INTERCONNECTION INNOVATION e-XCHANGE
U.S. DEPARTMENT OF ENERGY

Forum for the Implementation of Reliability Standards for Transmission (i2X FIRST) | 03/16/26

A DOE initiative supported by the Office of Critical Minerals and Energy Innovation (CMEI)

BERKELEY LAB

EPRI

ESIG

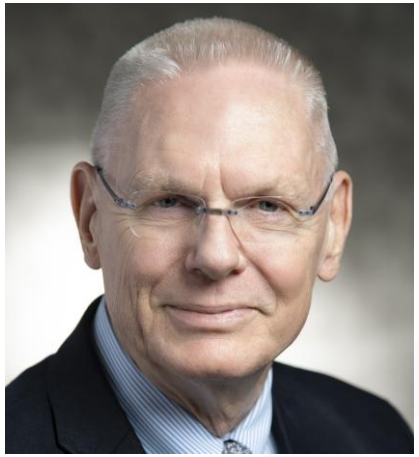
The first half of this meeting call is being recorded and may be posted on ESIG's website. If you do not wish to have your voice recorded, please do not speak during the call. If you do not wish to have your image recorded, please turn off your camera or participate by phone. If you speak during the call or use a video connection, you are presumed consent to recording and use of your voice or image.

Key Goals and Outcomes from i2X FIRST

- To facilitate understanding and adoption of new and recently updated standards relevant for existing and newly interconnecting inverter-based resources.
- The Forum will convene the industry stakeholders to enable practical and more harmonized implementation of these interconnection standards.
- The presentation portion of the meeting will be recorded and posted, and presentation slides will be shared.
- Additionally, the leadership team will produce **a summary of each meeting** capturing:
  - Recommended best practices
  - Challenges
  - Gaps that require future work

Leadership Team

Cynthia Bothwell, Boston Government Services, contractor to DOE



Robert Reedy, Lindahl Reed, contractor to DOE

Will Gorman, Lawrence Berkley National Laboratory

Jens Boemer, Electric Power Research Institute

Julia Matevosyan, Energy Systems Integration Group

Ryan Quint, Elevate Energy Consulting

Summary of the Last Meeting: IBR Standards – How to Make Sense of it All?

- **Meeting Introduction:** Ryan Quint, Elevate Energy Consulting
- **IBR Standards – How to Make Sense of it All?:** Jens Boemer, EPRI
- **Utility Perspective: Operational Readiness for Inverter-Based Resources:** Scott Anderson, SRP
- **Raising the Bar Through the IBR Lifecycle:** Ryan Quint, Elevate Energy Consulting
- **Q&A and Structured Discussion**, led by Ryan Quint, Elevate Energy Consulting
  - What is the best practice framework to keep up with changing standards landscape?
  - What can developer/generator owners do to pre-position themselves for upcoming changes/updates in standards?
  - What OEMs can do to future proof their equipment for upcoming changes/updates in standards?

Meeting summary, recording & presentations are posted here

Key Themes from the Last Meeting

- **Shift to Mandatory Reliability Standards:** The industry is transitioning from voluntary guidance to mandatory NERC standards and adoption of IEEE 2800-2022, requiring coordinated implementation across utilities, ISOs/RTOs, OEMs, developers, and regulators.
- **Operational Readiness for High IBR Penetration:** Utilities are launching cross-organizational initiatives—improving forecasting, situational awareness, modeling, training, and performance requirements—to prepare for growing IBR levels.
- **Interconnection Lifecycle Gaps:** Challenges remain with model accuracy, verification, and plant conformity assessments, driven by use of generic models, early-stage assumptions in studies, and limited oversight of final as-built configurations and commissioning.
- **Need for National Harmonization:** Differences in interconnection processes, modeling requirements, and performance standards across regions create complexity for developers and increase reliability and retrofit risks.
- **Lifecycle Accountability and Validation:** Structured milestones, design tracking, and systematic use of commissioning test data—aligned with IEEE P2800.2—are essential to ensure plant performance and validated models throughout the interconnection process.

Upcoming i2X FIRST Meetings – Season 2

1. May 27, 2025, 11 a.m. - 1 p.m. ET – **Season 2 Kick-Off**
2. June 24, 2025, 11 a.m.- 1 p.m. ET – **NERC Milestone 3 Standards**
3. July 22, 2025, 11 a.m.- 1 p.m. ET – **IBR Plant Design Evaluation with Applicable Requirements I**
4. August 26, 2025, 11 a.m.- 1 p.m. ET – **IBR Plant Design Evaluation with Applicable Requirements II**
5. September 23, 2025, 11 a.m.- 1 p.m. ET – **IBR Plant Modeling Requirements and Best Practices**
6. October 21, 2025, 11 a.m.- 1 p.m. ET – **Challenges with IEEE2800-2022, Planned Revisions**
7. November 25, 2025, 11 a.m.- 1 p.m. ET – **Change Management during IBR Plant Interconnection Process and Commissioning, How to Maintain Conformity**
8. December 16, 2025, 11 a.m.- 1 p.m. ET **– IBR Plant Commissioning Best Practices**
9. January 27, 2026, 11 a.m.- 1 p.m. ET **– NERC PRC-029 Implementation, Experience, and Recommended Practices**
10. February 24, 2026, 11 a.m. - 1 p.m. ET **– IBR Standards – How to Make Sense of it All?**
11. March 16, 2026, hybrid 1-day workshop during ESIG Spring Workshop**: Grid Forming IBR Needs, Specifications, Projects – Lessons Learned**

Follow ESIG i2X FIRST website https://www.esig.energy/i2x-first-forum/doe-i2x-season-2/ for meeting materials & recordings

DOE i2x What's Next?

- **I2x FIRST Season 3:** Four meetings June through January covering emerging topics, e.g.:
  - PRC-029 Implementation Process Updates (prior to 01/10/2026 effective date)
  - NERC Milestone 4 projects and NERC Project 2022—04 EMT Modeling
  - IEEE2800.2 deep dive and adoption pathways
  - Update on new IEEE 2800 series efforts (including GFM requirements)

DOE i2x What's Next?

NEW THIS YEAR!!!

- **I2x STITCH ((Studies, Tools, and InTerconnection Consistency & Harmonization)** Nine meetings May through March. Facilitate a forum (similar format to i2x FIRST) to:
  - summarize current interc)nnection studies approaches
  - identify opportunities to standardize/harmonize interconnection study methods,
  - identify industry best practices, and
  - discuss remaining gaps in this focus area.

- **i2x Technical Assistance Hours -** provide technical assistance to interconnection stakeholders focused on adoption of a harmonized and/or comprehensive interconnection requirements or standards. One-one sessions with ESIG and Elevate Energy Consulting for key interconnection stakeholders.

ESIG O&M UG Meeting – New IBR Developer Track

- Introduction to Developer Track
- Roundtable 1: IBR Unit Model Validation
- Roundtable 2: IBR Plant Design Evaluation
- Tech Talk: IBR Plant Model Verification at Commissioning
- Roundtable 3: Model Verification and Commissioning Testing
- Roundtable 4: IBR Plant Modeling Throughout the Interconnection Process
- Roundtable 5: NERC and Other Standards/Requirements
- Roundtable 6: Post-Commissioning

New this year: **the new Developer Track** focused on challenges associated with interconnection studies, performance standards for IBRs, and emerging best practices for ensuring reliable grid integration.

The Developer Track will feature an intro session, discussion roundtables and tech talks. The roundtables will provide the opportunity for frank and open discussion among users to promote knowledge and experience sharing.

Participation in the roundtables is limited to ESIG member organizations that own, develop or operate generation resources and consultants that are ESIG members and actively working with generator developers, owners and operators.

Two Trainings – Nov & Dec 2025, Materials Posted

ESIG Interconnection Studies Short Course

WHEN: November 17-19, 2025

WHERE: Manatee Lagoon, 6000 N Flagler Dr, West Palm Beach, FL 33407

MORE DETAILS:

This 3-day in-perso
knowledge and abi
focused on best p
necessary **to inter**
power system reliably. Training participants will learn practical methods and best practices that can be leveraged into enhanced study practices across the industry. These training modules will **focus on the expected day-to-day needs of engineers performing interconnection studies, model quality tests, or inverter-based resource model and simulation work** as well as managing study practices within their organization.

SLIDES AND RECORDINGS ARE POSTED HERE

DOE i2x / ESIG Electromagnetic Transient Training

WHEN: December 16 - 19, 2025

WHERE: Texas RE's Rio Grande Room, Austin, Texas

MORE DETAILS:

ed to **enhance the** workforce through **MT simulations** n the paradigm. Training participants will learn **practical methods and best practices that can be leveraged into enhanced study practices across the industry**. These training modules will **focus on the expected day-to-day needs of engineers performing EMT analysis** as well as managing EMT study practices within their organization.

SLIDES AND RECORDINGS ARE POSTED HERE

Stay tuned! Both Trainings coming up again in 2026!

Thanks to NextEra and Texas Reliability Entity for hosting at their facilities!

i2X FIRST Grid Forming IBR Workshop: Agenda

8:00 a.m. – 8:15 a.m.

DOE i2X FIRST Grid-Forming Inverter Workshop Introduction

Location: Kiva B

- Workshop Introduction
  Julia Matevosyan, Associate Director, Chief Engineer, ESIG
- U.S. DOE i2x Next Steps
  Cynthia Bothwell, Boston Government Services, contractor to DOE

8:15 a.m. -9:45 a.m.

Session 1 – Basics of Grid-Forming Inverter-Based Resources

Location: Kiva B

What is a grid-forming (GFM) inverter-based resource (IBR); how it is different from state-of-the-art grid following (GFL) IBRs; what GFM control exists; what are capabilities and limitations of GFM IBRs.

- **Deepak Ramasubramanian**, Principal Technical Leader, Electric Power Research Institute (EPRI)
- **Andrew Isaacs**, Vice President, Electranix (Canada)

9:45 a.m. -10:15 a.m.

Break

Location: Kiva Patio

i2X FIRST Grid Forming IBR Workshop: Agenda

10:15 a.m. – 12:00 p.m.

Session 2 – System Needs for Grid Forming Capabilities

Session Chair: Alex Shattuck, Director of Grid Transformation, ESIG

What prompts system operators to consider grid forming technology; what studies are carried to out identify if GFM is needed, where and how much is needed; what other considerations are necessary when determining the need for GFM requirements; what are other options that could be considered; have system operators looked at fully utilizing GFL IBR capabilities as per IEEE 2800-2022, how can system operators monitor and verify that GFM capabilities are indeed provided?

- **Weiqing Jiang**, Principal Engineer, Midcontinent Independent System Operator (MISO)
- **Mostafa Sedighizadeh**, Lead Engineer, Policy Planning and Research, Southwest Power Pool (SPP)
- **Scott Anderson**, Director Operational Readiness, Salt River Project (SRP)
- **Bin Wang**, Lead R&D Engineer, ISO-NE

12:00 p.m. – 1:00 p.m.

Lunch

Location: Kiva Patio

i2X FIRST Grid Forming IBR Workshop: Agenda

1:00 p.m. – 2:45 p.m.

Session 3 – Grid Forming Requirements

Increasingly, in the areas with high shares of IBRs and that have a determined need for GFM capabilities, system operators are coming up with requirements for GFM IBRs. What do these requirements entail, how are they formulated, do they apply to specific technologies or all IBRs and why, how is conformity with these requirements going to be evaluated?

- GFM Requirements at HECO, AEMO, ERCOT, MISO, etc.
  Andrew Isaacs, Vice President, Electranix (Canada)
- UNIFI GFM Requirements
  Dominic Gross, Associate Professor, University of Madison-Wisconsin & **Shahil Shah**, Principal Engineer, NLR
- IEEE/IEC New GFM Requirements Efforts
  Alex Shattuck, Director of Grid Transformation, ESIG
- VDE FNN GFM Requirements
  Roland Singer, Head of Group, Converter based Power Grids, Fraunhofer-Institute for Solar Energy Systems (Germany)

2:45 p.m. – 3:15 p.m.

Break

Location: Kiva Patio

i2X FIRST Grid Forming IBR Workshop: Agenda

3:15 p.m. – 5:00 p.m.

Session 4 – Global Landscape of Grid Forming Projects

Session Chair: Julia Matevosyan, Associate Director, Chief Engineer, ESIG

There is a growing number of GFM IBRs and other GFM devices being installed around the world, what are the main drivers; what are main challenges and gaps during interconnection process and after commissioning?

- **Sarah Walinga**, Sr. Staff Power Controls Engineer, Megapack Site Controls, Tesla
- **Jayanth Ranganathan Ramamurthy**, AEMO (Australia)
- **Laurence Copson**, Energy Storage Specialist, US Markets & Policy, Zenobe
- **Li Yu**, Manager, Transmission Planning, Hawaiian Electric Company (HECO)
- **Benjamin Braun**, Chief Engineer, Fluence (Germany)

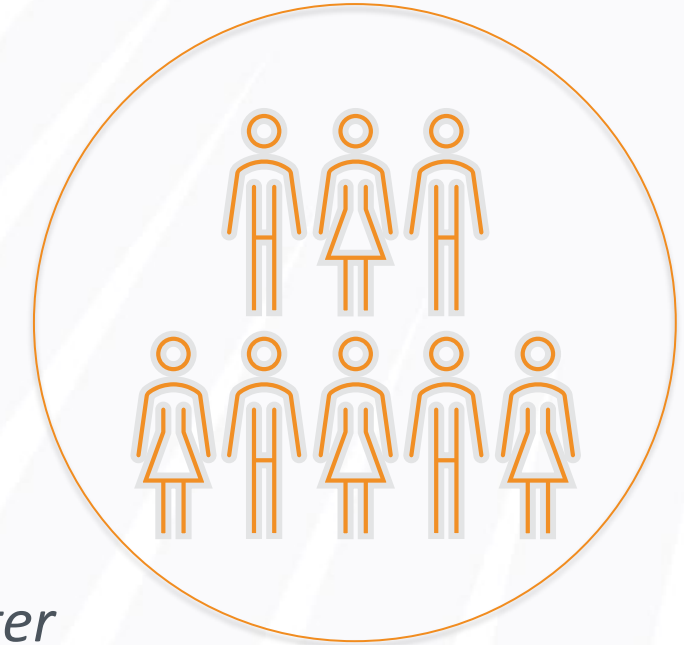
5:00 p.m. – 5:15 p.m.

Closing Remarks

- **Ryan Quint**, Founder and CEO, Elevate Energy Consulting

Virtual Meetings Code of Conduct

1. *Assume good faith and respect differences*
2. *Listen actively and respectfully*
3. *Use "Yes and" to build on others' ideas*
4. *Please self-edit and encourage others to speak up*
5. *Seek to learn from others*
6. *Please go to slido to ask questions: **slido.com** and enter event code **FIRST11***



Mutual Respect . Collaboration . Openness

Stakeholder Presentations