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
   a. High-level gap analysis: identify where ERCOT has no requirements, but IEEE 2800 does
   b. Detailed gap analysis: identify where ERCOT and IEEE 2800 both specify requirements and
      i. Where IEEE 2800 are more specific or more stringent than ERCOT requirements ("<")
      ii. Where ERCOT requirements and P2800 already align in stringency and level of specificity ("~")
      iii. 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, √ Allowed by Mutual Agreement, ‡ Capability Required, NR Not Required
(‡) Procedural Step Required as specified, Δ Test and Verification Defined, !!! Important Gap

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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			√
	Set Active Power		‡	√
	Scheduling Power Values		‡	√
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 / Current Injection during VRT	Balanced	‡	‡
		Unbalanced	NR (!!!)	‡

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