unproven facility changes or cease operations. In addition, and as described in Invenergy’s NOGRR245 comments filed on July 31, 2023, the New York State Reliability Council and MISO are focused on adopting IEEE 2800-2022 prospectively.[[20]](#footnote-21) Southern Power is unaware of any other planning region evaluating retroactive adoption of IEEE 2800-2022 with no accommodation for technical limitations of existing equipment.

Historically, ERCOT has grandfathered similarly situated resources facing technical infeasibility challenges. In particular, PUCT Docket No. 37817[[21]](#footnote-22) and NPRR 389[[22]](#footnote-23) spotlight the need for exemptions for existing generation resources where compliance is either impossible or impracticable. After long debate, ERCOT agreed to grandfather existing wind generation from newly created reactive power performance obligations.[[23]](#footnote-24) There is an obvious relationship between reactive power and the voltage at issue in NOGRR245 as voltage sags without adequate reactive power. However, NOGRR245 proposes a diametrically opposed path by mandating functionality without consideration for feasibility and calling for the potential prohibition of facilities operating on the ERCOT grid.[[24]](#footnote-25) As such, it deviates from ERCOT and PUCT precedent.

Further, NOGRR245 conflicts with PUCT Substantive Rules by ignoring the capabilities of IBRs and imposing a bright-line prohibition on operations without regard for equipment capability.

“A market participant may be excused from compliance with ERCOT instructions or Protocol requirements only if such non-compliance is due to communication or equipment failure beyond the reasonable control of the market participant; if compliance would jeopardize public health and safety or the reliability of the ERCOT transmission grid, or create risk of bodily harm or damage to the equipment; if compliance would be inconsistent with facility licensing, environmental, or legal requirements; if required by applicable law; or for other good cause.”[[25]](#footnote-26)

Market participants do not have reasonable control over equipment’s technical capabilities, the inability to meet a standard not in effect at the time of the facility’s development and construction, and the lack of a viable retrofit solution; so, 16 TAC § 25.503(f)(2)(C) should apply.

Where the effects of NOGRR245 are to cause a facility to be unable to generate power for the ERCOT grid and there is no way for that facility to comply with applicable requirements, NOGRR245 creates an impermissible takings and violates the Public Utility Regulatory Act (“PURA”) § 39.001(d), which provides, in pertinent part, that regulatory authorities, like ERCOT, “shall adopt rules and issue orders that are both practical and limited so as to impose the least impact on competition”.[[26]](#footnote-27) A requirement that is impossible to implement, due to technical infeasibility and the lack of a generally accepted testing standard, by definition is not practical. Similarly, a requirement cannot be considered “limited” if it is applied without exception and without consideration of the local needs of the grid.

In November 2022, the Federal Energy Regulatory Commission (“FERC”) issued a Notice of Proposed Rulemaking (“IBR NOPR”) directing the North American Electric Reliability Council (“NERC”) to develop new or modified Reliability Standards to address concerns pertaining to the impacts of IBRs on the reliable operation of the Bulk-Power System. While the NERC Reliability Standard drafting process is still underway, FERC directed NERC to require mitigation activities for existing facilities unable to comply with new voltage ride-through requirements, and NERC has recognized equipment limitations in prior alerts and reports rather than mandate retrofits.[[27]](#footnote-28) In reference to voltage-ride through requirements, FERC noted in the IBR NOPR:

“We are aware that certain registered IBRs currently in operation may not be able to meet the requirements proposed above. Therefore, we propose to direct NERC to require transmission planners and operators to implement mitigation activities that may be needed to address any reliability impact to the Bulk-Power System posed by these existing facilities. We believe that planners and operators should be able to accommodate this limited number of affected existing registered IBRs, and we expect that the technology of newer IBRs will not require such accommodation.”[[28]](#footnote-29)

NOGRR245 should similarly accommodate affected Existing IBRs. In addition, historically FERC and NERC have considered equipment limitations and the ability to recover newly imposed costs when setting just and reasonable rates and Reliability Standards.[[29]](#footnote-30)

1. **A Holistic Solution Must Improve IBR Performance and Transmission Grid Strength.**

By its very nature, a frequency or voltage ride-through event requires that a transmission or distribution facility carry a frequency or voltage anomaly to a generation resource. It is not produced by the IBRs on which the NOGRR proposes to place a new burden. Consequently, addressing ride-through issues should not focus solely on IBRs but should, in equal parts, identify solutions to prevent the root causes of disturbance events on the transmission and distribution system. The lack of transmission strength in far West Texas is exacerbating the impact of faults and creating larger and more frequent abnormal system conditions through which certain IBRs must ride through.[[30]](#footnote-31) Transmission solutions that mitigate the impact of grid disturbances and improve system resiliency must be evaluated and their implementation expedited.

At the Regional Planning Group meeting on June 13, 2023, ERCOT discussed the results of an assessment performed to identify needs and options to improve West Texas grid reliability and resiliency, including a recommendation of adding six new synchronous condensers across West Texas that would reduce the widespread impacts of transmission faults.[[31]](#footnote-32) Similar to benefits provided by synchronous condensers in the Texas Panhandle region,[[32]](#footnote-33) these six synchronous condensers would provide voltage and system strength support in West Texas and mitigate the electrical distortions created by grid faults. Southern Power supports the approval and expedited installation of these six synchronous condensers and urges continued evaluation of solutions to improve the strength of the West Texas transmission system.

Pursuant to recent changes approved by the Commission updating 16 TAC §25.101, Certification Criteria, the Commission may approve a transmission project that is submitted as an economic or reliability project and does not demonstrate sufficient economic savings or reliability benefits to merit approval on those grounds if ERCOT determines the project would provide resiliency benefits by reducing the impact of potential outages caused by extreme weather scenarios. Southern Power believes it is appropriate to broaden the types of transmission projects that qualify under 16 TAC §25.101 to provide resiliency benefits to include those that reduce load shed risk posed by transmission faults. For example, the transmission system in far West Texas is more susceptible to the impact of transmission faults and would benefit from improvements that reduce the impact of and improve recovery time from such faults. Southern Power recognizes that this is an issue outside the purview of the ERCOT stakeholder process and must be considered by the Commission.

Finally, Southern Power urges ERCOT to support the PUCT in its efforts to expedite the needed analysis and implementation of recently enacted legislation from Texas’ 88th Legislature. Specifically, HB2555 (proceeding under PUCT Project No. 55250) which creates incentive for electric utilities to develop and execute plans enhancing the resiliency of transmission and distribution facilities in the state, and HB5066 (proceeding under PUCT Project No. 55249) which requires ERCOT to develop a reliability plan for the Permian Basin region. The potential transmission projects resulting from this legislation can play a significant role in strengthening the resiliency of the Texas grid, decrease the probability and impacts of electrical disturbances, and improve ERCOT’s confidence to reliably serve the system’s growing load. NOGRR245 and frequency and voltage ride-through issues should not be evaluated in a vacuum but should be analyzed as part of a holistic review that includes upcoming transmission improvements.

1. **The Current Nodal Operating Guide Sets a Frequency and Voltage Protective Settings Standard and NOGRR245 Establishes New Requirements for the Existing Frequency and Voltage Ride-Through Curves.**

In July 2020, FERC approved NERC standard Protection and Control (“PRC”) 024-3 to address multiple gaps identified in the then current standard PRC-024-2, including the fact that PRC-024-2 applied solely to the voltage and frequency protective relay settings and not to the overall IBR plant.[[33]](#footnote-34) In NERC’s petition to FERC, it described PRC-024-3 to use “the term protection to indicate that the standard has a broader application than only protective relays.”[[34]](#footnote-35) The NERC Inverter-Based Resource Performance Task Force (“IRPTF”) developed a PRC-024-2 gaps whitepaper, in which it explained the difference between a ride-through standard and a protection settings standard:

“PRC-024-2 is often interpreted, or used by local utilities, as a ‘ride-through standard’, meaning that the entire plant is expected [to] ride through a disturbance within the PRC-024-2 curves. However, the standard requirements are specific in applying solely to the voltage and frequency protective settings and not to the overall plant. For example, a synchronous generating facility may trip on loss of synchronism, loss of auxiliary loads that could trip the turbine, or other forms of protection. As long as the resource has its voltage and frequency protective relaying set correctly, the resource is compliant with the standard. Similarly, for inverter-based resources, it is expected that a resource that trips on any DC bus protection, phase lock loop loss of synchronism, or other forms of inverter protection would also be compliant with the standard requirements so long as the voltage and frequency protective relaying is set according to the standard requirements.”[[35]](#footnote-36)

While PRC-024-2 required generator owners to set frequency and voltage protective relaying, PRC-024-3 more broadly required generator owners to set applicable frequency and voltage protection, which included relaying and functions within associated control systems. Similar to PRC-024-2, paragraphs (1) and (2) of Section 2.6.2, Generators and Energy Storage Resources, and paragraphs (3) and (5) of Section 2.9.1, Voltage Ride-Through Requirements for Intermittent Renewable Resources Connected to the ERCOT Transmission Grid, only reference setting frequency and voltage relays to prevent tripping in the applicable curves, respectively.

Table 2: Frequency and Voltage Ride-Through Requirements

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| --- | --- | --- |
| Applicable Regulatory Standard | Frequency Ride-Through Requirements | Voltage Ride-Through Requirements |
| PRC-024-2[[36]](#footnote-37) | “Each Generator Owner that has generator frequency protective relaying activated to trip its applicable generating unit(s) shall set its protective relaying such that the generator frequency protective relaying does not trip the applicable generating unit(s) within the ‘no trip zone’ of PRC-024 Attachment 1…” | “Each Generator Owner that has generator voltage protective relaying activated to trip its applicable generating unit(s) shall set its protective relaying such that the generator voltage protective relaying does not trip the applicable generating unit(s)as a result of a voltage excursion…that remains within the ‘no trip’ zone of PRC-024 Attachment 2.” |
| PRC-024-3[[37]](#footnote-38) | “Each Generator Owner shall set its applicable frequency protection[[38]](#footnote-39) in accordance with PRC-024 Attachment 1such that the applicable protection does not cause the generating resource to trip or cease injecting current within the ‘no trip zone’ during a frequency excursion…” | “Each Generator Owner shall set its applicable voltage protectionin accordance with PRC-024 Attachment 2, such that the applicable protection does not cause the generating resource to trip or cease injecting current within the ‘no trip zone’ during a voltage excursion…” |
| Currently Effective ERCOT Nodal Operating Guide | “…if under-frequency relays are installed and activated to trip the Generation Resource, these relays shall be setsuch that the automatic removal of individual Generation Resources or Energy Storage Resources from the ERCOT System meets or exceeds the following requirements…”“…if over-frequency relays are installed and activated to trip the Generation Resource, they shall be set such that the automatic removal of individual Generation Resources or Energy Storage Resources from the ERCOT System meets or exceeds the following requirements…” | “Each IRR is required to set generator voltage relays to remain in service for at least 0.15 seconds during all transmission faults and to allow the system to recover as illustrated in Figure 1, Default Voltage Ride-Through Boundaries for IRRs Connected to the ERCOT Transmission Grid, below.”“Each IRR shall set generator voltage relays to remain interconnected to the ERCOT system during the following high-voltage conditions, as illustrated in Figure 1…” |
| Language Proposed by NOGRR245 | “IBRs and Type 1 WGRs and Type 2 WGRs shall ride through the frequency conditions at the POIB specified in the following table…” | “All IBRs and Type 1 and Type 2 WGRs … shall ride through the root-mean-square voltage conditions in Table A below …” |

Similar to PRC-024-3 making changes so that ride-through requirements applied more broadly to protection settings rather than just protective relays, NOGRR245 proposes changes so that ride-through requirements more clearly apply to the IBR facility rather than just protective relays. Southern Power supports the establishment of an IBR performance standard, as this will improve facility performance and provide clarity to generation owners and equipment manufacturers. Due to the technical infeasibility concerns previously explained, Southern Power supports the regulatory and equipment limitation provided in PRC-024-3,[[39]](#footnote-40) but recognizes that ERCOT will likely oppose this concept. However, it is important context that legacy IBRs that have appropriately set their relay settings to not trip according to the currently effective Nodal Operating Guide are compliant with ERCOT’s existing requirements and that NOGRR245 establishes new requirements even for the existing curves proposed in Section 2.6.2.1.1, Temporary Frequency Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs) and Type 1 and Type 2 Wind-Powered Generation Resources (WGRs), and Section 2.9.1.2, Legacy Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs) and Type 1 and Type 2 Wind-Powered Generation Resources (WGRs).

1. **Conclusion**

Southern Power appreciates the opportunity to comment on NOGRR245 and urges ERCOT and stakeholders to approve NOGRR245 as amended by these comments.

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| Revised Cover Page Language |

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| Nodal Operating Guide Sections Requiring Revision  | 2.6.2, Generators and Energy Storage Resources2.6.2.1, Frequency Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs) and Type 1 and Type 2 Wind-Powered Generation Resources (WGRs) (new)2.6.2.1, Frequency Ride-Through Requirements for Distribution Generation Resources (DGRs) and Distribution Energy Storage Resources (DESRs)2.6.2.1.1, Temporary Frequency Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs) and Type 1 and Type 2 Wind-Powered Generation Resources (WGRs) (new)2.9, Voltage Ride-Through Requirements for Generation Resources2.9.1, Voltage Ride-Through Requirements for Intermittent Renewable Resources Connected to the ERCOT Transmission Grid2.9.1.1, Preferred Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs) (new)2.9.1.2, Legacy Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs) and Type 1 and Type 2 Wind-Powered Generation Resources (WGRs) (new) |
| Revision Description | This Nodal Operating Guide Revision Request (NOGRR) replaces the current voltage ride-through requirements for Intermittent Renewable Resources (IRRs) with voltage ride-through requirements for Inverter-Based Resources (IBRs) and Type 1 and Type 2 Wind-powered Generation Resources (WGRs) and provides new frequency ride-through requirements for IBRs and Type 1 and 2 WGRs consistent with or beyond requirements identified in the new 2800-2022 - Institute of Electrical and Electronics Engineers (IEEE) Standard for Interconnection and Interoperability of Inverter-Based Resources (IBRs) Interconnecting with Associated Transmission Electric Power Systems (“IEEE 2800-2022 standard”). |
| Business Case | ERCOT submits this NOGRR based on reliability issues associated with the inability of some IBRs or Type 1 WGRs or Type 2 WGRs to ride through system disturbances, and in light of the IEEE 2800-2022 standard. In its recently issued guidance document *Inverter-Based Resource Strategy*, theNorth American Reliability Corporation (NERC) noted it has supported the development of the IEEE 2800-2022 standard (and continues to support the IEEE P2800.2, Recommended Practice for Test and Verification Procedures for Inverter-based Resources (IBRs) Interconnecting with Bulk Power Systems, standards development efforts). Among other things, the document also highlights that:* New technology can introduce significant risks if not integrated properlywhich could result in high impact and high likelihood events that require substantive action;
* Inverter and plant controls and protection systems must support the reliable operation of the bulk power system during system disturbances;
* Disturbance reports, alerts, guidelines, and other deliverables have shown that abnormal IBR performance issues pose a significant risk to bulk power system reliability;
* Analyzed events identified new performance issues such as momentary cessation, unwarranted inverter or plant-level tripping issues, controller interactions and instabilities, and other critical performance risks that must be mitigated; and
* Generation ride-through and provision of essential reliability services is a core principle for reliable operation of the Bulk Electric System.

Consequently, this NOGRR proposes ride-through requirements for IBRs and Type 1 and Type 2 WGRs with specificity consistent with or beyond the IEEE 2800-2022 standard where appropriate (e.g., applying to the Point of Interconnection Bus (POIB) instead of the “Resource Point of Applicability”). The revisions specify the ride-through requirements for IBRs rather than IRRs or Energy Storage Resources (ESRs) because some ESRs may not be IBRs and the IBR attributes create unique ride-through requirements. Additionally, due to Type 1 and 2 WGRs failing to ride through normal system disturbances, ERCOT proposes to apply several of the new requirements to these Resources. Some clarifications included from the IEEE 2800-2022 standard may not require additional “capability” but provide additional specificity for settings that can prevent failures rather than adjustments being made after a failure occurs.Failure of IBRs and Type 1 and Type 2 WGRs to ride through normal frequency and voltage deviations on the ERCOT System can lead to severe consequences such as instability, cascading outages, or triggering an Under-Frequency Load Shed (UFLS) event which would result in the uncontrolled loss of firm Load. As such, ERCOT does not propose to grandfather existing IBRs and Type 1 and Type 2 WGRs indefinitely. Rather, ERCOT proposes that all IBRs and Type 1 and Type 2 WGRs with a Standard Generation Interconnection Agreement (SGIA) executed prior to June 1, 2026 (“existing IBRs”), use commercially reasonable efforts to maximize ride-through capability to meet or exceed the new frequency ride-through profile and new voltage ride-through profile as soon as practicable but no later than June 1, 2026 and December 31, 2027, respectively, except certain voltage ride-through requirements that must be met as soon as practicable but no later than December 31, 2028. IBRs and Type 1 and Type 2 WGRs that cannot meet the new ride-through requirements will need to submit a report by August 1, 2025 (or by a date required by ERCOT in the interconnection process for an IBR with an SGIA executed after August 1, 2025, and prior to June 1, 2026, as necessary), documenting such and provide a mitigation plan to give ERCOT an accurate understanding of the physical limitations and maximum ride-through capability. Existing IBRs and Type 1 WGRs or Type 2 WGRs are not required to meet the new ride-through requirements for which there are not both technically feasible and commercially reasonable modifications available and must provide supporting documentation. On an annual basis, such an existing IBR or Type 1 WGR or Type 2 WGR must submit an attestation indicating either (1) it has identified and plans to implement a retrofit that would improve capabilities to meet the new ride-through requirements or (2) there is not a technically feasible or commercially reasonable solution available to address the exempted capability.The proposed requirements will help improve several of the major failure modes identified in the Odessa disturbances in 2021 and 2022 as well as numerous other ride-through failure events. Market Participants in the Inverter Based Resource Task Force encouraged ERCOT to focus on enhancements adopting portions of the IEEE 2800-2022 standard or NERC Reliability Guidelines that would provide the most reliability benefit in the short-term rather than a holistic approach. As such, additional requirements on IBRs may be necessary based on additional event analyses, lessons learned, recommendations contained in the NERC Odessa 2022 report, IEEE requirements, and NERC Reliability Standard revisions. |

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| Revised Proposed Guide Language |

***2.6.2 Frequency Ride-Through Requirements for Generation Resources and Energy Storage Resources***

(1) Except for Generation Resources and Energy Storage Resources (ESRs) subject to Sections 2.6.2.1, Frequency Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs) and Type 1 and Type 2 Wind-Powered Generation Resources (WGRs) or 2.6.2.2, Frequency Ride-Through Requirements for Distribution Generation Resources (DGRs) and Distribution Energy Storage Resources (DESRs), if under-frequency relays are installed and activated to trip the Generation Resource or ESR, these relays shall perform such that the automatic removal of individual Generation Resources or ESRs from the ERCOT System meets or exceeds the following requirements:

|  |  |
| --- | --- |
| **Frequency Range** | **Delay to Trip** |
| Above 59.4 Hz | No automatic tripping(continuous operation) |
| Above 58.4 Hz up toand including 59.4 Hz | Not less than 9 minutes |
| Above 58.0 Hz up toand including 58.4 Hz | Not less than 30 seconds |
| Above 57.5 Hz up toand including 58.0 Hz | Not less than 2 seconds |
| 57.5 Hz or below | No time delay required |

(2) Except for Generation Resources subject to Sections 2.6.2.1 or 2.6.2.2, if over-frequency relays are installed and activated to trip the Generation Resource or ESR, they shall perform such that the automatic removal of individual Generation Resources or ESRs from the ERCOT System meets or exceeds the following requirements:

|  |  |
| --- | --- |
| **Frequency Range** | **Delay to Trip** |
| Below 60.6 Hz down to and including 60 Hz | No automatic tripping (continuous operation) |
| Below 61.6 Hz down to and including 60.6 Hz | Not less than 9 minutes |
| Below 61.8 Hz down to and including 61.6 Hz | Not less than 30 seconds |
| 61.8 Hz or above | No time delay required |

(3) If installed and activated to trip a Generation Resource or ESR, frequency protection schemes shall use filtered quantities or add sufficient time delays to prevent misoperations while providing the desired equipment protection. Protection schemes shall not trip a Generation Resource or ESR based on an instantaneous frequency measurement.

(4) This Section shall not affect the Resource Entity’s responsibility to protect Generation Resources or ESRs from damaging operating conditions. The Resource Entity for a Generation Resource or ESR subject to paragraphs (1) and (2) above that is unable to remain reliably connected to the ERCOT System as set forth in paragraphs (1) and (2), shall provide to ERCOT the reason(s) for that inability, including study results or manufacturer advice. The limitation description shall include the Generation Resource’s or ESR’s frequency ride-through capability in the format shown in the tables in paragraphs (1) and (2) above.

***2.6.2.1 Frequency Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs) and Type 1 and Type 2 Wind-Powered Generation Resources (WGRs)***

(1) All IBRs and Type 1 and Type 2 Wind-powered Generation Resources (WGRs) interconnected to the ERCOT Transmission Grid shall ride through the frequency conditions at the IBR’s Point of Interconnection Bus (POIB) specified in the following table:

|  |  |
| --- | --- |
| Frequency (f) in (Hz) | Minimum Ride-Through Time(seconds) |
| f > 61.8 | May ride-through or trip |
| 61.6 < f ≤ 61.8 | 299 |
| 61.2 < f ≤ 61.6 | 540 |
| 58.8 ≤ f ≤ 61.2 | continuous |
| 58.4 ≤ f < 58.8 | 540 |
| 57.0 ≤ f < 58.4 | 299 |
| f < 57.0 | May ride-through or trip |

(2) Nothing in paragraph (1) above shall be interpreted to require an IBR or Type 1 WGR or Type 2 WGR to trip for frequency conditions beyond those for which ride-through is required.

(3) If installed and activated to trip the IBR or Type 1 WGR or Type 2 WGR, all protection systems (including, but not limited to protection for over-/under-frequency, rate-of-change of frequency, anti-islanding, and phase angle jump) shall enable the IBR or Type 1 WGR or Type 2 WGR to ride through frequency conditions beyond those defined in paragraph (1) above to the maximum extent possible. An IBR or Type 1 WGR or Type 2 WGR shall ride through frequency excursions during which ride-through is required and the absolute rate-of-change of frequency magnitude does not exceed 5.0 Hz/second. The rate-of-change of frequency shall be considered the average rate of change of frequency over a period of at least 0.1 seconds unless ERCOT or the interconnecting Transmission Service Provider (TSP) specifies otherwise.

(4) An IBR or Type 1 WGR or Type 2 WGR shall inject electric current during all periods requiring ride-through.

(5) An IBR or Type 1 WGR or Type 2 WGR plant controls or inverter controls shall not disconnect the IBR or Type 1 WGR or Type 2 WGR from the ERCOT System or reduce its output during frequency conditions where ride-through is required unless necessary for providing appropriate frequency response or preventing equipment damage.

(6) An IBR or Type 1 WGR or Type 2 WGR with a Standard Generation Interconnection Agreement (SGIA) executed prior to June 1, 2026, must use commercially reasonable efforts to maximize frequency ride-through capability to the greatest extent possible to comply with paragraphs (1) through (5) above as soon as practicable but no later than June 1, 2026. Such IBRs or Type 1 WGRs or Type 2 WGRs shall comply with the frequency ride-through requirements specified in Section 2.6.2.1.1, Temporary Frequency Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs) and Type 1 and Type 2 Wind-Powered Generation Resources (WGRs), until the IBR or Type 1 WGR or Type 2 WGR implements changes to comply with paragraphs (1) through (5) above, unless the IBR or Type 1 WGR or Type 2 WGR has provided ERCOT documentation of any limitations making it technically infeasible or commercially unreasonable to meet the requirements in paragraphs (1) through (5) above. An IBR or Type 1 WGR or Type 2 WGR with an SGIA executed prior to June 1, 2026, is not required to meet the requirements in paragraphs (1) through (5) above for which there are not both technically feasible and commercially reasonable modifications available.

The Resource Entity or Interconnecting Entity (IE) for an IBR or Type 1 WGR or Type 2 WGR with an SGIA executed prior to June 1, 2026, that cannot comply with paragraphs (1) through (5) above shall by August 1, 2025, or by a date required by ERCOT in the interconnection process for an IBR with an SGIA executed after August 1, 2025 and prior to June 1, 2026, as necessary, submit to ERCOT a report and supporting documentation containing the following:

(a) The current and potential future IBR or Type 1 WGR or Type 2 WGR frequency ride-through capability (including any associated adjustments to improve frequency ride-through capability) in a format similar to the table in paragraph (1) above;

(b) The proposed modifications, if applicable, to maximize the IBR or Type 1 WGR or Type 2 WGR frequency ride-through capability and allow compliance with the frequency ride-through requirements in paragraphs (1) through (5) above;

(c) A schedule for implementing those modifications as soon as practicable but no later than June 1, 2026, unless the IBR or Type 1 WGR or Type 2 WGR has provided ERCOT documentation of any limitations making it technically infeasible or commercially unreasonable to meet the requirements in paragraphs (1) through (5) above; and

(d) Any limitations on the IBR or Type 1 WGR or Type 2 WGR frequency ride-through capability making it technically infeasible or commercially unreasonable to meet the requirements in paragraphs (1) through (5) above with documentation from the IBR or Type 1 WGR or Type 2 WGR original equipment manufacturer (or subsequent inverter/turbine vendor support company if the original equipment manufacturer is no longer in business) attesting there are no engineering, replacement, or retrofit solutions available, if applicable.

ERCOT may allow an exception to the highest and lowest frequency ride-through bands where an existing IBR or Type 1 WGR or Type 2 WGR with an SGIA executed before June 1, 2026, provides documented evidence from the original equipment manufacturer (or subsequent inverter/turbine vendor support company if original equipment manufacturer is no longer in business) stating no engineering, replacement, or retrofit solutions exist to fully meet the required duration of the lowest and highest frequency ride-through bands in paragraph (1) above if, after maximizing its frequency ride-through capabilities, it can ride through the frequency ride-through band between 57.0 Hz and 58.4 Hz for at least ten seconds and the frequency ride-through band between 61.6 Hz and 61.8 Hz for at least thirty seconds.

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(7) If an IBR or Type 1 WGR or Type 2 WGR fails to perform in accordance with the applicable frequency ride-through requirements, the Resource Entity for the IBR or Type 1 WGR or Type 2 WGR shall investigate the event and report to ERCOT the cause of the failure. All impacted TSPs shall provide available information to ERCOT to assist with event analysis.

(8) On an annual basis and starting with an initial due date of August 1, 2026, the Resource Entity for an IBR or Type 1 WGR or Type 2 WGR that has communicated a technically infeasible or commercially unreasonable limitation pursuant to paragraph (6)(d) above, shall submit a notarized attestation signed by an officer or executive with authority to bind the Resource Entity stating either that the Resource Entity has identified and plans to implement modifications to improve frequency ride-through capability or there is not a technically feasible or commercially reasonable solution available to address the exempted capability. If the Resource Entity can implement IBR or Type 1 WGR or Type 2 WGR modifications to resolve the technical limitations or performance failures, it shall submit to ERCOT a report and supporting documentation containing the following:

(a) The current technical limitations and IBR or Type 1 WGR or Type 2 WGR frequency ride-through capability in a format similar to the table in paragraph (1) above;

(b) The proposed modifications and frequency ride-through capability allowing the IBR or Type 1 WGR or Type 2 WGR to comply with the frequency ride-through requirements in a format similar to the table in paragraph (1) above; and

(c) A schedule for implementing those modifications.

In its sole and reasonable discretion, ERCOT may accept the proposed modification plan.

***2.6.2.1.1*** ***Temporary Frequency Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs)*** ***and Type 1 and Type 2 Wind-Powered Generation Resources (WGRs)***

(1) This Section applies only to certain IBRs and Type 1 and Type 2 WGRs with an SGIA executed prior to June 1, 2026, in accordance with paragraph (6) of Section 2.6.2.1, Frequency Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs) and Type 1 and Type 2 Wind-Powered Generation Resources (WGRs).

(2) IBRs and Type 1 WGRs and Type 2 WGRs shall ride through the frequency conditions at the POIB specified in the following table:

|  |  |
| --- | --- |
| **Frequency Range** | **Delay to Trip** |
| Above 59.4 Hz | No automatic tripping(continuous operation) |
| Above 58.4 Hz up toand including 59.4 Hz | Not less than 9 minutes |
| Above 58.0 Hz up toand including 58.4 Hz | Not less than 30 seconds |
| Above 57.5 Hz up toand including 58.0 Hz | Not less than 2 seconds |
| 57.5 Hz or below | No time delay required |

(3) IBRs and Type 1 WGRs and Type 2 WGRs shall ride through the frequency conditions at the POIB specified in the following table:

|  |  |
| --- | --- |
| **Frequency Range** | **Delay to Trip** |
| Below 60.6 Hz down to and including 60 Hz | No automatic tripping (continuous operation) |
| Below 61.6 Hz down to and including 60.6 Hz | Not less than 9 minutes |
| Below 61.8 Hz down to and including 61.6 Hz | Not less than 30 seconds |
| 61.8 Hz or above | No time delay required |

(4) This Section shall not affect the Resource Entity’s responsibility to protect equipment from damaging operating conditions. The Resource Entity for an IBR or Type 1 WGR or Type 2 WGR subject to paragraphs (2) and (3) above that is unable to remain reliably connected to the ERCOT System as set forth in paragraphs (2) and (3), shall provide to ERCOT the reason(s) for that inability, including study results or manufacturer advice. The limitation description shall include the IBR or Type 1 WGR or Type 2 WGR frequency ride-through capability in the format shown in the tables in paragraphs (2) and (3) above.

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***2.6.2.2 Frequency Ride-Through Requirements for Distribution Generation Resources (DGRs) and Distribution Energy Storage Resources (DESRs)***

(1) For any short-circuit fault or open-phase condition that occurs on the circuit to which the DGR or DESR is connected, the DGR or DESR will cease to energize and trip offline, and this will take priority over the frequency ride-through function.

(2) DGRs and DESRs must have over-/under-frequency relays set to ride through frequency conditions as specified in the following table:

|  |  |  |
| --- | --- | --- |
| Frequency (Hz) | Ride-Through Mode | Minimum Ride-through Time(seconds) |
|  *f > 61.8* | No ride-through requirements |
| 61.2 < f ≤ 61.8 | Mandatory Operation | 299 |
| 58.8 ≤ f ≤ 61.2 | Continuous Operation | continuous |
| 57.0 ≤ f < 58.8 | Mandatory Operation | 299 |
| *f < 57.0* | No ride-through requirements |

(3) Any Resource Entity with a DGR or DESR utilizing inverter-based generation that achieved Initial Synchronization before April 1, 2020 that is not capable of complying with the requirements of paragraph (2) above may request an exemption from those requirements. Such a request shall be submitted by November 2, 2020 and shall include documentation that demonstrates the DGR’s or DESR’s frequency ride-through capability to ERCOT’s satisfaction. If, after reviewing the request and documentation, ERCOT determines the DGR or DESR is not capable of complying with the requirements of paragraph (2), then the DGR or DESR shall be exempt from those requirements, but shall be required to comply with those requirements to the greatest degree possible within its capability, as determined in writing by ERCOT. Upon replacement or retirement of the inverter, the DGR or DESR shall no longer be exempt and shall at that time be required to comply with the requirements of paragraph (2) or other applicable requirement.

**2.9 Voltage Ride-Through Requirements for Generation Resources**

(1) Except for Generation Resources and Energy Storage Resources (ESRs) subject to Sections 2.9.1, Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs) and Type 1 and Type 2 Wind-Powered Generation Resources (WGRs), or 2.9.2, Voltage Ride-Through Requirements for Distribution Generation Resources (DGRs) and Distribution Energy Storage Resources (DESRs), each Generation Resource or ESR must remain reliably connected to the ERCOT Transmission Grid during the following:

(a) Generator terminal voltages are within 5% of the rated design voltage and volts per hertz are less than 105% of generator rated design voltage and frequency;

(b) Generator terminal voltage deviations exceed 5% but are within 10% of the rated design voltage and persist for less than ten seconds;

(c) Generator volts per hertz conditions are less than 116% of generator rated design voltage and frequency and last for less than 1.5 seconds;

(d) A transmission system fault (three-phase, single-phase or phase-to-phase), but not a generator bus fault, is cleared by the protection scheme coordinated between the Generation Entity and the Transmission Service Provider (TSP) on any line connected to the generator’s transmission interconnect bus, provided such lines are not connected to induction generators described in paragraph (12) of Protocol Section 3.15, Voltage Support; and

(e) In the case of a generator bus fault or a primary transmission system relay failure, the generator protective relaying may clear the generator independent of the operation of any transmission protective relaying.

(2) During operating conditions listed in paragraph (1) above, each Generation Resource and ESR subject to paragraph (1) shall not, during and following a transient voltage disturbance, cease providing real or reactive current except to the extent needed to provide frequency support or aid in voltage recovery.

(3) Synchronous Generation Resources required to provide Voltage Support Service (VSS) shall have and maintain the following capability:

(a) Over-excitation limiters shall be provided and coordinated with the thermal capability of the generator field winding and protective relays in order to permit short-term reactive capability that allows at least 80% of the unit design standard (ANSI C50.13-1989), as follows:

Time (seconds) 10 30 60 120

Field Voltage % 208 146 125 112

After allowing temporary field current overload, the limiter shall operate through the automatic AC voltage regulator to reduce field current to the continuous rating. Return to normal AC voltage regulation after current reduction shall be automatic. The over-excitation limiter shall be coordinated with the over-excitation protection so over-excitation protection operates only for failure of the voltage regulator/limiter.

(b) Under-excitation limiters shall be provided and coordinated with loss-of-field protection to eliminate unnecessary generating unit disconnection as a result of operator error or equipment malfunction.

(4) Generation Resources and ESRs shall have protective relaying necessary to protect equipment from abnormal conditions and be consistent with protective relaying criteria described in Section 6.2.6.3.4, Generator Protection and Relay Requirements.

(5) The voltage ride-through requirements do not apply to faults between the generator terminals and the transmission voltage side of the Main Power Transformer (MPT), or when clearing the fault effectively disconnects the Generation Resource from the ERCOT System.

(6) A Generation Resource or ESR may be tripped Off-Line or curtailed after the fault clearing period if part of an approved Remedial Action Scheme (RAS).

(7) The owner of each Generation Resource or ESR shall provide to ERCOT technical documentation of voltage ride-through capability upon request.

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| ***[NOGRR204: Replace Section 2.9 above with the following upon system implementation of NPRR989:]*****2.9 Voltage Ride-Through Requirements for Generation Resources and Energy Storage Resources**(1) Except for Generation Resources and Energy Storage Resources (ESRs) subject to Sections 2.9.1, Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs) and Type 1 and Type 2 Wind-Powered Generation Resources (WGRs), or 2.9.2, Voltage Ride-Through Requirements for Distribution Generation Resources (DGRs) and Distribution Energy Storage Resources (DESRs), each Generation Resource or ESR must remain reliably connected to the ERCOT Transmission Grid during the following:(a) Generator or inverter terminal voltages are within 5% of the rated design voltage and volts per hertz are less than 105% of generator rated design voltage and frequency;(b) Generator or inverter terminal voltage deviations exceed 5% but are within 10% of the rated design voltage and persist for less than ten seconds;(c) Generator or inverter volts per hertz conditions are less than 116% of rated design voltage and frequency and last for less than 1.5 seconds; and(d) A transmission system fault (three-phase, single-phase or phase-to-phase), but not a unit bus fault, is cleared by the protection scheme coordinated between the Resource Entity and the Transmission Service Provider (TSP) on any line connected to the Resource’s Point of Interconnection (POI), provided such lines are not connected to induction generators described in paragraph (12) of Protocol Section 3.15, Voltage Support. (2) In the case of a unit bus fault or a primary transmission system relay failure, the unit protective relaying may clear the unit independent of the operation of any transmission protective relaying.(3) During operating conditions listed in paragraph (1) above, each Generation Resource and ESR subject to paragraph (1) shall not, during and following a transient voltage disturbance, cease providing real or reactive current except to the extent needed to provide frequency support or aid in voltage recovery. Each ESR, if it is consuming active power from the ERCOT System when operating in the charging mode, shall reduce or cease power consumption as necessary to aid in voltage recovery during and following transient voltage disturbances. (4) Synchronous Generation Resources required to provide Voltage Support Service (VSS) shall have and maintain the following capability:(a) Over-excitation limiters shall be provided and coordinated with the thermal capability of the generator field winding and protective relays in order to permit short-term reactive capability that allows at least 80% of the unit design standard (ANSI C50.13-1989), as follows:Time (seconds) 10 30 60 120Field Voltage % 208 146 125 112After allowing temporary field current overload, the limiter shall operate through the automatic AC voltage regulator to reduce field current to the continuous rating. Return to normal AC voltage regulation after current reduction shall be automatic. The over-excitation limiter shall be coordinated with the over-excitation protection so over-excitation protection operates only for failure of the voltage regulator/limiter.(b) Under-excitation limiters shall be provided and coordinated with loss-of-field protection to eliminate unnecessary generating unit disconnection as a result of operator error or equipment malfunction.(5) Generation Resources and ESRs shall have protective relaying necessary to protect equipment from abnormal conditions and be consistent with protective relaying criteria described in Section 6.2.6.3.4, Generation Resource and Energy Storage Resource Protection and Relay Requirements.(6) The voltage ride-through requirements do not apply to faults at or behind the POI, when clearing the fault effectively disconnects the Resource from the ERCOT System.(7) A Generation Resource or ESR may be tripped Off-Line or curtailed after the fault clearing period if part of an approved Remedial Action Scheme (RAS). (8) The owner of each Generation Resource or ESR shall provide to ERCOT technical documentation of voltage ride-through capability upon request. |

***2.9.1*** ***Voltage Ride-Through Requirements for Transmission-Connected*** ***Inverter-Based Resources (IBRs)and Type 1 and Type 2 Wind-Powered Generation Resources (WGRs)***

(1) All Inverter-Based Resources (IBRs) and Type 1 Wind-powered Generation Resources (WGRs) and Type 2 WGRs interconnected to the ERCOT Transmission Grid shall comply with voltage ride-through requirements as follows:

(a) Section 2.9.1.1, Preferred Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs) shall apply to:

(i) IBRs with a Standard Generation Interconnection Agreement (SGIA) executed on or after June 1, 2026.

(ii) IBRs that implement any modification, as described in paragraph (1)(c) of Planning Guide Section 5.2.1, Applicability, for which a Generator Interconnection or Modification (GIM) was initiated on or after June 1, 2026, unless the modification was fully implemented prior to January 1, 2028 to comply with Section 2.9.1.2, Legacy Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs) and Type 1 and Type 2 Wind-Powered Generation Resources (WGRs).

(b) Section 2.9.1.2 shall apply to IBRs not subject to Section 2.9.1.1, and Type 1 and Type 2 WGRs.

(2) IBRs with an SGIA executed on or after June 1, 2026, or that implement any modification, as described in paragraph (1)(c) of Planning Guide Section 5.2.1, Applicability, for which a GIM was initiated on or after June 1, 2026, shall meet or exceed the capability and performance requirements in the following sections of Institute of Electric Engineers (IEEE) 2800-2022, Standard for Interconnection and Interoperability of Inverter-Based Resources (IBRs) Interconnecting with Associated Transmission Electric Power Systems “IEEE 2800-2022 standard” or any successor IEEE standard, including any intra-standard cross references or definitions, unless otherwise clarified, modified, or exempted in the ERCOT Protocols, these Operating Guides, or Planning Guide:

(a) Section 5, Reactive power-voltage control requirements within the continuous operation region;

 (b) Section 7, Response to TS abnormal conditions; and

 (c) Section 9, Protection.

 All IBR plant requirements and all IBR unit requirements described in the IEEE 2800-2022 standard apply at the Point of Interconnection Bus (POIB) and the individual inverter based unit terminal respectively unless otherwise clarified, modified, or exempted in the ERCOT Protocols.

 For IBRs with an original SGIA executed before June 1, 2026, any modifications implemented prior to January 1, 2028 for complying with Section 2.9.1.2 as described in paragraph (1)(c) of Planning Guide Section 5.2.1, for which a GIM was initiated are not required to meet or exceed the capability and performance requirements in sections 5, 7 and 9 of the IEEE 2800-2022 standard or any successor IEEE standard that are not required in the Protocols, these Operating Guides, or Planning Guide. Any IBR modifications implemented on after January 1, 2028 do not qualify for this exception.

 For any modifications implemented after January 1, 2028, for an IBR with an original SGIA executed before June 1, 2026, ERCOT may in its sole and reasonable discretion, allow limited exceptions to the voltage ride through requirements in Table 11 of the IEEE 2800-2022 standard or successor IEEE standard for Type 3 WGRs that implement a repower modification as described in paragraph (1)(c) of Planning Guide Section 5.2.1, for which a GIM was initiated. The Resource Entity or Interconnecting Entity (IE) must have provided documented evidence of technical infeasibility from its original equipment manufacturer (or subsequent inverter/turbine vendor support company if the original equipment manufacturer is no longer in business) that it maximized its voltage ride-through capability with the best available converter upgrade along with the repower and demonstrates it meets most of the low voltage ride-through curve portions in Table 11 of the IEEE 2800-2022 standard or successor IEEE standard as part of the repower modification.

 Type 1 and Type 2 WGRs are not required to meet or exceed the capability and performance requirements in sections 5, 7 and 9 of the IEEE 2800-2022 standard or any successor IEEE standard but must meet or exceed the capability and performance requirements in Section 2.9.1.2.

ERCOT and the interconnecting TSP may exempt an IBR from section 7.2.2.3.5, including Table 13, of the IEEE 2800-2022 standard when studies indicate a slower response time may be required or if the IBR may not be able to meet response times noted in Table 13 for certain system conditions. If so, greater response time and settling time are allowed with mutual agreement among an IBR owner, ERCOT and the interconnecting TSP.

***2.9.1.1 Preferred Voltage Ride-Through Requirements for Transmission-Connected*** ***Inverter-Based Resources (IBRs)***

(1) All IBRs subject to this Section in accordance with paragraph (1) of Section 2.9.1, Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs) and Type 1 and Type 2 Wind-Powered Generation Resources (WGRs), shall ride through the root-mean-square voltage conditions in Tables A or B below, as applicable, and the instantaneous phase voltage conditions in Table C below, as measured at the POIB:

**Table A: Applicable to WGR IBRs**

|  |  |
| --- | --- |
| Root-Mean-Square Voltage (p.u. of nominal) | Minimum Ride-Through Time(seconds) |
| V > 1.20 | May ride-through or trip |
| 1.10 < V ≤ 1.20 | 1.0 |
| 0.90 ≤ V ≤ 1.10 | continuous |
| 0.70 ≤ V < 0.90 | 3.0 |
| 0.50 ≤ V < 0.70 | 2.5 |
| 0.25 ≤ V < 0.50 | 1.2 |
|  V < 0.25 | 0.16 |

**Table B: Applicable to PhotoVoltaic Generation Resource (PVGR) and ESR IBRs**

|  |  |
| --- | --- |
| Root-Mean-Square Voltage (p.u. of nominal) | Minimum Ride-Through Time(seconds) |
| V > 1.20 | May ride-through or trip |
| 1.10 < V ≤ 1.20 | 1.0 |
| 0.90 ≤ V ≤ 1.10 | continuous |
| 0.70 ≤ V < 0.90 | 6.0 |
| 0.50 ≤ V < 0.70 | 3.0 |
| 0.25 ≤ V < 0.50 | 1.2 |
|  V < 0.25 | 0.32 |

In the event of multiple excursions, the minimum ride-through time in Tables A or B is a cumulative time over a ten second time window.

**Table C**

|  |  |
| --- | --- |
| Instantaneous Phase-to-Phase or Phase-to-Ground Voltage(p.u. of nominal) | Minimum Ride-Through Time(milliseconds) |
| V > 1.80 | May ride-through or trip |
| 1.70 < V ≤ 1.80 | 0.2 |
| 1.60 < V ≤ 1.70 | 1.0 |
| 1.40 < V ≤ 1.60 | 3.0 |
| 1.20 < V ≤ 1.40 | 15.0 |

The instantaneous voltages in Table C above are the residual voltages with surge arrestors, if applied. During the conditions identified in Table C, an IBR should continue injecting current, but need not respond to the sub-cycle transient overvoltage. If required by equipment limitations, the IBR may operate in current blocking mode when instantaneous voltage exceeds 1.20 p.u. at the POIB. If the IBR operates in current blocking mode, it shall restart current exchange in less than or equal to five cycles following instantaneous voltage falling below, and remaining below, 1.2 p.u. at the POIB. In the event of multiple excursions, the minimum ride through time in Table C is a cumulative time over a one minute time window.

(2) Nothing in paragraph (1) above shall be interpreted to require an IBR to trip for voltage conditions beyond those for which ride-through is required.

(3) If installed and activated to trip the IBR, all protection systems (including, but not limited to, protection for over-/under-voltage, rate-of-change of frequency, anti-islanding, and phase angle jump) shall enable the IBR to ride through voltage conditions beyond those defined in paragraph (1) above to the maximum extent possible.

(4) An IBR shall inject electric current during all periods requiring ride-through. When the POIB voltage is outside the continuous operating voltage range, an IBR shall continue to deliver pre-disturbance active current unless reduction is needed to allow for voltage support or otherwise specified by ERCOT or the interconnecting TSP. Any necessary reductions in active current to prioritize reactive current shall be relative to the voltage change at the POIB. Typically, more aggressive reductions in active current to allow for additional reactive current (if needed to stay within its current limitations) will occur at lower voltages (e.g., 0.4 pu or lower) but settings should be made based on the local needs of the ERCOT System where the IBR interconnects and ensures sufficient active current is available for protection system sensing. An IBR shall return to its pre-disturbance level of real power injection as soon as possible but no more than one second after POIB voltage recovers to normal operating range.

(5) IBR plant controls or inverter controls shall not disconnect the IBR from the ERCOT System or reduce IBR output during voltage conditions where ride-through is required unless necessary to provide appropriate frequency response or prevent equipment damage.

(6) If installed and activated to trip the IBR, instantaneous over-current or over-voltage protection systems shall use filtered quantities to prevent misoperation while providing the desired equipment protection. Any instantaneous over-voltage protection that could disrupt IBR power output shall use a measurement window of at least one cycle of fundamental frequency.

(7) The IBR shall ride through multiple excursions outside the continuous operation range in Tables A or B in paragraph (1) above as applicable, unless the conditions and situations specified below exist, in which case the IBR may trip to protect equipment from the cumulative effect of successive voltage deviations:

(a) More than four voltage deviations at the POIB outside the continuous operation zone within any ten second period.

(b) More than six voltage deviations at the POIB outside the continuous operation zone within any 120 second period.

(c) More than ten voltage deviations at the POIB outside the continuous operation zone within any 1,800 second period.

(d) Voltage deviations outside of continuous operation zone following the end of a previous deviation outside the continuous operation zone by less than twenty cycles of system fundamental frequency.

(e) More than two individual voltage deviations at the POIB below 50% of the nominal voltage (including zero voltage) within any ten second period.

(f) More than three individual voltage deviations at the POIB below 50% of the nominal voltage (including zero voltage) within any 120 second period.

(g) Individual wind turbines may trip for consecutive voltage deviations resulting in stimulation of mechanical resonances exceeding equipment limits.

 Individual voltage deviations begin when the voltage at the POIB drops below the lower limit of the continuous operation range or exceeds the upper limit of the continuous operation range. Individual voltage deviations end when the root-mean-square voltage magnitude at the POIB, for the previous one-cycle period of fundamental frequency, returns to the continuous operation region.

(8) An IBR shall ride-through any disturbance during which ride-through is required and the positive-sequence angle change within a sub-cycle-to-cycle time frame does not exceed 25 electrical degrees. In addition, the IBR shall ride-through any change in the phase angle of individual phases caused by unbalanced faults, provided the positive-sequence angle change does not exceed 25 electrical degrees. Positively damped active and reactive current oscillations in the post-disturbance period are acceptable in response to phase angle changes.

(9) In its sole and reasonable discretion, ERCOT may allow a temporary extension to allow for upgrades or retrofits to confirm capability specified in paragraphs (7) and (8) above if the Resource Entity or IE provides documented evidence of technical infeasibility from its original equipment manufacturer (or subsequent inverter/turbine vendor support company if the original equipment manufacturer is no longer in business) along with the modifications and the schedule for implementing those modifications. The Resource Entity or IE shall maximize the phase angle jump and multiple excursion ride-through capability within known equipment limitations as soon as practicable. Any temporary extensions shall be minimized and not extend beyond December 31, 2028.

(10) In its sole and reasonable discretion, ERCOT may allow temporary extensions to the voltage ride-through performance Tables A and C in paragraph (1) above for Type 3 WGRs if the Resource Entity or IE provides documented evidence of technical infeasibility from its original equipment manufacturer (or subsequent inverter/turbine vendor support company if the original equipment manufacturer is no longer in business) along with the modifications and the schedule for implementing those modifications. During any temporary extension, the Resource Entity or IE shall maximize its voltage ride-through capability within known equipment limitations as soon as practicable. Any temporary extensions shall be minimized and not extend beyond December 31, 2028. Temporary extensions for performance that do not meet the voltage ride-through performance in Table A in paragraph (1) of Section 2.9.1.2, Legacy Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs) and Type 1 and Type 2 Wind-Powered Generation Resources (WGRs), are not allowed.

(11) If an IBR fails to perform in accordance with the voltage ride-through requirements of paragraphs (1) through (8) above, the Resource Entity for the IBR shall investigate the event and report to ERCOT the cause of the IBR failure. All impacted TSPs shall provide available information to ERCOT to assist with event analysis.

(12) If the Resource Entity can implement IBR modifications to resolve the technical limitations or performance failures preventing compliance with applicable voltage ride-through requirements, the Resource Entity shall submit to ERCOT a report and supporting documentation containing the following:

(a) The current technical limitations and voltage ride-through capability in a format similar to the tables in paragraph (1) above;

(b) The planned modifications and voltage ride-through capability allowing the IBR to comply with the voltage ride-through requirements in a format similar to the tables in paragraph (1) above; and

(c) A schedule for implementing those modifications.

In its sole and reasonable discretion, ERCOT may accept the proposed modification plan.

***2.9.1.2*** ***Legacy Voltage Ride-Through Requirements for Transmission-Connected*** ***Inverter-Based Resources (IBRs) and Type 1 and Type 2 Wind-Powered Generation Resources (WGRs)***

(1) All IBRs and Type 1 and Type 2 WGRs subject to this Section in accordance with paragraph (1) of Section 2.9.1, Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs) and Type 1 and Type 2 Wind-Powered Generation Resources (WGRs) shall ride through the root-mean-square voltage conditions in Table A below as measured at the IBR’s POIB:

**Table A**

|  |  |
| --- | --- |
| Root-Mean-Square Voltage (p.u. of nominal) | Minimum Ride-Through Time(seconds) |
| V > 1.20 | May ride-through or may trip |
| 1.175 < V ≤ 1.2 | 0.2 |
| 1.15 < V ≤ 1.175 | 0.5 |
| 1.10 < V ≤ 1.15 | 1.0 |
| 0.90 ≤ V ≤ 1.10 | continuous |
| 0.0 < V < 0.90 | (V+0.084375)/0.5625 |
| V = 0.0 | 0.15 |

For voltage between zero and 0.9 pu the minimum ride-through time in Table A above is defined by a straight line mathematical function where the duration is 0.15 seconds at zero voltage and 1.75 seconds at 0.9 pu voltage. In the event of multiple excursions, the minimum ride-through time in Table A is a cumulative time over ten seconds.

(2) Nothing in paragraph (1) above shall be interpreted to require an IBR or Type 1 WGR or Type 2 WGR to trip for voltage conditions beyond those for which ride-through is required.

(3) If installed and activated to trip the IBR or Type 1 WGR or Type 2 WGR, all protection systems (including, but not limited to protection for over-/under-voltage, rate-of-change of frequency, anti-islanding, and phase angle jump) shall enable the IBR or Type 1 WGR or Type 2 WGR to ride through voltage conditions beyond those defined in paragraph (1) above to the maximum extent possible.

(4) An IBR or Type 1 WGR or Type 2 WGR shall inject electric current during all periods requiring ride-through, except for an IBR or Type 1 WGR or Type 2 WGR with a Standard Generation Interconnection Agreement (SGIA) executed prior to June 1, 2026, and for which there are not technically feasible or commercially reasonable modifications available to eliminate momentary cessation. When the POIB voltage is outside the continuous operating voltage range, an IBR or Type 1 WGR or Type 2 WGR shall continue to deliver pre-disturbance active current unless reduction is needed for voltage support or otherwise specified by ERCOT or the interconnecting TSP. Any necessary reductions in active current to prioritize reactive current shall be relative to the voltage change at the POIB. Typically, more aggressive reductions in active current to allow for additional reactive current (if needed to stay within its current limitations) will occur at lower voltages (e.g., 0.4 pu or lower) but settings shall be based on the local needs of the area of the ERCOT System to which the IBR interconnects and ensure sufficient active current is available for protection system sensing. An IBR or Type 1 WGR or Type 2 WGR shall return to its pre-disturbance level of real power injection as soon as possible but no more than one second after POIB voltage recovers to normal operating range. For an IBR or Type 1 WGR or Type 2 WGR with an SGIA executed prior to June 1, 2026, and for which momentary cessation cannot be eliminated entirely, the Resource Entity for an IBR or Type 1 WGR or Type 2 WGR shall prioritize a return to pre-disturbance real power output as quickly as possible and identify changes that can be made to settings to minimize the impact of momentary cessation to the greatest extent possible.

(5) Plant controls, turbine controls, or inverter controls shall not disconnect the IBR or Type 1 WGR or Type 2 WGR from the ERCOT System or reduce its output during voltage conditions where ride-through is required unless necessary to provide appropriate frequency response or prevent equipment damage.

(6) If installed and activated to trip the IBR or Type 1 WGR or Type 2 WGR, instantaneous over-current or over-voltage protection systems shall use filtered quantities to prevent misoperation while providing the desired equipment protection. Any instantaneous over-voltage protection that could disrupt power output shall use a measurement period of at least one cycle (of fundamental frequency).

(7) The IBR or Type 1 WGR or Type 2 WGR shall ride through multiple excursions outside the continuous operation range in Table A in paragraph (1) above, unless the conditions and situations specified below exist, in which case, it may trip to protect equipment from the cumulative effect of successive voltage deviations:

(a) More than four voltage deviations at the POIB outside the continuous operation zone within any ten second period.

(b) More than six voltage deviations at the POIB outside the continuous operation zone within any 120 second period.

(c) More than ten voltage deviations at the POIB outside the continuous operation zone within any 1,800 second period.

(d) Voltage deviations outside of continuous operation zone following the end of a previous deviation outside of continuous operation zone by less than 20 cycles of system fundamental frequency.

(e) More than two individual voltage deviations at the POIB below 50% of the nominal voltage (including zero voltage) within any ten second period.

(f) More than three individual voltage deviations at the POIB below 50% of the nominal voltage (including zero voltage) within any 120 second period.

(g) Individual wind turbines may trip for consecutive voltage deviations resulting in stimulation of mechanical resonances exceeding equipment limits.

 Individual voltage deviations begin when the voltage at the POIB drops below the lower limit of the continuous operation range or exceeds the upper limit of the continuous operation range. Individual voltage deviations end when the root-mean-square voltage magnitude at the POIB, for the previous one-cycle period of fundamental frequency, returns to the continuous operation range.

(8) An IBR or Type 1 WGR or Type 2 WGR shall ride-through any disturbance during which ride-through is required and the positive-sequence angle change within a sub-cycle-to-cycle time frame does not exceed 25 electrical degrees. In addition, the IBR or Type 1 WGR or Type 2 WGR shall ride-through any change in the phase angle of individual phases caused by unbalanced faults, provided the positive-sequence angle change does not exceed 25 electrical degrees. Positively damped active and reactive current oscillations in the post-disturbance period are acceptable in response to phase angle changes.

(9) An IBR or Type 1 WGR or Type 2 WGR with an SGIA executed prior to June 1, 2026, must use commercially reasonable efforts to maximize voltage ride-through capability to the greatest extent possible to comply with paragraphs (1) through (6) as soon as practicable but no later than December 31, 2027, and comply with paragraphs (7) and (8) above as soon as practicable but no later than December 31, 2028. An IBR or Type 1 WGR or Type 2 WGR with an SGIA executed prior to June 1, 2026, is not required to meet the requirements in paragraphs (1) through (8) above for which there are not both technically feasible and commercially reasonable modifications available.

The Resource Entity or IE for an IBR or Type 1 WGR or Type 2 WGR with an SGIA executed prior to June 1, 2026, that cannot comply with paragraphs (1) through (8) above shall by August 1, 2025, or by a date required by ERCOT in the interconnection process for an IBR with an SGIA executed after August 1, 2025, and prior to June 1, 2026, as necessary, submit to ERCOT a report and supporting documentation containing the following:

(a) The current and potential future voltage ride-through capability (including any associated adjustments to improve voltage ride-through capability) in a format similar to Table A in paragraph (1) above;

(b) The proposed modifications, if applicable, to maximize voltage ride-through capability and allow compliance with the applicable voltage ride-through requirements in paragraphs (1) through (8) above;

(c) Any limitations on voltage ride-through capability making it technically infeasible or commercially unreasonable to meet the requirements in paragraphs (1) through (8) above with documentation from the IBR or Type 1 WGR or Type 2 WGR original equipment manufacturer (or subsequent inverter/turbine vendor support company if the original equipment manufacturer is no longer in business) attesting there are no engineering, replacement, or retrofit solutions available, if applicable;

(d) A plan to comply with the voltage ride-through requirements of paragraphs (1) through (6) above as soon as practicable but no later than December 31, 2027, unless the IBR or Type 1 WGR or Type 2 WGR has provided ERCOT documentation of any limitations making it technically infeasible or commercially unreasonable to meet the requirements in paragraphs (1) through (6) above; and

(e) A plan to comply with the voltage ride-through requirements of paragraphs (7) through (8) above as soon as practicable but no later than December 31, 2028, unless the IBR or Type 1 WGR or Type 2 WGR has provided ERCOT documentation of any limitations making it technically infeasible or commercially unreasonable to meet the requirements in paragraphs (7) through (8) above.

ERCOT, in its sole and reasonable discretion, may allow mitigation plans where a Resource Entity or IE for a Type 1 WGR or Type 2 WGR installs supplemental dynamic reactive resources or an ESR that can provide sufficient leading and lagging dynamic Reactive Power to meet all Reactive Power requirements and the applicable ride-through requirements.

(10) If an IBR or Type 1 WGR or Type 2 WGR (including any supplemental dynamic reactive resource) fails to perform in accordance with the voltage ride-through requirements, the Resource Entity or IE shall investigate the event and report to ERCOT the cause of the failure. All impacted TSPs shall provide available information to ERCOT to assist with event analysis.

(11) On an annual basis and starting with an initial due date of August 1, 2026, the Resource Entity for an IBR or Type 1 WGR or Type 2 WGR that has communicated a technically infeasible or commercially unreasonable limitation pursuant to paragraph (9)(c) above, shall submit a notarized attestation signed by an officer or executive with authority to bind the Resource Entity stating either that the Resource Entity has identified and plans to implement modifications to improve voltage ride-through capability or there is not a technically feasible or commercially reasonable solution available to address the exempted capability. If the Resource Entity can implement modifications to resolve the technical limitations or performance failures, it shall submit to ERCOT a report and supporting documentation containing the following:

(a) The current technical limitations and voltage ride-through capability in a format similar to Table A in paragraph (1) above;

(b) The proposed modifications and voltage ride-through capability allowing the affected Resource to comply with the voltage ride-through requirements in a format similar to Table A in paragraph (1) above; and

(c) A schedule for implementing those modifications.

In its sole and reasonable discretion, ERCOT may accept the proposed modification plan.

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1. The EPA’s CSAPR would establish nitrogen oxide emission limits for fossil-fuel power plants in 22 states, including Texas. A preliminary ERCOT assessment identified approximately 11 GW of thermal generation that could potentially retire by 2026 and lead to increased load shed risk. See “ERCOT Analysis of EPA FIP Regional Ozone Transport Rule” presented at the ERCOT Board of Directors meeting on June 21, 2022, available at https://www.ercot.com/calendar/06212022-Board-of-Directors-Meeting. [↑](#footnote-ref-2)
2. See “Update on EPA Regulations Impacting Dispatchable Thermal Resources” presentation discussed at the ERCOT Board of Directors meeting on June 20, 2023, available at https://www.ercot.com/calendar/06202023-Board-of-Directors-Meeting. [↑](#footnote-ref-3)
3. A recent NERC survey shows that a significant number of OEMs are planning to develop inverters compliant with IEEE 2800-2022 by 2026 or later – in either case, sometime after IEEE P2800.2, which will develop testing and verification procedures for IEEE 2800-2022, has been published, clarified, and accepted by the industry. The survey also shows that some major OEM implementation plans currently exclude incorporating IEEE 2800 into projects and equipment that are already sold and are currently in production, let alone for retrofitting legacy IBRs. See slide 10 of the “IEEE 2800 OEM Readiness” presentation discussed at the Energy Systems Integration Group 2022 Fall Technical Workshop, available at https://www.esig.energy/event/2022-fall-technical-workshop/. [↑](#footnote-ref-4)
4. Southern Power is proposing an SGIA execution date of June 1, 2026, because (1) the development life cycle is several years long, (2) IEEE P2800.2 is currently targeting final publication of a testing and verification procedure for IEEE 2800-2022 sometime in Q1 – Q2 2025, and (3) OEMs need time to incorporate the new standard and testing procedures into their development processes. Over time, ERCOT and stakeholders can evaluate whether it is appropriate to make this SGIA execution date earlier in time based on actual availability of compliant equipment. Southern Power also considered setting an SGIA execution date earlier than June 1, 2026, for solar generation resources and Energy Storage Resources and is open to further consideration of this concept. [↑](#footnote-ref-5)
5. Southern Power disagrees with ERCOT’s characterization at the August 2023 Reliability and Operations Subcommittee meeting that retrofit solutions should generally exist for legacy IBRs with SGIAs executed after January 16, 2014. Southern Power’s experience and detailed discussions with OEMs indicate that there will be significant challenges and uncertainty meeting NOGRR245’s requirements for its operating IBRs, all of which have SGIAs executed after January 16, 2014. [↑](#footnote-ref-6)
6. See Southern Power’s NOGRR245 comments filed on May 1, 2023, for more details on technical capabilities and limitations of legacy equipment. [↑](#footnote-ref-7)
7. See NOGRR245 comments filed by GE on May 3, 2023, and on July 31, 2023. [↑](#footnote-ref-8)
8. See NOGRR245 comments filed by SGRE on June 6, 2023 (emphasis added). [↑](#footnote-ref-9)
9. See NOGRR245 comments filed by Vestas on June 22, 2023. [↑](#footnote-ref-10)
10. See slide 17 of “The IEEE 2800 Conformity Assessment Paradigm” presented at the Inverter-Based Resource Task Force meeting on April 14, 2023, available at https://www.ercot.com/calendar/04142023-IBRTF-Meeting-\_-Webex. [↑](#footnote-ref-11)
11. NERC’s October 2022 survey of OEMs states that it can cost millions of dollars for wind turbines just to re-test. See slide 11 of the “IEEE 2800 OEM Readiness” presentation discussed at the Energy Systems Integration Group 2022 Fall Technical Workshop, available at https://www.esig.energy/event/2022-fall-technical-workshop/. [↑](#footnote-ref-12)
12. There are over 53 gigawatts (“GW”) of operating wind and solar generating capacity in the ERCOT region, according to the 2023 Summer Seasonal Assessment of Resource Adequacy report located at https://www.ercot.com/gridinfo/resource. While some of these legacy resources will be able to implement feasible solutions, many others may not, and it is uncertain how expansive the impact of NOGRR245 will be. [↑](#footnote-ref-13)
13. See ERCOT’s Long-Term Load Forecast, “ERCOT Summer Peak Demand Forecast,” https://www.ercot.com/gridinfo/load/forecast, accessed 7/28/2023. [↑](#footnote-ref-14)
14. Including the Good Neighbor Plan, EPA Greenhouse Gas Rule, Texas Regional Haze FIP, and revisions to the 2012 Mercury and Air Toxics Standards (MATS) rule. [↑](#footnote-ref-15)
15. “Item 7: Update on EPA Regulations Impacting Dispatchable Thermal Resources”, as presented at the June 20, 2023, ERCOT Board of Directors meeting, available at https://www.ercot.com/calendar/06202023-Board-of-Directors-Meeting. [↑](#footnote-ref-16)
16. “Joint Comments of Electric Reliability Council of Texas, Inc.; Midcontinent Independent System Operator, Inc. (“MISO”); PJM Interconnection, L.L.C.; and Southwest Power Pool, Inc.”, page 10. The Joint RTO Comments were filed in Docket EPA-HQ-OAR-2023-0072, which is located at https://www.epa.gov/stationary-sources-air-pollution/greenhouse-gas-standards-and-guidelines-fossil-fuel-fired-power (emphasis added). [↑](#footnote-ref-17)
17. Id., page 2 (emphasis added). [↑](#footnote-ref-18)
18. See PURA § 39.151 (ERCOT must “perform the following functions: (1) ensure access to the transmission and distribution systems for all buyers and sellers of electricity on nondiscriminatory terms.”) [↑](#footnote-ref-19)
19. IEEE 2800-2022, Section 1.4: “The application of this standard may be limited to IBR plants for which interconnection requests are submitted after the date by which this standard is enforced by the responsible authority governing interconnection requests; this standard may not apply to IBR plants that are either already interconnected or for which interconnection requests had been submitted prior to the standard’s enforcement date (grandfathering).” [↑](#footnote-ref-20)
20. Invenergy’s NOGRR245 comments filed on July 31, 2023. [↑](#footnote-ref-21)
21. *Appeal and Complaint by Iberdrola Renewables, Inc. et al of ERCOT Decision to Approve PRR 830.* [↑](#footnote-ref-22)
22. Modification of Voltage Support Requirements to Address Existing Non-Exempt WGRs. [↑](#footnote-ref-23)
23. Nodal Protocol §3.15(7)(a). See also, NPRR389, Modification of Voltage Support Requirements to Address Existing Non-Exempt WGRs; PUCT Docket No.37817, Appeal and Complaint by Iberdrola Renewables, Inc. et al of ERCOT Decision to Approve PRR830; PUCT Docket No. 38981, Joint Appellants’ Appeal and Complaint Concerning the ERCOT Board’s Adoption of NPRR269 and Request for Related Relief. [↑](#footnote-ref-24)
24. Note that a renewable resource’s statutory obligations related to reactive power are scoped to only include the effects of that renewable resource on the system reliability, not the reliability harms created by a weak transmission system on the renewable resource. See PURA 39.904(l) (“The commission may adopt rules requiring renewable power facilities to have reactive power control capabilities or any other feasible technology designed to reduce the facilities' effects on system reliability.”) (emphasis added). [↑](#footnote-ref-25)
25. 16 Texas Administrative Code (“TAC”) §25.503(f)(2)(C) (emphasis added). [↑](#footnote-ref-26)
26. PURA §39.001(d) (emphasis added). [↑](#footnote-ref-27)
27. FERC’s NOPR on Reliability Standards to Address IBRs in Docket RM22-12-000. See paragraphs 62 (“NERC also recommended that solar photovoltaic IBR owners should ‘work with their inverter manufacturer(s) to identify the changes that can be made to eliminate momentary cessation of current injection to the greatest extent possible, consistent with equipment capability’”) and 63 (“For IBRs for which momentary cessation cannot be eliminated entirely, NERC recommended that generator owners should identify the changes that can be made to inverter settings to minimize the impact of momentary cessation on the Bulk-Power System”). [↑](#footnote-ref-28)
28. Id. at paragraph 95 (emphasis added). [↑](#footnote-ref-29)
29. *See, e.g.*, NERC’s Procedure for Requesting and Receiving Technical Feasibility Exception to NERC Critical Infrastructure Protection Standards, NERC Rules of Procedure App. 4D, available at https://www.nerc.com/AboutNERC/RulesOfProcedure/Appendix\_4D\_20160701.pdf. [↑](#footnote-ref-30)
30. Southern Power recently reviewed frequency data measured on a minute basis at power quality meters for two of its solar resources located in far West Texas for 14 operating days in August 2023. For these days, these two solar resources experienced approximately 200 – 350 frequency events per day that required response to frequency outside the deadband settings required by ERCOT. [↑](#footnote-ref-31)
31. See “Assessment of Synchronous Condensers to Strengthen West Texas System” presented at the Regional Planning Group meeting on June 13, 2023. ERCOT’s assessment showed an average of 21% reduction in numbers of 345 and 138 kV buses that experienced severe voltage dips (less than 0.85 per unit) for major West Texas transmission faults, an average of 22% reduction in IBR capacity that experiences severe voltage dip at generator terminals (less than 0.85 per unit) for major West Texas faults, and a 11% increase in system strength compared to the study base case without new synchronous condensers. [↑](#footnote-ref-32)
32. Two synchronous condensers were installed in 2018 in the ERCOT Panhandle to provide voltage and system strength support. [↑](#footnote-ref-33)
33. FERC’s order, dated July 9, 2020, approving PRC-024-3 in Docket RD20-7-000. [↑](#footnote-ref-34)
34. NERC’s petition for approval of Reliability Standard PRC-024-3, filed on March 20, 2020, in Docket RD20-7-000. See page 11. [↑](#footnote-ref-35)
35. See the NERC IRPTF PRC-024-2 Gaps Whitepaper, located at https://nerc.com/pa/Stand/Project%20201804%20Modifications%20to%20PRC0242/NERC%20IRPTF%20PRC-024-2%20Gaps%20Whitepaper.pdf. [↑](#footnote-ref-36)
36. PRC-024-2 is located at https://www.nerc.com/pa/Stand/Reliability%20Standards/PRC-024-2.pdf. [↑](#footnote-ref-37)
37. PRC-024-3 is located at https://www.nerc.com/pa/Stand/Reliability%20Standards/PRC-024-3.pdf. [↑](#footnote-ref-38)
38. PRC-024-3 defines frequency and voltage protection as “frequency, voltage, and volts per hertz protection (whether provided by **relaying** **or functions within associated control systems**) that respond to electrical signals and: (i) directly trip the generating resource(s); or (ii) provide signals to the generating resource(s) to either trip or cease injecting current” (emphasis added). [↑](#footnote-ref-39)
39. Id., Requirement Three: “Each Generator Owner shall document each known regulatory or equipment limitation that prevents an applicable generating resource(s) with frequency or voltage protection from meeting the protection setting criteria in Requirements R1 or R2, including (but not limited to) study results, experience from an actual event, or manufacturer’s advice.” [↑](#footnote-ref-40)