

**ERCOT BUSINESS PRACTICES**

**ERCOT AND QSE OPERATIONS PRACTICES DURING THE OPERATING HOUR**

 **June 28, 2024**

**Version 5.20**

**Document Revisions**

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| --- | --- | --- | --- |
| **Date** | **Version** | **Description** | **Author(s)** |
| 06/29/2010 | 0.1 | Initial draft | Bob Spangler/ Floyd Trefny |
| 07/23/2010 | 0.3 | Review draft | Bob Spangler/ Floyd Trefny |
| 08/02/2010 | 0.5 | Incorporate comments from:D. Maggio;Resmi Surendran07/28/2010 MeetingFloyd Trefny (07/29/2010 Discussions w/Bob) | RGS |
| 08/04/2010 | 0.6 | Draft Release for ERCOT drafting team meeting on 08/09/2010  | RGS/FJT |
| 08/09/2010 | 0.61 | Based on the 08/09 drafting team meeting, updated:Section 3.0 with editorial changes to improve readability;Section 3.1 revised to clarify limitation that AS Resource Responsibility may not be assigned to Generation Resources with net power below 90% of LSL.Section 3.2 revised to include only one procedure for a QSE to follow when setting a temporary hold on up or down Base Points during power operations.Section 3.3 revised to describe one method for shutdown of all non-wind Generation Resources and a method for WGRs. | RGS |
| 08/11/2010 | 0.62 | Revised Section 3.3, Generation Resource shutdown.Revised Section 4 Table to include the Generation shutdown sequence. | Bob Spangler |
| 08/23/2010 | 0.7 | Revised Section 3.3, Generation Resource Shutdown to incorporate decisions made on 08/23/2010 regarding the recommended QSE shutdown practice.Updated Section 4, Generation Resource Operational Evolutions & Real Time Telemetry Data from the QSE, Generation Resource Shutdown. | Bob Spangler |
| 08/25/2010 | 0.8 | Incorporate Floyd Trefny review commentsIncorporate comments from the ERCOT review team as discussed on 08/25. | Bob Spangler |
| 9/15/2010 | 0.9 | Incorporate Market Participants Comments with ERCOT Reply Comments | Floyd TrefnyBob Spangler |
| 9/15/2010 | 0.91 | Clean version with ERCOT Reply Comments | Floyd Trefny |
| 9/21/2010 | 0.95 | ERCOT Reply Comments | Floyd TrefnyBob Spangler |
| 9/21/2010 | 1.0 | ERCOT Approved Business Procedure | Floyd Trefny |
| 9/28/2010 | 1.01 | Minor Changes to the ERCOT Approved Business Procedure | Floyd Trefny |
| 11/18/2010 | 1.02 | Update for QSGR provisions added to Protocols in NPRR272. | Bob Spangler |
| 11/29/2010 | 1.03 | Incorporate Resmi Surendran comments in Section 3.7 and Section 4 table entries for QSGRs. | Bob Spangler |
| 12/13/2010 | 1.04 | Incorporate comments received from the ERCOT Management Team during the discussions at the 12/08 meeting. | Bob Spangler |
| 12/15/2010 | 2.0 | Final draft for approval.Added Section 3.7, Provisions for QSGR Provided for Deployment by SCED | R Spangler,R SurendranD Maggio  |
| 01/4/2011 | 2.01 | Updated Section 3.3, Generation Resource Shutdown, to revise the recommended practice to be followed when shutting down a Generation Resource. | R Spangler,R SurendranD Maggio |
| 01/20/2011 | 2.01 | Approved for Public Release | RGS |
| 09/28/201110/27/201111/14/2011 | 3.04.05.05.15.25.3 | Update to synchronize to current Protocol requirements, add additional guidance on HSL/HEL and LSL/LEL and editorial corrections and improvements.Rev 5.0 incorporates ERCOT management review comments.Updated to incorporate final editorial corrections and improvements in section 3.9, Provisions for Wind Generation Resources. | RGS |
| 11/30/2011 | 5.3 | Approved for posting | J Mickey |
| 02/14/2012 | 5.4 | Updated to synchronize with Protocol Requirements introduced by NPRRs 426, 427, and 428 |  |
| 02/24/2012 | 5.4 | Approved for posting | J Mickey |
| 08/27/2012 | 5.5 | Updates for NPRRs 348 and 434, NPRR348 Updates to sections 3.1. Generation Resource Startup and Ramp to LSL3.3. Generation Resource ShutdownNPRR434 Updates to section 2 to reflect the change to 24% for RRS. | S. Sharma, J. Hartmann |
| 08/27/2012 | 5.5 | Approved for posting | Dan Woodfin |
| 01/07/14 | 5.6 | Draft updates for NPRR 581Updates to section 3.5, Regulation Ancillary Service | S. Sharma |
| 4/10/2014 | 5.6 | Approved for posting | Dan Woodfin |
| 05/13/14 | 5.7 | Add the P1 value to 3.7. Non-Spin Ancillary Service | S. Sharma |
| 5/21/2014 | 5.7 | Approved for posting | Dan Woodfin |
| 6/21/2016 | 5.8 | NPRR669 updates to Section 2, Principles and Definitions, to reflect current RRS limit of 20% of HSL | S. Sharma |
| 10/29/2016 | 5.9 | Adding requirements for PVGRs in Section 3.9 Provisions for Wind and Photovoltaic Generation Resources. Clarify expectations related to turbine/inverter availability telemetry for IRR Resources in Section 3.9.2, Telemetry Requirements Related to Wind Turbine and Solar Inverter Availability. | S. SharmaN. SteffanN. Mago |
| 10/29/2016 | 5.9 | Approved for posting | Dan Woodfin |
| 6/16/2017 | 5.10 | Updated Sections 3.3 and 3.10 to capture Protocol changes. The revision also includes additional cleanup items. | A. TownsendP. ShawD. Maggio |
| 11/21/2017 | 5.11 | Update Section 3.4 to capture guidance on prepositioning Generation Resource output in an hour immediately preceding the Operating Hour where the Generation Resource first carries AS Resource Responsibilities. | S. SharmaD. JonesD. MaggioN. MagoL Butler |
| 11/21/2017 | 5.11 | Approved for posting | Dan Woodfin |
| 6/19/2018 | 5.12 | Update Section 3.2 to include guidance that approach an Aggregate Generation Resource may use when only a part of the generators within the aggregation are online. | S. SharmaD. JonesD. MaggioN. MagoL. Butler |
| 6/19/2018 | 5.12 | Approved for posting. | Dan Woodfin |
| 3/1/2020 | 5.13 | Update to Section 1 and 3.6.1 to include details related to Fast Frequency Response as implemented in NPRR 863 phase 1. | E. GonzalezL. ButlerN. Mago |
| 3/1/2020 | 5.13 | Approved for posting. | Dan Woodfin |
| 6/18/2021 | 5.14 | Update to Section 3.5 to clarify telemetry requirements for Resources that provide Regulation as Fast Responding Regulation Service. | N. Mago |
| 6/18/2021 | 5.14 | Approved for posting. | Dan Woodfin |
| 10/13/2021 | 5.15 | Update to Section 3.5 to add telemetry guidance for Energy Storge Resources (ESRs) providing Regulation. Add section 3.9.3 on telemetry guidance for ESRs co-located with IRRs. Add section 3.12 on ESR Expected Primary Frequency Response. Update Section 3.6 to clarify that QSEs should not move RRS Responsibilities while frequency is below 59.95 Hz. | L. ButlerN. Mago |
| 12/21/2022 | 5.16 | Update to Section 3.6.1 to align telemetry expectations for resources providing Fast Frequency Response. Update to Section 3.12 to include additional Provisions for Energy Storage Resources (ESRs) with additional focus on SOC expectations and AS transitions.  | L. HinojosaN. MagoJ. DuBroA. Gari |
| 08/08/2023 | 5.17 | Add Section 3.8 to clarify expected telemetry during RUC commitment hours. | R. Lee |
| 02/01/2024 | 5.18 | Update logic related to how Ancillary Service Telemetry should be provided by ESRs. Remove 3.8.1 due to NPRR1092 implementation | L. HinojosaN. MagoA. GariJ. DuBroH. You |
| 06/14/2024 | 5.19 | Additional clarification and examples included for Ancillary Service Telemetry updates for ESRs related to Resource Status.  | L. Hinojosa |
| 6/28/2024 | 5.20 | Updated to synchronize with Protocol Requirements introduced by NPRR1186. Additional edits in 3.13 for clarification of EPFR for ESRs.  | N. MagoA. GariS. FabricantL. Hinojosa |

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**Date: 06/28/2024**

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**PROTOCOL DISCLAIMER**

This Business Practice describes ERCOT Systems and the response of these systems to Market Participant submissions incidental to the conduct of operations in the ERCOT Texas Nodal Market implementation and is not intended to be a substitute for the ERCOT Nodal Protocols (available at <http://www.ercot.com/mktrules/nprotocols/> ), as amended from time to time. If any conflict exists between this document and the ERCOT Nodal Protocols, the ERCOT Nodal Protocols shall control in all respects.

# Background and Purpose

Nodal Protocol Sections 6.5.5.1, Changes in Resource Status, and 6.5.5.2, Operational Data Requirements, specify the data that must be provided by telemetry to ERCOT by each QSE with Resources. The telemetry data set, defined in the Nodal Protocols and described in the ERCOT Nodal ICCP Communications Handbook (“ICCP Handbook”) is used by ERCOT during the Operating Hour for SCADA monitoring, Real Time (RT) Network Security Analysis and other Real Time (RT) applications such as: Load Frequency Control (LFC); Resource Limit Calculator (RLC); and, Security Constrained Economic Dispatch (SCED).

The telemetry data set is the means by which the QSE communicates to ERCOT the current operational state associated with the evolution of its Generation Resources through startup, On-Line power operations with an Energy Offer Curve or Output Schedule, shutdown and, for both Generation and Load Resources, the Resource location of Ancillary Service Resource Responsibilities and deployments.

The purpose of this Business Practice is to describe the use of telemetry data values in the ERCOT Systems and the expected management of various Resource operations/evolutions during the Operating Hour by the QSE. The QSE manages its Resource evolutions by providing control signals to ERCOT systems via its RT Resource telemetry. QSEs and Resource Owners are solely responsible for the physical operation of their Resources and the accuracy of the associated telemetry data set required by the Protocols and the ICCP Handbook. ERCOT is providing guidance regarding the conduct of certain operational events (such as startup and shutdown operations) to organize a consistent and predictable ERCOT-wide methodology and approach to these operations. In the Nodal Market, ERCOT and the QSE share responsibilities for the Real-Time dispatch of Resources. A consistent approach such as described herein enhances communications between the ERCOT and the QSE Operators, assures ERCOT system reliability and supports adequate generation control within the ERCOT Control Area. It is both necessary and desirable from a reliability and operations viewpoint that ERCOT and the QSE keep one another informed as to the continuing availability and capability of the Generation Resources in the ERCOT Control Area.

This Business Practice is effective when issued as approved by ERCOT and it is posted to [www.ercot.com](http://www.ercot.com) in the Market Rules section.

Consistent with ERCOT Nodal Protocols, the term “Resource” is used throughout this document, without qualification, to refer to both Generation and Load Resources.

# Principles and Definitions

1. Real Time Telemetry data is provided to ERCOT over the ERCOT Wide Area Network via the ICCP Protocol as described in the ERCOT Nodal ICCP Communications Handbook (<http://www.ercot.com/services/mdt/userguides/index>) through redundant high speed interconnections.
2. During the Operating Period, QSEs are responsible for notifying ERCOT of a change in Resource Status (or availability as described below) via telemetry [Protocol 6.5.5.1 and 6.5.5.2].
3. A Generation Resource is “unavailable” if that Generation Resource is unable to start or synchronize to the ERCOT Transmission Grid due to a physical or regulatory impairment. For example, a Generation Resource can be unavailable because it or the associated transmission equipment necessary to interconnect the Generation Resource to the grid is undergoing an Outage. In other words, a Resource may be “unavailable” because of a Forced Outage (on either the Generation Resource or a Transmission element necessary for interconnecting the resource to the ERCOT Grid[[1]](#footnote-2)) or Maintenance Outage, fuel curtailment, or emissions limit exceedance, etc.
4. A Load Resource is “unavailable” if it is not available for ERCOT dispatch as determined by the Load Resource Owner and its QSE.
5. A Resource is “available” if it is not “unavailable”.
6. 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. The status of generation Resource’s AVR and PSS must be provided to ERCOT as part of the QSE’s ICCP telemetry data set. The use of ICCP telemetry satisfies the Protocol requirement for reporting the operating mode of the Generation Resource AVR and PSS. In the event of telemetry failures, the QSE should verbally report changes in the status of the AVR and PSS to ERCOT Operations.
7. Each QSE shall immediately verbally report to ERCOT and the TSP any inability of the QSE’s Generation Resources required to meet its reactive capability requirements as specified in the Nodal Protocols.
8. The Resource Status telemetry value is used in Load Frequency Control, SCED, the Resource Limit Calculator and other ERCOT applications to determine the operating status (e.g. available or unavailable for Dispatch) of the Resource.
9. For purposes of the determination of eligibility for DAM and RUC Make Whole payments in Settlements and Billing, ERCOT relies upon the Resource Status telemetry to infer a change in generator breaker status (refer to Protocol 4.6.2.3).
10. ERCOT uses the generator breaker telemetry status provided by the QSE in the RT Network Security Analysis applications such as State Estimator.
11. It is the QSE’s responsibility to assure that the Resource Status and generation unit Breaker Status telemetry is consistent (i.e. Breaker Status closed implies the Resource Status is selected from among the On-Line Resource Status codes).
12. The following checks are performed by ERCOT Real time systems:
* For both Generation Resources and Load Resources the High Sustained Limit (HSL) must be greater than or equal to the Low Sustained Limit (LSL) plus the sum of the Resource-specific designation of capacity to provide Responsive Reserve (RRS), Regulation Up (Reg-Up), Regulation Down (Reg-Down), and Non-Spinning Reserve (Non-Spin).
* For Off-Line Non-Spin, the amount of Non-Spin provided {i.e. the Non-Spin AS Resource Responsibility} must be less than or equal to the HSL for Off-Line Generation Resources.
* For RRS Service:
	+ The full amount of RRS awarded to or self-arranged from an On-Line Generation Resource is dependent upon the verified droop characteristics of the Resource. ERCOT shall calculate and update, using the methodology described in the Other Binding Document (OBD) [Procedure for Calculating Responsive Reserve (RRS) Limits for Individual Resources](http://www.ercot.com/content/wcm/lists/92931/Procedure_for_Calculating_Responsive_Reserve__RRS__Limits_for_Individual_Resources_112119.docx), a maximum MW amount (in percentage) of RRS for each Generation Resource subject to verified droop performance. The default value for any newly qualified Generation Resource shall be 20% of its HSL. RRS limits for non-thermal Resources will be based on their droop performance characteristics, actual governor tests (as submitted to ERCOT), proven rated capacity sustainable for an hour, and the need to keep the frequency responsive capability fairly distributed across multiple Resources;
	+ Generation Resources operating in the synchronous condenser fast-response mode may provide RRS up to the Resource’s proved 20-second response (which may be 100% of the HSL);
	+ The amount of RRS provided from a Resource capable of providing FFR must

be less than or equal to its proven rated capacity sustainable for 15 minutes; and

* + The amount of RRS provided from a Load Resource must be less than or equal to the HSL minus the sum of the LSL, Reg-Up Resource Responsibility, Reg-Down Resource Responsibility and Non-Spin Resource Responsibility.
1. For the purpose of controlling the economic dispatch of Wind-powered Generation Resources (WGRs) and PhotoVoltaic Generation Resources (PVGRs), collectively IRRs, ERCOT provides a flag available over ICCP to assist IRR recognition of the need to reduce output in response to transmission network constraint violations. This flag is referred to as the SCED Base Point Below HDL (SBBH). The ERCOT system logic that is used to set the flag is applied to all Resource types and does not consider Resource Status. Consequently a QSE’s ICCP client can receive SBBH flag for each of its Generation Resources; however, this flag is only intended to apply to an IRR. Non-IRR Generation Resources should ignore this flag and respond only to their Base Point Dispatch Instructions. IRRs with an OFF, OUT or ONTEST Resource Status should also ignore the SBBH flag. If a curtailment is necessary for an IRR in an ONTEST Resource Status, ERCOT Operations will verbally communicate appropriate Dispatch Instructions to the IRR’s QSE. If the IRR returns to an online Resource Status, then it is released for economic dispatch by SCED and the SBBH flag will apply.

##  Guidance Regarding the Use of Sustainable and Emergency Generation Resource Limits

The Protocols require the QSE to provide ERCOT the following operating limits for each of its Generation Resources:

* Low Emergency Limit (LEL) - The limit established by the QSE describing the minimum temporary unsustainable energy production capability of a Resource. This limit must be achievable for a period of time indicated by the QSE but not less than 30 minutes;
* Low Sustainable Limit (LSL) - The limit established by the QSE, continuously updatable in Real-Time, that describes the minimum sustained energy production capability of a Resource;
* High Sustainable Limit (HSL) - The limit established by the QSE, continuously updated in Real-Time, that describes the maximum sustained energy production capability of the Resource; and
* High Emergency Limit (HEL) - The limit established by the QSE describing the maximum temporary unsustainable energy production capability of a Resource. This limit must be achievable for a time stated by the QSE, but not less than 30 minutes.

The QSE is required to provide ERCOT the above limits via the COP for its Generation Resources in each reporting hour and via telemetry over ICCP during the Operating Hour.

The LSL and HSL values are used in the Day-Ahead and Hourly RUC studies for Generation Resource capacity limits. The COP values for these limits are also used by the Day Ahead Market. Similarly, the LSL and HSL telemetry values are used in the ERCOT EMS (e.g. in Network Security Analysis) and MMS (e.g. Security Constrained Economic Dispatch) Real Time applications for Generation Resource capacity limits. The LEL and HEL values are provided for ERCOT Operator information and are not explicitly used in the ERCOT EMS or MMS applications. ERCOT’s expectation is that the QSE will provide LEL/LSL/HSL/HEL values that represent the QSE’s expected limit of operation for each of the Generation Resources in the QSE’s portfolio.

ERCOT RUC applications calculate the Low Ancillary Service Limit (LASL = LSL + Reg Down AS Responsibility) and High Ancillary Service Limit (HASL = HSL – Reg Up – Responsive Reserve – Non-Spin AS Responsibilities) for each Generation Resource assigned an Ancillary Service Responsibility based on the QSE provided LSL and HSL. In Real Time systems, these calculations use telemetered AS Schedules for Responsive Reserve and Non-spin as opposed to AS Responsibilities. HASL and LASL limits are honored in the ERCOT RUC and Real Time SCED processes. The QSE is responsible for exposing a Generation Resource’s capacity associated with the difference between (LSL – LEL) and (HEL – HSL) to ERCOT DAM and Real Time Systems by adjusting the resource’s HSL. In the following examples the HEL and LEL values are assumed to be Generation Output values that are above or below, respectively, the Generation Resource’s normal high or low sustainable limits (HSL & LSL):

* if the QSE sets HSL = HEL in a COP reporting hour, the ERCOT RUC systems will recognize the added exposed capacity in the RUC processes and similarly for LSL= LEL, or
* if the QSE sets HSL = HEL in its Operating Hour telemetry, ERCOT systems will recognize the added exposed capacity in the SCED process and similarly for LSL=LEL. This action may also require the QSE to update its Energy Offer Curve (EOC) to cover the added capacity range for the affected Generation Resource, including any adjustments to the curve that may be required to correctly offer capacity amounts reserved for Ancillary Services in accordance with Protocol Section 6.4.3.1, EOC for Non-Spinning Reserve Capacity, and Section 6.4.3.2, EOC for Responsive Reserve and Regulation up Capacity. In the absence of an EOC that covers this added capacity range, ERCOT systems will create a proxy EOC that extends to the SWCAP to cover the added capacity in accordance with Protocol Section 6.5.7.3, Security Constrained Economic Dispatch.
* The QSE is responsible for managing the temporal constraints associated with the operation of its Generation Resources in the emergency energy production ranges. If a Generation Resource, for example, is limited to two hours operating time above a specified Real or Reactive Power output, the QSE is expected to adjust its LSL/HSL telemetry to communicate the availability of emergency capacity for SCED dispatch and the need to exit from the emergency output ranges. In other words, after a QSE has set its HSL telemetry equal to HEL to provide emergency energy to ERCOT, it is incumbent upon the QSE to accumulate the time during which its resource is deployed above its normal HSL and subsequently reduce its HSL value from HEL to meet the emergency operational time limits for its Generation Resource.

# Real Time Resource Activities

The ICCP telemetry update requirements are described in the ICCP Handbook. The QSE Resource telemetry provided to ERCOT through ICCP must be updated as described in the ICCP Handbook. QSEs also receive notices and other messages via MIS system for ERCOT detected errors in QSE telemetry or inconsistencies in the data being provided in Real-Time. Please see Appendix I, EMS Generated Notices, for additional details related to telemetry error messages.

Common Generation Resource evolutions, including startup and ramp to LSL, power operations, and shutdown from power operations, with and without Ancillary Service Resource Responsibility, are described in the following. The QSE may manage these evolutions by different methodologies and the following descriptions are not meant to be all-inclusive. The evolutions described below recognize that the control of Resources connected to the ERCOT Transmission Grid is a joint responsibility of both the QSE and ERCOT Operations personnel.

In the ERCOT implementation, the SCED application is an application that is responsible for determining the optimum RT generation dispatch that minimizes the SCED objective function (which can be generally described as representing the ERCOT total RT dispatch cost subject to reliability constraints). The SCED outputs include Generation Resource Base Points and Locational Marginal Prices (LMP). To perform the optimization calculation, the SCED uses input from the Resource Limit Calculator (RLC) and other EMS applications. In general, the RLC is responsible for determining the Generation Resource input data set for SCED. This includes the LSL/LASL/LDL/HDL/HASL/HSL, and Generation Resource maximum up and down ramp rates (SURAMP and SDRAMP) available to the SCED function. Additionally, any logic equations associated with the determination of these values based on Resource Status telemetry is also implemented in the RLC.

For example, RLC uses the Normal and Emergency Ramp Rates provided by QSE telemetry for each of its Generation Resources when determining these SCED Up and Down Ramp Rates. The Ramp Rate telemetry values include Normal Up Ramp Rate (NURR), Normal Down Ramp Rate (NDRR), Emergency Up Ramp Rate (EURR), and Emergency Down Ramp Rate (EDRR). These values are subject to ERCOT system validation rules described below. If a telemetered value fails a validation test, the Resource Limit Calculator utilizes in place of the telemetered value the appropriate ramp rate from the Resource Parameter Update Application, which provides ramp rate values as submitted in the RARF or changed by the QSE through the MMS Resource Parameter Update Application. Ramp Rate validation rules include:

1. the ICCP link is operable and unaffected by temporary failures in data transfer
2. the telemetered ramp-rate value is not NULL
3. the telemetered ramp-rate value is less than or equal to the High Reasonability Ramp Rate Limit and greater than or equal to the Low Reasonability Ramp Rate Limit identified in the RARF
4. the telemetered ramp-rate data quality is GOOD
5. the EURR value is greater than or equal to the NURR value
6. the NURR must be sufficient to cover the telemetered Regulation Up Service Responsibility for the Resource (i.e., NURR\*5 >= RURS)
7. the NDRR must be sufficient to cover the telemetered Regulation Down Service Responsibility for the Resource (i.e., NDRR\*5 >= RDRS)
8. the EURR must be sufficient to cover the telemetered Responsive Reserve Service Responsibility for the Resource (i.e., Min(0.20\*HSL, EURR\*10-RURS) >= RRRS)

Additionally, the ERCOT LFC system provides for each On-Line Generation Resource an Updated Desired Base Point (UDBP) in the telemetry data set. The UDBP is a calculated MW value representing the expected MW output of a Generation Resource ramping between successive SCED Base Points. The QSE is expected to control each of its Generation Resources to follow the UDBP and additionally if the Generation Resource is assigned Regulation AS Resource Responsibility it must follow UDBP plus the QSE assigned Regulation deployment.

##  Generation Resource Startup and Ramp to LSL

When a Generation Resource is synchronized to the ERCOT Grid and the generator breakers are closed, the Generation Resource net real power is included in the SCED generation-to-be dispatched calculation. Concurrent with the change in generator breaker status, the expectation is that the QSE will change the Resource Status telemetry from OFF to STARTUP. When SCED observes a telemetered Resource Status of STARTUP, SCED will issue a Base Point equal to the current telemetered net real power plus five times normal ramp rate of the Resource. The STARTUP telemetered Resource Status must be maintained until the Resource reaches a net real power level beyond which the Resource can begin responding to ERCOT dispatch instructions. When the Resource has reached this net real power level, the QSE sets the Resource Status to the appropriate Online condition (for example ON, ONREG, etc). The QSE controls the Generation Resource output during this period of operation and the Generation Resource is a price taker. It is the QSE’s responsibility to present a Resource Status consistent with the generator breaker status or, in the case of a PUN, its capability to inject energy into the ERCOT Grid. Additionally, it is expected that the values for the LSL and HSL telemetry is the QSE’s best estimate of the sustained capabilities of the Resource according to the definition of those terms in the protocols. During the period of time in which the Resource is in Startup mode:

1. the QSE may not assign AS Resource Responsibility on that Resource; and
2. the Resource will be exempt from Base Point Deviation penalties and GREDP calculations.

The following discussion applies to the treatment of Generation Resources by the Resource Limit Calculator (RLC) and the Security Constrained Economic Dispatch (SCED) applications when the resource has an online Resource Status and is operating at or near the telemetered LSL. When RLC detects an On-Line Generation Resource, based on Resource Status, and the net real power telemetry[[2]](#footnote-3) is less than (P1 \* LSL telemetry), RLC sets the Low Dispatch Limit (LDL) = High Dispatch Limit (HDL) = the net real power telemetry value and SCED will issue a Base Point equal to the net real power value received from the RLC. While this condition persists both the Base Point and Updated Desired Base Point (UDBP) sent to the QSE at the end of the SCED cycle equals the net real power previously provided by the QSE in the ICCP scan cycle snapshot at the start of the SCED execution. This condition continues as long as the Generation Resource’s net real power is less than P1 \* LSL telemetry. When a Generation Resource with an Energy Offer Curve (EOC) or an Output Schedule achieves a net real power output ≥ (P1\* the LSL telemetry), the Generation Resource is released to SCED for power operations dispatch as further described below. Upon release to SCED for power Operations, the QSE may telemeter AS Resource Responsibilities for the Generation Resource as was previously provided in the COP for the current Operating Hour and update the Resource Status telemetry to the appropriate status code for the assigned AS Resource Responsibility. ERCOT expects Resources providing AS Responsibility in an Operating Hour to be released to SCED for power operations at the top of the Operating Hour.

When the Generation Resource net real power is equal to or greater than (P1 \* LSL telemetry), the RLC calculates a HDL and LDL in MW based on the Generation Resource’s normal up/down ramp rate and the current net real power telemetry. Note that this current net real power value may actually be below LSL or above HSL, depending on the Resource’s current operating conditions. For example, consistent with Protocol Section 6.5.7.2, Resource Limit Calculator, if a Generation Resource’s current net power output telemetry is above HSL, the RLC sets HDL equal to LDL equal to the maximum of either (Net Power Output - (SDRAMP\*5)) or LASL. Given this input set, SCED-issued Base Points will move the Generation Resource toward its HSL.

ERCOT expects the QSE/Resource Owners to provide a telemetered ramp rate to ERCOT any time that the Resource is synchronized to the ERCOT Transmission Grid. In each case, the HDL and LDL are calculated by ERCOT systems based upon the HSL and LSL (or HASL and LASL, if the Generation Resource is assigned AS Resource Responsibilities). The Generation Resource Owner and QSE must assure that the High and Low Reasonability Ramp Rate Limits provided in the RARF are selected to allow validation of Ramp Rate telemetry throughout the full operational range for this parameter.

## Generation Resource Power Operations

After the Resource has completed Startup, the QSE will update the Resource Status telemetry to the appropriate On-Line conditions. If the Generation Resource has an Energy Offer Curve (EOC), the Resource becomes subject to economic dispatch by SCED according to its EOC (i.e. SCED- and LFC-issued Base Points and UDBP for the Generation Resource). SCED will continue to dispatch each Generation Resource, based on its economics relative to all other Generation Resources subject to transmission system topology, between LDL and HDL[[3]](#footnote-4). Every 4 seconds, the RLC calculates LDL and HDL values based on the Generation Resource’s SCED Up or Down ramp rates at its net real power times 5 minutes. The SCED up and down ramp rates used in this calculation are determined as follows:

1. If RRS is not deployed -
	* The Normal Ramp Rate values provided by each QSE less the share of the ramp rate for the Generation Resources Regulation Up/Down Service reserved in Real Time. The RLC determines the amount of ramp rate reserved for Reg Up/Down by dividing the Generation Resource’s Regulation Responsibility by 5 and multiplying by the fraction of Normal Ramp Rate reserved for Regulation Service in Real Time. This fraction is currently set at 0.714 (or 5/7), subject to revision by ERCOT from time to time. Changes to this value are included in the Market informational postings.
2. If RRS is deployed -
	* RLC uses the Emergency Up Ramp Rate value provided by the QSE less the share of ramp rate for the Generation Resource’s Regulation Up/Down Service reserved in Real Time. If the Generation Resources is not assigned RRS Responsibility, then the SCED Up and Down Ramp Rates are determined as described above. The amount of the Regulation Service reserved to Real Time is the same regardless of RRS deployment.

The HDL and LDL values are used in each SCED execution and constrain the SCED Base Point such that LDL ≤ SCED Base Point ≤ HDL. QSEs are responsible to assure that sufficient SCED ramp rate is available throughout the operating range of the Resource to provide the amount of Regulation Resource Responsibility assigned to the Generation Resource and to respond to the SCED Base Point. Generation Resources that are not assigned RRS Responsibility and desire to provide additional operational flexibility to ERCOT for use by the SCED can control the Resource’s response by increasing the Normal Up/Down Ramp Rate telemetry values. In all cases, the expectation is that the Normal Ramp Rate telemetry will not exceed the Emergency Ramp Rate.

If the Generation Resource is operating on an Output Schedule, the SCED will issue Base Points to the Resource, within its HDL and LDL, to ramp the Resource to the Output Scheduled level in effect for the SCED interval being executed. Once the Resource has achieved its target Output Schedule level, SCED will issue Base Points to the Resource, within its LDL and HDL, to correct net real power to the scheduled level for that SCED interval.

During power operations, if it is necessary to temporarily hold the Generation Resource at various levels of output between LSL and HSL to accommodate operational needs (i.e. the addition of condensate pumps, the transition from an electric feed water pump to a steam driven feed water pump, starting coal pulverizers, start-up of a CT or ST in a CCGR,, etc.) the following procedure should be used by the QSE to communicate the temporary hold to the SCED application.

Base Points from SCED will generally follow the total ERCOT demand, subject to Transmission Network constraints. Therefore, as the ERCOT system load increases, the QSE can anticipate a generation dispatch Base Point increase (and vice versa). A short “hold” (depending on its length) by the QSE in the dispatch of a unit to its Base Point while additional equipment is placed in service may be tolerable and result in no Base Point deviation charges or GREDP failed intervals. However, if the “hold” needs to be longer and assuming the Generation Resource is not assigned AS Resource Responsibility, the HSL telemetry can be temporarily set to the hold point. While the “hold” is in effect, the SCED HDL will consider the updated HSL telemetry value and thus the Base Point increase with ERCOT load will stop until the QSE releases the HSL back to its normal operational value. The LDL will be as calculated by the Resource Limit Calculator in accordance with the Resource’s SCED down ramp rate. Similarly, a temporary hold on down base points can be achieved by setting the LSL telemetry to the desired hold point in the same manner as described here. Note that setting HSL or LSL below the true capability of the Resource can facilitate the temporary hold as discussed, but such actions may also have an effect on the LMP at the Generation Resource Node as Resources operating with Base Points at either HSL or LSL cannot set the LMP at that node.

If the Resource has been assigned AS Resource Responsibility, then the QSE must recognize that the Resource HASL will be in control of the dispatch to increase Base Points. Therefore, if any temporary “hold” is needed, the HSL should be set at the hold point plus the sum of all AS Resource Responsibility.

For example, for a generation unit that has been assigned 100 MW of Responsive Reserve AS Resource Responsibility and a HSL of 750 MW that also requires a second boiler feed pump to be in service to generate over 400 MW the following scenario could apply at some point during power operations. When the Base Points are below 400 MW, the pump may not need to be in service (e.g. for economic or operational reasons). When it appears that system load and market price increases will cause this Resource’s Base Points to approach and potentially exceed 400 MW, the QSE must act to assure that the second boiler feed pump is online in sufficient time so as not to interfere with the SCED Base Point dispatch. If the QSE requires a temporary “hold” on the SCED up dispatch to start the second boiler feed pump, the QSE would have to set the HSL telemetry at 500 MW to accommodate the 400 MW HASL of the unit (500 minus the 100 RRS Responsibility equals 400 MW). Thus, SCED Base Points would be held to no more than 400 MW until the pump can be started after which the HSL telemetry can be returned to 750 MW. The QSE must recognize that if it is required to deploy this Resource’s RRS during power operation below 400 MW or during the temporary hold, the SCED will issue Base Points for the Resource based on the Emergency Ramp Rate Curve and timely action by the QSE to generate above 400 MW to deliver the RRS energy may be required to avoid performance penalties.

An Aggregate Generation Resource (AGR) should always telemeter an HSL that reflects the maximum sustained energy production capability for the sum of all generators within the aggregation. When operating such that only a portion of the generators within the AGR are online, the AGR should (1) telemeter HSL that reflects the total capacity of the entire AGR and (2) in order to reflect capacity within the HSL that is offline, the AGR should also telemeter a Responsive Reserve Schedule (RRSC) of 1 MW and a Non Frequency Responsive Capability (NFRC) reflects the capacity that is offline. Using these telemetry values ERCOT’s systems will calculate appropriate capacity limits for the AGR to be incorporated in ERCOT’s reliability studies. Note that as the generators within the aggregation are brought online, the NFRC value should vary and continue to reflect capacity of generators that are offline. The approach described in this paragraph is an interim solution until a long term solution that allows tracking of various operating configurations within an AGR is vetted and implemented.

## Generation Resource Shutdown

A Generation Resource shutdown from power operations consists of a controlled QSE/ERCOT dispatched reduction in net real power to the Resource’s LSL followed by the controlled lowering of the generation output from LSL by the Resource operator until the generator output breaker is opened. This section describes the ERCOT preferred methodology for moving a generator output down to a state suitable for de-synchronization.

Prior to beginning a QSE directed shutdown sequence all AS Resource Responsibility assigned to the Generation Resource must first be moved to other Generation Resources in accordance with ERCOT Protocol requirements. The one exception to this rule is the case in which a Generator is carrying Off-Line Non-spin and that Non-spin is being recalled. If the Generator intends to continue providing Non-spin after the shutdown process is complete, the QSE should continue to telemeter a Non-spin Resource Responsibility that accurately represents the amount of Non-spin service being carried on that Resource. Additionally, if the shutdown must be accompanied by a COP update to decommit the Generation Resource in future COP reporting hours, the QSE must consider the temporal limitations associated with restarting this Resource before commencing the shutdown evolution (i.e. depending on temporal limitations, the QSE may first need to submit the COP update for the de-commitment to ERCOT before directing the shutdown). The methodology described below applies to all Generation Resources operating with either an EOC or Output Schedule (including CCGR, WGR, and SGR).

Following the removal of AS Resource Responsibilities from the Resource to be shutdown, the QSE may direct the removal of the Generation Resource from service[[4]](#footnote-5). If the Generation Resource has been shown in the COP to be On-Line during the Operating Hour in which the shutdown is to commence, then the provisions of Protocol Section 6.4.6.1, QSE Request to Decommit Resources in the Operating Period, apply, and the QSE must request ERCOT approval prior to commencing the shutdown. If the Generation Resource has been shown in the COP to be Offline in the current Operating Hour, then the provisions of Protocol Section 6.4.6.1 do not apply; however, ERCOT requests that the QSE advise the ERCOT of its intent to shutdown the Resource in the current Operating Hour. If the Generation Resource is a QSGR then the provisions of Protocol Section 3.8.3.1, Quick Start Generation Resource Decommitment Decision Process, apply and the steps described in that Protocol Section should be followed.

A QSE shall initiate a normal shutdown (i.e. a non-emergency shutdown of a Resource) sequence by changing the telemetered Resource Status to “SHUTDOWN.” This action removes the Generation Resource from economic dispatch by SCED and will result in the HDL and LDL being set to the current telemetered net real power minus five times the normal ramp. During the subsequent SCED execution, ERCOT will begin to issue Base Points which ramp the Generation Resource from its current level of net output down to a Base Point of 0. The Generation Resource should not begin its shutdown sequence until a Base Point is received which begins ramping the Resource Off-Line according to its normal ramp rate. Upon the Generation Resource reaching a net real power output of 0 and the generator output breaker being opened, the telemetered Resource Status should be updated to reflect the appropriate Off-Line status (i.e. OFF).

In accordance with Nodal Protocols, a QSE representing a Generation Resource that is not providing Ancillary Services may only use a Resource Status of STARTUP and SHUTDOWN to indicate to ERCOT through telemetry that the Resource is in a start-up or shut-down sequence. In accordance with Nodal Protocols, a QSE representing a Generation Resource that is not providing Ancillary Services may only use a Resource Status of ONTEST to indicate to ERCOT in the COP and through telemetry that the Generation Resource is performing a test of its operations either manually dispatched by the QSE or by ERCOT as part of the test. If the ONTEST Resource Status Code is to be used to indicate that the Generation Resource is performing a test of its operations under manual dispatch by the QSE, the QSE must notify ERCOT by 1800 hours in the Day-Ahead of such a planned test.

## Power Operations with AS Resource Responsibility

Prior to the end of the Adjustment Period corresponding to an Operating Hour during which a Generation Resource is assigned an AS Resource Responsibility, the QSE shall ensure that a valid Output Schedule or Energy Offer curve for that Operating Hour has been submitted and accepted by ERCOT in accordance with Protocol Section 6.4.3.1, EOC for Non-Spinning Reserve Capacity, and Section 6.4.3.2, EOC for Responsive Reserve and Regulation Up Capacity.

When a Generation Resource, with either an EOC or Output Schedule, is assigned AS Resource Responsibilities, the ERCOT RLC calculates each Resource’s High and Low Ancillary Services Limits (HASL/LASL) for use by the SCED. The HASL is the HSL less the amount of AS Resource Responsibility telemetry for Reg-Up and the amount of AS Schedules for Responsive Reserve, and Non-Spin services. For the modeled Generation Resources that represent the injection component of an ESR (ESR-GR), HASL calculation will also take into account the state of charge (SOC) that is available for an injection Base Point after discounting the SOC required to discharge to support the Ancillary Service Responsibilities on the ESR-GR. Similarly for the modeled Controllable Load Resources that represent charging component of an ESR (ESR-CLR), HASL calculation will also take into account the additional energy that the ESR can gain via a withdrawal Base Point after discounting the SOC required to charge to support the Ancillary Service Responsibilities on the ESR-CLR. Section 3.13 provides additional details on this. The LASL is the LSL plus the AS Resource Responsibility telemetry for Reg-Down. The total of the AS Resource Responsibilities for all Resources in the QSE’s Real Time telemetry portfolio must equal the QSE’s total AS Supply Responsibilities. The QSE’s total AS Supply Responsibility is its total of awarded AS amounts adjusted for trades with other QSEs and self-provision. During Generation Resource start-up and shut-down operation, the Generation Resource cannot provide Ancillary Services (i.e. its AS Resource Responsibilities must be moved to another Resource). Except as noted below, the telemetry for AS Resource Responsibility must be exactly the same as the AS Resource Responsibility that was reported for that Generation Resource in the corresponding hour in the COP.

Movement of AS Resource Responsibility between Resources is accomplished during the Adjustment Period by use of COP updates. When such COP updates are submitted, the corresponding EOC updates must also be submitted as needed to ensure that the capacity range reserved for AS is offered in compliance with the Protocol Section 6 requirements governing EOC submissions. During the Operating Period, if the QSE experiences an equipment failure that results in a requirement to move an AS Resource Responsibility, the QSE may only change that AS Resource Responsibility subject to prior verbal approval by ERCOT Operations. AS Resource Responsibility moves within the Operation Period may only be to another like[[5]](#footnote-6) Resource qualified to provide that Ancillary Service within the requesting QSE’s portfolio. The QSE shall ensure that a valid Output Schedule or EOC meeting the Protocol Section 6 requirements is submitted as soon as reasonably practicable after the event that caused the movement.

On the Operating Hour clock change (i.e. top-of-hour) when AS Resource Responsibility changes for a Resource, the QSE is expected to update telemetry for AS Resource Responsibility and AS Schedule no earlier than 30 seconds before the top-of-hour and complete the update no later than 10 seconds before the top-of-hour. This update timeline assures that the AS Resource Responsibilities become effective in the first SCED execution that occurs in the new Operating Hour. The QSE should adjust the Resource Status, AS Resource Responsibility and AS Schedule telemetry for all its Resources that are dropping or adding AS Responsibilities keeping in mind that when complete the total of all AS must be equal to the QSE’s Supply Responsibility for each AS.

With the recent changes to the High Ancillary Service Limit (HASL) (NPRR 527, 687 and 710), transitioning from not carrying AS Resource Responsibilities to carrying large amounts of AS Resource Responsibilities can pose significant movement in the output of a Generation Resource that may not be achievable within a five minute SCED interval. The following approach primarily for Combined Cycle Resources or Generation Resources with Non Frequency Responsive Capability (NFRC) telemetry may be used as an interim solution until a long term solution is vetted and implemented.

1. A Generation Resource that is looking to preposition itself in anticipation of an AS Resource Responsibilities at the top of the next hour should telemeter a Responsive Reserve Schedule (RRSC) of 1 MW and a non-zero NFRC that reflects the full non-frequency response capability of the Generation Resource. This will cause SCED to provide Base Points to the Generation Resource that will bring the unit out of NFRC (an operating range which typically is severely restricting in ramping capabilities) consistent with the down ramp rate telemetered by the QSE.
2. When the Generation Resource switches to carrying AS Resource Responsibilities at the top of the hour, it should already be at an output level from where SCED should be able dispatch it down further to an output level that ensures deliverability of the AS Resource Responsibilities within one interval.

Note that when using the approach described above the Generation Resource’s HSL should not be changed. Also note that once the Generation Resource is generating at a level that is outside of Non Frequency Responsive range, it should continue carry the 1 MW RRSC and non-zero NFRC telemetry until just prior to top of the hour when the resource is carrying Ancillary Services. Just prior to top of the hour QSE representing the Generation Resource should update the resource’s telemetry to reflect actual AS Supply Responsibilities and actual NFRC.

## Regulation Ancillary Service

Regulation Ancillary Services (Reg-Up and Reg-Down) are dispatched by the ERCOT Load Frequency Control (LFC) system at the QSE level over the ERCOT WAN via ICCP. The ERCOT LFC distributes the required amount of Regulation control to each QSE based on the QSE’s portfolio participation factor as determined by the sum of QSE’s AS Resource Responsibility for Reg-Up and, separately, for Reg-Down. Each QSE may only assign AS Resource Responsibility for Reg-Up and Reg-Down to those Generation Resources within its portfolio that are qualified to provide Regulation Service. The total of the AS Resource Regulation Responsibility telemetry for each Generation Resource within the QSE’s portfolio must equal the QSE’s Regulation Supply Responsibility. The QSE’s Regulation Supply Responsibility is that amount of awarded Reg-Up and Reg-Down amounts adjusted for trades with other QSEs and self-provision. Regulation energy from a Generation Resource is always provided to the ERCOT system as price taker energy. This means that the portion of the Generation Resource’s EOC corresponding to the capacity reserved for Regulation Services is never exposed to SCED for economic dispatch.

The QSE is responsible for distributing the LFC MW deployment received from ERCOT to its Resources assigned AS Resource Regulation Responsibility such that 100% of the QSE Regulation Dispatch Instruction is distributed to those Generation Resources. The percent distribution, expressed as a decimal value, is provided to ERCOT by the Resource Regulation Up Participation Factor and Regulation Down Participation Factor telemetry. The sum of the Regulation Participation Factors for Reg-Up and Reg-Down, must separately sum to 1. If the QSE experiences a temporary response limitation from a Resource assigned Regulation Service responsibility, the QSE must on its own, assign more control to other like[[6]](#footnote-7) Resources in its portfolio to make up for the temporary loss of response and adjust the Regulation Participation Factors accordingly. The QSE’s MW control values for each of its Generation Resources providing Regulation is the same as the pro rata Reg-Up and Reg-Down Participation Factor telemetry (in decimal notation). For Settlement and Billing, the Reg-Up and Reg-Down Participation Factor telemetry values are used to determine the Regulation Service energy deployments in the calculation of Base Point Deviation Penalties. Additionally, LFC calculates the Reg-Up/Reg-Down deployment for each Resource based on the QSE’s portfolio deployment amount and each Resource’s Reg-Up and Reg-Down Participation Factors. This is used by LFC to compute how much additional regulation is needed on top of what has already been deployed to each Resource during previous regulation deployments. This avoids repeating a request for regulation that the QSE has already actually deployed to a Resource. The Reg-Up and Reg-Down MW assignments are incremental relative to the UDBP and accumulate during the SCED interval. This means that the Generation Resource on economic dispatch and providing Regulation Service is expected to follow UDBP dispatch plus the incremental Regulation MWs throughout the SCED Interval. If the AS Resource Regulation Responsibility moves totally from one Resource to another (e.g. at the top of the Operating Hour), the QSE should set the Regulation Participation Factor telemetry to zero for the loosing Resource. The Regulation Participation Factor telemetry values for the gaining Resource should be determined based on the next LFC instruction received after the AS Resource Responsibility move.

Controllable Load Resources with AS Resource Responsibility for Regulation are similarly dispatched by the QSE and this Resource’s pro rata share of the QSE Regulation dispatch instruction is represented by its Regulation Participation Factors. Controllable Load Resources must follow Scheduled Power Consumption (SPC) plus incremental Regulation MWs dispatched by ERCOT. SPC is provided by the QSE to ERCOT via ICCP telemetry that represents the Resource control set point minus any Ancillary Service deployments.

Refer to Section 3.13 Provisions for Energy Storage Resources (ESRs) which covers the expectations for ESRs that are carrying Regulation.

Resources providing Fast-Responding Regulation Service (FRRS-Up and FRRS-Down) are dispatched by the ERCOT Load Frequency Control (LFC) system, and Resource specific instructions are sent to Resources with FRRS responsibility over the ERCOT WAN via ICCP. The ERCOT LFC determines the required amount of Regulation control to each Resource carrying FRRS based on the Responsibility amount telemetered by the Resource. The FRRS-Up and FRRS-Down instructions are NOT based on participation factors, and the participation factor for a Resource with FRRS-Up and FRRS-Down should be zero. Responsibilities for FRRS-Up and FRRS-Down are separate. Only Resources qualified to provide FRRS are allowed to telemeter an FRRS Responsibility. FRRS energy from a Generation Resource is always provided to the ERCOT System as price taker energy. This means that the portion of the Generation Resource’s EOC corresponding to the capacity reserved for Regulation Service is never available to SCED for economic dispatch. Resources when providing FRRS are expected to telemeter a FRRS Responsibility telemetry and a corresponding Regulation Responsibility. For Ex. if a FRRS Up Responsibility is non-zero then REG Up Responsibility must be non-zero as well.

ERCOT will deploy FRRS Resources according to the following deployment logic:

**Deployment by Dispatch Instruction**: ERCOT may deploy FRRS Resources for up to two minutes when frequency reaches a deviation of more than +/- .03 Hz from the 60 Hz nominal system frequency. If the frequency deviation increases to more than +/- .05 Hz within the same frequency excursion (a single excursion is deemed to end when frequency deviation from 60 Hz decreases to +/- .01 Hz or less at any point and does not increase beyond .01Hz in the same direction of deviation within 12 seconds of reaching +/- .01 Hz, or when frequency deviation exceeds +/- .01 Hz in the direction opposite the excursion for which FRRS had been deployed), then ERCOT may require deployment for an additional two minutes. If frequency deviation further increases to more than +/- .09 Hz within the same frequency excursion, ERCOT may require deployment for an additional two minutes. If the deployment obligation is extended due to a frequency excursion reaching a greater frequency deviation threshold, any deployment time remaining under the previous threshold will not be added to the deployment. For purposes of FRRS deployed by Dispatch Instruction, ERCOT will not require additional deployment if frequency deviation decreases to a lower threshold before returning to a threshold already reached during the same deployment.

**Deployment by Trigger Frequency**: It is expected that each Resource with an FRRS Responsibility deploy 100% of its FRRS Responsibility within 60 cycles of a frequency deviation of more than +/- .09 Hz from the 60 Hz nominal system frequency. LFC will issue an Instruction, but this will be used only for the purpose of determining when to terminate the deployment. Each Resource shall remain deployed until recalled by ERCOT.

**Termination of Deployment:** ERCOT shall initiate termination of any deployment whenever frequency deviation is equal to or less than +/- .01 Hz for more than 12 continuous seconds, whenever frequency deviation exceeds +/- .01 Hz in the direction opposite the excursion for which FRRS was previously deployed, or until the maximum deployment time (as described above) has been reached. In all cases, ERCOT will release Resources from deployment through a Dispatch Instruction in 3 steps. In each step, ERCOT will release an additional 1/3 of the originally obligated capacity for each Resource by sending a deployment instruction reflecting the reduced obligation. Each step will follow the previous step by no fewer than 12 seconds.

**Subsequent Deployment:** ERCOT may initiate a new deployment at any time following the complete recall of FRRS, except that ERCOT will not initiate a new deployment during any single frequency excursion for which FRRS has previously been deployed. However, FRRS Resources must automatically re-deploy during a single excursion if frequency deviation begins to exceed +/- .09 Hz after recall of a preceding deployment.

The preceding language describes the logic used for deploying FRRS using a typical set of thresholds. These thresholds are subject to tuning based on ERCOT's frequency control performance and system needs.

**Note on CLR FRRS Status Codes FRRSUP (262) and FRRSDN (261):** Nodal Protocols 3.9.1(5)(b)(iii) specifies that both Real-Time telemetered statuses of 261 and 262 are not Dispatchable by SCED. ESR-CLRs will not receive BPs from SCED based on RTM Bids-to-Buy. SCED BPs for both statuses are based on the ESR-CLRs Net Power Flow (NPF) at the SCED snapshot.

## Responsive Reserve Ancillary Service

Responsive Reserve Ancillary Service provided on Generation Resources and Controllable Load Resources is deployed by the ERCOT Load Frequency Control (LFC) system at the QSE level over the ERCOT WAN via ICCP. The ERCOT LFC distributes the required amount of Responsive Reserve to be deployed to each QSE based on the QSE’s pro rata share of the ERCOT total Responsive Reserve Service Resource Responsibility on Generation Resources and Controllable Load Resources. ERCOT’s Responsive Reserve Service deployments and recall dispatch instructions are incremental deployment or recall amounts.

On receipt of a deployment instruction, each QSE must distribute its Responsive Reserve deployment to its Generation and Controllable Load Resources that have assigned AS Resource Responsibility for Responsive Reserve by reducing the Resource’s Responsive Reserve Schedule by its QSE assigned amount. The QSE must update the Resource Responsive Reserve AS Schedule telemetry within 1 minute following the ERCOT deployment instruction. Each QSE must assure that the total of its telemetered AS Responsive Reserve Service Responsibility minus the total of its AS Responsive Reserve Schedule for its Generation and Controllable Load Resources equals the QSE Responsive Reserve Service deployments from the LFC system. QSEs should not move AS Resource Responsibility for Responsive Reserve between Resources, including across an ESR charging/discharging mode, within its fleet while frequency is below 59.95 Hz.

For Load Resources RRS deployment instructions are issued by ERCOT via XML message. ERCOT shall follow this XML notification with a Hotline VDI, which shall initiate the ten-minute deployment period. On receipt of a deployment instruction, each QSE must deploy its Load Resources that have assigned AS Resource Responsibility for Responsive Reserve and reduce the Resource’s Responsive Reserve Schedule telemetry by its assigned amount similar to that performed for Generation Resources. Upon receipt of a RRS recall instruction the QSE shall take the appropriate actions to restore the ability the Load Resource to respond to a future RRS Deployment Instruction and should within 15 seconds following the receipt of the recall message reset the Load Resource’s AS Schedule equal to its AS Responsibility.

### Fast Frequency Response (FFR)[[7]](#footnote-8)

Resources providing Fast Frequency Response (FFR) are expected to respond autonomously when frequency is below the trigger criteria for FFR. The initiation setting of the automatic self-deployment of the Resource providing RRS as FFR must be no lower than 59.85 Hz. The Generation Resources including ESR’s when providing FFR are expected to telemeter Resource Status(RST) = ONFFRRRS (21). The ESR-CLR’s will be able to provide FFR while telemetering ONCLR or ONRGL statuses as long as the ESR-GR is telemetering RST = 21. The Load Resources with high set under frequency relays that are qualified to provide FFR when providing FFR in Real Time are expected to telemeter Resource Status = ONFFRRRSL(263). ERCOT’s Load Frequency Control (LFC) system will send a FFR deployment signal at the QSE level (FFRQ) over the ERCOT WAN via ICCP. The purpose of this signal is to confirm the start of an FFR event and to provide indication of when the event as ended. The FFR deployment signal will have a value equal to the total FFR capacity the QSE is carrying once the monitored frequency is below the 59.85 Hz, indicating the start of an FFR event. The FFR deployment signal will have a value of 0 MW once the frequency is above 59.98 Hz, indicating the recall/end of an FFR event.

* Once the frequency trigger criteria is met,
	+ Resources providing RRS as FFR are expected to deploy autonomously.
	+ It is expected that the QSE must update the FFRAS Schedule (FFSC) telemetry for a Resource providing RRS as FFR to zero within 1 minute following receipt of ERCOT’s FFR deployment instruction. The next SCED run will use the Resource's updated telemetered inputs (ex. High Sustained Limit (HSL), Low Sustained Limit (LSL), FFR AS Responsibility (FFRS), FFR AS Schedule (FFSC), etc.) and the submitted offer curves to set a new Base Point. This Resource is then recommended to follow its Updated Desired Base Point (UDBP)[[8]](#footnote-9).
* Upon receipt of a FFR recall instruction,
	+ The QSE is expected to take the appropriate actions to restore the ability of the Resource providing RRS as FFR to respond to a future FFR Deployment Instruction. The QSE shall update FFR AS Responsibility (FFRRS) and/or FFR AS Schedule (FFSC) according to the Resource’s capability as soon as practicable but no later than 15 minutes (or take steps to ensure the QSE’s total FFR obligation is met).
	+ If the Resource providing RRS as FFR is still responding to the event, the QSE is expected to set the Resource’s telemetry appropriately and follow its Updated Desired Base Point (UDBP).
	+ For Resources that need to charge in order to be meet their FFR obligation and be ready for next deployment, the telemetry of the Generation Resource that is providing RRS as FFR must be such that its High Sustained Limit (HSL) reflects the capacity that it is capable of sustaining for at least 5-minutes and its Normal/Up Down Ramp Rate (NURR/NDRR) reflects its ability to respond to Base Points. It is acceptable for the Normal Up/Down Ramp Rates to be set as low as 0 MW for short durations if operating conditions will inhibit the Resource’s ability to respond to Base Points.

## Non-Spin Ancillary Service

Non-Spin Service that is participating as On-Line during an Operating Hour shall always be deployed in that Operating Hour and will not require a Resource specific Operator Dispatch Instruction to be released to SCED. This type of deployment shall be considered as a standing Non-Spin deployment Dispatch Instruction. Prior to the top of the delivery hour, beginning no earlier than 30 seconds before the top of the hour and ending no later than 10 seconds before the top of the hour, the QSE shall respond to this standing Non-Spin deployment Dispatch Instruction for those Resources assigned On-Line Non-Spin Ancillary Service Resource Responsibility by setting the Non-Spin Ancillary Service Schedule telemetry equal to 0.

Non-Spin Service that is participating as Off-Line (i.e., it is either being provided from Off-Line Generation Resources, or it is being provided from On-Line Generation Resources through power augmentation) is deployed by Resource specific Operator Dispatch Instructions delivered over the ERCOT WAN via XML messages on the MIS User Interface and the External Interface Specification applications. Prior to the top of the delivery hour, during the 20-second timeframe previously described, the QSE shall set the Non-Spin Ancillary Service Schedule equal to the Non-Spin Ancillary Service Responsibility less any standing or Operator-instructed deployment amounts.

For Generation Resources providing Non-Spin participating as Off-Line, within 20 minutes following a deployment Dispatch Instruction for Non-Spin, the QSE must update the Resource’s Non-Spin AS Schedule to show the ordered deployment by reducing the AS Schedule amount by the amount of the deployment. In addition, for those Generation Resources that will be ramping from an Off-Line state and synchronizing to the ERCOT Grid to provide the Off-Line Non-Spin, within 25 minutes following the deployment Dispatch Instruction, the Resource Status must be ON (to indicate that the Resource is On-Line with an EOC) with the net real power telemetry greater than or equal to P1 **(0.90**)\* the telemetered Resource LSL and its Non-Spin AS Schedule updated to show the ordered deployment by reducing its AS schedule amount by the amount of the deployment. The END TIME that is provided in the deployment message for Non‑Spin is required by protocols and provides the QSE with the estimated duration of the Non-Spin deployment. A “Recall” message could be received before the END TIME or a re-deployment could also occur changing the END TIME. However, in absence of the additional message, the QSE must call ERCOT operations and verify that the operator desires the recall to occur at the scheduled time in the deployment message and, only if so authorized by ERCOT, the QSE should restore the Non-Spin at the END TIME without further messages from ERCOT.

On recall of the Non-Spin, Generation Resources that were previously Off-Line may remain On-Line following the recall. However, the amount of Non-Spin Resources Responsibility being provided must be less than the Resource’s HSL minus its LSL to receive any SCED economic dispatch (i.e. the AS Resource Responsibility telemetry must be greater than HSL – LSL for any Base Point to be greater than LSL). In the event that the duration of a Non-Spin deployment to an Off-Line Generation Resource is less than the Resource’s Minimum On-Line, the QSE may keep the Generation Resource On-Line to meet this limitation. While the Generation Resource remains On-Line, the QSE will set the value of the Non-Spin Ancillary Service Responsibility telemetry for that unit for that hour as follows: set the Non-Spin Ancillary Service Schedule equal to the MW amount of Non-Spin that will be provided via power augmentation; otherwise, the QSE will set the Non-Spin Ancillary Service Schedule to 0. Thereafter, the QSE may choose to return to the Off-Line operation, and maintain its Off-Line Non-Spin AS capacity, using the generation shutdown processes described above. During the generation shutdown, the Non-Spin AS Schedule should be adjusted to show the recovered Non-Spin capacity. If the QSE shuts down its Generation Resource, ERCOT is not obligated to honor the Resource’s temporal constraints to again deploy the Non-Spin ancillary service. Such deployments will again expect the Resource to be fully deployed in 30 minutes, and it is the QSE’s responsibility to assure that it can meet its Non-Spin AS Responsibilities.

##  Reliability Unit Commitment (RUC)

This section describes expectations of telemetry for hours in which a resource was committed by a RUC process.

### RUC-Committed Resources Providing Ancillary Services

The QSE may only use a RUC-committed Resource to meet its Ancillary Service Resource Responsibility during that Resource’s RUC-Committed Interval if the Resource has been committed by the RUC process to provide Ancillary Service, or the Resource is a Combined Cycle Generation Resource that was RUC-committed for additional capacity (RUCAC) by transitioning from one On-Line configuration to a configuration with higher capacity. [Protocol 5.5.2 (13)]

RUC-committed resources that are providing ancillary services and are choosing to opt-in or opt-out to RUC settlement should telemeter ONRUC and ONOPOUT, respectively, during the hours in which they were RUC committed, rather than using other online statuses which indicate the resource is providing ancillary services (such as ONREG).

## Provisions for Combined Cycle Generation Resources

Combined Cycle Trains are expected to operate in accordance with the Sections 3.1 through 3.4 above, subject to the following additional requirements. For Combined Cycle Trains, QSEs must provide Operational Parameter telemetry for the On-Line Combined Cycle Generation Resource (CCGR) for Resource Status, HSL, LSL, AS Resource Responsibility, etc. Telemetry for the underlying individual generation units (Combustion Turbines (CT) and Steam Turbines (ST)) that are registered to the Combined Cycle Train (CCT) is also required.

Only one of the CCGRs registered to the CCT may be On-Line at any time. The On-Line CCGR configuration is identified to ERCOT by the Combined Cycle Configuration Number telemetry. The SCED uses the Combined Cycle Configuration Number telemetry to select the Energy Offer Curve that has been submitted by the QSE for the designated Combined Cycle Generation Resource. The Resource Status telemetry must be one of the On-Line Resource Status codes as appropriate for use for the Generation Resource (e.g. ON, ONREG, etc). The QSE must calculate net real power and gross real power telemetry for the CCGR based on the aggregation of the net real power and gross real power for each of the individual generation units that are registered to the CCT and used in the CCGR configuration. An individual generation unit in the configuration can be Off-Line in that configuration; however, in doing so, the HSL must consider this generating unit as available for SCED dispatch. The net real power, gross real power, Breaker Status, and AVR Status telemetry data is specific to the individual CTs or STs. The CCGR net real power and gross real power must comply with the guidance in Appendix II, 5. Net Generation for a Generation Resource Definition. All other Telemetry data (Combined Cycle Configuration Number, DSR Schedule for eligible QSEs per Protocol Section 16.2.3.2, Emergency Ramp Rate, HEL, HSL, LEL, LSL, Normal Ramp rate, Resource Status and all of the AS Resource Responsibilities, Schedules and Participation Factors) is unique only to the CCGR configuration for each Combined Cycle Train.

The Combine Cycle Configuration Number and Resource Status telemetry should be updated at the appropriate time as determined by the QSE to reflect the transition of the CCT between CCGR configurations. If the QSE is bringing a CCT On-Line starting with no CT or ST On-line, the evolution in Section 3.1 applies to the start-up evolution. For transitions to a new configuration, the QSE is responsible for determining when its CCGR, CT and ST telemetry should be changed to report the new configuration as the CTs and/or STs associated with the from and to CCGRs become available for startup or shutdown. The LEL/LSL/HSL/HEL, Normal Ramp rate etc. for the to-CCGR configuration should be updated to show the “to CCGR” configuration’s operating limits; while the On-Line or Off-Line operating status of the CCT CTs or STs starting or stopping must telemeter the actual generation unit condition.

If the CCT has no CTs or STs On-Line, then the QSE should set the Resource Status telemetry to OFF or OUT depending on whether or not any of the CCGR configurations is available for commitment in ERCOT.

If a CCT CCGR configuration is providing Non-Spin Service from a unit in the CCGR that is Off-Line, the QSE must provide telemetry values that reflect the condition of the all the CCT generation units, and the CCGR assigned the Non-Spin Resource Responsibility for the CCGR. The Resource Status of OFFNS is not used if any part of the CCGR is On-Line. Resource Status should be set according to the operation of the remaining On-Line generation.

## Provisions for Wind-Powered Resources, PhotoVoltaic Resources, and IRRs Co-Located with Energy Storage Resources

WGRs and PVGRs are expected to follow the guidance provided above in Section 3.0 through 3.4 for startup, operations at power with/without AS Responsibilities, and shutdown. This section will reference WGR and PVGRs units as Intermittent Renewable Resources (IRRs).

### Telemetry Requirements

 IRRs must provide accurate site-specific meteorological telemetry data as required by Protocol section 4.2.2 (1), Wind-Powered Generation Resource Production Potential and 4.2.3 (1), PhotoVoltaic Generation Resource Production Potential, respectively. The required meteorological data for WGRs includes wind speed [mph], wind direction [degrees], barometric pressure [mbar] and temperature [ºC]. The required meteorological data for PVGRs includes the same data for WGRs with the addition of irradiance and back panel temperature. ERCOT uses this data for tuning wind generation forecasting, solar PV generation forecasting and other operational purposes.

The IRRs Resource Status telemetry data must indicate the appropriate current status for the unit (e.g. ON, ONOS, OFF, OUT, etc.). The IRRs net real power and gross real power telemetry must comply with the provisions of Protocol Section 6.5.5.2, Operational Data Requirements. The LSL telemetry IRRs may be set according to the facility’s operating conditions but is expected to be close to zero. The IRR generator breaker is that breaker connecting the high side of the IRR unit’s Generator Step-Up (GSU) transformer to the ERCOT Grid and if this output breaker is closed the IRR is On-Line. If the WGR Operator removes individual wind turbines from the collection system behind its GSU, whether for maintenance, outage or economic reasons, the contribution of the number of physical turbine/generators to the current net output capability of the WGR will change. Similarly, if the PVGR Operator removes individual inverter or panel groups from the collection system behind its GSU, whether for maintenance, outage or economic reasons, the contribution of the number of physical inverter/generators to the current net output capability of the PVGR will change.

Correspondingly, the WGR or PVGR’s HSL must comply with Protocol 6.5.5.2 (3):

“For each Intermittent Renewable Resource (IRR), the QSE shall set the HSL equal to the current net output capability of the facility. The net output capability should consider the net real power of the IRR generation equipment, IRR generation equipment availability, weather conditions, and whether the IRR net output is being affected by compliance with a SCED Dispatch Instruction.

Clarification of how to comply with this protocol during curtailment is detailed further in section 3.9.3.

In the Operating Hour, IRRs must also telemeter to ERCOT the unit’s normal up and down ramp rates. These ramp rates must comply with the provisions of Protocol Section 6.5.7.10, IRR Ramp Rate Limitations. The Normal Ramp Rate values are used in the calculation of the IRR’s SCED Up/Down Ramp Rates as described above in Section 3.2, Generation Resource Power Operations. The SCED Up/Down Ramp Rates are subsequently used, as described in Protocol section 6.5.7.2, Resource Limit Calculator, paragraphs (7) and (8), to set the IRR’s high and low dispatch limits for SCED.

### Telemetry Requirements Related to Wind Turbine and Solar Inverter Availability

Protocol Section 3.15(12) and (13) provides the following requirements:

“All WGRs must provide a Real-Time SCADA point that communicates to ERCOT the number of wind turbines that are available for real power and/or Reactive Power injection into the ERCOT Transmission Grid. WGRs must also provide two other Real-Time SCADA points that communicate to ERCOT the following:

(a) The number of wind turbines that are not able to communicate and whose status is unknown; and

(b) The number of wind turbines out of service and not available for operation.”

All PhotoVoltaic Generation Resources (PVGRs) must provide a Real-Time SCADA point that communicates to ERCOT the capacity of PhotoVoltaic (PV) equipment that is available for real power and/or Reactive Power injection into the ERCOT Transmission Grid. PVGRs must also provide two other Real-Time SCADA points that communicate to ERCOT the following:

(a) The capacity of PV equipment that is not able to communicate and whose status is unknown; and

(b) The capacity of PV equipment that is out of service and not available for operation.

ERCOT uses telemetered wind turbine and solar inverter availability when performing reactive studies as well as to ensure the most accurate meteorological and statistical models for wind/solar power forecasting. The following paragraphs describe the expectations regarding the following three telemetered turbine/inverter availability points:

1. Number of wind turbines/solar inverters *Available*
2. Number of wind turbines/solar inverters *Unavailable* (“out of service and not available for operation, independent of MW production”)
3. Number of wind turbines/solar inverters *Unknown* (“not able to communicate and whose status is unknown”)

The only instances that a wind turbine/solar inverter should be communicated as unavailable (offline) are when the IRR is conducting maintenance and/or during forced outages caused by meteorological phenomenon (icing, hurricane, etc.). If the unit is curtailed by ERCOT but is otherwise available, it should be communicated as *Available.*. When wind turbines are curtailed, their availability status should also be communicated as *Available* regardless if they are physically disconnected from the grid. If the unit must be disconnected from the grid to reach curtailed MW base point, the number of turbines online should still reflect these turbines. Specific examples are provided in the following table:

|  |  |
| --- | --- |
| **Situation: A Wind Turbine or Solar Inverter’s power production is reduced because of…** | **Expected Availability Status** |
| Maintenance or mechanical issues  | Unavailable |
| Curtailment | Available |
| Partial or complete high speed cut-out | Available |
| Partial or complete high/low temperature cut-out | Available |
| Turbine icing | Unavailable |
| Zero or near zero output  | Available |

It is expected that the *Unknown* availability status should only be used in the few and temporary occasions when there is a failure with the wind plant’s communication system. Finally, the sum of the telemetered number of turbines *Available*, *Unavailable* and *Unknown* should equal the total number of turbines identified in the RARF during the registration process.

### Telemetry Requirements Related to IRRs Co-Located with Energy Storage Resources

Energy Storage Resources and IRRs that are co-located should adhere to the following telemetry guidance:

1. Net Power Flow (NPF) for the modeled Energy Storage Resource Controllable Load Resource (ESR-CLR) shall reflect the response of the ESR-CLR to the ESR-CLR’s Base Point (BP). This may be different than the physical consumption of energy at the battery, specifically when the battery is self-charging from any co-located Resources.
2. The ESR-CLR will receive a BP based on the telemetered Maximum Power Consumption (MPC) and the bid to buy of the ESR-CLR. If the ESR-CLR’s MPC = “0” the ESR-CLR will get a “0” BP. If the telemetered MPC is less than the “true” MPC (i.e., the physical capability of the battery to consume energy), that difference is the quantity the battery is self-charging. It is the responsibility of the QSE to factor any self-charging into the MPC telemetry and COP submittals.
3. The PVGR/WGR HSL (net quantity) is a function of the self-charging of the battery. The PVGR/WGR HSL is decreased appropriately if there is anticipated or ongoing self-charging by the battery. It is the responsibility of the QSE to factor any self-charging into the HSL telemetry and COP submittals.
4. The Solar Forecast Vendor should provide the gross output expected from the PVGR based on the irradiance. The QSE shall adjust the PVGR HSL (net quantity) for the COPs HSL quantities and the telemetered HSL quantities as appropriate.
5. ERCOT requests that QSEs operating PVGR and WGR provide ERCOT with the telemetered Gross HSL, which represents MW production before netting any auxiliary load, co-located BTM load, and ESS self-charging where applicable.

### IRR Generator Power Operations and the SCED Base Point Below HDL Flag

With each SCED Base Point sent by ERCOT to the QSE over the ICCP data link, ERCOT also sends a curtailment flag (ON=TRUE=1; OFF=FALSE=0), hereafter referred to as the SCED Base Point Below HDL (SBBH), to indicate whether the SCED Base Point is less than the HDL that was used in the SCED calculation (refer to Protocol 6.5.7.4 (d), Base Points). ERCOT systems set the SBBH flag to TRUE when the SCED Base Point is below the IRR’s HDL used in SCED. While the SBBH flag is TRUE, the IRR is required to follow the SCED Base Point Dispatch Instructions. The SBBH flag also determines whether or not the Base Point Deviation Charges described in Protocol 6.6.5.2, IRR Generation Resource Base Point Deviation Charge, may apply in the current RT Settlement Interval. The SBBH flag condition, as determined during each SCED execution, is set to FALSE (i.e., 0) if the SCED Base Point does not meet the less than HDL condition.

As shown in the Figure 3.9.1, when a IRR is not being curtailed by SCED and it has not just been released from a curtailment, the telemetered HSL must be equal to the telemetered net power output.

Base Point [MW] Telemetered Net Power Output [MW]

Telemetered HSL [MW] Curtailment Flag [ON=1, OFF = 0]

7/5/2011 10:37:16 AM

7/5/2011 10:07:16 AM

30.00 minutes

0

5

10

15

20

25

30

Figure 3.9.1

On the other hand, as shown in Figure 3.9.2, when an IRR is being curtailed by SCED, the telemetered HSL remains equal to the current net output capability of the facility as defined in the Protocol. The current net output capability should correlate to the telemetered wind speed/irradiance. When an IRR is curtailed, since the HSL represents the current net output capability, it will no longer be equal to the telemetered net power output and the QSE should accomplish this transition smoothly with no abrupt changes.

Base Point [MW] Telemetered Net Power Output [MW] Telemetered HSL [MW] Curtailment Flag [ON=1, OFF = 0] Wind Speed [mph]

Curtailment Occurred

1. Smooth transition when Telemetered HSL and the net power output separate
2. Telemetered HSL correlates well with the telemetered wind speed/irradiance

Smooth Transition

Smooth Transition

6/29/2011 12:00:00 AM

6/28/2011 11:30:00 PM

30.00 minutes

0

5

10

15

20

25

29

Figure 3.9.2

Figure 3.9.3 shows the SCED intervals following a release from curtailment when the IRR is ramping back up under IRR Operator control. In this evolution the telemetered HSL should remain equal to the current net output capability. After the IRR Operator is no longer actively controlling the unit by limiting the IRR’s ramp rate and the IRR is fully recovered from its curtailed operations, the telemetered HSL and the net power output should become equal. This transition should occur smoothly and there should not be any abrupt changes in the telemetered HSL.

Base Point [MW] Telemetered Net Power Output [MW]

Telemetered HSL [MW] Curtailment Flag [ON=1, OFF = 0]

Smooth Transition

Curtailment Released

IRR operator is actively controlling the unit in order not to exceed the ramp rate limitation.

6/28/2011 1:50:00 AM

6/28/2011 1:20:00 AM

30.00 minutes

0

5

10

15

20

25

30

34

Figure 3.9.3

## Provisions for Quick Start Generation Resources Provided for Deployment by SCED

Nodal Protocol Section 2.1 defines a Quick Start Generation Resource (QSGR) as Generation Resource that can come On-Line from a cold start state within ten minutes of receiving a notice or instruction from ERCOT. Before engaging in the activities described in this section, a Generation Resource must be qualified by ERCOT as a QSGR in accordance with Protocol Section 8.1.1.2, General Capacity Testing Requirements, paragraph (15).

The decision to provide a QSGR for deployment by the SCED in the Operating Hour, in accordance with Protocol 3.8.3, is the responsibility of the QSE. To facilitate the deployment of QSGRs in the Operating Hour by SCED requires that QSE provide the following telemetry data to ERCOT:

* Resource Status “OFFQS”;
* Generator output breaker status “OPEN”;
* LSL = 0 prior to receiving a deployment instruction from SCED. After receiving a SCED deployment (i.e. a SCED Base Point > 0), the LSL telemetry values should comply with the guidance provided below in this Section;
* HSL = the QSE’s expected sustainable limit;
* AS Resource Regulation and Responsive reserve Responsibility equal 0 MW[[9]](#footnote-10); and,
* If the QSGR is assigned Non-Spin AS Resource Responsibility by the QSE, the Non-Spin AS Resource Responsibility telemetry value must equal the value reported in the COP for the current Operating Hour[[10]](#footnote-11) and the AS Non-Spin schedule telemetry value must equal zero to make the AS Non-Spin capacity available for SCED dispatch.

This telemetry set is necessary for SCED to recognize that the Resource can be dispatched for market purposes. The telemetry status of the QSGR output breaker shall be open (reflecting the physical state of the output breaker) such that the output of the Resource is 0 MW in order for the State Estimator to correctly assess the state of the system. Upon receipt of a non-zero Base Point from SCED, the QSE is expected to start and synchronize the QSGR with the ERCOT grid within 10 minutes of the receipt of the non-zero Base Point instruction and to ramp the QSGR to its physical LSL[[11]](#footnote-12).

The QSE must submit an Energy Offer Curve effective for the operating hour during which the QSGR is provided for deployment by SCED. The EOC must be non-decreasing and the first <MW, Price> pair must be <0 MW, Offer Price>. The QSGR must also have RARF entries set as follows:

* The QSGR Low Reasonability Limit (LRL) must equal 0 MW;
* The QSGR Resource Asset Registration Form must show Normal and Emergency Ramp Rate curves sufficient to allow the QSGR to ramp its ten-minute tested output from zero output in five minutes.

After being deployed for energy from SCED, the Resource shall telemeter an LSL equal to or less than the Resource’s actual output until the Resource has ramped to its physical LSL. After reaching its physical LSL, the QSGR shall telemeter an LSL that equals its physical LSL. Following a SCED QSGR deployment, the QSGR is expected to follow the SCED Base Points subject to the QSGR achieving its LSL net power output. If the QSGR is provided for deployment by SCED and is also assigned Non-Spin AS by the QSE the QSGR telemetry for Non-spin Ancillary Service Resource Responsibility must equal the amount of the assigned Non‑Spin AS and the Ancillary Service Schedule telemetry for Non-Spin must equal zero to make the QSGR capacity available for SCED. Once deployed by SCED, the QSE may, without prior ERCOT approval, decommit or shutdown the QSGR provided the QSGR is not committed by the RUC process in that Operating Period.

For purpose of determining whether SCED needs a QSGR to continue to generate, the QSE shall execute the process described in Protocols Section 3.8.3.1, Quick Start Generation Resource Decommitment Decision Process . Once the QSGR Output breaker is “OPEN”, the QSE must update the QSGR Resource Status telemetry. If time remains in the current Operating Hour and the QSGR has been decommitted or shutdown, the QSE may set the Resource Status:

* to “OFF” and set the LSL telemetry at the QSGR physical LSL, or
* to “OFFQS” and the LSL telemetry to 0 MW, if the QSE desires to continue to provide the QSGR for deployment by SCED in the Operating Hour.

If the QSGR is assigned Off-Line Non-Spin AS Responsibility and a Non-Spin Deployment Dispatch Instruction has **not** been received by the QSE, then the QSGR may be decommitted or shutdown and the QSGR placed in a Resource Status of either:

* “OFFNS” with LSL equal to the physical LSL and the Non-spin AS Responsibility and AS Schedule equal to the assigned Non-Spin AS, or
* to continue to provide the QSGR for SCED deployment, to “OFFQS,” with the LSL telemetry equal to 0 MW, the Non-Spin AS responsibility equal to the assigned Non-Spin amount and the Non-Spin AS Schedule equal to 0 MW.

If the QSE receives a Dispatch Instruction to deploy the Non-Spin AS Resource Responsibility assigned to a QSGR, the QSE is expected to comply with the Non-Spin Deployment Instruction whether or not the QSGR has been deployed by SCED in the Operating Hour during which the Non-Spin Deployment Instruction has been received. If not already accomplished, the QSE is expected to start and synchronize the QSGR and adjust its telemetry to be consistent with a Non-Spin deployment (i.e. Resource Status “ON,” AS Non-Spin Schedule at 0 MW, and LSL at the QSGR physical LSL). Following the receipt of a Non-Spin Deployment Instruction, the QSE must comply with the ERCOT Protocol requirements and procedures for the recall of Non-Spin AS. The ERCOT Non-Spin deployment and recall procedures are described in the TAC-approved ERCOT deployment and recall procedure. Following the completion of the Non-Spin deployment recall, the QSE may provide the QSGR for deployment by SCED in accordance with Protocol 3.8.3 or place the QSGR in an OFFNS Resource Status. The QSE is responsible for updating its COP for the COP reporting hours following the Operating Hour to properly reflect its current operating plan for its QSGR.

## Forced Outages and Derates in the Operating Period

If a Resource experiences a Forced Outage that trips a Resource Off-Line or a Forced Outage of Resource’s equipment that derates the Generation or Load Resource, the QSE must first verify that the telemetry of the Resource is correctly being provided to ERCOT showing the correct Off-Line or On-Line Resource Status of the Resource as well as the correct Generator breaker status. If the Resource goes Off-line and becomes unavailable as a result of the trip, the telemetered Resource Status should be set to OUT (OUTL for a Load Resource). Similarly, if the Resources goes Off-line but will be available for commitment, the telemetered Resources Status should be set to OFF. Finally, if the Resource remains On-Line, the Resource’s HEL, HSL, LSL and LEL and any AS Resource Responsibilities and Schedules must be updated as appropriate before the next SCED cycle in order to receive Base Points for the Resource that consider the altered condition of the Resource.

As soon as practicable following the loss of Resource HSL capability of more than 400 MW, the QSE operator should verbally discuss their situation with the ERCOT operator. Losses of Resources with capacity less than 400 MW should be verbally communicated to the ERCOT Operator within 15 minutes.

If the altered condition of the Resource is expected to extend into hours for which the Resource’s COP can still be updated, the QSE should make corresponding changes to the COP information. These changes should be made with one hour of the Forced Outage or Derate. The revised plan of operation for the Resource shall include any updates to the Resource’s Status, limits, and/or AS Resource Responsibilities.

## Provisions for Energy Storage Resources (ESRs)

An ESR is expected to have a maximum governor dead-band setting of 0.017 Hz. The frequency responsive capacity of an ESR is dependent on the mode of operation (charging/discharging) at the time of the frequency event, less any capacity reserved for FFR. Frequency responsive capacity utilizes the net output of the ESR along with the HSL and MPC telemetered by the resource. A non-co-located ESR’s HSL/MPC should reflect any physical limitations in real-time. Nodal Protocol Section 3.8.5 (3) does allow ESRs to update HSL/MPC based on SOC limitations. So, for example if an ESR is fully charged, it may reduce MPC to 0 or if an ESR has no SOC, it may reduce its HSL to 0.

* When discharging or idle
	+ For a low frequency event, the primary frequency responsive capacity is the real-time telemetered HSL of the ESR-GR less any FFR capacity.
		- For a high frequency event, the frequency responsive capacity is the real-time telemetered MPC of the ESR-CLR plus the ESR-GR injection MW.
* When charging
	+ - For a low frequency event, the frequency responsive capacity is the real-time telemetered HSL of the ESR-GR less any FFR capacity plus the ESR-CLR charging MW.
		- For a high frequency event, the frequency responsive capacity is the real-time telemetered MPC of the ESR-CLR.

Expected Primary Frequency Response (EPFR) is a function of the ESR-GR HSL and the frequency deviation from nominal regardless of if the ESR is charging, discharging or sitting idle for both low and high frequency events. As an example, if an ESR that was sitting idle and had a droop setting of 1% then for a 1% drop in frequency event to 59.4Hz the calculated EPFR would equal to ESR-HSL and the ESR would respond by providing MW from 0 to ESR-HSL. Additionally, for the same event and if the ESR was fully charging at MPC then EPFR again would be equal to ESR-HSL and the ESR would respond by reducing charging MW from MPC to 0. There may be instances where the available frequency responsive capacity is greater EPFR. During these instances, the EPFR will be capped to ESR-HSL. Note that PFR should not deploy capacity reserved for FFR unless the 59.85 Hz trigger frequency has been met.

ESRs are expected to follow a smooth ramp when moving from current Base Point to the next over a 5-min SCED interval. The ERCOT LFC system provides each ESR (both the ESR-GR and ESR-CLR) with an Updated Desired Base Point (UDBP) in the telemetry data set. The UDBP is a calculated MW value representing the expected MW output of a ESR ramping between successive SCED Base Points. The QSE is expected to control each of its ESRs to follow the UDBP and PFR expectation. Additionally, if the ESR is carrying Regulation AS Resource Responsibility, it must follow the QSE-assigned Regulation deployment in addition to the UDBP and EPFR. Note that if delta frequency is greater than 50 mHz and a resource is noted as ramping a direction that hurts frequency, ERCOT’s LFC may pause/freeze the UDBP at its current value until frequency recovers.

When providing Ancillary Service Responsibility telemetry in Real Time, QSEs representing ESRs must start by providing all up-AS Responsibilities (i.e. Regulation Up, Responsive Reserve Service (RRS), ERCOT Contingency Reserve Service (ECRS), Non-Spinning Reserve Service (Non-Spin)) first on the Generation Resource that represents the injection portion of the ESR (i.e. ESR-GR) up to the ESR’s HSL and any remaining up-AS Responsibility on the ESR can then be provided on the Controllable Load Resource (CLR) that represents charging of the ESR (ESR-CLR). Similarly, when providing Regulation Down, the QSEs representing an ESR must start by providing the Regulation Down Responsibility on the ESR-CLR up to the ESR’s MPC and any remaining Regulation Down Responsibility can then be carried on the ESR-GR. Additionally, when providing Regulation Responsibility, the ESR-GR and/or ESR-CLR that is telemetering the Regulation Responsibility must telemeter a valid Regulation Resource Status (ONREG, ONRGL, and ONFFRRRS) irrespective of Participation Factor. If the ESR-GR and/or ESR-CLR is not telemetering Regulation Responsibility but is providing a non-zero Participation Factor, then it must also be in a valid Regulation Resource Status. Transition of AS Responsibility across an ESR is possible but should be limited and must always meet the limitations of HSL and MPC. Please refer to the [EIP External Interface Specification](https://www.ercot.com/files/docs/2022/05/03/EIP-External-Interfaces-Specification-v1-25.zip) document which covers alarms and messages which are generated for different telemetry scenarios which can lead to unintended dispatch by SCED due to telemetry violations in RLC. Under this telemetry setup, QSEs are expected to dynamically change the Reg-Up Participation Factor and the Reg-Down Participation Factor as Reg-Up and Reg-Down are deployed to show how the ESR is providing AS energy on a percentage basis from each side. The examples below demonstrate these concepts.

Base Expectation for ESR AS Telemetry:



Example 1:

* ESR has an HSL/MPC = 100 and has an AS Responsibility for 50 MW of Regulation Up and 50 MW of Regulation Down.
* The ESR-GR has enough room to carry the Regulation AS Responsibility without any overflow to the ESR-CLR. The same can be said for the ESR-CLR which has enough room for the down responsibility.
* A HASL of 50 MW will be set on the ESR-GR while ESR-CLR will have a HASL set to 50 as well.
* Both ESR-GR and ESR-CLR should be in a valid Regulation Resource Status.



Example 2:

* ESR has an HSL/MPC = 100 and has an AS Responsibility for 50 MW of Regulation Up and 0 MW of Regulation Down.
* The ESR-GR has enough room to carry the Regulation AS Responsibility without any overflow to the ESR-CLR.
* A HASL of 50 MW will be set on the ESR-GR while ESR-CLR will have a HASL set to 100 MW.
* The ESR-GR will need to be in a valid Regulation Resource Status for the entire period it is carrying the responsibility. The ESR-CLR does not need to be in a Regulation Resource Status if its Participation Factor = 0.
* If there was a period where the ESR-CLR received a charging Base Point, then it may be providing some or all the Regulation Up and would be providing a non-zero Participation Factor. In this case the ESR-CLR would need to be in a valid Regulation Resource Status.



Example 3:

* ESR has an HSL/MPC = 100 and has an AS Responsibility for 125 MW of Regulation Up and 50 MW of Regulation Down.
* The ESR-GR can only carry 100 MW of Regulation Up. The remaining 25 MW must be carried on the ESR-CLR. There is no change to the Regulation Down from the last example.
* A HASL of 0 MW will be set on the ESR-GR while ESR-CLR HASL will be set to 50 MW and additionally a LASL will be set of 25 MW due to the Regulation Up Responsibility.
* Both ESR-GR and ESR-CLR should be in a valid Regulation Resource Status.
* 

Example 4:

* ESR-GR is providing 10 MW of Reg-Up Responsibility with a BP at 0 MW. Reg-Up Participation Factor (RUPF) is 1.0. ESR-CLR receives a BP to charge of 6 MW at t=0, and the ESR ramps to a Net MW value of -6 MW by t=5. [Point 1 in picture]
* Between t=0 and t=5, as the ESR moves toward its charging BP of -6MW, it shifts the RUPF to the ESR-CLR, so now the ESR-CLR has a RUPF of 1.0 and the ESR-GR has a RUPF of 0.
* At t = 5, Reg Up is deployed. RUPF-CLR is equal to 1, so the full deployment is expected to occur on the ESR-CLR and ESR-CLR’s net MW ramps back up in response to Reg Up deployment. [Point 2 in picture]
* Between t=5 and t=10, when the Reg Up deployment becomes greater than the ESR-CLR’s BP (6 MW), RUPF-GR becomes non-zero and the ESR-GR starts responding to the Reg Up deployment. [Point 3 in picture]
* Note that sum of RUPF-GR and RUPF-CLR consistently add up to the ESR’s expected total RUPF. In this example, the ESR’s total RUPF is 1.0, indicating it is the only Resource in the QSE’s portfolio carrying Regulation-Up, but this value may be less than 1.0 when a QSE has multiple Resources carrying Regulation-Up. [Point 4 in picture]. Note that the QSE total RUPF must always equal 1.0.
* The ESR-CLR RUPF is expected to be set dynamically such that the RUPF\*Reg Up Deployed is never greater than the BP-CLR. Also note that Reg Up Responsibility remains on the GR for the entire interval and never transfers to the CLR [Point 5 in picture]. All of this behavior could be mirrored for Reg Down Responsibility.
* Both ESR-GR and ESR-CLR should be in a valid Regulation Resource Status throughout this example.



To improve the situational awareness of the ERCOT System Operators, the ESRs are required to provide the next Operating Hour’s Ancillary Service Responsibilities for Regulation-Up, Regulation-Down, RRS-PPR, RRS-FFR, ECRS and Non-Spin for both the ESR-GR and ESR-CLR to ERCOT via ICCP.

ESRs are required to provide Real Time state of charge (SOC), maximum operating state of charge (MXOS), minimum operating state of charge (MNOS), Maximum Operating Discharge Power Limit (MXDP) and Maximum Operating Charge Power Limit (MXCP) telemetry information to ERCOT via ICCP.

* Maximum Operating State of Charge (MXOS) telemetry represents the maximum amount of stored energy capability in MWh that can be delivered at the POI and cannot be exceeded. For example, if the ESR currently has the capability of storing a maximum of 10 MWh and the discharge efficiency is 0.94, then this telemetered value (SOC\_Max) = 0.94\*10=9.4 MWh.
* State of Charge (SOC) telemetry represents the amount of energy in MWh that can be delivered to the POI. For example, if the ESR is currently storing 6 MWh and the discharge efficiency is 0.94, then this telemetered value (SOC) = 0.94\*6=5.64 MWh
* Minimum Operating State of Charge (MNOS) telemetry represents the required minimum amount of stored energy in MWh that can be delivered at the POI and cannot be go below. For example, if the ESR is required to store a minimum of 2 MWh and the discharge efficiency is 0.94, then this telemetered value (SOC\_Min) = 0.94\*2=1.88 MWh
* Maximum Operating Discharge Power Limit (MXDP) telemetry represents the true inverter discharge capability in MW. This point should account for derates for operational issues. Ideally this would be close to ESR-GR HSL. For example, if a +/-10 MW ESR is telemetering an HSL of 3 MW for the ESR-GR, the MXDP should be +10 MW unless there is a derate for operational reason.
* Maximum Operating Charge Power Limit (MXCP) telemetry represents the true inverter charging capability in MW. This point should account for derates for operational issues, but ideally this would be close to ESR-CLR MPC. For example, a +/-10 MW ESR is telemetering a MPC of 3 MW for the ESR-CLR, the MXCP should be +10 MW unless there is a derate for operational reason.

ERCOT uses this telemetered state of charge related information to gain situational awareness about the capabilities of ESRs and to accurately account for frequency responsive headroom from ESRs in ERCOT’s Physical Responsive Capability. It is important that this information is accurately telemetered to ERCOT and follows the scan rate granularity specified in the ICCP Handbook. The actual SOC telemetry is expected to smoothly increase as the ESR charges and smoothly decrease as the ESR discharges. SOC is expected to be greater than or equal to MNOS and less than or equal to MXOS (MNOS <= SOC <= MXOS).

An ESR that is carrying Ancillary Service Responsibilities must be capable of providing the carried AS per the duration requirement of the AS. Per Nodal Protocol Section 6.5.5.2, Operational Data Requirements, paragraph (14) and Section 6.5.7.2, Resource Limits Calculator, ERCOT will calculate the SOC an ESR has available for an injection or withdrawal Base Point and include it in the ESR’s HASL. Please review the previously mentioned Nodal Protocol sections for the specified calculations.



Figure 3.13.1

Figure 3.13.1 shows an example of an ESR carrying 60 MW of up AS on the GR with an HSL of 100 MW for three consecutive hours. This example is for illustration purposes only and is not to be interpreted as ERCOT’s expectation of SOC management behavior. In this example, the ESR may not be able to provide the full Ancillary Service obligation if deployed in the beginning of Hour 1 and Hour 2. The Discharging SOC Required (red line) represents the SOC required in order to provide the Ancillary Service Responsibility. In Hour 1, The ESRs SOC (green line) is less than the Discharging SOC Requirement. This causes the GR HASL (orange line) to be reduced until the SOC exceeds the SOC Requirement, restricting SCED from dispatching the ESR discharging Base Points. Once the SOC is greater than the SOC Requirement, HASL is increased to its nominal value of 40 MW (HASL = HSL – Up AS Resp.). Following the same logic, HASL is again reduced in Hour 2. However, near the end of Hour 2, the ESR charges, increasing the SOC to be greater than the SOC Requirement for the beginning of Hour 3. Throughout Hour 3, SOC remains above the SOC Requirement, therefore the HASL is never reduced below 40 MW.

Figure 3.13.2

Figure 3.13.2 shows an example of an ESR carrying 60 MW of Reg Down on the CLR with an MPC of 100 MW and MXOS of 100 MWh, for three consecutive hours. This example is for illustration purposes only and is not to be interpreted as ERCOT’s recommended SOC management behavior. In this example, the ESR may not be able to provide the full Ancillary Service obligation if deployed in the beginning of Hour 1. The Charging SOC Required (red line) represents the SOC charging room required to provide the Ancillary Service Responsibility. Entering Hour 1, the ESR has an SOC (green line) greater than the Charging SOC Requirement. The CLR-HASL (orange line) is reduced to zero until the SOC is less than the Charging SOC Requirement, preventing SCED from dispatching a charging Base Point in order to leave sufficient charging room to provide Reg Down. Near the end of Hour 1, the ESR discharges such that the SOC is less than the Charging SOC Required entering Hour 2. Since the ESR has sufficient charging room to provide Reg Down, the HASL is not reduced and remains at its nominal value of 40 MW (HASL = MPC – Down AS Resp.) in Hour 2 and Hour 3.

When carrying up AS (i.e., Reg-Up, RRS, ECRS, Non-Spin), ESRs are expected to be capable of providing the total responsibility being carried. If the ESR does not have sufficient SOC for the AS it is providing, the excess responsibility may be moved to another ESR or other Resource type subject to requirements specified in Nodal Protocol Section 4.4.7.3, Ancillary Service Trades (ex. RRS-PFR may be moved from ESR-Gen to Generation Resource or Controllable Load Resource; RRS-PFR cannot be moved to a Non-Controllable Load Resource etc.).

## Provisions for Split Generation Resources

Protocols allow each SGR to be represented by a different QSE; however, the Resource Entities that own or control the SGR from a single Generation Resource must designate a Master QSE. The Master QSE serves as the single point of contact for purposes of outage coordination, provides Real Time telemetry and is the recipient of Verbal dispatch Instructions issued by ERCOT Operations.

The QSE representing each SGR and the Master QSE must provide ERCOT with telemetry in accordance with Protocol 6.5.5.2, Operational Data Requirements, (refer to Section 4, SGR Telemetry Requirements, in the ERCOT Business Practice “Split Generation Resources in the ERCOT Market and Operations Systems” for additional details). It is the responsibility of the QSEs representing each SGR to coordinate among themselves to assure consistency of the telemetry among all of the QSE’s Split Generation Resource’s telemetry and the physical Generation Resource telemetry. For example, if an individual SGR telemeters an online Resource Status, then all SGRs for the generating facility must telemeter an On-Line Resource Status.

The SGR resource parameter telemetry provided by the QSEs that represent SGRs for the same Generation Resource must be mutually consistent and representative of the physical characteristics of the shared Generation Resource. For example, the capacity limits and ramp rates submitted for individual SGRs must be consistent with and reflect the physical capabilities of the generating facility. It is the responsibility of the QSE representing each SGR to assure the consistency of the parameters provided to ERCOT in the COP and by Real Time telemetry. Although submitted separately by each SGR’s QSE, startup and shutdown times, time limits for changes in Resource Status and the number of starts must be identical for all SGRs for the same physical generating facility. It is the responsibility of the QSE representing each SGR to assure at all times the consistency of these parameters as provided to ERCOT via the RARF and updated using the Resource Parameter Update application of the Market Manager.

Energy and AS may be offered separately by each individual SGR in all ERCOT Markets. Each SGR offer is treated as a separate offer, except that all SGRs in a single physical Generation Resource must be committed or de-committed together by the DAM and RUC. QSEs with SGRs shall coordinate the dispatch of the SGR physical Generation Resource according to the ERCOT Dispatch Instructions provided to each SGR (including SCED Base Points and other resource specific Dispatch and Commitment Instructions).

SGR Owners are jointly responsible for assuring the delivery of a consistent parameter set to ERCOT at all times during the Operating Hour. This includes, but is not limited to the following requirements and QSE responsibilities:

* SGR Owners must telemeter a net power output value in MW that represents the SGR’s instantaneous MW share of the total net power output from the physical Generation Resource. The ERCOT EMS system compares the SGR aggregated net power output telemetry to the net power output telemetry for the physical Generation Resource as provided by the Master QSE;
* SGR Owners are responsible for coordinating SGR AS capacity and energy deployments by the physical Generation Resource;
* SGR Owners are also responsible for jointly controlling the update of Resource Parameters used in the ERCOT commercial systems. These parameters are updated by use of the Resource Parameter Update application on the MIS Market Manager. The ERCOT Market Manager User Interface allows each SGR owner the ability to update resource parameters for its SGR independent of the other SGR owners. QSEs representing each SGR must coordinate parameter updates to assure the consistency of parameters with the physical Generation Resource. For example:
	+ In the case of the SGR up and down ramp rates, each SGR owner is expected to enter its allocation of the physical Generation Resource’s ramp rate. It is the responsibility of the SGR Owners to assure that the aggregated SGR ramp rates are equal to or less than the physical Generation Resource ramp rates; and
	+ SGR Owners must assure that each SGR’s temporal constraint parameters stored in the Resource Parameter Update system always equal the physical Generation Resource’s temporal constraints limits at all times.

## Provisions for Load Resources

Load Resources must provide telemetry similarly to that provided by Generation Resources. Specifically Load Resources must provide:

* 1. Load Resource net real power consumption (in MW);
	2. Any data mutually agreed to by ERCOT and the QSE to adequately manage

System reliability;

* 1. Load Resource breaker status;
	2. LPC (in MW)[[12]](#footnote-13);
	3. MPC (in MW)[[13]](#footnote-14);
	4. Ancillary Service Schedule (in MW) for each quantity of RRS and Non-Spin;
	5. Ancillary Service Resource Responsibility (in MW) for each quantity of Reg-Up and Reg-Down for Controllable Load Resources, and RRS and Non-Spin for all Load Resources;
	6. The status of the high-set under-frequency relay, if required for qualification;
	7. For a Controllable Load Resource, the Scheduled Power Consumption (SPC) that represents zero Ancillary Service deployments;
	8. For a Controllable Load Resource, net Reactive Power (in MVAr);
	9. Resource Status (Resource Status shall be “ONRL” if high-set under frequency relay is active); and
	10. Reg-Up and Reg-Down services participation factor that represents how a QSE is planning to deploy the Ancillary Service energy on a percentage basis to specific qualified Resource.

MPC is the Maximum Power Consumption and used the same as HSL. Similarly, LPC is the Minimum Power Consumption and used the same as LSL.

A single Load Resource may simultaneously provide both RRS and Non-Spin provided the Load Resource is so qualified. ERCOT deploys RRS and Non-Spin in separate unrelated dispatch instructions requiring the QSE to establish the AS Schedule appropriately for each. That portion on non-controllable Load Resources providing RRS must also automatically be deployed by relay action. Load Resources or that portion of a Load Resource providing Non-Spin AS must not be subject to a UFR that will trip during a frequency excursion.

**Appendix I, EMS System-Generated Notices**

**Selected Excerpts from MIS Business Requirements for Notices, Notifications, Alarms and Alerts Version 1.0 Applicable to RT Telemetry**

Because EMS has no market facing user interface, ERCOT is required to display these notices on MIS. In addition to the protocol-required notices, the EMS team identified several other notices that would help eliminate errors in input data to ERCOT applications. The following table identifies the description of the requirement, protocol reference for the requirement, notice type, priority, audience and text.

The priority is determined by whether the MP needs to take action in response to the notice. If it’s informational only, the notice priority would be lower.

| **#** | **Description** | **Source of Req** | **Owner** | **Type** | **Priority** | **Audience** | **Text** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | The telemetered HSL <= 0 | EMSNP3.10.7.5.2 (5) | Sys. Ops. | Telemetry | High | A QSE | Tel HSL is ≤ 0. Error for resource QSE. |
| 2 | The telemetered LSL < 0 | EMSNP3.10.7.5.2 (5) | Sys. Ops. | Telemetry | High | A QSE | Tel LSL ≤ 0. Error for resource, QSE. |
| 3 | The Ancillary Responsibilities (Reg-Up, Reg-Down, Responsive and Non-Spin) < 0 | EMSNP3.10.7.5.2 (5) | Sys. Ops. | Telemetry | High | A QSE | Tel Reg-Up AS Resource Responsibility is < 0. Error for resource, QSE.Tel Reg-Down AS Resource Responsibility is < 0. Error for resource, QSE.Tel Responsive AS Resource Responsibility is < 0. Error for resource, QSE. Tel Non-Spin AS Resource Responsibility is < 0. Error for resource, QSE. |
| 4 | The Ancillary Schedules (Responsive and Non-Spin) < 0 | EMSNP3.10.7.5.2 (5) | Sys. Ops. | Telemetry | High | A QSE | Tel Responsive AS Schedule is < 0 for resource, QSE.Tel Non-Spin AS Schedule is < 0 for resource, QSE. |
| 5 | HSL -LSL < AS Responsibilities | EMSNP3.10.7.5.2 (5) | Sys. Ops. | Telemetry | High | A QSE | Tel HSL - LSL is < sum of AS Responsibilities for resource, QSE.  |
| 6 | SCED Up Ramp Rate <= 0 | EMSNP3.10.7.5.2 (5) | Sys. Ops. | Telemetry | High | A QSE | Calculated SCED Up Ramp Rate is ≤ 0 for resource, QSE. Check Regulation AS Resource Responsibility |
| 7 | SCED Down Ramp Rate <= 0 | EMSNP3.10.7.5.2 (5) | Sys. Ops. | Telemetry | High | A QSE | Calculated SCED Down Ramp Rate is ≤ 0 for resource, QSE. Check Regulation AS Resource Responsibility.  |
| 8 | Quality checks for use of telemetry; use last good value if suspect. – MQC 3989 | EMSNP3.10.7.5.2 (5) | Sys. Ops. | Telemetry | High | A QSE | Tel Parameter, Ex. Resource Status Value Bad is suspect. ERCOT is using Value Good for resource, QSE. |
| 9 | For Combined Cycle configuration number validation, set it to default or last good value not 0, whichever is easier and also make HDL = LDL = Current MW | EMSNP3.10.7.5.2 (5) | Sys. Ops. | Telemetry | High | A QSE | Tel Parameter, Ex. Resource Status Value Bad is suspect. ERCOT is using Value Good for resource, QSE. |
| 10 | Set HSL = LSL = MW, in case of invalid telemetry – MQC 3990 | EMSNP3.10.7.5.2 (5) | Sys. Ops. | Telemetry | High | A QSE | Tel HSL or LSL is invalid. ERCOT is setting HSL=LSL=MW for resource, QSE. |
| 11 | Report the resources that are excluded from GTBD calculation due to invalid telemetered resource status code (NA, ONTEST, OUT, OFFNS, OFF, EMR). | EMSNP3.10.7.5.2 (5) | Sys. Ops. | Telemetry | High | A QSE | Tel resource status code Value Bad is invalid for resource, QSE. MW will be excluded from GTBD. |
| 12 | Add a SCADA calculation to sum the MW telemetry of transmission lines moving power from a generating plant.  Compare this total to the sum of the telemetered MW output of the Resources at the same plant.  Alarm the QSE if the amount exceeds a threshold. | NP3.10.7.5.2 (5) | Sys. Ops. | Telemetry | High | A QSE | Telemetry of Net MW Error for resource, QSE. Mismatch with Transmission Measurements |
| 13 | If the HDL = LDL = Actual Generation and Resource Status not ON TEST, or OFF alarm the QSE operator to verify data telemetry used by RLC. | NP3.10.7.5.2 (5) | Sys. Ops. | Telemetry | High | A QSE | HDL=LDL=MW for resource, QSE. Resource is not in test mode.  |
| 14 | If Resource Status is OFF, and Resource output MW is greater than 2 MW, then alarm incorrect status. | NP6.3.4 | Sys. Ops. | Telemetry | High | A QSE | Tel Resource Status is Resource Status and MW > MW Threshold for resource, QSE.  |
| 15 | If Resource Status is ON, and Resource output MW is zero or less than zero, then alarm incorrect status. | NP6.3.4 | Sys. Ops. | Telemetry | High | A QSE | Tel Resource Status is Resource Status and Tel MW ≤0 for resource, QSE.  |
| 16 | ERCOT shall notify each QSE representing the Split Generation Resource of any errors in telemetry detected by the State Estimator.  | NP3.10.7.5.2(2) | Sys. Ops. | Telemetry | High | A QSE | Sum of Tel SGL MW in SE Value and GS sum value = GS Value error. |
| 17 | ERCOT System, Weather Zone, and Load Zone Load forecasts for the next seven days, by hour, and a message on update indicating any changes to the forecasts by means of the Messaging System;  | NP4.2.3(d) | Sys. Ops. | Market Message | Low | All MPs | ERCOT 7-day LF updated Time. |
| 18 | Once transmission line and transformer Dynamic Ratings are retrieved, ERCOT shall compare the actual flow and state estimated flow calculation of MVA to the effective Transmission Element limit and, if an out-of-limit condition exists, ERCOT shall produce an overload notification | NP6.5.7.1.8 | Sys. Ops. | Telemetry | High | A TSP | Change in active constraints found. |
| 19 | The Reg-Up/Reg-Down Participation Factors < 0 | EMS | Sys. Ops. | Telemetry | High | QSE | Tel Reg-Up participation factor is < 0 for resource, QSETel Reg-Down participation factor is < 0 for resource, QSE. |
| 20 | Telemetered SoC > Telemetered Maximum SoC (MXOS) or Telemetered SoC < Telemetered Minimum SoC(MNOS) | EMS | Sys.Ops. | Telemetry | High | QSE | Tel SoC > MXOS for resource, QSE Tel SoC < MNOS for resource, QSE |

1. Note: The Nodal Market implementation does not include a payment to a Generation Resource forced off as the result of a Forced Transmission Outage. [↑](#footnote-ref-2)
2. The ICCP Handbook uses the term Net Power Flow to refer to the Protocol term net real power. [↑](#footnote-ref-3)
3. LDL may not be less than LSL (LASL if the Resource is assigned Reg-Dn), and HDL may not exceed HSL (HASL if the Resource is assigned RRS, Reg-Up or On-Line Non-Spin). These rules hold true for periods in which the Resource is operating between the Resource’s LASL and HASL. [↑](#footnote-ref-4)
4. If the Generation Resource is being shutdown and will provide Off-Line Non-Spin following the shutdown, any Non-Spin AS Resource responsibility equal to the amount of Off-Line Non-Spin AS Resource Responsibility to be assigned upon shutdown does not need to be moved to another resource. [↑](#footnote-ref-5)
5. Like means replacing a Generation Resource or Controllable Load Resource with another Generation Resource or Controllable Load Resource and a Load Resource with another Load Resource which is not a Controllable Load Resource. [↑](#footnote-ref-6)
6. See Footnote 5 [↑](#footnote-ref-7)
7. High level overview for implementation details on FFR as it relates to ERCOT systems setup can be found at [this link](https://www.ercot.com/calendar/event?id=1658240344448). [↑](#footnote-ref-8)
8. Note that Per Nodal Protocol Section 6.5.7.6.1 LFC Process Description Paragraph (9) if system frequency deviation is greater than an established threshold a LFC may update a Resource’s UDBP to temporarily suspend ramping if its Base Point is directionally opposite ACE. Resources when operating above Low Sustained Limit (LSL) are expected to follow this Dispatch Instruction. [↑](#footnote-ref-9)
9. A QSGR provided for deployment by SCED may not also provide Regulation or Responsive Reserve AS in the same Operating Hour. [↑](#footnote-ref-10)
10. Similar to other Generation Resources, a QSGR that is not provided to SCED for deployment in an Operating Hour may be assigned Off-Line Non-Spin AS by the QSE. In this event the QSGR Resource Status telemetry for the QSGR qualified Resource must be “OFFNS”. [↑](#footnote-ref-11)
11. The value of the physical LSL shall be the QSE’s expected low sustainable limit in the Operating Hour. [↑](#footnote-ref-12)
12. Low Sustained Limit (LSL) for a Load Resource is ”The limit calculated by ERCOT, using the QSE-established Low Power Consumption (LPC)” [↑](#footnote-ref-13)
13. High Sustained Limit (HSL) for a Load Resource is “The limit calculated by ERCOT, using the QSE-established Maximum Power Consumption (MPC)”. [↑](#footnote-ref-14)