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| Key Topic Concept (KTC) Number | 4 | KTC Title | Technical Requirements |
| Date Posted | October 22, 2019 |
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| Executive Summary | This KTC recommends technical requirements for Energy Storage Resources (ESRs). |
| Recommendation Description | This KTC recommends requirements for ESR reactive capability, Voltage Support Service (VSS), Voltage Ride-Through (VRT), Frequency Ride-Through (FRT), and Governor Deadband and Droop Settings. |
| BESTF Discussion  | On 10/18/19, ERCOT staff presented materials with proposed technical requirements (Reactive Capability, VSS, VRT, FRT, and Governor Deadband and Droop Setting Requirements) for ESRs.  |
| TAC Action Requested | None. |
| TAC Action Summary |   |

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| Proposed KTC Recommendation Language |

# *Key Topic/Concept recommendation Language for TAC ENDORSEMENT*

None

# *Key Topic/Concept recommendation Language Previously endorsed by tac*

None

# *Key Topic/Concept recommendation Language IN DISCUSSION AT BESTF*

1. All Generation Resources and ESRs (including self-serve generating units) that have a gross generating unit rating greater than 20 MVA or those units connected at the same Point of Interconnection (POI) that have gross generating unit ratings aggregating to greater than 20 MVA, that supply power to the ERCOT Transmission Grid, shall provide VSS.
2. ESRs must have sufficient reactive capability to provide 0.95 power factor leading and lagging relative to the maximum net real power deliverable to the POI at all MW levels from Pmax (max discharge level) to –Pmax (max charging level).
3. Each Resource Entity (RE) shall conduct Reactive capability tests on each of its ESRs to demonstrate their capability while both charging and discharging.
	1. Lagging Test 1:
		1. Lagging Test 1a: at ≥ 95% of the unit’s maximum discharging capability for at least 15 minutes.
		2. Lagging Test 1b: at ≥ 95% of the unit’s maximum charging capability for at least 15 minutes.
	2. Leading Test 1:
		1. Leading Test 1a: at ≥ 95% of the unit’s maximum discharging capability for at least 15 minutes.
		2. Leading Test 1b: at ≥95% of the unit’s maximum charging capability for at least 15 minutes.

Testing acceptance criteria is met if the unit achieved no less than 90% of the unit’s most recent CURL.

* 1. Lagging Test 2:

 Test with all inverters on-line for at least one hour. Testing acceptance criteria is met if the unit achieved at least 50% of its CURL for 1 hour.

1. Same VRT and FRT minimum performance requirements as currently apply to Intermittent Renewable Resources shall apply to inverter based ESRs when both charging and discharging.
2. ESRs shall not, during and following a transient voltage disturbance, cease providing real or reactive power except to the extent needed to provide frequency support or aid in voltage recovery. ESRs, when consuming active power (when operating at the charging mode), shall reduce or cease power consumption to aid in voltage recovery during and following a transient voltage disturbance.
3. FRT and VRT requirements for inverter based ESRs are the minimum performance requirements, protection settings should be based physical limitations of the IBR, and not FRT or VRT profile.
4. All On-Line ESRs should have Governors in service with deadband not to exceed 17 mHz, and droop setting not to exceed 5%, both while charging or discharging, and provide PFR, if they have headroom available to increase or decrease their production or consumption.
	1. Each RE shall conduct applicable Governor tests on each of its ESRs to demonstrate their capability while both charging and discharging.

Comments of Texas Advanced Energy Business Alliance (TAEBA)

TAEBA requests that ERCOT use IEEE 1547-2018 and IEEE P2800, the transmission interconnection standard currently in development, to define governor / primary frequency response, at least for inverter-based assets (slide 10 of KTC-4 deck). We question the need to create separate, ERCOT-specific governor / primary frequency response standards when IEEE already defines required generation/storage capability and provides the test standard for these assets in its standards, which are used across North America.

**IEEE P2800: Standard for Interconnection and Interoperability of Inverter-Based Resources Interconnecting with Associated Transmission Electric Power Systems**

Description: This standard establishes the recommended interconnection capability and performance criteria for inverter-based resources interconnected with transmission and networked sub-transmission systems. Included in this standard are recommendations on performance for reliable integration of inverter-based resources into the bulk power system, including, but not limited to, voltage and frequency ride-through, active power control, reactive power control, dynamic active power support under abnormal frequency conditions, dynamic voltage support under abnormal voltage conditions, power quality, negative sequence current injection, and system protection.

**IEEE 1547-2018:  IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces**

Description: The technical specifications for, and testing of, the interconnection and interoperability between utility electric power systems (EPSs) and distributed energy resources (DERs) are the focus of this standard. It provides requirements relevant to the performance, operation, testing, safety considerations, and maintenance of the interconnection. It also includes general requirements, response to abnormal conditions, power quality, islanding, and test specifications and requirements for design, production, installation evaluation, commissioning, and periodic tests. The stated requirements are universally needed for interconnection of DER, including synchronous machines, induction machines, or power inverters/converters and will be sufficient for most installations. The criteria and requirements are applicable to all DER technologies interconnected to EPSs at typical primary and/or secondary distribution voltages. Installation of DER on radial primary and secondary distribution systems is the main emphasis of this document, although installation of DERs on primary and secondary network distribution systems is considered. This standard is written considering that the DER is a 60 Hz source.

# *Future Decision Points and Issues for Developing Key topic/Concept recommendation Language*

None.

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| Applicable Protocol Section(s) |  |
| Impacted System(s) / Application(s) |  |