Harmonizing IBR Interconnection Requirements in the West

Industry Advisory Group

Kick-off Meeting

May 19, 2025

WIRAB
Western Interconnection
Regional Advisory Body

Meeting Logistics

Recording

This meeting is being recorded and **may be posted publicly**. By participating, you consent to your name, voice, and image being part of the recording.

How to Participate

Use the **"Raise Hand"** feature to ask questions or provide input

Feel free to use the **chat** for comments or clarifying questions

We will be using **Slido** later in the meeting to solicit feedback

Audio Etiquette

Everyone came into the meeting muted

Please **mute yourself** when not speaking

If joining by phone, please identify yourself in the chat

Materials & Follow-Up

Slides and materials will be shared after the meeting and available on the webpage

Contact information will be provided at the end for follow-up questions or comments

Outline

Introductions and Background	Overview of WIRAB's role and motivation for this effort Explanation of the Industry Advisory Group's role
Technical Overview	Highlights from *Inverter-Based Resource Risk Assessment Report* Vision for Template Facility Interconnection Requirements
Interactive Discussion and Q&A	Open Discussion and Slido Polls
Closing and Next Steps	Confirming upcoming meeting dates and schedule Preview of next meeting topics and expected deliverables

Introductions

WIRAB AND WIEB STAFF
(OVERSIGHT AND FACILITATION)

ELEVATE ENERGY CONSULTING
(TECHNICAL EXPERTS)

INDUSTRY PARTICIPANTS
(FEEDBACK AND DISCUSSION)

Please Introduce Yourself in the Chat

- Name
- Organization / Company
- Role or Title
- One reason you're interested in this effort / What you hope to get out of it (optional)

Who is WIRAB?

WIRAB
Western Interconnection Regional Advisory Body

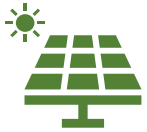
- **Statutory Authority:** Established in 2005, as an independent body with statutory authority under Section 215(j) of the Federal Power Act to Advise FERC, NERC, and WECC on reliability matters in the Western Interconnection.
- **Membership:** All state and provinces with load served in the Western Interconnection
- **Funding:** Assessments approved by FERC to load serving entities under Section 215 of the Federal Power Act.

WIRAB's 2025 Strategic Initiatives

WIRAB Western Interconnection Regional Advisory Body

Transmission Planning (WestTEC)

Initiative 1: Advise WECC to work collaboratively with the Western Power Pool and Western stakeholders to develop an investment-grade transmission plan that effectively improves reliability in the Western Interconnection.



Inverter-based Resource Risk

Initiative 2: Advise WECC to work collaboratively with Western regulators and stakeholders to address and proactively mitigate risks associated with the uncoordinated interconnection of inverter-based resources in the Western Interconnection.

Inter-regional Transfer Capability

Initiative 3: Advise WECC regarding a process for ongoing assessments and prudent upgrades for inter-regional transfer capabilities in the Western Interconnection to ensure reliable power flow when the system is stressed.

Extreme Weather Event Analysis

Initiative 4: Advise WECC to conduct a systematic review of recent extreme weather events that have tested the grid, focusing on the challenges of maintaining grid reliability during increased demand, unexpected outages, system stress, and near-miss incidents in the Western Interconnection.

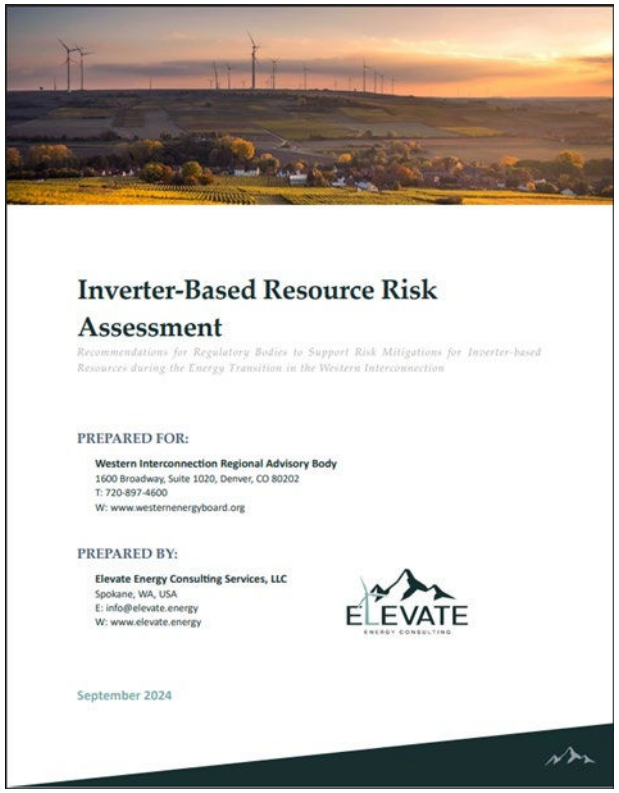
Grid Enhancing Technologies for Reliability

Initiative 5: Advise WECC to assess the reliability implications of innovative grid solutions used to maximize the potential of the existing transmission system as utilities modernize the grid in the Western Interconnection.

Inverter-Based Resource Risk Assessment Report

Western Interconnection Regional Advisory Body

- **Developed by Elevate Energy Consulting**
- **Report and Recommendations Endorsed by WIRAB in 2024.**
  - WIRAB to collaborate with WECC and other key stakeholders to prioritize and implement the recommendations outlined in this report.
- **Key Recommendation:** Create a standardized template for FIR enhancements, ideally implementing IEEE 2800 standard.



Industry Advisory Group Schedule

Date	Topics
May 19, 2025 from 3:00 – 4:00 p.m. MT	Introduction, Background, Goals, Timeline
June 26, 2025 from 1:00 – 2:00 p.m. MT	Overview of IEEE 2800 and IBR Requirements Plan
July 17, 2025 from 9:30 – 10:30 a.m. MT	IBR Requirements Enhancements – Industry Experience
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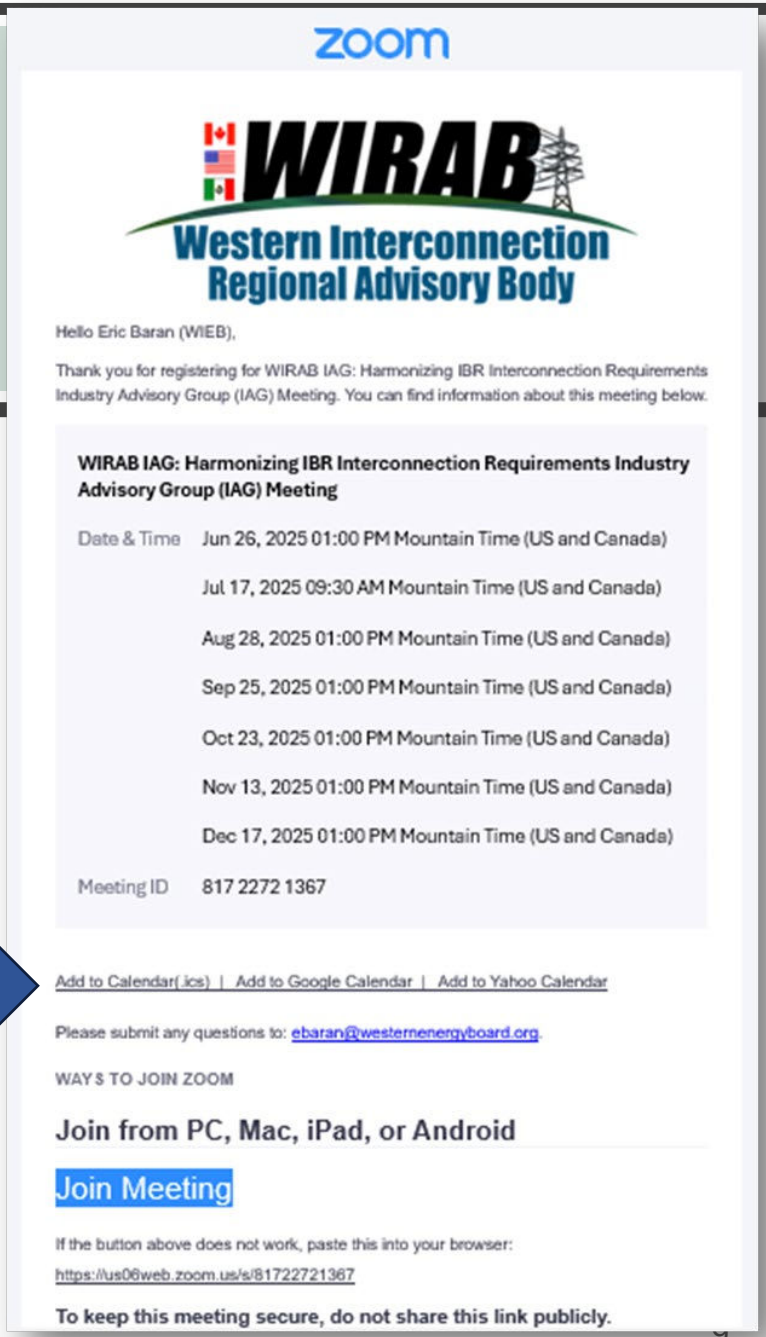
December 17, 2025 from 1:00 – 2:00 p.m. MT	Final Review & Closeout

Register for Future IAG Meetings

Follow up email to be sent with a new registration link → Registration will automatically approved → You will receive a confirmation email from Zoom

Add meetings to your calendar by clicking the calendar link in the email → Day of email reminders will also be sent



zoom

WIRAB
Western Interconnection Regional Advisory Body

Hello Eric Baran (WIEB),

Thank you for registering for WIRAB IAG: Harmonizing IBR Interconnection Requirements Industry Advisory Group (IAG) Meeting. You can find information about this meeting below.

WIRAB IAG: Harmonizing IBR Interconnection Requirements Industry Advisory Group (IAG) Meeting

Date & Time	Jun 26, 2025 01:00 PM Mountain Time (US and Canada)
	Jul 17, 2025 09:30 AM Mountain Time (US and Canada)
	Aug 28, 2025 01:00 PM Mountain Time (US and Canada)
	Sep 25, 2025 01:00 PM Mountain Time (US and Canada)
	Oct 23, 2025 01:00 PM Mountain Time (US and Canada)
	Nov 13, 2025 01:00 PM Mountain Time (US and Canada)
	Dec 17, 2025 01:00 PM Mountain Time (US and Canada)
Meeting ID	817 2272 1367

Add to Calendar(.ics) | Add to Google Calendar | Add to Yahoo Calendar

Please submit any questions to: ebaran@westernenergyboard.org

WAYS TO JOIN ZOOM

Join from PC, Mac, iPad, or Android

Join Meeting

If the button above does not work, paste this into your browser:
https://us06web.zoom.us/s/81722721367

To keep this meeting secure, do not share this link publicly.

Thank You!

Next Industry Advisory Group Meeting

June 26, 2025 at 1:00 PM MT

Eric Baran

ebaran@westernenergyboard.org

720-897-4600 x 207

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Western Interconnection
Regional Advisory Body

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Harmonizing IBR Interconnection Requirements in the West

Industry Advisory Group (IAG) Kickoff Meeting

Ryan D. Quint, PhD, PE, *President and CEO*
Kyle Thomas, PE, VP, *Engineering and Compliance Services*
Nick Giffin, PE, *Lead Engineer, Modeling and Studies*

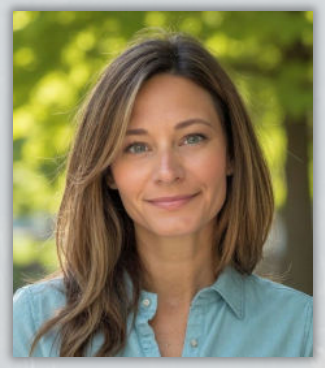
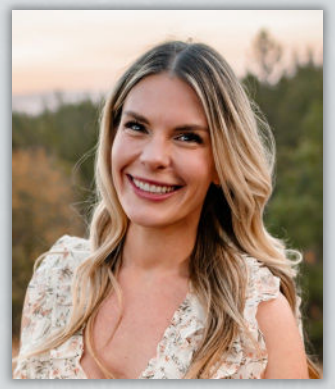
May 19, 2025

The Elevate Team











New Team Member Joining Soon

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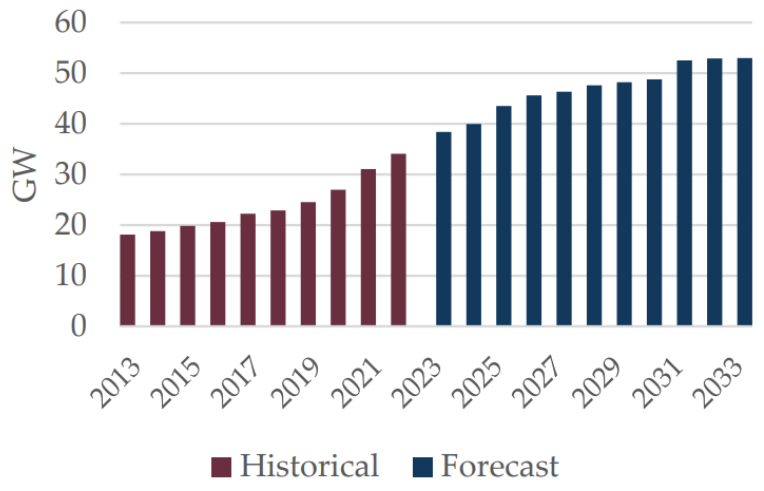
Slido Q&A and Polls

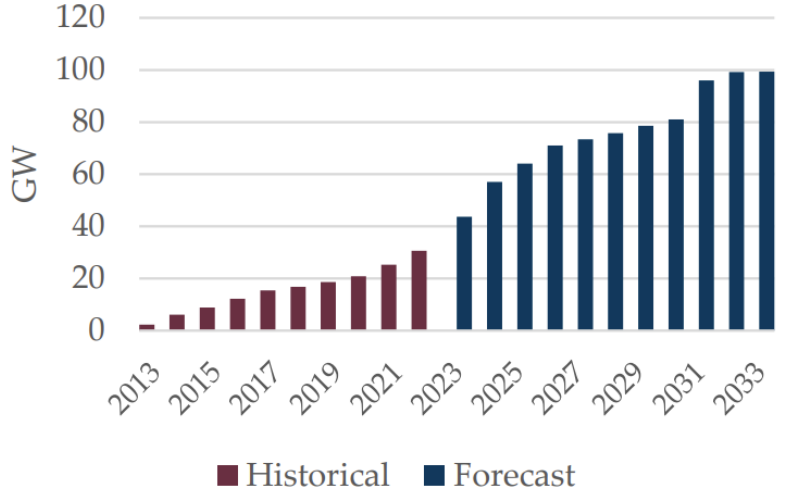
- Join Link: https://app.sli.do/event/wtMoSEvQxpzj35FZ9oVYWk
- Slido.com
- Join Code: 2146224

Wind, Solar, and Storage in the West

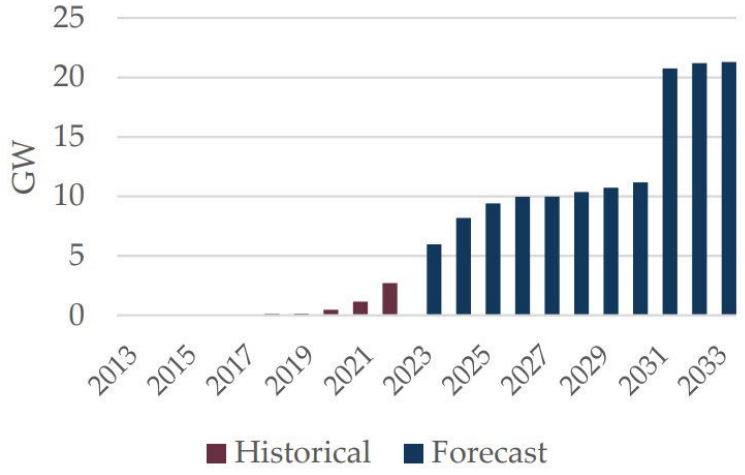
Wind



Solar and Hybrid Solar



Energy Storage



95 GW of resource addition in next 10 years
80% are solar, energy storage, and wind

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2023 Western Assessment of Resource Adequacy (WECC)

The Infamous Disturbance Reports

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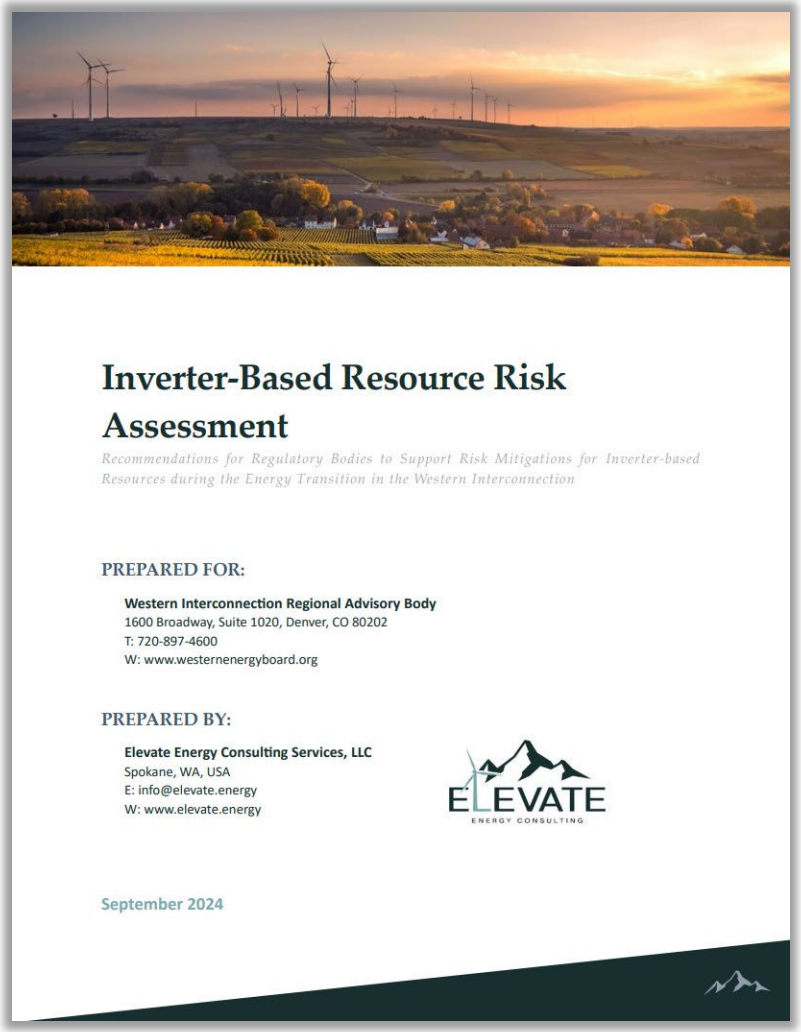
WIRAB report from 2024

- Identification and prioritization of IBR risks in the West
- Gap analysis of risks versus requirement
- Solutions, key players, and actions needed
- Recommended risk mitigations



IBR Risk Assessment (2024)

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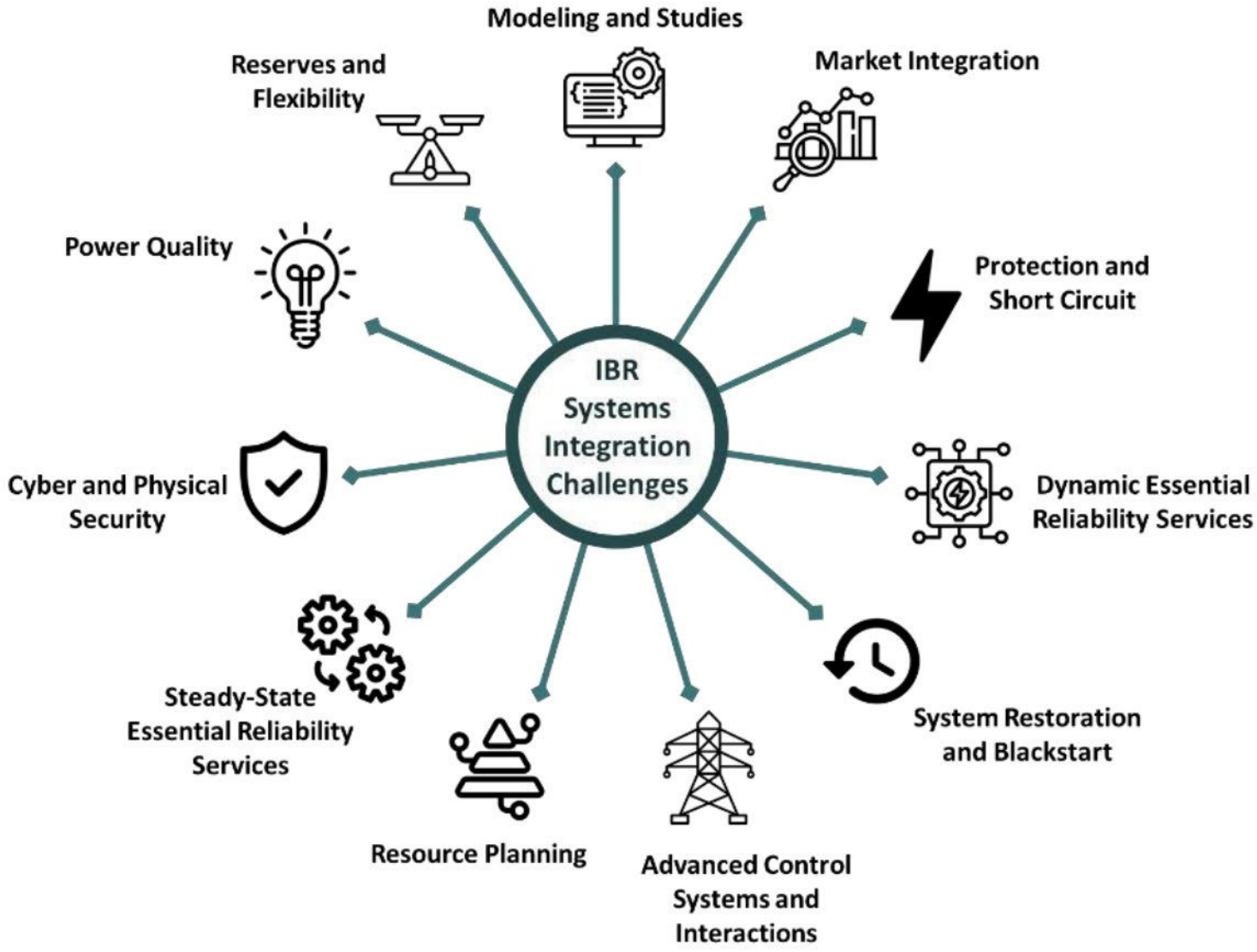
IBR Systems Integration Risks and Challenges



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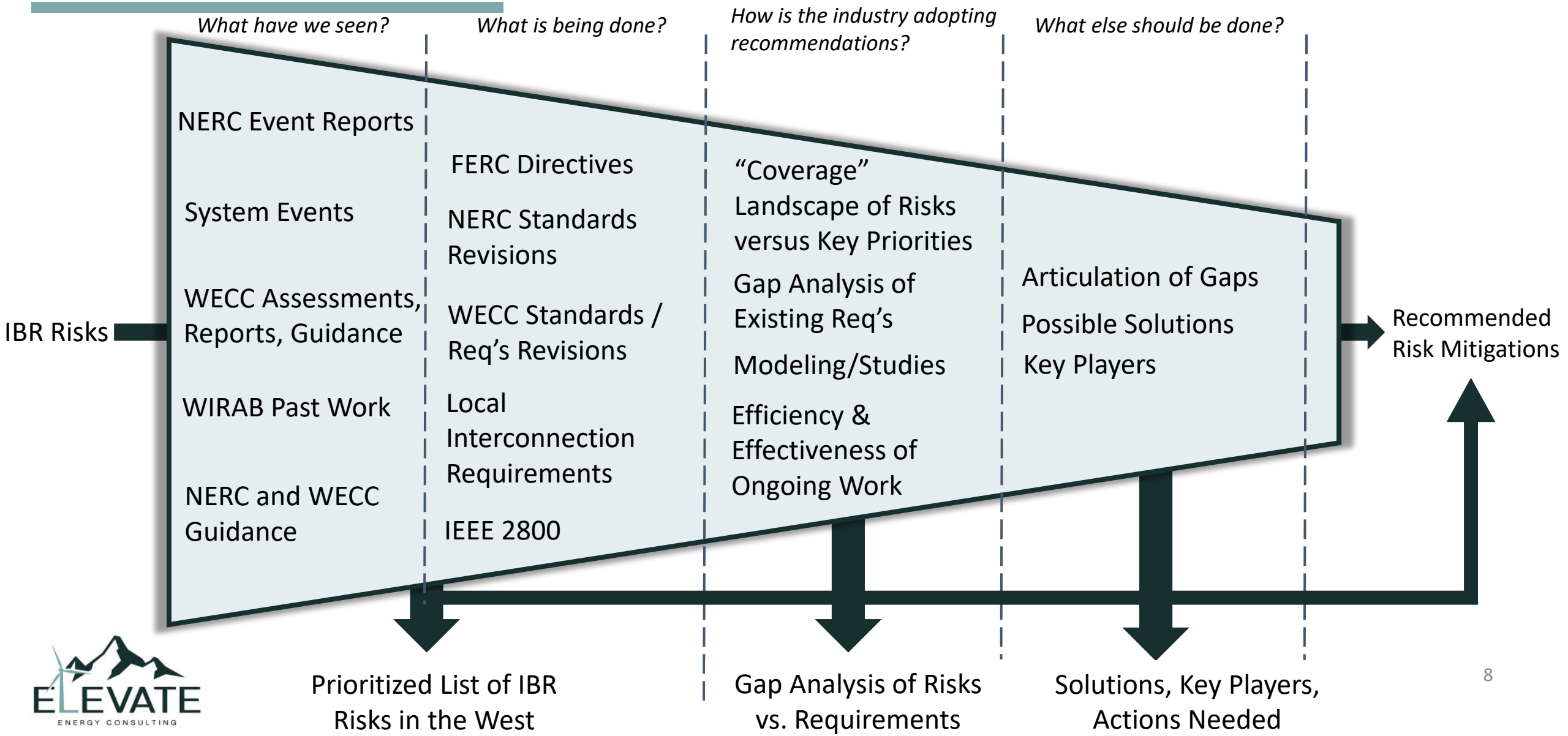
High-Level Process for the Report



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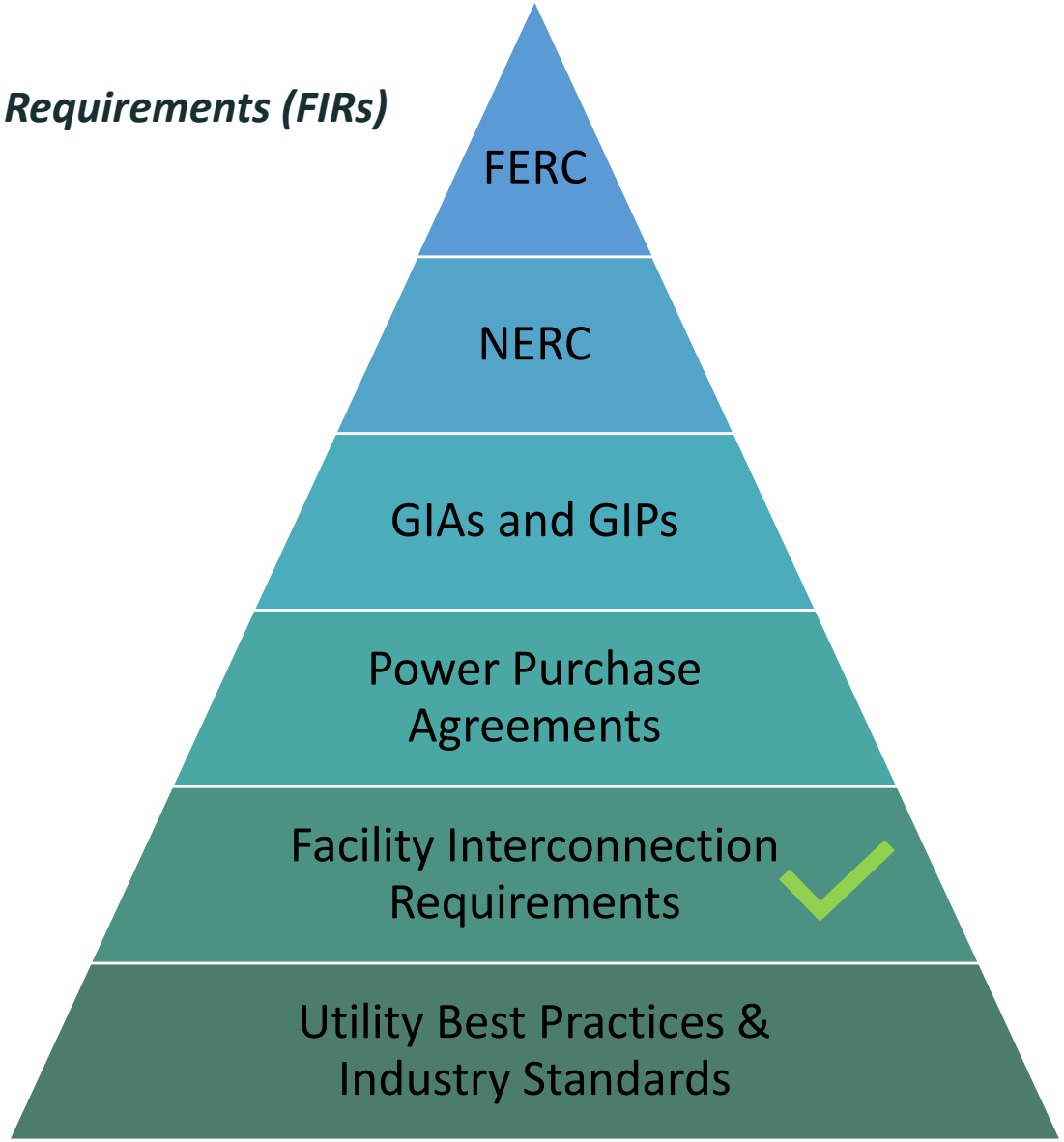
Is Industry Adopting Recommendations?

- Reviewed ***32 Western Interconnection Facility Interconnection Requirements (FIRs)***
- In each FIR, searched for IBR risk mitigations:
  - Inclusion of NERC Reliability Guideline recommendations
  - Adoption of the IEEE 2800-2022 standard
  - Enhanced IBR-Applicable and IBR-Specific Requirements
    - Ride-Through Capability and Performance
    - Oscillations and Instability
    - Modeling and Model Validation
    - Electromagnetic Transient (EMT) Modeling
    - Inertia and System Strength
    - Event Analysis and Performance Validation
    - Disturbance Monitoring (PMU and DFR)
    - Power Quality
    - Grid Forming
    - Testing and Commissioning



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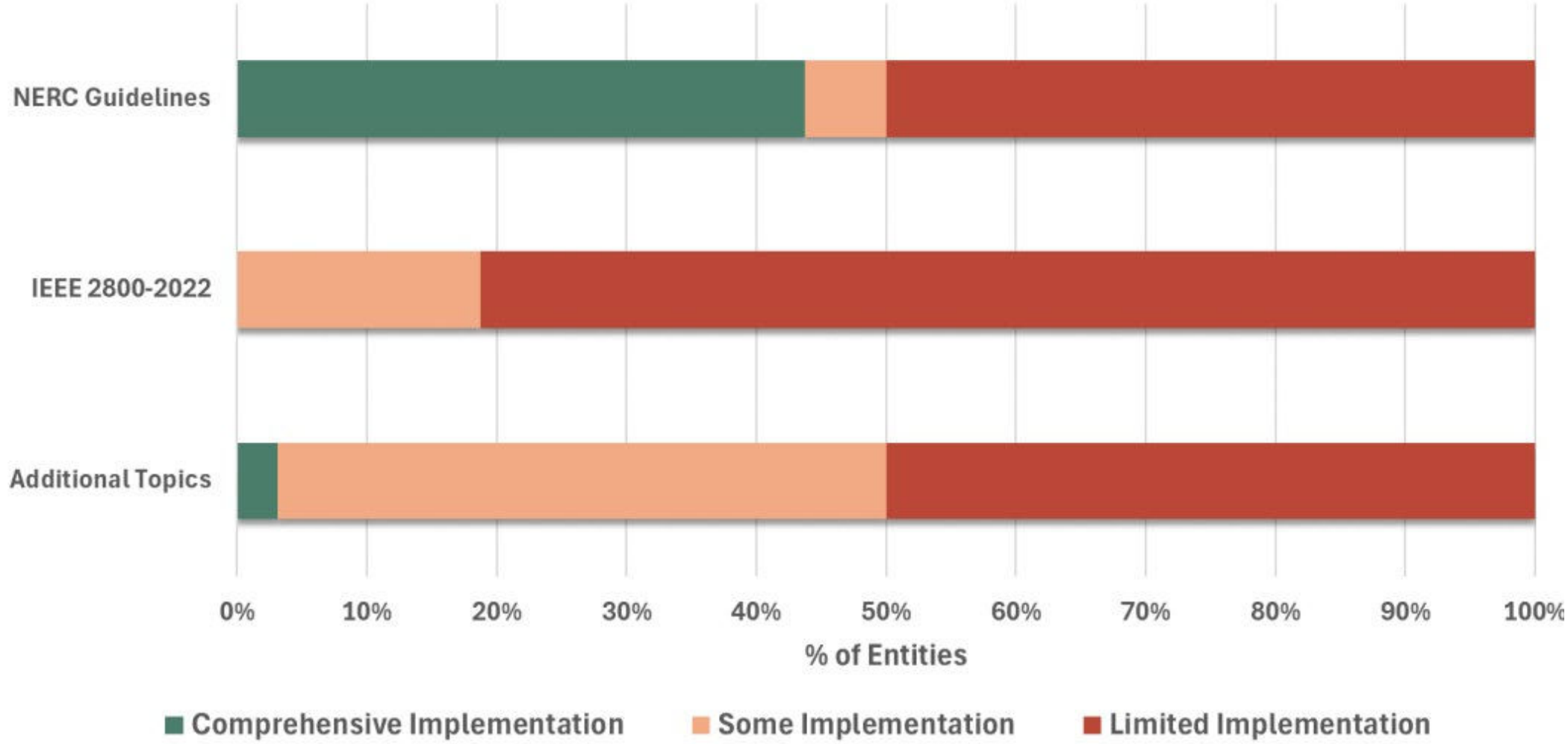

Recommendations

Step-by-step guide to help Western entities accelerate the mitigation of IBR risks

Near Term
1-2 years

1. WECC more directly and closely support industry enhance Facility Interconnection Requirements for IBRs (standardized template for enhancements, ideally implementing IEEE 2800 standard)

2. WECC conduct targeted regional training (and engage technical industry with working groups) for IEEE 2800, IBRs, EMT, GFM, and more

3. FERC and/or NERC adopt and implement IEEE 2800-2022 in Reliability Standard(s) – harmonized requirements for IBR capability and performance

4. State PUCs emphasize need for proactive enhancement of interconnection requirements (e.g., adopting IEEE 2800-2022)

Medium Term
3-4 years

1. Proactive stakeholder-engaged risk mitigations by WECC for emerging systems integration challenges for IBRs
   - GFM, oscillations, decreasing system strength and inertia, etc.)

2. WECC support pilot projects for emerging IBR risk mitigations (e.g., GFM, EMT, etc.)

3. If no NERC/FERC adoption of IEEE 2800-2022, WECC create a Regional Reliability Standard adopting IEEE 2800-2022 (and future P2800.2)
   - Harmonized West-wide IBR req's.

Long Term
2030+

1. The West consider shifting toward regional grid code approach including:
   - Proactively develop risk mitigations ahead of them occurring (leverage WECC studies program)
   - Independently developed and/or stakeholder-driven (by technical group(s))
   - Technical details defined in code
   - Harmonized across Region
   - Supports smaller entities
   - Clear compliance obligations and enforcement
   - Flexibility for utility-/system-specific needs allowed
   - Applicable to large loads, VPPs, etc.

Key Players in West: *WECC (and its members), Transmission Providers (TOs, ISO/RTOs, etc.), WIRAB, State PUCs*

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Industry Learnings

IBR Capability and Performance Improvements

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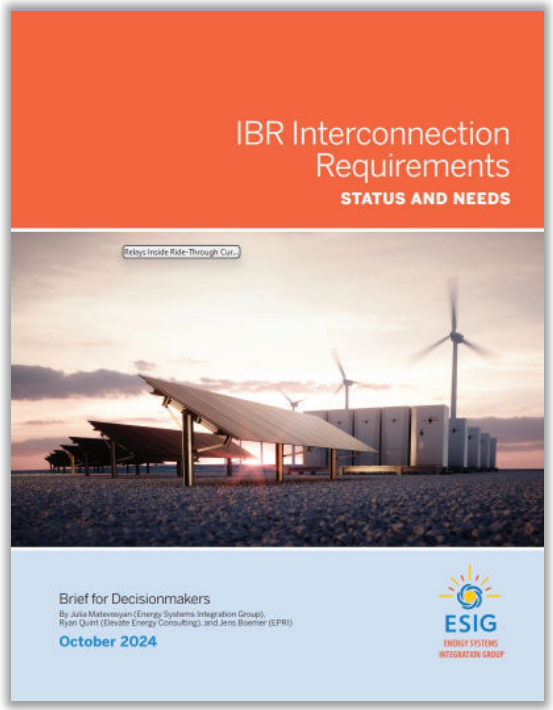
ESIG IBR Interconnection Requirements Brief



[ESIG Brief: IBR Interconnection Requirements]

IEEE 2800-2022 Adoption Strategies

General Reference *Cite IEEE 2800 in Full*	Detailed Reference *Cite IEEE 2800 Clauses*	Hybrid Integration *Organic Integration*	Detailed Spec *Recreate Specs of IEEE 2800*
"Point to standard in existing requirements"	"Point to specific clauses in existing requirements"	"Point to specific clauses and add clarifying language in existing requirements"	"Recreate requirements language entirely"
✓Minimal effort to adopt × **Limited system-specific details*** × Lacks clarity and specificity × **Leaves gaps in implementation and understanding**	✓Targeted enhancements ✓Allows phased approach × **Limited system-specific details***	✓Targeted enhancements ✓Allows phased approach ✓Allows adaptation and additional requirements ✓**System-specific and clear** ✓Enables conformity language additions	✓Targeted enhancements ✓Allows phased approach ✓Allows adaptation and tailored solution for specific rules framework ✓Enables conformity language × **Significant work and duplication for AGIR** × Copyright concerns

*** Industry practice has tended not to provide the necessary AGIR-specific details (i.e., functional settings) needed for complete adoption of IEEE 2800-2022.**

Notes: Green text indicates advantages of the adoption method, yellow text indicates limitations, and red text indicates gaps. More important advantages, limitations, and gaps are in bold. AGIR = Authority Governing Interconnection Requirements.

Source: Elevate Energy Consulting.

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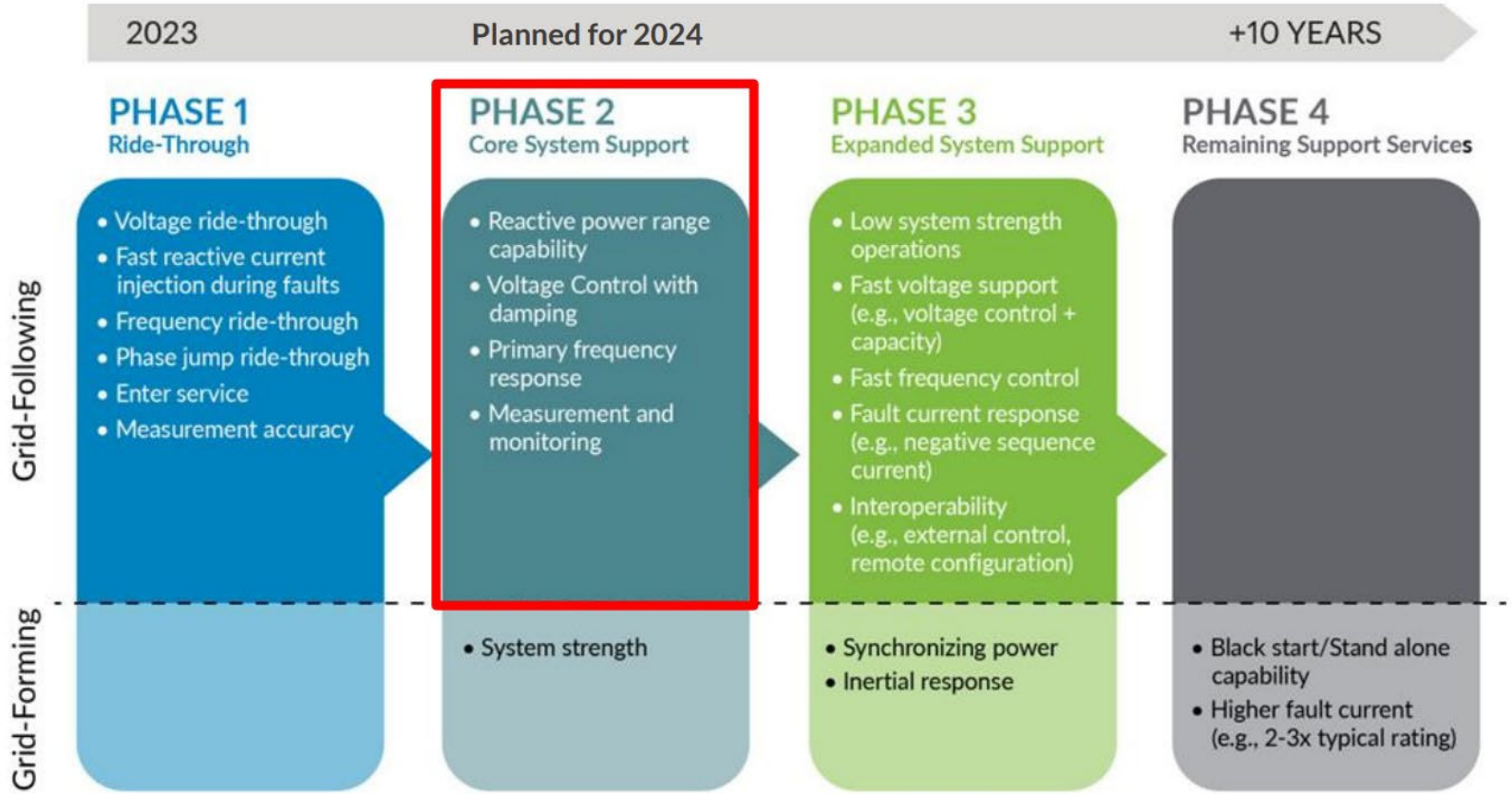
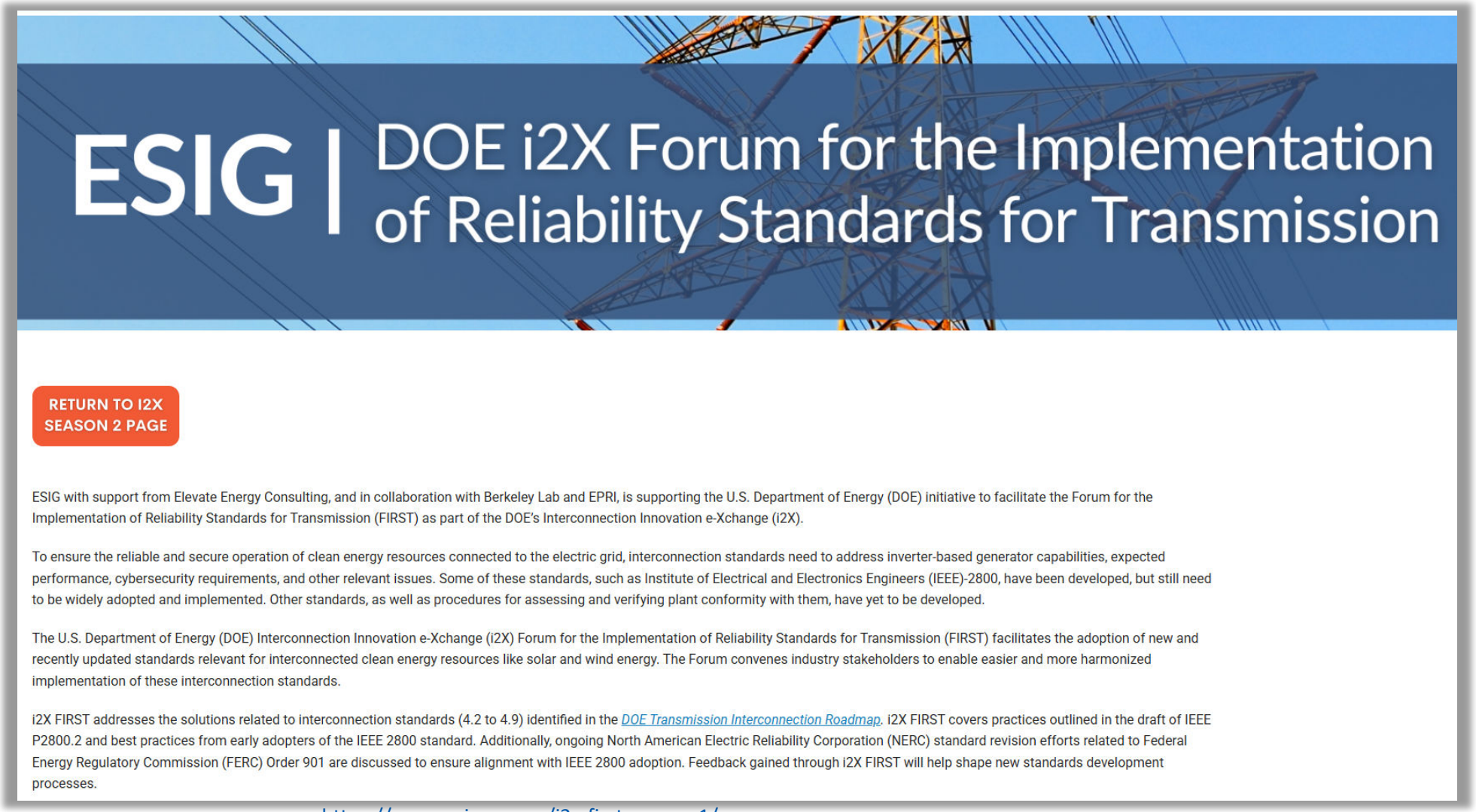
MISO Efforts for IEEE 2800 Adoption

IBR performance requirements were identified as a key solution to ensuring system stability, and four main phases were proposed in the Attributes roadmap



Attributes Roadmap Publication: https://cdn.misoenergy.org/2023%20Attributes%20Roadmap631174.pdf

DOE i2X FIRST Initiative

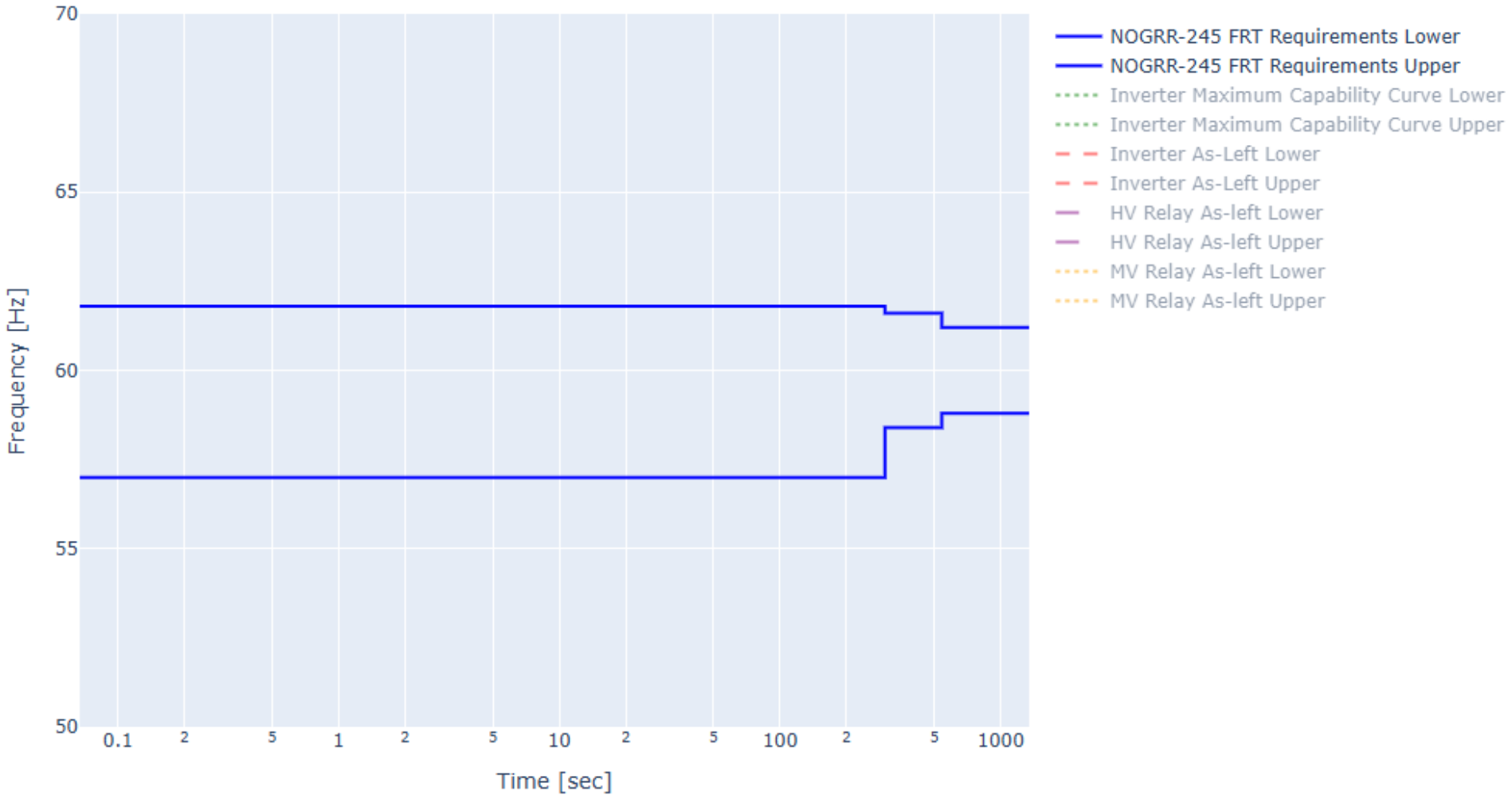


https://www.esig.energy/i2x-first-season-1/
https://www.esig.energy/i2x-first-forum/
Register for Season 2

NOGRR 245 Successes

- IBR ride-through maximization will likely dramatically improve the capabilities and operational performance of IBRs across the ERCOT system
- Maximization is a successful concept – many instances of IBR facilities commissioned with settings meeting requirements at the time but below maximum equipment capabilities
- Expanded ride-through capabilities at inverter level and balance of plant relaying, using software-based upgrades
- Disabling protections prone to tripping (phase jump, ROCOF, anti-islanding, instantaneous protection, unfiltered quantities, etc.), where possible
- Upcoming improved IBR model quality that aligns with as-left equipment in the field
- Resource Entities strongly leaning in to maximize ride-through capability and support the ERCOT system; seeking information from OEMs persistently, directly, and clearly

Frequency Ride-Through (FRT) Example



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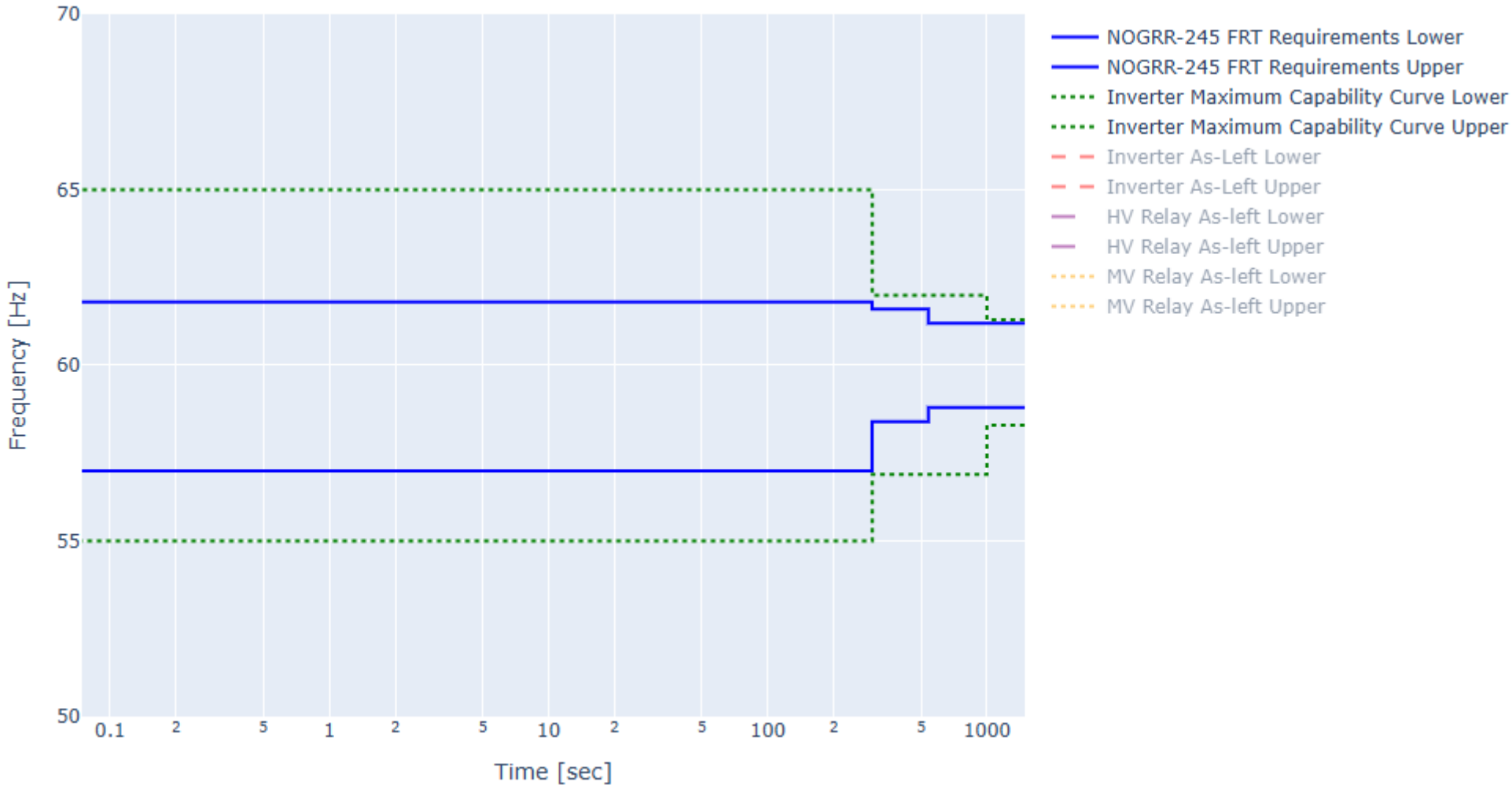
Frequency Ride-Through (FRT) Example



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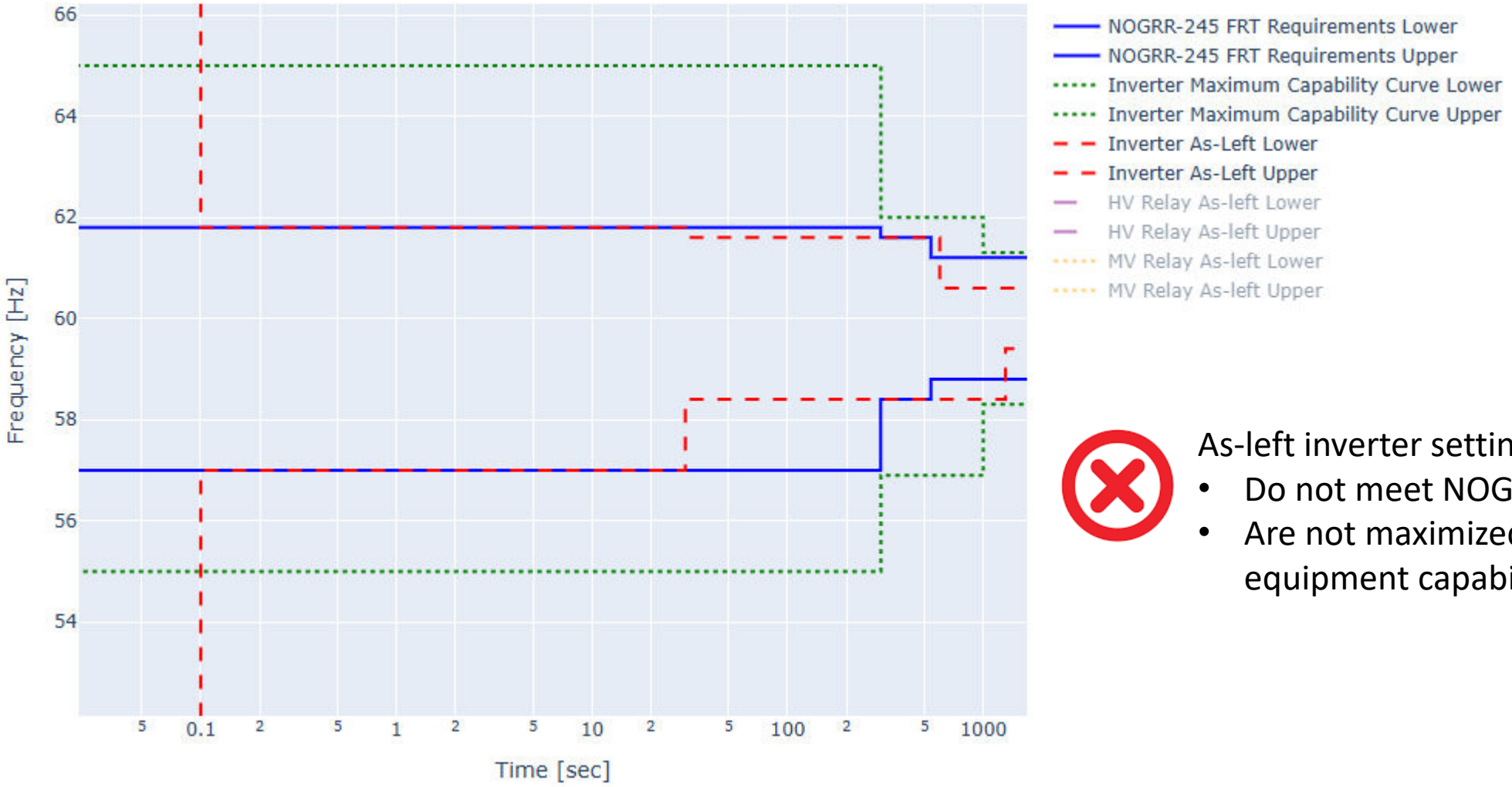
Frequency Ride-Through (FRT) Example



As-left inverter settings:

- Do not meet NOGRR curves
- Are not maximized to equipment capability

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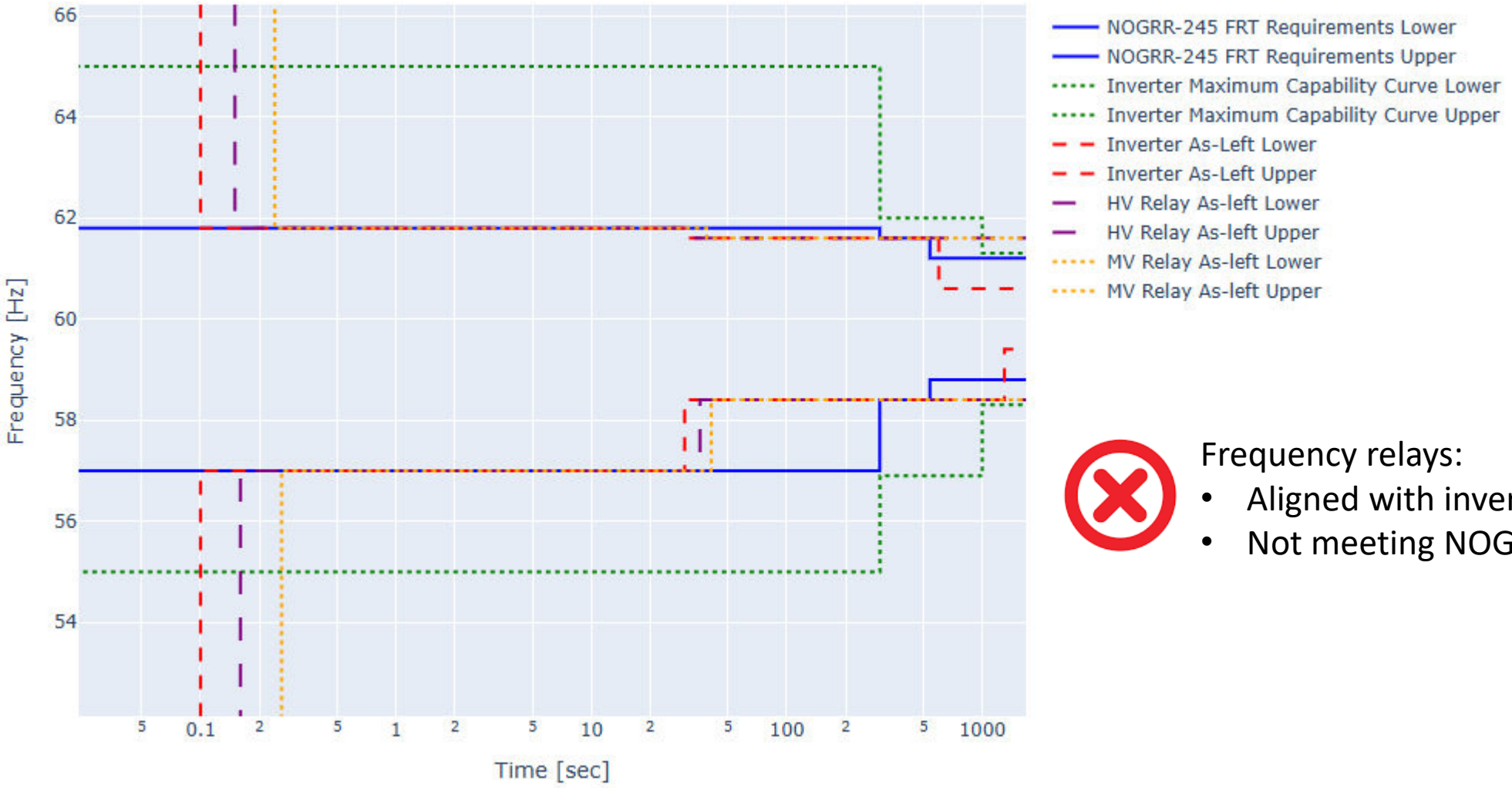
Frequency Ride-Through (FRT) Example



Frequency relays:

- Aligned with inverter
- Not meeting NOGRR curve

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NOGRR 245 Compliant FRT Curves

- Inverter settings set to maximum equipment capability
- Inverter and BOP relay settings outside NOGRR curve Aligned with inverter
- BOP relay settings coordinated with inverter settings.

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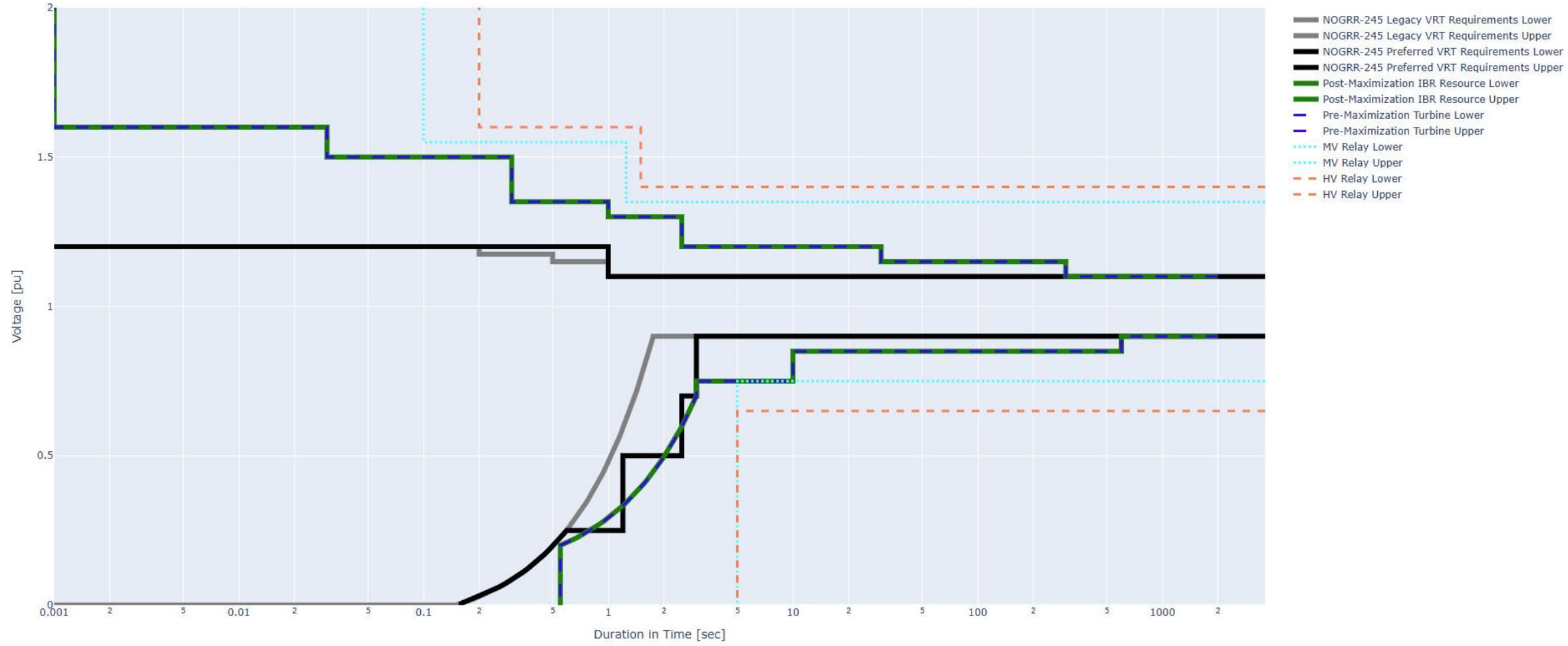
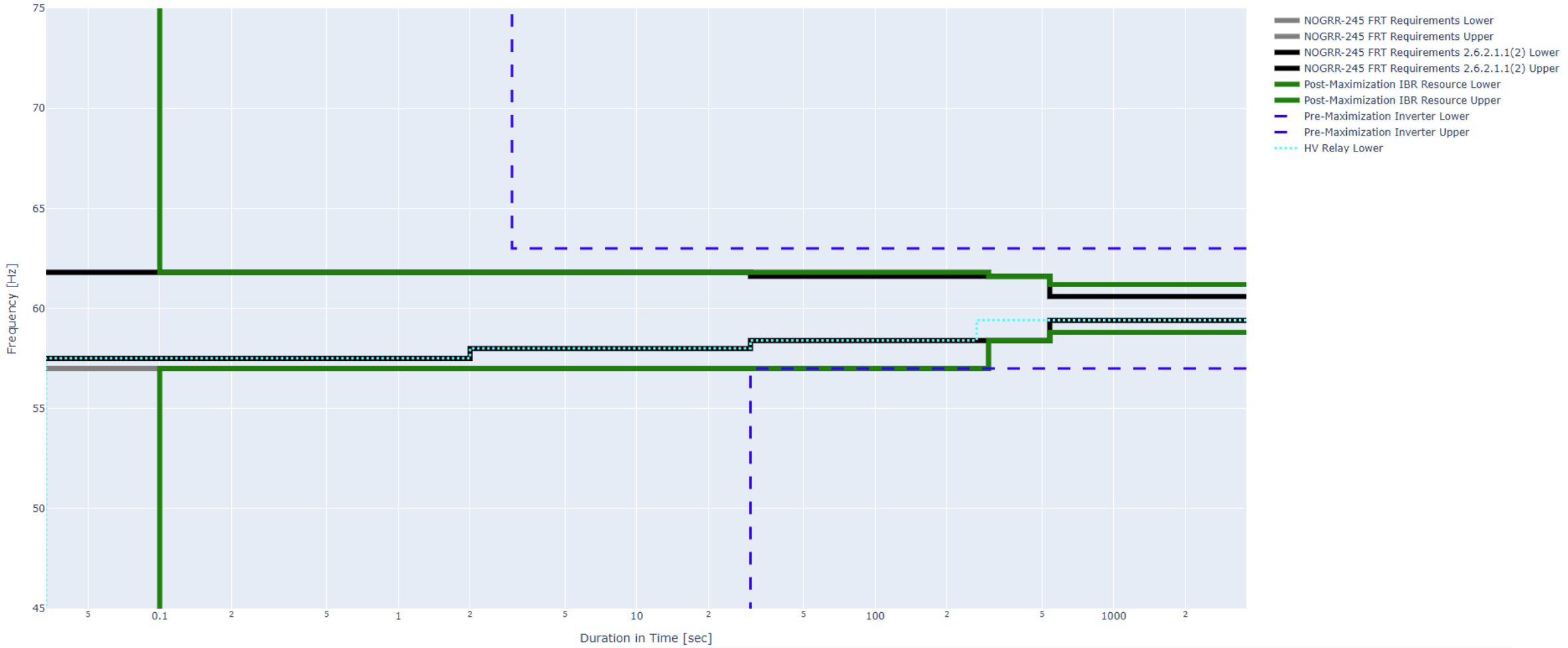
Sites Already Maximized



- IBR unit protections set based on capabilities
- Balance of plant protections well outside IBR unit ride-through capability
- Tripping-prone protections already disabled

Relays Inside Ride-Through Curve



- Relay settings unexpectedly inside IBR unit ride-through curves
- Relay settings unexpectedly inside ride-through curve (legacy)
- Relay settings being expanded to eliminate these risks

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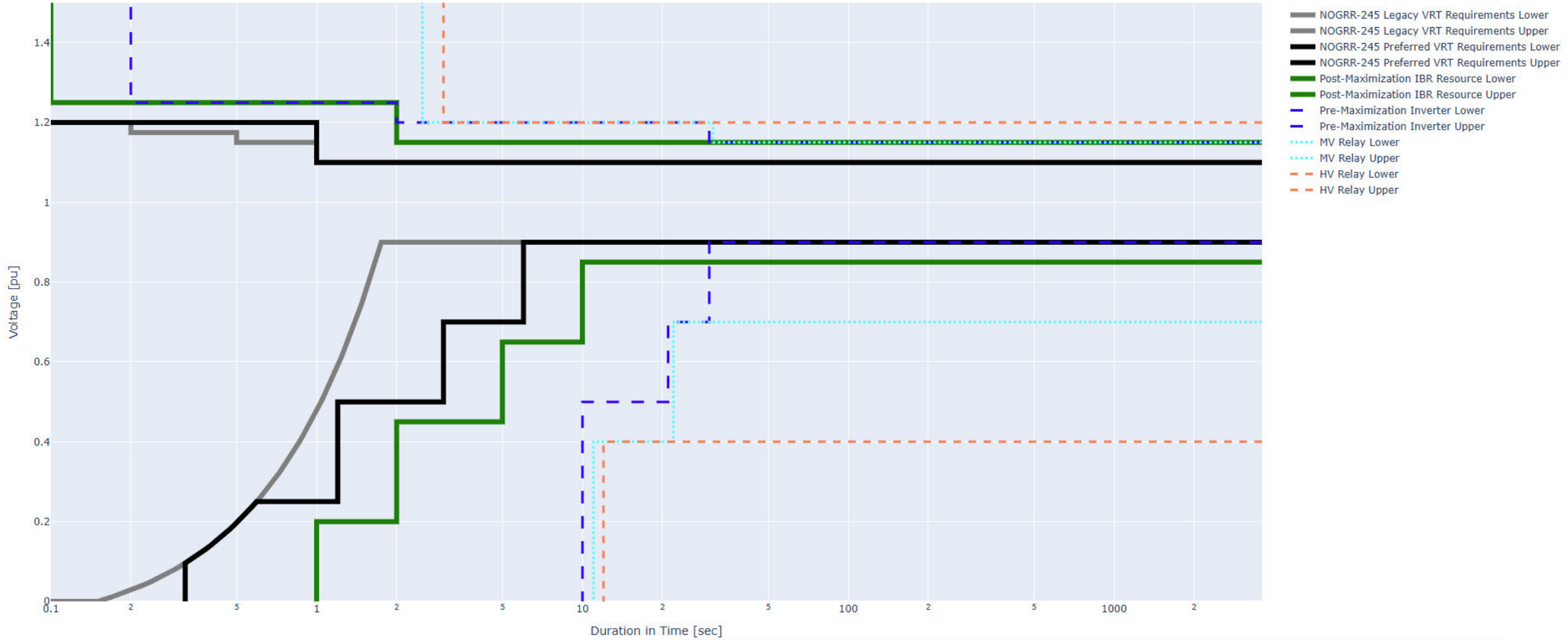
Inverter Protection Beyond Equipment Capability



- IBR unit protections set well beyond stated capabilities unexpectedly
- OEMs recommend bringing them in to protect inverters
- Aligning with concepts of maximization and well outside requirements

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Group Discussion

Overview, Discussion, and Next Steps

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This Industry Advisory Group (IAG) Initiative

- Create forum to share lessons learned, questions, findings, etc.
- Foster harmonization of interconnection requirements across the West, with adequate room for system-specific needs
- Support smaller entities or entities maybe further behind
- Improve adoption of industry-recommended standards like IEEE 2800-2022
- ***Goals:***
  - Develop and publish “template” Facility Interconnection Requirements (FIRs) that entities can adopt and adapt as needed
  - Open, engaging, informal, collaborative, and respectful environment – share and learn

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Slido Q&A and Polls

- Join Link: https://app.sli.do/event/wtMoSEvQxpzj35FZ9oVYWk
- Slido.com
- Join Code: 2146224

Discussion Points

- What have been the main challenges and/or barriers for enhancing IBR interconnection requirements?
- What would you like to get out of this IAG forum? How can it provide the most value to you, your department, and your organization?
- Open Q&A and discussion

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Meeting Series

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Register for the entire series!
https://us06web.zoom.us/meeting/register/FUwPrsIOS9q1gCpnkuZCPA

Slido Engagement

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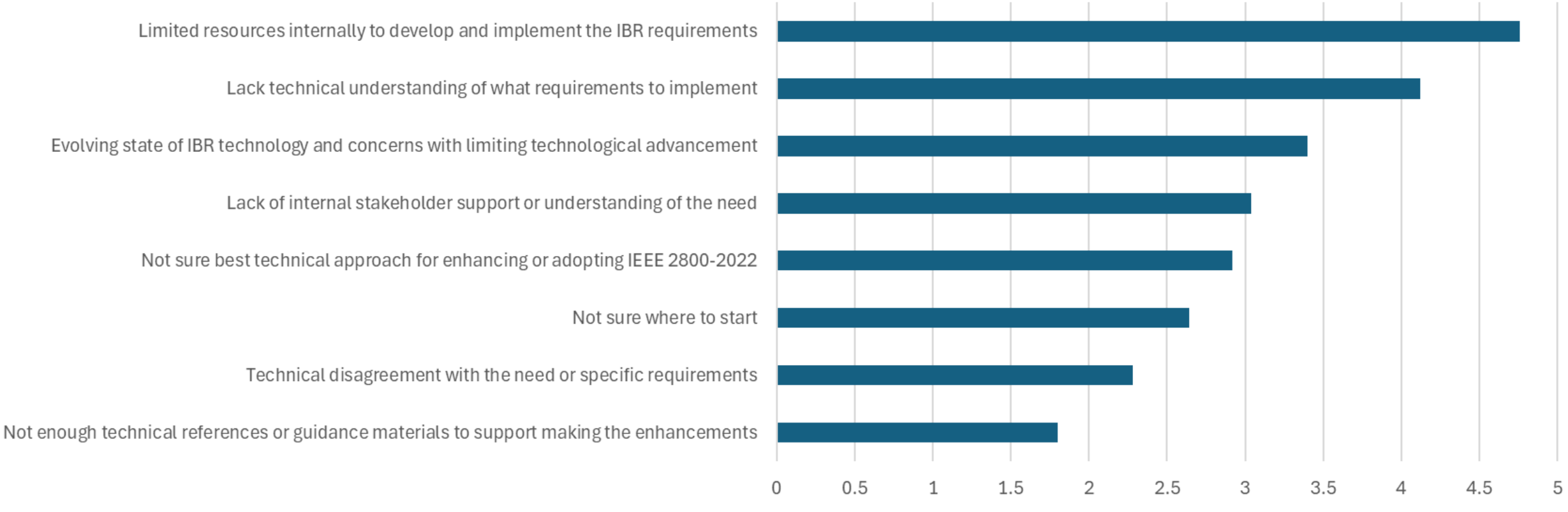
Q1: What have been the main challenges and/or barriers for enhancing IBR interconnection requirements?

**25 respondents*



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Q2: What would you like to get out of this IAG forum? How can it provide the most value to you, your department, and your organization?

- Guideline on the implementation of IEEE 2800, templates that can be used as a starting point. Better understanding of the technical requirements in the standard. Workshops on how to conducting performance-based studies to develop more specific and clear requirements.
- Identification and sharing of best practices would be very helpful. It would be helpful to not only see best practices for interconnection requirements, but also how requirements can best be met by developers
- Visibility of and confidence in interconnected IBR plant settings and conformity with NERC and IEEE 2800 standards.
- What else do we need above IEEE 2800 and NERC reliability standards being developed under FERC Order 901. Is there anything missing?
- Compliance once standards and grid codes are in place.
- Just hearing what obstacles are, have been, and how they are being overcome. Plus, what's good today and why it may not be good enough tomorrow.
- A common set of interconnection requirements that are consistent across the west and can be used by anyone.
- "Best Practice" Facility Interconnection Requirements

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