



IEEE 2800 vs Existing ERCOT Interconnection Requirements, Gap Analysis Learnings

ERCOT

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ERCOT Adoption of IEEE 2800 Objective, Approach, and Timeline

Objective

Inform strategic ERCOT decision on IEEE 2800 adoption method:

- General reference ('wholesale adoption')
- Detailed reference ('piecemeal adoption – per reference')
- Full specification ('piecemeal adoption – own language')

Tentative Timeline by Priority

Wholesale or High: Sept – Q1 2023

Medium: Q1 2023 – Q4 2023

Low: 2024

Approach

1) EPRI gap analysis

- High-level gap analysis: identify where ERCOT has no requirements, but IEEE 2800 does
- Detailed gap analysis: identify where ERCOT and IEEE 2800 both specify requirements and

Where IEEE 2800 are more specific or more stringent than ERCOT requirements (“<”)

- Where ERCOT requirements and IEEE 2800 already align in stringency and level of specificity (“~”)

Where ERCOT requirements exceed IEEE 2800 either in stringency or specificity (“>”)

2) Stakeholder discussion in ERCOT’s Inverter-Based Resources Task Force (IBRTF) (<https://www.ercot.com/committees/ros/ibrtf>)

ERCOT Stakeholder rules

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1. ERCOT Nodal Protocols (NPs) – applicable Sections available at <https://www.ercot.com/mktrules/nprotocols/current> and published on or prior to February 11, 2022.
–*The [Nodal] Protocols outline the procedures and processes used by ERCOT and Market Participants for the orderly functioning of the ERCOT system and nodal market.*
2. Nodal Operating Guides (NOGs) – applicable Sections available at <https://www.ercot.com/mktrules/guides/noperating/current> and published on or prior to March 1, 2022
–*The Nodal Operating Guides, which supplement the Protocols, describe the working relationship between ERCOT and the entities within the ERCOT Region that interact with ERCOT on a minute-to-minute basis to ensure the reliability and security of the ERCOT System.*
3. Planning Guide (PG) – applicable Sections available at <https://www.ercot.com/mktrules/guides/planning/current> and published on or prior to January 1, 2022
–*The Planning Guide, which supplements the ERCOT protocols, provides ERCOT stakeholders and market participants with information and documentation concerning the ERCOT transmission planning process.*
4. Model Quality Guide (MQG) – applicable Sections available at <https://www.ercot.com/services/rq/integration> and published on or prior to April 20, 2021
–*Assists REs/IEs submit stability models per Planning Guide Section 6.2, including the new Model Quality Testing requirements. Also includes the UDM Model Guideline and PSCAD Model Guideline.*

IEEE 2800-2022

- IEEE P2800 Draft 6.3 (December 2021)
- *Remarks on ERCOT documents:*
- Both NPs and NOGs are mandatory.
- NPs are broad in scope and tend to high level.
- NOGs tend to be narrower in scope and provide guidance on more practical/operational aspects.
- The language in NPs and NOGs should not be in conflict; if it is in conflict, it should be pointed out as a finding.
- Some requirements only apply to resources providing ancillary services (AS); this would be explicitly stated, or it is obvious from the Section of the NPs.
 - For example, where an entire section is on Responsive Reserve (RRS) qualification or performance.

Thirteen (13) high-level gaps in ERCOT relate to 2800 mandatory requirements

Preliminary High-Level Gap Assessment of ERCOT Nodal Protocols

Legend: X Prohibited, v Allowed by Mutual Agreement, ‡ Capability Required, NR Not Required
(‡) Procedural Step Required as specified, Δ Test and Verification Defined, **!!! Important Gap**

Function Set	Advanced Functions Capability	ERCOT Nodal Protocols	IEEE 2800-2022
Sec 4 General	Definitions	?	?
	Reference Point of Applicability	POI	POM
	Adjustability in Ranges of Available Settings	NR (!!!)	‡
	Prioritization of Functions	‡	‡
Sec 11 Monitoring, Control, and Scheduling	Ramp Rate Control		
	Communication Interface	‡	‡
	Disable Permit Service (Remote Shut-Off, Remote Disconnect/Reconnect)	‡	‡
	Limit Active Power	‡	‡
	Monitor Key Data	‡	‡
	Remote Configurability		v
	Set Active Power	‡	v
	Scheduling Power Values	‡	v
Sec 5 Reactive Power & (Dynamic) Voltage Support	Constant Power Factor	‡	‡
	Voltage-Reactive Power (Volt-Var)	‡	‡
	Autonomously Adjustable Voltage Reference	?	
	1 Capability at zero active power ("VArS at night")	NR (!!!)	‡
	Active Power-Reactive Power (Watt-Var)		
	Constant Reactive Power	NR (!!!)	‡
	Voltage-Active Power (Volt-Watt)	NR	NR
2	Dynamic Voltage Support /	Balanced	‡
	Current Injection during VRT	Unbalanced	NR (!!!)

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Function Set	Advanced Functions Capability	ERCOT Nodal Protoc.	IEEE 2800-2022
Sec 6&7 Bulk System Reliability & Frequency Support	3 Frequency Ride-Through (FRT)	‡	‡
	Rate-of-Change-of-Frequency (ROCOF) Ride-Through	NR (!!!)	‡
	Voltage Ride-Through (VRT)	‡	‡
	2 Transient Overvoltage Ride-Through	v (!!!)	‡
	2 Consecutive Voltage Dip Ride-Through	NR (!!!)	‡
	2 Restore Output After Voltage Ride-Through	NR (!!!)	‡
	2 Voltage Phase Angle Jump Ride-Through	NR (!!!)	‡
	Frequency Droop / Frequency-Watt	‡	‡
	3 Fast Frequency Response / Inertial Response	v (!!!)	‡
	Overfrequency FFR	NR	v
Sec 9 Protection Functions and Coordination	Return to Service (Enter Service)	?	‡
	Black Start	NR	v
	Abnormal Frequency Trip	NR	v
	Rate of Change of Frequency (ROCOF) Protection	?	v
	Abnormal Voltage Trip	NR	v
	AC Overcurrent Protection	?	v
Sec 8 Power Quality	Unintentional Islanding Detection and Trip	NR	v
	Interconnection System Protection	?	v
	Limitation of DC Current Injection		
	Limitation of Voltage Fluctuations	NR (!!!)	‡
	Limitation of Current Distortion	NR (!!!)	‡
	Limitation of Voltage Distortion	NR	v
	Limitation of (Transient) Overvoltage	NR (!!!)	‡

Thirteen (13) high-level gaps in ERCOT relate to 2800 mandatory requirements

2022 Odessa Event – Phase Angle Jump

- 3 plants had inverters trip off with combined loss of 385 MW
- All 3 plants have inverters from same OEM
- Plants had all inverters trip on Volt Phase Jump fault code – occurs when expected phase angle deviates > 15 degrees
- IEEE 2800 Section 7.2.3.4 requires ride through minimum to be 25 degrees.
- Current blocking is not allowed as post disturbance as well.
- IBRs need to be hardened or increase resilience to ride through disturbances.

2022 Odessa Event – AC Overvoltage

- One plant had inverters trip totaling 295 MW loss
- All inverters tripped on Instant AC Overvoltage in which inverter trip occurs in 1-3 ms when voltage exceeds 1.25pu
- Inverter terminal voltage reached 1.3pu during event, but high side of MPT only reached 1.056pu per PMU data provided by RE
- While ERCOT already has generic performance requirements that requires voltage ride through in general, IEEE 2800 Section 7.2.3 Transient overvoltage ride-through requirements clearly identifies transient overvoltage requirements for the plants to meet.
- If plant equipment designed and configured to meet IEEE 2800 Section 7.2.3 requirements, AC overvoltage trips should be reduced significantly or removed all together.

Questions?

