

Agenda

Reliability Issues Steering Committee

July 8, 2021 | 1:00-2:00 p.m. Eastern
Virtual Meeting

Attendee WebEx Link: [Join Meeting](#)

Introductions and Chair's Remarks

NERC Antitrust Compliance Guidelines

Agenda Items

1. 2021 ERO Reliability Risk Priorities Report* - **Approve**
2. Other Matters and Adjournment

*Background materials included.

Antitrust Compliance Guidelines

I. General

It is NERC's policy and practice to obey the antitrust laws and to avoid all conduct that unreasonably restrains competition. This policy requires the avoidance of any conduct that violates, or that might appear to violate, the antitrust laws. Among other things, the antitrust laws forbid any agreement between or among competitors regarding prices, availability of service, product design, terms of sale, division of markets, allocation of customers or any other activity that unreasonably restrains competition.

It is the responsibility of every NERC participant and employee who may in any way affect NERC's compliance with the antitrust laws to carry out this commitment.

Antitrust laws are complex and subject to court interpretation that can vary over time and from one court to another. The purpose of these guidelines is to alert NERC participants and employees to potential antitrust problems and to set forth policies to be followed with respect to activities that may involve antitrust considerations. In some instances, the NERC policy contained in these guidelines is stricter than the applicable antitrust laws. Any NERC participant or employee who is uncertain about the legal ramifications of a particular course of conduct or who has doubts or concerns about whether NERC's antitrust compliance policy is implicated in any situation should consult NERC's General Counsel immediately.

II. Prohibited Activities

Participants in NERC activities (including those of its committees and subgroups) should refrain from the following when acting in their capacity as participants in NERC activities (e.g., at NERC meetings, conference calls and in informal discussions):

- Discussions involving pricing information, especially margin (profit) and internal cost information and participants' expectations as to their future prices or internal costs.
- Discussions of a participant's marketing strategies.
- Discussions regarding how customers and geographical areas are to be divided among competitors.
- Discussions concerning the exclusion of competitors from markets.
- Discussions concerning boycotting or group refusals to deal with competitors, vendors or suppliers.

- Any other matters that do not clearly fall within these guidelines should be reviewed with NERC's General Counsel before being discussed.

III. Activities That Are Permitted

From time to time decisions or actions of NERC (including those of its committees and subgroups) may have a negative impact on particular entities and thus in that sense adversely impact competition. Decisions and actions by NERC (including its committees and subgroups) should only be undertaken for the purpose of promoting and maintaining the reliability and adequacy of the bulk power system. If you do not have a legitimate purpose consistent with this objective for discussing a matter, please refrain from discussing the matter during NERC meetings and in other NERC-related communications.

You should also ensure that NERC procedures, including those set forth in NERC's Certificate of Incorporation, Bylaws, and Rules of Procedure are followed in conducting NERC business.

In addition, all discussions in NERC meetings and other NERC-related communications should be within the scope of the mandate for or assignment to the particular NERC committee or subgroup, as well as within the scope of the published agenda for the meeting.

No decisions should be made nor any actions taken in NERC activities for the purpose of giving an industry participant or group of participants a competitive advantage over other participants. In particular, decisions with respect to setting, revising, or assessing compliance with NERC reliability standards should not be influenced by anti-competitive motivations.

Subject to the foregoing restrictions, participants in NERC activities may discuss:

- Reliability matters relating to the bulk power system, including operation and planning matters such as establishing or revising reliability standards, special operating procedures, operating transfer capabilities, and plans for new facilities.
- Matters relating to the impact of reliability standards for the bulk power system on electricity markets, and the impact of electricity market operations on the reliability of the bulk power system.
- Proposed filings or other communications with state or federal regulatory authorities or other governmental entities.
- Matters relating to the internal governance, management and operation of NERC, such as nominations for vacant committee positions, budgeting and assessments, and employment matters; and procedural matters such as planning and scheduling meetings.

2021 ERO Reliability Risk Priorities Report

Action

Approve

Summary

The draft RISC 2021 ERO Reliability Risk Priorities Report (Report) was posted for comment June 9 through June 23, 2021. Comments received recommended minor adjustments to the 2021 Report, as well as general comments for consideration for future reports. The comments were reviewed and changes made are noted in the attached redline copy of the Report.

Background

The RISC ERO Reliability Risk Priorities Report is published every two years and is intended to inform regulators, policy makers and industry on existing and emerging risks as well as proposed and implemented mitigating strategies. The report builds off the [2019 ERO Reliability Risk Priorities Report](#), [initial risk identification and mitigation framework](#), the risk survey, the Reliability Leadership Summit, as well as additional input from the RISC committee and individual industry leaders. The RISC Committee works diligently to leverage all information to build a cogent report. It is also incumbent on the RISC Committee to measure the effectiveness and progress toward resolution of identified risks and the efficacy of mitigating activities.



2021 ERO Reliability Risk Priorities Report

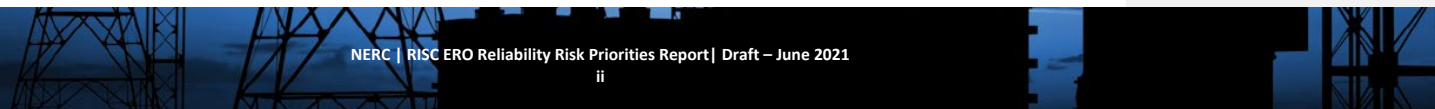
Draft – June 2021

NERC
NORTH AMERICAN ELECTRIC
RELIABILITY CORPORATION



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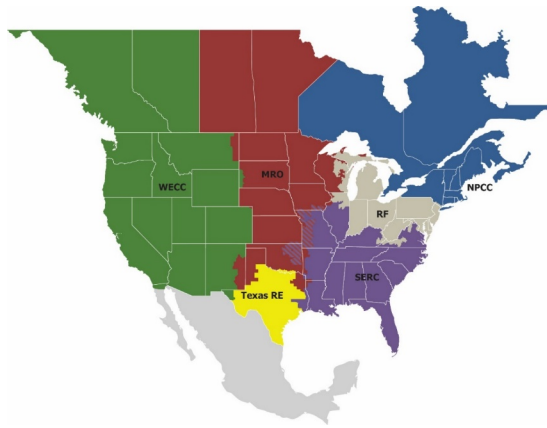


Preface

Electricity is a key component of the fabric of modern society and the Electric Reliability Organization (ERO) Enterprise serves to strengthen that fabric. The vision for the ERO Enterprise, which is comprised of the North American Electric Reliability Corporation (NERC) and the six Regional Entities (RE), is a highly reliable and secure North American bulk power system (BPS). Our mission is to assure the effective and efficient reduction of risks to the reliability and security of the grid.

Reliability | Resilience | Security
Because nearly 400 million citizens in North America are counting on us.

The North American BPS is divided into six RE boundaries as shown in the map and corresponding table below. The multicolored area denotes overlap as some load-serving entities participate in one Region while associated Transmission Owners/Operators participate in another.



MRO	Midwest Reliability Organization
NPCC	Northeast Power Coordinating Council
RF	ReliabilityFirst
SERC	SERC Reliability Corporation
Texas RE	Texas Reliability Entity
WECC	Western Electricity Coordinating Council

Reliability Issues Steering Committee

The Reliability Issues Steering Committee (RISC) is an advisory committee to the NERC Board of Trustees (Board). The RISC provides key insights, priorities, and high-level leadership for issues of strategic importance to BPS reliability. The RISC advises the Board, NERC committees, NERC staff, regulators, REs, and industry stakeholders to establish a common understanding of the scope, priority, and goals for the development of solutions to address emerging reliability issues. The RISC provides guidance to the ERO Enterprise¹ and the industry to effectively focus resources on the critical issues to improve the reliability of the BPS.

This ERO *Reliability Risk Priorities Report* (RISC Report) presents the results of the RISC's continued work to strategically define and prioritize risks to the reliable operation of the BPS and thereby provide recommendations to the Board regarding the approach that NERC, the ERO, and industry should take to enhance reliability and manage those risks.

¹ ERO Enterprise is interpreted to mean NERC, the Regional Entities, and the technical committees of NERC.

Executive Summary

The primary objective of the *2021 ERO Risk Priorities Report* is to report on key risks to the BPS that merit attention and recommend mitigating actions that align with those risks. This report differs from other ERO reports in that it is a forward-looking view of the BPS with the intent to provide industry with potential strategic direction to understand imminent risks and plan for the mitigation of those risks. For example, this is in contrast to the *State of Reliability*² report or Event Analysis Reports which reviews data from previous years or events to draw objective conclusions about events, emerging risks and appropriate monitoring for their mitigation. This year's report has been published earlier in the year versus previous reports to provide industry with additional time to plan and budget for potential action plans to mitigate risks.

This report reflects the collective opinion and conclusions drawn from the RISC membership regarding present and emerging risks and their respective priorities. The RISC reviewed and assembled information from ERO Enterprise stakeholders and policymakers³ and focused subgroup work to evaluate the current set of risk profiles to include the descriptors of the risks and recommended mitigating activities. Additional risks and potential mitigating activities were identified during the 2021 Reliability Leadership Summit that was held in January 2021. The Leadership Summit participants were comprised of industry leaders, executives, and subject matter experts with keen perspective on the inherent and trending risks that affect BPS reliability.

For the 2021 report, the RISC also reduced the number of recommendations. This was completed by consolidating overlapping recommendations and removing recommendations that reflected ongoing activities; though these activities are important, they are already well underway and monitored as part of NERC's Long-Term Strategy Plan and applicable NERC committee plans. This 2021 report builds on the 2019 report, recognizing progress, but also underscoring new risks continue to emerge and often times the potential severity of risks can increase as well. Industry must continue to be vigilant and collaborative to stay in front of those emerging risks and develop mitigating strategies before risks become more impactful.

The **Risk Profiles** section of this report provides a statement, descriptors, and recommendations for mitigating the risk. The RISC recommends actionable mitigating activities that enable the ERO Enterprise and industry to use the composite risk profiles and the mitigating activities map for baseline and recurring evaluations. Grid transformation has broad implications across the other risk profiles, as it catalyzes other changes and often amplifies their effects. As such, while the grid transformation risks and recommendations are broad in nature and overlap to some degree with other Risk Profile sections, grid transformation provides an important framework for this report and its recommendations.

² 2020~~19~~ State of Reliability Report: https://www.nerc.com/pa/RAPA/PA/Performance%20Analysis%20DL/NERC_SOR_2020.pdf

³ Policymakers is used generally to mean any organization that can impact the legal or regulatory framework in place at various levels, including local, state, federal, and provincial governmental authorities in addition to various trades and lobbying organizations.

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When possible, the RISC also identified the group or organization that it believes should lead the mitigating action. However, some recommendations do not present a clear owner or responsible party. In these cases, the recommendation is presented as a more generalized action item that can apply to numerous entities, including policymakers, industry, and the various organizations within the ERO Enterprise. The RISC did not assess resource needs for the mitigating actions that will be addressed with industry during the annual ERO Enterprise Business Plan and Budget activities.

Additionally, the committee evaluated risks based on impact to the BPS regardless of the source or location of the risk. To evaluate key risks to the system, the RISC recognized emerging issues emanating from different areas of the grid (e.g., resources like distributed energy resources (DERs) which are not located or directly connected to the BPS). Operators and planners of the BPS are aware of the need to have a wide-area view of changes to the system to provide an understanding of external conditions that can affect them. Therefore, the profiles identify several risks where the BPS can be impacted at interfaces (e.g., customers distributed resources, resources located on the electric distribution system, natural gas delivery system, grid infrastructure for energy deliverability telecom system, water system). The RISC is illuminating external factors that increase BPS risk and offer recommendations to address those risks.

Common Themes and Emerging Trends

For risks that the committee recommends active monitoring, a convergence of centralized themes and emerging trends is present. These themes and trends underscore not only the increasing interdependency between identified BPS risks, but also an increase in potential magnitude of emerging risks. Common themes and emerging trends are indicated as follows:

- Interdependencies between industries and fuel types;
- Increased security risks (both cyber and physical);
- The increase in natural gas and renewable variable energy generation coupled with the decline in nuclear and coal-fired generation, and implications resulting on dynamic performance of the BPS;
- The importance of emerging technologies and how to best plan and incorporate those into a reliable and secure BPS ;
- Significant changes to the grid require new models, more advanced tools, and grid infrastructure improvements for reliable integration; and
- Development of credible and centralized data sharing along with the right tools to proactively analyze system conditions is becoming more critical.

Background and Introduction

This report documents the results of the RISC's continued work to identify key risks to the reliable planning and operation of the BPS and provide recommendations to mitigate those risks. This report includes recommendations regarding priorities to assist the Board and NERC management as well as industry and its stakeholders.

The RISC's efforts are both responsive to and in support of the Board's resolutions in connection with the initial 2013 RISC recommendations⁴ that direct continued work by the RISC to define and prioritize risks, develop mitigating activities, and identify accountable parties for those risks.

There are important linkages between the risk priorities and the recommended actions for the ERO Enterprise and industry. While the risk profile recommendations in this report are presented individually, there are interdependencies between many of the risks that present unique challenges to the electric industry. These interdependencies have been acknowledged in the report. Further, many of these risks have been long recognized with commensurate NERC and industry monitoring for proper mitigation whereas others are newly emerging, requiring active management with a more aggressive immediate approach necessary for effective foresight and mitigation. The RISC acknowledges and appreciates the increased reliance of the Board and ERO Enterprise leadership on the results of the RISC's activities as an input for the ERO Enterprise's Long-Term Strategy Plan and Business Plan and Budget.

The RISC participants include representatives from the NERC committees, the Member Representatives Committee, and "at large" industry executives. The observations, findings, and guidance presented in this report include input from industry forums, trade associations, and other industry groups through multiple channels. The RISC also received feedback through both the Reliability Leadership Summit and an Emerging Risks Survey.

This report relies on and extends the comprehensive assessment and corresponding recommendations to the Board made in November 2019 that have been updated and refined. This report and recommendations also reflect discussions with representatives from the NERC committees, and the many technical reports and assessments conducted by NERC and industry.

⁴See minutes from the Board's February 7, 2013, meeting: <http://www.nerc.com/gov/bot/Agenda%20and%20Minutes%202013/BOT%20-%20February%207%202013%20Minutes.pdf>

ERO Collaboration

The RISC has entered into a bilateral communication protocol with NERC's Reliability and Security Technical Committee (RSTC) whereby the RISC will communicate identified risks and mitigating activities and the RSTC will work with industry to implement strategic plans for executing those plans and developing commensurate timelines around those activities.

This framework is meant to guide the ERO in the prioritization of risks and provide guidance on the application of ERO Policies, Procedures, and Programs, to inform resource allocation and project prioritization in the mitigation of those risks. Additionally, the framework accommodates measuring residual risk after mitigation is in place, enabling the ERO to evaluate the success of its efforts in mitigating risk, which provides a necessary feedback for future prioritization, mitigation efforts, and program improvements.

The successful reduction of risk is a collaborative process between the ERO, industry, and the technical committees including the Reliability and Security Technical Committee (RSTC) and RISC. The framework provides a transparent process using industry experts in parallel with ERO experts throughout the process, from risk identification, deployment of mitigation strategies, to monitoring the success of these mitigations.

Six specific steps have been identified, consistent with risk management frameworks used by other organizations and industries: 1) Risk Identification; 2) Risk Prioritization; 3) Mitigation Identification and Evaluation; 4) Deployment; 5) Measurement of Success; and 6) Monitoring. Each of these steps will require process development, including stakeholder engagement, validation/triage approaches, residual risk monitoring, ERO's level of purview over a risk, etc. These processes will be developed once the framework has been finalized.

1. Risk Identification and Validation: As mentioned above, the ERO identifies risks using both leading and lagging approaches. The RISC biennial report and Long-Term and Seasonal Reliability Assessments (leading) have successfully brought together industry experts to identify and prioritize emerging risks, as well as suggest mitigation activities. A partnership between the ERO leadership and both the RISC and RSTC enables input from the ERO program areas, industry Forums and trade associations to provide additional context in risk identification.

Once the ERO, NERC Committees, Forums, or industry subject matter experts identify and validate a risk, it is critical that the corresponding recommendation for mitigation describe, explain, and provide support for the basis for selecting the particular approach to mitigation. A template will be created, that mirrors the Standards Authorization Request template, that requires an explanation of the risk, approach(es) for mitigation, and estimate of residual risk.

Risk Identification: The ERO has a number of ways that it identifies risks:

- ERO stakeholder supported technical organizations, industry forums, and associated subject matter experts
- Focused Compliance monitoring activities
- Reliability and Risk Assessments
- Events Analysis
- State of Reliability Report, including the analysis of Availability Data Systems (BASS, TADS, GADS, DADS, MIDAS, etc.)
- Frequency Response, Inertia, and other essential reliability service measurements
- Interconnection simulation base case quality and fidelity metrics
- Reliability Issues Steering Committee (RISC) Biennial Risk Report
- Regional Risk Assessments
- Communication with external parties, such as DOE, DHS, Natural Resources Canada, CEA and EPRI
- Shared public and/or government intelligence with special emphasis on cyber security

Risk Validation: The ERO and industry subject matter experts continuously work together validating risks to the reliable and secure operation of the BPS based on analysis of ongoing performance of the system (lagging). Validation of the magnitude and priority of the risks includes analysis from the ERO databases of system performance and Events Analysis. These outputs are generally covered in NERC’s State of Reliability Report. In addition, the risks are further validated through working with NERC Committees, and socializing them with Forums, government, and research organizations. Leading risk validation requires analysis of system simulations, forecasts, and performance projections.

2. **Risk Prioritization:** Prioritizing risks is accomplished through an analysis of their exposure, scope, and duration as well as impact and likelihood. The primary sources of data used to support this analysis come from the Risk Identification step. Deciding if the risk requires near-term mitigation or continued monitoring is informed by technical expertise. Depending on the complexity of the risk, new models, algorithms and processes may need to be developed to better understand the potential impacts of the risk, which is necessary to develop risk mitigation tactics. The process would be consistent with other risk management frameworks used by other industries, and was recently successfully tested in collaboration with industry through a survey issued by the RISC, based upon the risks that group prioritized in early 2019.

An ERO risk registry and heat maps are being developed encompassing prior RISC report findings, ongoing technical committee activities, and risks being monitored. This registry is expected to be completed by the end of the third quarter of 2021. Work plans of the technical committees will then be periodically reviewed to ensure that ongoing activities are tied to identified risks in the risk registry. Further, if new risks emerge they can be added to the registry, and if it is deemed that the risks are sufficiently mitigated, they will be moved to the monitored portion of the risk registry. As the RSTC develops its annual work plan and following the publication of the biennial ERO Reliability Risk Priorities Report, the risk registry is reviewed by the RISC and the RSTC to evaluate how completed work addressed these identified risks, whether any new risks have been identified by either committee that need to be added to the risk register, and documenting monitored risks which require no additional mitigation.

3. **Remediation and Mitigation Identification and Evaluation:** The right mix of mitigation activities is balanced against both the effective and efficient use of resources and the potential risk impact and likelihood. Further,

the risk tolerances needs to be balanced against potential impacts so that the remediation/mitigation plans can be developed accordingly. Determining the best mix depends on a number of factors, such as:

- What is the potential impact or severity of the risk?
- How probable is the risk? Is it sustained, decreasing or growing?
- Is the risk here today or anticipated in the next 3-5 years?
- How pervasive is the risk?
- Is mitigation expected to be a one-time action, or ongoing?
- Have we had experience with events being exacerbated by the risks, or there is no experience, but the probability is growing (i.e. cyber or physical security)?
- Have previous mitigation efforts been deployed? If so, were they effective? Why or why not?
- What is an acceptable residual risk level after mitigating activities have been deployed?
- Is the risk man-made or by natural causes?
- Does the mix of mitigations vary based on jurisdictional or regional differences?
- Is the risk fully or partially within the purview of the ERO?

Input from, and allocation of, subject matter expertise through multiple sources is part of this consideration, including resources within the ERO and its stakeholders (such as standing technical committees and their subgroups, or standard drafting teams). External parties are important sources as well, such as the North American Transmission and Generation Forums (NATF and NAGF), North American Energy Standards Board (NAESB), the Institute of Electrical and Electronic Engineers (IEEE), and EPRI, to name a few.

Once a risk to the BES has been prioritized according to its impact and likelihood, the ERO, NERC Committees, Forums, and industry subject matter experts recommend and can take on potential mitigation activities and assess their anticipated effectiveness. Coordination is key to avoid duplication and provide supportive, rather than conflicting actions.

The ERO remains responsible for risks to the reliable and secure operation of the BES. Risk mitigation should still be followed by the ERO no matter which organization takes on activities. Examples of mitigation efforts include, but are not limited to:

- Reliability Standards, with Compliance and Enforcement for risks that are:
 - Sustained, moderate to severe impact, and likely
 - Sustained, severe impact, and unlikely
 - Focused monitoring based on risk, and in response to major events
- Reliability Guidelines for risks that are:
 - Sustained, low to moderate impact, and likely
- Lessons Learned for risks that are:
 - Sustained, low impact, and likely
- Assist Visits for risks that are:
 - Compliance-related

- Focused on a very specific situation or configuration
- Generally on specific industry or entity practices or conditions
- Analysis of Major Events for risks that are:
 - Identified after a Major Event (e.g., Category 3 or higher, [definitions can be found in 2020 State of Reliability Report](#))
 - Discreet/one-time, severe impact, unlikely
 - identified through recommended reliability improvements or best practices and lessons learned
- Analysis of “Off-Normal” Events for risks that are
 - Identified after an unusual operational condition has occurred and likely not a categorized event.
 - Discreet/one-time, moderate impact, unlikely
 - Identified through recommended reliability improvements or best practices and lessons learned
- Advisories, Recommendations or Essential Actions⁵
- Alerts⁶
- Technical Conferences and Workshops

Field Code Changed

When reviewing the type and/or depth of remediation and mitigation, a form of cost-effectiveness analysis may be considered to understand impacts and potential burdens. This analysis can then be compared to potential impacts of the risk.

4. Mitigation Deployment: Mitigation projects will be deployed by the ERO and/or industry stakeholder groups, as determined by the “Mitigation Identification and Evaluation” step. A specific mitigation plan would involve a suitable mix of the ERO policies, procedures and programs discussed in Section I. These mitigations would be coordinated with Canadian, industry partners and stakeholders.

From time-to-time, the Federal Energy Regulatory Commission (FERC) may order the development of Reliability Standards, which can occur in this step.

5. Measurement of Success: Once a set of solutions has been deployed, the effectiveness of the mitigation must be measured to determine if the residual risk has been reduced to an acceptable level. Effectively, if the desired level of risk mitigation is not met, the risk is fed back to Step 1, enabling a new prioritization of risks, factoring in historic mitigation, ensuring resource allocation is adapted to the changing risk landscape. This step also informs future mitigation efforts, as industry and the ERO learn from the effectiveness of mitigation mixes for reducing risk. A partnership between the ERO leadership and both the RISC/RSTC will enable input from the ERO program areas, industry Forums and trade associations to provide additional context in the measurement of success. That said, criteria and other related processes should be developed for determining risk severity, likelihood, and mitigation activity effectiveness.

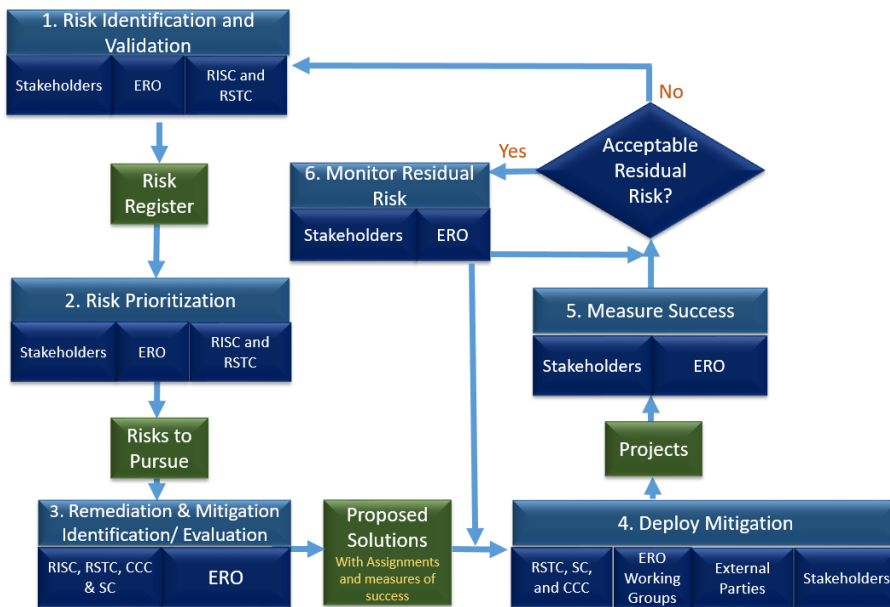
6. Monitor Residual Risk: Once the level of residual risk is at an acceptable level, the risk is monitored through ongoing performance measures to ensure that risk remains at acceptable risk levels. The residual risk should

⁵ LEVEL 1 (Advisories) – purely informational, intended to advise certain segments of the owners, operators and users of the Bulk Power System of findings and lessons learned; LEVEL 2 (Recommendations) – specific actions that NERC is recommending be considered on a particular topic by certain segments of owners, operators, and users of the Bulk Power System according to each entity’s facts and circumstances; LEVEL 3 (Essential Actions) – specific actions that NERC has determined are essential for certain segments of owners, operators, or users of the Bulk Power System to take to ensure the reliability of the Bulk Power System. Such Essential Actions require NERC Board approval before issuance.

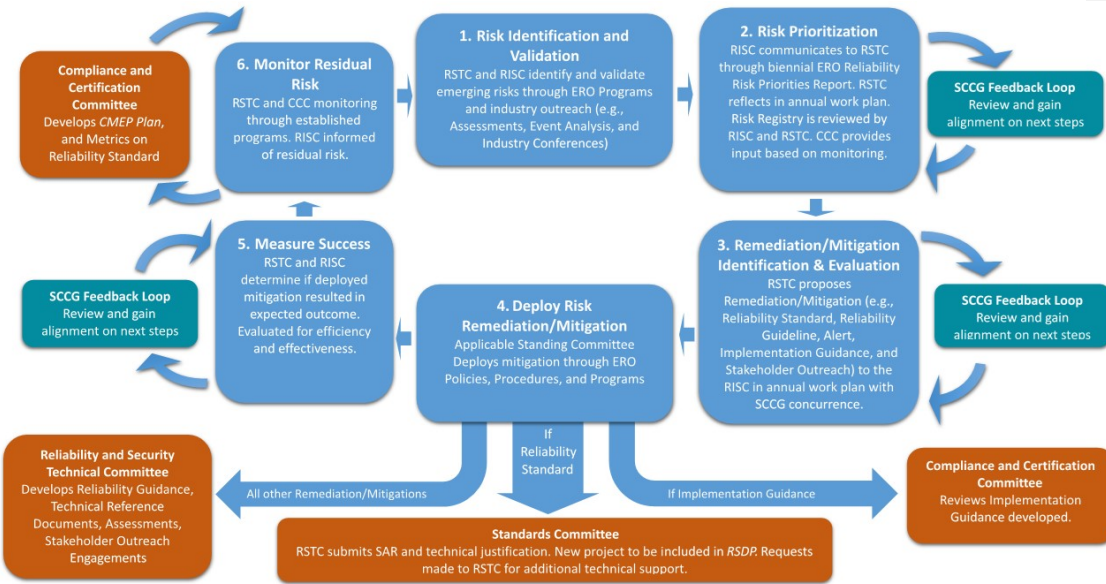
⁶ ALERT 1: Industry Action Requested: Fast moving or recently detected, impacts moderate, ALERT 2: Industry Action Required: Fast moving or recently detected, impacts moderate to severe, ALERT 3: Industry Action Mandatory: Fast moving or recently detected, impacts moderate to severe.

be monitored for progress and to ensure that the mitigations that are in place continue to address the risk (Step 5). At times, mitigations need to be deployed on a periodic basis (e.g. annual workshops, Reliability Guideline updates, etc.) to ensure continued success (Step 4). If the risk levels heighten, or increased mitigation efforts are necessary due to the changing nature of the BPS, the risk can be fed back (Step 1) for prioritization and the development of additional mitigation approaches. The ERO, working with its industry partners, technical committees, stakeholders and forums, would determine if the residual risk was acceptable or if additional mitigations required.

From-time-to-time risks are identified and validated which require an accelerated industry attention. The ERO risk framework can support quick implementation of industry awareness and mitigation activities. Figure 1 provides a pictorial flow chart of the ERO’s risk management process.

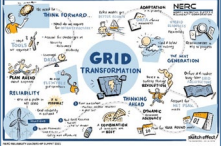


This risk framework serves to ensure effective collaboration within the ERO and industry, appropriate identification of critical industry risks, and an effective establishment of work plans that ensure mitigating activities are implemented, measured, evaluated, and reevaluated in a strategic and effective manner.



Inputs to the Risk Profiles

DAY 1: GRID TRANSFORMATION



TURAL



DAY 2 – SECURITY RISKS



DAY 2 – CRITICAL INFRASTRUCTURE INTERDEPENDENCIES

Reliability Leadership Summit

On January 26-27, 2021, NERC and the RISC hosted its first fully virtual summit with leaders of the reliability community, including top industry executives, state and federal regulators, along with NERC and Regional Entity senior leadership. The summit focused on four specific areas: 1) Grid Transformation, 2) Extreme Natural Events, 3) Security Risks, and 4) Critical Infrastructure Interdependencies. Open discussions at the end of each day addressed these and any other risks that required deeper discussion.

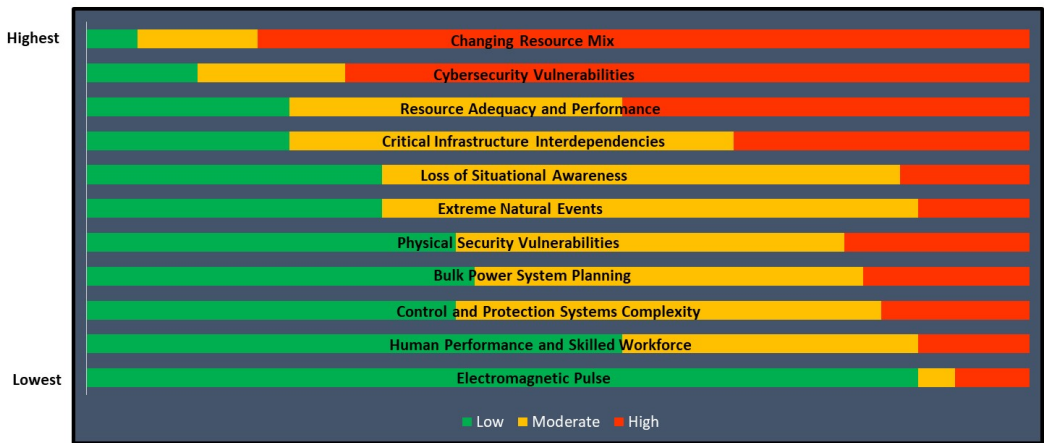
The panel discussions underscored the importance of conducting cross-sector coordination with other industries and covered such areas as the transformation of the grid, the challenges that they pose for their integration, and reliability and security impacts and considerations; lessons learned and unique challenges posed by extreme natural events, and ways to prepare for them; cyber and physical security risks, their evolution, and impacts that could cause [assess](#) damage; and implications of the increased critical infrastructure interdependencies, and how to address the jurisdictional issues that need to be tackled to address the risks they present.

In addition, a refined Emerging Risks Survey was issued in December 2020 (with responses due mid-January 2021) that sought stakeholder input on the continued relevancy of the eleven (11) individually identified risks, the overall risk profile groups, and the mitigating activities within each of the profile groups as detailed in the 2019 RISC Report. The objective of this year's survey was to gauge if the RISC Report is providing the correct level of information and recommendations to ultimately have an effect in the likelihood and impact to the BPS risks.

As part of the 2020 Emerging Risks Survey, respondents were asked if each of the eleven (11) identified risks from the 2019 RISC Report were still relevant and to rank them from 1-11, with 11 as highest and 1 as lowest. Each risk was identified as still relevant and in evaluating the rankings, the responses were classified as Low (1-4), Moderate (5-8), and High (9-11) to provide an overall view of each risk. The accompanying chart reveals that Changing Resource Mix followed by Cybersecurity Vulnerabilities lead industry perception on the criticality of these risks. This information is useful for industry as a whole to prioritize and dedicate resources and budget. The 2021 report has identified modified risks which will subsequently be incorporated into the 2023 Emerging Risks Survey.



Risk Ranking



In addition, the graphic below depicts the classification of manage or monitor for each of the identified risks. Those risks identified as “**manage**” are emerging, imminent, and pose significant threats and where thorough strategic planning and industry collaboration are needed for risks mitigation. Those risks identified as “**monitor**” are risks that are of critical importance to BPS reliability, though are considered well managed with established industry practices in place to mitigate and lessen potential impacts to BPS reliability.

The graphic indicates that extreme events should be monitored going forward, which may seem counterintuitive with recent events. Extreme events though is made up of those events in which industry has a great deal of experience, for example hurricanes, tornadoes, derecho, etc., industry has put forth emergency operating plans, usual aid programs, drills, and studies.

With the recent grid transformation, the resource mix is increasingly characterized by one that is sensitive to extreme, widespread, and long duration temperatures as well as wind and solar droughts. For example, having sufficient capacity does not necessarily mean that adequate energy will be available as widespread extreme temperatures are experienced. Neighboring organizations may not necessarily always support each other as they are all experiencing the same conditions.

These risks need to be better understood with mitigation approaches developed to manage them. In the future the RISC may collect information from industry about both those extreme events for which a great deal of experience is available versus those that industry is gaining experience and understanding in due to the grid transformation.

Input to Risk Profiles

Changing Resource Mix	Manage - 2019	Manage - 2021
Cybersecurity Vulnerabilities	Manage - 2019	Manage - 2021
Resource Adequacy and Performance	Manage - 2019	Manage - 2021
Critical Infrastructure Interdependencies	Manage - 2019	Manage - 2021
Loss of Situational Awareness	Manage - 2019	Monitor - 2021
Extreme Natural Events	Monitor - 2019	Monitor - 2021
Physical Security Vulnerabilities	Monitor - 2019	Monitor - 2021
Bulk Power System Planning	Manage - 2019	Monitor - 2021
Control and Protection Systems Complexity	Monitor - 2019	Monitor - 2021
Human Performance and Skilled Workforce	Monitor - 2019	Monitor - 2021
Electromagnetic Pulse		Monitor - 2021**

**EMP was not individually surveyed as manage vs. monitor in the 2019 Risk Report.

Finally, the report was posted for stakeholder comment in June 2021 and comments received were reviewed and incorporated as applicable.

Risk Groupings

Grid Transformation

- A. Bulk Power System Planning
- B. Resource Adequacy and Performance
- C. Increased Complexity in Protection and Control Systems
- D. Situational Awareness Challenges
- E. Human Performance and Skilled Workforce
- F. Changing Resource Mix

Extreme Natural Events

- A. Extreme Natural Events, Widespread Impact
 - GMD
- B. Other Extreme Natural Events

Security Risks

- A. Physical
- B. Cyber
- C. Electromagnetic Pulse

Critical Infrastructure Interdependencies

- A. Communications
- B. Water/Wastewater
- C. Oil
- D. Natural Gas

Though there are fundamental system characteristics that are critical to support BPS reliability such as energy, frequency, voltage, and ramping capability, the sources of each of these are rapidly changing. The resource mix is transforming from large, remotely-located coal-fired and nuclear power plants, towards gas-fired, renewable, and distributed energy resources. The changing resource mix has resulted in a large magnitude of renewable variable energy resources, distributed energy resources, micro- and smart-grids, demand response technologies as well as an increasing reliance on just-in-time delivery of natural gas to fuel new generating capacity. This transformation is causing different utilization-use of the power lines and changing dynamic performance of the system. In parallel, the potential for cyber and physical attacks has increased as the adoption of advanced technologies compounds the reliance on digital controls and communication systems.

Electrification of many sectors such as transportation and technology continues to increase, which in turn will increase both demand for electricity and the importance of effective management of the significant changes the grid is presently undergoing. There are three main characteristics of this change: decarbonization, digitization and decentralization. Decarbonization is occurring as a result of improved technologies as well as governmental mandates. Increased digitization poses potential challenges from a cyber-security stand point. Decentralization, including proliferation of microgrids and behind the meter generation, is another grid development that necessitates proper system planning and effective deployment of risk mitigation strategies.

There are four significant evolving risks, which are not independent from each other, that result from these electric industry developments. The **Grid Transformation** includes the shift away from conventional synchronous central-station generators toward a new mix of resources which includes natural-gas-fired generation; unprecedented proportions of non-synchronous resources, including renewables and battery storage; demand response; smart- and micro-grids; and other emerging technologies which will be more dependent on communications and advanced coordinated controls which can increase the potential **Security Risks**. Collectively, these new resources can be more susceptible to long-term, widespread Extreme Events such as extreme temperatures or wind/solar droughts that can impact their ability to provide sufficient energy as their fuel supply is less certain. ~~Collectively, these new resources are more susceptible to widespread Extreme Events impacting their ability to provide sufficient energy as their fuel supply is less certain.~~ Further, there is an increase in **Critical Infrastructure Interdependencies**. For example, for natural-gas-fired generation, there is increased interdependency on delivery of fuel from the natural gas industry, which also depends on electricity to support its ability to operate.

Each of these risk areas requires steps to mitigate or control their impacts for the continued reliable planning and operation of the BPS. In this way, the goals of

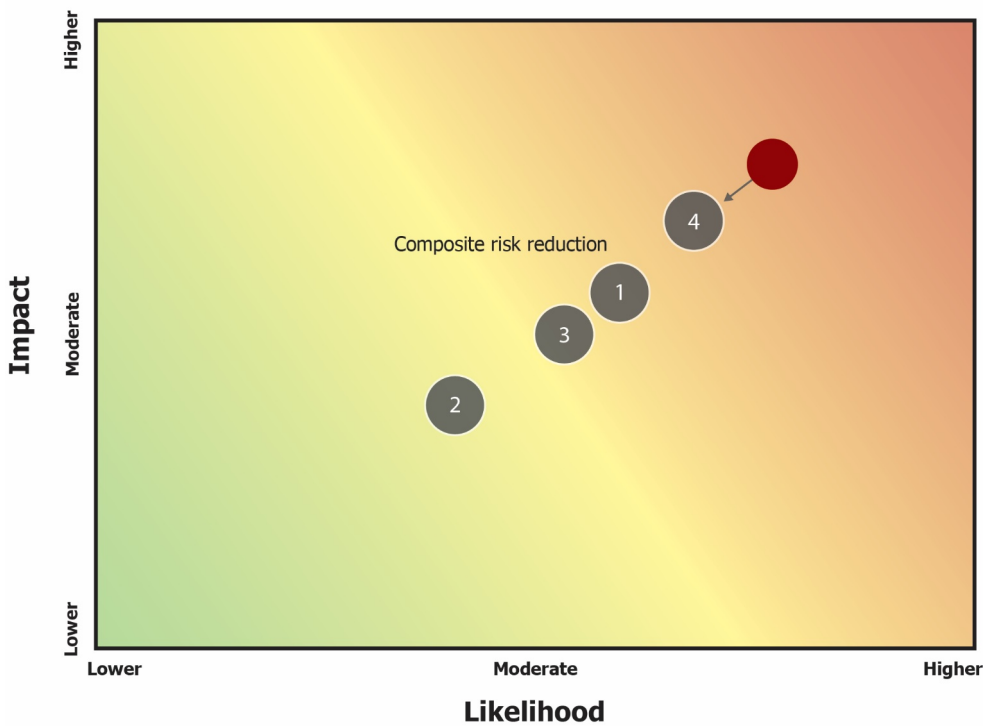
Prioritization of Inherent Priority Risks

the transformation can be met, while at the same time ensuring a reliable, secure, and resilient BPS.

The following graphics, [which are](#) based on the Emerging Risks Survey results [where respondents ranked the activities as still relevant, and high, medium or low with regard to Likelihood and Impact reduction, and then those results given and assigned numerical identifier to aid in the mapping, as well as](#) ~~and~~ input from the RISC, [are a visual demonstration of the](#) ~~demonstrates the~~ potential or actual effects that the mitigating activities from the 2019 RISC Report can have if implemented or did have when implemented on both the likelihood and impact of baseline risks. This can be used as a potential tool for industry to compare mitigating activities, their [individual](#) potential effects, and best use of resources and budget. In addition, these results assisted in the development of the recommended mitigating activities in this 2021 RISC Report as provided below.

In this and the subsequent charts, successful mitigating activities would result in the [activity risk](#) migrating away from the red area and toward the green area (as shown by the direction of the arrow). The numbers identify the mitigating activities themselves as listed in the key below the chart. By implementing successful mitigation activities, survey results should ideally confirm that both likelihood and impact of the risk is reduced.

Grid Transformation



Mitigating Risks Key

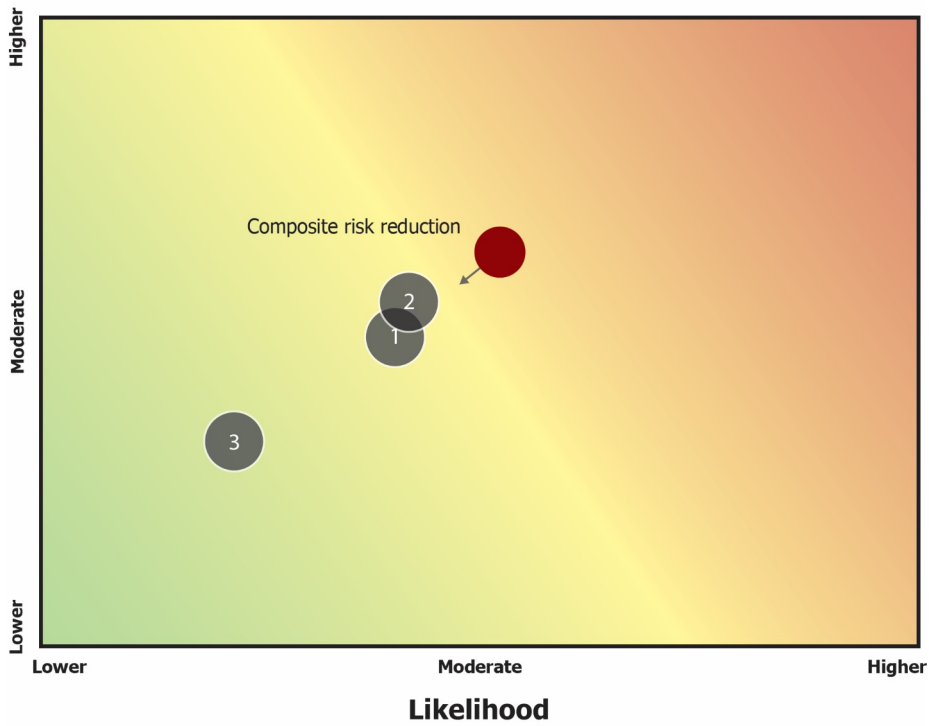
- 1 Update data, modeling and assessment requirements to ensure valid and accurate results given resource and grid transformation (ongoing effort).



Prioritization of Inherent Priority Risks

- 2 The technical committees should establish and implement an approach to evaluate the potential impacts of energy storage on reliability.
- 3 Improve inverter-based resource BPS interconnection and operation and stay abreast of new technologies, such as storage/hybrid resources.
- 4 Ensure sufficient operating flexibility at all stages of resource and grid transformation.

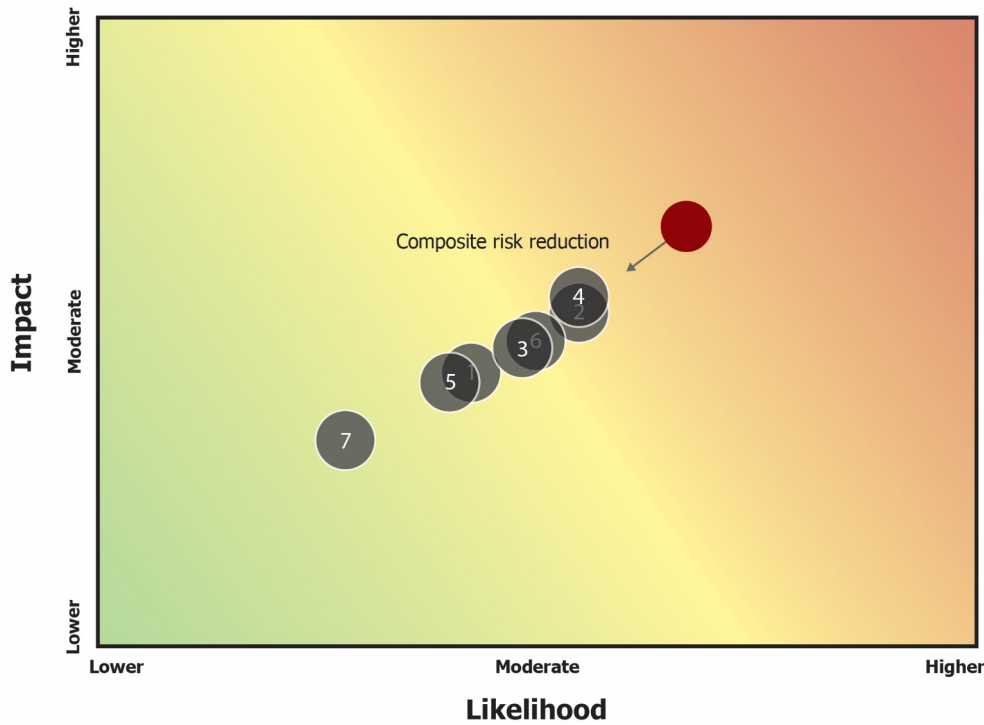
Extreme Events



Mitigating Risks Key

- 1 Special assessments of extreme natural event impacts, including capturing lessons learned, creating simulation models, and establishing protocols and procedures for system recovery and resiliency.²¹
- 2 Development of tools for BPS resiliency.
- 3 Understanding of Geomagnetic Disturbance (GMD) events on BPS.

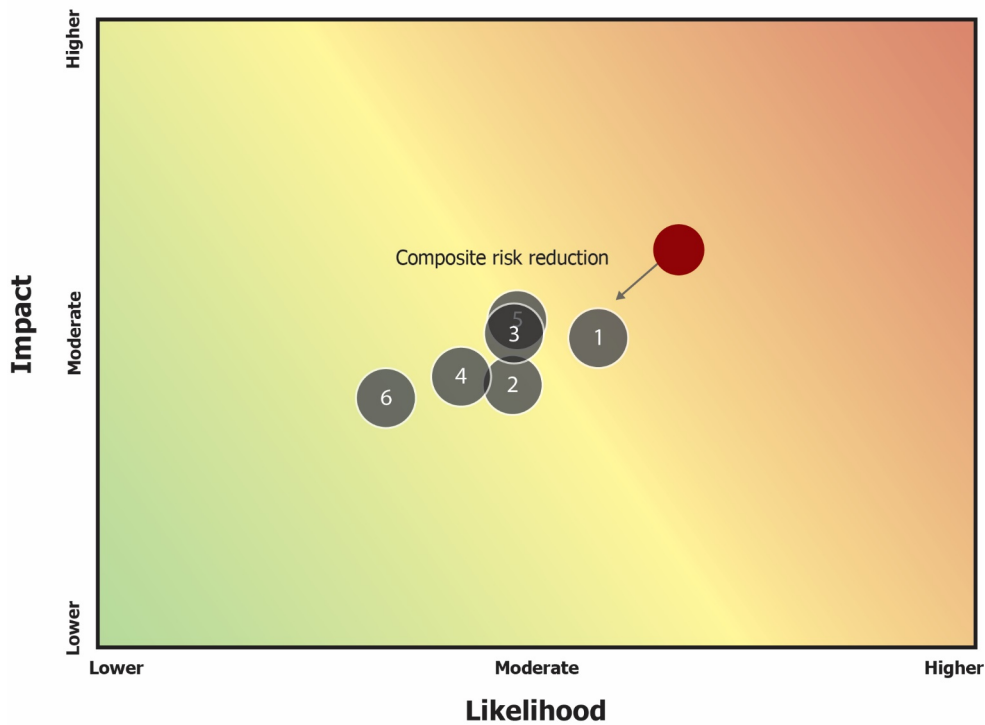
Security Risks



Mitigating Risks Key

- 1 NERC, in collaboration with industry, should evaluate the need for additional assessments of the risks of attack scenarios (e.g., vulnerabilities related to drone activity, attacks on midstream or interstate natural gas pipelines or other critical infrastructure).
- 2 The E-ISAC should encourage continued industry efforts on workforce cyber education to raise awareness of methods and tactics used by cyber attackers (e.g., email phishing, credential theft).
- 3 NATF and NAGF should develop supply chain cyber security superior practices.
- 4 E-ISAC should execute a long-term strategy to improve cyber and physical security information-sharing, protection, risk analysis, and increase engagement within the electric sector as well as with other ISACs.
- 5 NATF, NAGF, Trades Associations, and E-ISAC should develop tiered security performance metrics. Such metrics would track and evaluate events and use predictive analysis to identify and address prospective vulnerabilities on a risk prioritized basis.
- 6 NERC should facilitate the development of planning approaches, models, and simulation approaches that reduce the number of critical facilities and mitigate the impact relative to the exposure to attack.
- 7 NERC’s EMP taskforce should highlight key risk areas that arise from the EPRI’s EMP analysis for timely industry action.

Critical Infrastructure Interdependencies



Mitigating Risks Key

- 1 NERC, in collaboration with industry and industry partners, should identify and prioritize limiting conditions and/or contingencies that arise from other sectors that affect the BPS.
- 2 NERC and industry partners should host strategic interactions among critical infrastructure partners (e.g., industry and regulators) to identify and align on mutual priorities.
- 3 NERC and industry partners should increase emphasis on cross-sector considerations in industry drills (e.g., NERC Grid-Ex, DOE drills, utility exercises (e.g., Southern California Edison (SCE) Resilient Grid Exercise)).
- 4 NERC should evaluate the need to conduct special regional assessments that address natural gas availability and pipeline impacts under cyber and physical attack scenarios.
- 5 EPRI and the DOE should continue their work on communication alternatives but also the use of same or similar technologies for critical SCADA data. New technologies should be explored that could assist in providing unique and hardened back-up telecommunication methods for the most critical data.
- 6 NERC and industry partners should conduct various meetings and conferences to highlight the importance of cross-sector interdependence and coordination, such as the NERC Reliability Summit, NATF/EPRI resiliency summits, and FERC/DOE technical conferences.

Risk Profile #1: Grid Transformation



Statement of the Risk

Changes in generating resources, fuel sources and fuel deliverability, energy deliverability to the load, and load characteristics are accelerating, challenging the traditional methods of long-term planning, short-term planning and real-time operations.

Regulatory and socioeconomic policies for grid transformation have significantly increased since the prior report, initially driven by the decarbonization goals of states, utilities and customers. Now, the new federal administration appears likely to further accelerate the significant evolution of grid resources with infrastructure improvements. The shift away from conventional synchronous central-station generators toward a new mix of resources continues to challenge generation and grid planners and operators. This new paradigm of the resource mix includes natural-gas-fired generation; unprecedented proportions of non-synchronous resources, including renewables and battery storage; demand response; smart- and micro-grids; and other emerging technologies. Recent events have raised awareness of how extreme events and fuel supply interdependencies may result in energy sufficiency issues for all types of resources, and it becomes even more important to revisit resource adequacy concepts, modeling methods, operating practices, and the data that are needed for reliable planning both on generation and transmission, modeling and operation of the rapidly transforming grid. Looking forward, policy requirements to decarbonize the energy systems, changes in the economics of various energy sources, deployment of storage in many configurations, participation of distribution-connected resources and the aging of existing infrastructure will alter the nature and dispatch of generation, leading to further resource and grid transformation.

This transformation presents a number of potential challenges and opportunities when it comes to reliability of the BPS as detailed in the risk descriptors below. Grid transformation has broad implications across the other risk profiles, as it catalyzes other changes and often amplifies their effects. As such, while the grid transformation risks and recommendations are broad in nature, they provide a vital framework for all of the RISC recommendations in this report.

Descriptors of the Risk

- **Changing Resource Mix, Bulk Power System Planning, and Resource Adequacy and Performance**
 - **Resource Adequacy Assessment Scopes – Network Realities versus Political Boundaries:** Current resource planning and resource adequacy assessments are often performed with a limited scope (political or utility boundary) that does not take into account potentially significant electrical impacts and interactions due to the interconnected nature of the bulk grid outside of that limited scope. The result may be resource or energy or transmission capacity insufficiencies in operational timeframe.
 - **Consideration of Weather, Forecasting and Combined Effects:** With the changing resource mix, traditional analytical methods do not fully account for system characteristics associated with the uncertainty of variable resources, interactions of inverters and dynamic power system devices, declining performance of fossil fueled resources that are nearing retirement, uncertainties associated with emerging technologies, and increased sensitivity to widespread common weather such as extreme temperatures. The result may be resource, energy or transmission capacity insufficiencies in the operational horizon. Forecasts of weather and energy demand, and the implications of such forecasts on the increasingly interrelated combined effects with resources, fuel supplies and extreme events, must continue to be improved and advanced.
 - **Resource Adequacy does not necessarily equal Energy Adequacy:** Resource adequacy assessments have mostly focused on generation and transmission capacity available to serve peak demand. With the previous resource mix, real-time energy adequacy was assumed under that capacity umbrella and transmission was not highlighted as a requirement; however recent extreme temperature events have shown energy adequacy to be a new dimension of risk given the changing resource mix and actual performance of the grid versus assumptions used in previous resource mix studies.
 - **Potential Impact on Essential Reliability Services:** Transformation of the resource mix can alter the provision of and need for Essential Reliability Services and other ancillary services needed for BPS reliability and system operations, such as voltage control and reactive support, frequency response, and ramping/balancing. Restoration services, such as blackstart capabilities and procedures, could be affected as well. Organized and bilateral markets must recognize and incent resources which are capable of providing Essential Reliability Services to ensure reliable operations.
 - **Technology with Different Design and Performance Characteristics:** The continued integration of large amounts of new resource technologies (e.g., DERs, grid and distribution system-connected inverter-based resources, and energy storage) could lead to inaccurate forecasting of anticipated net demand. The dynamic and transient performance and response of these technologies also brings new challenges. Changing technology also has implications for control and protection systems complexity as is further described below.
 - **New Data and Information Requirements:** The need for data and information about new and changing resource characteristics must be incorporated into the long-term planning, operational planning, and operating time horizons. Further, this integration can also result in other planning and operational challenges if these resource additions are not observable or predictable or are otherwise not accounted for. Some of this new information will be from nontraditional sources (e.g., DERs and inverter operating parameters) that may present challenges to those responsible for incorporating the information into models representing future conditions.
 - **Energy Storage Technologies:** Storage capabilities and uses will likely transform both distribution and bulk system operations. Whether in combination with renewable or conventional resources and whether connected to distribution systems or the BPS, storage and hybrid technologies will further magnify the pace of innovation and the evolution of resource capabilities during both steady state and transient conditions.

- **Fuel Supply Considerations:** Fuel sourcing and disruption, such as from weather events and other extreme natural events, are driving new scenarios and case studies and broadening the range of dependencies for reliability planning and operations. Fuel constraints and environmental limitations might not be sufficiently reflected in current assessments of resource adequacy.
- **Resource Adequacy Elements Timeline Consideration:** In addition to fuel sourcing, other elements of resource adequacy (e.g., transmission development, generator retirements, pipeline construction, and environmental permitting, right away acquisition) may require long-lead time to assure future reliability and resource adequacy of the system. Various elements may also need to be carefully sequenced to ensure reliability throughout the transition, and the interrelated nature and contribution of transmission, generation and fuel sources must be appreciated and considered in resource adequacy assessments, timelines and deployments.
- **Ensuring Sufficiently Flexible Resources to Meet Demand:** With the expected volume of wind and solar resources and their characteristic fuel-driven commitment and dispatch capabilities, as well as the characteristics of other resources that may constrain their near-term ability to respond, sufficient amounts of flexible resources will be needed to meet demand when the less flexible resources are unavailable. The flexible resources will need to be dispatchable within the forecasting period of the fuel-driven or less flexible resources becoming unavailable.
- **Coordination of [Behind-the-Meter DERs](#) with the BPS:** Distributed generation, distributed storage and other DER technologies currently follow local interconnection requirements and operational protocols, posing potential challenges to the BPS from a planning and forecasting perspective as penetration levels increase.
- **Human Performance and Skilled Workforce:** The BPS is becoming more complex, and the industry will have difficulty staffing and maintaining necessary skilled workers as it faces turnover in technical expertise. The proliferation of entities providing services and grid transforming technologies will compete for available skilled workers
- **Loss of Situational Awareness:** Loss or degradation of situational awareness poses BPS challenges as it affects the ability of personnel or automatic control systems to perceive and anticipate degradation of system reliability and take preemptive action. Maintaining situational awareness will become increasingly complex as the numbers and types of resources expands from the Bulk Electric System to the distribution system.
- **Control and Protection Systems Complexity:** The interaction and performance of control systems during transient events, including the control systems in remedial action schemes (RAS) and other protection systems, must be understood to prevent new common-mode failures that may not have been anticipated (e.g., the inverter performance as demonstrated during the Blue Cut Fire and related events, misoperation of RAS logic and control systems, interdependencies of RAS operations in sequence and follow through).
- **Cybersecurity Risks:** With the expansion of resources and participants down to the consumer level, the number and types of Cybersecurity Risks will evolve and expand. Awareness of this threat, improved planning approaches to build in cyber robustness, and application of best practices will be necessary to promote reliable operations.

Recommendations for Mitigating the Risk

As a result of this complex set of factors, the traditional methods of assessing resource adequacy (i.e., by focusing primarily on generating capacity, transmission and pipeline capacity, and fuel availability at traditional peak load times) may not accurately or fully reflect the ability of the new resource mix to supply energy and reserves for all operating conditions. Historic methods of assessing and allocating ancillary services (e.g., regulation, ramping, frequency response, and voltage support during transient, recovery and follow through) may no longer ensure that sufficient Essential Reliability Services and contingency reserves are available at all times during real time, next hour, and next day operations. Balancing and ramping concerns that up to now have been largely confined to limited

locations will likely expand regionally as solar and wind generation continues to grow and provides a larger portion of the energy mix. Changes in resources will increasingly challenge concepts of available capacity in traditional integrated resource planning models and methods, likely leading to a need to revise resource adequacy, energy adequacy, and transmission adequacy concepts to assure reliability of the BPS in near-term to long-term planning horizons.

The combination of these many factors related to resource and grid transformation offer both challenges and opportunities as a result of the transformation and call for a planned set of NERC activities as described in the following action plan.

Resource and grid transformation will require new and updated tools, methods, and strategies that are used in planning, modeling, and operating the BPS. To best achieve those goals, the RISC encourages the following actions:

- **Ensure sufficient operating flexibility at all stages of resource and grid transformation:** System operators and planners should ensure sufficiently flexible ramping/balancing capacity is available as a tool to meet the needs of changing patterns of variability and new characteristics of system performance. Traditional concepts of resource adequacy may need to evolve to consider adequacy and flexibility during all hours, including consideration of correlated outages, transmission availability and common-mode fuel supply dependencies.
- **Update data, modeling and assessment requirements to ensure valid and accurate results given resource and grid transformation (ongoing effort):** The Reliability and Security Technical Committee (RSTC) should identify the information and modeling capabilities needed to ensure the efficacy of assessments while taking into consideration the complex and interrelated aspects of the ongoing transformation, including the evolving nature of resource adequacy itself. The ERO should continue to pay attention to settings of controllable devices, remedial action schemes, and power electronics installed to stabilize the system.
- **The RSTC should establish and implement an approach to evaluate the potential impacts and benefits of energy storage, hybrid/storage resources, aggregated DER resources and other emerging technologies on reliability:** Work with industry stakeholders to use available information and experience to support an evaluation of these rapidly emerging and evolving technologies. It is important that the operators of these emerging technologies participate in the ERO process to provide input and implement these recommendations, especially at the distribution level.
- **Improve inverter-based resource BPS interconnection and operation and stay abreast of new inverter technologies:** The ERO Enterprise should continue its effort to address the recommendations of the Inverter-Based Resource Performance Working Group (IRPWG).⁷ Ongoing advances in inverter technologies, including those resulting from encouraging work of the IEEE P2800 equipment standard and grid-forming inverter research, should also be reflected in ongoing efforts of the IRPWG and related aspects of the ERO Enterprise. With future adoption of technical guidelines and equipment standards, and soon with selective deployment of emerging grid-forming inverter technology when needed, inverter-based resources will make important contributions to BPS reliability during grid transformation.
- **The RSTC should develop methods, processes, tools, metrics, and/or standard authorization requests for development of new standards that are needed to address energy security. Development of methods, process, tools, metrics, and/or standards are needed to address energy security:** Recent experiences have demonstrated that capacity alone, given the grid transformation, is not sufficient to ensure sufficient energy is available to serve consumer needs. Capacity analysis is vital, but now must be buttressed with energy assessments to ensure that the system is planned and operated in a way that provides sufficient energy event during widespread, long duration extreme conditions.

⁷ [IRPTF Recommendations - https://www.nerc.com/comm/PC_Reliability_Guidelines_DL/Reliability_Guideline_IBR_Interconnection_Requirements_Improvements.pdf](https://www.nerc.com/comm/PC_Reliability_Guidelines_DL/Reliability_Guideline_IBR_Interconnection_Requirements_Improvements.pdf)

Risk Profile #2: Extreme Events



Statement of the Risk

Extreme events (e.g., storms, wildfire, extreme temperatures etc.) cause a significant proportion of major BPS impacts. For example, NERC's 2019 *State of Reliability* report⁸ noted weather was responsible for both Category 3 events (there were no Category 4 or 5 events) across the ERO Enterprise's footprint in 2018. Extreme weather events tend to be regional in nature. Natural events may affect BES-BPS equipment, resources, or infrastructure required to operate the BES-BPS. Certain events are unique to areas that they impact while others may occur in any area of the BPS. Extreme weather events historically have been regional in nature. Planning studies confined to regional boundaries may not account for events that cross regional boundaries. Recent cold weather events in ERCOT, MISO, and SPP, as well as heat events like 2020 California event, underscore that not only do extreme events pose challenges due to the nature and frequency of the extreme event itself, but that the grid transformation that is occurring also heightens the effects and complicates mitigation of an extreme event. Each type of event brings unique challenges from energy supply sufficiency, spare-parts availability, delivery, and restoration perspectives. Impacts from recent weather-related events have resulted in longer duration load loss, exacerbating human impacts due to the inability to access other needed critical infrastructure. Preparation and proactive planning of procedures and protocols are critical for utilities to assess and determine appropriate steps for both reliability and resiliency.

Other extreme events such as pandemics and threats to national security can pose challenges to grid reliability. Most notably, the Covid-19 Pandemic altered almost all aspects of management of the power grid in one way, shape, or form. For these reasons the 2021 Risk Report reflects this profile as Extreme Events rather than specifically to extreme natural events as identified in the 2019 Risk Report.

The performance and solutions relied upon historically are not always an indicator of future performance as events of the recent past and resulting outages indicate. The BPS now has new technologies and resources that have often times not experienced extreme weather phenomena in the quantities seen on the BES-BPS today. Further, the performance of the evolving resource mix appears to be more sensitive to extreme events.

While this does not signal that new technologies and resources are not capable of operating in extreme conditions, it does underscore the need for analysis as inverter based resources, distributed energy resources and behind the meter generation become more prevalent. The precise risk of these having widespread impacts cannot yet be proven because the full penetration of these resources is yet to be realized. However from a planning and preparation perspective these cannot be ignored. Other risks described in this report can be "driven" by extreme events. Grid Transformation, Cyber Threats, and Critical Infrastructure Interdependencies all have underlying issues that can be exacerbated with the advent of extreme events.

⁸ https://www.nerc.com/pa/RAPA/PA/Performance%20Analysis%20DL/NERC_SOR_2019.pdf

Descriptors of the Risk

Various North American regions routinely incur severe events, such as hurricanes and extreme cold weather. While the risk of these events in those regions is high, the relative impact on the BPS is low. See the following examples:

- **Hurricanes:** They can cause widespread destruction to BPS equipment, degradation of communication capabilities, loss of load, and damage to generation resources. Recovery and restoration efforts can be hampered due to the size or scope of the storm and damage to interdependent infrastructure.
- **Tornados/Derecho:** They can cause localized destruction to BPS equipment, local degradation of communication capabilities, loss of load, and damage to generation resources. Recovery and restoration efforts can be hampered due to local damage to interdependent infrastructure
- **Extreme Heat and Drought:** They can cause higher than anticipated demand, overloading and failure of BPS equipment, and degradation of resource availability. There can be limited water available for operating hydroelectric generation or reduced cooling water capacity. Drought can also be a precursor to wild fire risk as described in the next bullet.
- **Wild Fires:** They can be a direct threat to BPS equipment. Pre-emptive actions must be taken to de-energize equipment without causing additional cascading effects in areas where wild fire risk is significant.
- **Flooding:** This can occur in any area and in any season of the year. The impacts from flooding include mechanical damage to BPS equipment, degradation of clearances, fuel infrastructure, personnel access, and communications capabilities.
- **Extreme Cold Weather (Polar Vortices):** This can cause higher than anticipated demand, overloading and stress failure of BPS equipment, increased reliance on interdependent critical infrastructures, and degradation of energy availability via resource mechanical failure or fuel supply interruption.
- **Ice Storms:** They can be a direct threat to BPS equipment. The impacts from these storms, combined with high winds, include infrastructure damage, personnel access and communication capabilities.

Other types of severe natural events, though less likely, could have a higher impact given the potentially broader geographic footprint. See the following examples:

- **Earthquakes:** These are possible in many areas of the United States and Canada. Depending on the scope and magnitude of the event, mechanical damage may occur to BPS facilities and interdependent critical infrastructure (e.g., communications, fuel, transportation). The duration to recover from earthquakes could be long, and further assessment and coordination is required among utilities and the ERO Enterprise.
- **Geomagnetic Disturbances:** These can induce harmonic currents in BPS circuits and equipment. In addition the impacts of these disturbances result in induced currents that may overheat of transformers, result in relay misoperations, and increased reactive demand or damage to reactive resources. GMD events can also affect communications capabilities, fuel delivery, and GPS systems.
- **Pandemics:** The Covid19 Pandemic forever altered the way the BPS is operated. Effective telecommuting and cloud-based data exchanges enabled the grid to almost seamlessly continue reliable operation, resulting in no major disruptions to power deliveries. However, this new paradigm also underscores the necessity to maintain proper controls and protocols for security around both systems and human capital.
- **National Security Risks:** Civil unrest, riots, and other events could create potential issues around physical security of the BPS as well as safety of critical personnel necessary to carry out the actions needed to maintain the reliable operation of the BPS.

Recommendations for Mitigating the Risk

Extreme events and their potential impacts on BPS reliability should be monitored and addressed to maintain reliability and improve resiliency. Based on uncertainties predicting some events, it is important for operations and

planning personnel to remain vigilant and prepare for high-risk seasons by learning from prior events, practicing recovery efforts, and anticipating impacts of an event to critical infrastructure. Seasonal reliability assessments should consider how more prolonged and widespread natural events may stress the system. Sufficient capacity and energy is needed to prepare for, operate, or when necessary, restore the BES. NERC and industry have taken actions to mitigate some of these risks by recent efforts in developing a Cold Weather standard for generators, the development of a joint NERC/WECC guide on effective management of wildfire, and the formation of the Energy Resource Adequacy Task Force. Further, certain regions may become more dependent on neighboring regions if greater than anticipated forced generator outages occur. These dependencies should be identified.

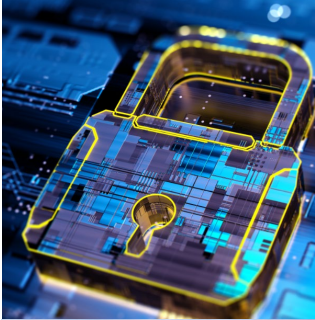
In order to continue the efforts toward mitigating the effects of extreme events, the RISC encourages the following actions:

- **Special assessments of extreme event impacts, including capturing lessons learned, creating simulation models, and establishing protocols and procedures for system recovery and resiliency:** The ERO Enterprise should conduct detailed special assessments of extreme event impacts by geographical areas that integrate the following:
 - Critical Infrastructure interdependencies (e.g., telecommunications, water supply, generator fuel supply)
 - Analytic data and insights regarding resilience under extreme events

Based on those assessments, the ERO Enterprise should develop detailed special assessments on possible mitigation plans and provide a roadmap for their implementation. The roadmap should include specific protocols and procedures for system restoration and system resiliency.

- **Development of tools for BPS resiliency:** The Department of Energy (DOE) is in [the](#) process of developing the North American Energy Resiliency Model (NAERM) to evaluate both static, dynamic, and real time scenarios that affect grid reliability. NERC should continue to work with DOE on this effort to ensure a robust tool that can be used industry wide to evaluate potential threats to generation, transmission, and fuel supplies.
- **Understanding of Geomagnetic Disturbance (GMD) events on BPS:** The ERO Enterprise should assist the industry to implement the necessary protocols and mitigation plans to reduce the risk and maintain reliability and security for the BPS.
- **FERC/NERC joint inquiry on cold weather outages in ERCOT, MISO, SPP:** The ERO Enterprise should continue to work with FERC to better understand the root causes of the cold weather outages in ERCOT, MISO, and SPP. Actions in the final report, when released, should be implemented and facilitated by NERC and the ERO. NERC should conduct analysis to determine the effects of the existing cold weather event to other cold weather events in the past, taking into account the difference in the resource mix over time and the performance of those resources during these widespread extreme temperature events.
- **Regional coordination:** States should meet, discuss, and understand impacts to ensure a part of the resiliency discussion. This coordination will ensure the acknowledgement of roles in understanding the impacts and implementing mitigating activities.
- **Industry forums** should share and coordinate information sharing on best practices around resiliency efforts related to design considerations and identification and response to major storm events. Sharing experiences and best practices is critical.

Risk Profile #3: Security Risks



Statement of the Risk

Operational security is an essential element of a highly reliable BPS (BPS). Cyber and physical security are interdependent aspects, as exploitation of either physical or cyber security vulnerabilities could be used to compromise the other dimension. Resultant impacts could cause asset damage, functionality loss, or limit the situational awareness needed to reliably operate or promptly restore the BPS. Additionally, the operational and technological environment of the BPS is evolving significantly and rapidly, potentially thereby increasing the potential cyberattack surface. Sources of potential exploitation include increasingly sophisticated attacks by nation states, terrorist, and criminal organizations. Vulnerability to such exploits are exacerbated by insider threats, poor cyber hygiene, supply-chain considerations, and dramatic transformation of the grid's operational and technological environment. These transformative changes include convergence of information and operational technology (IT/OT), reliance on cloud-based technology, and potential workforce knowledge gaps. Additional automation and integration of OT networks is increasing the attack surface of cyber risk, while the use of cloud-based hosting or services introduces the risk of code and/or data breach vulnerabilities through the use of third party software and/or hardware.

Exploitation could occur directly against equipment used to monitor, protect, and control the BPS or indirectly through supporting systems, such as voice communications or interdependent critical infrastructure sectors⁹ and subsectors (e.g., water supply and natural gas used for electrical power generation). A coordinated cyber and physical attack scenario that is, potentially targeted to occur simultaneously with an extreme natural event, could further impact reliability and/or complicate recovery activities. A man-made electromagnetic pulse (EMP) event targeted at the BPS may impact operations and result in damaged equipment that may require extensive time to replace

⁹ <https://www.dhs.gov/cisa/critical-infrastructure-sectors>

The following graphic, based on the Emerging Risks Survey results, as well as input from the RISC, demonstrates the potential effects that the mitigating activities from the 2019 RISC Report can have on both the likelihood and impact of baseline risks and can be used as a potential tool for industry to compare mitigating activities, their potential effects, and best use of resources. In addition, these results assisted in the development of the recommended mitigating activities provided below.

Descriptors of the Risk

Whereas the incidence of both cyber and physical security attacks specifically targeted against the BPS have to date not shown any clearly increasing trend, recent threats in other industries underscore a need for increased vigilance and a much more concerted effort to develop counter- measures to prevent and/or recover from more serious attacks against the electric industry.

- **Physical Security Risks:** The nature and impact of physical vulnerabilities are better understood than other security risks (e.g., cyber or EMP). The impacts from significant physical attacks are likely to be more localized geographically. There is modest, ongoing evolution of the physical security risk via drones. The largest risk considerations are considered to be the co-dependence with cyber security (e.g., computer controls for physical access) and the prospective impact of replacing long lead-time equipment (e.g., large power transformers) damaged during an attack.
- **Cyber Security Risks:** Exploitation of cyber security risks could arise from a variety of external and/or internal sources. Additionally, the operational and technological environment of the electrical grid is evolving significantly and rapidly, potentially increasing the potential cyberattack-surface. Sources of potential exploitation include increasingly sophisticated attacks by nation states, terrorist, and criminal organizations. Vulnerability to such exploits are exacerbated by insider threats, poor cyber hygiene, supply-chain considerations, and dramatic transformation of the grid's operational and technological environment. These transformative changes include convergence of information and operational technology (IT/OT), increasing reliance on cloud-based technology, and potential workforce knowledge gaps.
 - Potential for increasing cyber attacks across all sectors: The [2020 SolarWinds](#) and [2021 Colonial pipeline attacks that occurred in 2020](#) accentuate supply chain vulnerabilities as well as threats from both foreign actors and domestic adversaries.
 - Artificial Intelligence and Machine Learning can also be used as tools that cyber criminals employ.
 - The potential trend toward virtualization and the housing of critical systems in the cloud could expose the electric industry to additional risks for which industry must both account and plan.
 - Supply chains are a targeted opportunity for nation states, terrorists and criminals to penetrate organizations without regard to whether the purchase is for IT, OT, software, firmware, hardware, equipment, components, or services.
- **Electromagnetic Pulse Risk:** An EMP is a short-duration, high-energy burst that may be disruptive or damaging to electronic equipment. For security purposes, EMP refers to man-made sources. A high-altitude EMP (HEMP) is an electromagnetic pulse stimulated by a nuclear blast in the atmosphere and such action would likely be initiated by a nation-state and thus have clear national security implications. HEMP concerns include the large geographic footprint susceptible to the pulse, range of electric grid equipment at risk (generation, transmission, distribution, and load), and lack of definitive forewarning. Smaller, handheld devices are relatively limited in potential impact and can be considered analogous to the physical attack vector.

Recommendations for Mitigating the Risk

- NERC should facilitate the development of planning approaches, models, and simulation approaches that reduce the number of critical facilities and mitigate the impact relative to the exposure to attack.

- NERC, in collaboration with industry, should evaluate the need for additional assessments of the risks from attack scenarios (e.g., vulnerabilities related to drone activity, attacks on midstream or interstate natural gas pipelines or other critical infrastructure).
- NERC has been conducting an annual industry exercise, GridEx, which helps industry both prepare and react to potential BPS security threats. GridEx, a distributed play grid exercise that enables participants to engage remotely, simulates a cyber and physical attack on the North American electricity grid and other critical infrastructure. Led by NERC's E-ISAC, GridEx gives participants a forum to demonstrate how they would respond to and recover from coordinated cyber and physical security threats and incidents. Other activities that NERC and the E-ISAC have undertaken include enhancements to the Cybersecurity Risk Information Sharing Program (CRISP) as well as outreach transcending borders and industries. NERC should expand the scope of GridEx to include and collaborate with cross-sector industries such as natural gas, telecom, and water.
- The Electricity Information Sharing and Analysis Center (E-ISAC) should encourage continued industry efforts on workforce cyber education to raise awareness of methods and tactics used by cyber attackers (e.g., email phishing, credential theft).
- E-ISAC should execute a long-term strategy to improve cyber and physical security information-sharing, protection, risk analysis, and increase engagement within the electric sector as well as with other ISACs.
- NATF and NAGF should develop supply chain cyber and apply security superior practices. NATF has developed and publicly issued supply chain cyber security framework and detailed criteria that envelops applicable NERC standards and maps to existing security frameworks used by many vendors. NATF is leading an Industry Organizations Team (IOT) comprised of electric utilities, vendors, and solution providers to help promote convergence on the use to the criteria and framework.
- Supply chain risk management and the threats from components and sub-components developed by potential foreign adversaries should continue to be addressed by NERC and industry with evaluation of CIP-013 standard for any needed improvements.
- [Many additional efforts to develop cyber security tools are underway with NATF and Trade Associations. For example in 2020, both the American Public Power Association \(APPA\) and National Rural Electric Cooperative Association \(NRECA\) entered into new three-year cooperative agreements with the Department of Energy \(DOE\) to develop and deploy operational technology \(OT\) cybersecurity technologies to public power and cooperative utilities. NRECA, with previous funding from the DOE, has developed a set of tools \(Essence 2.0\) that will help utilities rapidly identify cyber security threats in OT systems. These types of efforts should continue. Many additional efforts to develop cyber security tools are underway with NATF and Trade Associations. For example in 2020, American Public Power Association \(APPA\) entered into a new three-year cooperative agreement with the Department of Energy to develop and deploy operational technology \(OT\) cybersecurity technology to public power utilities. These type of efforts should continue.](#)
- NATF, NAGF, Trades Associations, and E-ISAC should develop tiered security performance metrics. Such metrics would track and evaluate events and use predictive analysis to identify and address prospective vulnerabilities on a risk-prioritized basis. Security metrics are included in NATF 2021 work plan.
- NERC's EMP taskforce should highlight key risk areas that arise from the EPRI's EMP analysis for timely industry action.

Risk Profile #4: Critical Infrastructure Interdependencies

Statement of the Risk

Significant and evolving critical infrastructure sector (e.g., communications, water/wastewater, financial) and subsector (e.g., oil, natural gas) interdependencies are not fully or accurately characterized, resulting in incomplete information about prospective BPS response to disruptions originating from or impacting other sectors or subsectors and resultant reliability and security implications. Further, as there is increasing interdependencies between these critical infrastructures, impacts on one can have a rippling effect on another.

The following graphic, based on the Emerging Risks Survey results, as well as input from the RISC, demonstrates the potential effects that the mitigating activities from the 2019 RISC Report can have on both the likelihood and impact of baseline risks and can be used as a potential tool for industry to compare mitigating activities, their potential effects, and best use of resources. In addition, these results assisted in the development of the recommended mitigating activities provided below.



Descriptors of the Risk

- Recent BPS events have highlighted that sector interdependence is becoming more critical particularly during emergency events. Digital communications for electric system protection and control, and voice communications, particularly cellular, for emergency response and restoration are critical. Remote work arrangements by critical electric sector employees further underscores the need for seamless and uninterrupted communications during emergency events.
- Subsector interdependence continues to increase and has reached an inflection point with the natural gas subsector. Growing reliance on natural gas as an electrical generation fuel source creates the potential for common-mode failures that could have widespread reliability impacts. The dependence of BPS reliability on natural gas-fired generation does not align with service priorities within the natural gas delivery system and weatherization requirements for gas gathering and delivery systems. Furthermore, the natural gas delivery system depends on reliable electric service to deliver natural gas at acceptable pressures, and the foreseeable growth and dependence of BPS reliability on natural gas-fired generation does not align with the expected pace of pipeline development.
- The financial sector could also be impacted by major outages resulting in failure to approve everyday transactions and provide the necessary financial capital needed to ensure restoration.
- Cross-sector and subsector implications and coordination are not routinely socialized or thoroughly tested during drills or fully understood by both industry participants and regulators
- State and federal governmental oversight and regulatory constructs differ widely among the sectors and subsectors, impeding information sharing and alignment on the criticality of service.
- Grid Transformation also plays a significant role in evaluating critical infrastructure interdependencies. A grid that relies more on renewables and natural gas with less coal and nuclear may face different challenges. Furthermore, the reaction to extreme events that may have been managed in a particular way given the old resource paradigm must now be managed under an entirely different set of circumstances.
- [The electric](#) subsector is dependent on other infrastructures such as water, sewer, transportation roads, and communications. If they become unavailable due to widespread power outages [this](#) could impact the reliable operation of the BPS. Furthermore, electrified transportation will be challenged to bring materials, supplies and equipment supplies to areas with widespread outages (e.g. after a hurricane) which could hamper restoration efforts.

Recommendations for Mitigating the Risk

- NERC, in collaboration with industry and industry partners, should identify and prioritize limiting conditions and/or contingencies that arise from other sectors that affect the BPS.
- NERC and industry partners should host strategic interactions among critical infrastructure partners (e.g., industry and regulators) to identify and align on mutual priorities.
- NERC and industry partners should increase emphasis on cross-sector coordination in industry drills (e.g., NERC Grid-Ex, DOE drills, utility exercises (e.g., Southern California Edison (SCE) Resilient Grid Exercise)).
- NERC should conduct special assessments that address natural gas availability and pipeline common mode failures.
- Electric and natural gas sub-sectors should create and enforce weatherization standards.
- EPRI and the DOE should continue their work on communication alternatives but also the use of same or similar technologies for critical SCADA data. New technologies should be explored that could assist in providing unique and hardened back-up telecommunication methods for the most critical data.

- NERC and industry partners should conduct various meetings and conferences to highlight the importance of cross-sector interdependence and coordination, such as the NERC Reliability Summit, NATF/EPRI resiliency summits, and FERC/DOE technical conferences.
- NERC should communicate to every state and federal regulator of natural gas of the critical interdependence of this fuel source with the other infrastructure sectors.
- NERC should communicate to every state the need for their intrastate gas infrastructure to explicitly classify power generation Firm Transportation services as critical and ensure its curtailment prioritization is ahead of non-essential Firm Commercial and Industrial gas loads.
- NERC and industry partners should evaluate voice communication interdependencies and strategies for ensuring continuous communications during an emergency event particularly as remote working arrangements grow.
- NERC and industry partners should evaluate processes and assumptions around identification of critical loads in load shed and load restoration plans.
- NERC and registered entities should develop and study extreme event scenarios under a future resource mix to ensure that both generation and transmission systems can ensure energy delivery is adequate to meet peak conditions in extreme event scenarios, also taking into account the interdependencies between power and other industries that may pose challenges.
- NERC and industry should consider the unavailability of other infrastructures such as water, sewer, roads, and communications in their emergency plans.
- NERC and industry should develop seasonal extreme temperature energy management plans along with rolling 21-day operational planning plans that accommodate the ongoing weather forecasts and projections.

Draft 2021 ERO Reliability Risk Pr	
Instructions	<p>Please use this form to submit comments on the draft 2021 ERO Reliability Risk Priorities Report. Comments must be submitted within the review period below to tina.buzzard@nerc.net with the words "2021 ERO Reliability Risk Priorities Report Comments" in the subject line. Only comments submitted in this Microsoft Excel format will be accepted. Both general and specific comments should be provided within this form.</p> <p>Comments may be submitted by individuals or organizations. Please provide the requested information in Row 6. If comments are submitted on behalf of multiple organizations, list all organizations in Row 6. Please provide the Industry Segment and Region (if applicable) in Rows 7 and 8 and provide the requested contact information in Rows 9 and 10.</p> <p>If you have any questions regarding this process, please contact Tina Buzzard.</p>
Review Period	June 9 - June 23, 2021

Name of Individual or Organization(s) (list multiple if submitted by a group):	
Industry Segment (if applicable):	
Region (if applicable):	
Contact Telephone	
Contact Email	

Organization(s)	Chapter	Page Number	Comment	Proposed Change	Response
Marc Child, Great River Energy	Risk Profile #3: Security Risks	31	Bullet #7 mentions an example of APPA partnering with DOE. The cooperative community was also part of that partnership.	Many additional efforts to develop cyber security tools are underway with NATF and Trade Associations. For example in 2020, both the American Public Power Association (APPA) and National Rural Electric Cooperative Association (NRECA) entered into new three-year cooperative agreements with the Department of Energy (DOE) to develop and deploy operational technology (OT) cybersecurity technologies to public power and cooperative utilities. NRECA, with previous funding from the DOE, has developed a set of tools (Essence 2.0) that will help utilities rapidly identify cyber security threats in OT systems. These types of efforts should continue.	change made
SEPC	Risk Profile #2: Extreme Events	28	We noticed a misleading statement in the instructions and questions tab. The instructions state "The SOR focuses on bulk power system (BPS) performance during the prior complete year...." We feel this report goes beyond the prior complete year. On page 28 of the report we noticed that "FERC/NERC joint inquiry on cold weather outages in ERCOT, MISO, SPP" that occurred in 2021 was included as an inject to the report.	Instructions should align with the actual content.	no change. The Instructions tab in the comment form template was from the SOR comment form and should have been deleted - was not related to the RISC report.
Andrea Koch EEI	Background and Introduction	8	EEI recommends adding information at the end of the first paragraph clarifying that the remainder of the section is the Framework to Address Known and Emerging Reliability and Security Risks document.	Add - The RISC and RSTC leadership developed the Framework to Address Known and Emerging Reliability and Security Risks ("Framework") to document the process, and the Framework is below.	no change - though most of the section is from the framework additional summarizing was added just for the RISC report.
	Inputs to the Risk Profiles	16	The diagram on page 16 shows Control and Protection Systems Complexity moved from "Monitor" in 2019 to "Manage" in 2021. Should the diagram still show a status of "Monitor" for 2021?	Change "Manage" to "Monitor"	change made
	Risk Groupings	17	There is a statement that variable resources are more susceptible to extreme weather. EEI recommends refining the statement by adding information that variable resources that are dependent on wind and sun, for example, and can be more impacted than traditional generation during certain weather conditions.	Add information that variable resources that are dependent on wind and sun, for example, and can be more impacted than traditional generation during certain weather conditions.	change made
	Risk Groupings	18	Second paragraph, first sentence "In this and the subsequent charts, successful mitigating activities would result in the activity migrating away from the red area..." EEI recommends changing the word "activity" to "risk" to state that risk would migrate away from the red area of the heat map.	Change the word "activity" to "risk".	change made
	Risk Groupings	18	Regarding the Heat Maps (pages 18 – 21), EEI suggests adding additional clarification that the heat maps are a visual aid to show the general level of risk and likely direction (impact and likelihood) of that risk if the proposed mitigations were implemented.	Add clarification that the heat maps are a visual aid to show the general level of risk and likely direction (impact and likelihood) of that risk if the proposed mitigations were implemented.	change made
	Risk Groupings	18 - 21	It is not clear as to whether industry should take the Mitigating Risks Key items sequentially, selectively, or cumulative. For example, on the "Critical Infrastructure Interdependencies" (page 21 of the report), does the risk reduce to the lowest level (level 6) by simply adopting Mitigating Risks Key #6, or does the industry have to perform all Mitigating Risks Keys 1 through 6 to reduce the risk to the lowest level (the level shown in circle 6). NERC should clarify this for the graphs, so industry will know how to best evaluate the Mitigating Risks Keys.	Clarify the graphs to address whether industry should take the Mitigating Risks Key items sequentially, selectively, or cumulative.	change made- added emphasis of "individual"
	Risk Groupings	21	Item #4, EEI recommends adding collaborating with gas industry groups when evaluating and potentially conducting the assessment.	Add collaborating with gas industry groups when evaluating and potentially conducting the assessment.	no change made- can look to change for 2022 survey - this information not editable as its taken directly from the 2020 survey
	Risk Profile #1	24	EEI recommends removing the language "behind the meter". The focus should be on DERs.	Remove "behind the meter".	change made
Risk Profile #3 and #4	30 and 32	"The following graphic..." paragraph on pages 30 and 32 no longer align with the sequencing of the RISC graphics and should be deleted.	Delete "The following graphic..." paragraph on pages 30 and 32.	change made	
General		EEI supports the four evolving risks areas identified in the report.		Thank you!	
ISO-NE	General	General	Throughout the report 2019 Risk Report items were mentioned as removed. While the projects and/or monitoring are still on-going these items may be better served in an "on-going" or "current" section. By removing these items from this report there are now two reports that may need to be reviewed instead of one. Human Nature can show that individuals may not review the last report in addition to any newly released report.	Where applicable add details from the 2019 RISC Report.	no change made - This report builds on the 2019 report and the reflective changes/carry overs.
ISO-NE	Risk Profile #2, Extreme Events	26-28	Recent Cold weather events in the Southeast have shown the industry the importance of extreme weather preparations, however even this week ERCOT has issued a conservation request for the extreme hot weather. The modifications to the IRO-010/TOP-003/EOP-011 have been focused on Cold Weather, and while very important, severe hot weather events seem to occur more frequently in more regions.	Suggest a greater emphasis on both hot and cold weatherizations. Although these events do fall within the Emergency Operations and should be included in any Emergency Operating Plans in accordance with EOP-011.	no change made - Believe this is covered in current content - specific cold weather inquiry acknowledgement is needed based on anticipated actions from the final report to be completely by industry
ISO-NE	Risk Profile #3, Security Risks	Top Page 30	"The following graphic" is the first 3 words on page 30, however there is no graphic associated with this section. This paragraph is the same as the paragraph on the bottom of page 17. It may be a copy and paste error?	Remove the paragraph as it is a repeat from the Risk Groupings section with the graphics on the bottom of page 17.	change made
ISO-NE	Executive Summary	5	Why don't you list the 4 Risk Profiles in the Executive Summary in bullet form with reference page numbers so that the reader would know what they are and go to the right location in the report for details, if so desire.		no change made - table of contents provides the links
ISO-NE	Executive Summary	5	Why not reference the 2020 State of Reliability Report instead of referencing the 2019 report?	Footnote 2 – should reference the 2020 State of Reliability Report (https://www.nerc.com/pa/RAPA/PA/Performance%20Analysis%20DL/NERC_SOR_2020.pdf) instead of the 2019 report. Please note that the current title "2019 State of Reliability Report" is incorrect.	change made
ISO-NE	Background and Introductions	7	The first sentence of the fourth paragraph which read "The RISC participants include representatives from the NERC committees, the Member Representative Committee, and "at large" industry executives." should be relocated to page iv, which describes the Reliability Issues Steering Committee.		no change made

ISO-NE	Background and Introductions	7	The link to the minutes from the Board's February 7, 2013 meeting does not work.	provide the correct link.	change made - link removed as minutes only go back to 2015 on website now based on current NERC website protocols
ISO-NE	Input to the Risk Profiles	14	In the middle of the second paragraph, there is the verbiage "impacts that could cause assess damage" that does not sound right.		change made - removed assess
ISO-NE	Risk Profile # 3	30	The attack on the Colonial Pipeline occurred in 2021.		change made
ISO-NE	Risk Profile #1	23	Under Resource Adequacy does not necessarily equal Energy Adequacy what do you mean by "transmission was not highlighted as a requirement"?	Suggested replacement for the language to the left to get away from asking a question. Under Resource Adequacy does not necessarily equal Energy Adequacy, it is not clear what is meant by "transmission was not highlighted as a requirement". Further explanation would be helpful.	no change made - feel the context is explanatory and clear
ISO-NE	Risk Profile #4	32	The graph mention in the first sentence of the second paragraph is missing.		change made
ISO-NE		20	missing open parenthesis in risk key 1		change made
ISO-NE		19	There is a single quotation mark at the end of risk key 1		change made
ISO-NE	Risk Profile #4	33	In the last bullet under descriptors of risk, there is a sentence that appears to be missing a word where brackets have been added: If they become unavailable due to widespread power outages { } could impact the reliable operation of the BPS.		change made
Capital Power	General		<p>Capital Power is an Independent Power Producer with diverse fuel generating facilities across Canada and the United States. On behalf of our fleet, Capital Power's centralized compliance team engages with, relies heavily on, and is appreciative of, NERC stakeholder consultation opportunities and reliability awareness events and materials. To this end, we appreciate the opportunity to provide feedback on the 2021 DRAFT ERO Reliability Risk Priorities Report. As we are offering general feedback vs. discrete feedback centered on a specific page, we have formatted our response in email vs. using the excel template.</p> <p>Recommendation / Observation #1: Risk Assessment With Clear CMEP Alignment</p> <p>In general, Capital Power uses the ERO Reliability Risk Priorities report (alongside other NERC and industry materials and events) as part of our external monitoring program which informs our compliance program as well as some of our operating and security decisions. While we understand that the ERO Risk Priorities Report is forward looking, we would like to see the report evolve into one that more clearly links the inherent risks, existing mitigations (including existing standards, task forces, guidelines etc.), residual risks, gaps and mitigation recommendations. We believe that contextualizing the risks and against existing mitigations and recommended mitigations more holistically represents the true current and future risk to the grid and may allow industry to better assess and gage their response. This alignment would also be useful in connecting the ERO Reliability Risk Priorities report to CMEP activities, which would directly support the ERO Enterprise Long Term Strategy Focus Area of: Expanding Risk-Focus in Standards, Compliance Monitoring, and Enforcement.</p> <p>For reference, Capital Power offers an example of a CMEP that is very clearly aligned with the risk element outcomes resulting from previous risk priority studies: LINK</p>	<p>Recommendation / Observation #2: Clear Identification of Primary / Secondary / Tertiary Mitigation Strategies</p> <p>Capital Power applauds the RISC membership in not only the identification, consolidation, and communication of critical grid reliability risks but also in the preparation of well-thought out mitigation recommendations. Capital Power notes that, although the Risk Framework (pg. 10) indicates that Reliability Standards, with Compliance and Enforcement are appropriate mitigations for higher risk areas, very few of the current mitigation strategies recommend new or revised mandatory Reliability Standards. Instead, the report offers many valuable, though not enforceable, recommendations largely focused on vigilance and collaboration by industry and industry groups. While Capital Power recognizes the value, and actively engages in, voluntary collaborative activities (i.e. NAGF, NERC Stakeholder Engagement events, GridEX etc.) this is not an consistent option for all entities. Pragmatically, like NERC, many entities employ a risk based approach to compliance and prioritize resources on high risk areas – which, theoretically, should somewhat align with mandatory Reliability Standards (pg. 10). However, because this report does not contextualize the risks against existing primary mitigations (i.e. Reliability Standards), the perception may be that the recommended secondary and tertiary mitigations (i.e. best practices) are the only / best course of action to address the risk. As a result entities, may redirect limited resources to the recommended risk mitigation strategies which could compromise focus on higher risk areas supported by mandatory reliability standards. Given this risk, Capital Power recommends the clear identification of primary, secondary and tertiary risk mitigation strategies such that entities are better able to direct their risk based compliance programs.</p> <p>Related to this recommendation, where secondary and tertiary mitigation strategies (i.e. best practices) are being recommended in response to ineffective, or absence of, mandatory Reliability Standards, Capital Power recommends the inclusion of appropriate risk analysis and mitigation recommendations (i.e. recommended mitigation: revise standard XYZ to more appropriately address risk ABC).</p> <p>Though Capital Power has offered some recommendations for consideration, we want to reiterate our appreciation of NERC's commitment to the generation of resources such as this as well as the opportunity for consultation. Our program is significantly shaped by these valuable resources and engagement opportunities, and as a result, we are better able to do our part in improving the reliability, resiliency, and security of the bulk electric system.</p>	no change made - Thank you for the general comments and the RISC will be review and consider appropriate actions within its scope and coordination with the RSTC.
David Jacobson (RSTC Member)		Page 11	Category 3 or higher	Suggest adding a footnote to point to the 2021 State of Reliability report, for example, for a description of Category 1-5 events.	change made
David Jacobson (RSTC Member)		Page 11/12	Step 5: Measurement of Success/Step 6: Monitoring Residual Risk	Does the ERO plan to develop a separate report that documents these two steps in the risk management process or will they be documented in the RISC report? Is there a schedule in mind? Steps 1 through Steps 4 have well defined processes and a significant number of projects have been completed over the past several years. There are likely examples where success can measured and residual risk monitored. Geomagnetic Disturbances come to mind as the GMD task force completed their work plan and has been disbanded in 2020.	no change made - will evaluate and determine future actions.
David Jacobson (RSTC Member)		Page 25	General comment that assigning actions to specific groups/committees will help ensure that the actions receive attention. The last action "Development of methods, process, tools, metrics, and/or standards are needed to address energy security" is not assigned.	This could be assigned to the RSTC. "The RSTC should develop methods, processes, tools, metrics, and/or standard authorization requests for development of new standards that are needed to address energy security." This could be considered for addition to the work plan of the new Energy Reliability Assessment task force.	change made
David Jacobson (RSTC Member)		Page 28	Development of tools for BPS resiliency - Is the work of the DOE sufficient? Is there a need for work to be completed by the RSTC?	Suggest "NERC and the RSTC should continue to work with DOE on this effort to ensure a robust tool that can be used industry wide to evaluate potential threats to generation, transmission, and fuel supplies."	no change made - NERC (which encompasses RSTC) works with DOE
David Jacobson (RSTC Member)		Page 28	Is this action needed "The ERO Enterprise should assist the industry to implement the necessary protocols and mitigation plans to reduce the risk and maintain reliability and security for the BPS."?	Planning Coordinators and Transmission Owners are working through the requirements of TPL-007, assessing any potential thermal overloads due to GIC and developing mitigation plans. This process seems to moving along, therefore ERO assistance may not be necessary.	no change made - recommended mitigating activity of ERO assistance
David Jacobson (RSTC Member)		Page 31	Any actions assigned to the RSTC should be highlighted.	The first action on planning approaches and the seventh action on supply chain risk management are candidates for RSTC. The EMP task force reports to the RSTC, which could be noted.	no change made - NERC is correct in these actions
David Jacobson (RSTC Member)		Page 32	In the second paragraph, it says "The following graphic..." There is no graphic.	Please review and revise.	change made
David Jacobson (RSTC Member)		Page 33/34	Any actions assigned to the RSTC should be highlighted.	Please review and revise.	no change made - RSTC will have the opportunity to review and highlight as appropriate upon posting final board approved report
David Jacobson (RSTC Member)		Page 34	The following action may fit better under Risk Priority 1, 1A: "NERC and industry partners should evaluate processes and assumptions around identification of critical loads in load shed and load restoration plans."	Please review and revise.	no change made for the next three - location ok as is- we also note within the report that many recommendations/context cross multiple profiles.
David Jacobson (RSTC Member)		Page 34	The following action may fit better under Risk Priority 2, 2B: "NERC and registered entities should develop and study extreme event scenarios under a future resource mix to ensure that both generation and transmission systems can ensure energy delivery is adequate to meet peak conditions in extreme event scenarios, also taking into account the interdependencies between power and other industries that may pose challenges."	Please review and revise.	

David Jacobson (RSTC Member)		Page 34	The following action may fit better under Risk Priority 1, 1B: "NERC and industry should develop seasonal extreme temperature energy management plans along with rolling 21-day operational planning plans that accommodate the ongoing weather forecasts and projections."	Please review and revise.	
APPA	GENERAL		APPA believes the RISC has done a great job of collecting and sorting through significant amount of data to reach common themes and identify emerging trends. The Report demonstrates the difficulty of this task due to multiple risk issues associated with each risk. For example, the risk grouping of Grid Transformation includes 6 risk issues and 11 risk sub-issues. The many risks presented make it difficult to see what risk(s) NERC needs to focus on. In its effort to be complete, the Report approaches violating the maxim of, "if everything is a priority, then nothing is a priority." The Report can be made more efficient by decreasing the number of risks and in turn reducing the number of risks that will be managed and monitored in the short-term.		no change made - RISC has evaluated and reduced the risks and can look to 2023 report to see if further reduction is able/needed.
APPA	GENERAL		The report's broad approach identifies many reliability risks making it difficult to determine what NERC's specific priorities will be over the next two years. While there are many physical, cyber and economic variables that can affect electric reliability not all are risks that are pertinent or can be controlled or influenced by NERC. The current process has a place for the Reliability Security and Technology Committee (RSTC) to play a role in the process to help the RISC scope and focus risks. It is likely that this Report did not have the full benefit of the RSTC performing that role because the RSTC was forming during the drafting of this RISC Report. Therefore, APPA believes that further refinement of the new NERC Committee structure's coordination as well as the risk framework, will assist in better focusing RISC Report risks and mitigation strategies going forward.		no change made - Valued comment, will include in risc/rstc coordination meetings.
APPA	General		One key aspect that the RISC report needs to review is the use of Bulk Power System (BPS) versus Bulk Electric System (BES) in the Report. For example, in describing the use of the evolving risk framework, "Once a risk to the BES has been identified..." (Page 10) seems to conflict with Report's Risk Profiles that state, "Each of these risk areas requires steps to mitigate or control their impacts for the continued reliable planning and operation of the BPS." (Page 17) This suggests that risks coming out of the framework are for the BES, yet mitigation efforts are for the BPS. APPA believes that there needs to be clear delineation for the use of the terms so that mitigation measures can be appropriately understood. Further, the RISC Report needs to better distinguish the terms so that it can be discerned whether a risk is within the purview of NERC (BES) versus a risk that needs to be considered outside of NERC (BPS).		change made - clarification to BPS as needed through the report
APPA	General		<p>APPA's comments on the 2021 report are relevant not only to the current report but are also relevant to improving the future RISC reports. APPA as part of the State Municipal and Transmission Dependent Utilities Sector (SM-TDUs) has commented on the evolving ERO Risk Framework. Going forward APPA believes focusing on priority risks and better aligning risks and mitigations to specific actions within the scope of the ERO can increase the value of the RISC report to stakeholders.</p> <p>The RISC Report details its connection to the new risk framework model. The risk framework looks at issues in and outside of the ERO's purview. The RISC process needs coordination with the RSTC to establish when identified reliability and security risks fall under the purview of the ERO and can be mitigated by the ERO. APPA believes this process needs to be better established to better focus the RISC Report. To what degree a risk is the responsibility of the ERO is an important question to be answered before appropriate mitigation measures can be considered. Risks related to natural gas interdependency, electromagnetic pulse, and more recently telecommunication equipment and services, are just a few examples of issues that have several aspects not within the purview of the ERO to address or mitigate. APPA continues to believe this is an important part of the process that needs to be detailed for the framework and tangential efforts such as the RISC Report to be effective and efficient.</p> <p>APPA believes that once a risk is identified, there is a need to determine if that risk is the responsibility of the ERO. Doing so will be important in determining the appropriate mitigation measures. Risk identification and validation needs to include a process that recognizes what is, and what is not, within the purview and control of NERC. Such recognition will help determine prioritization and the potential mitigations that can then be fitted and aligned with the ERO Business plan and Budget. Any ERO mitigation efforts that duplicates or works against mandates or guidelines outside of NERC's purview, would counterproductive and not be in the best interest of promoting grid reliability in an efficient and effective manner.</p> <p>The RISC Report identifies risks and provides the context to the ERO. However, as mentioned earlier it is the RSTC in its tactical role that connects identified risks to the relevant needed risk mitigation strategies. The "Mitigating Risk Key[s]" in report provide issue and mitigation direction for different risk profiles. While the Risk Keys provide high level subject areas to improve, there is no specificity about the connection to NERC's strategic plan, specific standards or guidelines that industry stakeholders can connect to. For example, a mitigating risk key for "Grid Transformation" is, "Ensure sufficient operating flexibility at all stages of resource and grid transformation." This mitigation has no specific connection to the ERO's strategic plan or something a regulatory authority or registered entity could take action on. APPA believes that the RSTC in its role can assist in making such actions more specific and connected to ERO operation and would recommend that the RSTC do so in the future</p>		no change - valued overall comments, will review with the RSTC during RISC/RSTC coordination efforts.