NOGRR272/PGRR121 Advanced Grid Support Requirements for Inverter-Based ESRs

Shun Hsien (Fred) Huang
ERCOT Operations Support

ERCOT Reliability and Operations Subcommittee (ROS) Meeting

February 6, 2025

Purpose

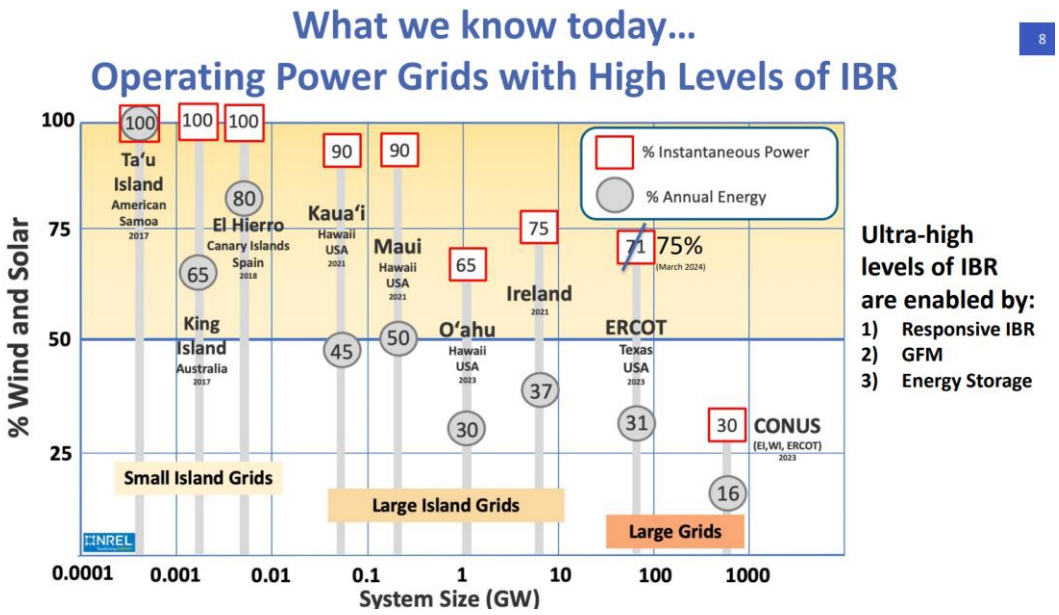
- It was recommended at the Inverter-Based Resource Working Group (IBRWG) in January to have ERCOT provide an update to ROS on the needs and benefits of the proposed AGS-ESRs in the NOGRR272 and PGRR121
  - NORGG272-Advanced Grid Support Requirements for Inverter-Based ESRs
  - PGRR121-Related to NOGRR272

- ERCOT provided several updates to IBRWG in 2024
  - ERCOT AGS-ESR Model Quality Tests and Discussion (October 2024)
  - ERCOT Advanced Grid Support ESR Test Requirement (September 2024)
  - ERCOT AGS-ESR Assessment and Adoption Discussion (July 2024)
  - AGS-ESR Functional Specification and Test Protocol (July 2024)

- This presentation summarizes the needs, reliability benefits of AGS-ESRs for the ERCOT grid, and the proposed adoption requirements

Quick Facts of IBR Integration in ERCOT

- ERCOT is one of largest grids in the world (largest in US) with high penetration of IBRs (75% in 2024)
- Existing and Interconnection Agreement (IA) signed with financial security posted transmission connected IBRs could reach to 130 GW
  - (Capacity Changes by Fuel Type Charts December 2024)



Wind		Solar		Storage	
2005	1,967 MW	2005	< 15 MW	2005	0 MW
2010	9,532 MW	2010	15 MW	2010	0 MW
2015	16,377 MW	2015	302 MW	2015	38 MW
2020	31,127 MW	2020	6,035 MW	2020	275 MW
2024	39,470 MW	2024	29,148 MW	2024	10,017 MW
2027	41,958 MW	2029	59,348 MW	2029	28,114 MW

Notable Options Adopted to Support IBR Integration

- ERCOT and the stakeholders have identified and implemented options to improve grid stability and support IBR integration

Synchronous condensers	• 2*150 MVA were installed in 2018 • 6*350 MVA are scheduled by 2027
IEEE 2800-2022 Adoption	• Adopt voltage/frequency ride through and section 5,7,9 • Plan to adopt other applicable requirements in the future
Dynamic Model Validation and Verification	• Establish requirements to ensure accurate dynamic models • Plan to adopt applicable IEEE 2800.2 requirements in the future
Generic Stability Constraints	• Establish and enforce operational stability constraints in real time operations • Implement online stability assessment

Although these improvements facilitate the existing IBR integration in the ERCOT grid, additional options will be needed to facilitate integration of new Resources

ERCOT IBR Integration Challenges

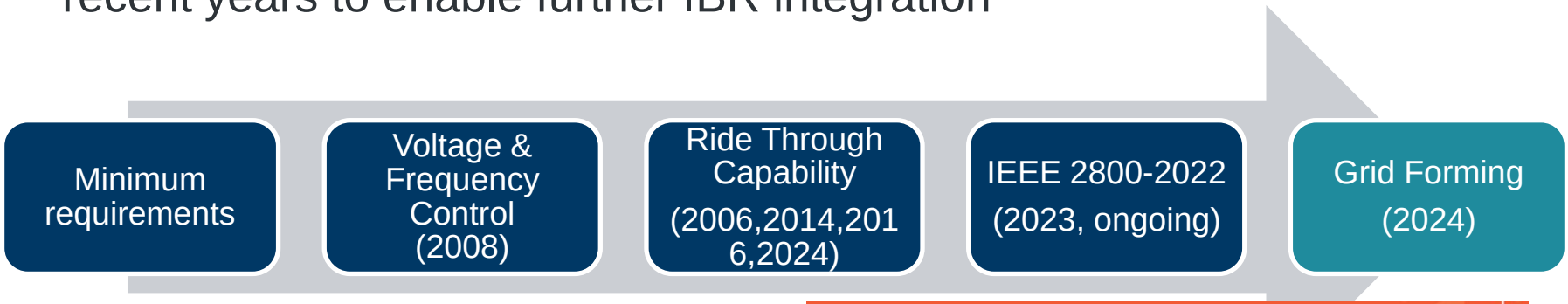
- The benefits and effectiveness of several adopted options are expected to diminish

Challenges	ERCOT Grid Impact
Stability Constraints	• Increase stability issues and delay the generation interconnection. As observed in the recent QSA/GTC studies, the use of GTCs may not be enough to maintain stability. • Reduce utilization of the transmission grid • Increase constraints in real time operations
Event Impact	• Increased risk of unit unstable operation or trip due to voltage/frequency volatility • Wide area impact and increase # of affected IBRs
Situational Awareness	• Reduce confidence of simulation models and tools • Increase oscillations in real time and needs to constrain resources' output until issues are resolved

Low system strength is an emerging ERCOT grid issue

ERCOT IBR Integration Overview

- With the advanced IBR development and grid reliability support needs, several IBR performance requirements were adopted to support resource integration and grid operation
- The advanced grid support (grid forming like) IBR technology has been increasing considered and adopted in the industry and globally in recent years to enable further IBR integration



GFM Requirements vs Incentives for at Glance

ESIG

Voluntary (no market)	Incentive: Market , Tender for Stability Products, Other Forms of Payment	Requirement
NESO (Great Britain) =>	NESO (Great Britain) =>	Fingrid (Finland)
AEMO (Australia)	Germany =>	MISO
		ERCOT
		ENTSO-E draft
		HECO
		CEN (Chile)

Reference:

- Grid forming requirements - IBRWG 121324
- https://www.esig.energy/working-users-groups/reliability/grid-forming/gfm-landscape/specifications-and-requirements/

ERCOT Proposed AGS-ESRs Requirements

- ERCOT proposed AGS-ESRs requirements
  - Provide support when resources have available capacity/state of charge (SOC) and are within the design capability
  - Don't require additional short circuit current capability
  - Don't need to maintain available capacity/SOC in real time
  - Require to meet the proposed model quality and unit validation tests as stated in the PGRR121
  - Require to meet the same performance requirements as the existing IBRs

- ERCOT's proposal is to have the minimum requirements without requiring ESRs to provide additional hardware or energy reserves to provide specific short circuit current or inertia contribution
- The primary benefit AGS-ESRs provide to the ERCOT grid is the system strength improvement and grid stability