NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Standards Committee and NERC Ride-through Technical Conference

Conference Details

September 4-5, 2024 | 9:00 a.m. – 4:00 p.m. Eastern

Location: The Westin Washington, DC Downtown
999 9th St NW, Washington, DC 20001

Click here for: Virtual Registration Only
Click here for: Agenda
Click here for: Panel Questions

Background

On August 15, 2024, the NERC Board of Trustees (Board) invoked Section 321 of the NERC Rules of Procedure (ROP) to address critical and rapidly growing risk to the reliability of the Bulk Power System associated with inverter-based resources (IBR) in response to FERC Order No. 901 directives. PRC-029-1 (Frequency and Voltage Ride-through Requirements for Inverter-based Resources) is a draft standard designed to establish capability-based and performance-based Ride-through requirements for IBRs during grid disturbances. The draft standard failed to achieve consensus from the Registered Ballot Body over multiple ballots, calling into question whether development would be completed by FERC's filing deadline of November 4, 2024, which resulted in the Board acting under Section 321 of the ROP. Under this special authority, the Board directed the Standards Committee to work with NERC to host a technical conference. This technical conference will address the remaining issues for the proposed Ride-through standard (PRC-029-1). Using input from the technical conference, the proposed Reliability Standard will be revised as appropriate, then put to one more stakeholder ballot. If the standard achieves at least 60% stakeholder approval, the Board may consider it for adoption under this special process. There is a 45-day deadline to complete the process.

Meeting Format

This technical conference will be in-person near the NERC Washington, DC office – location to be announced - with a virtual option available. The technical conference will be recorded and transcribed. Recordings will be made available following the technical conference. Breakfast and lunch will be provided.

Registration

In-person registration has reached capacity. Only virtual registrations are being accepted at this time.

Agenda

A detailed agenda will be provided. Some of the topics to be covered include:

1. the definition of Ride-through,
2. newly proposed criteria for frequency Ride-through performance, and
3. allowable hardware-based exemptions under FERC Order No. 901.

Submittal of Comments

As part of the preparation for the technical conference and to support the decisions by the Standards Committee and NERC, the public is encouraged to provide comments for consideration on the topics identified on the agenda. In particular, any information on hardware-based limitations that would prevent IBR from meeting the proposed frequency criteria within PRC-029-1 is requested. Commenters are advised this information will be used as part of the record of development and should not include information that would be considered Critical Energy/Electric Infrastructure Information (CEII) or proprietary information. Summarized, aggregated, or otherwise non identifying information that can be substantiated with verifiable data, is requested for these submittals. NERC may request follow-ups with individual commenters to review this data through separate and non-public mechanisms.

Include in Comments

1. Indicate if you are representing a NERC registered entity and, if so, which functional registrations.
2. Indicate if you are representing an original equipment manufacturer of IBR.
3. Indicate if your company provided comments through the Standards Development process for Project 2020-02 Modifications to PRC-024 (Generator Ride-through), to allow the team to cross reference previous information. If your entity is part of the Registered Ballot Body, also provide what segment(s) your company is in.
4. Provide comments specific to the proposed frequency Ride-through criteria.
5. Provide comments specific to the proposed Ride-through definition.
6. Provide comments specific to hardware-based limitations that would prevent IBR from meeting the proposed frequency criteria within PRC-029-1.

Instructions for Submittal

Please submit comments via email and include any attachments in PDF to the parties listed below:

- Jamie Calderon, Manager of Standard Development (jamie.calderon@nerc.net)
- Alison Oswald, Manager of Standard Development (alison.oswald@nerc.net)
- Lauren Perotti, Assistant General Counsel (lauren.perotti@nerc.net)
- Todd Bennett, Standards Committee Chair (tbennett@aeci.org)
- Troy Brumfield, Standards Committee Vice-Chair (lbrumfield@atcllc.com)

Comments received after August 27, 2024 will be accepted but may not be reviewed prior to completing the Board directed actions.

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Agenda
Standards Committee and NERC Ride-through Technical Conference

September 4 - 5, 2024 | 9:00 a.m.- 4:00 p.m. Eastern

Location: The Westin Washington, DC Downtown
999 9th St NW, Washington, DC 20001

Wednesday, September 4, 2024

8:55 AM - 9:00 AM
Safety Briefing
Event Space Staff

9:00 AM - 9:05 AM
NERC Antitrust Compliance Guidelines and Commission Staff Disclaimer
NERC Staff

9:05 AM - 9:15 AM
Welcome and Opening Remarks – NERC Board of Trustees
Speaker: Rob Manning

9:15 AM - 9:25 AM
Opening Remarks – NERC
Speaker: Mark Lauby

9:25 AM - 9:35 AM
Opening Remarks – FERC
Speaker: David Ortiz

9:35 AM – 9:50 AM
Technical Conference Overview - Standards Committee
Speaker: Todd Bennett (AEC)
Introduction to the conference objectives. Walk through the agenda and expectations for next steps and interactions through any usage of Slido.

9:50 AM – 10:15 AM
Presentation: Summary Review of 901 and Milestone 2
Speaker: Jamie Calderon (NERC)
Summary overview of FERC Order 901, the associated Milestone 2 Reliability Standard projects and details of how those projects interrelate. Includes Q&A.

10:15 AM - 10:30 AM
Morning Break

10:30 AM - 11:15 AM
Presentation: Review of Voltage and Frequency Ride-through Criteria in PRC-029-1
Speakers: Husam Al-Hadidi and Shawn Wang (2020-02 Drafting Team Members)
Drafting Team members will review their approach to drafting PRC-029-1 along with key decisions made throughout the project development. Includes Q&A.

11:15 AM - 12:00 PM
Presentation: Review of Voltage and Frequency Ride-through Criteria
Speaker: Alex Shattuck (NERC)
A detailed review of proposed voltage and frequency criteria in used in the industry. This includes proposed criteria in PRC-024, PRC-029-1, and other criteria options such as IEEE 2800-2022. The presentation will explore the challenges associated with this requirement, particularly for existing generators, and will discuss known issues regarding quality of model data, issues obtaining capability information, and other issues that have been identified in recent NERC disturbance reports and NERC Alert reports. Includes Q&A.

12:00 PM - 1:00 PM
Lunch Break

1:00 PM - 2:00 PM
Panel Discussion: Original Equipment Manufacturer Perspectives on Voltage and Frequency Ride-through Criteria
Moderators: Alex Shattuck (NERC) and Charlie Cook (Duke Energy)
Panelists:

- Thomas Schmidt Grau (Vestas)
- Thierry Ngassa (Power Electronics)
- Scott Karpiel (SMA)
- Dinesh Pattabiraman (TMEIC)
- Samir Dahal (Siemens Energy)
- Arne Koerber (GE Vernova)

This session will focus on the challenges with meeting the proposed voltage and frequency criteria. This session is informed by original equipment manufacturer (OEM) concerns pertaining to the usage of different criteria values for both voltage and frequency, particularly in relation to older generators and FERC Order 901 directives. Panelists will discuss challenges and potential solutions aimed at maximizing Ride-through capability while balancing reliability needs and implementation practicality.

2:00 PM - 2:15 PM
Afternoon Break

2:15 PM – 3:00 PM
Panel Discussion with Q&A: Addressing the Challenges of Voltage and Frequency Ride-through Criteria
Moderators: Howard Gugel (NERC) and Charlie Cook (Duke Energy)
Panelists:

- Mark Lauby (NERC)
- Manish Patel (EPRI)
- Todd Chwialkowski (EDF)
- Andy Hoke (NREL)
- Michael Goggin (Grid Strategies LLC)

During this session, we will talk about the differences in the recommended voltage and frequency Ride-through Reliability Standards compared to other potential criteria. This discussion has been initiated due to concerns raised by stakeholders about using different standard values for voltage and frequency, especially with regards to older generators and FERC Order 901 directives. The panelists will examine possible solutions to find a middle ground between reliability needs and the feasibility of making adjustments to current protection and controller settings.

3:00 PM - 3:30 PM
Slido Polling: Voltage and Frequency Ride-through Criteria
Moderator: Amy Casuscelli (Xcel energy) and NERC Staff
Conference participants will be presented various options through Slido live polling to provide immediate feedback on proposed revisions to PRC-029-1 voltage and frequency Ride-through criteria. The session is intended to collect industry feedback to gauge consensus on definition revisions. The Standards Committee members assigned to revise PRC-029-1 will leverage these polling results as determined by the Standards Committee.

3:30 PM – 3:45 PM | **Parking Lot**

3:45 PM - 4:00 PM
Day 1 Wrap-Up
Board Member – Sue Kelly

Thursday, September 5th

9:00 AM - 9:15 AM
Recap of Day 1 and Introduction to Day 2
Todd Bennett (AEC) and Soo Jin Kim (NERC)

9:15 AM - 10:15 PM
Panel Discussion: Discussion on Frequency Ride-Through Exemptions in PRC-029-1
Moderators: Charles Yeung (SPP) and Alex Shattuck (NERC)
Panelists:

- Howard Gugel (NERC)
- Dane Rogers (OGE)
- Jason MacDowell (ESIG)
- Mark Ahlstrom (NextEra)

This session will focus on the differences posed by the proposed draft which does not include exemptions for hardware-based limitations in meeting frequency criteria. This session is informed by submitted stakeholder concerns pertaining to proposed PRC-029-1 providing no hardware-based limitations for frequency criteria. Panelists will discuss known limitations and what options are available to balance reliability needs with the practicality of implementation for older type IBR.

10:15 AM - 10:30 AM
Morning Break

10:30 AM - 11:00 AM
Presentation: Outlining Objectives of a Ride-through Definition
Speaker(s): Joel Anthes (2020-02 Drafting Team Member)
A thorough examination of the usage of the term “Ride-through” within NERC reports, IEEE, currently active Ride-through Reliability Standards, and other industry usage of this term. This presentation(s) will also review the proposed definition in the current draft of PRC-029-1 and a comparative analysis of other proposed definitions evaluated by the drafting team during development. Special attention will be given to stakeholder comments during the last draft ballot regarding the clarity and scope of terms such as "entire" and "in its entirety." The discussion will also emphasize the critical nature of finalizing a single definition for usage in NERC’s Glossary of Terms and associated Reliability Standards.

11:00 AM - 12:00 PM
Slido Polling: Gathering Stakeholder Input on Revised Definitions
Moderator: Amy Casuscelli (Xcel Energy)
Conference participants will be presented various options through Slido live polling to provide immediate feedback on proposed revisions to the Ride-through definition regarding this topic. The session is intended to collect industry feedback to gauge consensus on definition revisions. The Standards Committee members assigned to revise PRC-029-1 will leverage these polling results as determined by the Standards Committee.

12:00 PM - 1:00 PM
Lunch Break

1:00 PM – 1:15 PM
Presentation: Detailed Review of Milestone 2 Implementation Plans
Speaker: Jamie Calderon (NERC)
A comprehensive presentation, on the alignment of implementation plans and effective dates between PRC-028-1 and PRC-030-1, as related to PRC-029-1. The discussion will cover the importance of coordinating timelines to avoid gaps or overlaps that could compromise reliability or complicate compliance efforts.

1:15 PM - 2:00 PM
Panel Discussion: Strategizing Implementation Plans and Effective Dates
Moderator: Charles Yeung (SPP) and Jamie Calderon (NERC)
Panelists:

- Howard Gugel (NERC)
- Sam Hake (AES)
- Manish Patel (EPRI)
- Rhonda Jones (Invenergy)

This panel will discuss additional facts and circumstances to consider when developing strategies to effectively implement Milestone 2 Reliability Standards and aligning Implementation Plans and effective dates between PRC-028-1, PRC-029-1, and PRC-030-1. The discussion will explore the potential challenges and proposed solutions that assist industry in ensuring a smooth transition to these new standards, maintaining compliance, and minimizing the risk of any operational disruptions.

2:00 PM - 2:15 PM
Afternoon Break

2:15 PM - 2:45 PM
Slido Polling: Consensus on Implementation Plans
Moderator: Amy Casuscelli (Xcel Energy)
Conference participants will be presented various options through Slido live polling to provide immediate feedback on proposed revisions to PRC-029-1's Implementation Plan. The session is intended to collect industry feedback to gauge consensus on definition revisions. The Standards Committee members assigned to revise PRC-029-1 will leverage these polling results as determined by the Standards Committee.

2:45 PM - 3:15 PM:
Final Slido Polling: The Proposed Path Forward
Moderator: Amy Casuscelli (Xcel Energy)
A final set of polls will be conducted to gauge participant support for specific solutions discussed throughout the conference and any other recommendations identified. Th The Standards Committee members assigned to revise PRC-029-1 will leverage these polling results as determined by the Standards Committee.

3:15 PM – 3:45 PM
Parking Lot

3:45 PM - 4:00 PM:
Closing Remarks and Next Steps
Speakers: Sue Kelly (NERC) and Todd Bennett (AEC)

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Standards Committee (SC) and NERC Ride-through Technical Conference Bio's

Standards Committee and NERC Leadership

Todd Bennett

Managing Director, Reliability Compliance & Audit Services Associated Electric Cooperative, Inc. and SC Chair

I have been active in the power industry for 23 years and directly involved with ERO initiatives since 2009. My industry background includes 7 years at Sho-Me Power Electric Cooperative which included roles as a transmission facility design engineer and director of power grid operations; and 15 years at AECI working in NERC compliance. My focus while at AECI has been operations, planning, and critical infrastructure protection issues. AECI is registered as a Jointly Registered Organization (JRO) for the following functions on behalf of a diverse set of organizations: BA, DP, GO, GOP, PC, RP, TO, TOP, TP, and TSP. Resolving issues based on these functional registrations has made me deeply aware of the current reliability issues and challenges that NERC and the industry are facing.

I have participated in multiple NERC & SERC industry groups and was a past chair of the SERC registered entity forum, the current chair of the NERC Standards Committee, and previous co-chair of the NERC Standing Committees Coordinating Group. My current role at AECI is the Managing Director of Reliability Compliance and Audit Services. My professional focus is management of the AECI NERC compliance program, participation in NERC standards development, participation in industry initiatives, monitoring compliance with effective standards, and implementation of an AECI Board approved internal audit work plan.

I obtained a BS in Engineering from the University of Missouri and an MS of Engineering Management from the Missouri Institute of Science & Technology. I am a registered Professional Engineer (PE) and have obtained Certified Internal Auditor (CIA) and Certification in Risk Management Assurance (CRMA) credentials as well.

Troy Brumfield

Regulatory Compliance Manager American Transmission Company and SC Vice Chair

Troy is an employee at American Transmission Company LLC (ATC) his current position is Manager Reliability Standards Compliance. In this role, Mr. Brumfield is responsible for leading the overall development, and directing the activities and execution of ATC's regulatory strategy (2) monitoring ATC's regulatory environment (3) representing ATC at industry committees and trade organization meetings; and (4) working with ATC legal staff to develop regulatory strategies and resolve compliance and enforcement related issues.

Mr. Brumfield is the Vice-Chair of the NERC Standards Committee (SC), Chair of the Standards Committee Process Subcommittee (SCPS) and serves as a member of the Standards Committee Executive Committee (SCEC).

Mr. Brumfield is also a member of the MRO Compliance Monitoring and Enforcement Program Advisory Council (CMEPAC). The CMEPAC provides advice and counsel to MRO's Board of Directors, staff, members and registered entities on topics like the development, retirement, and application of NERC Reliability Standards, risk assessment, compliance monitoring, and the enforcement of applicable standards.

He has served as a chair and contributing member of several NERC Standards Drafting Teams and NERC Initiative Teams. These include NERC Project 2017-07 Standards Alignment with Registration, Guidelines and Technical Basis (GTB) Review Team, Standards Efficiency Review-Phase 1 Team (sub-team chair), Member of NERC Compliance and Certification Committee-ERO Monitoring Subcommittee, Observer and Active participant in the 2018-03 Standards Efficiency Review Retirements project, and Member of MRO NERC Standards Review Forum.

Prior to joining ATC Mr. Brumfield was employed at Wisconsin Energy Corporation (WEC). While at WEC Mr. Brumfield held various leadership roles in the Operations and Engineering-Major Projects work group and the Operations Support group where he was responsible for managing regulatory obligations, standards development, compliance, and asset management. During his time at WEC Mr. Brumfield served as Chair of several generation and distribution regional committees and councils that were tasked with promoting and strengthening governmental and industry partnerships. Mr. Brumfield utilized these committees and councils as a forum to facilitate discussions related to standards interpretation and standards execution by utility and governmental employees focused on the reliable design, construction, operation, and maintenance of electric and gas facilities.

Mr. Brumfield earned a Bachelor of Applied Science in Electronics Engineering Technology. He also earned a Master of Science in Engineering Management from the Milwaukee School of Engineering University

Robin Manning

Board of Trustees Member, NERC

Robin E. Manning was elected to the NERC Board of Trustees in February 2018. Mr. Manning is the chair of the Compliance Committee and serves on the Enterprise-wide Risk and Technology and Security Committees and as the Reliability and Security Technical Committee observer. Prior to joining the Board, Mr. Manning served as vice president of Transmission and Distribution Infrastructure for the Power Delivery and Utilization research sector at the Electric Power Research Institute (EPRI). He had overall management and technical responsibility for the annual research activities conducted by EPRI's transmission and distribution programs in collaboration with its global membership. Prior to joining EPRI, Mr. Manning served as an executive vice president with the Tennessee Valley Authority (TVA) from 2008 to 2014, where he was responsible at different times during his tenure for external relations, shared services, and power systems operations, and served as Chief Energy Delivery Officer. Previously, he served as vice president at Duke Energy, with responsibility for power delivery and gas transmission. Mr. Manning served on the University of Houston Engineering Leadership Board and serves as immediate past president of the North Carolina State Engineering Foundation Board. He is also the president of One Heart Global Ministries, a non-profit ministry organization. Mr. Manning received a bachelor's degree in Electrical Engineering from North Carolina State University where he was recently named to the NC State Electrical and Computer Engineering Hall of Fame. He also holds a master's degree in Business Administration from Queens College in Charlotte, North Carolina.

Sue Kelly

Board of Trustees Member, NERC

Susan (Sue) Kelly was elected to the NERC Board of Trustees in February 2021 and serves on the Finance and Audit, Nominating, Regulatory Oversight, and Technology and Security Committees. Ms. Kelly also serves as the observer for the Reliability and Security Technical Committee and Standards Committee. Ms. Kelly previously served as president and CEO of the American Public Power Association (APPA) from 2014 to 2019, where she led the national trade association serving public power utilities. She came to APPA in 2004 as its senior vice president of Policy Analysis and General Counsel and was responsible for APPA's energy policy formulation and policy advocacy before FERC, the federal courts, and other governmental and industry policy forums. Ms. Kelly has served on a number of committees, including the Steering Committee of the Electricity Subsector Coordinating Council (2014 to 2019), the Commodity Futures Trading Commission's Energy and Environmental Markets Advisory Committee (2015 to 2019), the U.S. Department of Energy's Electricity Advisory Committee (2008 to 2009 under the Bush Administration; 2012 to 2014 under the Obama Administration), and as the president of the Energy Bar Association (2010 to 2011). She was also a member of the Board of Directors of the Center for Energy Workforce Development. She currently serves on the Energy Bar Association's Masters Council and helped start a virtual mentoring program for Energy Bar Association members. She also serves on the E Source Advisory Board. Ms. Kelly was named one of Washington's "Most Powerful Women" in the November 2015 issue of Washingtonian magazine in the "Business, Labor, and Lobbying" category. In March 2017, she was honored as Woman of the Year by the Women's Council on Energy and the Environment. In January 2020, she received Public Utility Fortnightly's Owen Young Award to honor her exceptional contributions to the electric utility industry. Ms. Kelly earned her bachelor's degree in Honors Interdisciplinary Studies and Economics from the University of Missouri and her juris doctorate from George Washington University, both with high honors.

Mark Lauby

Senior Vice President and Chief Engineer, NERC

Mark G. Lauby is senior vice president and chief engineer at NERC. Mr. Lauby joined NERC in January 2007 and has held several positions, including vice president and director of Standards and vice president and director of Reliability Assessments and Performance Analysis. In 2012, Mr. Lauby was elected to the North American Energy Standards Board and was appointed to the Department of Energy's Electric Advisory Committee by the Secretary of Energy in 2014. Mr. Lauby has served as chair and is a life member of the International Electricity Research Exchange and served as chair of several Institute of Electrical and Electronics Engineers (IEEE) working groups. From 1999 to 2007, Mr. Lauby was an appointed member of the Board of Excellent Energy International Co., Ltd., an energy service company based in Thailand. He has been recognized for his technical achievements in many technical associations, including the 1992 IEEE Walter Fee Young Engineer of the Year Award. He was named a Fellow by IEEE in November 2011 for "leadership in the development and application of techniques for bulk power system reliability." In 2014, Mr. Lauby was awarded the IEEE Power and Energy Society's Roy Billinton Power System Reliability Award. In 2020, the National Academy of Engineering elected Mr. Lauby as a member, citing his development and application of techniques for electric grid reliability analysis. He is also a member of the IEEE Power & Energy Society (PES) Executive Advisory Committee, focused on providing strategic support to the PES Board of Directors. Prior to joining NERC, Mr. Lauby worked for the Electric Power Research Institute (EPRI) for 20 years, holding several senior positions, including: director, Power Delivery and Markets; managing director, Asia, EPRI International; and manager, Power System Engineering in the Power System Planning and Operations Program. Mr. Lauby began his electric industry career in 1979 at the Mid-Continent Area Power Pool in Minneapolis, Minnesota. His responsibilities included transmission planning, power system reliability assessment, and probabilistic evaluation. Mr. Lauby is the author of more than 100 technical papers on the subjects of power system reliability, expert systems, transmission system planning, and power system numerical analysis techniques. He earned his bachelor's and master's degrees in electrical engineering from the University of Minnesota. In addition, Mr. Lauby attended the London Business School Accelerated Development Program as well as the Executive Leadership Program at Harvard Business School.

Soo Jin Kim
Vice President of Engineering and Standards, NERC

Soo Jin Kim is the vice president of Engineering and Standards. In this role, she is responsible for providing engineering analysis and support for NERC activities and directing all aspects of NERC's continent-wide standards development process by providing oversight, guidance, coordination, and industry education around the development of Reliability Standards. Throughout her time at NERC, Ms. Kim has worked on numerous initiatives involving Standards, Compliance, and coordination across the ERO Enterprise. She joined NERC in 2012 as a standards developer and has since served as reliability manager and senior manager of Standards. From 2020 to 2023, she served as director of Power Risk Issues and Strategic Management (PRISM) where she transformed the group into a cross-cutting department that serves as technical advisors to other NERC functions. Under her leadership, PRISM initiated several projects to tackle energy assurance risks, particularly those addressing extreme weather challenges. Most notably, her team was instrumental in the formation of the Energy Reliability Assessment Task Force and the efforts to provide the technical support for registering new inverter-based resources. She also works with the Reliability Issues Steering Committee, and she was an integral leader in planning and executing the 2023 NERC Leadership Summit. Prior to joining NERC, Ms. Kim was an associate at Troutman Sanders LLP in Washington, D.C. in their Energy Practice. At Troutman Sanders, she worked on a variety of Federal Energy Regulatory Commission compliance matters. Prior to attending law school, she was a consultant/business analyst with various consulting firms focused on energy and commodity trading. Ms. Kim has a bachelor's degree in Economics and English from the University of Georgia and her juris doctor degree from American University, Washington College of Law. She is licensed to practice law in Georgia and Washington, D.C. She also served for five years on the board of the Women's Energy Network and as co-president for two of those years.

David Ortiz

Director of the Office of Electric Reliability, FERC

David is the Director of the Office of Electric Reliability (OER) at the Federal Energy Regulatory Commission. OER helps the Commission to oversee the reliability and security of the electric grid. OER's responsibilities include oversight of the North American Electric Reliability Corporation in its development and enforcement of mandatory reliability and cybersecurity standards. David leads over 90 staff, including electrical engineers, statisticians, attorneys and analysts. OER's recent accomplishments include: a standard ensuring that the grid can operate through extreme cold weather; standards for securing the supply chain for grid-related cyber systems and protecting the integrity and availability of grid communications; a standard requiring increased grid cybersecurity incident reporting; a rule requiring new generators to be able to provide frequency response, ensuring reliability of the grid as it incorporates more renewable resources; a standard protecting the grid from solar storms; a series of reports documenting utility best practices in grid restoration and recovery; and a series of best practice reports in utility cybersecurity.

From 2013 to 2016, David was a Deputy Assistant Secretary for Energy Infrastructure Modeling and Analysis (EIMA) in the Office of Electricity Delivery and Energy Reliability at the Department of Energy. From 1998 through 2013, David worked at the RAND Corporation, where he built a program of energy policy research and analysis.

David earned his doctorate in Electrical Engineering from the University of Michigan. He graduated from Princeton University.

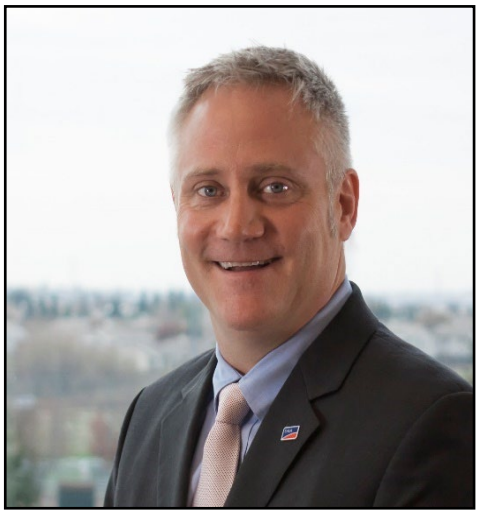
David lives in Falls Church, Virginia with his wife, Nicole, and two children. He is an avid tennis player, cyclist, home cook, and musician.

Panelists – Original Equipment Manufacturer Perspectives on Voltage and Frequency Ride-through Criteria

Thomas Schmidt Grau

Global Lead for RMS and EMT Development and Strategies for Vestas

Thomas has 15 years of experience in the industry in power plant systems. Started my career in Vestas working on system impact studies. Moved into modeling and became the global lead for all RMS and EMT development and strategies, supporting all markets Vestas is represented in. Nearly 5 years in the US being the Director for our Power Plant Solutions group, having grid accountability across Development, Sales, Construction, and Service. My focus is on supporting renewable growth and ensuring Vestas takes accountability in the renewable transition, especially around models and ensuring the right quality is provided for utilities to carry out reliable studies and ensure grid reliability for a green energy transition.



Scott Karpiel

Principal Application Engineer, SMA America

Scott Karpiel is a Principal Application Engineer at SMA America, the U.S.-based subsidiary of solar and storage inverter leader SMA Solar Technology AG, headquartered in Germany.

In this role, he provides design and consultation services, as well as technical support, for North American photovoltaic (PV) and storage customers, engineers, developers, owners and utilities. He also is responsible for identifying market requirements with his involvement in inverter-based resources working groups and standards drafting teams to drive product enhancements and bridge any technical gaps in the product offering. He is a subject-matter expert on utility scale renewable energy generation.

Karpiel, who joined SMA as an application engineer, has more than 30 years of experience in various engineering disciplines, including architectural engineering, quality engineering, compliance engineering, research and development, hardware engineering and technical support. Previous rolls in the renewable sector include commissioning, field engineering, product management and Director of Applications Engineering for various inverter manufacturers.

Karpiel earned a Bachelor of Science degree in electrical engineering, with a focus on energy conversion and power electronics from the University of Colorado, Boulder.

Dinesh Pattabiraman

Development Engineer in the Product Development Group at TMEIC Corporation Americas

Dinesh is currently working as a Development Engineer in the Product Development group at TMEIC Corporation Americas. He is experienced in power electronics hardware, control, modeling and power system dynamic performance studies. In his current role, he supports EMT modeling of TMEIC inverters, helping clients through interconnection studies and compliance with interconnection requirements and resolving inverter performance issues during grid events. Dinesh completed his PhD and M.S. in Electrical Engineering from the University of Wisconsin-Madison and his bachelor's in electrical & Electronics Engineering from the National Institute of Technology – Trichy, India.

Samir Dahal

Manager of Grid Interconnection and Modeling for Siemens Gamesa Renewable Energy

Samir Dahal is a seasoned electrical engineer who manages grid interconnection and modeling efforts at Siemens Gamesa Renewable Energy, overseeing over 10 GW of onshore projects across the Americas. He has extensive experience leading generator interconnection studies, managing engineering teams, and developing inverter models, previously serving as a Principal Consulting Engineer at Mitsubishi Electric Power Products Inc.

Samir holds a Ph.D. in Electrical Engineering from the University of North Dakota and a Bachelor's degree from NYU Tandon School of Engineering. His expertise spans renewable energy, power systems, and grid integration, supported by a strong research background and multiple academic honors.

Arne Koerber

Product Line Leader for GE Vernova

Dr. Arne Koerber is the Product Line Leader, Controls & Software for GE Vernova's wind business. In this role, he leads product strategy for control and software systems including turbine and plant-level controls, SCADA, farm optimization, grid integration, and condition monitoring systems.

Arne joined GE in 2008 and has held a number of roles focused on system simulation and controls engineering both in Europe and the US including leading Controls & Operability Engineering for GE's Onshore Wind business.

Arne graduated from TU Berlin, Germany with a degree in Engineering Science and holds a PhD in Control Systems from the same University.

Moderator(s)

Alex Shattuck

Senior Engineer, Engineering & Security Integration, NERC

Alex Shattuck is a Senior Engineer in the Engineering and Security Integration department at the North American Electric Reliability Corporation. He contributes heavily on a number of NERC's efforts related to grid transformation including initiatives focused on inverter-based resources, distributed energy resources, integrating security with conventional engineering practices, and emerging technologies. In addition to helping to lead NERC's IBR activities, Alex currently coordinates NERC's Inverter-based Resource Performance Subcommittee and has experience throughout the industry through work as a modeling subject matter expert at an IBR equipment manufacturer, modeling lead at a power engineering consultancy, and as a planning engineer at an Independent System Operator.

Charlie Cook

Lead Compliance Analyst for Duke Energy and SC Member

Charlie Cook is a seasoned Regulator Compliance Specialist with over 25 years of experience in the industry. With a strong background in Internal Controls and Audits, he has participated in numerous assessments of several companies' adherence to regulatory requirements. As a driven and detail-oriented professional, Charlie is dedicated to ensuring that every project achieves the highest level of quality and meets the needs of clients. When not working, Charlie enjoys boating and off-roading and participates in volunteer and charitable fund-raising events as a member of his local Masonic Lodge.

Panelists – Panel Discussion with Q&A: Addressing the Challenges of Voltage and Frequency

Mark Lauby – Senior Vice President and Chief Engineer, NERC Bio located with the Executive Team

Manish Patel

Technical Executive for Electric Power Research Institute (EPRI)

Manish Patel, PhD, PE is a Technical Executive at Electric Power Research Institute (EPRI) since April 2024. Before EPRI, he was with Southern Company for 17.5 years in various roles, with experience in Protection & Control and Transmission Planning. He is an active member of the IEEE Power System Relaying Committee. He is a registered Professional Engineer in the state of Alabama.

Todd Chwialkowski

Director, Transmission Regulatory and Compliance for EDF Renewables

Todd Chwialkowski is a Director of Regulatory and Compliance for EDF Renewables. He is currently based out of Denver, CO. Prior to this position at EDFR, Todd worked as a Manager of NERC Business Development and NERC Compliance Subject Matter Expert, and Senior Project Manager, Cyber Security, contracting at the Department of Interior, Bureau of Reclamation in their Power Resources Office. He earned an engineering degree from the University of Minnesota, and his MBA from the American Military University. He is a current Certified Information Systems Security Professional (CISSP) and a Certified Information Systems Auditor (CISA).

Andy Hoke

Principal Engineer in the Power Systems Engineering Center at the National Renewable Energy Laboratory (NREL)

Andy Hoke is a principal engineer in the Power Systems Engineering Center at the National Renewable Energy Laboratory (NREL), where he has worked for the past 14 years. He received the Ph.D. and M.S. degrees in Electrical, Computer, and Energy Engineering from the University of Colorado, Boulder, in 2016 and 2013, respectively. Dr. Hoke's expertise is in grid integration of power electronics and inverter-based renewable and distributed energy. His work includes power systems modeling and simulation, advanced inverter controls design, hardware-in-the-loop testing and model development, and standards development. He has served as Chair of IEEE 1547.1-2020 and P2800.2, which contain the test and verification procedures to ensure DERs and inverter-based resources conform to the grid interconnection requirements of IEEE Standards 1547 and 2800, respectively. He is a registered professional engineer in the State of Colorado.

Michael Goggin

Consultant for Grid Strategies LLC

Michael Goggin has worked on renewable energy, transmission, and reliability issues for 20 years. He has testified in dozens of state regulatory and FERC proceedings on those topics. At Grid Strategies he serves as a consultant for a range of clean energy industry clients. For the preceding 10 years he held various positions at the American Wind Energy Association, now known as the American Clean Power Association. Michael has previously served on the NERC Standards, Operating, and Planning Committees. He graduated with honors from Harvard University.

Moderator(s)

Howard Gugel

Vice President of Regulatory Oversight, NERC

Howard Gugel is the vice president of Regulatory Oversight at NERC. In this role, he is responsible for directing programs and processes to monitor, review, and evaluate program effectiveness of the Electric Reliability Organization (ERO) Enterprise's implementation of risk-based compliance monitoring and enforcement. This includes adherence to the NERC Rules of Procedure, the Compliance Monitoring and Enforcement Program, and approved delegation agreements. He is also responsible for overseeing the ERO's Organization Registration and Certification process. Prior to this, he was vice president of Engineering and Standards at NERC. In this role, he provided engineering analysis and support for NERC activities and directed all aspects of NERC's continent-wide standards development process by providing oversight, guidance, coordination, and industry education of the development of Reliability Standards. He also previously served as the director of Performance Analysis, where he was responsible for the development, maintenance, and analysis of reliability performance metrics, including those in NERC's annual State of Reliability report. This included analyzing various databases of transmission and generations outages to look for statistically significant trends. In 2022, Mr. Gugel was appointed to the Department of Energy's Electric Advisory Committee by the Secretary of Energy. He also serves on the North American Energy Standards Board. Mr. Gugel has more than 34 years of experience in the electric utility industry. Prior to joining NERC, he was a transmission area maintenance manager for Progress Energy Florida, where he managed a staff of field personnel who maintained transmission lines and substation equipment. Prior to that, he was a transmission planning manager, also for Progress Energy Florida. His background includes management experience in operations and energy marketing. He has worked for two investor-owned utilities, a rural electric cooperative, and an energy marketing firm. Mr. Gugel earned his bachelor's and master's degree in Electrical Engineering from the University of Missouri – Rolla. He is a licensed professional engineer in Missouri.

Panelists – Discussion on Frequency Ride-through Exemptions in PRC-029-1

Howard Gugel – Vice President of Regulatory Oversight, NERC Bio located above

Dane Rogers

Lead NERC Compliance Analyst for Oklahoma Gas and Electric Company (OG&E)

Dane Rogers is a Lead NERC Compliance Analyst for Oklahoma Gas and Electric Company (OG&E). He is responsible for ensuring compliance with current O&P NERC Reliability Standard as well as monitoring new and revised Standards, assessing feasibility and impact, and coordinating Company position for balloting and commenting. He is actively engaged in multiple industry trade groups, serving as the Chair of the Midwest Reliability Organization's NERC Standards Review Forum (MRO NSRF), and serving on the Advisory Committee of the North American Generator Forum (NAGF).

In addition to his compliance experience at OG&E, Dane has held process and plant engineering positions at a synchronous generating facility as well as an operational reliability engineering position on the distribution system. Dane has also worked as a Quality Manager at a high-speed manufacturing facility owned by AB-InBev.

Prior to earning his BS in Mechanical Engineering from Oklahoma State University, Dane served in the Oklahoma Army National Guard.

Mark Ahlstrom

Vice-President, Renewable Energy Policy for NextEra Energy Resource

Mark Ahlstrom is Vice President of Renewable Energy Policy for NextEra Energy Resources and President of the Board of Directors of the Energy Systems Integration Group. He currently serves on NERC's Reliability Issues Steering Committee and chairs the SPP Future Grid Strategy Advisory Group, and he previously served on the NERC Essential Reliability Services Working Group and the NERC Integrating Variable Generation Task Force. Today, Mark focuses on rapid grid transformation pathways that are accelerated by the Inflation Reduction Act of 2022 with emphasis on reliability, economics, and innovation. Mark is a senior member of IEEE and a CIGRE member.

A biochemistry and biomedical engineering graduate of the University of Wisconsin-Madison, Mark initially worked as a software engineer at Honeywell Avionics and then as an artificial intelligence researcher at the Honeywell Computer Sciences Center before leaving to be founder of two software companies. In late 2000 he became CEO of WindLogics, a venture-funded computational weather modeling company that applied its technologies to improved understanding of wind energy projects. WindLogics was acquired in 2006 and is now the NextEra Analytics division of NextEra Energy Resources—America's premier clean energy leader and the world's largest producer of wind and solar energy.

Moderator(s)

Charles Yeung

Executive Director Interregional Affairs Southwest Power Pool

Charles H. Yeung is Executive Director of Interregional Affairs for the Southwest Power Pool (SPP). Since 2004, he has been responsible for leading SPP in the development of reliability and business standards at the national and continent-wide level. He is also SPP's primary contact to the ISO RTO Council's Standards Review Committee (SRC), a multi-member ISO/RTO group who works closely with ISO/RTO CEOs to formulate regulatory policy and to assess proposals for reliability standards and business practices impacting ISO/RTO reliability and markets.

Mr. Yeung has experience in the engineering and the regulatory side of electric utilities. His first professional employment was in 1988 at Houston Lighting & Power Co, (HL&P, now Centerpoint Energy). There Mr. Yeung worked as a relay protection engineer and engineered transmission protection systems to ensure safe and reliable operations of transmission networks in the HL&P service territory. He also calculated power flow information for transmission service contracts in the 1990's prior to FERC Order 888 for Open Access. In 1995 he began work in the HL&P Regulatory Department where he was involved in creating rules for the formation of ERCOT, the Texas regional transmission organization.

Mr. Yeung is a 1988 graduate of Texas A&M College Station with a bachelor's degree in electrical engineering and is a registered Professional Engineer. He also holds a Master of Business Administration from the University of Houston

Alex Shattuck – Senior Engineer, Engineering & Security Integration, NERC Bio located above

Panelist(s) – Strategizing Implementation Plans and Effective Dates

Howard Gugel – Vice President of Regulatory Oversight, NERC Bio located above

Sam Hake

NERC Compliance Engineer for AES Clean Energy

I have been part of the energy sector since 2015. In 9 years, I have had several different roles including NERC Compliance support, Transmission Planning, Asset Management, and P&C Engineering. Currently, I am supporting the NERC Compliance Program at AES Clean Energy as a NERC Compliance engineer. In this role I have experience working with Operations and Planning experts, focusing on the PRC suite of Standards, supporting integration and operation of renewable resources. Prior to joining AES Clean Energy I spent six years at Eversource Energy. At Eversource I had the opportunity to be part of several different departments including NERC Compliance, Asset Management, and Protection and Controls Engineering. Before joining Eversource, I was with Burns & McDonnell for two years working as a Transmission Planning Engineer.

Manish Patel – Technical Executive for Electric Power Research Institute (EPRI) Bio located above

Rhonda Jones

Vice President of Reliability Compliance at Invenergy LLC

As a 14-year NERC Regulatory Compliance leader, she administers Invenergy's NERC Compliance Programs. Her teams are responsible for ensuring 70+ power generation companies, across North America and Canada, are positioned to demonstrate how its strong operational practices adhere with regulations. The effectiveness of the programs is based on the promotion of reliable and safe operations, continuous training and development, interwoven internal controls, standards development participation, and a depth of both regulatory and technical expertise. Additionally, Rhonda leads Invenergy's RTO/ISO Market Registration & Compliance Program.

Rhonda served as a founder and chair of Black and Brown at Invenergy, an employee affinity group focused on increasing awareness, presence, opportunity, and participation, for people of African ancestry in sustainable energy careers. Rhonda is also a member of Invenergy's DEI Corporate Committee and a contributor to North American Generator Forum efforts.

She holds a BBA in Accounting, an MBA and a Juris Doctorate.

When this change agent takes a break from promoting grid resiliency, she enjoys hosting events, teaching Business Ethics and DEI in the Workplace, and live music.

Moderator(s)

Charles Yeung – Executive Director Interregional Affairs Southwest Power Pool Bio located above

Jamie Calderon

Manager, Standards Development, NERC

Jamie joined NERC in 2015 as an engineer developing Reliability Assessments and transitioned in 2017 to a senior engineer role with Compliance Assurance. Prior to joining NERC, Jamie served as a Transmission Planning Engineer and Bulk Power dispatcher for the Municipal Electric Authority of Georgia (MEAG). Jamie Calderon received her bachelor's degree of science in Electrical Engineering Technology from Southern Polytechnic State University in Marietta, Georgia.

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Standards Committee & NERC Ride-Through Technical Conference

Panel Questions

September 4 – 5, 2024 | 9:00 a.m.- 4:00 p.m. Eastern

Location: The Westin Washington, DC Downtown
999 9th St NW, Washington, DC 20001

Wednesday, September 4, 2024

Panel Discussion: Original Equipment Manufacturer Perspectives on Voltage and Frequency Ride-through Criteria

This session will focus on the challenges with meeting the proposed voltage and frequency criteria. This session is informed by original equipment manufacturer (OEM) concerns pertaining to the usage of different criteria values for both voltage and frequency, particularly in relation to older generators and FERC Order 901 directives. Panelists will discuss challenges and potential solutions aimed at maximizing Ride-through capability while balancing reliability needs and implementation practicality.

Questions:

1. Do you anticipate challenges with your equipment meeting the voltage Ride-through criteria as specified in Attachment 1 of the draft PRC-029?
    a. If so, do you have an estimate for how many products would be affected?
    b. How does this estimate change when considering IEEE 2800-2022 criteria?
    c. How does this estimate change when considering PRC-024 boundaries?
2. Do you anticipate challenges with your equipment meeting the frequency Ride-through criteria as specified in Attachment 2 of the draft PRC-029?
    a. If so, do you have an estimate for how many products would be affected?
    b. How does this estimate change when considering IEEE 2800-2022 criteria?
    c. How does this estimate change when considering PRC-024 boundaries?
3. What documentation is necessary from manufacturers to prove which hardware limitations exist that would prevent your equipment from meeting the criteria in draft PRC-029 Attachments 1 and Attachment 2?
4. What documentation are you comfortable sharing with Generator Owners (GO), Transmission Planners, or NERC?

5. What is the generalized length of time associated with any redesign of current products to meet the criteria specified in PRC-029 without exception?
6. Are there any future or currently in design products able to meet the criteria in PRC-029?

Panel Discussion with Q&A: Addressing the Challenges of Voltage and Frequency Ride-through Criteria

During this session, we will talk about the differences in the recommended voltage and frequency Ride-through Reliability Standards compared to other potential criteria. This discussion has been initiated due to concerns raised by stakeholders about using different standard values for voltage and frequency, especially with regards to older generators and FERC Order 901 directives. The panelists will examine possible solutions to find a middle ground between reliability needs and the feasibility of making adjustments to current protection and controller settings.

Questions:

1. Approximately what percentage of GO portfolios are potentially affected by PRC-029 draft criteria. How does this change if thresholds are lowered to 2800-2022 criteria?
2. What are reasonable solutions to ensure legacy equipment can be compliant with voltage criteria in draft PRC-029 Attachment 1.
3. What are reasonable solutions to ensure legacy equipment can be compliant with frequency criteria in draft PRC-029 Attachment 2.
4. Do you expect equipment to fail to meet the voltage Ride-through criteria as specified in Attachment 1 of the draft PRC-029 due to hardware limitations?
    a. If so, do you have an estimate for how many products would be affected?
    b. How does this estimate change when considering IEEE 2800-2022 criteria.
    c. How does this estimate change when considering PRC-024 boundaries?
5. What considerations are needed regarding software-based maximizations to optimize voltage and frequency Ride-through capabilities?

Thursday, September 5, 2024

Panel Discussion: Discussion on Frequency Ride-through Exemptions in PRC-029-1

This session will focus on the differences posed by the proposed draft which does not include exemptions for hardware-based limitations in meeting frequency criteria. This session is informed by submitted stakeholder concerns pertaining to proposed PRC-029-1 providing no hardware-based limitations for frequency criteria. Panelists will discuss known limitations and what options are available to balance reliability needs with the practicality of implementation for older type Investor-based Resources (IBR).

Questions:

1. What are the financial and practical impacts between hardware-based and software-based solutions?
2. What is the timeline of software-based updates necessary to meet PRC-029 draft criteria? How does this timeline differ from hardware-based updates?
3. Do you expect equipment to fail to meet the frequency Ride-Through criteria as specified in Attachment 2 of the draft PRC-029 due to hardware limitations.
    a. If so, do you have an estimate for how many products would be affected?
    b. How does this estimate change when considering IEEE 2800-2022 criteria?
    c. How does this estimate change when considering PRC-024 boundaries?
4. What difficulties do GOs have when attempting to obtain hardware limitation data from OEM?
5. What difficulties do GOs have when attempting to coordinate their plant to successfully meet the criteria specified in Attachment 2 of the draft PRC-029?
6. Many commenters have said that it would only be fair to grandfather existing facilities and in-construction facilities from ride through requirements due to the costs of retrofitting. Other commenters have said that their facilities have an expected shelf life of up to 30 years, meaning there may be facilities in place in 2050 - when IBR penetration is expected to be much higher - that are not able to comply with requirements NERC wrote in 2024. How should NERC balance the burden on generators who may be asked to incur large retrofitting costs, with the burden on Transmission Owners, Transmission Planners, and end-use customers from poor or unexpected IBR performance?

Panel Discussion: Strategizing Implementation Plans and Effective Dates

This panel will discuss additional facts and circumstances to consider when developing strategies to effectively implement Milestone 2 Reliability Standards and aligning implementation plans and effective dates between PRC-028-1, PRC-029-1, and PRC-030-1. The discussion will explore the potential challenges and proposed solutions that assist industry in ensuring a smooth transition to these new Reliability Standards, maintaining compliance, and minimizing the risk of any operational disruptions.

Questions:

1. Given the complexities of aligning PRC-028-1, PRC-029-1, and PRC-030-1, what strategies would you recommend in synchronizing implementation to avoid conflicts or gaps in compliance? What considerations are needed to prevent potential overlaps or inconsistencies between implementation plans?
2. What do you anticipate will be the most significant challenges when retrofitting or modifying legacy IBR to comply with these new standards? Can you share any practical solutions or best practices that have proven effective in ensuring compatibility and minimizing operational disruptions?
3. With NERC expanding its registration criteria for GO, how should companies approach the integration of new assets or changes in ownership to ensure seamless compliance? What are the key considerations to keep in mind?
4. How do supply chain issues impact the timely implementation of these new standards, particularly in terms of retrofitting existing or new installs? What proactive measures can be taken to mitigate potential risks?
5. What are some of the most challenging aspects of testing and verification in the context of these new standards, especially when dealing with a mix of new and retrofitted IBR? How do you ensure that testing protocols are robust enough to meet compliance requirements without introducing unnecessary complexity or delays?

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Welcome to the Standards Committee and NERC Ride-through Technical Conference Day 1

RELIABILITY | RESILIENCE | SECURITY

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Safety Briefing

RELIABILITY | RESILIENCE | SECURITY

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NERC Antitrust Compliance Guidelines and Commission Staff Disclaimer

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Welcome and Opening Remarks

Rob Manning – NERC Board of Trustees

Mark Lauby – NERC

David Ortiz – FERC

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Technical Conference Overview - Standards Committee

Todd Bennett – AEC

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Summary Review of Milestone 2 and Order 901

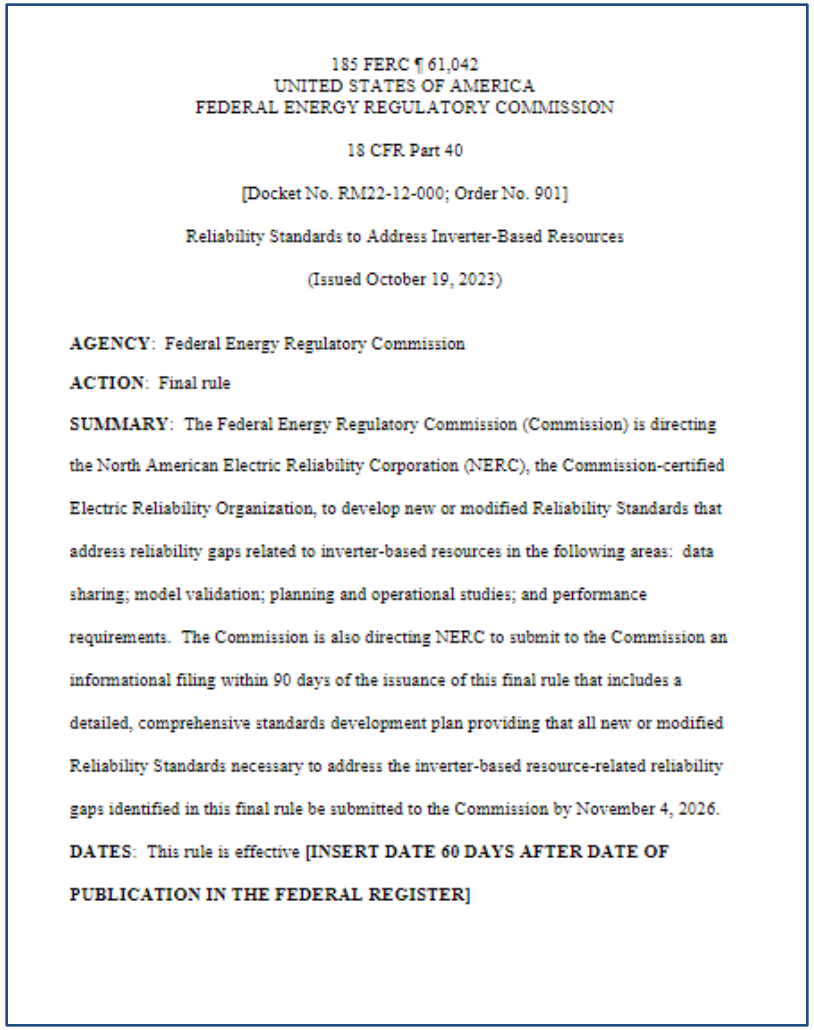
Jamie Calderon - Manager, Standards Development
Standards Committee & NERC Ride-through Technical Conference
September 4, 2024

Order 901 Summary

- FERC Order 901
  - October 2023
  - 4 Milestones through November 2026
  - IBR related performance issues
  - Leverage existing guidance where possible

Order 901 Summary

- IBR Data Sharing
- IBR Model Validation
- IBR Planning and Operational Studies
- IBR Performance Requirements



185 FERC ¶ 61,042
UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

18 CFR Part 40

[Docket No. RM22-12-000; Order No. 901]

Reliability Standards to Address Inverter-Based Resources

(Issued October 19, 2023)

AGENCY: Federal Energy Regulatory Commission

ACTION: Final rule

SUMMARY: The Federal Energy Regulatory Commission (Commission) is directing the North American Electric Reliability Corporation (NERC), the Commission-certified Electric Reliability Organization, to develop new or modified Reliability Standards that address reliability gaps related to inverter-based resources in the following areas: data sharing; model validation; planning and operational studies; and performance requirements. The Commission is also directing NERC to submit to the Commission an informational filing within 90 days of the issuance of this final rule that includes a detailed, comprehensive standards development plan providing that all new or modified Reliability Standards necessary to address the inverter-based resource-related reliability gaps identified in this final rule be submitted to the Commission by November 4, 2026.

DATES: This rule is effective **[INSERT DATE 60 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**

E-1-RM22-12-000 | Federal Energy Regulatory Commission (ferc.gov)

Order 901 Summary

Registered IBRs

- *Bulk-Power System connected IBRs registered with NERC for compliance purposes*

Unregistered IBRs

- *Bulk-Power System connected IBRs not registered with NERC for compliance purposes*

"IBR-DER"

- *Distribution connected IBRs that in the aggregate have a material impact on the Bulk-Power System*

FERC Order 901 Milestones

1 COMPLETED JANUARY 2024

Order No. 901 Work Plan submission

2 DUE NOVEMBER 4, 2024

Standards development and filing to address performance requirements and post-performance validations for Registered IBRs

3 DUE NOVEMBER 4, 2025

Development and filing of Reliability Standards to address data sharing and model validation for all IBRs

4 DUE NOVEMBER 4, 2026

Development and filing of Reliability Standards to address use of performance data in Operational and Planning studies

Project 2021-04
Modifications to PRC-002 - Phase II

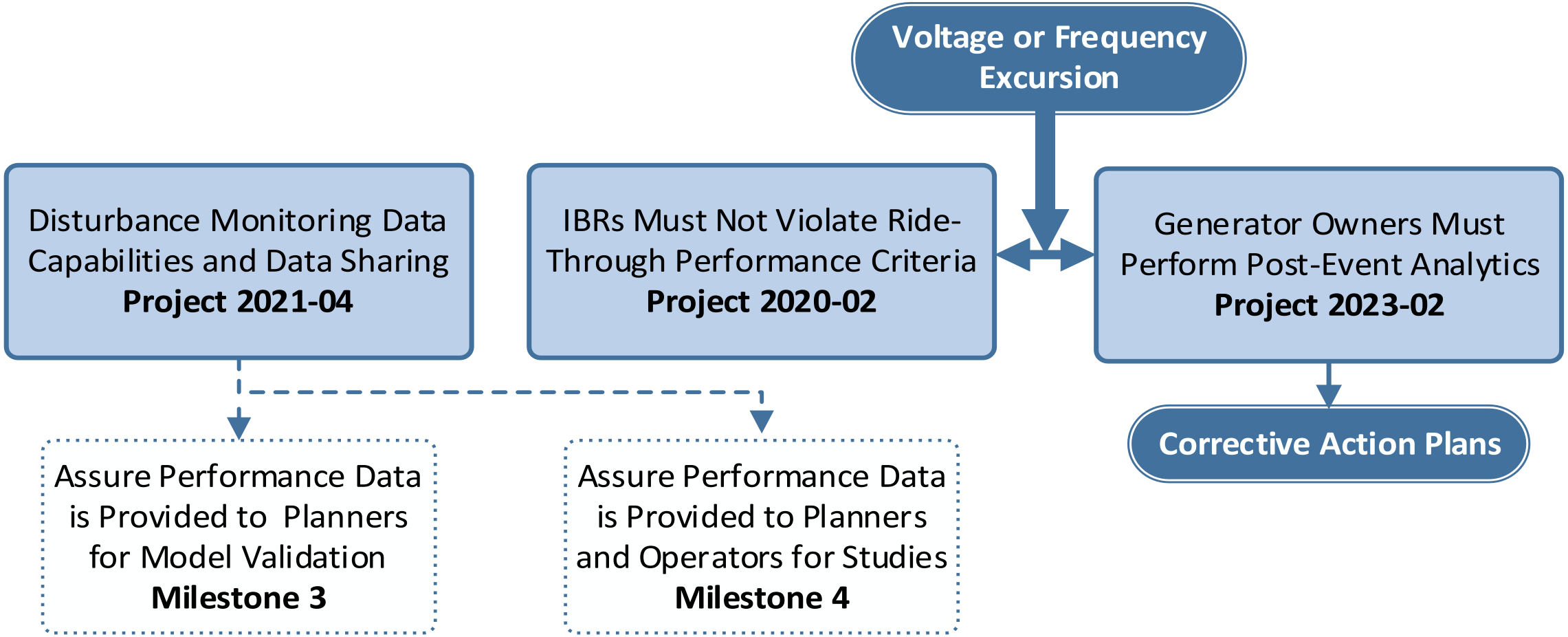
- New Standard: PRC-028-1 Disturbance Monitoring and Reporting Requirements for Inverter-Based Resources
- Data needed by all 901 related Standards
- Requires installation of equipment - phased-in through 2030
- Share data on request

Project 2020-02
PRC-024 (Generator Ride-through)

- New Standard: PRC-029-1 Frequency and Voltage Ride-through Requirements for Inverter-Based Resources
- Establish capability-based ride-through criteria
- Establish performance-based ride-through criteria

- New Standard: PRC-030-1 Unexpected Inverter-Based Resource Event Mitigation
- Analysis of performance during a disturbance
- Triggers what is evaluated for ride-through performance

Milestone 2 Summary



Questions and Answers

Quick Reference Guide: IBR Registration Initiative

August 2024

As part of its *Inverter-Based Resource Strategy*, NERC is dedicated to identifying and addressing challenges associated with inverter-based resources (IBR) as the penetration of these resources continues to increase. ERO Enterprise assessments identified a reliability gap associated with the increasing integration of IBRs as part of the grid in which a significant level of bulk power system-connected IBR owners and operators are not yet required to register with NERC or adhere to its Reliability Standards.

In response, FERC issued an order in 2022 directing NERC to identify and register owners and operators of currently unregistered bulk power system-connected IBRs. Working closely with industry and stakeholders, NERC is executing a FERC-approved work plan to achieve the identification and registration directive by 2026. Resources are also posted on the Registration page of the NERC website.

Key Activities

- NERC's Board of Trustees approved proposed Rules of Procedure revisions on February 22 and filed them with FERC on March 19.
- FERC issued an order approving the Rules of Procedure revisions, subject to submitting a compliance filing, on June 27.
- NERC published its Q2 2024 Quarterly Update on July 11.
- NEW NERC submitted its quarterly work plan update to FERC on August 9.

IBR Registration Milestones

Phase 1: May 2023–May 2024

- Complete Rules of Procedure revisions and approvals
- Commence Category 2 GO and GOP candidate outreach and education (e.g., through trade organizations)

Phase 2: May 2024–May 2025

- Complete identification of Category 2 GO and GOP candidates
- Continue Category 2 GO and GOP candidate outreach and education (e.g., quarterly updates, webinars, workshops, etc.)

Phase 3: May 2025–May 2026

- Complete registration of Category 2 GO and GOP candidates thereafter subject to applicable NERC Reliability Standards
- Conduct specific Category 2 GO and GOP outreach and education (e.g., quarterly updates, webinars, workshops, etc.)

LEARN MORE ABOUT NERC AND THE E-ISAC

Available Resources

- NERC Registration Page
- Standards Under Development Page | FERC Order No. 901 Milestone 2 Summary
- Q1 2024 Update | Q2 2024 Update
- IBR Webinar Series and FAQs
- Quick Reference Guide: Candidate for Registration
- Quick Reference Guide: Inverter-Based Resource Activities
- Learn about NERC and Join the E-ISAC

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Review of Voltage and Frequency Ride-through Criteria in PRC-029-1

Project 2020-02 Modifications to PRC-024 (Generator Ride-through)

Xiaoyu (Shawn) Wang, Chair (Enel North America)
Husam Al-Hadidi, Vice Chair (Manitoba Hydro
NERC Ride-through Technical Conference
September 04, 2024

Drafting Team Roster

	Name	Entity
Chair	Xiaoyu (Shawn) Wang	Enel North America
Vice Chair	Husam Al-Hadidi	Manitoba Hydro
Members	Ebrahim Rahimi	California ISO
	John B. Anderson	Xcel Energy
	Johnny C. Carlisle	Southern Company Services, Inc.
	Robert J. O'Keefe	American Electric Power
	Rajat Majumder	Invenergy
	Alex Pollock	RES
	Ebrahim Rahimi	California ISO
	Fabio Rodriguez	Duke Energy
	Kenneth Silver	8minute Solar Energy
	Ovidiu Vasilachi	Independent Electricity System Operator (IESO)
	John Zong	Electric Power Engineers
NERC Staff	Jamie Calderon	North American Electric Reliability Corporation

Project 2020-02 SAR1

- **Title**: Revision of relevant Reliability Standards to include applicability of transmission-connected dynamic reactive resources
- **Date Submitted**: Feb 24, 2020 (Revised on February 3, 2022)

Project 2020-02 SAR2

- **Title**: **Generator Ride-through Standard (PRC-024-03 Replacement)**
- **Date Submitted**: April 28, 2022 (revised March 31, 2023)
- **Industry Need:**
- Based on the ERO Enterprise analyzing over 10 disturbances reports highlighting key findings and recommendations
  - A widespread loss of generating resources – solar PV, wind, synchronous generation, and battery energy storage systems (BESS)
  - Multiple IBR experience abnormally tripping, ceasing current injection, or reducing power output with control interactions.
  - The unexpected loss of widespread generating assets poses a significant risk to BPS reliability.
- The existing PRC-024-3 is an equipment settings standard focused solely on voltage and frequency protection and is inadequate to address the IBR performance issues
- The proposed standards project will address this known reliability risk with a more suitable performance-based standard that ensures generating resource ride-through performance for expected or planned BPS disturbances

Project 2020-02 SDT Approach

- Modify PRC-024-3 to retain the Reliability Standard as a protection-based standard, applicable only to synchronous generators, synchronous condensers, and Type 1 and Type 2 wind turbines
- Create a new Reliability Standard (PRC-029-1) to address inverter-based resource (IBR) disturbance ride-through performance criteria
- Coincide with ride-through requirements of IEEE standards but structure to follow language from FERC Order No. 901, which states that "NERC has the discretion to consider during its standards development process whether and how to reference IEEE standards in the new or modified Reliability Standards"

Project 2020-02 after 1st Comment Period

- The comment period and initial ballot for the first draft: 3/27/2024 – 4/27/2024
- The first draft failed the initial ballot and received ~200 pages of comments from different stakeholders
- The drafting team went through a series of meetings to address all the comments in May and early June, including an in-person meeting and dedicated meetings with specific stakeholders, e.g., EPRI
- The second comment period on Draft 2: 6/18/2024 – 7/8/2024
- The drafting team went through a series of meetings to address all the comments in July and issued Draft 3: 7/22/2024 – 8/12/2024
- PRC-024-4 has passed ballot
- Draft 3 of PRC-029-1 failed to pass ballot
- On August 15, the NERC Board of Trustees invoked Rule 321

A. Introduction

1. **Title:** **Frequency and Voltage Ride-through Requirements for Inverter-Based Resources**
2. **Number:** **PRC-029-1**
3. **Purpose:** To ensure that ~~Inverter-Based Resources (~~IBR~~s)~~ ~~adhere to~~ Ride-through ~~requirements as expected~~ to support the Bulk Power System (BPS) during and after defined frequency and voltage excursions.
4. **Applicability:**

4.1 Functional Entities:

4.1.1. Generator Owner

~~**4.1.2.** Transmission Owner[1]~~

4.2 Facilities:

4.2.1. The Elements associated with (1) Bulk Electric System (BES) IBRs ~~inverter based resources~~[2] and (2) Non-BES IBRs that either have or contribute to an aggregate nameplate capacity of greater than or equal to 20 MVA, connected through a system designed primarily for delivering such capacity to a common point of connection at a voltage greater than or equal to 60 kV.

~~**4.2.2.** IBR Registration Criteria~~

Project 2020-02
Draft Language PRC-029-1

R1. Each Generator Owner ~~or Transmission Owner~~ shall ensure the design and operation is such that each ~~facility~~ IBR meet or exceed ~~adheres to~~ Ride-through requirements, in accordance with the "must Ride-through[3] zone" as specified in Attachment 1, except for the following: *[Violation Risk Factor: High] [Time Horizon: Operations Assessment]*

- The ~~facility~~ IBR needed to electrically disconnect in order to clear a fault; or
- The voltage at the high side of the main power transformer[4] went outside an accepted~~A documented equipment~~ hardware limitation, ~~exists~~ in accordance with Requirement R4; or
- The instantaneous positive sequence voltage phase angle change is more than 25 electrical degrees at the high-side of the main power transformer and is initiated by a non-fault switching event on the transmission system[5]; or
- The Volts per Hz (V/Hz) at the high-side of the main power transformer exceed 1.1 per unit for longer than 45 seconds or exceed 1.18 per unit for longer than 2 seconds.

Project 2020-02
Draft Language PRC-029-1

M1. Each Generator Owner ~~and Transmission Owner~~shall have evidence ~~of dynamic simulations, studies, or other evidence~~ to demonstrate the design of each facility will adhere to Ride-through requirements, as specified in Requirement R1. Examples of evidence may include, but are not limited to dynamic simulations, studies, plant protection settings, and control settings design evaluation. Each Generator Owner ~~and Transmission Owner~~ shall ~~have~~ retain evidence of actual disturbance monitoring (i.e. Sequence of Event Recorder, Dynamic Disturbance Recorder, and Fault Recorder) to demonstrate that the operation of each ~~facility~~ IBR did adhere to Ride-through requirements, as specified in Requirement R1. If the Generator Owner ~~and Transmission Owner~~ choose to utilize Ride-through exemptions that occur within the "must Ride-through zone" and are caused by non-fault initiated phase jumps of greater than 25 electrical degrees, then each Generator Owner ~~and Transmission Owner~~ shall also ~~have~~ retain evidence of actual disturbance monitoring (i.e. Sequence of Event Recorder, Dynamic Disturbance Recorder, and Fault Recorder) data to demonstrate that the ~~facility~~ IBR failed to Ride-through during a phase jump of greater than or equal to 25 electrical degrees, and documentation from their Transmission Planner, Reliability Coordinator, Planning Coordinator, or Transmission Operator that a non-fault initiated switching event occurred.

Project 2020-02
Draft Language PRC-029-1

R2. Each Generator Owner ~~or Transmission Owner~~ shall ensure the design and operation is such that ~~-~~the voltage performance for each ~~facility~~ IBR adheres to the following during a voltage excursion, unless a documented ~~equipment~~ hardware limitation

2.1. While the voltage at the high-side of the main power transformer[6] remains within the continuous operation region as specified in Attachment 1, each ~~facility~~ IBR shall:

2.1.1 Continue to deliver the pre-disturbance level of ~~active~~ Real ~~p~~Power or available ~~active~~ Real ~~p~~Power[7], whichever is less.[8]

2.1.2 Continue to deliver R~~r~~eactive ~~p~~Power up to its ~~r~~Reactive ~~p~~Power limit and according to its controller settings.

2.1.3 Prioritize Real Power or Reactive Power ~~If the facility cannot deliver both active and reactive power due to a current limit or reactive power limit,~~ when the voltage is less than~~below~~ 0.95 per unit, the voltage is ~~and still~~ within the continuous operation region, and the IBR cannot deliver both Real Power and Reactive Power due to a current limit, unless otherwise specified through other mechanisms by an associated~~then preference shall be given to active or reactive power according to requirements if required by the~~ Transmission Planner, Planning Coordinator, Reliability Coordinator, or Transmission Operator.

2.2. While voltage at the high-side of the main power transformer is within the mandatory operation region as specified in Attachment 1, each IBR shall exchange current, up to the maximum capability to provide voltage support, on the affected phases during both symmetrical and asymmetrical voltage disturbances, either under[9]:

- Reactive P~~p~~ower priority by default; or
- ~~Active~~ Real ~~p~~Power priority if required through other mechanisms by an~~the~~ associated Transmission Planner, Planning Coordinator, Reliability Coordinator, or Transmission Operator.

Project 2020-02
Draft Language PRC-029-1

2.3. While voltage at the high-side of the main power transformer is within the permissive operation region, as specified in Attachment 1, each ~~facility~~ IBR may operate in current block mode if necessary to avoid tripping. Otherwise, each ~~facility~~ IBR shall follow the requirements for the mandatory operation region in Requirement R2.2.

2.3.1 If a ~~facility~~ IBR enters current block mode, it shall restart current exchange in less than or equal to five cycles of positive sequence voltage returning to a continuous operation region or mandatory operation region.

2.4. Each ~~facility~~ IBR shall not itself cause voltage at the high-side of the main power transformer to exceed the applicable high voltage thresholds and time durations in its response as voltage recovers from the mandatory or permissive operation regions to the continuous operation region.

2.5. Each ~~facility~~ IBR shall restore ~~active~~Real ~~p~~Power output to the pre-disturbance or available level[10] (whichever is lesser) within 1.0 second when the voltage at the high-side of the main power transformer returns from the mandatory operation region or permissive operation region (including operating in current block mode) to the continuous operation region, as specified in Attachment 1, unless ~~the~~ an associated Transmission Planner, Planning Coordinator, Reliability Coordinator, or Transmission Operator requires a lower post-disturbance ~~active~~ Real ~~p~~Power level requirement or requires a different post-disturbance ~~active~~ Real ~~p~~Power restoration time through other mechanisms.[11]

Project 2020-02
Draft Language PRC-029-1

R3. Each Generator Owner ~~or Transmission Owner~~ shall ensure the design and operation is such that each ~~facility~~ IBR meets or exceeds~~adheres to~~ Ride-through requirements during a frequency excursion event whereby the System frequency remains within the "must Ride-through zone" according to Attachment 2 and the absolute rate of change of frequency (RoCoF)[12] ~~–~~magnitude is less than or equal to 5 Hz/second. *[Violation Risk Factor: High] [Time Horizon: Operations Assessment]*

Project 2020-02
Draft Language PRC-029-1

R4. Each Generator Owner ~~and Transmission Owner~~ identifying an ~~facility~~ IBR that is in-service by the effective date of PRC-029-1, has known hardware limitations that prevent the ~~facility~~ IBR from meeting voltage Ride-through criteria as detailed in Requirements R1 and R2, and requires an exemption from specific voltage Ride-through criteria shall:[13] *Lower] [Time Horizon: Long-term Planning]*

4.1. Document information supporting the identified hardware limitation no later than 12 months following the effective date of PRC-029-1. This documentation shall include:

4.1.1 Identifying information of the IBR (name, facility #~~, other~~);

4.1.2 Which aspects of voltage ride-through requirements that the IBR would be unable to meet and the capability of the ~~equipment~~ hardware due to the limitation;

4.1.3 Identify the specific piece(s) of ~~equipment~~ hardware causing the limitation;

4.1.4 Supporting technical documentation verifying the limitation is due to hardware that needs to be physically replaced or that the limitation cannot be removed by software updates or setting changes, and;

4.1.5 Information regarding any plans to remedy the ~~equipment~~ hardware limitation (such as an estimated date).

Project 2020-02
Draft Language PRC-029-1

4.2. Provide a copy of the information detailed in Requirement R4.1 to the ~~applicable~~ associated Planning Coordinator(s), Transmission Planner(s), Transmission Operator(s), Reliability Coordinator(s), and ~~to~~ the ~~Regional Entity~~CEA no later than 12 months following the effective date of PRC-029-1.

4.2.1 Any response to additional information requested by the ~~applicable~~ associated Planning Coordinator(s), Transmission Planner(s), Transmission Operator(s), Reliability Coordinator(s), and ~~to~~ the ~~Regional Entity~~CEA shall be provided back to the requestor within 90 days of the request.

~~4.2.1~~**4.2.2** Provide a copy of the acceptance of an hardware limitation by the CEA to the associated Planning Coordinator(s), Transmission Planner(s), Transmission Operator(s), and Reliability Coordinator(s).[14]

4.3. Each Generator Owner ~~and Transmission Owner~~ with a previously ~~submitted~~ accepted limitation~~request for exemption~~ that replace the ~~equipment~~hardware causing the limitation shall document and communicate such an hardware ~~equipment~~ change to the associated Planning Coordinator(s), Transmission Planner(s), Transmission Operator(s), and Reliability Coordinator(s) within 90 days of the hardware ~~equipment~~ change.

4.3.1 When existing ~~equipment~~ hardware causing the limitation is replaced, the exemption for that Ride-through criteria no longer applies.

Table 1: Voltage Ride-Through Requirements for AC-Connected Wind ~~Facility~~IBR [15]

Voltage (per unit)[16]	Operation Region	Minimum Ride-Through Time (sec)
> 1.20	N/A[17]	N/A
~~≤ 1.20 and~~ ≥ 1.10	Mandatory Operation Region	1.0
~~≤ 1.10 and~~ > 1.05	Continuous Operation Region	1800
≤ 1.05 and ≥ 0.90	Continuous Operation Region	Continuous
< 0.90 ~~and ≥ 0.70~~	Mandatory Operation Region	3.00
< 0.70 ~~and ≥ 0.50~~	Mandatory O	
< 0.50 ~~and ≥ 0.25~~	Mandatory O	
< 0.25 ~~and ≥ 0.10~~	Mandatory O	
< 0.10	Permissive O	

Table ~~22~~2: Voltage Ride-Through Requirements for All Other ~~Inverter-based Resource Facilities~~IBR

Voltage (per unit)[18]	Operation Region	Minimum Ride-Through Time (sec)
> 1.20	N/A[19]	N/A
~~≤ 1.20 and~~ > 1.10	Mandatory Operation Region	1.0
~~≤ 1.10 and~~ > 1.05	Continuous Operation Region	1800
≤ 1.05 and ≥ 0.90	Continuous Operation Region	Continuous
< 0.90 ~~and ≥ 0.70~~	Mandatory Operation Region	6.00
< 0.70 ~~and ≥ 0.50~~	Mandatory Operation Region	3.00
< 0.50 ~~and ≥ 0.25~~	Mandatory Operation Region	1.20
< 0.25 ~~and ≥ 0.10~~	Mandatory Operation Region	0.32
< 0.10	Permissive Operation Region	0.32

Attachment 2: Frequency Ride-Through Criteria

Table 3: Frequency Ride-Through Capability Requirements

System Frequency (Hz)	Minimum Ride-Through Time (sec)
≥~~≥~~ 64.0	May trip
~~< 64 and~~ ≥ 61.8	6
~~< 61.8 and~~ ≥ 61.5	299
~~< 61.5 and~~ > 61.2	660
≤ 61.2 and ≥~~<~~ 58.8	Continuous
≤ 58.8 ~~and < 58.8~~	660
≤~~<~~ 58.5 ~~and ≥ 57~~	299
≤~~<~~ 57.0 ~~and ≥ 56~~	6
< 56.0	May trip

Project 2020-02

- Relevant information
  - Project page
- Contact information
  - Jamie Calderon: Jamie.Calderon@nerc.net
  - Xiaoyu (Shawn) Wang: xiaoyu.wang@enel.com
  - Husam Al-Hadidi: halhadidi@hydro.mb.ca

Questions and Answers

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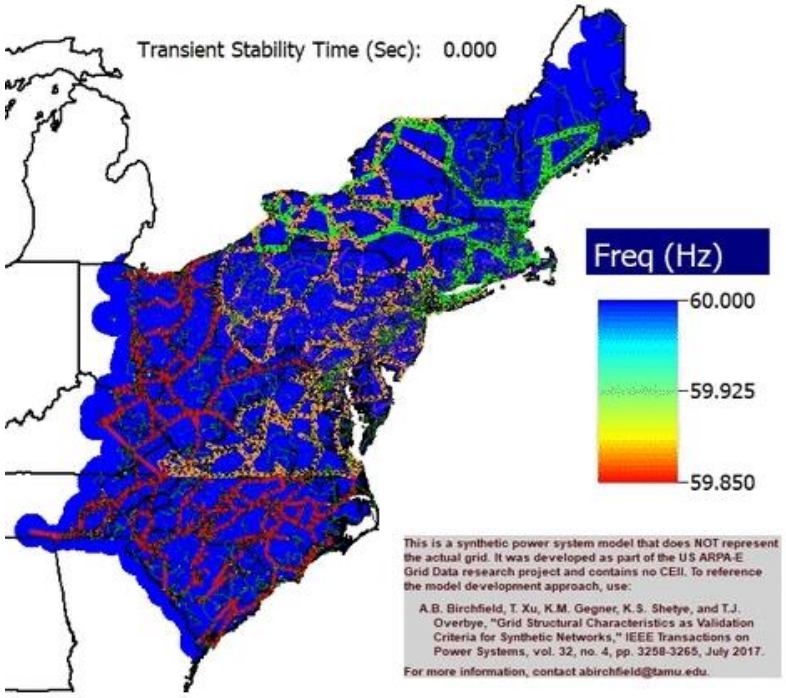
Review of Voltage and Frequency Ride Through

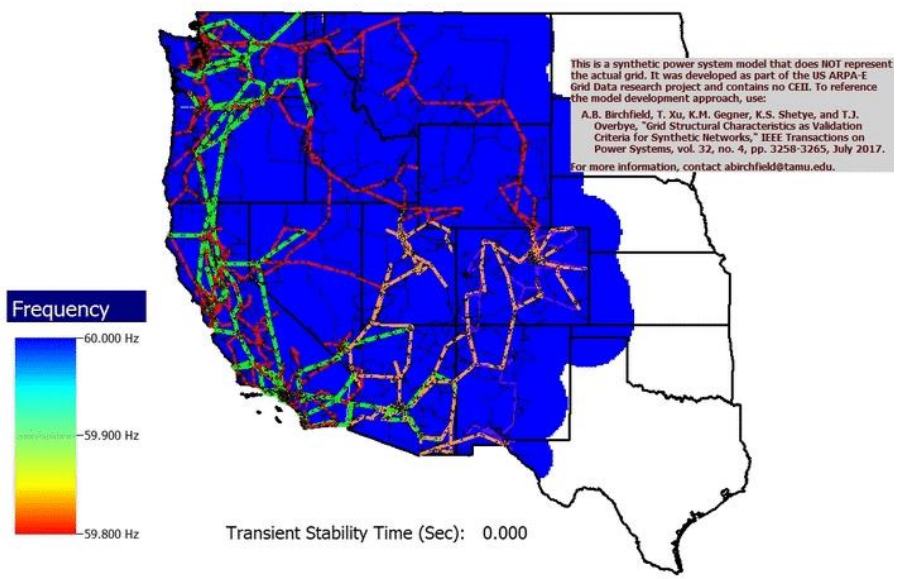
Alex Shattuck, Senior Engineer
NERC Ride-through Technical Conference
September 04, 2024

Why do we need Ride-through?

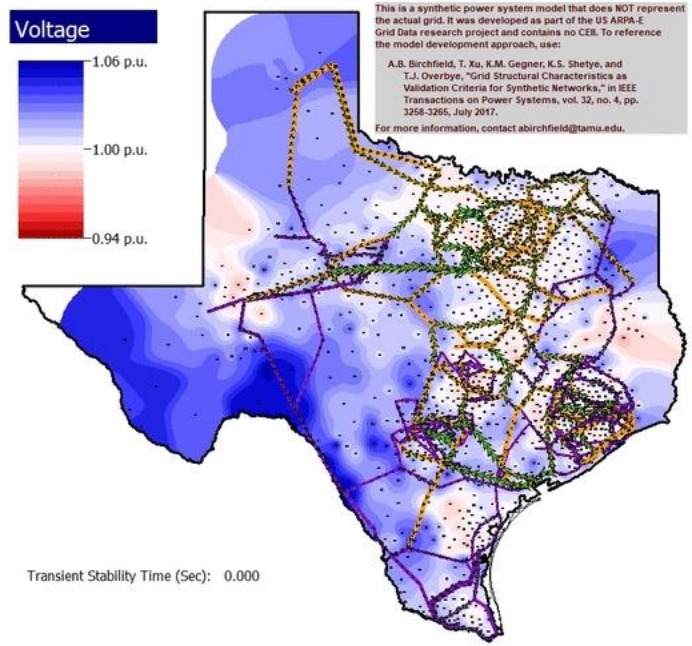
- Unexpected events happen often on the bulk power system
  - These events cause varied deviations from nominal in system voltage and frequency
    - Not all unexpected events cause major deviations, but the bulk power system must be prepared to perform reliably when major events occur
- NERC must create effective and efficient criteria to reduce reliability risks



[25,000 Bus Synthetic Grid - Northeastern United States (tamu.edu)]



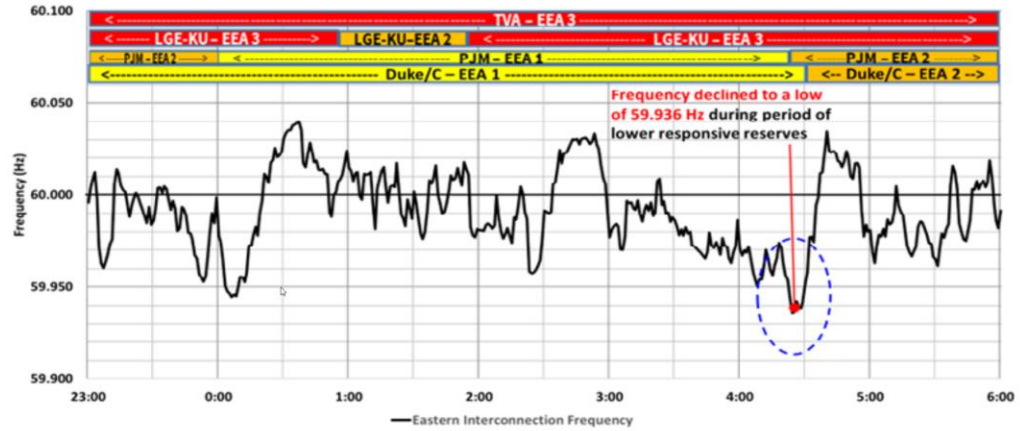
[10000 Bus Synthetic Grid - Western United States (tamu.edu)]



[2000 Bus Synthetic Grid - Texas (tamu.edu)]

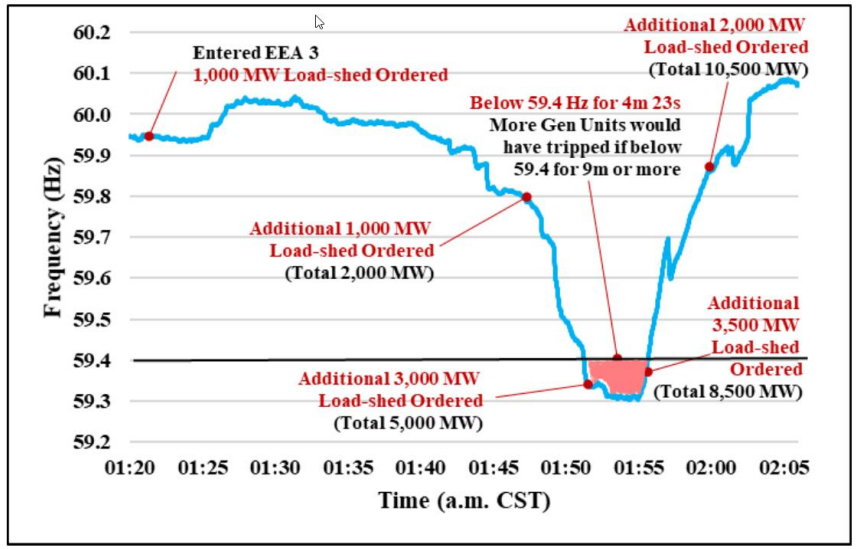
Summary of Observed Major Events

- 10 published major disturbance reports published since 2016 with an approximate total of 15,000 MW
- Numerous wind-related events in ERCOT area that did not trigger event reports
- Winter storms Uri and Elliot stressed system frequency



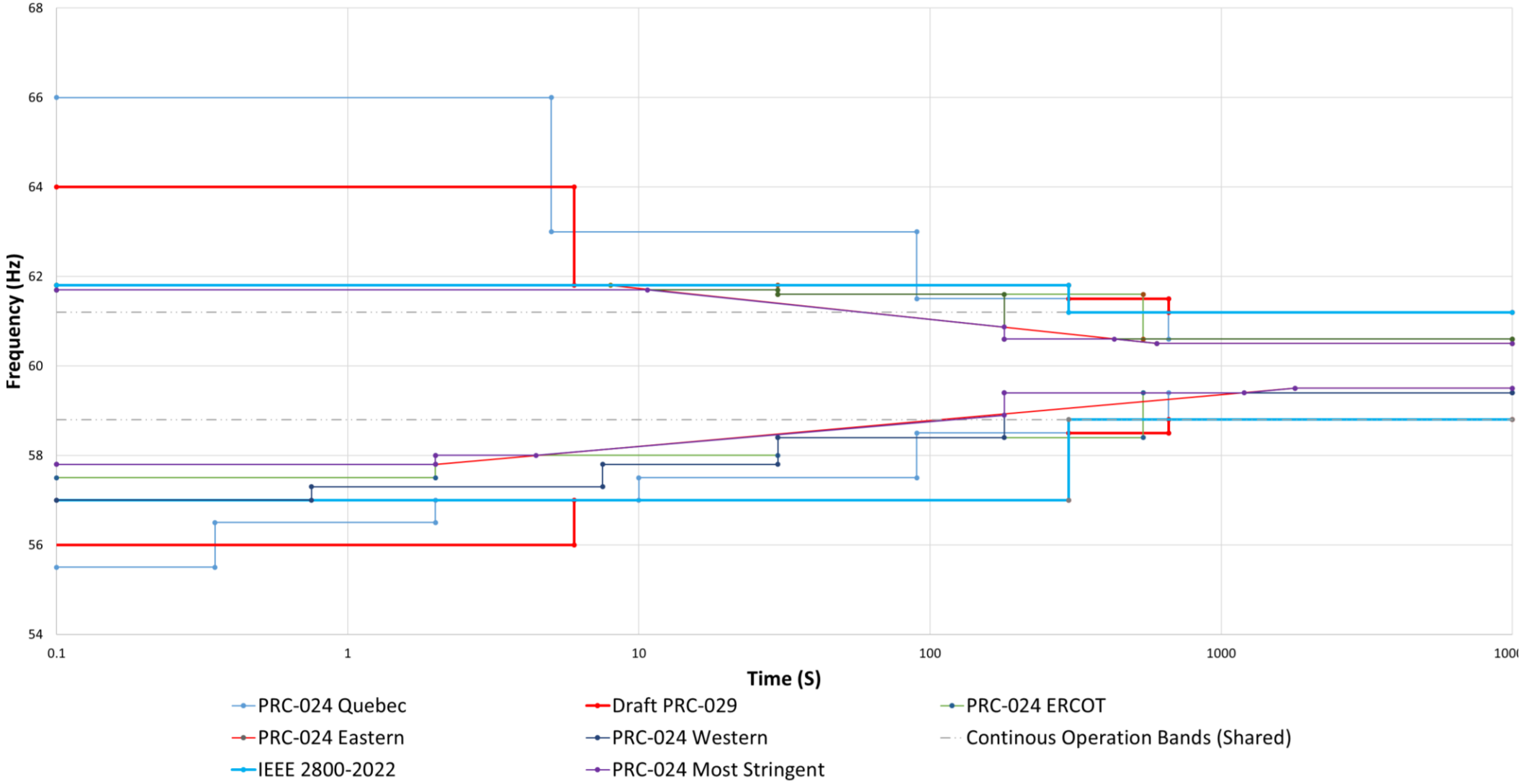
Eastern Interconnection System Frequency | Winter Storm Elliott Report

Reference Number	Disturbance	IBR Reduced (MW)	Year
#1	Blue Cut Fire	1,753	2016
#2	Canyon 2 Fire	1,619	2017
#3	Angeles Forest & Palmdale Roost	1,588	2018
#4	San Fernando	1,205	2020
#5	2021 Odessa	1,112	2021
#6	Victorville & Tumbleweed & Windhub & Lytle Creek Fire	2,464	2021
#7	Panhandle Wind	1,222	2022
#8	2022 Odessa	1,711	2022
#9	Southwest Utah	921	2022
#10	California Battery Energy Strorage	906	2023

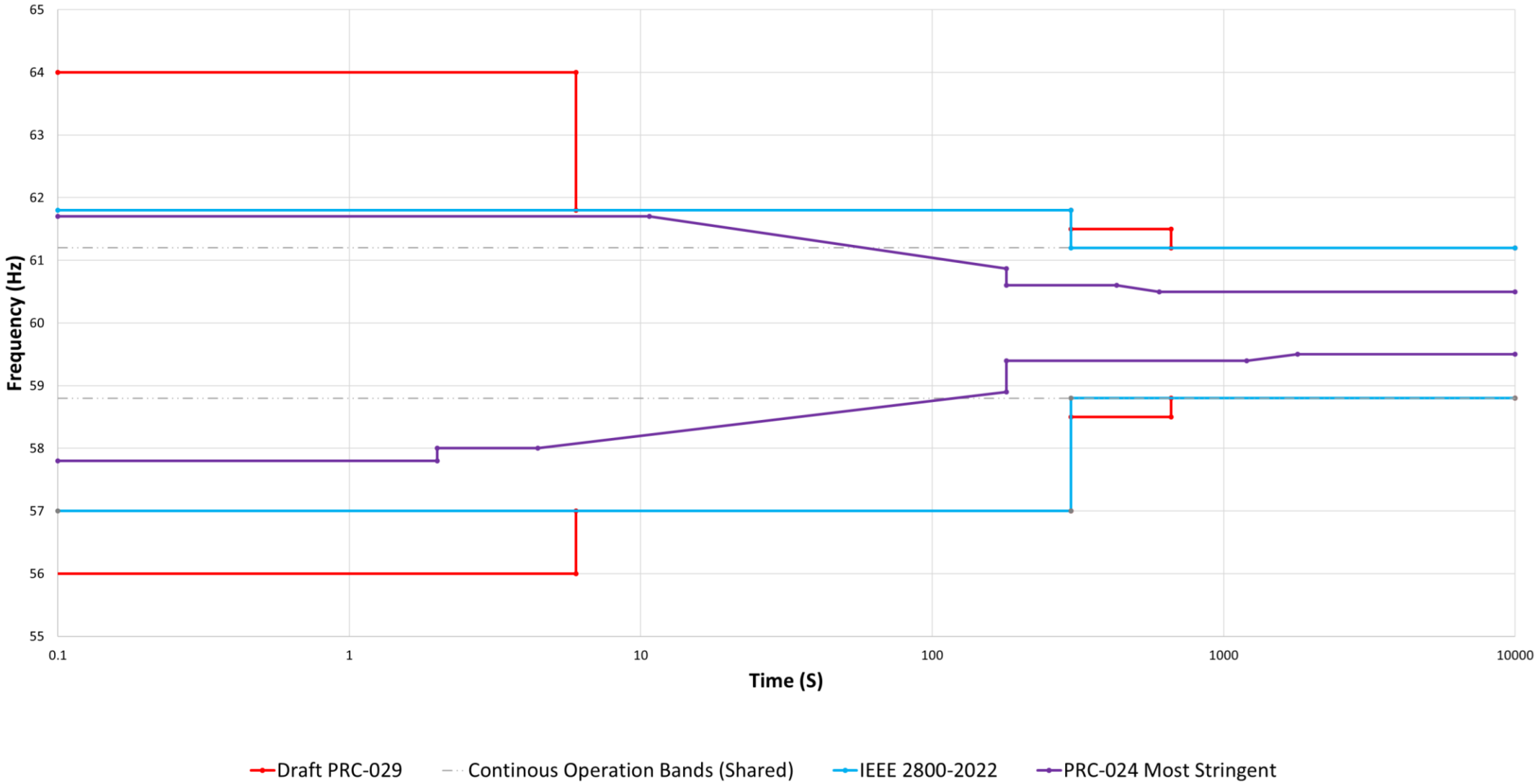


ERCOT System Frequency |The February 2021 Cold Weather Outages in Texas and the South Central United States

Comparing Frequency Criteria

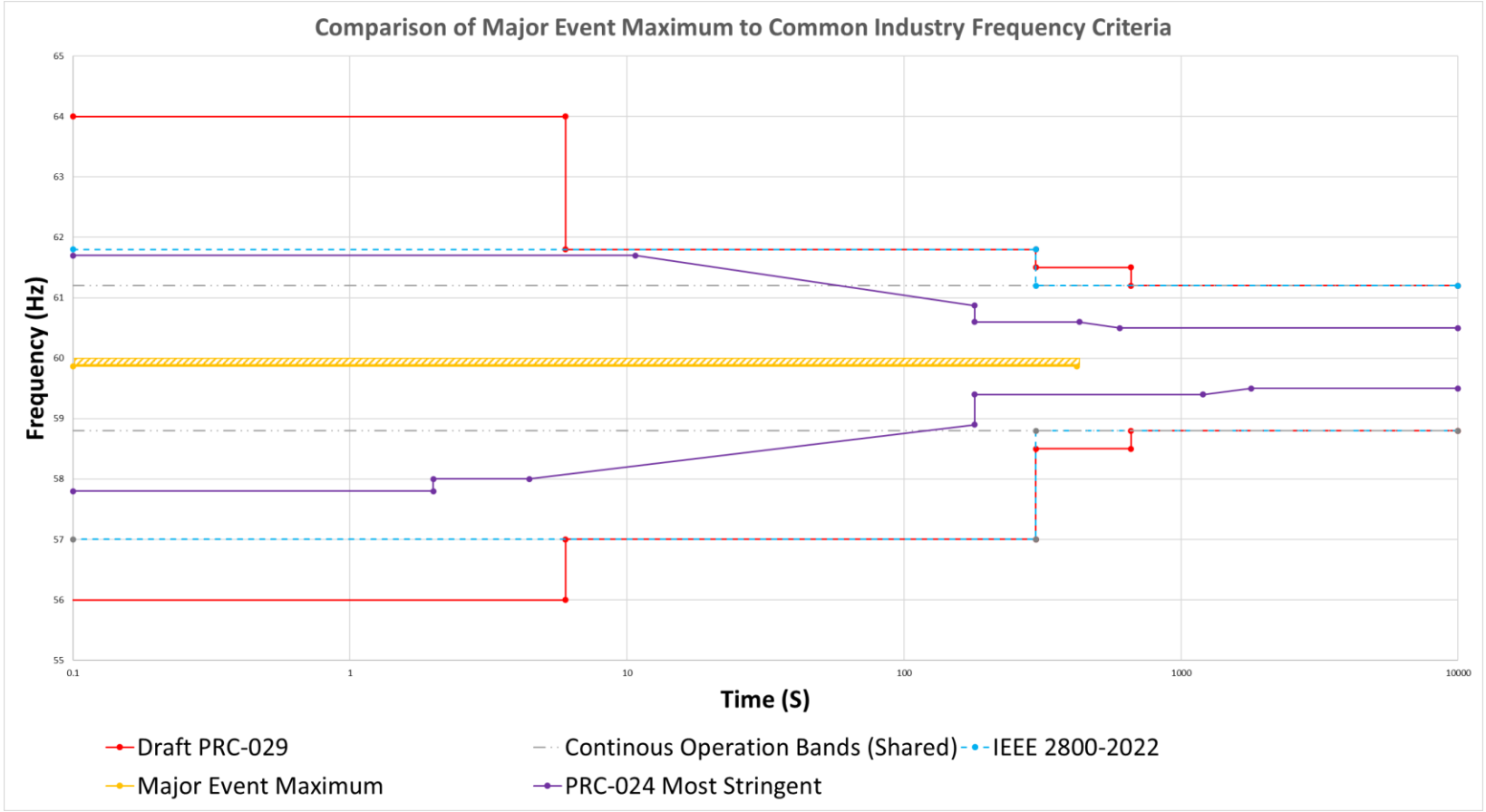


Comparing Frequency Criteria



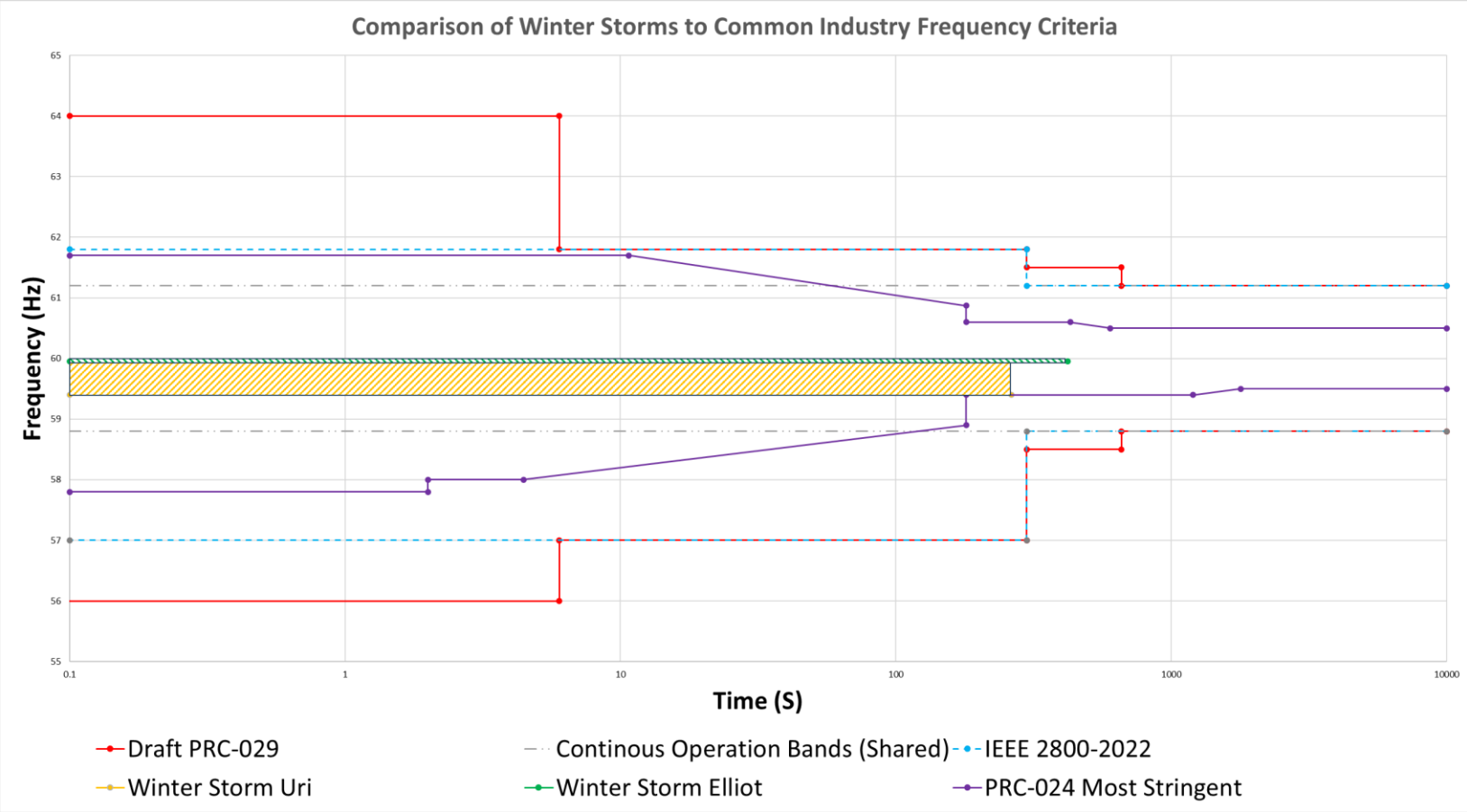
Comparing Major Events to Ride-through Criteria

- All events in published major event reports saw deviations within continuous operation bands in draft PRC-029 and IEEE 2800-2022
- Nearly all frequency-related tripping was due to the use of instantaneous measurements



Comparing Winter Storms to Ride-through Criteria

- Winter storms resulted in significantly more severe frequency deviations
- Winter storm Uri frequency deviation touches PRC-024 criteria but is far from draft PRC-029 and IEEE 2800-2022 criteria



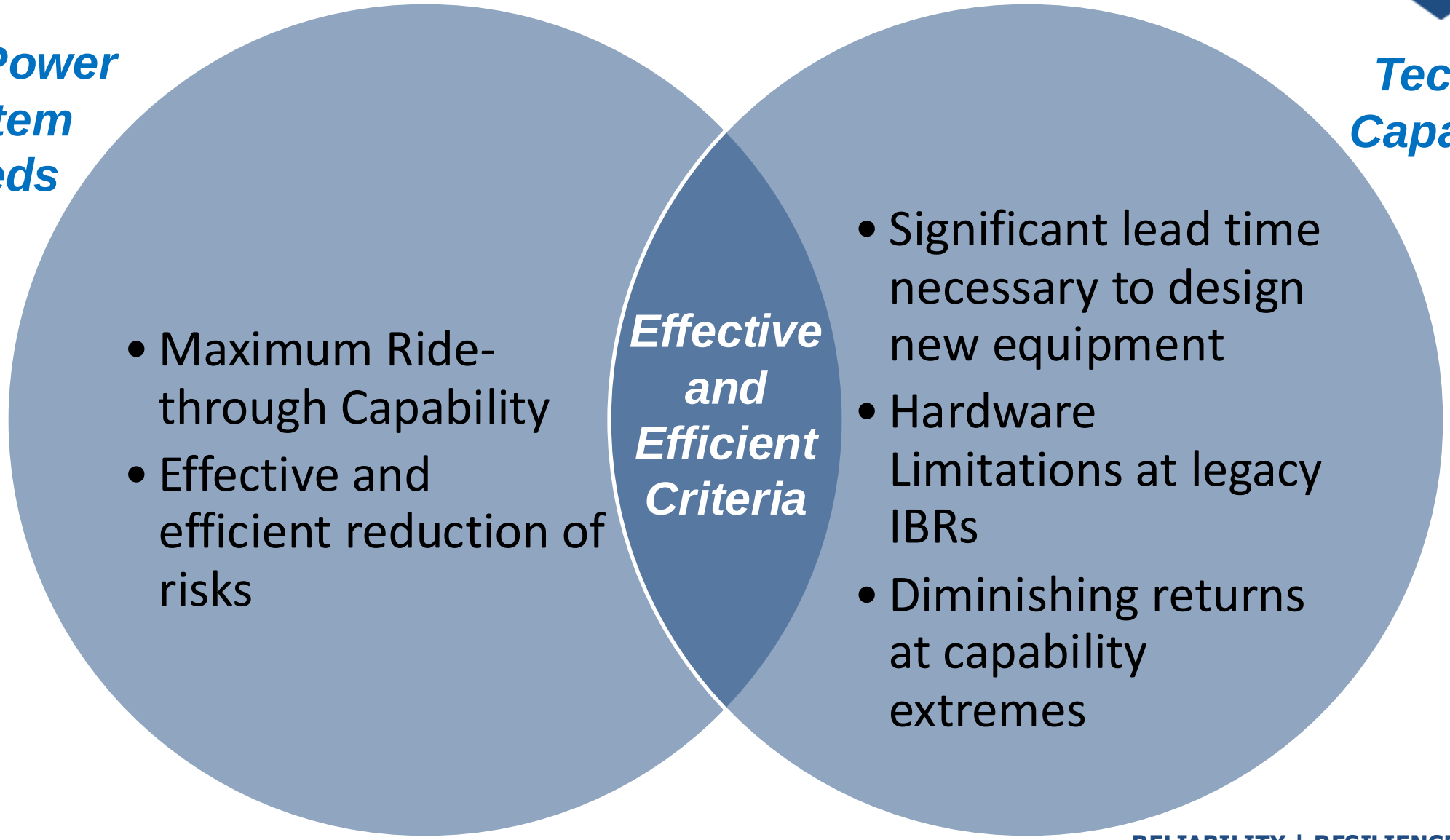
Summary of Disturbance Observations

- Analyzed major events and both winter storm Uri and Elliot resulted in frequency deviations **within the continuous operation bands detailed in the draft PRC-029 and IEEE 2800-2022**
- Currently **no "benchmark event"** for frequency and voltage criteria to be based on
- **Branching Paths:** Set protection settings as wide as possible to maximize ride-through capability **– or –** determine *reasonable* criteria that will ensure BPS reliability

NERC's Published Recommendations for Ride-Through

- From the March 14, 2023 Level 2 Alert: Inverter-Based Resource Performance Issues
  - *Expand AC voltage protection settings as widely as possible within the inverter equipment capability. Eliminate or minimize the use of inverter instantaneous AC voltage tripping (e.g., zero or near-zero3 time delay using instantaneous peak measurements)*
  - *Inverter frequency protection should be set based on equipment capability. Frequency protection should operate on a filtered frequency measurement over a time window. Eliminate or minimize the use of inverter instantaneous frequency tripping.*
    - Notes 2-3 on Table 3 of draft PRC-029 Attachment 2 address the filtered measurement performance issue
- These recommendations have been repeated in numerous major event reports

Balance is Needed



How Can New Equipment Meet Criteria?

- **Criteria need to be reasonable** when compared to current and future equipment capabilities
- If criteria are outside of current equipment capabilities, **sufficient lead time is necessary** for manufacturers to make necessary design changes and come to market
- Sufficient time is necessary for **testing** to ensure equipment can meet proposed criteria
- **Manufacturer input and evidence is crucial**

What if Criteria Cannot Be Met by Legacy Equipment?

Manufacturer input and detailed documentation is critical for determining solutions

- Software-based protection parameter changes
- Small hardware-based retrofits of equipment
- Significant hardware-based retrofit or replacement

Are Exemptions Necessary?

- Some amount of legacy IBR may not be able to meet newly proposed criteria
  - Software-based upgrades are a simple path towards compliance with newly proposed criteria
- Additional considerations are needed when software-based upgrades are not sufficient
- Exemptions can allow legacy equipment to remain connected to the BPS while maximizing their capabilities and sharing this data with affected entities
  - Efficacy of exemptions is dependent on:
    - Sufficient documentation detailing a hardware-based limitation
    - Sufficient documentation that software-based protection settings are set at the maximum capability of the equipment
    - Review of the provided documentation to determine the level of risk associated with the documented maximum
  - **Blanket exemptions** without detailed documentation is **not a sufficient solution**

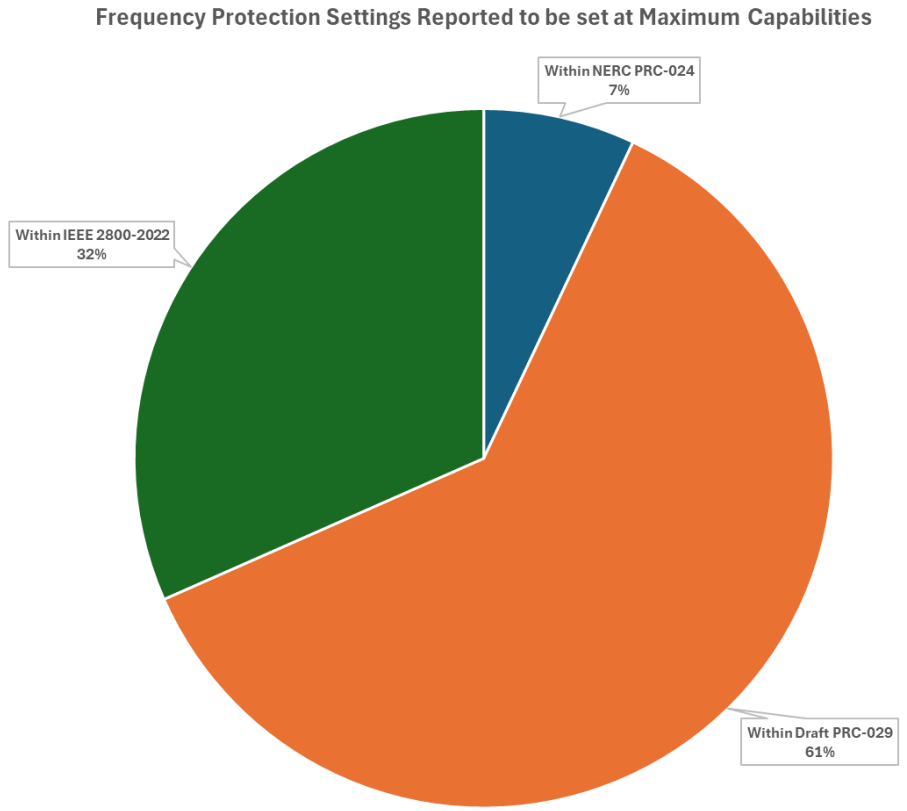
Quantifying Risks for Legacy IBR

- Data from Level 2 Alert on IBR Performance includes all BPS-connected solar PV and BESS
- Reported data shows significant number of resources with possible software-based solutions
- Reported settings at maximum capability allow the risks of different criteria to be quantified

Table 2.1: Protection Settings Based on Maximum Equipment Capability

Ride-Through Protection Type	Yes	No	Percent Yes
High Voltage	617	1,399	30.61%
Low Voltage	722	1,209	37.39%
High Frequency	376	931	28.77%
Low Frequency	476	1,021	31.80%
Total	2,191	4,560	32.45%

NERC_Inverter-Based_Resource_Performance_Issues_Public_Report_2023



Manufacturer Challenges

- **Challenges for new IBR equipment:**
  - Deciding which criteria to design for
  - Procuring testing locations to show compliance
  - Long lead times for design changes driven by changing requirements
  - Ride-through capabilities can become cost prohibitive at extremes

- **Challenges for Legacy IBR Equipment:**
  - Hardware-based limitations exist
  - Software-based solutions may still not meet new criteria
  - Legacy equipment was tested in accordance with applicable requirements at the time of interconnection
    - True capability is “unknown” and retesting legacy equipment may not be feasible
  - Coordinating and implementing effective and efficient solutions can be difficult

Industry Challenges

- **Challenges for new IBR equipment:**
  - Deciding which equipment will be needed to meet new requirements
  - Obtaining evidence that equipment can meet new requirements
  - Communicating technical details necessary to provide sufficient model and facility data

- **Challenges for Legacy IBR Equipment:**
  - How to manage facilities with hardware-based limitations
  - Assessing the feasibility of software-based solutions can be difficult
  - Sometimes challenging to obtain objective capability-based information
  - Coordinating and implementing effective and efficient solutions can be difficult

Key Takeaways

- NERC has **analyzed over 15,000 MW** of unexpected disturbances with very few IBR tripping due to frequency criteria exceedance
  - All analyzed events caused frequency deviations **within continuous operation** bands of draft PRC-029 and IEEE 2800-2022
- NERC recommends to **maximize ride-through** capability
- **Validated documentation on limitations is crucial** for efficient and effective criteria but has proven **difficult to obtain**
- **Manufacturer input on true capabilities of legacy and new equipment is critical**

Questions and Answers

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Panel Discussion: Original Equipment Manufacturer Perspectives on Voltage and Frequency Ride-through Criteria

Thomas Schmidt Grau – Vestas
Thierry Ngassa – Power Electronics
Scott Karpiel – SMA
Dinesh Pattabiraman – TMEIC
Samir Dahal – Siemens Energy
Arne Koerber – GE Vernova

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Panel Discussion with Q&A: Addressing the Challenges of Voltage and Frequency Ride-through Criteria

Mark Lauby – NERC
Manish Patel – EPRI
Todd Chwialkowski – EDF
Andy Hoke – NREL
Michael Goggin – Grid Strategies LLC

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Slido Polling: Voltage and Frequency Ride-through Criteria

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Parking Lot

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Day 1 Wrap-up

Sue Kelly – NERC Board of Trustees

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Welcome to the Standards Committee and NERC Ride-through Technical Conference Day 2

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NERC Antitrust Compliance Guidelines and Commission Staff Disclaimer

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Recap of Day 1 and Introduction to Day 2

Todd Bennett – AEC
Soo Jin Kim – NERC

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Panel Discussion: Discussion on Frequency Ride-Through Exemptions in PRC-029-1

Moderators: Charles Yeung – SPP and Alex Shattuck – NERC

Panelist: Howard Gugel – NERC, Dane Rogers – OGE, Jason MacDowell – GE Vernova, Mark Ahlstrom – NextEra

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Outlining Objectives of a Ride-through Definition

Joel Anthes, P.E. – 2020-02 Drafting Team Member

NERC Ride-through Technical Conference

September 5, 2024

Definition Overview

Why is PRC-029-1 Including a Definition of Ride-through?

The Project 2020-02 SAR Generator Ride-through Standard (PRC-024-3 Replacement) – submitted April 28, 2022(revised March 31, 2023), includes additions to the NERC Glossary of Terms and directs the drafting team to "define the term ride-through, as necessary".

The drafting team for PRC-030-1 – "Unexpected Inverter-Based Resource Event Mitigation", under Project 2023-02, requested that the drafting team for PRC-029-1 include a definition for Ride-Through. This was necessary to link their requirement 2 reference to "Document the facility's Ride-through performance…"

Definition Overview

Drafting Team's Goals in Defining Ride-through Were:

- Create a stand-alone definition that could be included in the NERC Glossary that was not tied to or limited by the PRC-029-1 standard.
- Create a definition that could be used within other standards, namely PRC-030-1, to allow them to reference IBR Ride-through performance requirements.

Definition Overview

Drafting Team's Goals in Defining Ride-through Were Not:

- To create an additional quantitative performance requirement(s) merely by defining the term Ride-through.
- To define the IBR performance necessary to support system reliability (this is instead defined under Requirements 1-4 of PRC-029-1).

Proposed Definition

Draft 2 Definition: Remaining connected, synchronized with the Transmission System, and continuing to operate in response to System conditions through the time-frame of a System Disturbance.

Draft 3 Definition: The entire plant/facility remaining connected to the Bulk Power System and continuing in its entirety to operate through System Disturbances.

- Removed "synchronized with", in response to System conditions"
- Added "entire" and "in its entirety"
- Replaced "Transmission System" with "Bulk Power System"

Proposed Definition

Draft 3 Definition: The entire plant/facility remaining connected to the Bulk Power System and continuing in its entirety to operate through System Disturbances.

Uses approved NERC Glossary terms:

Bulk-Power System	(A) facilities and control systems necessary for operating an interconnected electric energy transmission network (or any portion thereof); and (B) electric energy from generation facilities needed to maintain transmission system reliability. The term does not include facilities used in the local distribution of electric energy. (Note that the terms "Bulk-Power System" or "Bulk Power System" shall have the same meaning.)
Disturbance	1. An unplanned event that produces an abnormal system condition. 2. Any perturbation to the electric system. 3. The unexpected change in ACE that is caused by the sudden failure of generation or interruption of load.

IEEE 2800-2022 Definition

IEEE 2800 Ride-through Definition: *Ability to withstand voltage or frequency disturbances inside defined limits and to continue operating as specified.*

Drafting Team Comments:

- "Ability to withstand" may not be clearly construed to mean "remaining connected"
- "inside defined limits" is a reference to requirements in a standard, is unnecessary to describe the essence of what it means to ride through, and results in the definition not being stand-alone
- "as specified" is again a reference to requirements in a standard that is unnecessary to describe the essence of what it means to ride through, and results in the definition not being stand-alone

Other Proposed Definitions

- **Other Ride-through Definition 1:** *Ability to withstand System disturbances inside defined limits and to continue operating as specified.*
  - Very similar to IEEE 2800-2022 definition.
- **Other Ride-through Definition 2:** *Ability to withstand voltage or frequency Disturbances within defined regulatory limits remaining connected, synchronized with the Transmission System, and continuing to operate.*
- Merges aspects of IEEE and SDT draft 2 definitions; what is meant by “regulatory limits” is not clear.

Other Proposed Definitions

- **Other Ride-through Definition 3:** *Facilities, including all individual dispersed power producing resources, remaining connected to the electric system and continuing to operate in a manner that supports grid reliability throughout a System Disturbance, including the period of recovery back to a normal operating condition.*
  - Seems more a system level definition than facility level; the phrase “in a manner that supports grid reliability” makes it dependent on what a standard or a description found elsewhere would describe; last phrase underlined is viewed as equivalent to “operate through System Disturbances”

Other Proposed Definitions

- **Other Ride-through Definition 4:** *Remaining connected, synchronized with the Transmission System, and continuing to operate by delivering power in response to System conditions through the time-frame of a System Disturbance.*
  - Very similar to Draft 2 definition adding only "by delivering power" which will not always be the case with batteries in charging or idle modes
- **Other Ride-through Definition 5:** *The entire plant/facility remaining connected to the Bulk Power System and continuing to operate through System Disturbances.*
  - Similar to Draft 3 definition only removing "in its entirety"

Other Proposed Definitions

- **Other Ride-through Definition 6:** *The plant/facility remaining connected to the Bulk Power System and continuing to operate through System Disturbances as defined in applicable reliability standards*
  - Removing "entirety" and "in its entirety" could make it possible to qualify partial tripping as ride-through; adding "as defined in applicable reliability standards" makes definition dependent on what such standards would describe
- **Other Ride-through Definition 7:** *The entire plant/facility remaining connected to the Bulk Power System, and continuing in its entirety to operate as specified through the time-frame of System Disturbances.*
  - Draft 3 definition with "as specified" which makes it dependent on a standard and inserting "the time-frame of" which is pretty similar to "through" [System Disturbances]

Other Proposed Definitions

- **Other Ride-through Definition 8:** *The entire plant/facility remaining connected and continuing to operate through the duration of a frequency or voltage Disturbance in its entirety, from its start to the return to pre-disturbance conditions.*
  - Essentially the same as SDT draft 3 with non-substantive changes and removal of "Bulk Power System"
- **Other Ride-through Definition 9:** *The entire plant/facility remaining connected to the Bulk Power System and continuing in its entirety to operate as specified through System Disturbances inside defined limits.*
  - Same as SDT draft 3 definition adding "as specified" and "inside defined limits" which makes it dependent (not stand-alone)

Other Proposed Definitions

- **Other Ride-through Definition 10:** *The entire plant/facility (including its dispersed power producing inverters) remaining connected to the electric system and continuing in its entirety to operate in a manner that supports grid reliability through a System Disturbance, including the period of recovery back to a normal operating condition".*
  - Adding "in a manner that supports grid reliability" makes it dependent on what a standard or a description found elsewhere would describe; substituting "electric system" for "Bulk Power System" counters a draft 3 revision to satisfy other commenters that distribution is off limits to NERC; other additions viewed as non-substantive

Other Proposed Definitions

- **Other Ride-through Definition 11:** *The plant/facility shall remain connected and in service, maintaining the pre-disturbance equipment configuration in operation, throughout the entirety of the system disturbance and recovery.*
  - Removing “entirety” and “in its entirety” could make it possible to qualify partial tripping as ride-through; other changes viewed as non-substantive.

Questions and Answers

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Slido Polling: Gathering Stakeholder Input on Revised Definitions

Moderator: Amy Casuscelli – Xcel Energy

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Detailed Review of Milestone 2 Implementation Plans

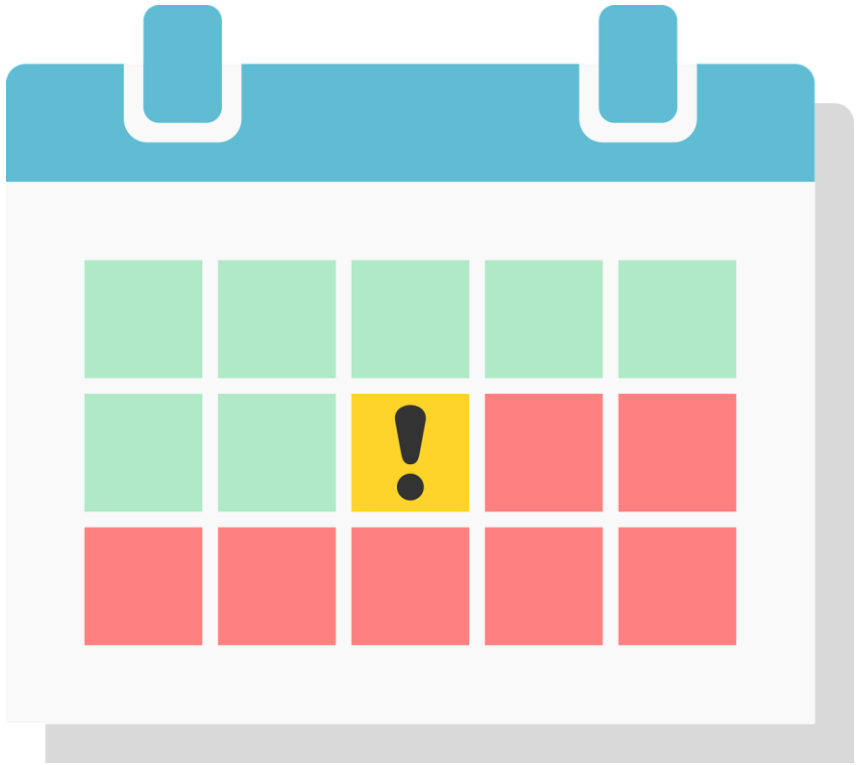
Jamie Calderon - Manager, Standards Development
Standards Committee & NERC Ride-through Technical Conference
September 5, 2024

What is an Implementation Plan?

- Created For:
  - New/Modified Reliability Standards
  - Retiring Reliability Standards
  - New/Modified Definitions
- Ensures no overlap or gap in time between versions

Key Terms and Sections of an IP

- “Effective Date”
  - Specific Date
  - Time Period after approval by governmental authority
- “Retirement Date”
  - Immediately Prior
- General Considerations
- Other Standard specific



Phased-In Implementation

- Often used to avoid everything all at once
- Milestones beginning after “Effective Date”
- Examples:
  - Percentage of Facilities
  - Requirement R1 and then later R2
- Assists Entities in

Project 2021-04
Modifications to PRC-002 - Phase II

- New Standard: PRC-028-1 Disturbance Monitoring and Reporting Requirements for Inverter-Based Resources
- **Shall become effective on the first day of the first calendar quarter after the effective date of the Applicable Governmental Authority's order approving the standard**

- **Phased-In Implementation for:**
  - Existing BES Inverter-Based Resources (in commercial operation on or before the effective date),
  - New BES Inverter-Based Resources
  - Existing Non-BES Inverter-Based Resources
  - New Non-BES Inverter-Based Resources

Project 2021-04
Modifications to PRC-002 - Phase II

- **Existing BES IBR:** 50% of IBR within three years of the effective date of PRC-028-1 and 100% of BES IBR by January 1, 2030
- **New BES IBR:** BES IBRs entering commercial operation after July 1, 2025, but on or before October 1, 2026, entities shall comply with Requirements R1 through R7 by October 1, 2026

- **Existing Non-BES IBR:** 100% January 1, 2030.
- **Existing Non-BES IBR:** within 15 calendar months following the effective date of the standard or the commercial operation date, whichever is later.
- **Process for Compliance Extensions**

Project 2020-02
PRC-024 (Generator Ride-through)

- New Standard: PRC-029-1 Frequency and Voltage Ride-through Requirements for Inverter-Based Resources
- **Shall become effective twelve months after the effective date of the applicable governmental authority's order approving the standard**

Project 2020-02
PRC-024 (Generator Ride-through)

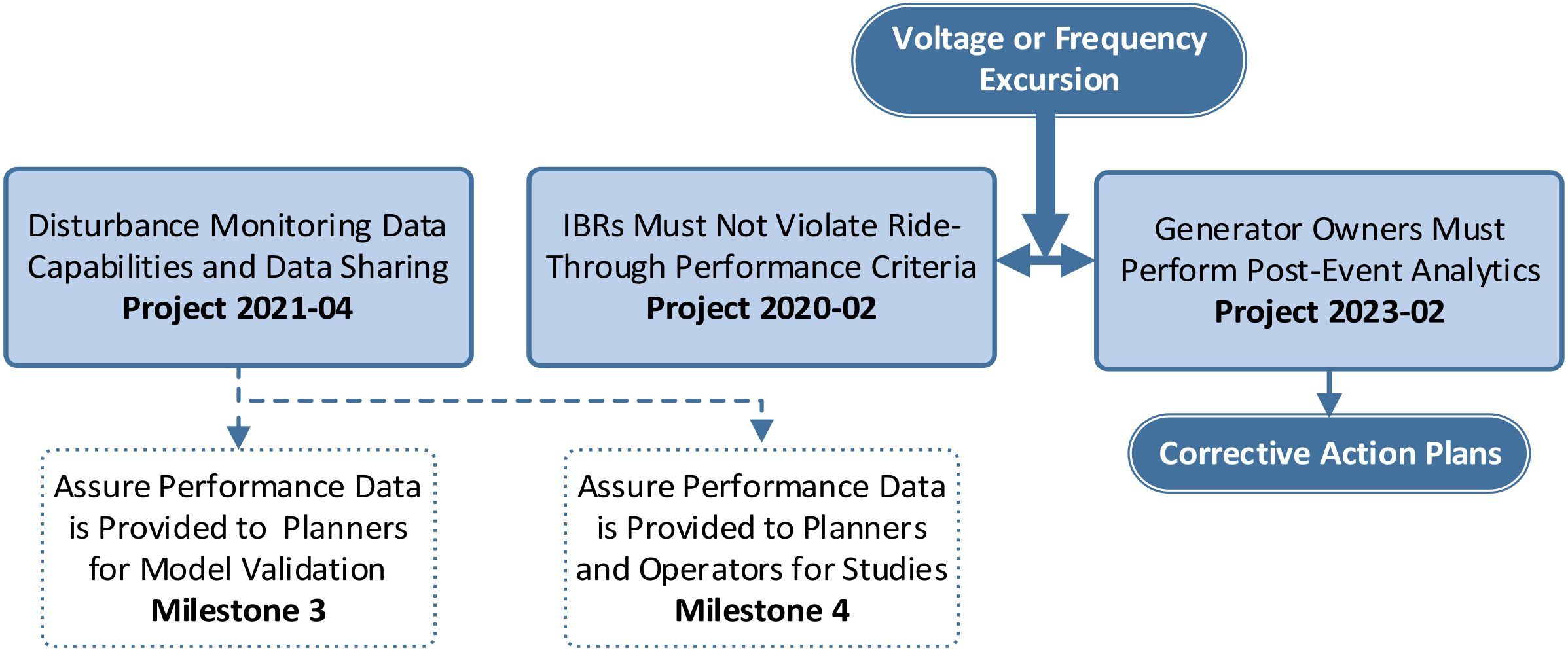
- Capability-based ride-through criteria
  - BES IBR: the effective date of the standard.
  - Non-BES IBR: later of January 1, 2027; or the effective date of the standard.
- Performance-based ride-through criteria
  - BES IBR and Non-BES IBR: Align with PRC-028 Implementation Plan dates

Project 2023-02
Analysis and Mitigation of BES IBR Performance Issues

- New Standard: PRC-030-1 Unexpected Inverter-Based Resource Event Mitigation
- IP revised in current draft posted for formal comment. Currently under ballot and cannot discuss during Q&A.
- Removed performance-based and capability-based language

- Later of 1) the first day of the first calendar quarter that is twelve (12) months after the effective date of the applicable governmental authority's order approving the standard; or 2) the first day of the first calendar quarter that is twelve (12) months after the effective date of the applicable governmental authority's order approving Reliability Standard PRC-029-1,
- Aligns with PRC-029

Aligned Implementation



Questions and Answers

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NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Panel Discussion: Strategizing Implementation Plans and Effective Dates

Moderator: Charles Yeung – SPP and Jamie Calderon – NERC

Panelist: Howard Gugel – NERC, Sam Hake – AES, Manish Patel – EPRI, Rhonda Jones – Invenergy

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Afternoon Break
15 Minutes

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Slido Polling: Voltage and Frequency Ride-through Criteria

Moderator: Amy Casuscelli – Xcel Energy and NERC Staff

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Slido Polling: Consensus on Implementation Plans

Moderator: Amy Casuscelli (Xcel Energy)

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Slido Polling: The Proposed Path Forward

Moderator: Amy Casuscelli – Xcel Energy and NERC Staff

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Closing Remarks and Next Steps

Sue Kelly – NERC Board of Trustees and Todd Bennett – AEC