

WIRAB Monthly Meeting

December 4, 2025



Introductions



Agenda



WECC Activities:

WECC Update



WIRAB Activities:

Harmonizing Interconnection Requirements in the
West Project

Resource Adequacy Update



Upcoming WIRAB Meetings

WECC Update

Kris Raper

Vice President, Strategic Engagement & External Affairs

**Electric Reliability
& Security for the West**

December 4, 2025

Outage Update

- Thursday, November 13 at 12:45 p.m. MST
- 4 GW of generation was lost, and several transmission lines
- Widespread outages in SW Wyoming and SW South Dakota
 - Affected utilities included Rocky Mountain Power, Black Hills Energy, and Powder River Energy Corporation
 - The Western Area Power Administration's (WAPA) distribution utility customers in Wyoming and South Dakota were also impacted
- Cause remains unknown
- WECC/NERC review under way

2025–2026 Winter Reliability Assessment Western Overview

- NERC's 2025–2026 Winter Reliability Assessment (WRA) evaluates system resource adequacy and reliability across North America for the upcoming winter season
- Western Interconnection takeaways:
 - Most of the West is at normal risk with reserves ready for expected peak load conditions
 - Two subregions, Northwest and Basin, are expected to be at an elevated risk for shortages during extreme weather
 - Natural gas production and supply will be crucial during the highest risk periods
 - Cold weather standards have been improved to address recommendations from recent winter storms
- [Read](#) the western overview
- [Read](#) the full report

Board of Directors

- December 9–10 in Salt Lake City
- [Register](#) to attend virtually
- Technical session December 9, 2:30–3:30 p.m. MST
 - Market development in the West
 - Topics to be addressed:
 - Current state of market development in the West
 - What to anticipate
 - Reliability considerations of market expansion
 - Importance of coordination and communication



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Harmonizing IBR Interconnection Requirements Across the West



Overview:

WIRAB and Elevate Energy are advancing a 2024 WIRAB recommendation to harmonize Inverter-Based Resource (IBR) interconnection requirements across the Western Interconnection.



Deliverable:

A publicly available template for Facility Interconnection Requirements (FIRs) for Transmission Providers.



Goals:

Increase IBR requirements education
Promote best practices aligned with IEEE 2800-2022
Encourage consistency and transparency across the West
Regular updates to WIRAB



Approach:

Hold monthly virtual stakeholder meetings (May–Dec 2025)
Review industry experiences
Draft and refine a FIR template
Facilitate regional information exchange



Industry Advisory Group:

Transmission Providers
Transmission Planners
Transmission Regulatory Compliance Specialists
IBR Developers
Other technical experts



Enhancing IBR Requirements

Template Facility Interconnection Requirements for IBRs

Ryan D. Quint, PhD, PE, *President and CEO, Elevate*

December 4, 2025

IBR Risk Assessment Report

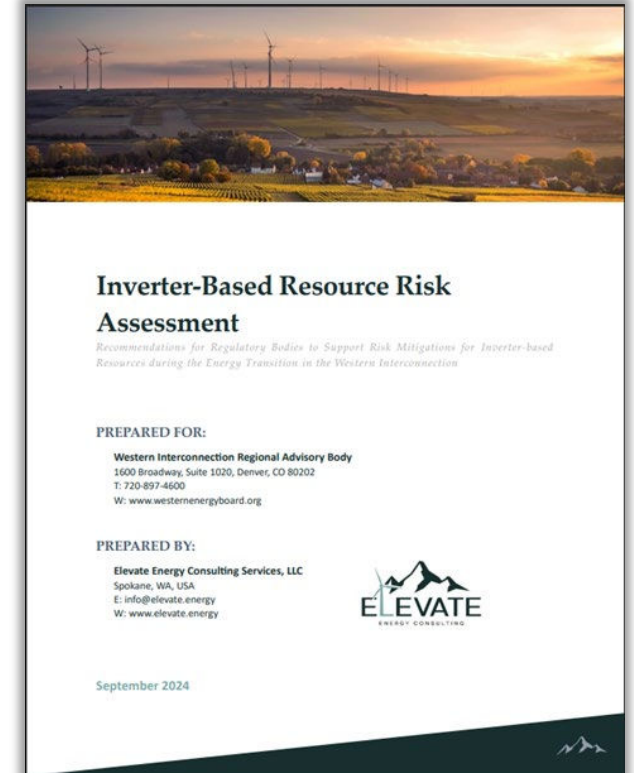


- **2024 Report and Recommendations Endorsed by WIRAB:**
 - WIRAB to collaborate with WECC and other key stakeholders to prioritize and implement the recommendations outlined in this report.
- **Key Message:**
 - Create a standardized template for FIR enhancements, ideally implementing IEEE 2800-2022 standard.



Risk Assessment Recommendations

- **Harmonize requirements for IBRs across the West**
 - Leverage IEEE 2800-2022 and latest implementation learnings
 - Enhance Facility Interconnection Requirements for IBRs
 - Produce a standardized template for requirements enhancements
- **Lead proactive, stakeholder-engaged risk mitigation efforts**
 - Conduct regional training, education, and engagement
 - Support smaller entities, allow utility/system-specific flexibility
 - Focus on both observed risks and future challenges
- **Consider developing related requirements for large loads**



Industry Advisory Group Initiative

- Forum to educate stakeholder about IEEE 2800-2022, support broader adoption of the standard
- Sharing experience and lessons learned among transmission entities
- Fostering harmonization of interconnection requirements across the West
- Supporting smaller entities or entities maybe further behind
- Publishing “template” Facility Interconnection Requirements (FIRs) appendix for entities to adopt and adapt, as needed

Template Facility Interconnection Requirements for Adopting
IEEE 2800-2022 for Inverter-Based Resources Connecting to
the Bulk Power System

Version 1.0

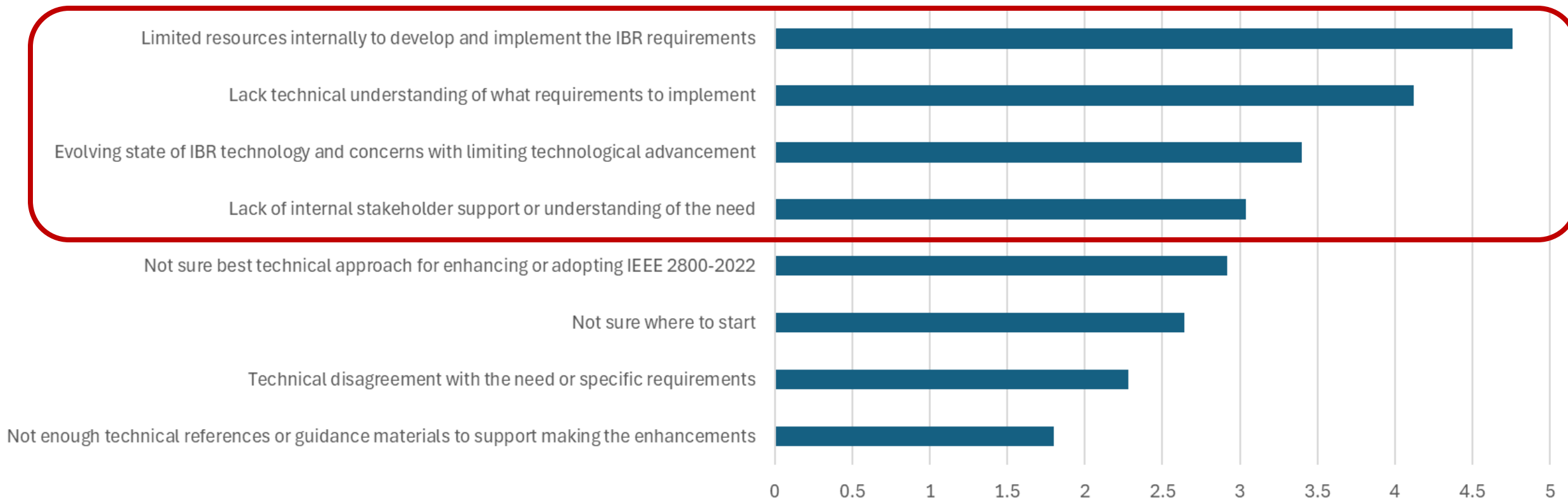
Published: December 2025

Developed by Elevate Energy Consulting in collaboration with transmission providers across the
Western Interconnection and endorsed by the Western Interconnection Regional Advisory Body
(WIRAB) in December 2025.

Action: adopt the template and harmonize!

Learn more [here!](#)

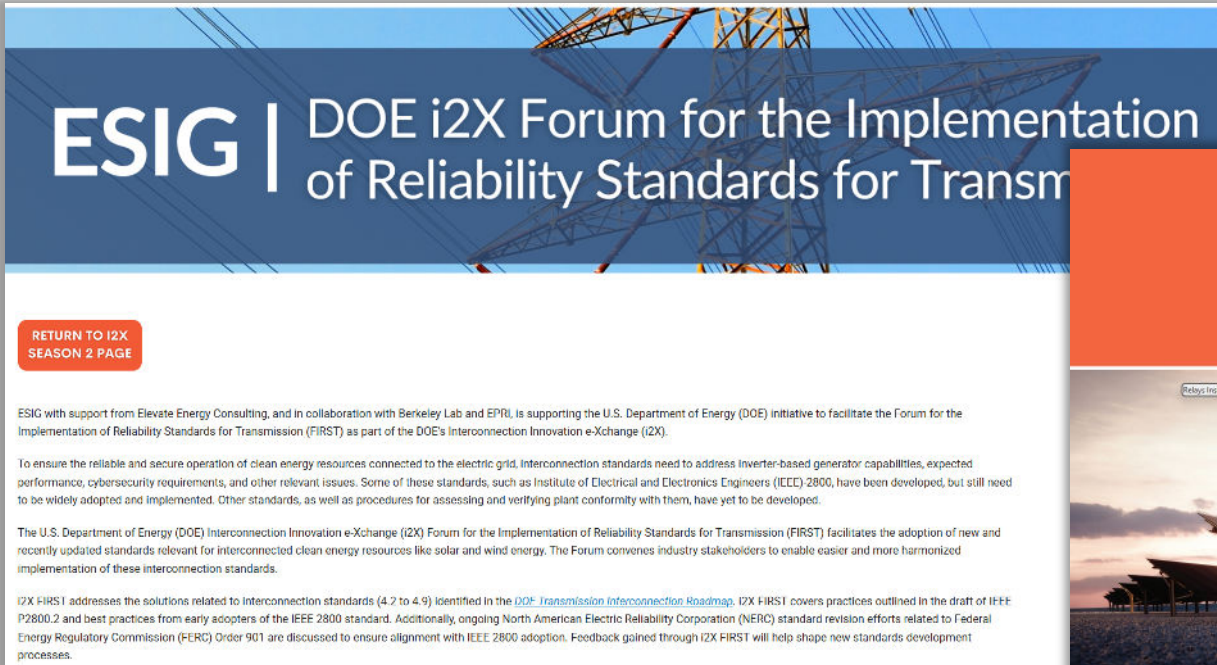
“What have been the main challenges and/or barriers for enhancing IBR interconnection requirements?”



“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?”

- Guidelines on the implementation of IEEE 2800; “best practices” template that can be used as a starting point
- Deeper understanding of technical requirements in standard
- Learning from others – obstacles, challenges, successes
- Identification and sharing of best practices (developing requirements and implementing such requirements)
- Visibility of and confidence in interconnected IBR plant settings and conformity with NERC and IEEE 2800 standards
- Alignment with FERC Order 901 activities – what’s missing or different

DOE i2X FIRST Initiative



ESIG | DOE i2X Forum for the Implementation of Reliability Standards for Transmission

RETURN TO I2X SEASON 2 PAGE

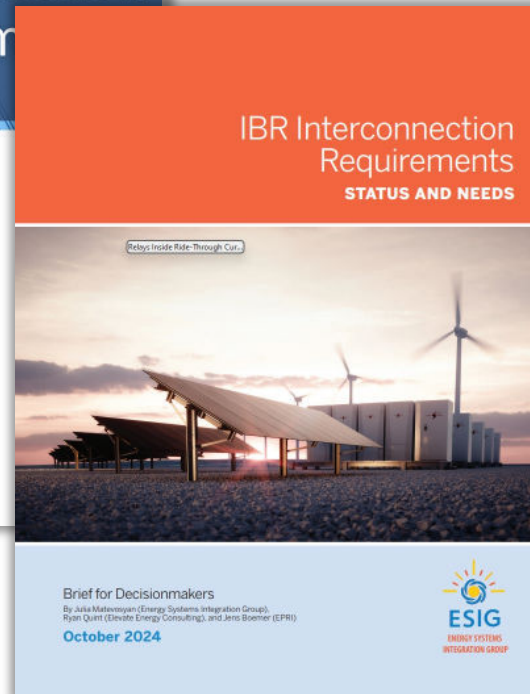
ESIG with support from Elevate Energy Consulting, and in collaboration with Berkeley Lab and EPRI, is supporting the U.S. Department of Energy (DOE) initiative to facilitate the Forum for the Implementation of Reliability Standards for Transmission (FIRST) as part of the DOE's Interconnection Innovation e-Xchange (i2X).

To ensure the reliable and secure operation of clean energy resources connected to the electric grid, interconnection standards need to address inverter-based generator capabilities, expected performance, cybersecurity requirements, and other relevant issues. Some of these standards, such as Institute of Electrical and Electronics Engineers (IEEE) 2800, have been developed, but still need to be widely adopted and implemented. Other standards, as well as procedures for assessing and verifying plant conformity with them, have yet to be developed.

The U.S. Department of Energy (DOE) Interconnection Innovation e-Xchange (i2X) Forum for the Implementation of Reliability Standards for Transmission (FIRST) facilitates the adoption of new and recently updated standards relevant for interconnection clean energy resources like solar and wind energy. The Forum convenes industry stakeholders to enable easier and more harmonized implementation of these interconnection standards.

i2X FIRST addresses the solutions related to interconnection standards (4.2 to 4.9) identified in the DOE *Transmission Interconnection Roadmap*. i2X FIRST covers practices outlined in the draft of IEEE P2800.2 and best practices from early adopters of the IEEE 2800 standard. Additionally, ongoing North American Electric Reliability Corporation (NERC) standard revision efforts related to Federal Energy Regulatory Commission (FERC) Order 901 are discussed to ensure alignment with IEEE 2800 adoption. Feedback gained through i2X FIRST will help shape new standards development processes.

<https://www.esig.energy/i2x-first-season-1/>
<https://www.esig.energy/i2x-first-forum/>
[Register for Season 2](#)




IBR Interconnection Requirements
STATUS AND NEEDS

Delays Inside Rate-Through Cut...

Brief for Decisionmakers
By Arisa Malesiosyan (Energy Systems Integration Group), Ryan Quitt (Elevate Energy Consulting), and Jens Boerner (EPRI)
October 2024

ESIG
ENERGY SYSTEMS INTEGRATION GROUP

[ESIG Brief: IBR Interconnection Requirements](#)



IEEE SA
STANDARDS ASSOCIATION

IEEE Standard for Interconnection and Interoperability of Inverter-Based Resources (IBRs) Interconnecting with Associated Transmission Electric Power Systems

IEEE Power and Energy Society

Developed by the
Energy Development & Power Generation Committee, Electric Machinery Committee, and Power System Relaying & Control Committee

IEEE Std 2800™-2022

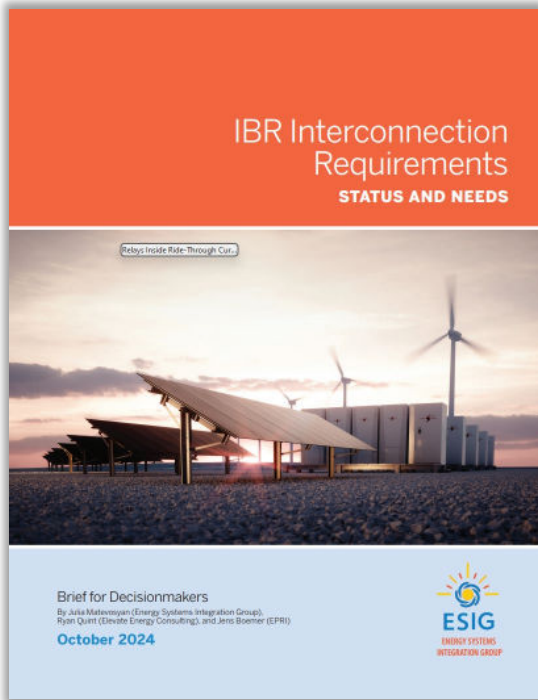
IEEE

STANDARDS

[IEEE 2800-2022](#)

ESIG IBR Requirements Brief

IEEE 2800-2022 Adoption Strategies



General Reference

Cite IEEE 2800 in Full

“Point to standard in existing requirements”

- ✓ Minimal effort to adopt
- × **Limited system-specific details***
- × Lacks clarity and specificity
- × **Leaves gaps in implementation and understanding**

Detailed Reference

Cite IEEE 2800 Clauses

“Point to specific clauses in existing requirements”

- ✓ Targeted enhancements
- ✓ Allows phased approach
- × **Limited system-specific details***

Hybrid Integration

Organic Integration

“Point to specific clauses and add clarifying language in existing requirements”

- ✓ Targeted enhancements
- ✓ Allows phased approach
- ✓ Allows adaptation and additional requirements
- ✓ **System-specific and clear**
- ✓ Enables conformity language additions

Detailed Spec

Recreate Specs of IEEE 2800

“Recreate requirements language entirely”

- ✓ 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.

Template Facility Interconnection Requirements



Template Facility Interconnection Requirements for Adopting IEEE 2800-2022 for Inverter-Based Resources Connecting to the Bulk Power System

Version 1.0

Published: December 2025

Developed by Elevate Energy Consulting in collaboration with transmission providers across the Western Interconnection and endorsed by the Western Interconnection Regional Advisory Body (WIRAB) in December 2025.



1. General Disclaimer

This document is provided for informational purposes only and does not constitute legal, technical, or regulatory advice. WIRAB and Elevate Energy Consulting make no representations or warranties regarding the accuracy, completeness, or applicability of the information contained herein.

2. No Endorsement or Obligation

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4. Responsibility of Implementing Parties

Utilities and other implementing parties assume full responsibility for the interpretation, adaptation, and application of this template. It is the sole responsibility of such parties to verify that any implementation aligns with applicable standards, including IEEE 2800-2022 and NERC/WECC Reliability Standards, and to seek independent professional advice as needed.

5. No Guarantee of Compliance

This template does not guarantee compliance with IEEE 2800-2022 or any other regulatory or technical standards such as NERC/WECC Reliability Standards. Users must conduct their own due diligence and consult qualified professionals before implementation.

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EXECUTIVE SUMMARY

This document provides a recommended template for Facility Interconnection Requirements (FIRs)¹ focused on bulk power system-connected inverter-based resources (IBRs), in alignment with [IEEE 2800-2022](#), *IEEE Standard for Interconnection and Interoperability of Inverter-Based Resources Interconnecting with Associated Transmission Electric Power Systems*. The purpose of this template is to assist transmission providers across the Western Interconnection in establishing consistent and technically sound requirements that can be adopted or appended to their existing FIRs.

The Western Interconnection is seeing rapid growth in IBR development, driven by decarbonization policies, market signals, and resource planning. However, diverging technical interconnection requirements for IBRs across transmission providers introduces uncertainty for IBR developers, creates inefficiencies in the study and commissioning processes, and can potentially raise reliability risks since non-standardized approaches can lead to errors.

To address these challenges, the Western Interconnection Regional Advisory Body (WIRAB) partnered with [Elevate Energy Consulting](#) to develop this document with input from transmission providers across the West. It distills key elements of IEEE 2800-2022 into practical utility-facing requirements, covering topics such as disturbance ride-through, reactive power-voltage control, active power-frequency control, protection and coordination, modeling expectations, and monitoring and verification activities. Where appropriate, explanatory guidance is included to support consistent implementation across jurisdictions and technology platforms.

Transmission providers are encouraged to integrate this template (and adapt as needed) into their existing FIR documents, either by direct incorporation or as a referenced appendix. Use of this common framework will support greater regional consistency, reduce developer confusion, and help ensure that newly interconnected IBRs contribute positively to grid reliability and performance.

This template is intended to evolve over time. Feedback from utilities, developers, and equipment manufacturers is welcome to ensure that the content remains clear, current, and technically appropriate.

More information about the development of this project is available on the project webpage: [Harmonizing IBR Interconnection Requirements in the West](#)

¹ Also referred to as Facility Connection Requirements (FCRs)

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Template FIRs for IBRs

- Implementation Details
 - Applicability
 - Adoption Strategy
 - Clarification of Terms
 - Technical Exceptions
 - Entity Roles and Responsibilities
 - Noncompliance Consequences
- IEEE 2800-2022 Adoption
 - Front Matter (Clauses 1-3)
 - General Technical Specs (Clause 4)
 - Reactive Power-Voltage Control (Clause 5)
 - Active Power-Frequency Response (Clause 6)
 - Response to Abnormal Conditions (Clause 7)
 - Power Quality (Clause 8)
 - Protection (Clause 9)
 - Modeling and Studies (Clause 10)
 - Measurement Data (Clause 11)

Template FIRs for IBRs

Clause 4.10: Enter Service

[INSERT TRANSMISSION PROVIDER NAME] adopts the requirements for IBR plants to enter service as defined in Clause 4.10 of IEEE 2800-2022 and its sub-clauses. The table below replaces Table 3 of IEEE 2800-2022 for enter service criteria for IBR plants.

Enter service criteria		Default settings
Permit service	When enabled	Disabled
Applicable voltage within range	Minimum value	[Enter value – e.g., 0.95 pu]
	Maximum value	[Enter value – e.g., 1.05 pu (operating voltage)]
Applicable frequency within range	Minimum value	[Enter value – e.g., 59.4 Hz]
	Maximum value	[Enter value – e.g., 60.12 Hz]

Footnote a. For any IBR plant connected to a weak grid, the default minimum voltage value to enter service shall be [Enter value – e.g., 0.98 pu]. [INSERT TRANSMISSION PROVIDER NAME] will inform the IBR owner of this modified requirement, if applicable.

Clause 4.10.3: Performance During Entering Service

The default enter service period for IBR plants shall be [INSERT VALUE] seconds unless otherwise directed by [INSERT TRANSMISSION PROVIDER NAME]. The IBR plant shall have a smooth and continuous active power ramp while operating on voltage control with no significant oscillations or instability characteristics during return to service operation.

CLAUSE 5: REACTIVE POWER-VOLTAGE CONTROL REQUIREMENTS IN CONTINUOUS OPERATION REGION

[INSERT TRANSMISSION PROVIDER NAME] adopts Clause 5 of IEEE 2800-2022 with the following clarifications and modifications.

Clause 5.1: Reactive Power Capability

The RPA for Clause 5 shall be the [select POM or POI].

The IBR plant shall provide reactive power support when the primary energy source is available and not available, and during the transition between these availability states. Reactive power capability during resource active power unavailability shall be reported to [INSERT TRANSMISSION PROVIDER NAME] by the IBR owner and shall be enabled by default when the IBR plant is connected to the [INSERT TRANSMISSION PROVIDER NAME] system.

[INSERT TRANSMISSION PROVIDER NAME] will provide a voltage schedule to the IBR owner. The IBR plant shall operate on automatic voltage control to maintain voltage within the defined ranges provided.

The following table replaces Table 4 of IEEE 2800-2022 regarding RPA voltage ranges.

TS Nominal Voltage at [INSERT RPA LOCATION]	V1	V2	V3	V4	V5
115 kV or 69kV	VAL	VAL	VAL	VAL	VAL
230 kV (including 345kV)	VAL	VAL	VAL	VAL	VAL
500 kV	VAL	VAL	VAL	VAL	VAL

Implementation Note: Update the table above with operational voltage schedules.

The RPA location is typically either the POI or POM. Ensure that the per unit values in the table align with operational expectations by system operators. For example, 500 kV systems may be operated at, say, 525 kV. An example table would look like:

TS Nominal Voltage at POI	V1	V2	V3	V4	V5
115 kV or 69kV	0.90	0.99	1.03	1.05	1.10
230 kV (including 345kV)	0.90	1.00	1.04	1.05	1.10
500 kV	0.9	1.02	1.06	1.10	1.10

Clause 5.2.1 General (Voltage and Reactive Power Control Modes)

IBR plants, unless otherwise specified by [INSERT TRANSMISSION PROVIDER NAME], shall operate in RPA voltage control mode. [INSERT TRANSMISSION PROVIDER NAME] will communicate any modifications to voltage control mode and an acceptable implementation time, if needed.

Clause 5.2.2 Voltage control (Voltage and Reactive Power Control Modes)

[INSERT TRANSMISSION PROVIDER NAME] will specify the RPA voltage set point to the IBR owner. The RPA set point may include a range of acceptable voltages.

The IBR plant shall be configured with a default voltage droop setting of [insert value between 0 and 0.3] per unit voltage change for 1.0 per unit reactive power on the ICR base, unless otherwise specified by [INSERT TRANSMISSION PROVIDER NAME]. [INSERT TRANSMISSION PROVIDER NAME] may provide different voltage droop settings to the IBR plant owner at any time based on system studies. The IBR owner shall configure the IBR plant with these modified

Upcoming Industry Webinar

Upcoming Webinar: December 17 at 1:00 PM MT (12:00 PM PT)

Join us for a live webinar introducing the FIR Template, walking through major sections, and discussing implementation of the FIR template into utility procedures across the West.

REGISTER FOR THE WEBINAR

Previous Meeting Materials:

- May 19, 2025 | **Introduction, Background, Goals, Timeline** | [Agenda](#), [Slide Deck](#), [Meeting Recording](#)
- June 26, 2025 | **Overview of IEEE 2800 and IBR Requirements Plan** | [Agenda](#), [Slide Deck](#), [Meeting Recording](#)
- July 17, 2025 | **IBR Requirements Enhancements – Industry Experience** | [Agenda](#), [Slide Deck](#), [Meeting Recording](#)
- August 28, 2025 | **Draft Template Review: General Interconnection Requirements*** | [Agenda](#), [Slide Deck](#)
- September 25, 2025 | **Draft Template Review: Technical Performance Requirements*** | [Agenda](#), [Slide Deck](#)
- October 23, 2025 | **Draft Template Review: Model & Study Requirements*** | [Agenda](#), [Slide Deck](#)
- November 13, 2025 | **Draft Template Review: SCADA, Monitoring, Compliance*** | [Slide Deck](#)
- December 17, 2025 from 1:00 – 2:00 p.m. MT | **Final Review & Closeout**

Thank You!

Eric Baran, ebaran@westernenergyboard.org

Ryan Quint, ryan.quint@elevate.energy



Resource Adequacy Update

Laura Rennick
Executive Director, WIEB



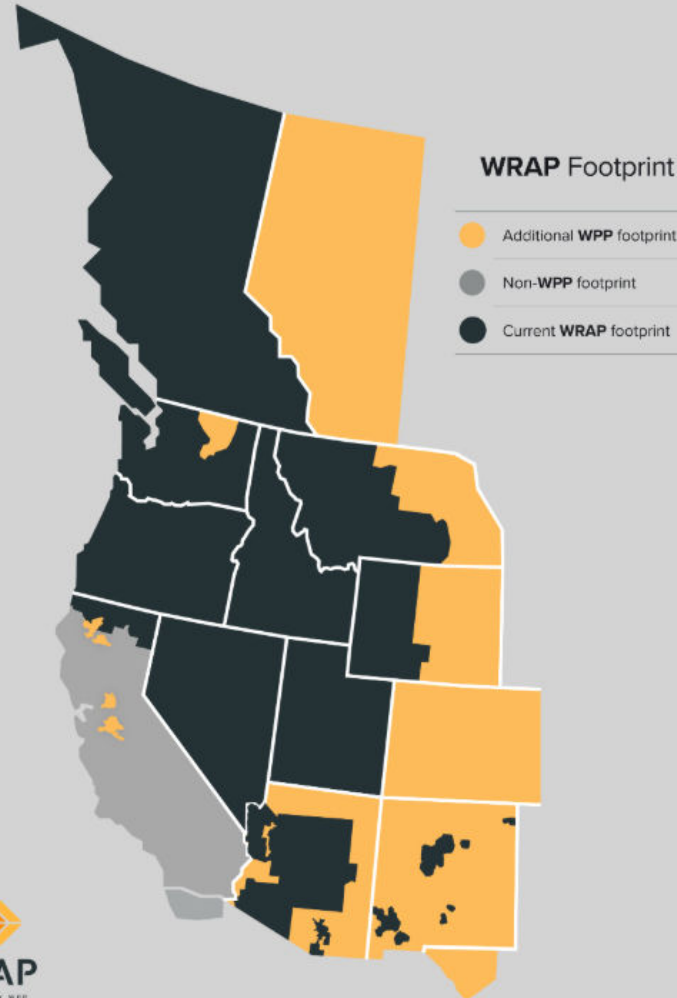
WPP WRAP Footprint

Current participants in the Western Resource Adequacy Program. All will be part of binding operations beginning in Winter 2027/2028 unless otherwise noted.

- Arizona Public Service Company
- Avista Corp
- Bonneville Power Administration
- Calpine Energy Solutions*
- PUD No. 1 of Chelan County
- Clatskanie People's Utility District
- Constellation
- Eugene Water & Electric Board*
- PUD #2 of Grant County
- Idaho Power
- NorthWestern Energy
- NV Energy*
- PacifiCorp*
- Portland General Electric Company*
- Powerex Corp.
- Public Service Company of New Mexico*
- Puget Sound Energy
- Salt River Project Agricultural Improvement and Power District
- Seattle City Light
- Shell Energy North America^
- Tacoma Power
- The Energy Authority, Inc.
- Tucson Electric Power

* Provided exit notice in October 2025; will leave the program prior to Winter 2027/2028 binding season

^ Provided exit notice in 2024; will leave the program by the end of 2026



**Western Interconnection
Regional Advisory Body**

Resource Adequacy Next Steps



COSR to continue to monitor and engage as appropriate in WRAP task forces and program development at WPP



WECC to release Western Assessment of Resource Adequacy in January 2026

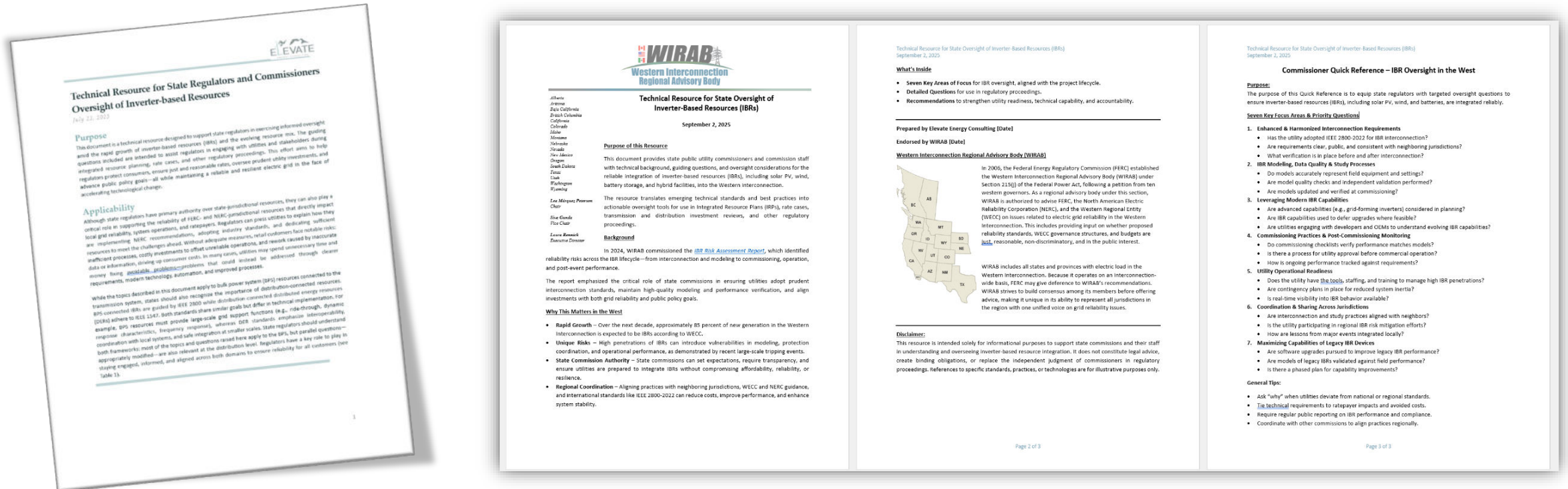


WIRAB host Resource Adequacy discussion at February WIRAB Monthly Meeting

Technical Resources for State Regulators on IBR Oversight



Technical Resources Document available on the [WIEB Website](#)



Upcoming Meetings



WIRAB Monthly Meeting

First Thursday of the Month at 2:00 PM MT

Next Meeting: January 8, 2025 at 2:00 PM MT

Spring 2026 Joint CREPC-WIRAB Meeting

May 12-14, 2026 in San Diego, CA

<https://www.westernenergyboard.org/meeting-calendar/>

Thank You!

Eric Baran

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720-897-4600 x 207

