



Item 4.2.1: ERCOT Comments on NOGRR245

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Reliability and Markets Committee Meeting

ERCOT Public

April 22, 2024

Overview

- **Purpose**

Describe significant risk to system reliability due to ride-through failures by Inverter-Based Resources (IBRs) and highlight issues in TAC-recommended version of NOGRR245 that must be addressed to alleviate the risks as originally intended by this Nodal Operating Guide Revision Request (NOGRR)

- **Voting Items / Requests**

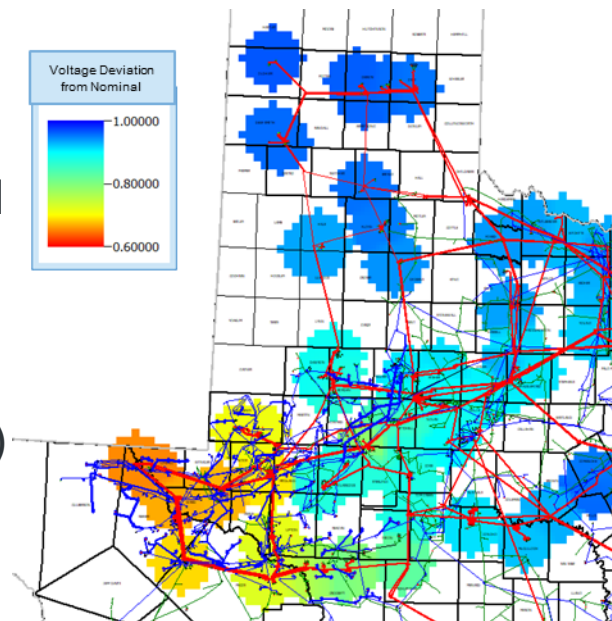
ERCOT requests the Reliability and Markets (R&M) Committee recommend to the Board remand of NOGRR245 to TAC to address the reliability risk issues in the TAC-recommended version; or alternatively, recommend approval of the TAC-recommended version as amended by the 4/15/24 ERCOT Comments

- **Key Takeaways**

- IBR ride-through failures are widely recognized as a significant and increasing risk that could result in rapid collapse of part of or all the ERCOT System under common conditions
- ERCOT proposed NOGRR245 based on the nationally-established IEEE 2800 standard and as recommended by the IBR Working Group to clarify existing ride-through requirements and enhance requirements for future IBRs to address causes of actual recent events and NERC and international guidelines and standards
- The version of NOGRR245 recommended by TAC reduces IBRs' compliance risk, rather than resolving ERCOT System reliability risk

What is Ride-Through?

- Following a lightning strike or equipment failure, voltage or frequency in an area may be distorted until protection systems trip equipment to clear the fault
 - Weaker the grid in fault area, more widespread disturbance will be (see graphic)
 - Note: Previous presentation to R&M Committee in June 2023 ([Link](#))
- Generators in area must “ride-through” disturbances and continue producing power, supporting voltage, and staying synced with grid frequency
 - If generators do *not* ride-through (*i.e.*, if they trip), *more* MWs are lost
 - If remaining generators do not ride-through, even *more* MWs lost (cascading)
 - Outcome: Outages of local area to *system-wide instability* potentially causing immediate catastrophic grid failure without time for operator action



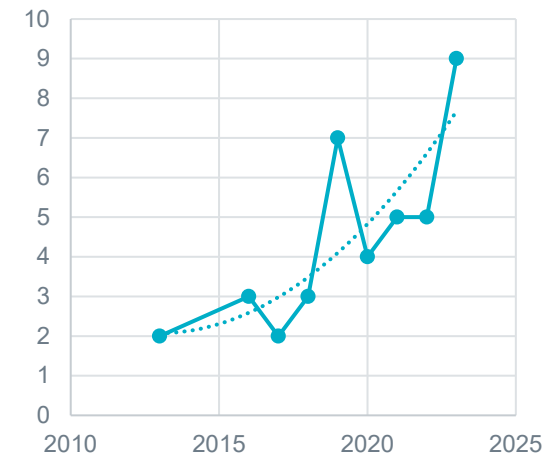
Key Takeaway: Generators must ride-through routine grid events or risk causing system-wide reliability failures

Many IBR Failure to Ride-Through Events

- ERCOT has experienced numerous and growing number of events. Any event could have been larger if the units' output had been higher
- In addition to the ERCOT Region, other regions experience similar IBR failures, driving the international discussion on current and future ride-through requirements

• 444 MWs	- 11/22/13 (ERCOT)	• 1148 MWs	- 5/9/21 (ERCOT)
• 550 MWs	- 11/26/13 (ERCOT)	• 910 MWs	- 6/24/21 (WECC Victorville)
• 415 MWs	- 3/22/16 (ERCOT)	• 518 MWs	- 6/26/21 (ERCOT)
• 356 MWs	- 4/9/16 (ERCOT)	• 776 MWs	- 7/4/21 (WECC Tumbleweed)
• 1178 MWs	- 8/16/16 (WECC Blue Cut)	• 557 MWs	- 7/28/21 (WECC Windhub)
• 551 MWs	- 1/10/17 (ERCOT)	• 886 MWs	- 8/25/21 (WECC Lytle Creek)
• 1619 MWs	- 10/9/17 (WECC Canyon 2)	• 492 MWs	- 3/22/22 (ERCOT)
• 2102 MWs	- 4/20/18 (WECC Angeles Forest)	• 457 MWs	- 3/22/22 (ERCOT)
• 1656 MWs	- 5/11/18 (WECC Palmdale Roost)	• 1711 MWs	- 6/4/22 (ERCOT)
• 222 MWs	- 12/26/18 (ERCOT)	• 542 MWs	- 10/21/22 (ERCOT)
• 382 MWs	- 1/22/19 (ERCOT)	• 179 MWs	- 10/27/22 (ERCOT)
• 241 MWs	- 1/22/19 (ERCOT)	• 106 MWs	- 1/16/23 (ERCOT)
• 269 MWs	- 4/18/19 (ERCOT)	• 253 MWs	- 1/23/23 (ERCOT)
• 497 MWs	- 5/20/19 (ERCOT)	• 372 MWs	- 1/24/23 (ERCOT)
• 21 MWs	- 10/6/19 (ERCOT)	• 271 MWs	- 3/10/23 (ERCOT)
• 298 MWs	- 10/25/19 (ERCOT)	• 396 MWs	- 3/24/23 (ERCOT)
• 201 MWs	- 12/17/19 (ERCOT)	• 921 MWs	- 4/10/23 (WECC SW Utah)
• 562 MWs	- 3/18/20 (ERCOT)	• 246 MWs	- 10/6/23 (ERCOT)
• 112 MWs	- 5/7/20 (ERCOT)	• 108 MWs	- 11/7/23 (ERCOT)
• 1290 MWs	- 7/7/20 (WECC San Fernando)	• 31 MWs	- 12/10/23 (ERCOT)
• 157 MWs	- 11/16/20 (ERCOT)	• 219 MWs	- 3/5/24 (ERCOT)

IBR Ride-Through Failures Over Time (Events Per Year)



Key Takeaway: Actual events demonstrate common and increasing risk. This is a now reliability risk and not a future theoretical concern.

IBR Failure to Ride-Through has become a Known Risk

Importance of rectifying this risk is recognized globally

- IEEE developed transmission connected IBR standard (IEEE 2800-2022)
- NERC issued multiple guidelines regarding IBRs
 - Loss of Resources due to Inverter Settings (Jun 2017)
 - Loss of Resources due to Inverter Settings – II (May 2018)
 - Reliability Guideline - BPS-Connected IBR Performance (Sep 2018)
 - Industry Recommendation - IBR Performance Issues (Mar 2022)
 - NERC Alert - Level 2 (Mar 2023)
- FERC Order 901 (Oct 2023) – FERC ordered NERC to implement reliability standards on IBR ride-through

NERC Disturbance Reports on ERCOT 2021 and 2022 Odessa Events contain the following recommendation:

*ERCOT should ensure that the recommendations contained within the NERC reliability guidelines are comprehensively reviewed **and adopted to ensure mitigating actions are put in place to prevent these types of issues in the future.** (emphasis added)*

An emerging problem for grids nationwide is already a ***critical reliability risk*** for the Texas power grid

- ERCOT already has ~ 70,000 MWs of IBRs on the ERCOT System

Key Takeaway: ERCOT filed NOGRR245 to implement NERC recommendations because IBR owners have not implemented them voluntarily.

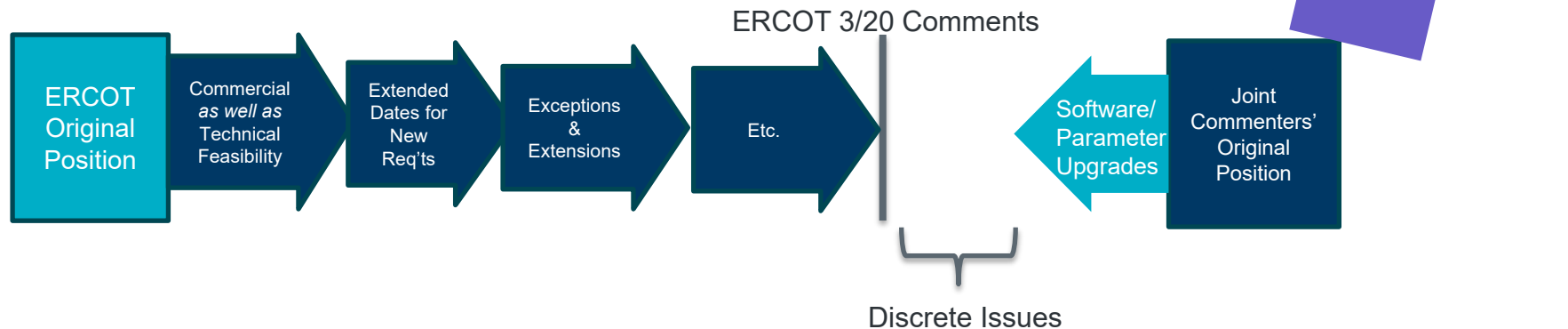
Background of NOGRR245

- ERCOT originally implemented current IBR-specific voltage ride-through requirements in 2008 (with minor revision in 2014)
 - As more events have occurred (Slide 3) and event analyses done, it has become clear current requirements are not as “airtight” as intended
- Original intent for NOGRR245 (submitted January 2023) was to reduce reliability risk from these events by:
 - Adding clarity and specificity for **existing** IBR ride-through requirements
 - Implementing recommendations from NERC reliability guidelines
 - Strengthening requirements for future IBRs by requiring compliance with IEEE-2800-2022 as soon as reasonable

Key Takeaway: ERCOT intended NOGRR245 to mitigate reliability risk from IBR failures to ride-through events.

ERCOT made significant compromises during stakeholder discussions

- ERCOT worked with equipment manufacturers and Resource Entities to understand IBR capabilities and concerns and iteratively modified NOGRR245 to ultimately produce its 3/20/24 comments containing the results of that effort
- Joint Commenters' (JCs') 3/22/24 comments recommended by TAC includes concepts significantly different from previous discussions and ignores ERCOT System reliability needs



Key Takeaway: NOGRR245 as recommended by TAC effectively eliminates all compliance risk related to ride-through for existing and future IBRs

Framework

- The following four slides describe:
 - Several significant issues
 - ERCOT's approach to address these issues
 - The approach to these issues in the TAC-recommended version of NOGRR245
 - ERCOT's concerns with the TAC-recommended approach to each issue
- **This is not a comprehensive or detailed list of all issues and concerns with the TAC-recommended version of NOGRR245**
- **Note: TAC version passed with only 69% after two failed votes; TAC does not adequately explain how it addressed current reliability risk**
- Definitionally, 3 sets of requirements are relevant to this discussion:
 - **Current** requirements in place for IBRs since 2014
 - **"Legacy"** requirements for IBRs based on the current Operating Guides requirements but with more specificity
 - **"Preferred"** requirements based on IEEE-2800-2022 standard to resolve IBR ride-through problems (*i.e.*, improvements above current requirements)

Concerns with TAC-recommended Version – page 1/4

1. Timing of transition to “Preferred” requirements for new IBRs

- ERCOT: June 1, 2023 (6 months after NOGRR was filed)
- TAC: June 1, 2024
- **Concern:** Allows for the potential of 20-30 GWs of additional IBRs to meet only “legacy” requirements rather than “preferred” requirements

2. Existing IBRs that fail to meet applicable requirements

- ERCOT: Must remedy cause of failure
- TAC: Can request exemption to applicable requirements (and can indefinitely request new exemptions to requirements that were set under the previous exemption upon a subsequent failure)
- **Concern:** Effectively neutralizes the purpose of applicable requirements – no incentive to make improvements to meet any requirements

3. Existing IBRs that cannot meet “Current” requirements

- ERCOT: Allows exemption requests within defined parameters and assesses reliability impacts in decision process
- TAC: Allows exemption requests with no limitations and does not include reliability impact assessment in decision process
- **Concern:** Exemptions could increase from ~5 GWs to ~50 GWs of existing connected IBRs

4. Can units continue operating after a failure?

- ERCOT: Limit output or connection if IBR presents unacceptable system risk (mandated by NERC Reliability Standards TOP-001-05; IRO-001-4)
- TAC: Always allowed to continue operating
- **Concern:** Conflict between Operating Guides and NERC Reliability Standards

5. Mitigation requirements following a performance failure

- ERCOT: Must develop and *implement* mitigation plans
- TAC: New IBRs that fail must develop mitigation plans but no requirement to implement plan
- **Concern:** New IBRs with performance failures not required to implement mitigation plans, leading to repeated failures for same cause

6. Allowed deviations from requirements (e.g., slower controls)

- ERCOT: Allow only when overall system reliability can accommodate or there is a system benefit
- TAC: Must always be allowed with broad exception language
- **Concern:** Forces ERCOT to allow unreliable performance on the ERCOT System

7. NOGRR245 dates for agreed improvements (e.g., software)

- ERCOT: “Legacy” IBR improvement implementation dates clearly identified
- TAC: No firm implementation dates and allow for indefinite extensions
- **Concern:** No urgency and certainty for implementing even *readily-available* improvements

NOGRR245 – ERCOT Recommendations

- ERCOT primarily recommends that the R&M Committee recommend to the Board remand of NOGRR245 to TAC with the following instructions:
 - Modify the language to address the ***current reliability risks*** ERCOT has identified in its comments; or
 - Explain in detail how each of ERCOT's concerns are addressed in the TAC-recommended version, along with any other questions presented by the R&M Committee or Board.
- Alternatively, ERCOT recommends that the R&M Committee recommend to the Board the 3/27/24 TAC-recommended version of NOGRR245 as amended by the 4/15/24 ERCOT Comments.

Key Takeaway: TAC-recommended version does not address current, *critical* reliability risk and must be modified to protect the Texas power grid.

Immediate Action to Start Lowering Reliability Risk

- Joint Commenters, whose 3/22/24 comments were incorporated in the TAC-recommended version of NOGRR245, have generally agreed maximizing IBRs' ride-through capabilities through available software upgrades and parameter changes is commercially reasonable
- ERCOT plans to issue a Market Notice soon to encourage IBR owners to maximize IBR ride-through capabilities through available software upgrades and parameter changes as soon as feasible
 - No reason to wait on outcome of this NOGRR to begin these improvements to reduce reliability risk since IBR owners agreed these changes are commercially-reasonable

Key Takeaway: ERCOT urges IBR owners to immediately take actions to reduce reliability risk from ride-through failures.

Questions?

ERCOT Major Concerns with TAC-Recommended Version of NOGRR245

1. Maintains/expands exemptions without guardrails

- Currently, if performance requirements violated, Resource Entity (RE) must mitigate, ERCOT reports to Reliability Monitor and violations go to PUCT enforcement
 - Enforces rules and incentivizes RE to mitigate
- ERCOT version maintains this process to incentivize RE mitigation
- ERCOT version requires mitigation plans be implemented
- TAC-recommended version removes this process and modifies:
 - Signed generation interconnection agreement (SGIA) after 6/1/24 must submit mitigation plan with no requirement to implement it
 - SGIA before 6/1/24 must implement mitigation steps **RE determines** are commercially reasonable and get exemption to allow lower performance
 - Cycle continues indefinitely - allowing continuous decrease of performance requirements over time and lowering reliability > **70 GWs** of IBRs/WGRs

Key Takeaway: Instead of mitigating reliability risk, TAC-recommended version **increases risk** by not requiring performance failure mitigation, which lowers performance requirements over time

2. Prioritizes commercial discretion over reliability

- Current performance requirements required regardless of cost
 - RE determines most cost-effective way to meet performance requirements and has incentive to avoid compliance penalties
- ERCOT-recommended version provides exemptions/extensions process to minimize requirements to minimum extent needed to assure reliability of the ERCOT System
- TAC-recommended version does not assure ERCOT System reliability and instead seeks to give RE authority to determine what it will spend on improvements (*i.e.*, commercially reasonable) and, thus, level of performance it will provide
- TAC-recommended version allows REs to make determinations w/o regard to ERCOT System reliability impact or impact on consumers/other MPs
- If this approach is allowed for **most critical risks** (ride-through failure), precedent forms basis for any other reliability requirement

Key Takeaway: TAC-recommended version allows REs to make decisions that critically impact ERCOT reliability without information and skills to properly assess that impact; ERCOT must avoid that precedent for current and future reliability.

3. Delays implementing industry-standard requirements for 20-30

GWs of IBRs despite current ability to achieve

- TAC-recommended version places SGIA date for higher requirements at 6/1/24 vs ERCOT-recommended 6/1/23
- ERCOT already moved from 1/1/23 SGIA date to 6/1/23 date, allowing additional 6 GW of IBRs to meet lower standard
- Further delay results in 20-30 GW of IBRs held to lower performance requirement than what they are capable of meeting
- ERCOT further increased the window for exemptions to phase in new requirements from 6/1/26 commercial operations dated to 12/31/26
- ERCOT made further allowances for up to an *additional* two year extension to 12/31/28 if needed to fully meet requirements (based on OEM feedback)
- REs have argued ERCOT must respect capability limitations for legacy IBRs, which ERCOT does through exemptions for technically infeasible limitations; *however in this instance, even though capable*, the TAC version still mandates another year delay to higher performance requirements that could help improve reliability simply to lower compliance risk

Key Takeaway: Resource Entities prioritize compliance risk reduction over the reliability assurance that reasonable, higher performance requirements support.

Appendix

FERC Order 901

1. We direct NERC to develop new or modified Reliability Standards addressing reliability gaps pertaining to IBRs in four areas: (1) data sharing; (2) model validation; (3) planning and operational studies; and (4) performance requirements. [Ref: Reliability Standards to Address Inverter-based Res., Notice of Proposed Rulemaking, 87 FR 74541 (Dec. 6, 2022), 181 FERC ¶ 61,125, at P 1 (2022) (NOPR)]
2. According to NERC, the rapid integration of IBRs is “the most significant driver of grid transformation” on the Bulk-Power System.” (¶ 2)
3. “The new or modified Reliability Standards must require registered IBRs to continue to inject current during system disturbances” (¶ 191)
4. “Ride through requirements set forth in Reliability Standards will apply to both *existing IBRs* and newly interconnecting IBRs” (¶ 191) (emphasis added)
5. “Regarding...an explicit exemption for existing IBRs with equipment limitations, we agree that a subset of existing registered IBRs - typically older IBR technology with hardware that needs to be physically replaced and whose settings and configurations cannot be modified using software updates - may be unable to implement the voltage ride through performance requirements directed herein.” (¶ 193)
6. “We direct NERC...to determine whether the...Reliability Standards should provide for a limited and documented exemption for certain registered IBRs.... Any such exemption should be only for voltage ride-through performance for those existing IBRs...unable to modify their coordinated protection and control settings to meet the requirements without physical modification of the IBRs’ equipment.” (¶ 193) (emphasis added)
7. “We direct NERC to ensure that any such exemption would be applicable for *only existing equipment...unable to meet voltage ride- through performance.*” (¶ 193) (emphasis added)
8. “NERC [should] require...planners and operators to implement mitigation activities that may be needed to address any reliability impact...posed by these existing facilities.” (¶ 196) (citations omitted)
9. “To the extent NERC determines that a limited and documented exemption for...IBRs currently in operation and *unable to meet voltage ride-through requirements* is appropriate due to their *inability to modify their coordinated protection and control settings*, we direct NERC to develop new or modified Reliability Standards *to mitigate the reliability impacts to the Bulk-Power System of such an exemption.*” (¶ 199) (emphasis added)



Appendix

FERC Order 901 – Summary

- New rules should require IBRs to continue to inject current during system disturbances [ERCOT's version of NOGRR245 does this – § 2.6.2.1; § 2.6.2.1.1; § 2.9.1; § 2.9.1.1; § 2.9.1.2]
- Ride-through requirements will apply to existing IBRs and new IBRs [ERCOT's version of NOGRR245 does this - § 2.6.2.1; § 2.6.2.1.1; § 2.9.1; § 2.9.1.1; § 2.9.1.2]
- IBRs w/ equipment limitations (cannot modify settings/configurations using software updates) may be unable to implement new ride-through requirements in FERC Order 901. Therefore, NERC must determine whether new Reliability Standards should provide *limited* and *documented exemption for certain IBRs* and any such exemption should be *only* for ride-through performance for existing IBRs unable to modify their coordinated protection and control settings to meet the requirements without physical modification of equipment.
 - ERCOT's version of NOGRR245 does all those things:
 - New, more stringent ride-through requirements apply to new IBRs [§ 2.6.2.1; § 2.6.2.1.1; § 2.9.1.1]
 - Existing IBRs that *can* comply through software, firmware, or parameterization changes must comply with the new requirements [§ 2.6.2.1(8); § 2.9.1(7); § 2.9.1.2(11)]
 - Existing IBRs that *cannot* comply through software, firmware, or parameterization changes must maximize their ride-through capabilities and comply with – at a minimum – the existing ride-through requirements [§ 2.6.2.1(3), (6) [§ 2.9.1(6); § 2.9.1.1(9); § 2.9.1.2(7), (11); § 2.10.1(1); § 2.10.2(1)]
 - Existing IBRs that *cannot* comply through software, firmware, or parameterization changes can obtain an exemption or extension [§ 2.10.1; § 2.10.2]
 - For units receiving exemption, planners and operators must implement mitigation activities to address reliability impacts. [ERCOT's version of NOGRR245 does - § 2.6.2.1(10); § 2.9.1.1(12); § 2.9.1.2(13)]

Appendix

FERC Order 901 Requirement	ERCOT Proposal
New rules should require IBRs to continue to inject current during system disturbances	§ 2.6.2.1 § 2.9.1.1
New ride-through requirements apply to <i>existing</i> IBRs and <i>new</i> IBRs	§ 2.6.2.1 § 2.6.2.1.1 § 2.9.1 § 2.9.1.1 § 2.9.1.2
NERC to determine whether new Reliability Standards should provide <i>limited</i> /documented exemption only for existing IBRs <i>unable to modify protection and control settings</i> to meet new requirements w/o physical modifications	
Existing IBRs that can comply w/o physical modifications must comply w/ new requirements	§ 2.6.2.1(8) § 2.9.1(7) § 2.9.1.2(11)
Existing IBRs that cannot comply w/o physical modifications must maximize ride-through capabilities and comply with – at a minimum – existing ride-through requirements	§ 2.6.2.1(3), (6) § 2.9.1(6) § 2.9.1.1(9) § 2.9.1.2(7), (11) § 2.11.1(1) § 2.11.2(1)
Existing IBRs that cannot comply w/o physical modifications can obtain exemption/extension	§ 2.11.1 § 2.11.2
BPS planners and operators must <i>implement mitigation activities</i> to address reliability impacts of units receiving exemptions	§ 2.6.2.1(10) § 2.9.1.1(12) § 2.9.1.2(13)

Appendix

FERC Order 901 - Commissioner Danly concurring (paraphrased):

1. Concurs in order directing NERC to develop new/modified mandatory/enforceable Reliability Standards to address reliability risks ***we have known about and been actively discussing since at least 2016***. Is today's order important and necessary? Yes. ***Is it timely? No***. Six of 13 documented events occurred in 2021. ***FERC and NERC could have - and should have - acted sooner.*** (§1)
2. Reliability risks arise from rapid, widespread (reckless) addition of IBRs to Bulk-Power System. ***According to NERC, "[t]he rapid interconnection of [BPS]-connected [IBRs] is the most significant driver of grid transformation and poses a high risk to BPS reliability" - "[e]ach event analyzed has identified new performance issues, such as momentary cessation, unwarranted inverter or plant-level tripping issues, controller interactions and instabilities, and other critical performance risks that must be mitigated."*** NERC simulations demonstrate the reliability risks posted by momentary cessation are greater than any actual IBR disturbances NERC has documented since 2016 and ***results indicate IBR momentary cessation can lead to instability, system-wide uncontrolled separation, and voltage collapse.*** (§2)
3. NERC observes multiple recent disturbances involve widespread reduction of PV resources in California, Utah, and Texas. First major events involving battery facilities occurred in March/April, 2022. ***Reliable operation of BPS remains imperiled until issues are addressed. Time is of the essence.*** (§3)
4. FERC role requires it to remain vigilant in ensuring NERC Reliability Standards are timely, efficient, and effective. ***Up to nearly fourteen years to establish mandatory and enforceable Standards to address a known and potentially catastrophic risk to reliability is simply too long and we must wait longer to learn whether new standards are effective. Who knows what will happen in the meantime.*** (§4)
5. Better late than never, I suppose. (§5)

Key Takeaway: ERCOT version of NOGRR245 addresses the issues FERC ordered NERC to address; ERCOT is ahead on setting these standards and must be because 70,000 MWs of IBRs in ERCOT (highest relative percentage of any grid in US) have had numerous ride-through failures