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| NPRR Number | [1138](https://www.ercot.com/mktrules/issues/NPRR1138) | NPRR Title | Communication of Capability and Status of Online IRRs at 0 MW Output |
| Date of Decision | December 20, 2022 |
| Action | Recommended Approval |
| Timeline | Urgent |
| Proposed Effective Date | February 1, 2023 |
| Priority and Rank Assigned | Not Applicable |
| Nodal Protocol Sections Requiring Revision  | 3.15.3, Generation Resource Requirements Related to Voltage Support6.5.5.1, Changes in Resource Status |
| Related Documents Requiring Revision/Related Revision Requests | None |
| Revision Description | This Nodal Protocol Revision Request (NPRR) requires each Resource Entity to ensure the reactive capability curve for any Intermittent Renewable Resource (IRR) accurately reflects the IRR’s reactive capability when it is not providing real power or is operating at lower levels of real power output. |
| Reason for Revision |  Addresses current operational issues. Meets Strategic goals (tied to the [ERCOT Strategic Plan](http://www.ercot.com/content/wcm/lists/144926/ERCOT_Strategic_Plan_2019-2023.pdf) or directed by the ERCOT Board). Market efficiencies or enhancements Administrative Regulatory requirements Other: (explain)*(please select all that apply)* |
| Business Case | This NPRR introduces requirements to improve consistency in the reporting of IRR reactive capabilities. ERCOT has observed Market Participants reporting reactive capabilities at low levels of output and at no real power output in a variety of inconsistent ways. For example, Resource Entities for some IRRs have reported no reactive capability below 10% of nameplate capacity. While not required to have reactive capability at that level of real power output, IRRs generally have *some* capability below that level and ERCOT needs an accurate understanding of IRR capability for operations and planning purposes. ERCOT also needs to know an IRR’s Reactive Power capability when it is producing no real power. If an IRR can produce Reactive Power when not producing real power and it remains synchronized to the ERCOT System, ERCOT must coordinate that Reactive Power capability with other actions of the Transmission Service Provider (TSP) for Real-Time voltage control in Real-Time operations. If an IRR cannot produce Reactive Power when not producing real power, ERCOT must know that fact so it does not inadvertently depend on the IRR for Reactive Power for system balance. If an IRR cannot provide Reactive Power when not producing real power and the IRR is contributing to a voltage or stability event, the IRR may be disconnected consistent with paragraph (4)(e) of Section 3.15, Voltage Support. This NPRR requires each Resource Entity to ensure the reactive capability curves for its IRRs accurately reflect reactive capability at the lowest output level. This NPRR also standardizes IRR practices for setting Low Sustained Limit (LSL) values and providing telemetry of Automatic Voltage Regulator (AVR) status when IRR real power output is zero. Some IRRs demonstrate oscillations with unstable Reactive Power control at very low output levels due to equipment limitations, requiring the LSL be set at a slightly higher level to avoid the oscillations. These oscillations have been observed primarily on solar IRRs during mornings, evenings, and when being constrained close to 0 MW when the PhotoVoltaic (PV) array supplies very low Direct Current (DC) power levels. In some cases, Resource Entities initially set the LSL values too high. Resource Entities representing IRRs must minimize equipment limitations to allow them to set the LSL as close to 0 MW as possible, including coordinating with the Original Equipment Manufacturer, if necessary.The standardization of these practices will help ensure ERCOT studies accurately identify voltage and stability issues and will provide greater clarity to ERCOT’s expectations for IRRs in the interconnection process. While this NPRR does not modify reactive capability requirements for IRRs, it requires that an IRR must utilize its reactive capability to maintain voltage at the Point of Interconnection Bus (POIB) even if the IRR is producing no real power when it remains synchronized to the ERCOT System. IRRs capable of providing reactive capability when producing no real power that are not synchronized to the ERCOT System would not have any requirements to maintain voltage at the POIB.  |
| PRS Decision | On 6/9/22, PRS voted unanimously to table NPRR1138 and refer the issue to WMS and ROS. All Market Segments participated in the vote.On 11/11/22, PRS voted unanimously to grant NPRR1138 Urgent status; to recommend approval of NPRR1138 as amended by the 11/7/22 Luminant comments; and to forward to TAC NPRR1138 and the 5/25/22 Impact Analysis. All Market Segments participated in the vote. |
| Summary of PRS Discussion | On 6/9/22, participants requested that PRS table and refer NPRR1138 to WMS and ROS for further discussions regarding NPRR1138’s proposed requirements.On 11/11/22, participants reviewed the 11/7/22 Luminant comments; the 11/10/22 ERCOT comments and the request for urgency; and ROS’s endorsement of NPRR1138 as amended by the 11/7/22 Luminant comments at the November 7, 2022 ROS meeting.  |
| TAC Decision | On 12/5/22, TAC voted to recommend approval of NPRR1138 as recommended by PRS in the 11/11/22 PRS Report as amended by the 11/30/22 ERCOT comments. There was one abstention from the Independent Retail Electric Provider (IREP) (Reliant) Market Segment. All Market Segments participated in the vote. |
| Summary of TAC Discussion | On 12/5/22, participants reviewed the ERCOT Opinion, ERCOT Market Impact Statement, Independent Market Monitor (IMM) Opinion, and 11/30/22 ERCOT comments for NPRR1138. |
| Board Decision | On 12/20/22, the ERCOT Board voted unanimously to recommend approval of NPRR1138 as recommended by TAC in the 12/5/22 TAC Report and the 12/13/22 Revised Impact Analysis. |
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| **Opinions** |
| **Credit Work Group Review** | ERCOT Credit Staff and the Credit Work Group (Credit WG) have reviewed NPRR1138 and do not believe that it requires changes to credit monitoring activity or the calculation of liability. |
| **Independent Market Monitor Opinion** |  IMM has no opinion on NPRR1138. |
| **ERCOT Opinion** | ERCOT supports approval of NPRR1138. |
| **ERCOT Market Impact Statement** | ERCOT Staff has reviewed NPRR1138 and believes it provides a positive reliability impact toward current Real-Time operational issues by requiring each Resource Entity to ensure that the reactive capability curve, AVR status, and unit status for any IRR accurately reflect the IRR’s reactive capability when it is not providing real power or is operating at lower levels of real power output. |
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| Market Segment | Not Applicable |

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| **Comments Received** |
| **Comment Author** | **Comment Summary** |
| WMS 080522 | Requested PRS continue to table NPRR1138 for further discussion by the Wholesale Market Working Group (WMWG) after discussion by the ROS |
| ROS 081122 | Requested PRS continue to table NPRR1138 for further discussion by the Operations Working Group (OWG) and the Inverter-Based Resource Task Force (IBRTF) |
| AEP 101122 | Proposed additional clarification language to Section 3.15.3 regarding Reactive Power and control expectations |
| ERCOT 101322 | Clarified that NPRR1138’s requirements only apply when the IRR is synchronized to the ERCOT System; that the second-lowest MW point on a reactive curve for IRRs that do not have the capability to provide Reactive Power at 0 MWs should be set at LSL when LSL is not 0 MW; and provided additional clarifying edits regarding LSL differences between operating conditions where an IRR does and does not have fuel |
| Luminant 101822 | Proposed allowing Inverter-Based Resources (IBRs) to open their virtual or pseudo breakers and provided additional party-specific guidelines |
| EDFR 102022 | Proposed changes in order to clarify NPRR1138’s requirements and goals |
| Luminant 110722 | Proposed alternative language for Section 3.15.3 allowing an IRR to physically desynchronize its inverters from the grid when it is unwilling or temporarily incapable of providing reactive capability when it is not producing real power without fully disconnecting the IRR site, including high and medium voltage equipment that has to remain in service |
| ERCOT 111022 | Requested that PRS grant urgency to NPRR1138 in order to be considered at the January 19, 2023 Public Utility Commission of Texas (PUCT) meeting |
| ERCOT 113022 | Removed the unnecessary phrase, “but is unwilling or temporarily incapable of providing any reactive capability” in paragraph (11) of Section 3.15.3 and paragraph (12) in the corresponding greybox |

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| **Market Rules Notes** |

Administrative changes to the language were made and authored as “ERCOT Market Rules.”

Please note the baseline language in the following Section has been updated to reflect the incorporation of the following NPRR(s) into the Nodal Protocols:

* NPRR1085, Ensuring Continuous Validity of Physical Responsive Capability (PRC) and Dispatch through Timely Changes to Resource Telemetry and Current Operating Plans (COPs) (incorporated 10/1/22)
	+ Section 6.5.5.1
* NPRR1100, Allow Generation Resources and Energy Storage Resources to Serve Customer Load When the Customer and the Resource are Disconnected from the ERCOT System (incorporated 7/15/22)
	+ Section 6.5.5.1

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| Proposed Protocol Language Revision |

***3.15.3*** ***Generation Resource Requirements Related to Voltage Support***

(1) Generation Resources required to provide VSS shall have and maintain Reactive Power capability at least equal to the Reactive Power capability requirements specified in these Protocols and the ERCOT Operating Guides.

(2) Generation Resources providing VSS shall be compliant with the ERCOT Operating Guides for response to transient voltage disturbance.

(3) Generation Resources providing VSS must meet technical requirements specified in Section 8.1.1.1, Ancillary Service Qualification and Testing, and the performance standards specified in Section 8.1.1, QSE Ancillary Service Performance Standards.

(4) Each Generation Resource providing VSS shall operate with the unit’s Automatic Voltage Regulator (AVR) in the automatic voltage control mode unless specifically directed to operate in manual mode by ERCOT, or when the unit is telemetering its Resource Status as STARTUP, SHUTDOWN, or ONTEST, or the QSE determines a need to operate in manual mode due to an undue threat to safety, undue risk of bodily harm, or undue damage to equipment at the generating plant.

(5) Each Generation Resource providing VSS shall maintain the Voltage Set Point established by ERCOT, the interconnecting TSP, or the TSP’s agent, subject to the Generation Resource’s operating characteristic limits, voltage limits, and within tolerances identified in paragraph (4) of Nodal Operating Guide Section 2.7.3.5, Resource Entity Responsibilities and Generation Resource Requirements.

(6) The reactive capability required must be maintained at all times that the Generation Resource is On-Line.

(7) Each QSE shall send to ERCOT, via telemetry, the AVR and Power System Stabilizer (PSS) status for each of its Generation Resources providing VSS. For AVRs, an “On” status will indicate the AVR is on and set to regulate the Resource’s terminal voltage in the voltage control mode, and an “Off” status will indicate the AVR is off or in a manual mode. For PSS, an “On” status will indicate the service is enabled and ready for service, and an “Off” status will indicate it is off or out of service. Each QSE shall monitor the status of its Generation Resources’ regulators and stabilizers, and shall report status changes to ERCOT.

(8) Each Resource Entity shall provide information related to the tuning parameters, local or inter-area, of any PSS installed at a Generation Resource.

(9) The Resource Entity for an IRR synchronized to the ERCOT System that is not capable of providing Reactive Power when not producing real power shall:

(a) When capable of providing real power, set the IRR’s Low Sustained Limit (LSL) to 0 MW, or the lowest MW level, not to exceed 1 MW, at which the IRR can provide stable Reactive Power after appropriate tuning of settings;

(b) Ensure the lowest MW point on the submitted reactive capability curve reflects 0 MVAr leading and lagging reactive capability at 0 MW;

(c) Ensure the second-lowest MW point on the submitted reactive capability curve accurately reflects the IRR’s leading and lagging reactive capability at its LSL when the LSL is not 0 MW; and

(d) Send to ERCOT, via telemetry, an AVR status of “Off” when the IRR is synchronized to the ERCOT System and not producing Reactive Power.

(10) The Resource Entity for an IRR synchronized to the ERCOT System that is capable of providing any net Reactive Power when not producing real power shall:

(a) Provide stable Reactive Power output at all MW levels at which the IRR has Reactive Power capability;

(b) When capable of providing real power, set the IRR LSL to 0 MW or the lowest MW level, not to exceed 1 MW, at which the IRR can provide stable Reactive Power after appropriate tuning of settings;

(c) Ensure the lowest MW point on the submitted reactive capability curve accurately reflects the IRR’s MVAr leading and lagging reactive capability when not producing real power;

(d) Ensure the second-lowest MW point on the submitted reactive capability curve accurately reflects the IRR’s leading and lagging reactive capability at its LSL when the LSL is not 0 MW;

(e) Send to ERCOT, via telemetry, an AVR status of “On” when the IRR is synchronized to the ERCOT System, not producing real power, and reactive control is working properly; and

(f) Meet the requirements in paragraphs (2), (4), (5), and (7) above when the IRR is synchronized to the ERCOT System and not producing real power.

(11) The Resource Entity for an IRR that is capable of providing any net Reactive Power when not producing real power may physically desynchronize its inverters from the ERCOT System instead of providing Reactive Power when not producing real power.

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| ***[NPRR989 and NPRR1026: Replace applicable portions of Section 3.15.3 above with the following upon system implementation:]******3.15.3 Generation Resource and Energy Storage Resource Requirements Related to Voltage Support***(1) Generation Resources and ESRs required to provide VSS shall have and maintain Reactive Power capability at least equal to the Reactive Power capability requirements specified in these Protocols and the ERCOT Operating Guides.(2) Generation Resources and ESRs providing VSS shall be compliant with the ERCOT Operating Guides for response to transient voltage disturbance.(3) Generation Resources and ESRs providing VSS must meet technical requirements specified in Section 8.1.1.1, Ancillary Service Qualification and Testing, and the performance standards specified in Section 8.1.1, QSE Ancillary Service Performance Standards. (4) Each Generation Resource and ESR providing VSS shall operate with the unit’s Automatic Voltage Regulator (AVR) in the automatic voltage control mode unless specifically directed to operate in manual mode by ERCOT, or when the unit is telemetering its Resource Status as STARTUP, SHUTDOWN, or ONTEST, or the QSE determines a need to operate in manual mode due to an undue threat to safety, undue risk of bodily harm, or undue damage to equipment at the generating plant.(5) Each Generation Resource and ESR providing VSS shall maintain the Voltage Set Point established by ERCOT, the interconnecting TSP, or the TSP’s agent, subject to the Generation Resource’s or ESR’s operating characteristic limits, voltage limits, and within tolerances identified in paragraph (4) of Nodal Operating Guide Section 2.7.3.5, Resource Entity Responsibilities and Generation Resource Requirements.(6) The reactive capability required must be maintained at all times that the Generation Resource or ESR is On-Line.(7) Each QSE shall send to ERCOT, via telemetry, the AVR and Power System Stabilizer (PSS) status for each of its Generation Resources providing VSS. Each QSE shall send to ERCOT via telemetry the AVR status for each of its ESRs providing VSS. For AVRs, an “On” status will indicate the AVR is on and set to regulate the Resource’s terminal voltage in the voltage control mode, and an “Off” status will indicate the AVR is off or in a manual mode. For PSS, an “On” status will indicate the service is enabled and ready for service, and an “Off” status will indicate it is off or out of service. Each QSE shall monitor the status of its Generation Resources’ and ESRs’ regulators and stabilizers, and shall report status changes to ERCOT. (8) Each Resource Entity shall provide information related to the tuning parameters, local or inter-area, of any PSS installed at a Generation Resource.(9) If any individual Resource within a Self-Limiting Facility is incapable of meeting its Reactive Power requirement at the POI, the QSE must bring On-Line additional Resource(s) within the Self-Limiting Facility to provide VSS as specified in paragraph (4) of Section 3.15, Voltage Support, while respecting the limit on MW Injection.(10) The Resource Entity for an IRR synchronized to the ERCOT System that is not capable of providing Reactive Power when not producing real power shall:(a) When capable of providing real power, set the IRR’s Low Sustained Limit (LSL) to 0 MW, or the lowest MW level, not to exceed 1 MW, at which the IRR can provide stable Reactive Power after appropriate tuning of settings;  (b) Ensure the lowest MW point on the submitted reactive capability curve  reflects 0 MVAr capability leading and lagging at 0 MW; (c) Ensure the second-lowest MW point on the submitted reactive capability curve accurately reflects the IRR’s leading and lagging reactive capability at its LSL when the LSL is not 0 MW; and(d) Send to ERCOT, via telemetry, an AVR status of “Off” when the IRR is synchronized to the ERCOT System and not producing Reactive Power.(11) The Resource Entity for an IRR synchronized to the ERCOT System that is capable of providing any net Reactive Power when not producing real power shall:(a) Provide stable Reactive Power output at all MW levels at which the IRR has Reactive Power capability; (b) When capable of providing real power, set the IRR LSL to 0 MW, or the lowest MW level, not to exceed 1 MW, at which the IRR can provide stable Reactive Power after appropriate tuning of settings;(c) Ensure the lowest MW point on the submitted reactive capability curve accurately reflects the IRR’s MVAr leading and lagging reactive capability when not producing real power; (d) Ensure the second-lowest MW point on the submitted reactive capability curve accurately reflects the IRR’s leading and lagging reactive capability at its LSL when the LSL is not 0 MW;(e) Send to ERCOT, via telemetry, an AVR status of “On” when the IRR is synchronized to the ERCOT System, not producing real power, and reactive control is working properly; and(f) Meet the requirements in paragraphs (2), (4), (5), and (7) above when the IRR is synchronized to the ERCOT System and not producing real power.(12) The Resource Entity for an IRR that is capable of providing any net Reactive Power when not producing real power may physically desynchronize its inverters from the ERCOT System instead of providing Reactive Power when not producing real power. |

6.5.5.1 Changes in Resource Status

(1) Each QSE shall notify ERCOT of a change in Resource Status via telemetry and through changes in the Current Operating Plan (COP) as soon as practicable following the change.

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| ***[NPRR1085: Replace paragraph (1) above with the following upon system implementation:]***(1) Each QSE shall notify ERCOT via telemetry of a change in Resource Status that is not related to a Forced Outage as soon as practicable but no longer than 15 minutes after the change in status occurs and through changes in the Current Operating Plan (COP) as soon as practicable but no longer than 60 minutes after the change in status of the Resource occurs. |

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| ***[NPRR1085: Insert paragraph (2) below upon system implementation and renumber accordingly:]***(2) When an On-Line Resource is experiencing an event that may affect its availability and/or capability and that requires further actions to stabilize the Resource and/or determine the impact of the event, the QSE may change the Resource Status to ONHOLD within 15 minutes of experiencing an event. Following this Resource Status change, the telemetered HSL and any other applicable telemetry of the Resource as specified in paragraph (2) of Section 6.5.5.2, Operational Data Requirements, shall be updated as soon as practicable but no longer than 15 minutes after the change in Resource Status to ONHOLD. After the QSE has determined the impact of the event, the QSE shall change the Resource Status to its updated status as soon as practicable but no longer than 60 consecutive minutes of being in the ONHOLD status. |

(2) Each QSE shall promptly inform ERCOT when the operating mode of its Generation Resource’s Automatic Voltage Regulator (AVR) or Power System Stabilizer (PSS) is changed while the Resource is On-Line. The QSE shall also provide the Resource’s AVR or PSS status logs to ERCOT upon request.

(3) Each QSE shall immediately report to ERCOT and the TSP any inability of the QSE’s Generation Resource required to meet its reactive capability requirements in these Protocols.

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| ***[NPRR1085: Insert paragraph (5) below upon system implementation and renumber accordingly:]***(5) Each QSE shall timely update the telemetered Resource Status unless in the reasonable judgment of the QSE, such compliance would create an undue threat to safety, undue risk of bodily harm, or undue damage to equipment. The QSE is excused from updating the telemetered Resource Status only for so long as the undue threat to safety, undue risk of bodily harm, or undue damage to equipment exists. The time for updating the telemetered Resource Status begins once the undue threat to safety, undue risk of bodily harm, or undue damage to equipment no longer exists. |

(4) A QSE or Resource Entity may use a Generation Resource or ESR to serve Customer Load as part of a Private Microgrid Island (PMI) in any circumstance in which the Customer Load and the Resource are both disconnected from the ERCOT System due to an Outage of the transmission and/or distribution system, provided that the configuration complies with the requirements of paragraph (7) of Section 10.3.2.3, Generation Netting for ERCOT-Polled Settlement Meters, and provided that the QSE or Resource Entity has notified the Transmission and/or Distribution Service Provider (TDSP) of the establishment of a PMI configuration. The QSE shall ensure that the Load served by the Resource in the PMI configuration is de-energized at the time it is reconnected to the ERCOT System following the PMI configuration. All operations in a PMI configuration and any reconnection of Load following a PMI configuration shall be coordinated with the TDSP.

(5) A TDSP shall not intentionally disconnect, or direct another TDSP to disconnect, a Generation Resource or ESR included in a PMI configuration from the ERCOT System except in the following circumstances:

(a) An approved or accepted Planned or Maintenance Outage of a Transmission Facility reasonably requires, or would otherwise result in, the disconnection of the Resource from the ERCOT System;

(b) The Resource is a Distribution Generation Resource or Distribution Energy Storage Resource (DESR), and disconnection of the Resource is required for Distribution System maintenance;

(c) The TDSP’s disconnection of the Resource is necessary to maintain the security of the TDSP’s system or the ERCOT System;

(d) The TDSP’s disconnection of the Resource is necessary to protect the public from a safety risk attributable to the operation of the Resource; or

(e) ERCOT directs the disconnection of the Resource.

(6) For each Intermittent Renewable Resource (IRR) synchronized to the ERCOT System and not capable of providing real power due to a lack of fuel, the Resource Entity and QSE shall send ERCOT, via telemetry, a Real-Time On-Line status and HSL and LSL of 0.