Questionnaire and Guideline for new Inverter Based Resources Interconnecting in ERCOT

**DISCLAIMER: This document is a draft meant to facilitate discussion for the appropriate framework and content of such a questionnaire and guidelines for IBRs and is not a vetted draft ready for formal proposal. It is the hope that awareness of this document to be provided as part of the ERCOT Generator Interconnection process will spur participation in an IBRTF sub team to collaborate on a formal proposal draft that achieves the intended reliability objective in a reasonable manner.**

# Introduction:

Inverter Based Resources (IBRs) are quickly becoming the dominant Generation Resource (GR)technology in the ERCOT Interconnection. These Generation Resources bring new and evolving technology that must be safely and reliably interconnected to the ERCOT system. In recent years, several events on different electrical systems in the United States have been observed, investigated, and reported on while identify several Recommendations to minimizing and or preventing future events from occurring on the system. This Questionnaire and Guideline for new Inverter Based Resources Interconnecting in ERCOT is meant to educate and raise awareness for developers seeking to build and energize new IBRs to the relevant rules and recommendations made by NERC Reliability Standards and Guidelines, ERCOT Protocols and Operating Guides, and IEEE standards. It is also meant to provide reasonable assurance that these rules and recommendations have or will be implemented prior to energization of the IBR. The ERCOT Inverter Based Resource Task Force (IBRTF) is actively working on formally implementing the relevant recommendation into ERCOT Protocols and Guides. This document will also help prevent the need to retrofit equipment later when these rules become mandatory and effective in the months to come. ERCOT retains the right as the NERC Reliability Coordinator and ERCOT Control Area Authority to take actions necessary to protect reliability of the ERCOT system up to and including delaying energization of new IBRs until reasonable assurances that these rules and recommendations have or will be implemented prior to energization of the IBR.

# References

### NERC Guidelines

* <https://www.nerc.com/comm/RSTC_Reliability_Guidelines/Guideline_IEEE_1547-2018_BPS_Perspectives.pdf>
* <https://www.nerc.com/comm/RSTC_Reliability_Guidelines/Reliability_Guideline_BESS_Hybrid_Performance_Modeling_Studies_.pdf>
* <https://www.nerc.com/comm/RSTC_Reliability_Guidelines/Item_4a._Integrating%20_Inverter-Based_Resources_into_Low_Short_Circuit_Strength_Systems_-_2017-11-08-FINAL.pdf>
* <https://www.nerc.com/comm/RSTC_Reliability_Guidelines/Inverter-Based_Resource_Performance_Guideline.pdf>

### Event Reports with Recommendations

* [https://www.nerc.com/pa/rrm/ea/Pages/CAISO-2021-Disturbance-Report.aspx](https://www.nerc.com/pa/rrm/ea/Pages/CAISO-2021-Disturbance-Report.aspx%20)
* <https://www.nerc.com/pa/rrm/ea/Documents/Odessa_Disturbance_Report.pdf>
* <https://www.nerc.com/pa/rrm/ea/1200_MW_Fault_Induced_Solar_Photovoltaic_Resource_/1200_MW_Fault_Induced_Solar_Photovoltaic_Resource_Interruption_Final.pdf>
* <https://www.nerc.com/pa/rrm/ea/April_May_2018_Fault_Induced_Solar_PV_Resource_Int/April_May_2018_Solar_PV_Disturbance_Report.pdf>
* <https://www.nerc.com/pa/rrm/ea/Documents/San_Fernando_Disturbance_Report.pdf>

### IEEE standards

* IEEE – 1547- <https://standards.ieee.org/ieee/1547/5915/>
* IEEE – 2800 -<https://standards.ieee.org/ieee/2800/10453/>

### NERC Standards

* PRC-024-2 - <https://www.nerc.com/files/PRC-024-2.pdf>

### ERCOT Protocols, Nodal Operating Guides, and Planning Guides

* ERCOT Protocols - <https://www.ercot.com/mktrules/nprotocols/current>
* ERCOT Nodal Operating Guides - <https://www.ercot.com/mktrules/guides/noperating/current>
* ERCOT Planning Guides - <https://www.ercot.com/mktrules/guides/planning>

# Guideline:

**Core Performance Principle #1:** IBR GRs are expected to ride through with no loss of real or reactive power output during system disturbances whose frequencies and voltages at the Point of Interconnection Bus (POIB) are within the curves identified in Attachment 1 and Attachment 2 of NERC Reliability Standard PRC-024-2 and ERCOT Nodal Operating Guide Sections 2.6.2 and 2.9. Any temporary reduction in real power to provide reactive power for a system fault shall return to its pre-disturbance output within 1 second.

This goes beyond protective relay settings and must also be designed, and controls set to meet this performance expectation.

**Core Performance Principle #2:** IBR GRs are expected to provide and maintain positive sequence PSSE, TSAT, and EMT models that match their actual performance. Any actual performance that does not match modeled performance must be corrected with updates. Field verification of settings compared to the models should be performed prior to energization and models updated accordingly.

**Core Performance Principle #3:** Minimum capability performance requirements does not necessitate tripping at just beyond those settings. Protection settings should be set to utilize the maximum capability available while still protecting equipment, even if well beyond the minimum capability performance requirements.

**Core Performance Principle #4: Unnecessary protection settings should be disabled to prevent erroneous or unnecessary trips. Any protection setting that can trip off an inverter or turbine should be reviewed with the OEM/vendor to determine if it is necessary or not. Previous events have found some inverters did not need to have certain protective relays to be armed or could be set with time delays to prevent unnecessary trips (e.g. PLL loss of synch, feeder protection, underfrequency protection, etc).**

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5. or ESR. Please provide a comparison of the frequency and voltage ride through settings to the actual equipment limitations.
6. Has the developer of the new IBR GR or ESR confirmed with its OEM that its PLL loss of synch relay is or will be disabled if it is able to do so prior to energization? Please confirm if the IBR GR or ESR can disable its PLL loss of synch.
7. Has the developer of the new IBR GR or ESR confirmed with its OEM that its feeder protection relays are or will be disabled if it is able to do so prior to energization? Please confirm if and which feeder protection relays IBR GR or ESR can disable.
8. Has the developer of the new IBR GR or ESR confirmed with its OEM that its under frequency protection relay settings very fast setting has a time delay (e.g. .6 sec or greater) that would prevent erroneous frequency measurements from tripping off the inverter? Please confirm what this setting is. Please also identify any frequency measurement algorithm or filter enhancements that are being made to prevent erroneous frequency measurements.
9. Has the developer of the new IBR GR or ESR confirmed that the Power Plant Controller will not introduce any ramp or other limitations that prevent the IBR from returning to its pre disturbance MW value within one second after its inverter exits its ride through mode?
10. Has the developer of the new IBR GR or ESR confirmed the minimum MW level needed to ensure no oscillations will occur at very low MW levels? Please identify what this minimum MW level is and that settings have been coordinated to make this equipment limitation as close to 0 MW as possible.

# FAQs:

Version History:

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| Version | Comments | Effective Date |
| Draft 0.1 | Initial Draft |  |
| Draft 0.2 | Second Draft – Added new CAISO event, updated P2800 link, added Core Performance Principle #4, added additional questionnaire questions based on Odessa event and real time operations Lessons Learned. |  |