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| Key Topic Concept (KTC) Number | 4 | KTC Title | Technical Requirements |
| Date Posted | November 5, 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.On 11/4/19, the BESTF reached consensus on KTC 4 after making a few minor edits to the section describing the Reactive capability tests. |
| TAC Action Requested | BESTF plans to request at the 11/20/19 TAC meeting a vote to approve KTC 4. |
| TAC Action Summary |   |

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| Proposed KTC Recommendation Language |

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

11/20/19 TAC Meeting (Consensus from 11/4/19 BEST meeting):

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 or entire duration if less than 15 minutes.
		2. Lagging Test 1b: at ≥ 95% of the unit’s maximum charging capability for at least 15 minutes or entire duration if less than 15 minutes.
	2. Leading Test 1:
		1. Leading Test 1a: at ≥ 95% of the unit’s maximum discharging capability for at least 15 minutes or entire duration if less than 15 minutes.
		2. Leading Test 1b: at ≥95% of the unit’s maximum charging capability for at least 15 minutes or entire duration if less than 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.

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

None.

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

None.

# *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) |  |