STATE ENERGY POLICY WEBINAR

March 13, 2023

RELIABILITY FIRST

AGENDA

Presentation	Presenter
Welcome and Introductions	Diane Holder, RF Vice President of Entity Engagement and Corporate Services
FERC Update – NOPRS and Technical Conferences	Emma Nicholson, FERC Office of Energy Policy and Innovation
NERC Long Term Reliability Assessment	John Moura, NERC Director Reliability Assessment & Performance Analysis
	Break
Essential Reliability Services	Alex Shattuck, NERC Senior Engineer
Panel Discussion – Reliability Through the Grid Transformation	Hosted by: Brian Thiry, Director Entity Engagement and External Affairs with Panelists: Jeff Craigo, RF Sr. Vice President of Reliability & Risk; Melissa Seymour, MISO Vice President Central Region Member Relations & Seams Coordination; Asim Haque, PJM Vice President State and Member Services
Lessons Learned from Past Events	Ryan Quint, NERC Director of Engineering & Security Integration
Closing Remarks	Michelle Cross, RF Manager External Affairs

FORWARD TOGETHER RELIABILITYFIRST

STATE ENERGY POLICY WEBINAR

March 13, 1 – 4:30 p.m. EST

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WELCOME AND INTRODUCTION

Diane Holder
ReliabilityFirst
Vice President, Entity Engagement and Corporate Services

RELIABILITY FIRST

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Updates on Relevant FERC Final and Proposed Rulemakings, Technical Conferences, Workshops, and Forums

Presentation for ReliabilityFirst Corporation's State Energy Policy Webinar, March 13, 2023

Emma Nicholson, Ph.D. Senior Economic Advisor, Office of Energy Policy and Innovation,
Federal Energy Regulatory Commission

Disclaimer: Any views expressed herein are solely those of the speaker and do not necessarily represent the views of the Federal Energy Regulatory Commission Staff, Chairman, or Commissioners.

Recent Final Rules and Proposed Rules on Relevant Topics

Note: The following is not an exhaustive list of the Commission's pending proposed rules.

Final Rule: Internal Network Security Monitoring for High and Medium Impact Bulk Electric System Cyber Systems

- Final Rule issued at the January 2023 Open Meeting, Docket No. RM22-3-000
- Directs NERC to develop new or modified Critical Infrastructure Protection (CIP) Reliability Standards that require internal network security monitoring (INSM) for CIP-networked environments for all high impact bulk electric system (BES) Cyber Systems with and without external routable connectivity and medium impact BES Cyber Systems with external routable connectivity
- Directs NERC to submit a report within 12 months of issuance of this final rule that studies the feasibility of implementing INSM at all low impact BES Cyber Systems4 and medium impact BES Cyber Systems without external routable connectivity (i.e., BES Cyber Systems not subject to the new or revised Reliability Standard

Order Approving Extreme Cold Weather Reliability Standards EOP-011-3 AND EOP-012-1 and Directing Modification of Reliability Standard EOP-012-1

- Issued at the February 2023 Open Meeting, Docket No. RD23-1-000
- FERC approved two new reliability standards proposed by the North American Electric Reliability Corporation (NERC) in October 2022
- The two new extreme cold weather reliability standards were aimed at implementing key recommendations from the joint FERC-NERC inquiry into 2021’s Winter Storm Uri
- Directs NERC to modify the extreme cold weather preparedness and operations reliability standard to address concerns related to applicability, ambiguity, a lack of objective measures and deadlines, and prolonged, indefinite compliance periods
- Directs NERC to collect and assess data over time to monitor and assess entities’ implementation of the new requirements

NOPR: Reliability Standards to Address Inverter-Based Resources

- Notice of Proposed Rule (NOPR) issued at the November 2022 Open Meeting, Docket No. RM22-12-000
- Initial comments requested by 2/2/2023 and replies by 3/4/2023
- NOPR proposes to direct NERC to develop new or modified Reliability Standards that address four reliability gaps related to Inverter-Based Resources (IBRs)
  - Data sharing
  - Model validation
  - Planning and operational studies
  - Performance requirements
- NOPR proposes to direct NERC to submit a compliance filing within 90 days of the effective date of the final rule

Order: Registration of Inverter-based Resources

- Order issued concurrently with IBR NOPR at the November 2022 Open Meeting, Docket No. RD22-4-000
- Order directs NERC to:
  1. Complete modifications to its registration processes no later than 12 months after Commission approval of the work plan.
  2. Identify all owners and operators of Bulk-Power System-connected Inverter-Based Resources (IBRs) that in the aggregate affect the reliable operation of the Bulk-Power System no later than 24 months of Commission approval of the work plan.
  3. Register owners and operators of Bulk-Power System-connected IBRs that in the aggregate have a material impact on the reliable operation of the Bulk-Power System no later than 36 months after Commission approval of the work plan

NOPR: Transmission System Planning Performance Requirements for Extreme Weather

- NOPR issued at the June 2022 Open Meeting, Docket No. RM22-10-000
- Comments requested by 8/27/2022
- NOPR proposed to direct the NERC to submit to the Commission modifications to Reliability Standard TPL-001-5.1 (Transmission System Planning Performance Requirements) within one year of the effective date of any final rule
- NOPR proposed to require NERC to develop reliability standard modifications to require that:
  - NERC develop benchmark planning cases based on information such as major prior extreme heat and cold weather events or future meteorological projections
  - Transmission providers conduct studies of extreme heat and cold conditions including the expected resource mix's availability during such extreme conditions
  - Transmission providers develop corrective action plans for any instances where performance requirements for extreme heat and cold events are not met

NOPR: One-Time Reports on Extreme Weather Vulnerability Assessments

- NOPR issued at the June 2022 Open Meeting, Docket Nos. AD21-14-000 and RM22-16-000
- Comments requested by 8/30/2022
- NOPR proposed to direct transmission providers to submit one-time informational reports describing their current or planned policies and processes for conducting extreme weather vulnerability assessments and mitigating identified extreme weather risks
- NOPR proposes to require transmission providers to submit one-time informational reports about how they:
  1. Establish a scope for their extreme weather vulnerability assessments
  2. Develop inputs
  3. Identify vulnerabilities and determine exposure to extreme weather hazards
  4. Estimate the costs of impacts
  5. Develop mitigation measures to address extreme weather risks

NOPR: Building for the Future Through Electric Regional Transmission Planning and Cost Allocation and Generator Interconnection

- NOPR issued at April 2022 Open Meeting, Docket No. RM21-17-000
- Initial comments requested 8/17/2022 with reply comments by 9/19/2022
- Proposes to require longer-term approaches to regional transmission planning that will facilitate the development of more efficient and cost-effective energy infrastructure to meet transmission needs driven by changes in the resource mix and demand
- Proposes a new cost allocation approach for transmission planning regions that provides a larger role for state entities
- Proposes to amend Order No. 1000 to permit the exercise of a federal rights of first refusal for certain transmission facilities

NOPR: Improvements to Generator Interconnection Procedures and Agreements

- NOPR issued at June 2022 Open Meeting, Docket No. RM22-14-000
- Initial comments requested 10/13/2022 with reply comments by 12/14/2022
- NOPR proposed to require utilities and transmission providers to group interconnection customers together by using a "first-ready, first-served cluster study process."
- NOPR proposed to increase the speed of interconnection queue processing by clarifying the interconnection study process for neighboring regions (affected systems), establishing penalties for delayed interconnection studies, commercial readiness requirements for projects, ride-through requirements for IBRs and better accommodating state energy goals by offering a resource solicitation study process.
- NOPR proposed to allow interconnection customers and transmission providers to incorporate technological advancements into the interconnection process

FERC Technical Conferences, Workshops, Forums, and Roundtables on Relevant Topics

Note: The following is not an exhaustive list of the Commission's technical conferences, workshops, forums, and roundtables.

Modernizing Wholesale Electricity Market Design

- Docket No. AD21-10-000
- Four technical conferences
  - February 2021 and May 2021 conferences focused on capacity markets
  - September and October 2021 conferences focused on energy and ancillary services markets
- Commission issued an Order Directing Reports at the April 2022 Open Meeting
  - RTO/ISO reports filed 10/17/2022
  - Comments requested by 1/18/2023

New England Gas-Electric Forum

- Docket No. AD22-9-000
- First Forum held on 9/8/2022 in Burlington, Vermont
  - Comments requested by 11/7/2022
- Second Forum scheduled for 6/20/2023 in Portland, Maine (will be webcast)
  - Chairman Phillips announced forum at February 2023 Open Meeting
  - Save the Date Notice issued 2/16/2023

    “The purpose of this forum is to continue discussions from the September 8, 2022 forum regarding the electricity and natural gas challenges facing the New England Region. The objective of the forum is to shift from defining electric and natural gas system challenges in the New England Region to discussing potential solutions, including both infrastructure and market-based solutions.”

Joint Federal-State Task Force on Electric Transmission

- Docket No. AD21-15-000
- Commission held the first Task Force meeting in Nov 2021 and has held six meetings to date
  - The most recent (sixth) Task Force meeting was on 2/15/2023 and focused on the Physical Security of the Transmission System
- Chairman Phillips announced that the next (seventh) Task Force meeting will occur at the NARUC summer meeting in Austin in July 2023
- Commission generally requests comments after each Task Force meeting

Roundtable on Environmental Justice and Equity in Infrastructure Permitting

- Scheduled for March 29, 2023 (will be webcast)
- First notice issued on 1/27/2023 in Docket No. AD23-5-000

The Commission is convening this roundtable to strengthen our efforts to identify, address, and avoid adverse impacts to environmental justice communities associated with permitting applications for hydroelectric, natural gas pipeline, liquified natural gas, and transmission infrastructure subject to our jurisdiction. The roundtable will provide an opportunity for the Commissioners and staff to hear from environmental justice community members, including those impacted by the infrastructure we regulate, as well as advocates, researchers, industry representatives and government leaders on steps the Commission can take to better incorporate environmental justice and equity considerations into our decisions and processes.

- Supplemental notice with Agenda issued 2/14/2023

PJM Capacity Market Forum

- Commission announced on 2/21/2023 that will convene a forum to examine the PJM capacity market and how best to guarantee it achieves the objective of ensuring resource adequacy at just and reasonable rates
- Commission will provide details about the forum in the near future

NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

2022 Long-Term Reliability Assessment

John Moura, Director, Reliability Assessments and Performance Analysis
RF Energy Policy Webinar
March 13, 2023

RELIABILITY | RESILIENCE | SECURITY




Long-Term Challenges

How are we going to integrate…

Through 2032

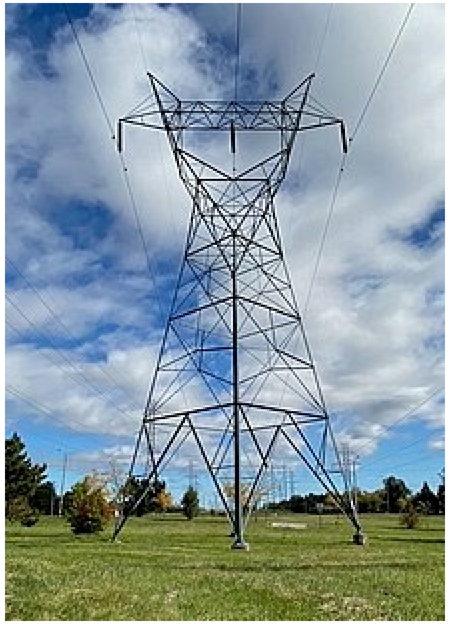
400,000 MW of Solar

250,000 MW of Wind

80,000 MW of DER

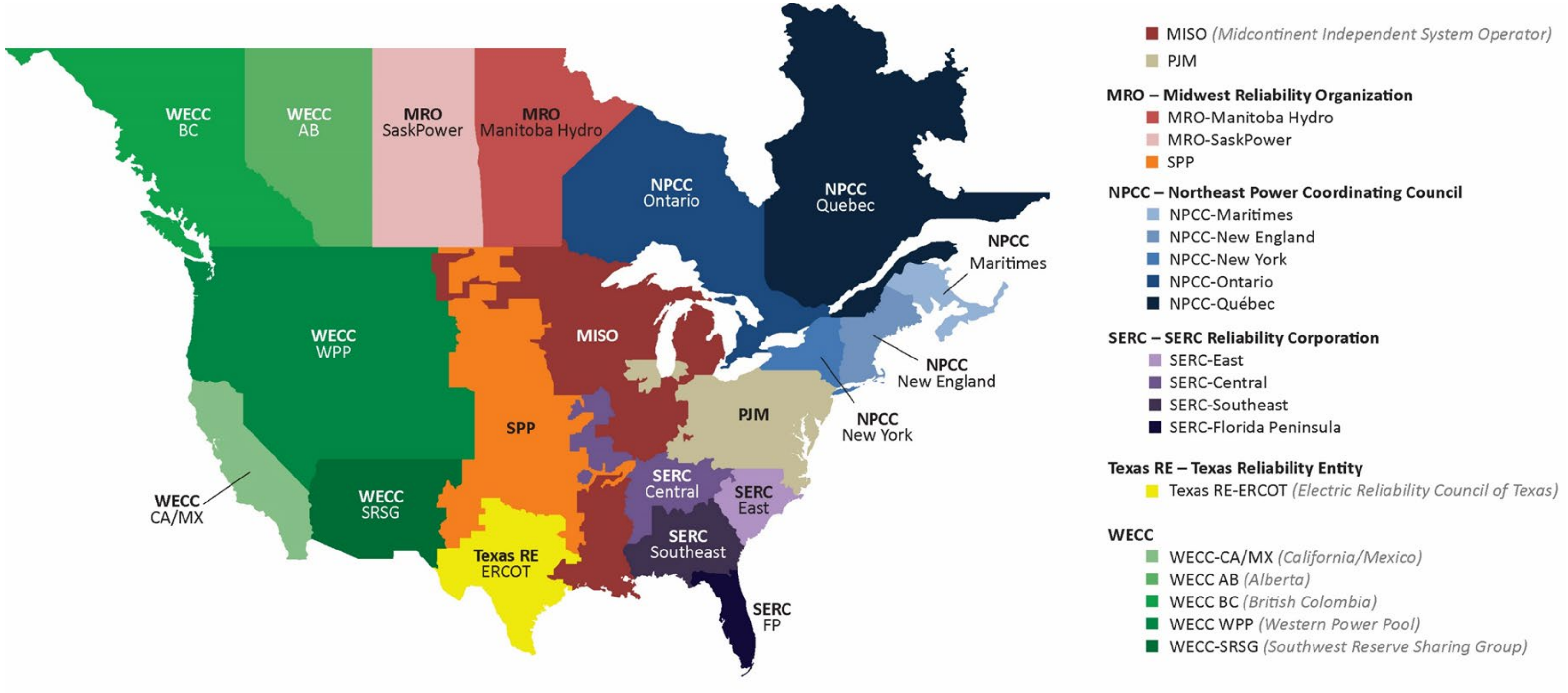
70,000 MW of Batteries

without more of this….



Long-Term Reliability Assessment

- Assessment of resource capacity and energy risks
- Demand, generation, and transmission projections
- Demand-side resources
- Emerging Issues
- Coordination and Review with Regional Entities and Stakeholder Groups



LTRA Risk Assessment Approach

On-Peak Reserve Margins

- **Compares margin between resources and peak demand to a reference margin level (RML)**
- Variable energy resources are rated at expected output
- Demand Response resources are included as reduced peak demand
- RML is set by regulators, ISO/RTO, or other authorities to achieve an accepted level of risk

Probabilistic Energy Assessment

- **Compares calculated load loss and unserved energy metrics from probabilistic study to criteria**
- Demand and resources modeled probabilistically at all hours
- Generator availability, demand variation and resource output can be modeled probabilistically
- Various load loss and energy metrics can be calculated

LTRA Risk Assessment Criteria

Resource capacity and energy risks are assessed for Years 1 – 5* in all assessment areas using the following criteria:

High Risk

- Supply shortfall can occur in **forecast conditions**
  - Historical peak demand and resource performance
- Indicators
  - Reserve margins fall below RML
  - Loss of Load Hours (LOLH) exceed 1-day-in-10 years
- Extreme conditions are also likely to result in shortfall

Elevated Risk

- Supply shortfalls are likely in **extreme conditions** only
  - Extreme high demand or abnormal low resource output
- Indicators
  - LOLH expected but less than 1-day-in-10 years
  - Unserved energy expected
  - Supply risks found in studies of extreme conditions

*Resource adequacy trends are reported for years 6 - 10

Preliminary

Capacity and Energy Risk Assessment

Ontario

- Reserve Margins below target in 2025
- Planned retirements and nuclear work

MISO

- Reserve Margins below target in 2023
- 5,700 MW of thermal generation retirements since 2022

California-Mexico

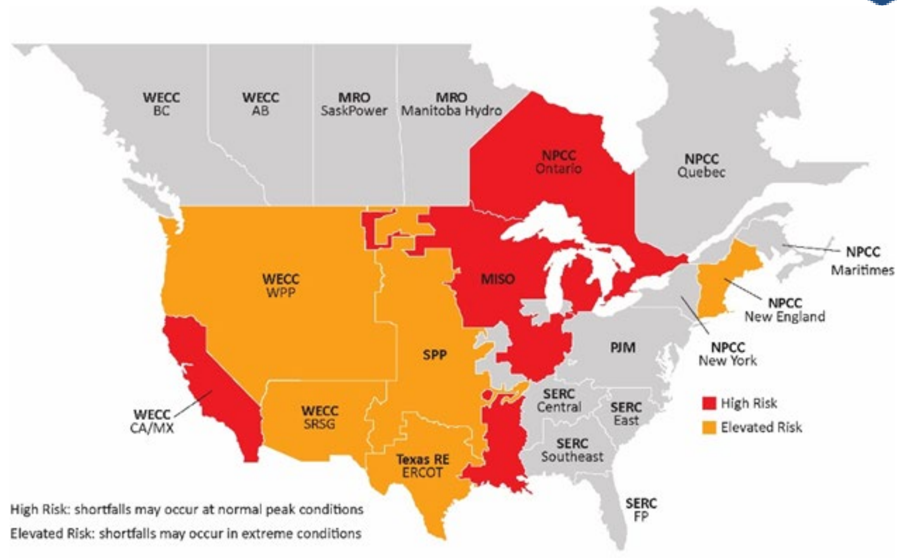
- Load loss hours anticipated due to variable resource mix and demand
- Improving trend in metrics with recent capacity additions

U.S. West

- Unserved energy projections are increasing in summer months

New England

- Fuel risk in extended cold weather



ERCOT

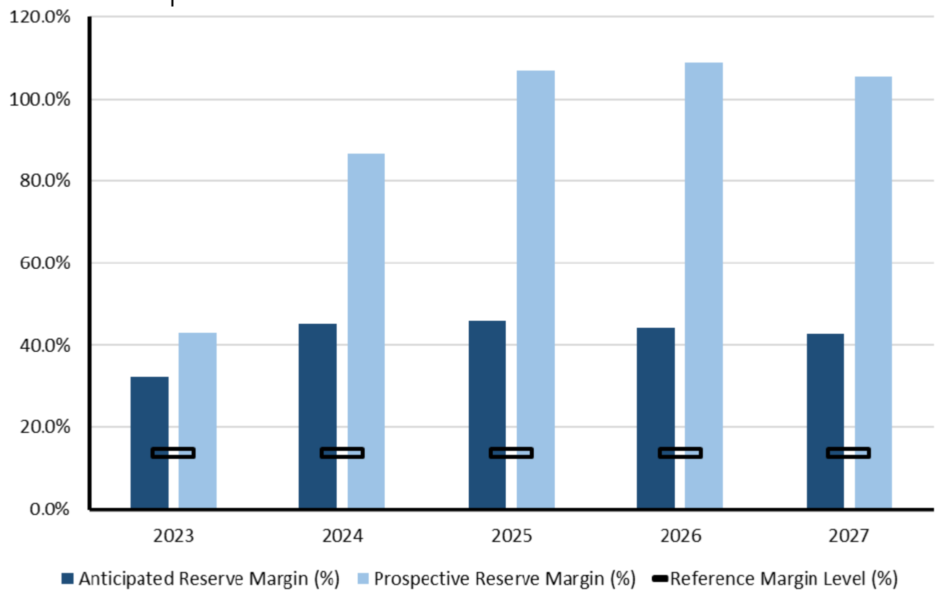
- Energy risk shifts to winter due to potential impacts of extreme weather

SPP

- Energy shortfalls likely during low-wind and high demand periods

A Closer Look at Texas

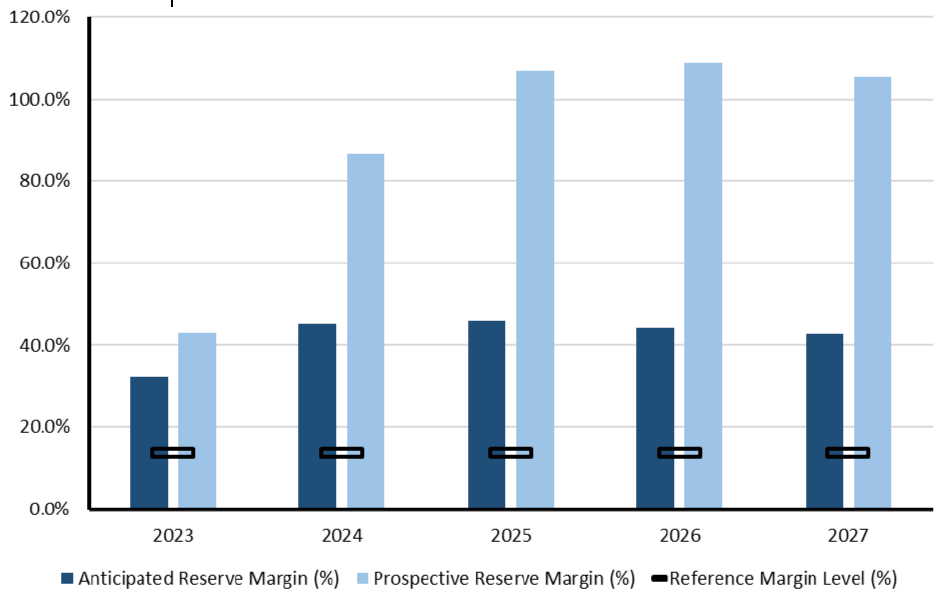
Sufficient capacity projected to meet established resource adequacy target



Capacity

A Closer Look at Texas

Sufficient capacity projected to meet established resource adequacy target



Capacity

EUE (MWh)

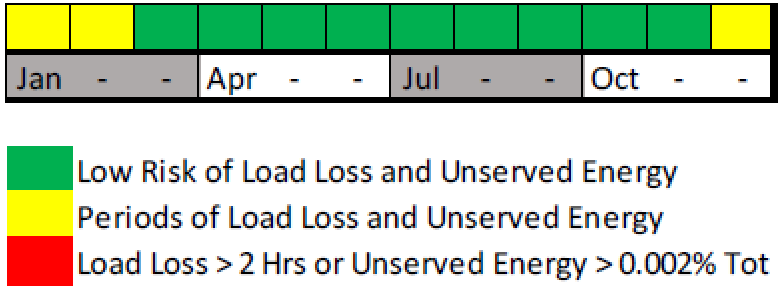
2024:
754 MWh

2026:
1,478 MWh

LOLH (hours)

2024:
0.2 Hours

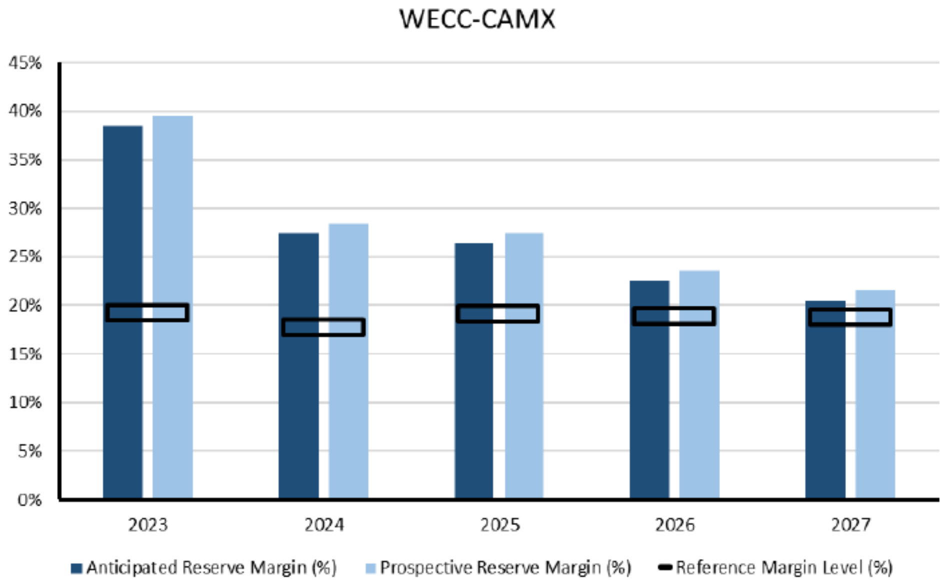
2026:
0.3 Hours



Energy

A Closer Look at California

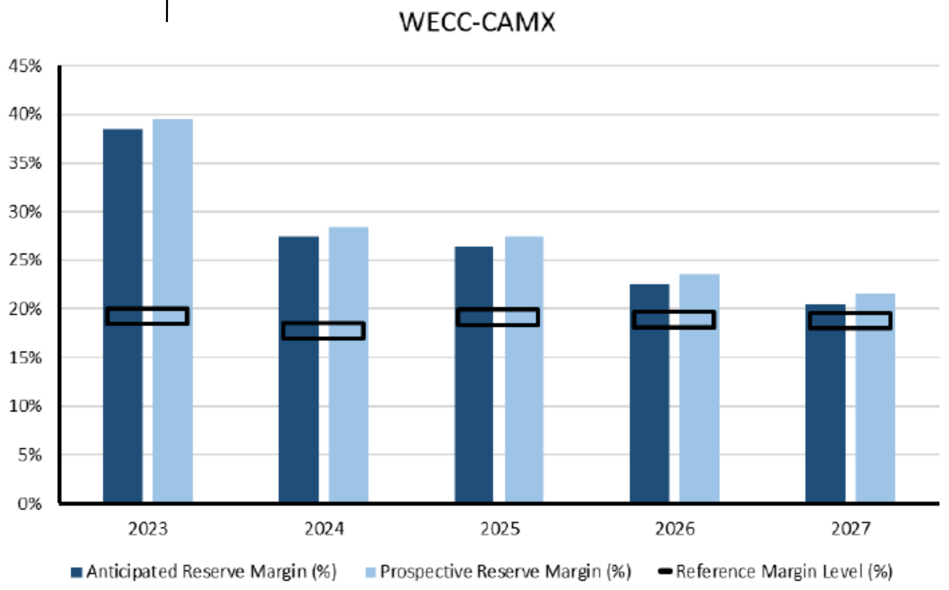
Sufficient capacity projected to meet established resource adequacy target



Capacity

A Closer Look at California

Sufficient capacity projected to meet established resource adequacy target



Capacity

EUE (MWh)

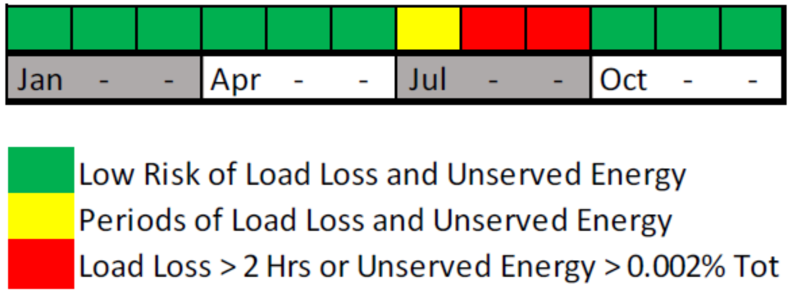
2024: 37,305 MWh

2026: 498,885 MWh

LOLH (hours)

2024: 0.7 Hours

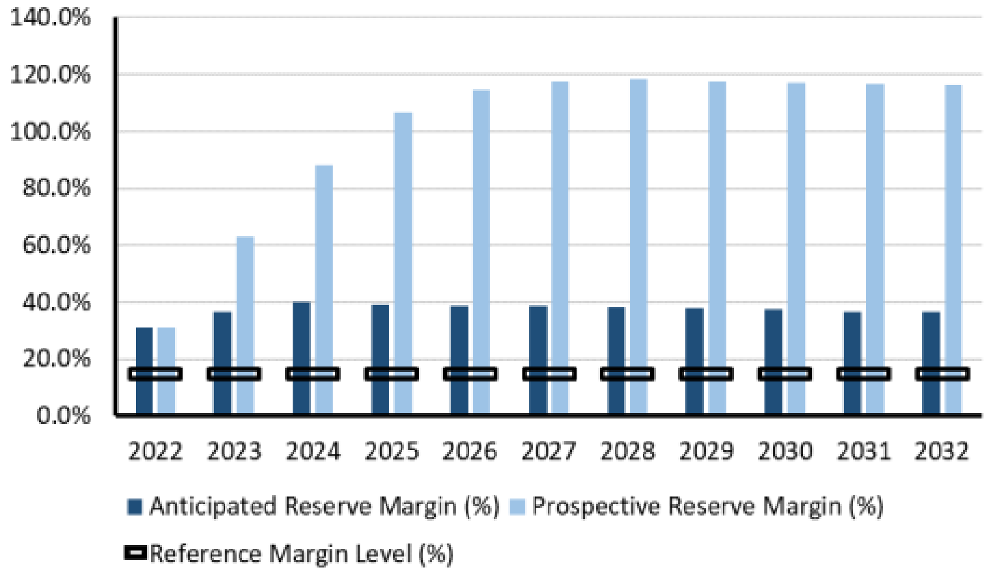
2026: 9.8 Hours



Energy

A Closer Look at PJM

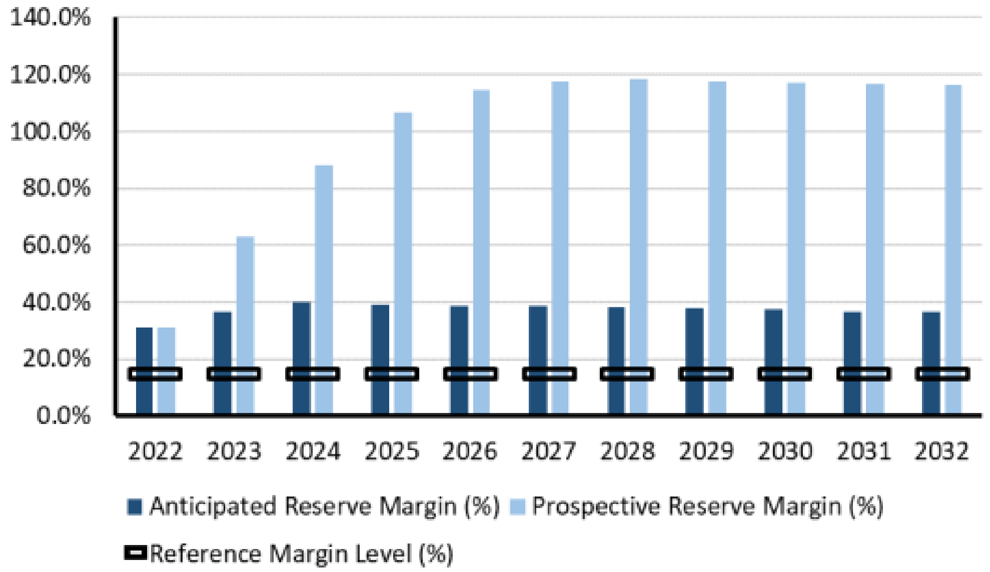
Sufficient capacity projected to meet established resource adequacy target



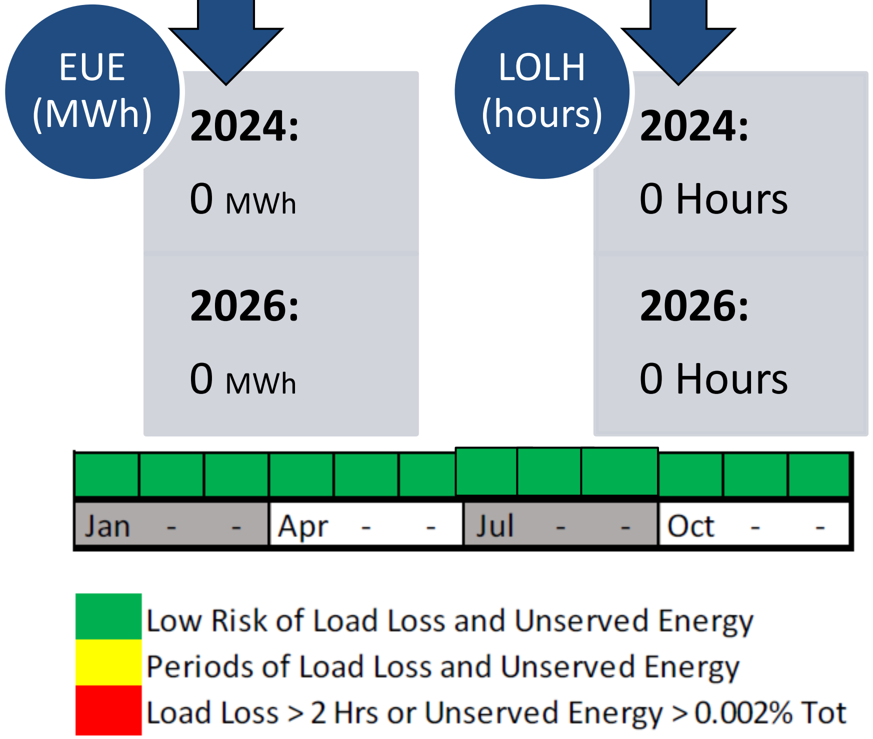
Capacity

A Closer Look at PJM

Sufficient capacity projected to meet established resource adequacy target



Capacity



Energy

Generator Retirements

- Retirements factor into risk assessment and resource mix trends
- Generators that are *Confirmed* for retirement by ISO/RTO and Planners are not counted as capacity in the LTRA

Table 2: Generation Retirement Projections through 2032

Type	Confirmed (MW)	Baseline Case (MW)[1]	High-Retire Scenario (MW)[2]
Natural Gas and Oil	29,639	38,602	41,603
Coal	52,931	89,539	97,439
Nuclear	6,163	15,194	18,594

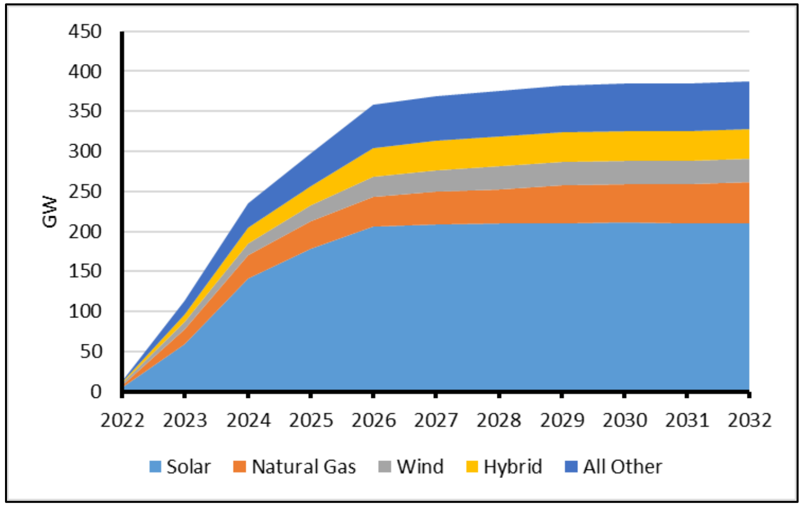
Changing Resource Mix

- Wind, solar, and hybrid generation leads the continued energy transition as older thermal resources retire
- Implications:
  - Increasing hourly and weather dependent variability
  - Increasing loss-of-load risk during shoulder months
  - New resource characteristics and performance issues
  - Less fuel diversity in dispatchable fleet

Table 1: 2022 Capacity at Peak Demand

Type	Capacity (GW)	Change since 2021 (GW)
Natural Gas	477	+14
Coal	202	-18
Nuclear	106	-2
Solar and Wind	70	+19
All others	189	+2

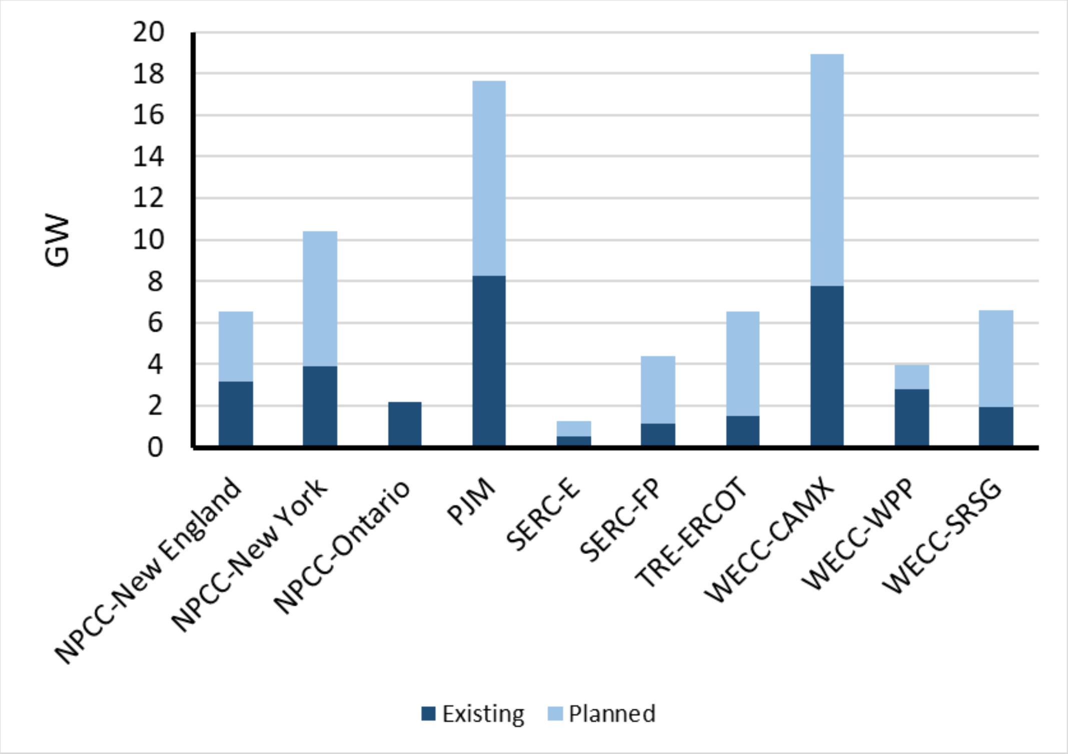
Contributions at hour of peak demand. VER (solar, wind, and some hydro) typically count less than installed nameplate capacity.



Resource Capacity in Development (Tier 1 and 2)

Changing Resource Mix - DER

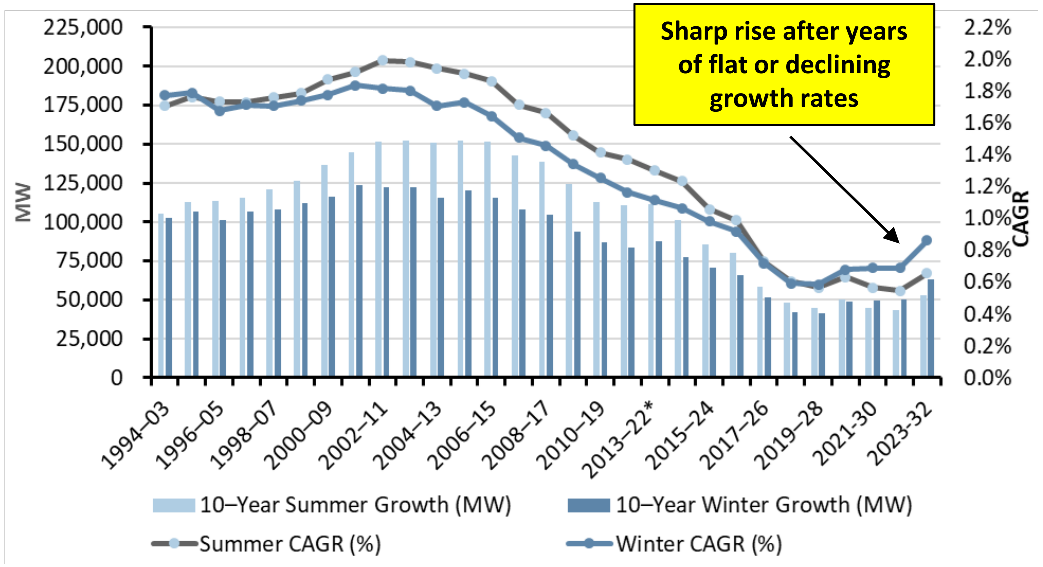
- Cumulative solar PV DER expected to reach over 80,000 MW by the end of the 10-year assessment period (up 25% since 2021)
  - 12 assessment areas expect to double the amount of DER by 2032



Solar DER by Assessment Area by 2032 – Select Areas

Peak Demand: Growth across the BPS

- 10-year Peak Demand growth showing largest increases in recent years
- Electric vehicle growth influences projections
- Demand Response offsets Peak Demand
- Dual-peaking or changing from summer to winter peaking anticipated in some parts of the U.S. Southeast and Northeast



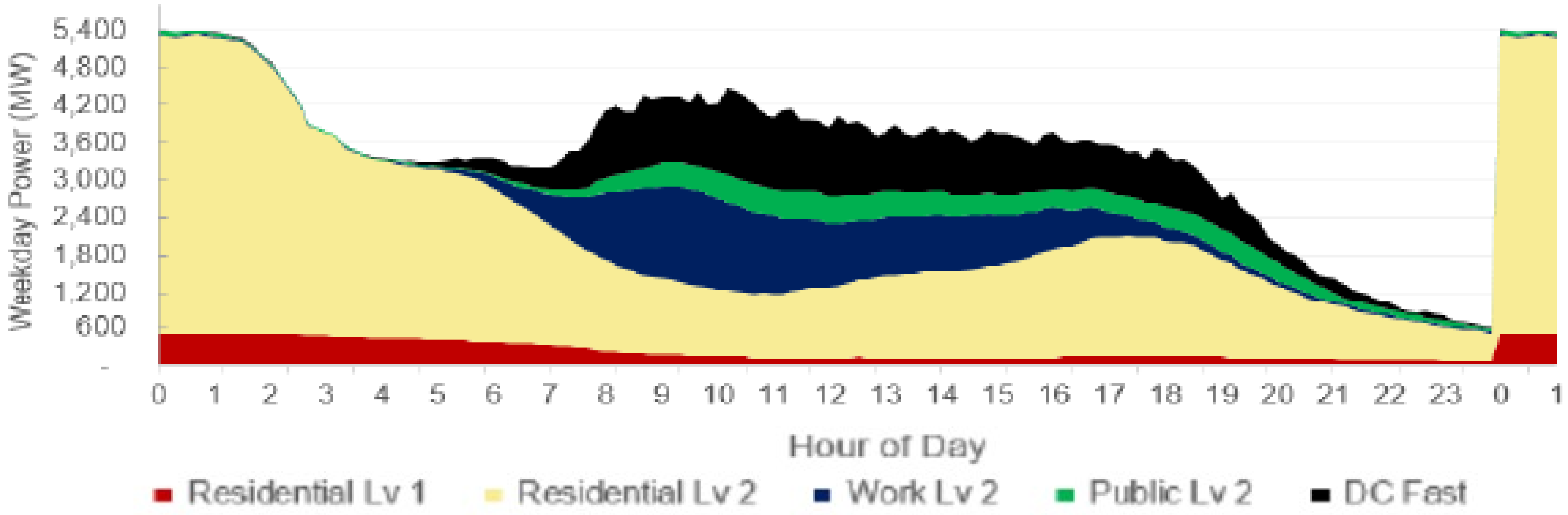
10-year Summer and Winter Peak Demand Growth

Largest 10-year Winter Peak Demand Growth	
Assessment Area	**Demand Change**
NPCC-New York	2.36%
WECC-SRSG	2.06%
NPCC-New England	1.95%
NPCC-Ontario	1.32%
Texas RE-ERCOT	1.30%

Largest 10-year Summer Peak Demand Growth	
Assessment Area	**Demand Change**
WECC-SRSG	1.69%
NPCC-Ontario	1.27%
WECC-CAMX	1.19%
MRO-SaskPower	1.05%
NPCC-Maritimes	1.03%

EV Charging Assessment - CAISO

- **Executive Order N-79-20:** By 2035, 100 percent EV sales
- Charging millions of EVs will introduce significant new electric load
- By one estimate, up to 5,500 MW
- Early alignment and coordination needed

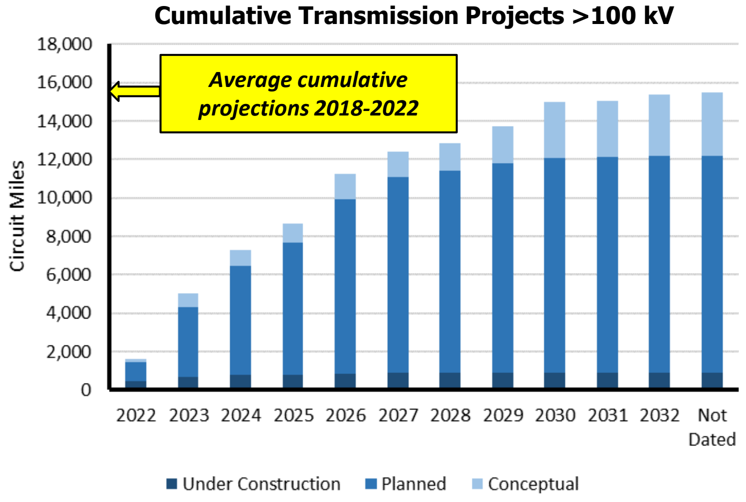


Projected 2030 Statewide PEV Charging Load for Intraregional Travel of 8 Million Light-Duty EVs

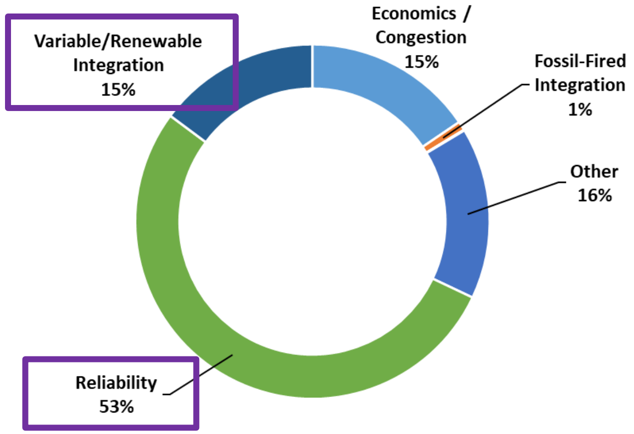
AB 2127 Report: https://www.energy.ca.gov/programs-and-topics/programs/electric-vehicle-charging-infrastructure-assessment-ab-2127

Trend in Transmission Projects: Steady

- Little change in transmission miles projections in past five years
- Most projects are initiated to support grid reliability
- Miles of transmission being planned or constructed for renewable integration increased from 1,589 mi to 2,376 mi since 2021 LTRA



Transmission Miles in Planning or Construction through 2032			
Area	**Miles**	**Area**	**Miles**
WECC WPP	3,439	SERC SE	629
NPCC New York	1,635	WECC SRSG	581
PJM	983	NPCC Ontario	570
WECC CAMX	902	NPCC New England	506
WECC BC	775	All other areas	<500 mi each



Transmission Project Primary Driver

A Changing Context for the BPS

<u>Must Wins:</u>

1. Develop sufficient **transmission**, to integrate renewables and distribute them
2. Maintain a robust fleet of **balancing resources**, with an ability to provide **Essential Reliability Services**
3. Ensure a robust **energy supply chain** for the balancing resources, with sufficient access to fuel and stored energy to withstand long-duration, wide-spread extreme weather events
4. **STATES:** Institute/Refine robust resource adequacy requirements that preserves energy assurance and extends beyond "capacity planning"

Questions and Answers

THE WEBINAR WILL RESUME SHORTLY

Give us your feedback

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FORWARD TOGETHER RELIABILITYFIRST

NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Essential Reliability Services

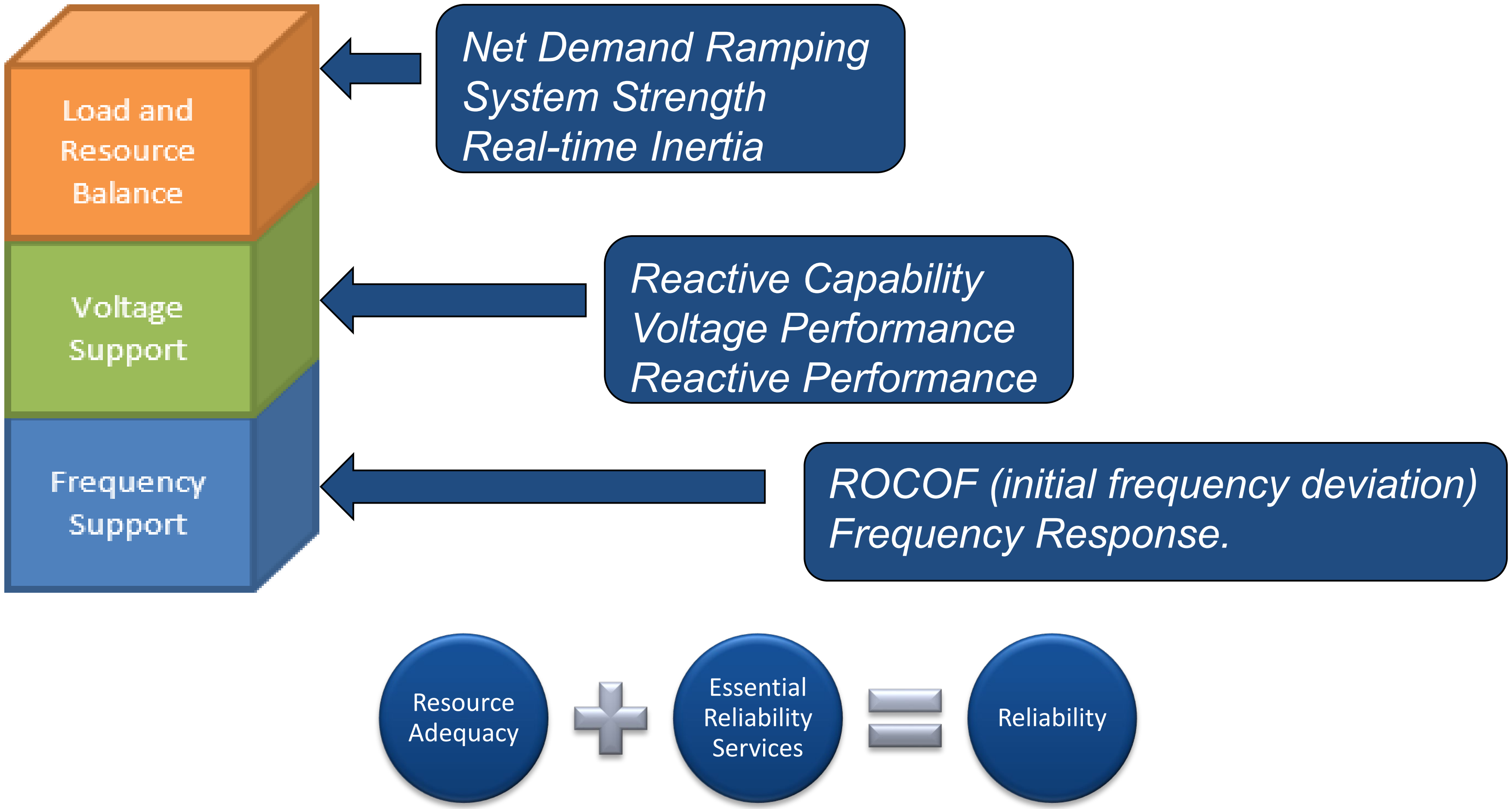
Lessons Learned and Key Findings from Past Events

Alex Shattuck
Senior Engineer, Engineering & Security Integration (Engineering and Standards)
North American Electric Reliability Corporation
ReliabilityFirst State Energy Policy Webinar
March 2023

RELIABILITY | RESILIENCE | SECURITY

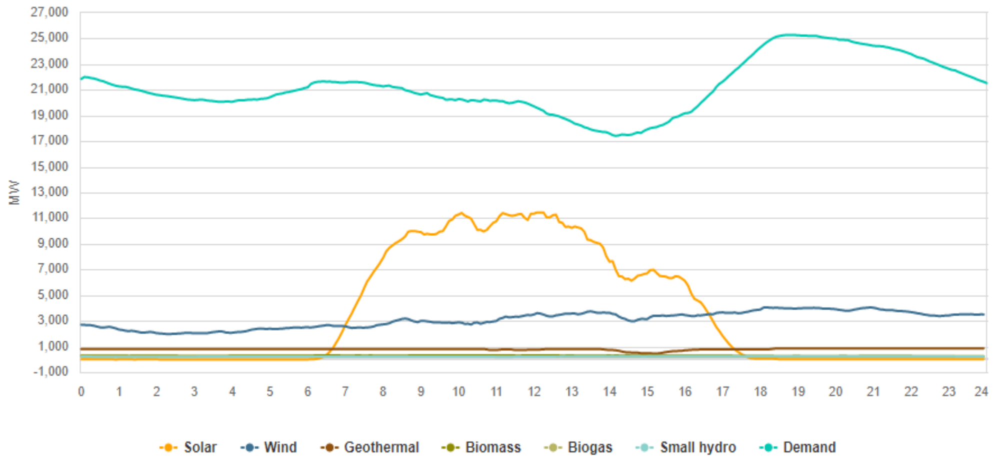



Essential Reliability Services: Fundamentals



Net Demand Ramping

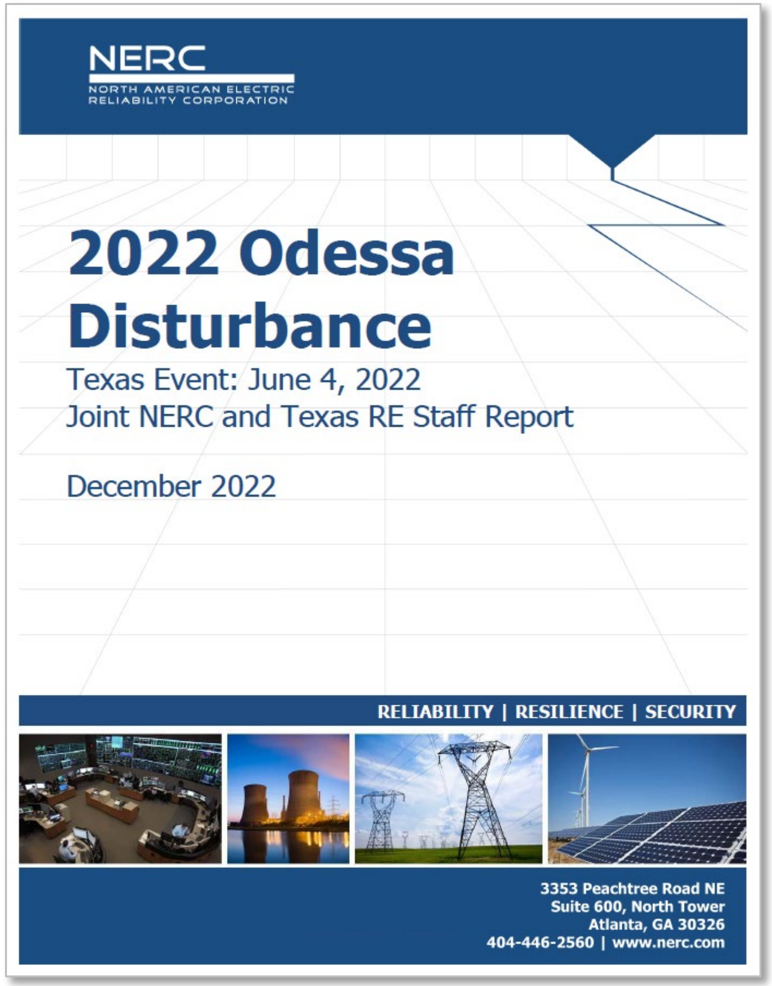
- Rapidly increasing penetration of variable resources (inverter-based renewable resources)
  - Requires planning for the generation variability
  - Interconnected services contribute to mitigation
    - Market forces
    - Reserve requirements
  - Generation and load balance depends on the responsiveness (ramping) of "reserve" resources
    - Spinning synchronous reserves
    - Quick-start generators
    - Battery Energy Storage



CAISO Renewable Generation 03/04/2023

IBR Fault Ride Through

- Generating resources must stay on-line and producing active and reactive power during normal BPS disturbances
  - IBR can't provide ERS if they disconnect from the system during or immediately following a disturbance
  - Numerous NERC disturbance reports show systemic failure to ride through normally cleared BPS faults
  - Additional due diligence is needed to ensure IBR protection settings are set as wide as possible, and that IBR controls do not drive themselves into trip conditions


NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

2022 Odessa Disturbance

Texas Event: June 4, 2022
Joint NERC and Texas RE Staff Report

December 2022

RELIABILITY | RESILIENCE | SECURITY

3353 Peachtree Road NE
Suite 600, North Tower
Atlanta, GA 30326
404-446-2560 | www.nerc.com

https://www.nerc.com/comm/RSTC_Reliability_Guidelines/NERC_2022_Odessa_Disturbance_Report%20(1).pdf

IBR Fault Ride Through

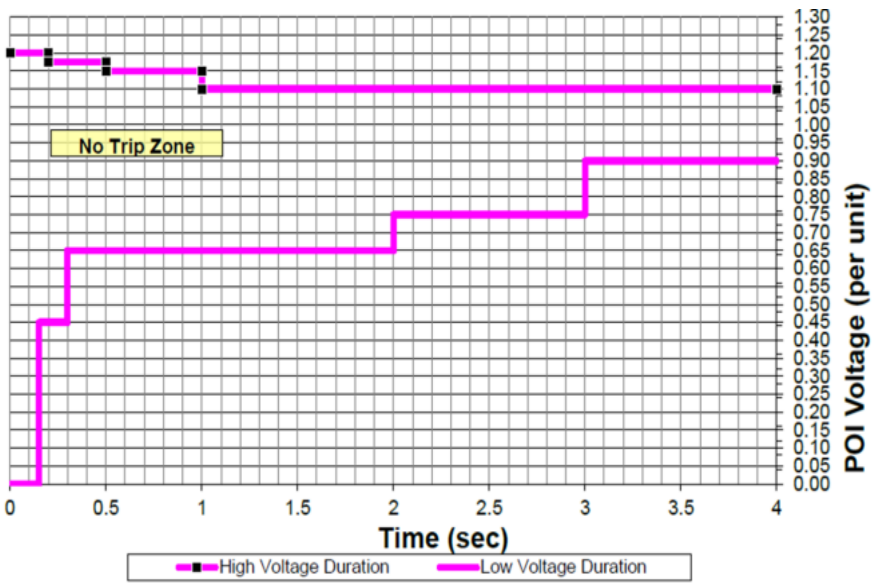


Figure 4.4: Voltage Ride-Through Time Duration Curve from PRC-024-2

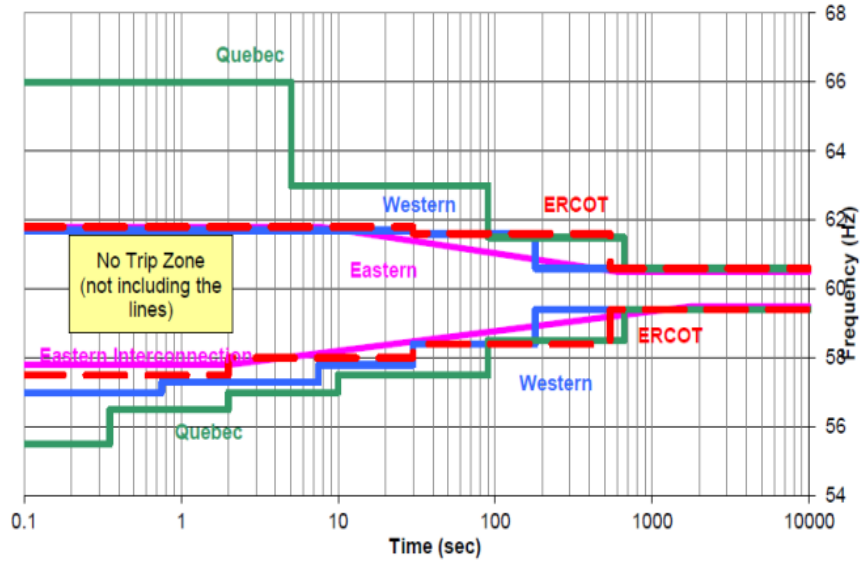


Figure 4.3: Off-Nominal Frequency Capability Curve from PRC-024-2

System Reactive Capability and Performance

- IBR reactive capability is currently under-utilized
  - New technology allows IBR to provide reactive power even without wind/sun
  - Increased utilization of IBR reactive capability can be driven by market forces or regional requirements
- IBR need to have the capability to respond to changes in system voltage and provide reactive power
- Voltage moves megawatts!

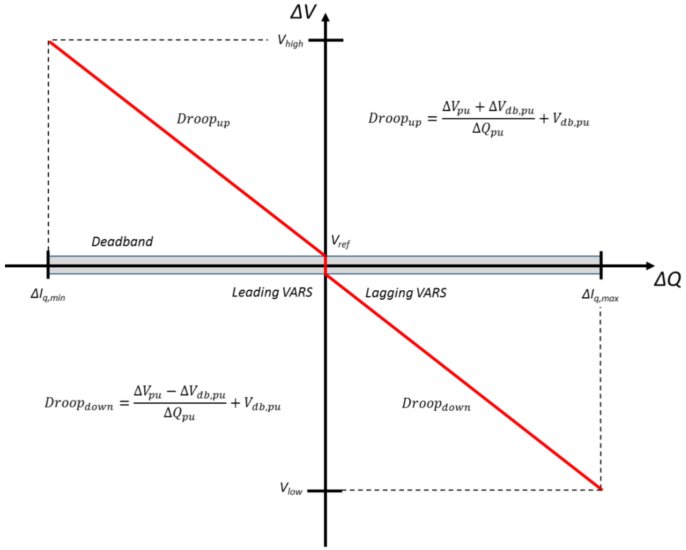
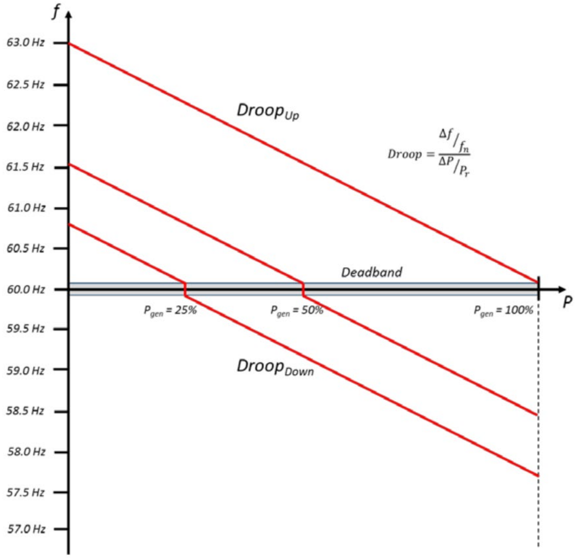
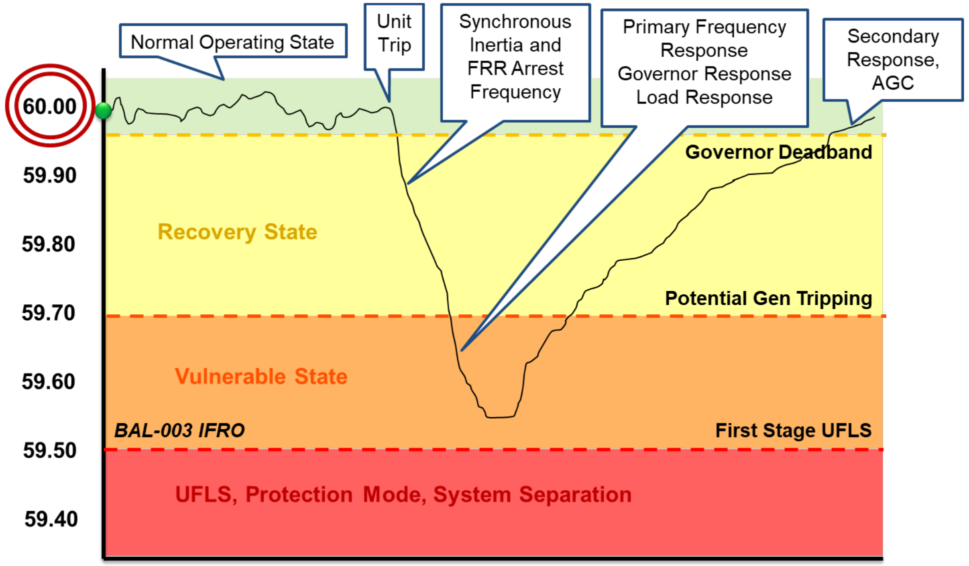


Figure 3.7: Reactive Power-Voltage Control Characteristic

Frequency Response

- Generating resources need to respond to changes in measured system frequency
  - Adjusting active power delivered (or consumed) to help keep system frequency near 60Hz
  - This includes primary and fast frequency response





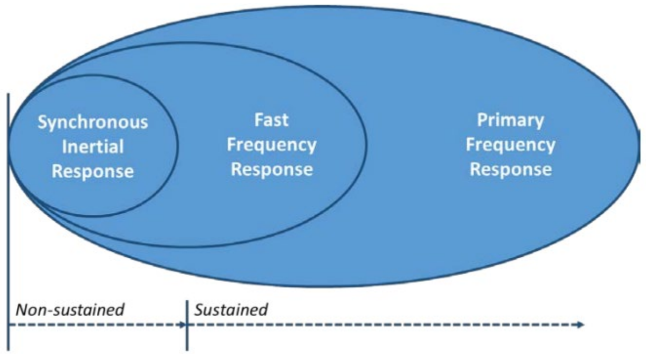
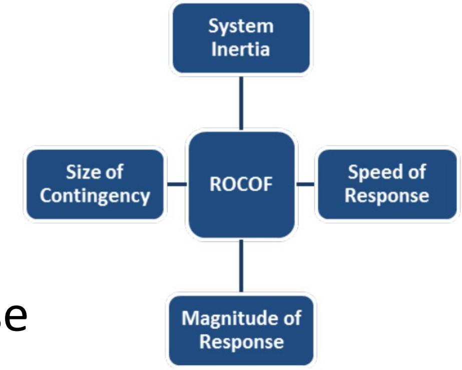


Figure 2.1: Simultaneous Contributions of Inertia Response, PFR, and FFR

NERC White Paper: Fast Frequency Response

System Inertia and ROCOF

- Overall system inertia decreases with an increase in IBR penetration
  - IBR do not provide system inertia
  - New control technology has potential to provide “artificial inertia” responses like fast frequency response
- ROCOF is directly linked to overall system inertia
  - Lower system inertia leads to larger ROCOF



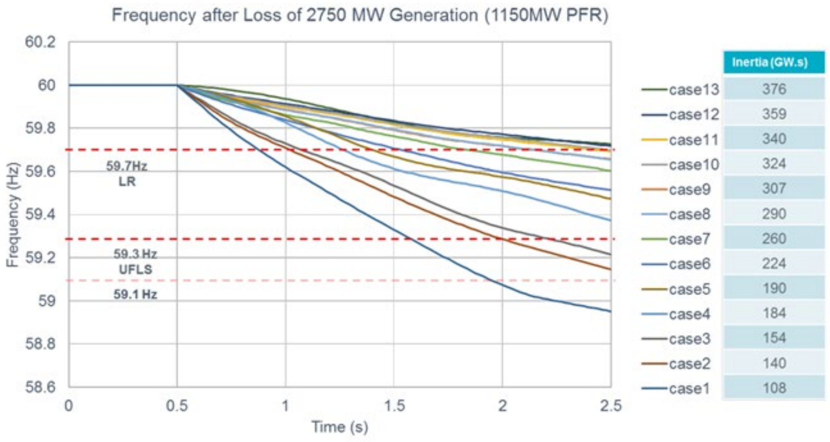
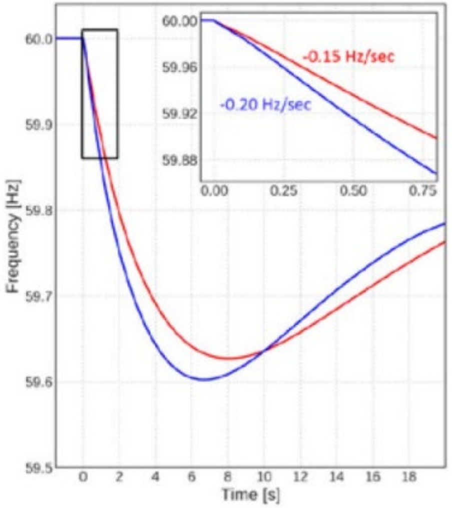


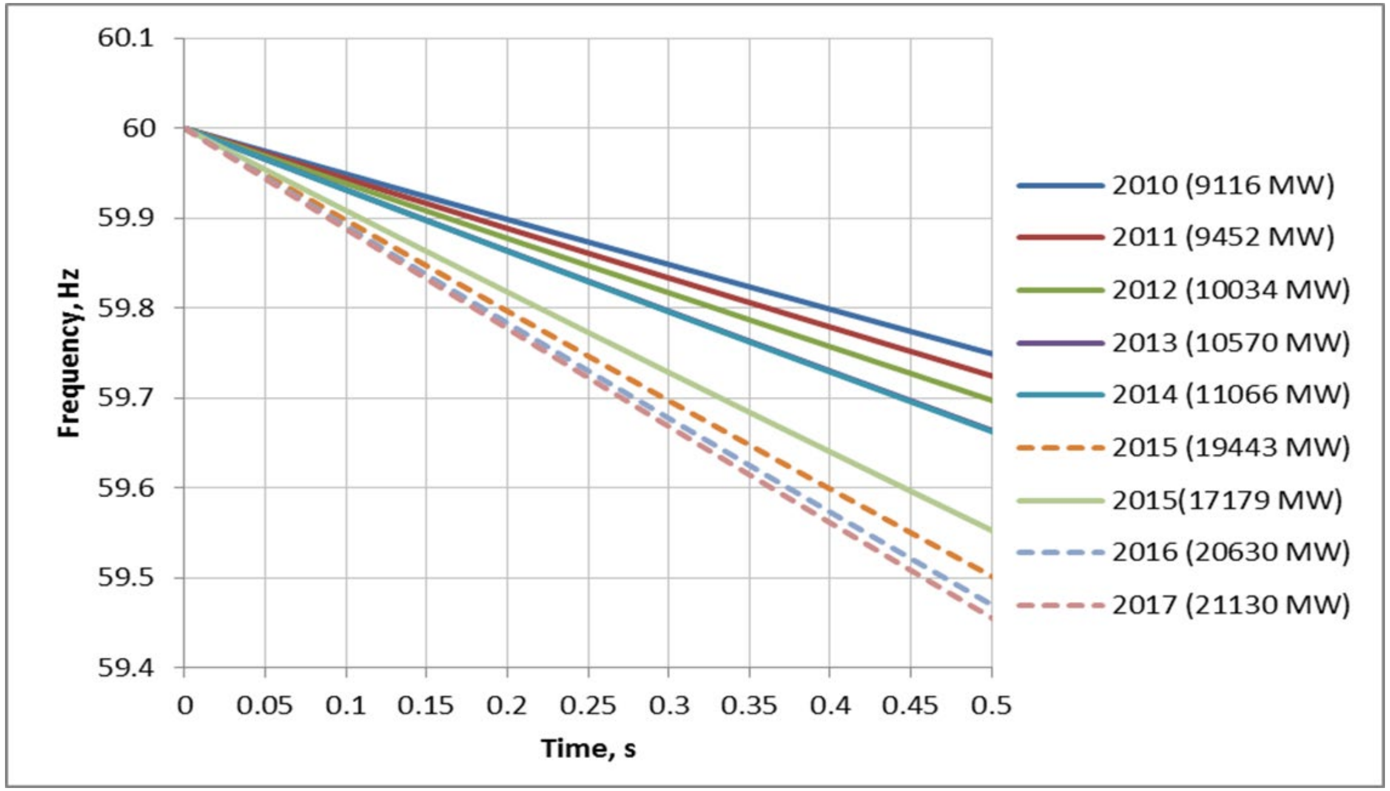
Figure 8: Frequency Response after loss of 2,750 MW for 13 cases with different inertia levels



CERTS – Frequency Control Requirements for Reliable Interconnection Frequency Response

System Inertia and ROCOF

- System Inertia and “system strength” are expected to continue to decrease with increased IBR penetration



Calculated ERCOT System Frequency after 2750 MW Generation Trip (2010-2017)

Supporting High IBR Penetration System With Advanced Controls

- While increased penetration of IBR lowers system inertia and increases ROCOF, advanced IBR controls can mitigate and even potentially out perform an entirely synchronous system
  - Details on fast frequency response can be found in the NERC IRPTF white paper: Fast Frequency Response Concepts and Bulk Power System Reliability Needs

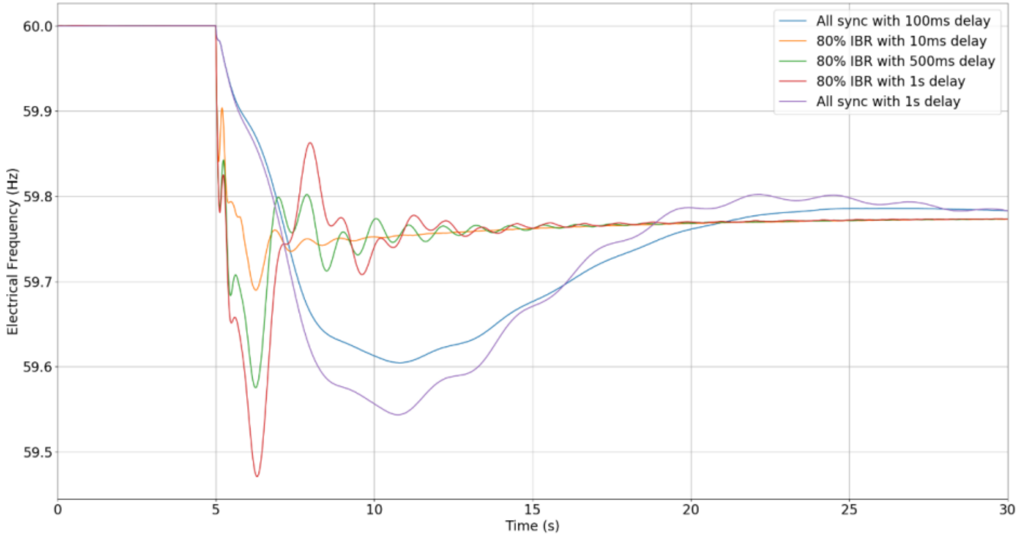
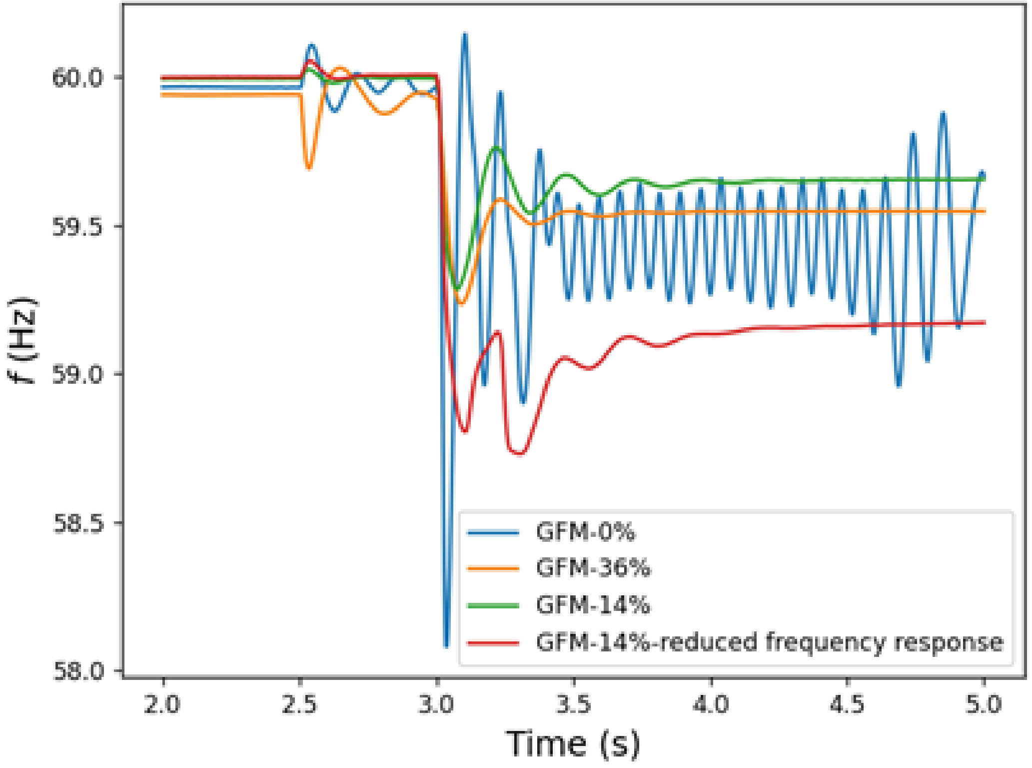


Figure 2.3: Example Simulation of FFR with Varying Controls and IBR Penetrations [Source: EPRI]

Supporting High IBR Penetration System With Advanced Controls

- Grid forming IBR include new technology to respond immediately to the external system and maintain IBR control and stability in high penetration, low inertia scenarios



[Source: EPRI]

Questions and Answers

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PANEL DISCUSSION – RELIABILITY THROUGH THE GRID TRANSFORMATION

Host

Brian Thiry

ReliabilityFirst Director of Entity Engagement and External Affairs

Jeff Craigo

ReliabilityFirst Sr. Vice President of Reliability & Risk

Asim Haque

PJM Vice President State and Member Services

Melissa Seymour

MISO Vice President Central Region Member Relations & Seams Coordination

FORWARD TOGETHER RELIABILITYFIRST

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NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Reliability Perspectives

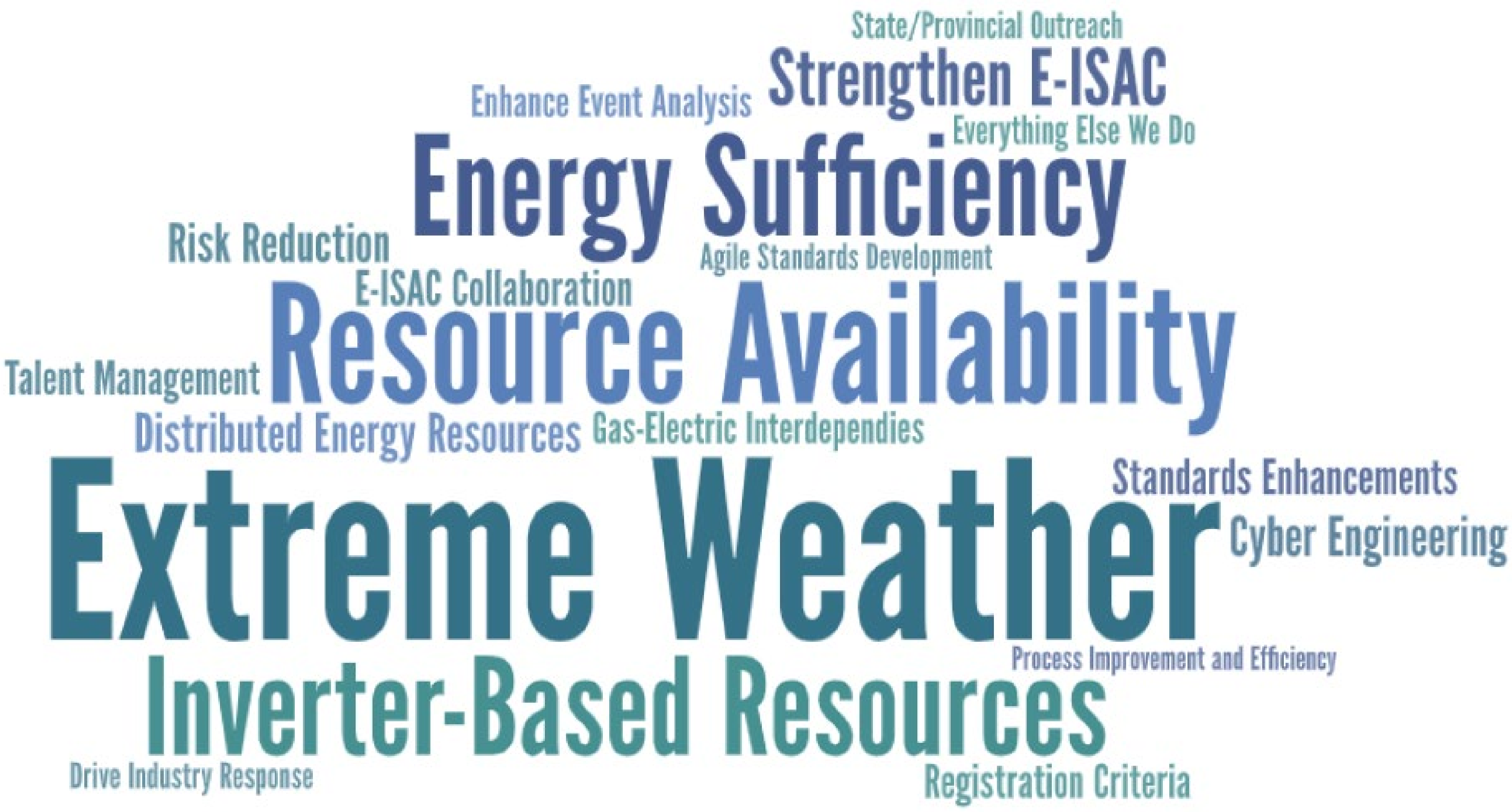
Lessons Learned and Key Findings from Past Events

Ryan D. Quint, PhD, PE
Director, Engineering and Security Integration
North American Electric Reliability Corporation
ReliabilityFirst State Energy Policy Webinar
March 2023

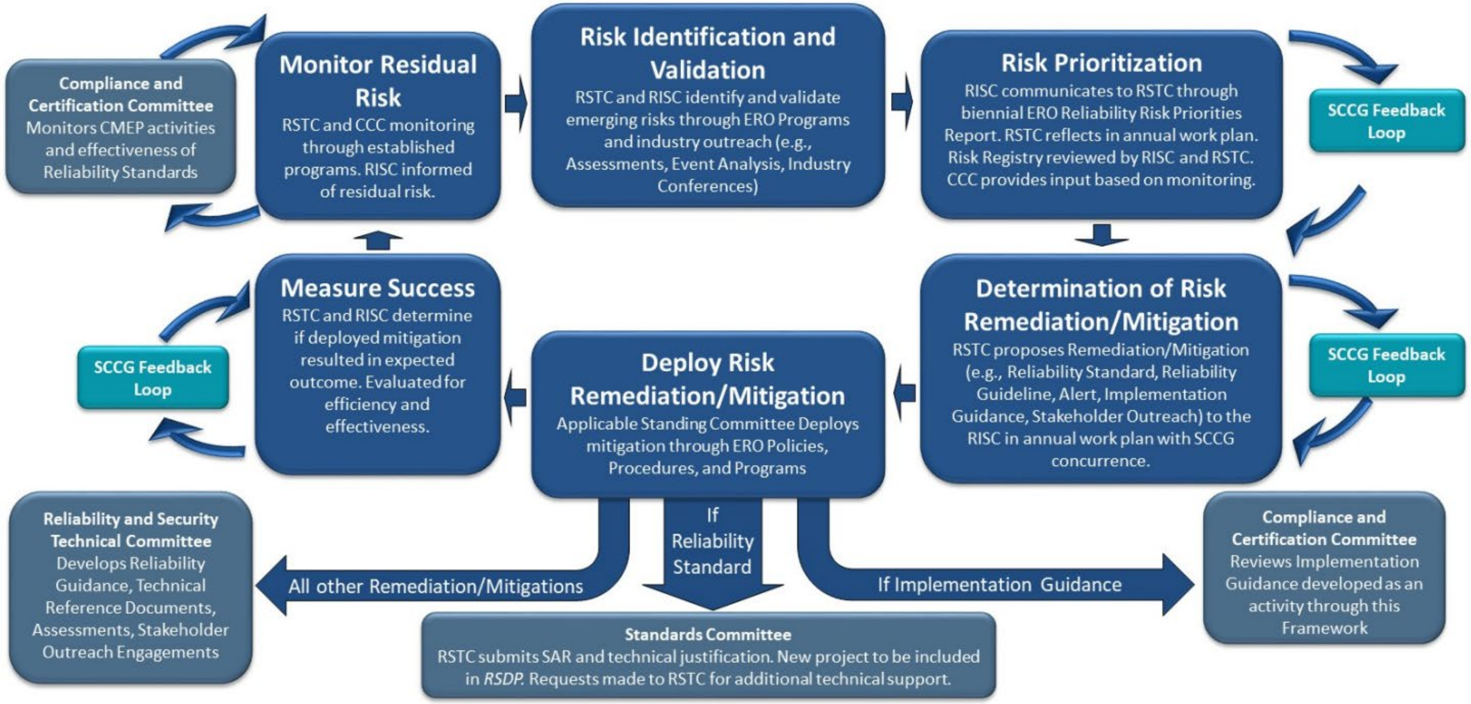
RELIABILITY | RESILIENCE | SECURITY




ERO Work Priorities



ERO Risk Management Framework



2021 ERO Reliability Risk Priorities Report

Risk Mitigation Toolbox:

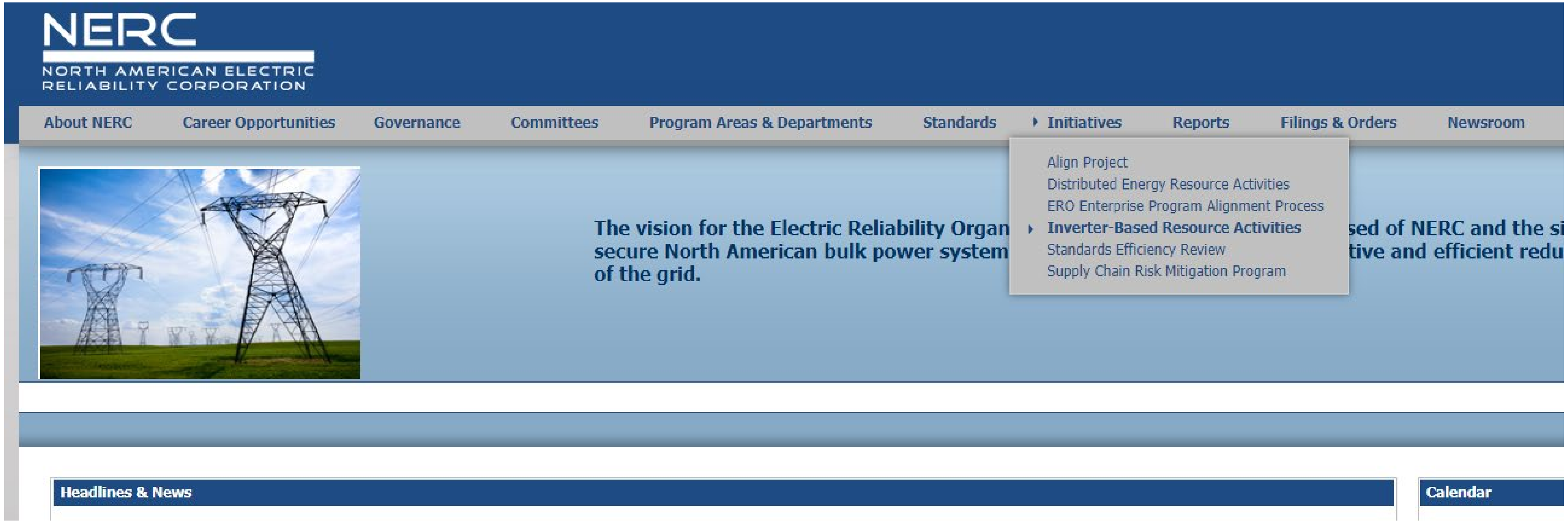
- ERO Reports and Assessments
- Standard Authorization Requests
- Reliability and Security Guidelines
- Compliance Implementation Guidance
- Technical Reference Documents
- Technical Reports
- White Papers
- Lessons Learned
- Alerts
- Industry Outreach and Engagement
- Etc.

NERC IBR Strategy

Risk Analysis	Interconnection Process Improvements	Best Practices and Education	Regulatory Enhancements
Event Analysis	Improvements to GIAs and GIP	Reliability Guidelines	NERC Standards Projects
Disturbance Reports	Enhanced Interconnection Requirements	Webinars and Workshops	BES Definition Review
Alerts	Modeling and Study Improvements	Outreach and Engagement	Inverter-Specific Requirements and Standards
Lessons Learned	IEEE 2800-2022	Emerging Reliability Risk Issues	Risk-Based Compliance

NERC IBR Strategy

IBR and Other Initiatives



https://www.nerc.com/pa/Documents/IBR_Quick%20Reference%20Guide.pdf

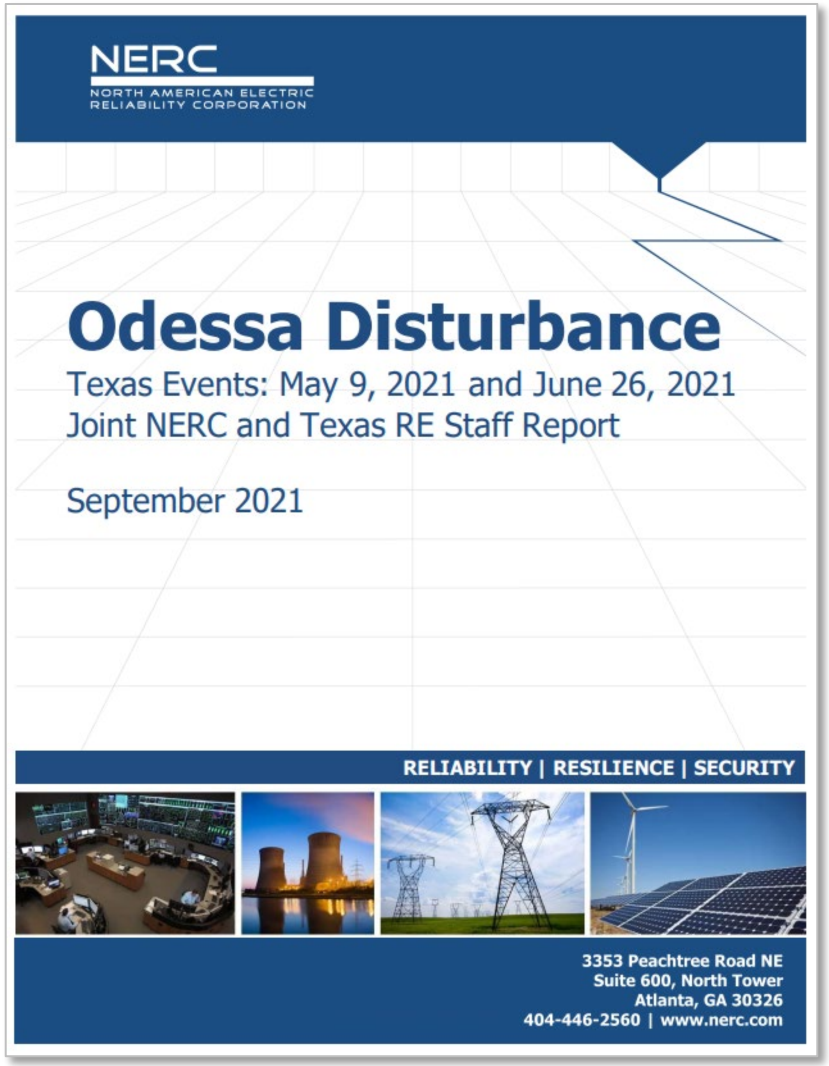
NERC Disturbance Reports

Planned Upcoming Reports:

- BESS-Related Events in California in 2022
- Wind Event(s) in Texas in 2022

https://www.nerc.com/pa/rrm/ea/Pages/Major-Event-Reports.aspx

Odessa Disturbance Reports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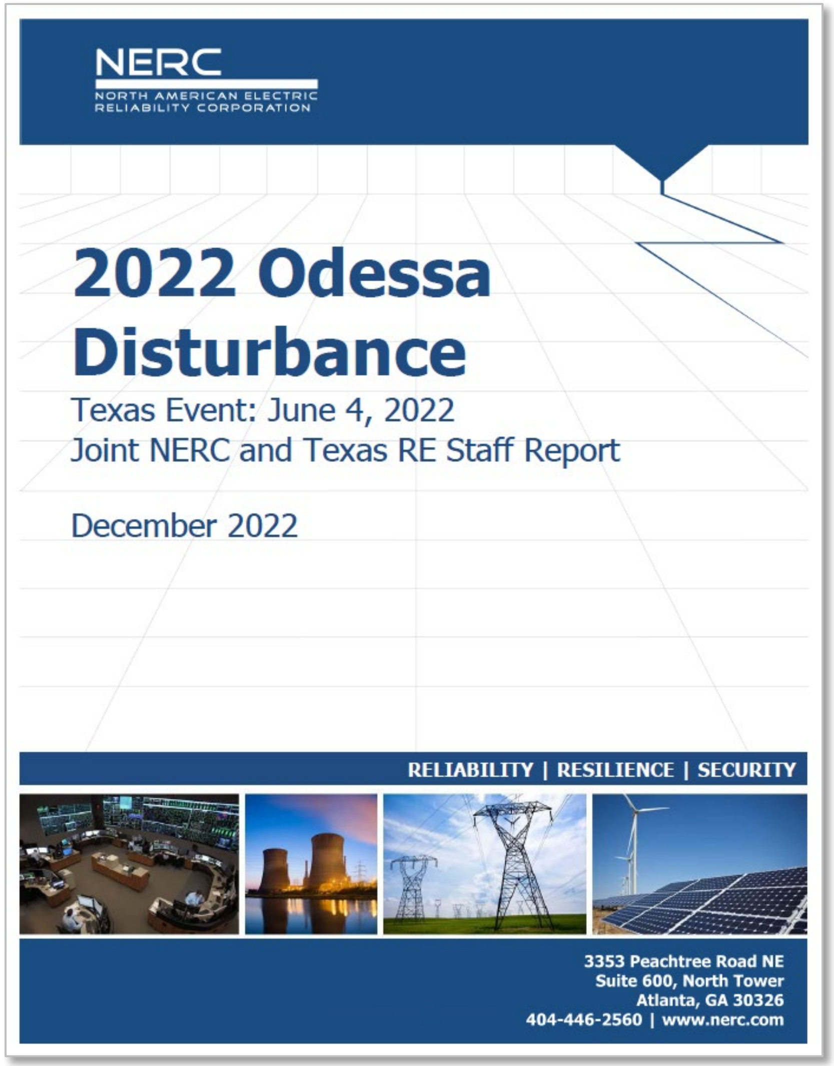
Odessa Disturbance
Texas Events: May 9, 2021 and June 26, 2021
Joint NERC and Texas RE Staff Report

September 2021

RELIABILITY | RESILIENCE | SECURITY

3353 Peachtree Road NE
Suite 600, North Tower
Atlanta, GA 30326
404-446-2560 | www.nerc.com

https://www.nerc.com/pa/rrm/ea/Documents/Odessa_Disturbance_Report.pdf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2022 Odessa Disturbance
Texas Event: June 4, 2022
Joint NERC and Texas RE Staff Report

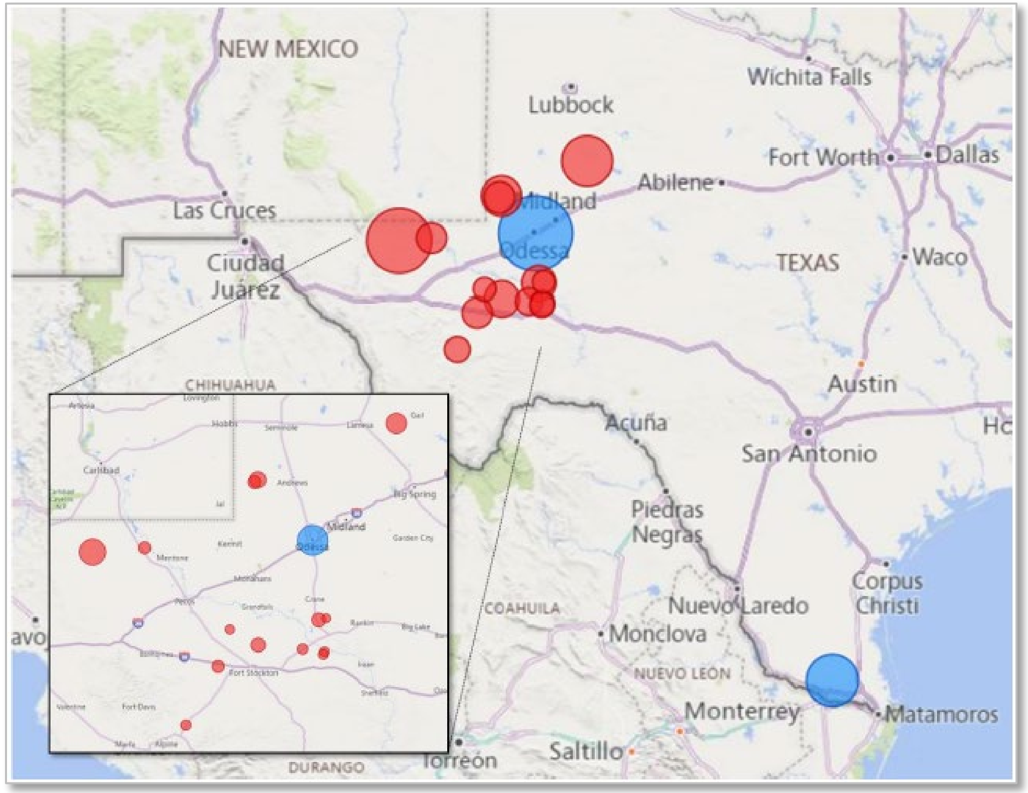
December 2022

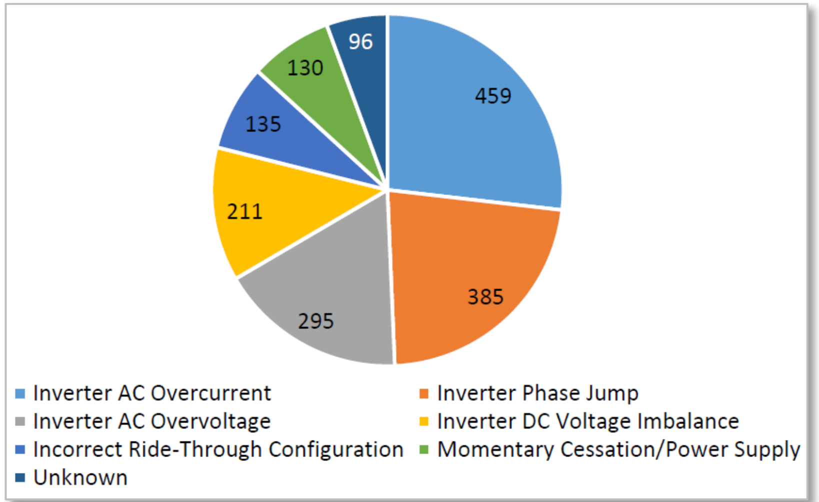
RELIABILITY | RESILIENCE | SECURITY

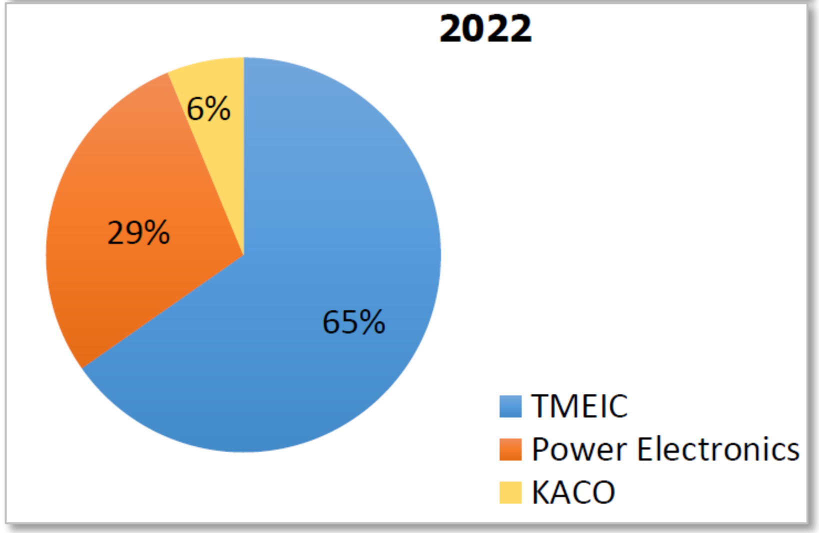
3353 Peachtree Road NE
Suite 600, North Tower
Atlanta, GA 30326
404-446-2560 | www.nerc.com

https://www.nerc.com/comm/RSTC_Reliability_Guidelines/NERC_2022_Odessa_Disturbance_Report%20(1).pdf

2022 Odessa Disturbance Details







Cause of Solar PV Reduction

Table 1.1: Causes of Solar PV Active Power Reductions

Cause of Reduction	Odessa 2021 Reduction [MW]	Odessa 2022 Reduction [MW]
Inverter Instantaneous AC Overcurrent	–	459
Passive Anti-Islanding (Phase Jump)	–	385
Inverter Instantaneous AC Overvoltage	269	295
Inverter DC Bus Voltage Unbalance	–	211
Feeder Underfrequency	21	148*
Unknown/Misc.	51	96
Incorrect Ride-Through Configuration	–	135
Plant Controller Interactions	–	146
Momentary Cessation	153	130**
Inverter Overfrequency	–	–
PLL Loss of Synchronism	389	–
Feeder AC Overvoltage	147	–
Inverter Underfrequency	48	–
Not Analyzed	34	–

* In addition to inverter-level tripping (not included in total tripping calculation.)
** Power supply failure

Review of Affected Solar Plants

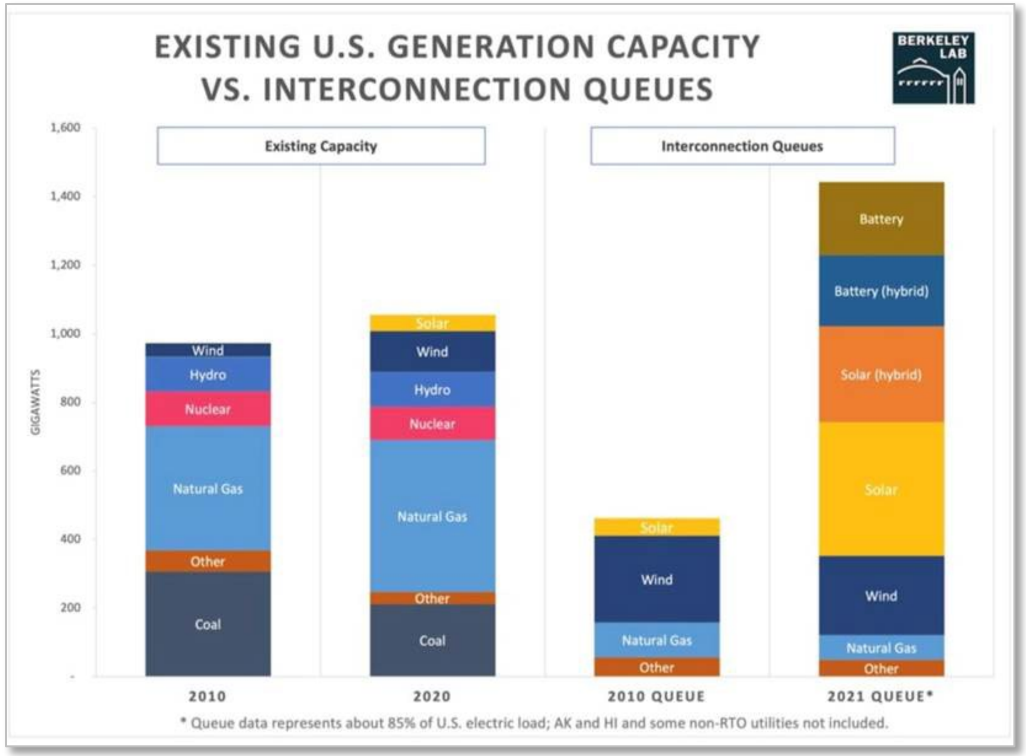
Table A.1: Review of Solar PV Facilities

Facility ID	Capacity [MW]	Reduction [MW]	POI Voltage [kV]	In-Service Date	Cause of Reduction
Plant B	152	133	138	June 2020	Inverter phase jump (passive anti-islanding) tripping.
Plant C	126	56	345	November 2020	Inverter phase jump (passive anti-islanding) tripping.
Plant E	162	159	138	May 2021	Inverter ac overvoltage tripping.
Plant U	143.5	136	138	August 2021	Inverter ac overvoltage tripping; feeder underfrequency tripping.
Plant F	50	46	69	September 2017	Unknown.
Plants I & J	304	196	345	June 2020	Inverter phase jump (passive anti-islanding) tripping.
Plant V	253	106	345	July 2021	Inverter dc voltage imbalance tripping.
Plants K & L	157.5	130	138	September 2016	Momentary cessation/inverter power supply failure.
Plant M	155	146	138	March 2018	Inverter dc voltage imbalance tripping; incorrect inverter ride through configuration.
Plant N	110	35	138	March 2017	Unknown.
Plant O	50	15	138	November 2016	Unknown.
Plant P	157.5	10	138	August 2017	Inverter ac overcurrent tripping.
Plant Q	255	12	138	December 2020	Inverter ac overcurrent tripping.
Plant R	268	261	138	June 2021	Inverter ac overcurrent tripping.
Plant S	100	94	138	December 2019	Inverter dc voltage imbalance tripping.
Plant T	187	176	138	September 2021	Inverter ac overcurrent tripping; feeder underfrequency tripping.
TOTAL		**1,711**			

* Naming convention of facilities is a continuation of the 2021 Odessa Disturbance; therefore, plant numbering is not necessarily alphanumeric but does match the labeling used in the 2021 Odessa Disturbance.

* Denotes plants that went into commercial operation in late 2020 onward

Rapidly Growing Solar PV Portfolio



Source: LBNL

ERCOT Interconnection Queue for ~~2021~~ 2022 Odessa Events:

- **Time of Event:** ~~7,200~~ 8,660 MW solar PV resources in ERCOT
  - Additional ~~790~~ 3,010 MW in commissioning process
- **Near Future:** ~~25,000~~ 28,850 MW solar PV resources with signed interconnection agreements in ERCOT generation interconnection queue between now and 2023

Recommended Practices and Industry Guidance

Here

FERC Order on IBR Registration

- NERC filing regarding work plan
- Operate in coordination with efforts to modernize standards

In particular, NERC plans to work with the six Regional Entities and stakeholders to:

(i) Revise the NERC Rules of Procedure ("ROP") to include Generator Owner – IBR ("GO-IBR") as a new registered entity function within 12 months of Commission order approving the Work Plan;

(ii) Identify candidates for GO-IBR registration within 24 months of Commission order approving the Work Plan; and

(iii) Effectuate registration of GO-IBRs within 36 months of Commission order approving the Work Plan.

In the attached Work Plan, NERC proposes adding and registering GO-IBRs according to the following concept:[20]

Generator Owner – Inverter-Based Resource (GO-IBR):

Owners of IBRs which have aggregate nameplate capacity of less than or equal to 75 MVA and greater than or equal to 20 MVA interconnected at a voltage greater than or equal to 100 kV; or

Owners of IBRs which have aggregate nameplate capacity of greater than or equal to 20 MVA interconnected at a voltage less than 100 kV.

[20] This concept does not intend to result in registration of owners of facilities used solely in local distribution.

FERC NOPR on Standards Enhancements for IBRs

- NOPR to address IBR issues
- ERO Enterprise comments on NOPR
  - Data sharing
  - Modeling and model validation
  - Planning and operations studies
  - Performance requirements
- Topics aligned with NERC deliverables over past 5+ years
- Alignment with numerous existing NERC standards projects
- Proactively addressing these issues; will await final Order for additional details

NERC Standards Under Development

Inverter-Based Resource Performance Enhancements:

- Project 2021-04 Modifications to PRC-002-2
- Project 2020-02 Modifications to PRC-024 (Generator Ride-Through)
- Project 2020-06 Verification of Models and Data for Generators
- Project 2021-01 Modifications to MOD-025 and PRC-019
- Project 2022-04 EMT Modeling
- Project 2021-02 Modification to VAR-002
- (Upcoming Project) Updates to EOP-004
- (Upcoming Project) IBR Performance Issues
- (FERC NOPR) Future IBR Projects…

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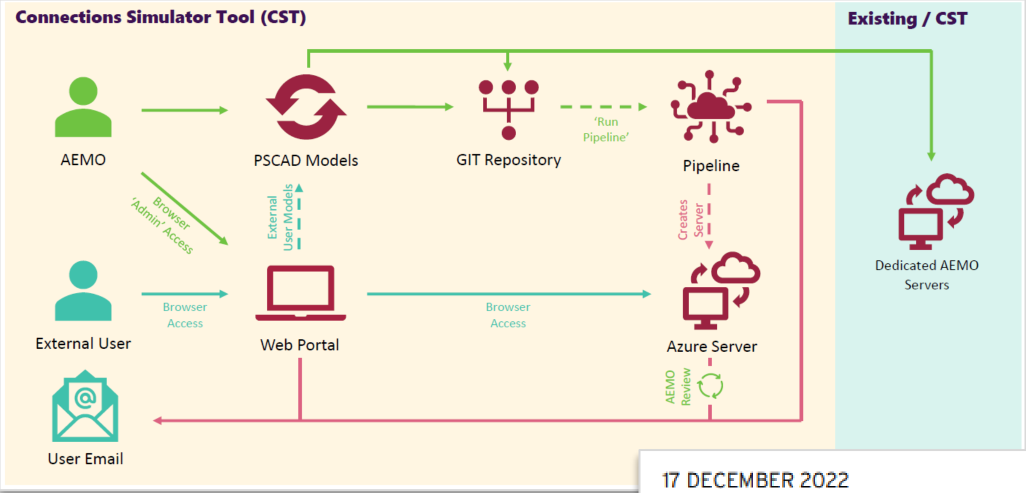
A Couple Examples of Proactive Actions from Down Under



Source: AEMO

17 DECEMBER 2022

ARENA backs eight grid scale batteries worth $2.7 billion

On behalf of the Australian Government, the Australian Renewable Energy Agency (ARENA) has today announced $176 million in conditional funding to eight grid scale battery projects across Australia.

Funded under ARENA's *Large Scale Battery Storage Funding Round*, each battery will be equipped with grid-forming inverter technology, allowing them to provide essential system stability services traditionally provided by synchronous generation such as coal and gas.

With a total project value of $2.7 billion and a capacity of 2.0 GW / 4.2 GWh these projects represent a tenfold increase in grid-forming electricity storage capacity currently operational in the National Electricity Market.

The developers and projects ARENA has selected for support are:

- **AGL**: a new 250 MW / 500 MWh battery in Liddell, NSW.
- **FRV**: a new 250 MW / 550 MWh battery in Gnarwarre, VIC.
- **Neoen**: retrofitting the 300 MW / 450 MWh Victorian Big Battery in Moorabool, VIC to enable grid-forming capability.
- **Neoen**: a new 200 MW / 400 MWh battery in Hopeland, QLD.
- **Neoen**: a new 200 MW / 400 MWh battery in Blyth, SA.
- **Origin**: a new 300 MW / 900 MWh battery in Mortlake, VIC
- **Risen**: a new 200 MW / 400 MWh battery in Bungama, SA.
- **TagEnergy**: a new 300 MW / 600 MWh battery in Mount Fox QLD.

Source: ARENA

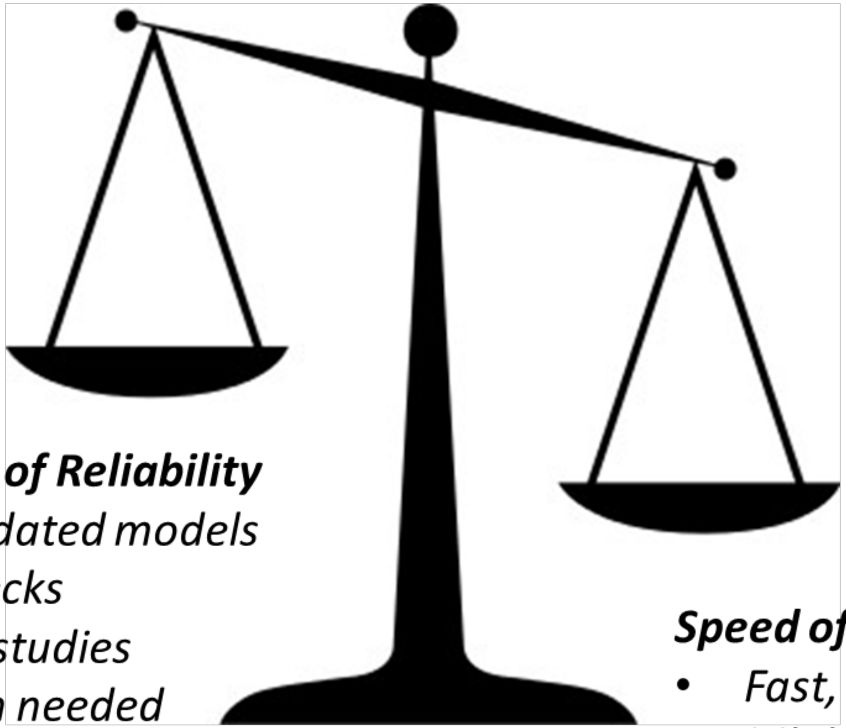
IBR Risk Issues

- Poor IBR modeling during interconnection process
- Lack of adequate studies during interconnection process
- Poor and disparate interconnection requirements
- Lack of industry-wide performance standards
- Poor IBR commissioning practices
- IBR ride-through performance failures
- Pace of interconnection with insufficient reliability studies
- Complacency regarding need for emerging technologies
- Energy sufficiency and energy security risks
- Lack of industry resourcing, expertise, and knowledge

DO NOT DISCREDIT THE CRITICALITY OF EACH AND EVERY ONE OF THESE BULLETS

Delicate Balancing Act

Under Conditions of High Penetrations of Inverter-Based Resources…



Adequate Assurance of Reliability

- *Accurate and validated models*
- *Model quality checks*
- *Detailed stability studies*
- *EMT studies when needed*

Speed of Interconnection

- *Fast, effective, streamlined*
- *Minimal re-work*
- *Clear modeling requirements*
- *Quick studies*

Key Takeaways for States

- Balancing pace of change with BPS reliability assurance
- Resource and energy adequacy, energy security
  - Thoughtful planning of long-term, viable resource mix moving forward
- Enhancements to the interconnection processes
  - Not just the size of the queue, but the quality of the analyses
  - Due diligence for reliability considerations
- Consideration of full suite of solutions to address reliability gaps
  - Balancing least-cost with sufficient reliability margin
- Learning from lessons learned around the industry globally
- Adoption of IEEE standards, where appropriate
- Ensuring essential reliability services
- Proactively preparing for future grid needs
- Ensure adoption of IEEE 1547-2018 for distributed energy resources (distribution-connected)

Questions and Answers

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CLOSING REMARKS

Reliability First

Diane Holder, Vice President, Entity Engagement and Corporate Services

Resource Adequacy
Essential Reliability Services
Pace of Change

FERC

Emma Nicholson, PhD Senior Economic Advisor

Updates on NOPRS, final rules, orders and upcoming conferences

NERC

John Moura-debrief of the NERC LTRA

Alex Shattuck- Essential Reliability Services

Ryan Quint - lessons learned from past events

Panel

Brian Thiry- Host

Jeff Craigo - ReliabilityFirst

Asim Haque- PJM

Melissa Seymour- MISO

Thank You

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FORWARD TOGETHER RELIABILITYFIRST