NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Agenda
Reliability Issues Steering Committee

December 9, 2020 | 4:00-5:00 p.m.
Conference Call

Attendee Webex Link: Join Meeting

Introduction and Chair's Remarks

NERC Antitrust Compliance Guidelines*

Agenda Items

1. **Framework to Address Known and Emerging Reliability and Security Risks* – Endorse**
   a. RISC/RSTC Collaboration
2. **2021 ERO Reliability Risk Priorities Report Schedule* – Review**
   a. RISC 2020 Emerging Risks Survey
   b. 2021 Reliability Leadership Summit
3. **2021 Reliability Indicators* – Review**
4. **RISC Membership – Update**
5. **Other Matters and Adjournment**

*Background materials included.

NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

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.

Framework to Address Known and Emerging Reliability and Security Risks

Action

Endorse

Summary

The ERO's mission requires establishing a consistent framework to identify, prioritize, and address known and emerging reliability and security risks. The *Framework to Address Known and Emerging Reliability and Security Risks* (Whitepaper), which has been reviewed by the Reliability and Security Technical Committee (RSTC) and Reliability Issues Steering Committee (RISC), identifies the policies, procedures, and programs developed by the ERO to support its mission and incorporates them into an iterative six-step risk management framework. The mitigation of risks to Bulk Electric System (BES) reliability and security are classified according to the likelihood of the risk occurring and the severity of its impact. The ERO's policies, procedures, and programs are mapped to target risk mitigation against severity and likelihood. Further, the Whitepaper reviews how resilience is an important component of reliability risk management. Finally, the whitepaper considers the application of ERO policies, procedures, and programs, within time required to apply the mitigation and the likelihood and severity.

The Framework was issued as part of the Policy Input letter for the NERC Board of Trustees in October 2020 and comments were reviewed and incorporated as applicable. A matrix of these comments is included as **Attachment 2.** NERC plans to request Board endorsement of the Whitepaper at the Board's open meeting in February 2021.

Attachment

1. *Framework to Address Known and Emerging Reliability and Security Risks*
2. *MRC Policy Input: Risk Framework Comment Response Matrix*

NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Framework to Address Known and Emerging Reliability and Security Risks

November 2020

This document outlines a risk framework for the ERO and details how such a framework provides an important extension of the ERO's core activities. The ERO mission[1] requires establishing a consistent framework to identify, prioritize and address known and emerging reliability and security risks. To support its mission the ERO has developed policies, procedures and programs, which are identified and briefly described in Section I. These policies, procedures and programs have been incorporated into an iterative six-step risk management framework outlined in Section II. Mitigation of risks to Bulk Electric System (BES) reliability can be classified according to the likelihood of the risk occurring and the severity of its impact. Section III addresses how the ERO's policies, procedures and programs identified in Section II map into the risk likelihood and severity space**.** Resilience is an important component of reliability risk management and is discussed in Section IV. Section V cover the application of ERO Policies, Procedures and Programs, within time required to apply the mitigation and the likelihood and severity.

I. ERO Policies, Procedures and Programs

The ERO's mission ultimately exists to serve the public interest, and it must serve that interest by developing and using the ERO Policies, Procedures and Programs to monitor and mitigate risks to the BES, balancing their use by considering what is possible against what is reasonable and necessary. Further, ensuring reliability and security also require improving the resilience of the BES by building the robustness to withstand unexpected events, supporting controlled degradation when an event is beyond design basis (providing an Adequate Level of Reliability), and supporting restoration following an event.

The ERO identifies risk both in a leading and lagging manner. The ERO scans the horizon for emerging risks such as grid transformation and critical infrastructure interdependencies (leading). At the same time, the ERO is gathering data and information on the performance of the existing bulk power system to uncover unexpected risks such as large quantities of photovoltaic generation ceasing to operate under certain system conditions (lagging). In addition, the ERO annually releases its State of Reliability Report that documents the annual system performance in a comparative fashion. The ERO's Policies, Procedures and Programs are then used to address mitigation of these identified risks.

Five of NERC's most significant reliability risk mitigation activities are Reliability Standards, Assurance and Enforcement activities; Reliability Guidelines; Technical Engagement; Reliability and Risk Assessments; and Alerts:

1. **Reliability Standards, Assurance, and Enforcement** processes are the common way to address reliability and security risks when addressing sustained risks with moderate impacts which are

[1] Electric Reliability Organization (ERO) consists of NERC and the 6 Regional Reliability Organizations. The ERO's mission is to assure the reliability and security of the North American bulk electric system (BES). The ERO is supported by subject matter expertise from the owners and operators of the bulk electric system. In the United States the ERO is authorized the Energy Policy Act of 2003 and overseen by FERC.

likely (e.g., inaccurate planning models), and high impacts, whether likely or unlikely (e.g., vegetation management and geomagnetic disturbances). Standards provide the greatest degree of certainty for risk mitigation. Following NERC and Regional Reliability Standards should not be seen as a burden but rather an outcome of good reliability performance, with that desired outcome on each individual system contributing to the reliability of the entire interconnection, and ultimately, the North American BES.

As a matter of public policy, Reliability Standards should credibly address primary risks that are sustained, high impact and likely. Establishing a baseline of Reliability Standards assures accountability for the public's benefit when minimum expectations of performance or behavior are not met. The public expects a regulator to enforce accountability on at least those actions related to sustained, high impact, and likely risks within its scope of oversight.

A key factor in the success of compliance monitoring and enforcement of mandatory standards rests on a common understanding among industry and the ERO as set forth in the ERO's Compliance Monitoring and Enforcement Program (CMEP) which details how compliance will be monitored and enforced. Implementation Guidance is developed by industry and/or vetted through pre-qualified organizations to show examples of compliant implementations. These vetted examples can then be submitted to the ERO for endorsement, and, if endorsed, the ERO would give the example deference during CMEP activities with consideration of facts and circumstances.

Risk elements associated with the Reliability Standards are documented annually in the ERO CMEP Implementation Plan, which provides guidance to industry on North American-wide and regional risks that the ERO's Reliability Assurance and Enforcement staff will be focusing on addressing in the coming year. Regional Entities review the risks each individual registered entity may have, and identify which Reliability Standards they wish to focus on based on these risks. This risk-based approach enables focus on the most important risks to reliability, and review of the controls in place to address them for each individual organization.

Information and data gathered as a result of compliance monitoring and enforcement activities can inform about the effectiveness of a Reliability Standard or the need for enhancements. At a high level, this recommendation can be passed on through the Standards Development process for consideration.

2. **Reliability Guidelines** are the common approach to use when addressing moderate impact sustained risks that are unlikely, and low impact sustained risks that are unlikely or likely (such as reduced or lack of equipment maintenance resulting in the loss of an individual element which is a low impact to BPS reliability, while the probability of failure increases over time). Reliability Guidelines are also used for those issues that are or are not in the ERO's jurisdiction, but are practices that improve reliability. Guidelines provide three advantages:

   - Together with a strong minimum baseline fabric of standards, guidelines can be a strong and timely way to address risk.
   - Reliability Guidelines enable the ERO to highlight expectations or priorities on appropriate practices for a given subject area.

- Reliability Guidelines may also be used to establish performance expectations for emerging risks rather than or prior to codifying those expectations into Reliability Standards.

3. **Technical Engagement** can be used to address sustained risks or one-and-done activities with low impacts, whether likely or unlikely. Activities here include webinars, site visits, presentation and reports, workshops, conferences and technical meetings. This includes not only activities of the ERO, but the ERO supporting industry engagement through the reliability ecosystem, such as the North American Transmission and Generation Forums, professional organizations, researchers, and government. Technical engagement also serves to promote future sustained risk mitigation and support for using Reliability Guidelines, industry notices, newsletters, bulletins, or Reliability Standards.
4. **Reliability and Risk Assessments** coupled with the biennial report outlining the Reliability Issues Steering Committee's (RISC) findings identifies risks, whether likely or unlikely.[2] Generally, these activities are used to inform and influence policymakers, industry leaders, and the general public about the impact of important public and energy policy issues impacting BPS reliability.
5. **Alerts** are used for sharing information, especially time-sensitive information, to request action or direct action. They can also serve as a more nimble, foundational activity for other ERO Policies, Procedures and Programs. As part of its normal course of business, NERC often either discovers, identifies, or is provided with information that is critical to ensuring the reliability of the bulk power system in North America. In order to effectively disseminate this information, NERC utilizes email-based "alerts" designed to provide concise, actionable information to the electricity industry. As defined in its Rules of Procedure, NERC alerts are divided into three distinct levels, as follows:

   - **Level 1 Industry Advisory**: Purely informational, intended to alert registered entities to issues or potential problems. A response to NERC is not necessary.
   - **Level 2 Recommendation to Industry**: Recommends specific action be taken by registered entities. A response from recipients, as defined in the alert, is required.
   - **Level 3 Essential Action**: Identifies actions deemed to be "essential" to bulk power system reliability and requires NERC Board of Trustees' approval prior to issuance. Like recommendations, essential actions also require recipients to respond as defined in the alert.

   Since Level 2 and Level 3 alerts require acknowledgement of receipt and response to the alerts, they are used in higher risk impact situations than Level 1 alerts, which are purely informational.

II. ERO Iterative Risk Management Framework

During the last ten years, the ERO has expanded its implementation of risk-based approaches across its program areas. During this transition, the ERO has continued to lead industry in reliability, resilience, and security initiatives to identify known and emerging risks, and to engage industry in a collaborative approach to mitigating that risk. The primary reliability, resilience, and security activity for risk mitigation the ERO currently deploys includes, but is not limited to: outreach events such as webinars and conferences, Reliability Guidelines, Alerts, Reliability Standard development, registration and certification, and compliance monitoring and enforcement. In addition, the ERO can engage Forums

[2] Instead of using "mitigating risks," the RISC uses "managing risks." These terms are used interchangeably and mean the same thing in this whitepaper.

such as the North American Transmission Forum (NATF) and the North American Generator Forum (NAGF), as well as the industry trade associations, industry groups such as the Energy Systems Integration Group (ESIG), and research organizations such as the Electric Power Research Institute and the Power Systems Engineering Research Center (PSERC) to assist with development of best practices, increased awareness, Implementation Guidance, and other solutions used to address identified risks.

Additionally, a set of industry indicators has been developed to measure reliability and security. These indicators need further refinement, maturation and linkage to industry performance, as they are key to evaluating the effectiveness of mitigation efforts, identifying the residual risk that remains, and considering whether the remaining risk is at acceptable levels.

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 bulk power system 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.

   A ERO risk registry and heat maps will be developed encompassing prior RISC report findings, ongoing technical committee activities, and risks being monitored. This registry would be developed by the end of the second 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 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 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)
  - 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 Actions[3]
- Alerts[4]
- Technical Conferences and Workshops

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.

[3] 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.

[4] 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.

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 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 bulk power system, 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 of 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.

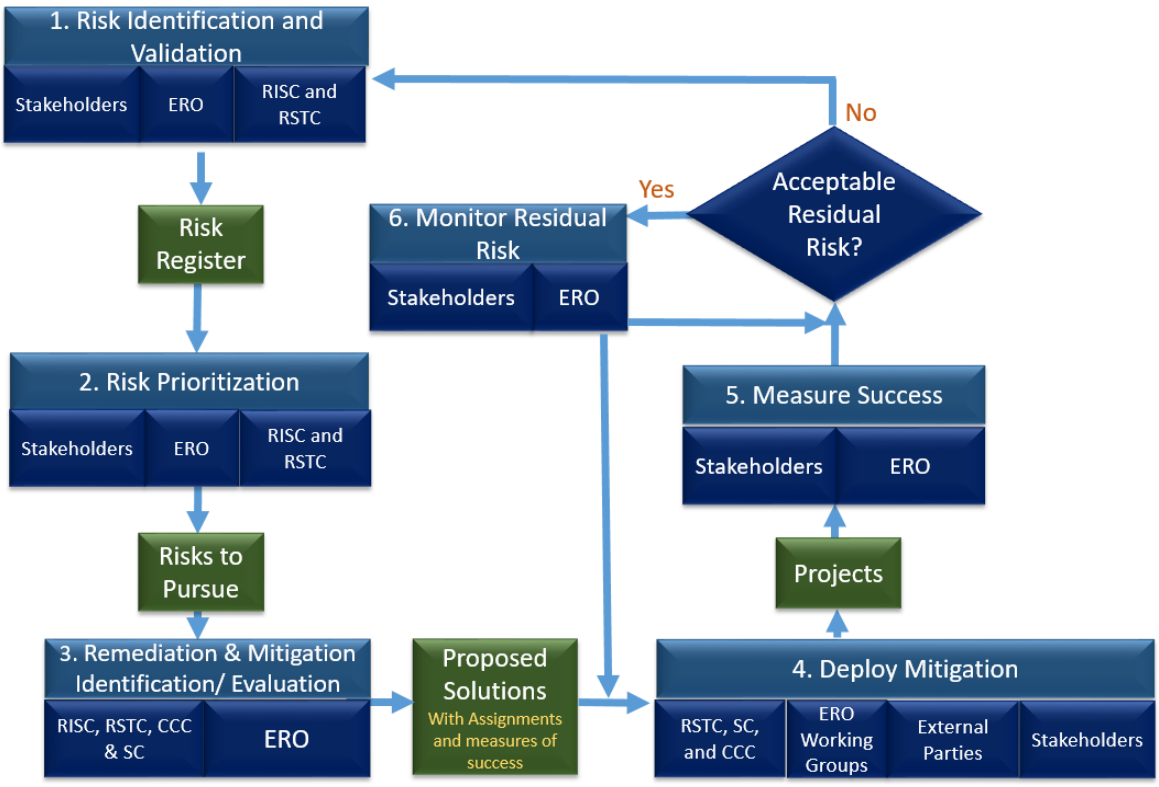


Figure 1: ERO Risk Management Process

In order to coordinate risk mitigation, the RISC and RSTC triage risk mitigations together as called for in the iterative RISC Framework process. The Standards Committee (SC) and the Compliance and Certification Committee (CCC) are key stakeholder groups that are part of this iterative process. Further, the Standing Committee Coordination Group (SCCG) is a group made up of the leadership (Chair and Vice Chair) of each Standing Committee. This group coordinates and aligns the Standing Committees activities. The touch points are shown in Figure 2.

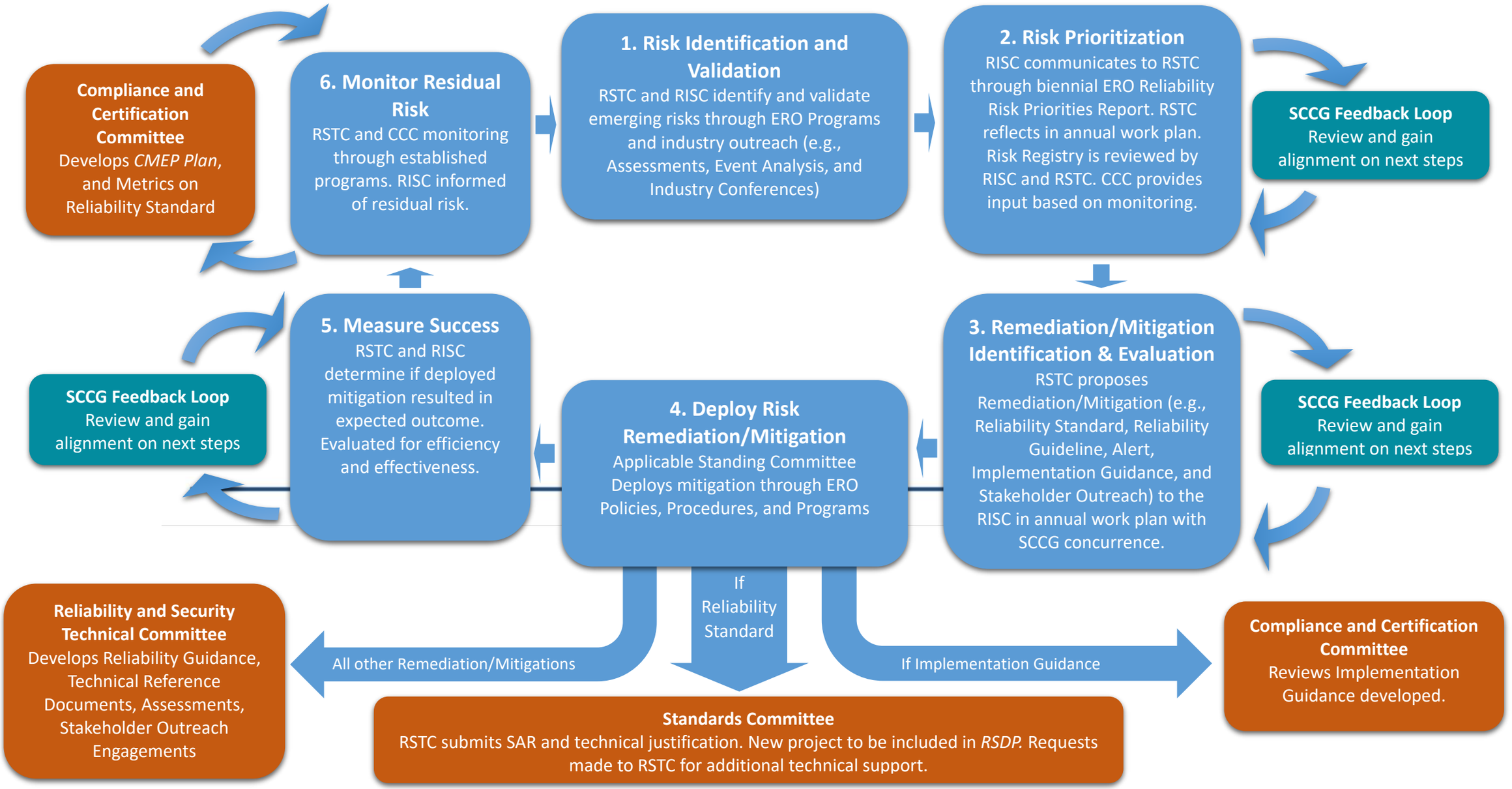


Figure 2: RSTC, RISC,. SC,. and CCC Coordination within the Risk Framework

1. **Risk Identification and Validation** is completed by the RSTC and RISC as they review the annual State of Reliability Report, Long-Term and Seasonal Reliability Assessments, Event Analysis records and with a joint review the biennial RISC Report incorporating prioritized risks into the RSTC's subgroup's work plans. Further, the RSTC coordinates with the RISC on long-term risks and mitigations. In this way, risks determined by monitoring the ongoing performance of the bulk power system and those identified by scanning the horizon. The risk registry will be maintained by the RISC and RSTC to determine if an inherent nature of a risk changes over time, and consider removing risks or adding others.
2. **Reliability Risk Prioritization** is completed collaboratively between the RSTC and RISC on an annual basis. Ongoing activities are calibrated, and newly identified risks are prioritized. The SCCG will serve as a coordination point to ensure broad alignment across the Standing Committees.
3. **Remediation & Mitigation Identification & Evaluation** activities to address the risks are assigned to the appropriate RSTC subgroups accounting for changing needs across the BPS. They create the ERO Policies, Procedures and Programs to address the risks. Frequent communications ensures coordination of ongoing risk prioritization. RSTC will provide updates to the RISC on the subgroup activities being taken on a quarterly basis. The SCCG will serve as a coordination point to ensure broad alignment across the Standing Committees.
4. **Deploy Mitigations** by putting ERO Policies, Procedures and Programs into effect. Depending on the Risk Remediation/Mitigation activities selected, the RSTC, SC, and CCC will be assigned certain activities. If Implementation Guidance is identified, the CCC will be assigned to review the developed guidance. If a Reliability Standard is identified, the RSTC (or identified stakeholder) will need to submit a SAR to the SC and that project is to be included in the annual Reliability Standards Development Plan. For all other mitigation/remediation activities, the RSTC will be responsible for developing remediation/mitigation.
5. **Measure Success** of the strategies/plans which are jointly evaluated for effectiveness, highlighting next steps. RSTC will measure success using its annual performance measurement activities (e.g., State of Reliability Report, Long-Term Reliability Assessment, and Event Analysis). RSTC will provide updates to the RISC on the actions being taken on a quarterly basis.
6. **Residual Risk** is monitored in coordination between the RSTC coordinates and RISC towards maintaining an acceptable level of residual risk. The CCC will be responsible for measuring the effectiveness of Reliability Standard developed, as well as residual risk, and report back to the RISC through its Compliance and Enforcement Implementation Plan and specific metrics used to measure effectiveness. The SCCG will serve as a coordination point to ensure broad alignment across the Standing Committees.

III. Risk Mitigation from Likelihood and Severity Perspective

From a likelihood and impact perspective, the ERO Policies, Procedures, and Programs above overlap based on the specifics of each risk being mitigated. In addition, there are a host of additional activities that work together to manage risks, such as engagement with the reliability ecosystem, (e.g. Forums, professional organizations (IEEE-PES, CIGRE, etc.), and government). A combination can be used towards

gaining industry action, setting the stage for standards as well as addressing a risk while a standard is being developed. Likelihood and impact have a bearing when a Reliability Standard is required. Figure 3 provides an illustration that is representative of the principles:

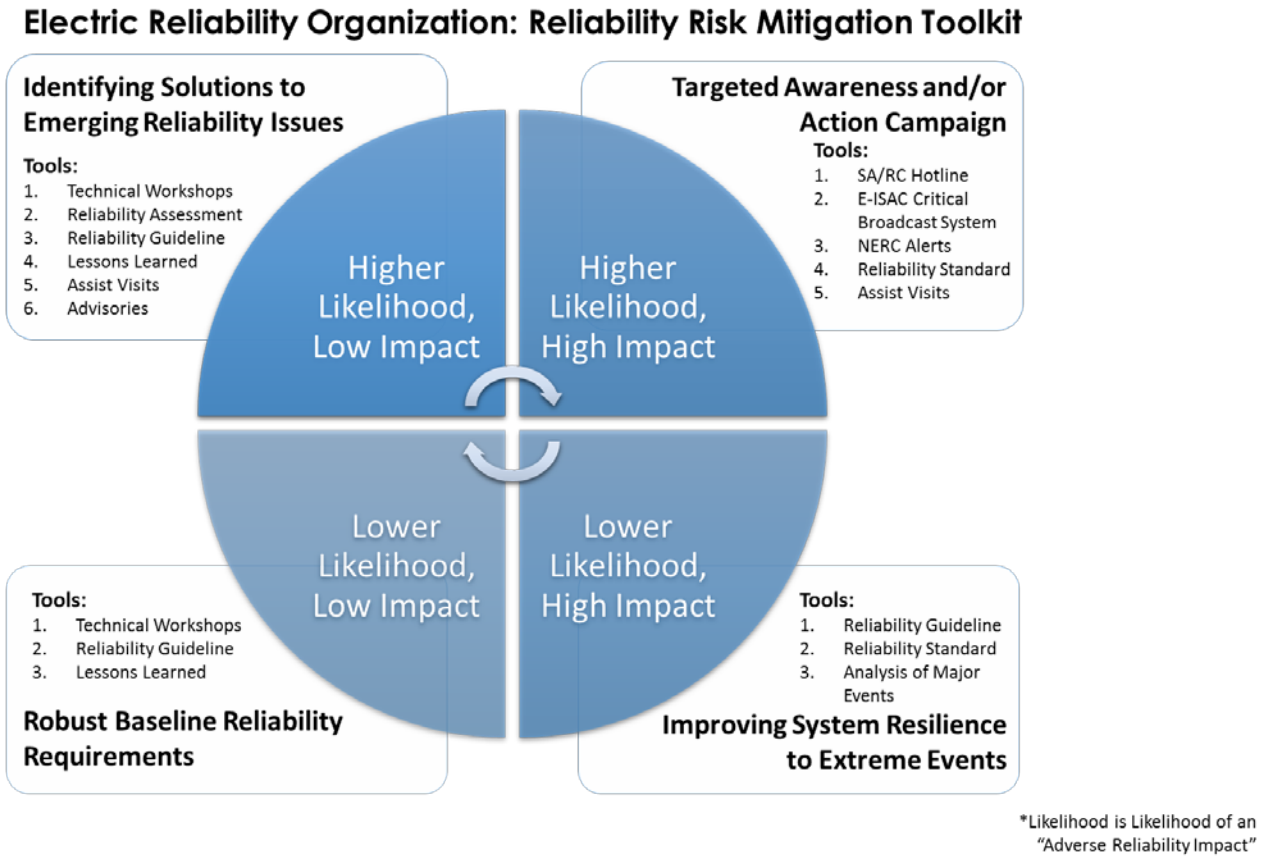


Figure 3: ERO Reliability Risk Mitigation Portfolio

IV. Resilience Impact on Risk Management

In August 2017, the Department of Energy (DOE) issued a Staff Report to the Secretary on Electricity Markets and Reliability (DOE Grid Report) regarding reliability and resilience in light of the changing energy environment. One recommendation in the DOE Grid Report stated that NERC should consider adding resilience to its mission and broadening its scope to address resilience. In response to the DOE report and NERC assessments, the NERC Board of Trustees (NERC Board) directed the Reliability Issues Steering Committee (RISC) to develop a model for resilience and examine resilience in today's environment.

In accordance with the NERC Board's directive, the RISC worked with NERC stakeholders to reexamine the meaning of resilience in today's changing environment and how resilience impacts NERC activities. Meanwhile, the DOE and FERC have continued evaluating the relationship of resilience and reliability.

In November of 2018, the NERC Board accepted the RISC's Report, titled "Reliability Issues Steering Committee Resilience Report." This report summarizes the results of the RISC's examination of resilience, including the RISC Resilience Model.

NERC has developed, filed with FERC, and later updated a definition of the adequate level of reliability (ALR) along with a technical report to guide Reliability Standards development, Reliability Assessments, guideline development, data collection, system analysis and standing committee work. In particular, the ALR, or design basis of the system, is defined as the state that design, planning, and operation the BES will achieve when five ALR performance objectives are met.[5] Each objective addresses Reliable Operation of the BES over four time frames:

1. **Steady state:** the period before a disturbance and after restoration has achieved normal operating conditions
2. **Transient:** the transitional period after a disturbance and during high-speed automatic actions in response
3. **Operations response:** the period after the disturbance where some automatic actions occur and operators act to respond
4. **Recovery and system restoration:** the time period after a widespread outage through initial restoration rebounding to a sustainable operating state and recovery to a new steady state

Further, there is a need to development of additional metrics that measure impacts from emerging risks (e.g. energy sufficiency and transmission/generation operating technology security). These metrics can inform industry on the extent of the condition, level of risk, and relative success of their mitigation.

V. Incorporating Risk Adds a Critical Dimension to the ERO's Mission

Application of ERO Policies, Procedures and Programs provides a multi-dimensional approach to address risks. Namely, some of these approaches can be put in place swiftly, while others require industry collaborative action which can take more time. Further, there are time considerations on the speed of the ERO Policies, Procedures and Programs deployment, as well as the speed at which a risk should be addressed. Figure 4 provides a risk time horizon perspective. The application of mitigation approaches in this Framework are not meant to be static. There are risks, however, that include dynamic forces outside the ERO or risks may not be fully within the ERO's purview. This can and will influence the timing and impact of risks.

The ERO Policies, Procedures and Programs deployed are largely dependent on the likelihood that a given risk would impact reliability. For example, reliability issues that have occurred are generally more

[5] **The ALR Performance Objectives are as follows:**

1. The BES does not experience instability, uncontrolled separation, Cascading, or voltage collapse under normal operating conditions and when subject to predefined Disturbances.
2. BES frequency is maintained within defined parameters under normal operating conditions and when subject to predefined Disturbances.
3. BES voltage is maintained within defined parameters under normal operating conditions and when subject to predefined Disturbances.
4. Adverse Reliability Impacts on the BES following low probability Disturbances (e.g., multiple contingences, unplanned and uncontrolled equipment outages, cyber security events, and malicious acts) are managed.
5. Restoration of the BES after major system Disturbances that result in blackouts and widespread outages of BES elements is performed in a coordinated and controlled manner.

The ALR also lists two assessment objectives for purposes of assessing risks to reliability:

1. BES transmission capability is assessed to determine availability to meet anticipated BES demands during normal operating conditions and when subject to predefined Disturbances.
2. Resource capability is assessed to determine availability to the Bulk Electric System to meet anticipated BES demands during normal operating conditions and when subject to predefined Disturbances.

likely than those that have not occurred, and risks/issues that have occurred are generally more likely to occur again.

Therefore, the ERO Policies, Procedures and Programs used to mitigate risks that have occurred may be different than those used to mitigate longer-term issue that haven't impacted reliability yet. For instance, after analysis of major and/or off-normal events, depending on the potential impacts and reoccurrence likelihood, strong action can be taken by the ERO with nearly immediate response by issuing up to three levels of NERC Alerts, Assist Visits, followed by Reliability Guidelines, technical conferences, and enhancement of Reliability Standards.

Generally, industry action to address medium to high impact and likelihood risks employs Reliability Standards which provide the highest certainty of risk mitigation. Following Reliability Standards is mandatory and provides a high value by creating comfort and certainty for interconnected organizations of expectations and roles, ensuring that the adequate level of reliability will be maintained. In the end, following the Reliability Standards is an outcome of good industry reliability performance.

High-Impact, Low-Frequency-type risks generally do not have a historical record of technical information. Longer-term risks can be difficult to quantify—therefore, much of the work the ERO can do is to assemble industry experts and stakeholders to agree on and validate what the reliability risk is and how it should be considered and addressed within the ERO Policies, Procedures and Programs, including the full reliability ecosystem. These risks require more collaborative effort and more time towards developing technical references, convening industry stakeholders, and conducting independent reliability assessments to determine the best way to mitigate the risk.

The ERO's risk-based approach is fundamental to the success of its mission to ensure the reliability and security of the BES in North America.

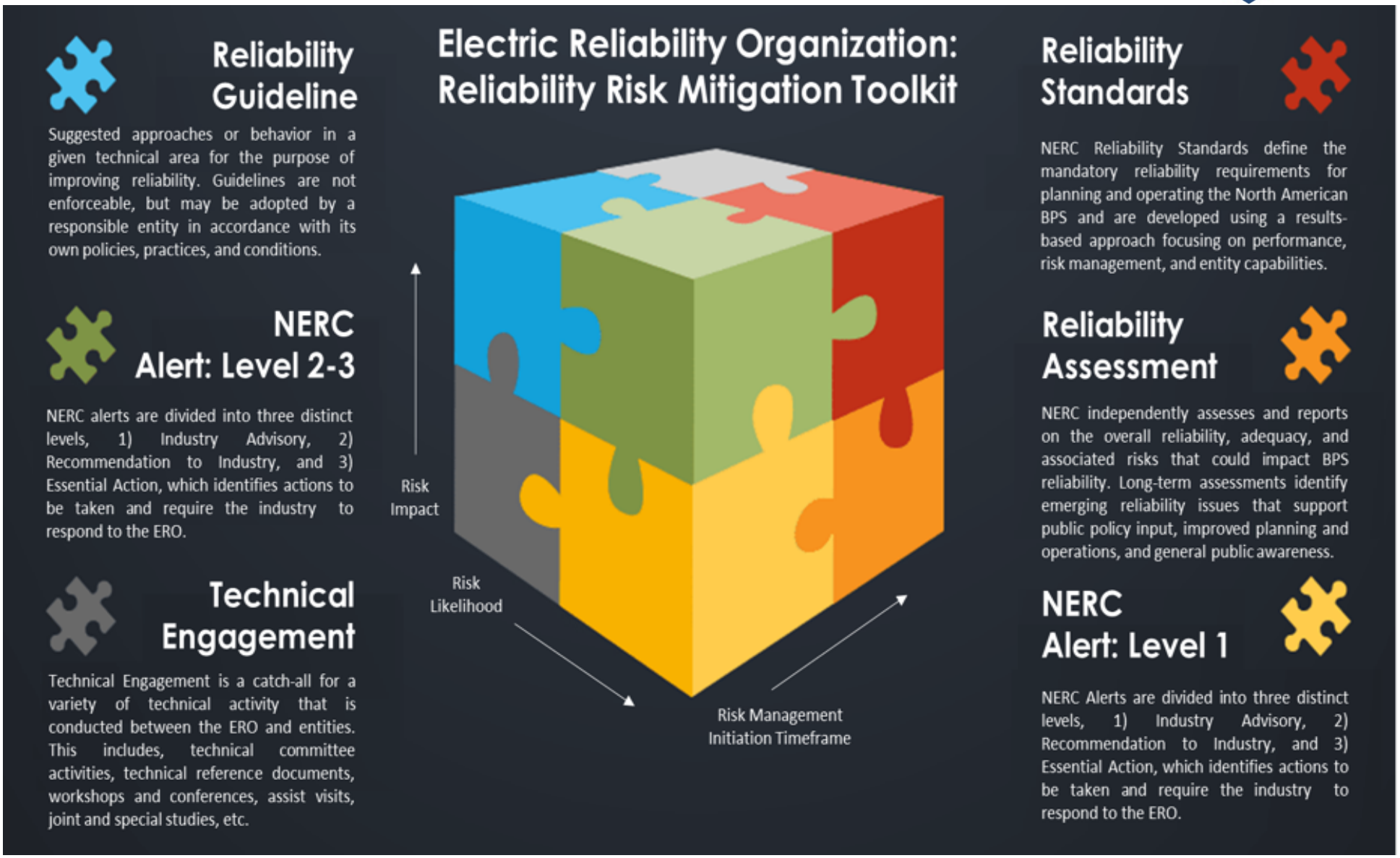


Figure 4: Risk Time Horizon

NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Framework to Address Known and Emerging Reliability and Security Risks

~~September~~ November 2020

This document outlines a risk framework for the ERO and details how such a framework provides an important extension of the ERO's core activities. The ERO mission[1] requires establishing a consistent framework to identify, prioritize and address known and emerging reliability and security risks. To support its mission the ERO has developed policies, procedures and programs, which are identified and briefly described in Section I. These policies, procedures and programs have been incorporated into an iterative six-step risk management framework outlined in Section II. Mitigation of risks to Bulk Electric System (BES) reliability can be classified according to the likelihood of the risk occurring and the severity of its impact. Section III addresses how the ERO's policies, procedures and programs identified in Section II map into the risk likelihood and severity space**.** Resilience is an important component of reliability risk management and is discussed in Section IV. Section V cover the application of ERO Policies, Procedures and Programs, within time required to apply the mitigation and the likelihood and severity.

I. ERO Policies, Procedures and Programs

The ERO's mission ultimately exists to serve the public interest, and it must serve that interest by developing and using the ERO Policies, Procedures and Programs to monitor and mitigate risks to the BES, balancing their use by considering what is possible against what is reasonable and necessary. Further, ensuring reliability and security also require improving the resilience of the BES by building the robustness to withstand unexpected events, supporting controlled degradation when an event is beyond design basis (providing an Adequate Level of Reliability), and supporting restoration following an event.

The ERO identifies risk both in a leading and lagging manner. The ERO scans the horizon for emerging risks such as grid transformation and critical infrastructure interdependencies (leading). At the same time, the ERO is gathering data and information on the performance of the existing bulk power system to uncover unexpected risks such as large quantities of photovoltaic generation ceasing to operate under certain system conditions (lagging). In addition, the ERO annually releases its State of Reliability Report that documents the annual system performance in a comparative fashion. The ERO's Policies, Procedures and Programs are then used to address mitigation of these identified risks.

Five of NERC's most significant reliability risk mitigation activities are Reliability Standards, Assurance and Enforcement activities; Reliability Guidelines; Technical Engagement; Reliability and Risk Assessments; and Alerts:

1. **Reliability Standards, Assurance, and Enforcement** processes are the common way to address reliability and security risks when addressing sustained risks with moderate impacts which are

[1] Electric Reliability Organization (ERO) consists of NERC and the 6 Regional Reliability Organizations. The ERO's mission is to assure the reliability and security of the North American bulk electric system (BES). The ERO is supported by subject matter expertise from the owners and operators of the bulk electric system. In the United States the ERO is authorized the Energy Policy Act of 2003 and overseen by FERC.

likely (e.g., inaccurate planning models), and high impacts, whether likely or unlikely (e.g., vegetation management and geomagnetic disturbances). Standards provide the greatest degree of certainty for risk mitigation. Following NERC and Regional Reliability Standards should not be seen as a burden but rather an outcome of good reliability performance, with that desired outcome on each individual system contributing to the reliability of the entire interconnection, and ultimately, the North American BES.

As a matter of public policy, Reliability Standards should credibly address primary risks that are sustained, high impact and likely. Establishing a baseline of Reliability Standards assures accountability for the public's benefit when minimum expectations of performance or behavior are not met. The public expects a regulator to enforce accountability on at least those actions related to sustained, high impact, and likely risks within its scope of oversight.

A key factor in the success of compliance monitoring and enforcement of mandatory standards rests on a common understanding among industry and the ERO as set forth in the ERO's Compliance Monitoring and Enforcement Program (CMEP) which details how compliance will be monitored and enforced. Implementation Guidance is developed by industry and/or vetted through pre-qualified organizations to show examples of compliant implementations. These vetted examples can then be submitted to the ERO for endorsement, and, if endorsed, the ERO would give the example deference during CMEP activities with consideration of facts and circumstances.

~~Annual~~ Risk elements associated with the Reliability Standards are documented annually in the ERO CMEP Implementation Plan, which provides guidance to industry on North American-wide and regional risks that the ERO's Reliability Assurance and Enforcement staff will be focusing on addressing in the coming year. Regional Entities review the risks each individual registered entity may have, and identify which Reliability Standards they wish to focus on based on these risks. This risk-based approach enables focus on the most important risks to reliability, and review of the controls in place to address them for each individual organization.

Commented [A1]: NPCC

Information and data gathered as a result of compliance monitoring and enforcement activities can inform about the effectiveness of a Reliability Standard or the need for enhancements. At a high level, this recommendation can be passed on through the Standards Development process for consideration.

Commented [A2]: NRECA

2. **Reliability Guidelines** are the common approach to use when addressing moderate impact sustained risks that are unlikely, and low impact sustained risks that are unlikely or likely (such as reduced or lack of equipment maintenance resulting in the loss of an individual element which is a low impact to BPS reliability, while the probability of failure increases over time). Reliability Guidelines are also used for those issues that are or are not in the ERO's jurisdiction, but are practices that improve reliability. Guidelines provide three advantages:

   - Together with a strong minimum baseline fabric of standards, guidelines can be a strong and timely way to address risk.

- Reliability Guidelines enable the ERO to highlight expectations or priorities on appropriate practices for a given subject area.
- Reliability Guidelines may also be used to establish performance expectations for emerging risks rather than or prior to codifying those expectations into Reliability Standards.

3. **Technical Engagement** can be used to address sustained risks or one-and-done activities with low impacts, whether likely or unlikely. Activities here include webinars, site visits, presentation and reports, workshops, conferences and technical meetings. This includes not only activities of the ERO, but the ERO supporting industry engagement through the reliability ecosystem, such as the North American Transmission and Generation Forums, professional organizations, researchers, and government. Technical engagement also serves to promote future sustained risk mitigation and support for using Reliability Guidelines, industry notices, newsletters, bulletins, or Reliability Standards.
4. **Reliability and Risk Assessments** coupled with the biennial report outlining the Reliability Issues Steering Committee's (RISC) findings identifies risks, whether likely or unlikely.[2] Generally, these activities are used to inform and influence policymakers, industry leaders, and the general public about the impact of important public and energy policy issues impacting BPS reliability.
5. **Alerts** are used for sharing information, especially time-sensitive information, to request action or direct action. They can also serve as a more nimble, foundational activity for other ERO Policies, Procedures and Programs. As part of its normal course of business, NERC often either discovers, identifies, or is provided with information that is critical to ensuring the reliability of the bulk power system in North America. In order to effectively disseminate this information, NERC utilizes email-based "alerts" designed to provide concise, actionable information to the electricity industry. As defined in its Rules of Procedure, NERC alerts are divided into three distinct levels, as follows:
   - **Level 1 Industry Advisory**: Purely informational, intended to alert registered entities to issues or potential problems. A response to NERC is not necessary.
   - **Level 2 Recommendation to Industry**: Recommends specific action be taken by registered entities. A response from recipients, as defined in the alert, is required.
   - **Level 3 Essential Action**: Identifies actions deemed to be "essential" to bulk power system reliability and requires NERC Board of Trustees' approval prior to issuance. Like recommendations, essential actions also require recipients to respond as defined in the alert.

   Since Level 2 and Level 3 alerts require acknowledgement of receipt and response to the alerts, they are used in higher risk impact situations than Level 1 alerts, which are purely informational.

Commented [A3]: TAPS: footnote explains this word use inconsistency between the RISC report and the framework: manage = mitigate

II. ERO Iterative Risk Management Framework

During the last ten years, the ERO has expanded its implementation of risk-based approaches across its program areas. During this transition, the ERO has continued to lead industry in reliability, resilience, and security initiatives to identify known and emerging risks, and to engage industry in a collaborative approach to mitigating that risk. The primary reliability, resilience, and security activity for risk mitigation the ERO currently deploys includes, but is not limited to: outreach events such as webinars and

[2] Instead of using "mitigating risks," the RISC uses "managing risks." These terms are used interchangeably and mean the same thing in this whitepaper.

conferences, Reliability Guidelines, Alerts, Reliability Standard development, registration and certification, and compliance monitoring and enforcement. In addition, the ERO can engage Forums such as the North American Transmission Forum (NATF) and the North American Generator Forum (NAGF), as well as the industry trade associations, industry groups such as the Energy Systems Integration Group (ESIG), and research organizations such as the Electric Power Research Institute and the Power Systems Engineering Research Center (PSERC) to assist with development of best practices, increased awareness, Implementation Guidance, and other solutions used to address identified risks.

Commented [A4]: Covers NRECA's comments on how we work with industry on risks

Additionally, a set of industry indicators has been developed to measure reliability and security. These indicators need further refinement, maturation and linkage to industry performance, as they are key to evaluating the effectiveness of mitigation efforts, identifying the residual risk that remains, and considering whether the remaining risk is at acceptable levels.

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.

Commented [A5]: TAPS

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.

Commented [A6]: EEI, NPCC, and TAPS

~~In addition, the ERO and industry subject matter experts continuously work together identifying and validating risks to the reliable and secure operation of the bulk power system based on analysis of ongoing performance of the system (lagging). Validation of the magnitude and priority of the risk includes working with NERC Committees, and socializing it with Forums, government and research organizations.~~

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: ~~In addition,~~ T~~ t~~he ERO and industry subject matter experts continuously work together ~~identifying and~~ validating risks to the reliable and secure operation of the bulk power system 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 ~~it~~them with Forums, government, and research organizations. Leading risk validation requires analysis of system simulations, forecasts, and performance projections.

Commented [A7]: EEI and NPCC

~~1.~~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.

~~The~~ A ERO risk registry and heat maps will be developed encompassing prior RISC report findings, ongoing technical committee activities, and risks being monitored. This registry would be

Commented [A8]: NRECA

developed by the end of the second 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.

~~2.~~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 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. ~~Coordination is key to avoid duplication and provide supportive, rather than conflicting actions.~~

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.

Commented [A9]: CEA

Commented [A10]: NAGF and NPCC

Commented [A11]: CEA

Commented [A12]: TAPS

Commented [A13]: Clean up a long sentence

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 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)
  - 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 Actions[3]
- Alerts[4]
- Technical Conferences and Workshops

Commented [A14]: TAPS: this explains that all risks do not necessarily fall under NERC's purview.

[3] 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.

[4] 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.

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.

Commented [A15]: NPCC

~~3.~~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.

~~4.~~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.

~~5.~~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 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 bulk power system, 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 of 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.

Commented [A16]: NPCC

Commented [A17]: NAGF

Commented [A18]: NRECA

Commented [A19]: NAGF, NRECA and NPCC

Commented [A20]: PMA

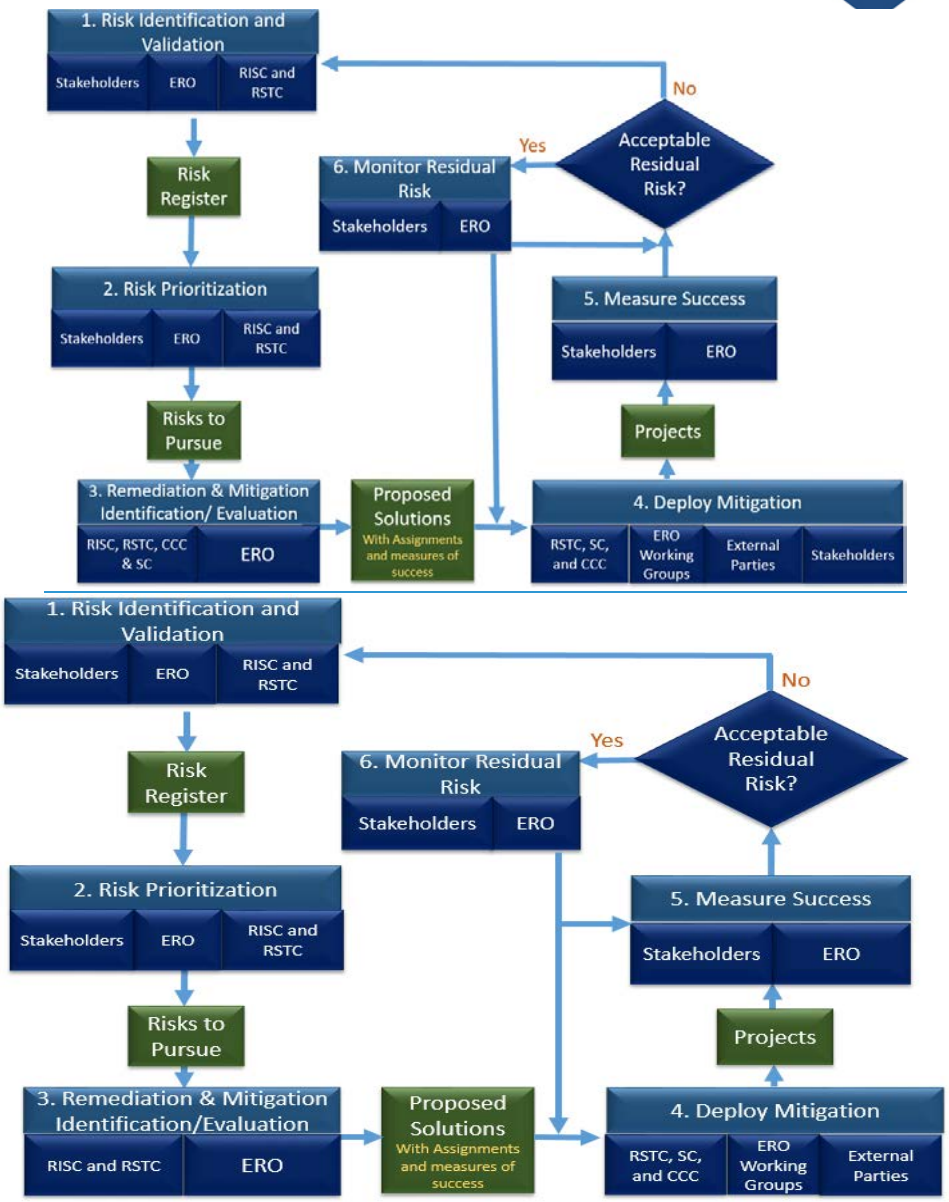
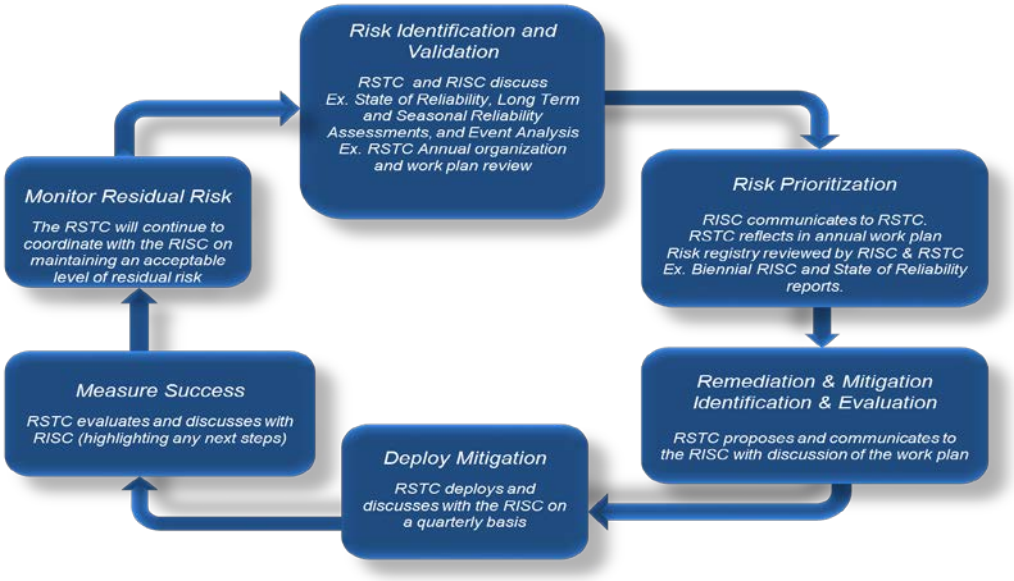


Figure 1: ERO Risk Management Process

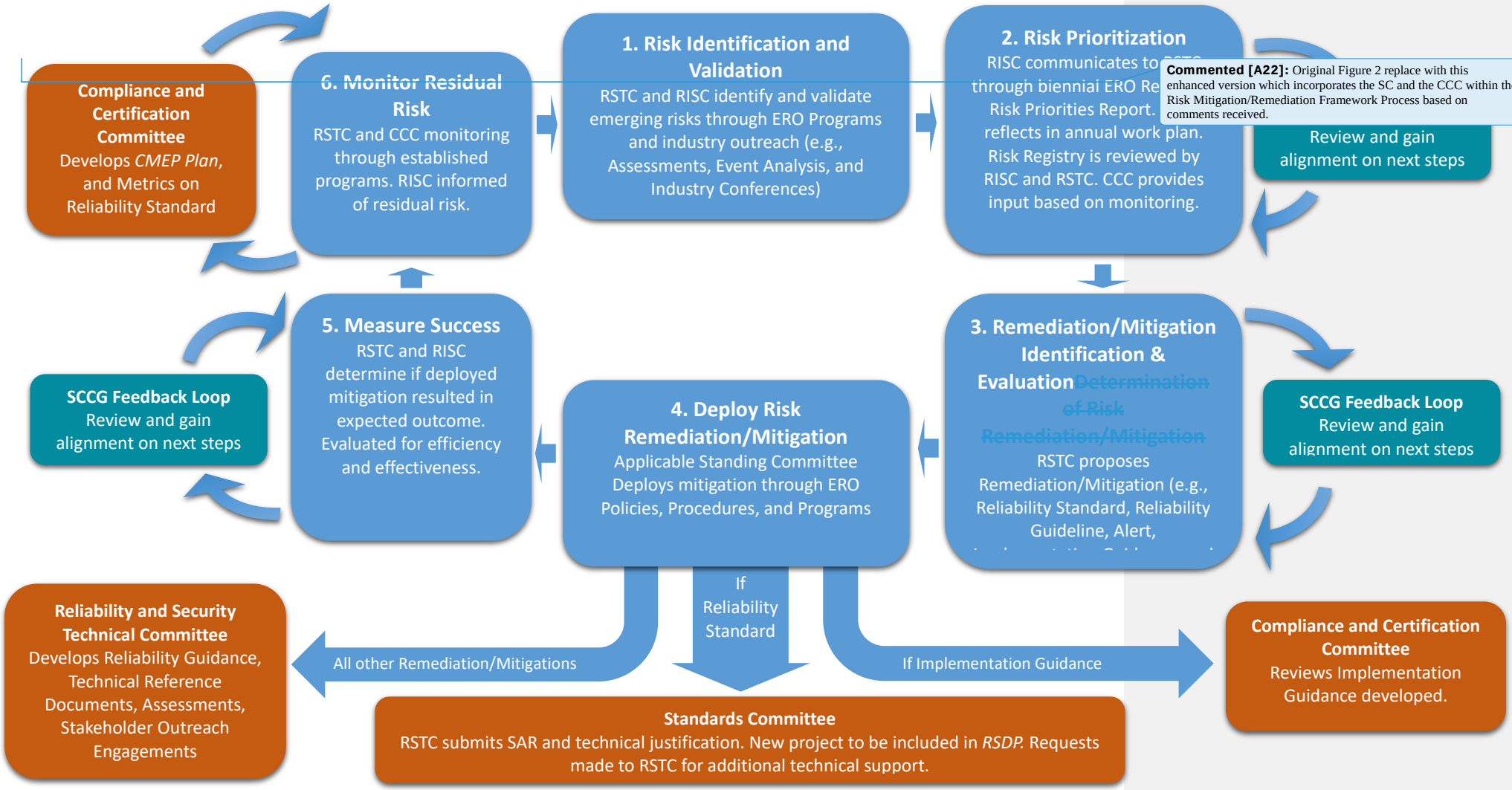
Commented [A21]: IRC added SC to Remediation & Mitigation Identification/Evaluation. NPCC added stakeholders to communications feedback loop. TAPS: Added CCC for Remediation

In order to coordinate risk mitigation, the RISC and RSTC triage risk mitigations together as called for in the iterative RISC Framework process. The Standards Committee (SC) and the Compliance and Certification Committee (CCC) are key stakeholder groups that are part of this iterative process. Further,

the Standing Committee Coordination Group (SCCG) is a group made up of the leadership (Chair and Vice Chair) of each Standing Committee. This group coordinates and aligns the Standing Committees activities. The touch points are shown in Figure 2.



~~Figure 2: RSTC/RISC Coordination within the Risk Framework~~



Commented [A22]: Original Figure 2 replace with this enhanced version which incorporates the SC and the CCC within the Risk Mitigation/Remediation Framework Process based on comments received.

Figure 2: RSTC, RISC. SC. aAnd CCC Coordination within the Risk Framework

1. **Risk Identification and Validation** is completed by the RSTC and RISC as they review the annual State of Reliability Report, Long-Term and Seasonal Reliability Assessments, Event Analysis records and with a joint review the biennial RISC Report incorporating prioritized risks into the RSTC's subgroup's work plans. Further, the RSTC coordinates with the RISC on long-term risks and mitigations. In this way, risks determined by monitoring the ongoing performance of the bulk power system and those identified by scanning the horizon. The risk registry will be maintained by the RISC and RSTC to determine if an inherent nature of a risk changes over time, and consider removing risks or adding others.
2. **Reliability Risk Prioritization** is completed collaboratively between the RSTC and RISC on an annual basis. Ongoing activities are calibrated, and newly identified risks are prioritized. The SCCG will serve as a coordination point to ensure broad alignment across the Standing Committees.
3. **Remediation & Mitigation Identification & Evaluation** ~~**Remediation & Mitigation Identification & Evaluation**~~ activities to address the risks are assigned to the appropriate RSTC subgroups accounting for changing needs across the BPS. They create the ERO Policies, Procedures and Programs to address the risks. Frequent communications ensures coordination of ongoing risk prioritization. RSTC will provide updates to the RISC on the subgroup activities being taken on a quarterly basis. The SCCG will serve as a coordination point to ensure broad alignment across the Standing Committees.
4. **Deploy Mitigations** by putting ERO Policies, Procedures and Programs into effect. Depending on the Risk Remediation/Mitigation activities selected, the RSTC, SC, and CCC will be assigned certain activities. If Implementation Guidance is identified, the CCC will be assigned to review the developed guidance. If a Reliability Standard is identified, the RSTC (or identified stakeholder) will need to submit a SAR to the SC and that project is to be included in the annual Reliability Standards Development Plan. For all other mitigation/remediation activities, the RSTC will be responsible for developing remediation/mitigation.
5. **Measure Success** of the strategies/plans which are jointly evaluated for effectiveness, highlighting next steps. RSTC will measure success using its annual performance measurement activities (e.g., State of Reliability Report, Long-Term Reliability Assessment, and Event Analysis). RSTC will provide updates to the RISC on the actions being taken on a quarterly basis.
6. **Residual Risk** is monitored in coordination between the RSTC coordinates and RISC towards maintaining an acceptable level of residual risk. The CCC will be responsible for measuring the effectiveness of Reliability Standard developed, as well as residual risk, and report back to the RISC through its Compliance and Enforcement Implementation Plan and specific metrics used to measure effectiveness. The SCCG will serve as a coordination point to ensure broad alignment across the Standing Committees.

Commented [A23]: NRECA

Commented [A24]: Described the enhanced interaction between RISC, RSTC, CCC, and SC based on new Figure 2.

III. Risk Mitigation from Likelihood and Severity Perspective

From a likelihood and impact perspective, the ERO Policies, Procedures, and Programs above overlap based on the specifics of each risk being mitigated. In addition, there are a host of additional activities that work together to manage risks, such as engagement with the reliability ecosystem, (e.g. Forums, professional organizations (IEEE-PES, CIGRE, etc.), and government). A combination can be used towards gaining industry action, setting the stage for standards as well as addressing a risk while a standard is being developed. Likelihood and impact have a bearing when a Reliability Standard is required. Figure 3 provides an illustration that is representative of the principles:

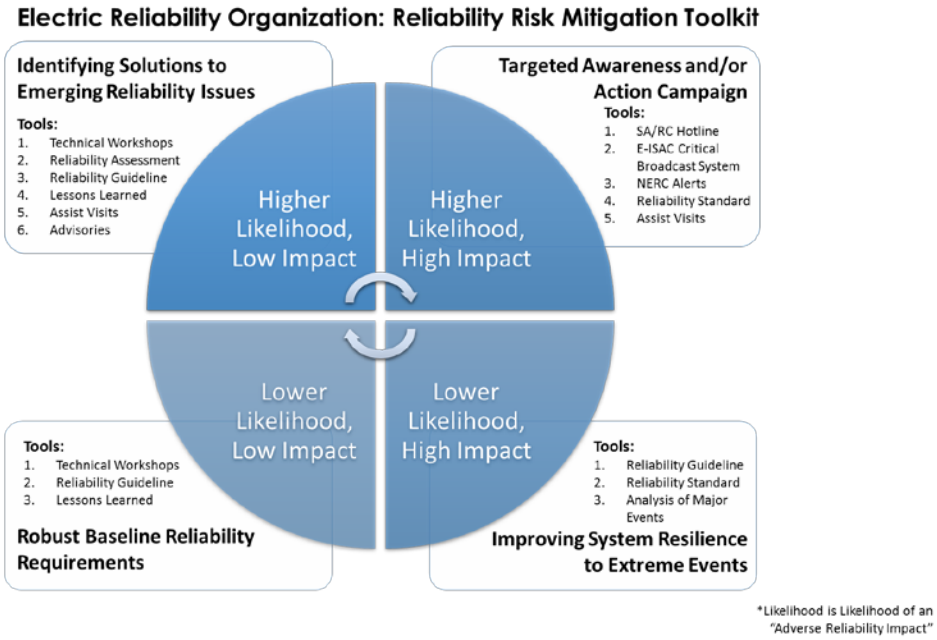


Figure 3: ERO Reliability Risk Mitigation Portfolio

Commented [A25]: This addresses NRECA's comments on Figure 4. Their concern is addressed in Figure 3

"there is concern that, where extremely valuable tools like assist visits and "Technical Engagement" are applicable across the risk spectrum (high impact and low impact), the figure may not fully represent such value. To ensure that these critical elements are recognized, when using the model, we request that NERC consider clarifying that the tools are agile and cumulative e.g., listed tools may be applicable and available to address issues across the risk spectrum."

IV. Resilience Impact on Risk Management

In August 2017, the Department of Energy (DOE) issued a Staff Report to the Secretary on Electricity Markets and Reliability (DOE Grid Report) regarding reliability and resilience in light of the changing energy environment. One recommendation in the DOE Grid Report stated that NERC should consider adding resilience to its mission and broadening its scope to address resilience. In response to the DOE report and NERC assessments, the NERC Board of Trustees (NERC Board) directed the Reliability Issues Steering Committee (RISC) to develop a model for resilience and examine resilience in today's environment.

In accordance with the NERC Board's directive, the RISC worked with NERC stakeholders to reexamine the meaning of resilience in today's changing environment and how resilience impacts NERC activities. Meanwhile, the DOE and FERC have continued evaluating the relationship of resilience and reliability.

In November of 2018, the NERC Board accepted the RISC's Report, titled "Reliability Issues Steering Committee Resilience Report." This report summarizes the results of the RISC's examination of resilience, including the RISC Resilience Model.

Commented [A26]: Flows better

NERC has developed, filed with FERC, and later updated a definition of the adequate level of reliability (ALR) along with a technical report to guide Reliability Standards development, Reliability Assessments, guideline development, data collection, system analysis and standing committee work. In particular, the ALR, or design basis of the system, is defined as the state that design, planning, and operation the BES will achieve when five ALR performance objectives are met.[5] Each objective addresses Reliable Operation of the BES over four time frames:

1. **Steady state:** the period before a disturbance and after restoration has achieved normal operating conditions
2. **Transient:** the transitional period after a disturbance and during high-speed automatic actions in response
3. **Operations response:** the period after the disturbance where some automatic actions occur and operators act to respond
4. **Recovery and system restoration:** the time period after a widespread outage through initial restoration rebounding to a sustainable operating state and recovery to a new steady state

Further, there is a need to development of additional metrics that measure impacts from emerging risks (e.g. energy sufficiency and transmission/generation operating technology security). These metrics can inform industry on the extent of the condition, level of risk, and relative success of their mitigation.

Commented [A27]: NPCC

~~In November of 2018, the NERC Board accepted the RISC's Report, titled "Reliability Issues Steering Committee Resilience Report." This report summarizes the results of the RISC's examination of resilience, including the RISC Resilience Model.~~

V. Incorporating Risk Adds a Critical Dimension to the ERO's Mission

Application of ERO Policies, Procedures and Programs provides a multi-dimensional approach to address risks. Namely, some of these approaches can be put in place swiftly, while others require industry collaborative action which can take more time. Further, there are time considerations on the speed of the ERO Policies, Procedures and Programs deployment, as well as the speed at which a risk should be addressed. Figure 4 provides a risk time horizon perspective. The application of mitigation approaches in this Framework are not meant to be static. There are risks, however, that include dynamic forces outside the ERO or risks may not be fully within the ERO's purview. This can and will influence the timing and impact of risks.

Commented [A28]: TAPS

[5] **The ALR Performance Objectives are as follows:**

1. The BES does not experience instability, uncontrolled separation, Cascading, or voltage collapse under normal operating conditions and when subject to predefined Disturbances.
2. BES frequency is maintained within defined parameters under normal operating conditions and when subject to predefined Disturbances.
3. BES voltage is maintained within defined parameters under normal operating conditions and when subject to predefined Disturbances.
4. Adverse Reliability Impacts on the BES following low probability Disturbances (e.g., multiple contingences, unplanned and uncontrolled equipment outages, cyber security events, and malicious acts) are managed.
5. Restoration of the BES after major system Disturbances that result in blackouts and widespread outages of BES elements is performed in a coordinated and controlled manner.

The ALR also lists two assessment objectives for purposes of assessing risks to reliability:

1. BES transmission capability is assessed to determine availability to meet anticipated BES demands during normal operating conditions and when subject to predefined Disturbances.
2. Resource capability is assessed to determine availability to the Bulk Electric System to meet anticipated BES demands during normal operating conditions and when subject to predefined Disturbances.

The ERO Policies, Procedures and Programs deployed are largely dependent on the likelihood that a given risk would impact reliability. For example, reliability issues that have occurred are generally more likely than those that have not occurred, and risks/issues that have occurred are generally more likely to occur again.

Therefore, the ERO Policies, Procedures and Programs used to mitigate risks that have occurred may be different than those used to mitigate longer-term issue that haven't impacted reliability yet. For instance, after analysis of major and/or off-normal events, depending on the potential impacts and reoccurrence likelihood, strong action can be taken by the ERO with nearly immediate response by issuing up to three levels of NERC Alerts, Assist Visits, followed by Reliability Guidelines, technical conferences, and enhancement of Reliability Standards.

Generally, industry action to address medium to high impact and likelihood risks employs Reliability Standards which provide the highest certainty of risk mitigation. Following Reliability Standards is mandatory and provides a high value by creating comfort and certainty for interconnected organizations of expectations and roles, ensuring that the adequate level of reliability will be maintained. In the end, following the Reliability Standards is an outcome of good industry reliability performance.

High-Impact, Low-Frequency-type risks generally do not have a historical record of technical information. Longer-term risks can be difficult to quantify—therefore, much of the work the ERO can do is to assemble industry experts and stakeholders to agree on and validate what the reliability risk is and how it should be considered and addressed within the ERO Policies, Procedures and Programs, including the full reliability ecosystem. These risks require more collaborative effort and more time towards developing technical references, convening industry stakeholders, and conducting independent reliability assessments to determine the best way to mitigate the risk.

The ERO's risk-based approach is fundamental to the success of its mission to ensure the reliability and security of the BES in North America.

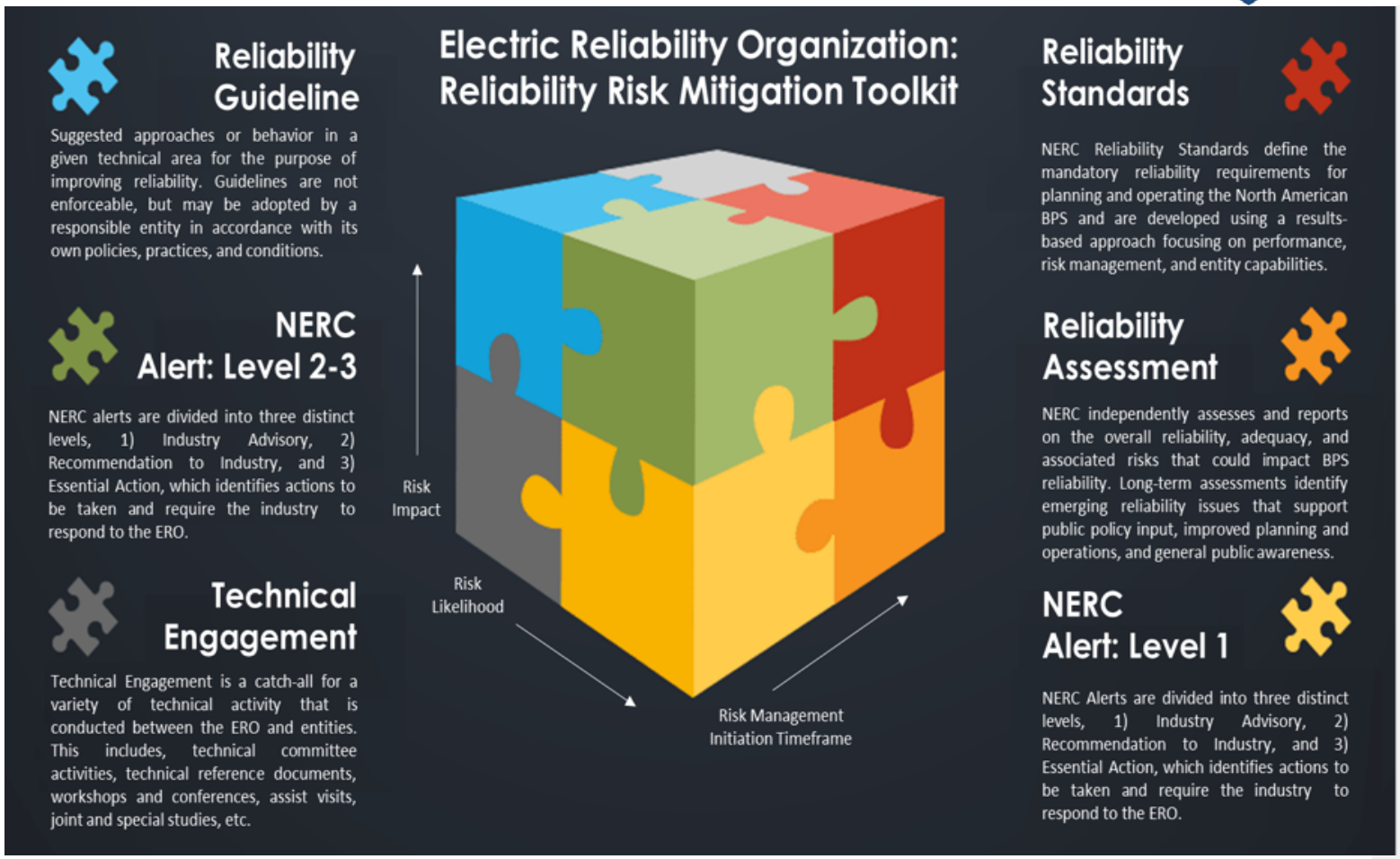


Figure 4: Risk Time Horizon

MRC Policy Input-October 2020
Risk Framework Comment Response Matrix

Comment	Response
CEA 1. NERC should ensure any framework to address risk allows appropriate flexibility in risk identification and management activities. 2. The Whitepaper could more clearly define where new or modified programs or efforts to implement any of the framework would be required, and the expected timelines and prioritization for doing so.	1. Added *"Does the mix of mitigations vary based on jurisdictional or regional differences?"* in risk prioritization section 2. Added expected time lines for registry development (2nd quarter of 2021)
EEI 1. EEI recommends clarifying the concepts of risk identification and risk validation, including addressing the need for a technical justification to support an identified risk 2. EEI suggests that those who recommend mitigation adequately support the basis for selecting the particular approach to mitigation over the other available tools.	1. Added subsections in the Risk Identification and Validation. 2. Added the call for a template like the SAR to provide a basis of the risk and potential mitigations in Risk Identification and Validation. 3. Enhanced Figure 2 to include the Standards Committee, Compliance and Certification Committee, and the Standing Committee Coordinating Group.
Federal Utilities and Federal Power Marketing Administrations (Sector 4) 1. Ensure that the process identified in the whitepaper on The Framework to Address Known and Emerging Reliability and Security Risks is flexible enough to deal with new unexpected risks.	1. Added: "*From-time-to-time risks are identified and validated which require an accelerated industry attention. The ERO risk framework can support quick implementation industry of awareness and mitigation activities*."
ISO/RTO Council (IRC) 1. The IRC generally supports the NERC Framework to Address Known and Emerging Reliability and Security Risks. The document indicates how NERC working with the RISC/RSTC and stakeholders collect, evaluate and then prioritizes risks that need to be mitigated or monitored; the MRC and stakeholders have been supportive of development of such a document.	1. Added Standards Committee to the Remediation & Mitigation Identification/ Evaluation feedback loop in Figure 1 2. Enhanced Figure 2 to include the Standards Committee, Compliance and Certification Committee, and the Standing Committee Coordinating Group.
NAGF 1. **Remediation and Mitigation Identification and Evaluation:** The NAGF believes that prior to the development of mitigation activities, the risk tolerance level needs to be defined for each risk and then remediation/mitigation plans can be developed accordingly. Input from the NERC resources, stakeholders, industry experts, and external parties such as	1. Added **Remediation and Mitigation Identification and Evaluation**: *"Further, the risk tolerances needs to balanced against potential impacts so that the remediation/ mitigation plans can be developed accordingly."* 2. Added **Measurement of Success:** : *A partnership between the ERO leadership and both the RISC/RSTC will enable input from the*

Comment	Response
the NAGF are important to help ensure the success of remediation/ mitigation activities. 2. **Measurement of Success:** The NAGF agrees with the need to evaluate the effectiveness of mitigation activities against the defined risk tolerance/residual risk. The NAGF believes the Trades and Forums working together could provide measures and evaluations of the effectiveness. 3. **Monitor Residual Risk**: The NATF agrees with the need to periodically monitor risks that achieve acceptable risk levels	*ERO program areas, industry Forums and trade associations to provide additional context in the measurement of success*. 3. Added **Monitor Residual Risk**: *The ERO, working with its industry partners, technical committees, stakeholders and forums, would determine if the residual risk was acceptable of if additional mitigations required* 4. Enhanced Figure 2 to include the Standards Committee, Compliance and Certification Committee, and the Standing Committee Coordinating Group.
NRSRC No Comments	
NPCC 1. Augmenting the explanation of the Reliability Standards, Assurance, and Enforcement process to summarize the Compliance Oversight Process that identifies high risk areas for registered entities' that focuses on improving their individual performance. 2. Expanding the communications feedback loop to more explicitly include industry stakeholders not directly involved in either the RISC or RSTC efforts. 3. Inclusion of cost-effectiveness analysis to the framework when considering the type and/or depth of remediation and mitigation of identified risks. 4. Increased coordination of the identified risk mitigation activities with Canadian entities and other industry partners. 5. Appropriate ERO committees work to develop risk metrics for transmission security and energy sufficiency, and to examine the risk balance provided by the current definition of an adequate level of reliability to re-affirm the industry's risk appetite and risk tolerance.	1. Added: *Regional Entities review the risks each individual registered entity may have, and identify which Reliability Standards they wish to focus on based on these risks. This risk-based approach enables focus on the most important risks to reliability, and review of the controls in place to address them for each individual organization* 2. In Figure 1, Added stakeholders in Deploy Mitigation communications feedback loop 3. Added: *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. Added: *These mitigations would be coordinated with Canadian, industry partners and stakeholders.* 5. This is more around a specific risk set metric development, and the need to update the ALR. Added the call for a template like the SAR to provide a basis of the risk and potential mitigations in Risk Identification and Validation. Added subsections in the Risk Identification and Validation. Added **Remediation and Mitigation Identification and Evaluation**: *"Further, the risk tolerances needs to balanced against potential impacts so that the remediation/ mitigation plans can be developed accordingly."*

Comment	Response
	Added **Monitor Residual Risk**: *The ERO, working with its industry partners, technical committees, stakeholders and forums, would determine if the residual risk was acceptable of if additional mitigations required* Added in **Resilience Impact on Risk Management**: *Further, there is a need to development of additional metrics that measure impacts from emerging risks (e.g. energy sufficiency and transmission/generation operating technology security). These metrics can inform industry on the extent of the condition, level of risk, and relative success of their mitigation.* Enhanced Figure 2 to include the Standards Committee, Compliance and Certification Committee, and the Standing Committee Coordinating Group.
Coop 1. Provide additional explanation on how NERC utilizes data and information gathered as a result of compliance monitoring and enforcement activities; 2. The proposed framework relies heavily on the membership and expertise of its participants, e.g., the RSTC and the RISC. Both are committees with membership that changes over time, and risk identification and prioritization efforts include elements of subjectivity, which can make risk trending difficult. The addition of documented criteria and processes would address these realities and provide significant benefits for risk trending over time. 3. As experience is gained with the risk framework and associated processes, the ERO Enterprise should consider several potential areas for enhancement. a. Additional clarity regarding how identified risks will be managed through the risk registry versus other methods (potentially through a heat map); b. Addition of roles and responsibilities for the management of the risk registry and decision making regarding acceptable residual risk and appropriate mitigation activities; and	1. Added in **Reliability Standards, Assurance, and Enforcement:** *Information and data gathered as a result of compliance monitoring and enforcement activities can inform about the effectiveness of a Reliability Standard or the need for enhancements. At a high level, this recommendation can be passed on through the Standards Development process for consideration*. 2. Last paragraph on page 3 and first paragraph on page 4 covers this already. 3. Added a. "*and heat maps*" on page 5 b. *"That said, criteria and other related processes should be developed for determining risk severity, likelihood, and mitigation activity effectiveness*" on page 8 c. Considered as "Stakeholders" in the Figure 1 4. Added: *"The risk registry will be maintained by the RISC and RSTC to determine if an inherent nature of a risk changes over time, and consider removing risks or adding others"* on page 10 5. This is already covered in Figure 3 6. Enhanced Figure 2 to include the Standards Committee, Compliance and Certification

Comment	Response
c. Additional clarity regarding how the ERO enterprise integrates into the risk framework its ongoing engagement with stakeholders, such as the ESCC, NATF, NAGF, EPRI, government partners, and trade organizations, as well as stakeholder involvement outside of these groups. 4. Clearly describe how the holistic review of the identified risks, risk register, and the inherent risk identified, and overall risk register maintenance is performed when the inherent nature of an identified risk changes over time. 5. To ensure that these critical elements are recognized, when using the model, we request that NERC consider clarifying that the tools are agile and cumulative e.g., listed tools may be applicable and available to address issues across the risk spectrum.	Committee, and the Standing Committee Coordinating Group.
Merchant Electricity Generator Called out in NAGF	
SM-TDU 1. Comments include: a. What is not apparent from the process steps are specifics about how the collaborative process will work and decisions made, as the Framework steps are implemented. This is particularly true for the identification and prioritization steps. b. It would be helpful if the Framework paper detailed how management versus monitored risks would work within the Risk Framework process. c. The Framework model appears to assume that all identified reliability and security risks will fall under the purview of the ERO and be completely mitigated by the ERO. This is simply not the case. 2. NA 3. There are process steps inclusive to the six steps, that need to be added and documented. Already mentioned are the validation/prioritization triage group, a process for distinguishing items outside of the ERO's purview and transparency considerations for each validated risk. Moreover, the MRC pre-meeting call identified the need for more detail on the formation and responsibilities for developing and maintaining the Risk Register, with which we agree.	1. Response: a. Not going to detailed processes behind each box. These can be developed once the framework is finalized. Added*: 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* b. Added a foot note that clarifies that mitigate = management c. Added a question under mitigation: *Is the risk fully or partially within the purview of the ERO?* In addition, afterward added, *"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."* 2. NA 3. See 1.a above 4. Response: a. Add: *"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*

Comment	Response
4. Included: a. Much like Standard Authorization Requests (SARs) can be offered by ERO Staff or the general public, the same would be true for risk consideration requests. b. SM-TDUs believe it would be valuable to include the CCC with respect to mitigation decisions because this is an area that they have specific experience with and can provide valuable input. c. Currently, the model does not include dynamic forces outside of the ERO. As mentioned earlier there are risks that are not (completely) included in the purview of the Figure 4 model that can and will impact the timing and impact of risks.	*particular approach to mitigation. A template will be created, that mirrors the Standards Authorization Request template, that requires an explanation of the risk and approach(es) for mitigation."* b. Updated Figure 1 *c.* Added: "*The application of mitigation approaches in this Framework are not meant to be static. There are risks, however, that include dynamic forces outside the ERO or risks may not be fully within the ERO's purview. This can and will influence the timing and impact of risks."* *d.* Enhanced Figure 2 to include the Standards Committee, Compliance and Certification Committee, and the Standing Committee Coordinating Group.

2021 ERO Reliability Risk Priorities Report Schedule

Action
Review

Summary
NERC management will provide an update on the 2021 ERO Reliability Risk Priorities Report schedule, the RISC 2020 Emerging Risks Survey, and the 2021 Reliability Leadership Summit.

NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

RISC Annual Process Manual

Risk Identification and Mitigation Framework

December 2020

Annual Process

Every two years the NERC RISC committee develops a report that identifies key risks to bulk power system (BPS) reliability as well as a framework for mitigating those risks. The report is published in November of odd-numbered years. The recommended production timeline of that report is shown below:

- Fourth Quarter 2020 (Every other year)
  - Develop and distribute the risk template/industry survey
  - Finalize summit topics/recommended speakers; begin summit preparations
- December
  - RISC meeting - December 1 (11:00 a.m –Noon)
  - Review/initiate the RISC 2020 Emerging Risks Survey
- January
  - Reliability Leadership Summit (January 26-27, virtual)
  - RISC meeting – January 28 (1:00-4:00 p.m. Eastern)
  - Analyze additional identified risks as a result of RISC 2020 Emerging Risks Survey and the annual Long-Term Reliability Assessment
  - Analyze additional identified risks as a result of new data and information received at the Reliability Leadership Summit
  - Assign report writing teams
- February
  - RISC subcommittees convene for report writing
- March
  - RISC meeting - March 24 (1:00-3:00 p.m. Eastern)
  - RISC subcommittees convene for report writing
  - Work with RSTC on potential risks identified in the upcoming State of Reliability Report

- April
  - RISC subcommittees convene for report writing
  - Work with RSTC on potential risks identified in the upcoming Summer Reliability Assessment
- May
  - RISC meeting – May 19 (1:00-3:00 p.m. Eastern)
  - Report completed
  - Present preliminary results to the Board
- June
  - Publication/editing
  - Distribute report for public comment
- July
  - RISC meeting – July 7 (1:00-3:00 p.m. Eastern)
  - Publication/editing
  - RISC to approve the report and recommend to Board of Trustees for approval
- August
  - Report approval by NERC Board of Trustees
- September - March
  - Upon approval from the NERC Board of Trustees, RISC and RSTC leadership will convene to ensure that identified risks along with associated mitigating activities are adequately addressed either in committee and sub-committee work plans, or by other groups as identified by RISC. For those items not incorporated into existing work plans, RISC and RSTC leadership will have joint strategic collaboration meetings no less than once a quarter to develop appropriate strategies for ensuring that all risks and mitigating activities are properly addressed, monitored, and measured through the committee and sub-committee process. The execution of this plan along with the measurement of success is depicted in Figure 1 which can also be found in the Risk Framework Document.

2021

September 15, 1:00-3:00 p.m.
October 20, 1:00-3:00 p.m. Eastern
December 15, 1:00-3:00 p.m. Eastern

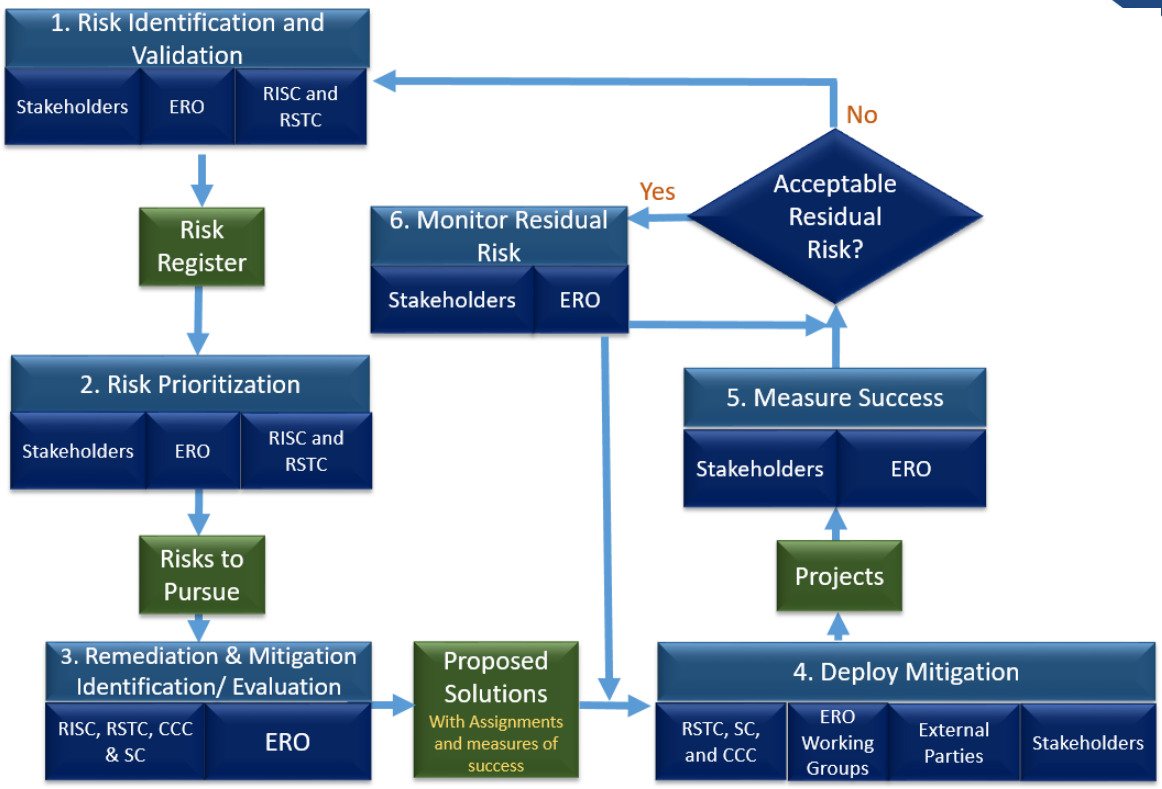


Figure 1

- March – December (years in which a RISC report will not be presented for BOT approval)
  - During this time period the RISC and RSTC will measure the effectiveness of the identified risks and mitigating strategies as incorporated into work plans of committees and sub-committees. This will be an ongoing process which will follow the flow chart included in the Risk Framework document.

Key Milestones

I. Risk Template

The risk template is put together at the beginning of the fourth quarter prior to report publication. Each cycle the RISC committee will review the previous risk template and update based on potential emerging risks and potential new challenges introduced to the BPS since the last template was compiled. The updated and refined template will be used to compile the comprehensive survey, which will be distributed to industry leaders.

II. Industry Survey

The comprehensive industry survey serves as a vehicle to prioritize identified risks as well as to potentially identify new and emerging risks. In order to ensure the greatest accuracy and integrity of the survey NERC will conduct an industry webinar for training around proper completion of the survey. As part of the training NERC will define key terms. For example, one of the key objectives is to determine if a particular risk category should be managed versus monitored. If a risk should be managed, it means that active management is required and industry does not have a clear and precise solution or action plan to solve. If a risk should be

monitored it means that the risk has been well defined with well-documented industry procedures for addressing or resolving. Additionally, the rankings for risk items will be adequately defined during the survey training webinars. The survey and training will be scheduled early in the fourth quarter.

Proposed Key Terms

Baseline Impact – The Baseline Impact is the relative scale ranking of the impact of an identified risk without the implementation of any mitigating efforts.

Baseline Likelihood – the Baseline Likelihood is the relative scale ranking of how likely an identified risk will occur or have a potential effect on the Bulk Power System.

Baseline Risk – the Baseline Risk is the risk itself prior to the implementation of any mitigating activities. For example the Changing Resource Mix is a stand- alone risk. Prior to the implementation of any mitigating activities around this risk it would be considered to be a baseline risk.

Mitigation Actions – Mitigation Actions are any type of action employed with the intent to address and reduce a risk. The effect of mitigating actions should be to lower the impact or the likelihood of a risk.

Reduced Impact – Reduced Impact is the amount of reduction in the relative scale ranking of a risk as a result of implementation of a mitigating action. For example if the Changing Resource Mix risk to the grid has a Baseline Impact of 3.0 and a mitigating activity would reduce the impact to 2.5, the Reduced Impact as a result of that mitigating activity is .5.

Reduced Likelihood – Reduced Likelihood is the amount of reduction in the relative scale ranking of a risk as a result of implementation of a mitigating action. For example if the Changing Resource Mix risk to the grid has a Baseline Likelihood of 3.0 and a mitigating activity would reduce the likelihood to 2.5, the Reduced Likelihood as a result of that mitigating activity is .5.

Remaining Risk Impact – Remaining Risk Impact is equivalent to Baseline Impact minus Reduced Impact

Remaining Risk Likelihood – Remaining Risk Likelihood is equivalent to Baseline Likelihood minus Reduced Likelihood.

Risk – A risk is an event, condition, trend, or situation which if realized would have a negative impact on BPS reliability.

Risk Control – for purposes of the survey Risk Control is defined as the collective elements and mitigating activities and their associated reductions in risk likelihood and impact.

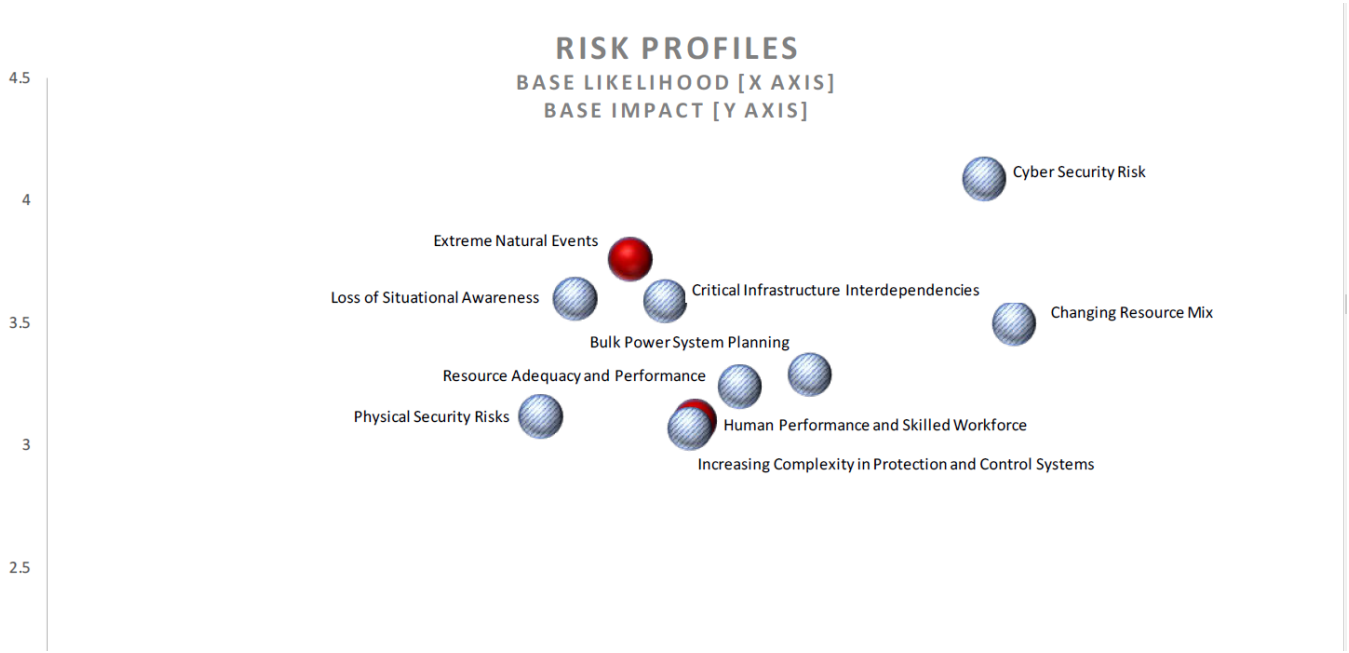
Risk Profile – A Risk Profile is a definition of a given risk along with the description of that risk.

III. Reliability Leadership Summit

The purpose of the Reliability Leadership Summit is to gather industry leaders to engage in constructive dialogue using the survey results as a framework. Keynote speakers and other speakers provide unique perspective into the key drivers of existing and emerging risks and help to identify areas that were potentially overlooked in the survey. Panel sessions are put together to collaborate around key risks and mitigating strategies as well as to engage in meaningful debate about their relative importance and significance. The Reliability Leadership Summit serves as a key building block to the ultimate RISC report.

IV. Heat Map/Risk Matrix

A visual depiction of the key risks and mitigating activities as well as those affects is a valuable tool in discerning what risks are potentially the most critical or where industry attention can have the most impact. Decision makers can have a better visual of the potential impacts of investment and attention. The heat map is an important derivative of the collected results from the survey and the Reliability Leadership Summit.



V. Report Compilation

The RISC 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 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.

2020 RISC Emerging Risks Survey

Introduction

The following survey provides identified bulk power system (BPS) reliability risks and recommended mitigating activities to control them compiled by the NERC Reliability Issues Steering Committee (RISC) in the 2019 ERO Reliability Risk Priorities Report. The survey serves as a vehicle to prioritize identified risks as well as to potentially identify new and emerging risks.

Additionally, the survey responses set a framework for the development of the 2021 ERO Reliability Risk Priorities report (See the 2019 report for background) which will provide an overview of inherent BPS risks, current mitigating activities and recommendations for additional activities to control the risks. This report is widely used by the Electric Reliability Organization, industry, policymakers, and regulators to more fully understand inherent risks to the BPS and serve as a guide to further develop and refine mitigating strategies. The RISC report is expected to be released in August 2021.

The deadline for completion is *January 8, 2021*. Should you have any questions with respect to the survey or obstacles with using SurveyMonkey feel free to contact Thomas Coleman at (404) 446-9628, thomas.coleman@nerc.net or Tina Buzzard at (404) 446-9686, tina.buzzard@nerc.net.

The survey will take approximately 10-15 minutes to complete. You are able to stop and return to the survey at any time if unable to complete in one sitting, however *you must return to the survey on the same device used when starting the survey originally*.

The RISC thanks you for your time and effort in completing the survey!

Survey Participant Information

Name:

Title

Company

Size

Type

Select all that are appropriate.

- [ ] Transmission
- [ ] Generation
- [ ] Distribution
- [ ] Other

Affiliation

Risk Profiles

In 2019, the RISC reviewed and assembled information from ERO Enterprise stakeholders and policymakers and focused subgroup work to develop an initial composite set of risk profiles. Further review and consolidation resulted in four high level risks: Grid Transformation, Extreme Natural Events, Security Risks, and Critical Infrastructure Interdependencies.

Is each of these risk profiles still relevant?

	Yes	No
Grid Transformation	○	○
Extreme Natural Events	○	○
Security Risks	○	○
Critical Infrastructure Interdependencies	○	○

Other profiles for consideration?

Grid Transformation

In the 2019 ERO Reliability Risk Priorities Report, the following are the identified risks under Grid Transformation, considering current times, are these risks still relevant?

	Yes	No
Changing Resources Mix	○	○
Bulk Power System Planning	○	○
Resource Adequacy and Performance	○	○
Increasing Complexity in Protection and Control Systems	○	○
Human Performance and Skilled Workforce	○	○
Loss of Situational Awareness	○	○

Are there other identified risks to be considered under Grid Transformation?

The following are the recommended mitigation activities under Grid Transformation. Are these activities still appropriate?

If you think the mitigation activity is still appropriate, how effective do you think the activity will be at reducing the likelihood and impact of a reliability event associated with the risks listed above. Please choose:

High – Significant measurable mitigation is achieved
Medium – a moderate, but measurable mitigation is achieved
Low – Little or no measurable mitigation is achieved

	Activity Still Appropriate	Likelihood Reduction	Impact Reduction
Update data, modeling and assessment requirements to ensure valid and accurate results given resource and grid transformation (ongoing effort).			
The technical committees should establish and implement an approach to evaluate the potential impacts of energy storage on reliability.			
Improve inverter-based resource BPS interconnection and operation and stay abreast of new technologies, such as storage/hybrid resources.			
Ensure sufficient operating flexibility at all stages of resource and grid transformation.			

Are there other mitigation activities for consideration?

Extreme Natural Events

In the 2019 ERO Reliability Risk Priorities Report, the following are the identified risks under Extreme Natural Events, considering current times, are these risks still relevant?

	Yes	No
Hurricanes, Tornados/Derecho, Extreme Heat/Drought, Wild Fires, Flooding, Extreme Cold	○	○
Earthquakes	○	○
Geomagnetic Disturbances	○	○

Are there other extreme natural events to consider?

The following are the recommended mitigation activities under Extreme Natural Events. Are these activities still appropriate?

If you think the mitigation activity is still appropriate, how effective do you think the activity will be at reducing the likelihood and impact of a reliability event associated with the risks listed above. Please choose:

High – Significant measurable mitigation is achieved
Medium – a moderate, but measurable mitigation is achieved
Low – Little or no measurable mitigation is achieved

	Activity Still Appropriate	Likelihood Reduction	Impact Reduction
Special assessments of extreme natural event impacts, including capturing lessons learned, creating simulation models, and establishing protocols and procedures for system recovery and resiliency.			
Development of tools for BPS resiliency			
Understanding of Geomagnetic Disturbance (GMD) events on BPS.			

Are there other mitigation activities for consideration?

Security Risks

In the 2019 ERO Reliability Risk Priorities Report, the following are the identified risks under Security Risks, considering current times, are these risks still relevant?

	Yes	No
Physical Security Risks	○	○
Cyber Security Risks	○	○
Electromagnetic Pulse Risk	○	○

Are there other security risks to consider?

The following are the recommended mitigation activities under Security Risks. Are these activities still appropriate?

If you think the mitigation activity is still appropriate, how effective do you think the activity will be at reducing the likelihood and impact of a reliability event associated with the risks listed above. Please choose:

High – Significant measurable mitigation is achieved
Medium – a moderate, but measurable mitigation is achieved
Low – Little or no measurable mitigation is achieved

	Activity Still Appropriate	Likelihood Reduction	Impact Reduction
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).			
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).			
NATF and NAGF should develop supply chain cyber security superior practices.			
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, 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.			
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's EMP taskforce should highlight key risk areas that arise from the EPRI's EMP analysis for timely industry action.			

Are there other mitigation activities for consideration?

Critical Infrastructure Interdependencies

In the 2019 ERO Reliability Risk Priorities Report, the following are the identified risks under Critical Infrastructure Interdependencies, considering current times, are these risks still relevant?

	Yes	No
Sector interdependence is becoming more critical, such as the added importance of digital communications for electric system protection and control and voice communications for emergency response and restoration.	○	○
Subsector interdependence is increasing (e.g., growing reliance on natural gas as an electrical generation fuel source with potential needs for fuel switching in the event of natural gas unavailability), creating the potential for more limiting contingencies, including single-point failures.	○	○
Cross-sector and subsector implications and coordination are not routinely socialized or thoroughly tested during drills.	○	○
Governmental oversight and regulatory constructs differ widely among the sectors and subsectors, impeding information sharing and alignment.	○	○

Are there other critical infrastructure interdependencies to consider?

The following are the recommended mitigation activities under Critical Infrastructure Interdependencies. Are these activities still appropriate?

If you think the mitigation activity is still appropriate, how effective do you think the activity will be at reducing the likelihood and impact of a reliability event associated with the risks listed above. Please choose:

High – Significant measurable mitigation is achieved
Medium – a moderate, but measurable mitigation is achieved
Low – Little or no measurable mitigation is achieved

	Activity Still Appropriate	Likelihood Reduction	Impact Reduction
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 considerations in industry drills (e.g., NERC Grid-Ex, DOE drills, utility exercises (e.g., Southern California Edison (SCE) Resilient Grid Exercise)).			
NERC should evaluate the need to conduct special regional assessments that address natural gas availability and pipeline impacts under physical attack scenarios.			
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.			

Are there other mitigation activities for consideration?

Risk Ranking

Considering your responses above, please rank the 10 identified risks with 10-highest, 1-lowest.

	10	9	8	7	6	5	4	3	2	1
Changing Resource Mix	○	○	○	○	○	○	○	○	○	○
Bulk Power System Planning	○	○	○	○	○	○	○	○	○	○
Resource Adequacy and Performance	○	○	○	○	○	○	○	○	○	○
Increasing Complexity in Protection and Control Systems	○	○	○	○	○	○	○	○	○	○
Human Performance and Skilled Workforce	○	○	○	○	○	○	○	○	○	○
Loss of Situational Awareness	○	○	○	○	○	○	○	○	○	○
Extreme Natural Events	○	○	○	○	○	○	○	○	○	○
Physical Security Vulnerabilities	○	○	○	○	○	○	○	○	○	○
Cybersecurity Vulnerabilities	○	○	○	○	○	○	○	○	○	○
Critical Infrastructure Interdependencies	○	○	○	○	○	○	○	○	○	○

Considering your responses above, please classify the 10 identified risks as:

Monitor (risks that have been long recognized with commensurate NERC and industry monitoring for proper mitigation), or

Manage (newly emerging, requiring active management with a more aggressive immediate approach necessary for effective foresight and mitigation).

	Monitor	Manage
Changing Resource Mix	○	○
Bulk Power System Planning	○	○
Resource Adequacy and Performance	○	○
Increasing Complexity in Protection and Control Systems	○	○
Human Performance and Skilled Workforce	○	○
Loss of Situational Awareness	○	○
Extreme Natural Events	○	○
Physical Security Vulnerabilities	○	○
Cybersecurity Vulnerabilities	○	○
Critical Infrastructure Interdependencies	○	○

Thank you for taking the time to complete the 2020 RISC Emerging Risks Survey!

NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Agenda
2021 Reliability Leadership Summit

January 26, 2021 | 1:00-5:00 p.m. Eastern
January 27, 2021 | 1:00-5:00 p.m. Eastern

January 26, 2021 | Panelist WebEx Link

Welcome Remarks — 1:00–1:15 p.m.

***Nelson Peeler*,** Senior Vice President, Transmission and Fuels Strategy and Policy, Duke Energy, and RISC Chair
Mark Lauby, Senior Vice President and Chief Engineer, NERC

Opening Keynote — 1:15–1:45 p.m.

Cheryl LaFleur, Former Commissioner and Chairman, FERC

Panel 1 – Grid Transformation — 1:45–2:45 p.m. - Panel; 2:45–3:00 p.m. - Q&A

Panelists
Patricia Hoffman, Principal Deputy Assistant Secretary, Office of Electricity, DOE
Elliot Mainzer, CEO, CAISO
Julia Matevosyan, Lead Planning Engineering, ERCOT
Jesse Jenkins, Assistant Professor, Princeton University

Moderator
Mark Ahlstrom

Public inputs along with the influence of regulatory and socioeconomic policies are continuing to drive a significant evolution in the mix of power resources. 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. The transformation of generating resources and fuel sources along with changes in load characteristics are creating new reliability risks from long and short-term planning to real-time operations. Impacts and considerations include: 1) Bulk Power System planning; 2) Resource adequacy and performance; 3) Increased complexity in protection and control systems; 4) Situational Awareness challenges; 5) Human performance and skilled workforce; and 6) Changing resource mix.

This panel will discuss the transformation of the grid, the challenges that they poise for their integration, and reliability and security impacts and considerations.

Break — 3:00–3:15 p.m.

Panel 2 – Extreme Natural Events

3:15–4:15 p.m. – Panel
4:15–4:30 p.m. – Q&A

Would Extreme natural events be a good place holder for providing further emphasis on the pandemic?

Panelists
Carla Peterman, Senior Vice President Regulatory Affairs, Southern California Edison
Ken Peterson, CEO, BC Hydro
Nicholas Andersen, Principal Deputy Assistant Secretary, CESER, DOE
Jim Schott, VP of Transmission, Entergy Corporation

Moderator
Priti Patel

Some extreme natural events (e.g., storms, wildfire) cause a significant proportion of major Bulk Power System impacts. Other extreme events (e.g. pandemics) are "people" events where staff availability can impact essential functions of system operations, maintenance, testing and construction, while at the same time creating uncertainty in load patterns and generation requirements. Natural events may affect BES equipment, resources, or infrastructure required to operate the BES. Certain events are unique to areas that they impact while others may have widespread impacts. Each type of event brings unique challenges from supply sufficiency, spare-parts availability, delivery, and restoration perspectives. Preparation and proactive planning of procedures and protocols are critical for utilities to assess and determine appropriate steps for both reliability and resiliency.

This panel will discuss any lessons learned and unique challenges posed by extreme natural events, and ways to prepare for them.

Open Discussion

4:30–4:45 p.m.

Moderators
Jennifer Sterling and Maury Galbraith

In this open-format discussion, Summit attendees will share thoughts and ideas on the priority and significance of BPS reliability risks. This discussion will concentrate on distilling the observations and themes discussed in the earlier panels, identifying potential blind spots or risks not revealed during the Summit panels or from general industry experience, and outlining strategic approaches for consideration by the ERO Enterprise, industry, policy makers, regulators, and other stakeholders in addressing significant emerging reliability risks. Discussion items can be, but are not limited to, practical BPS operations and planning, policy development at the FERC, NERC, or Regional Entity level (*e.g.*, standards and requirements), critical infrastructure protection, etc. *See* reference material: 2019 ERO Reliability Risk Priorities Report.

Wrap-up - Nelson (include look ahead for next day)

4:45–5:00 p.m.

Virtual Reception

5:30-6:30 p.m.

Dr. Peter Fox-Penner

Dr. Fox-Penner is a frequent speaker on energy topics and the author of numerous published articles and books, including the highly acclaimed *Smart Power: Climate Change, the Smart Grid, and the Future of*

Electric Utilities (Island Press, 2010) and its sequel *Power After Carbon: Building a Clean, Resilient Grid* (Harvard University Press, 2020). His research has been widely cited, including in one Supreme Court decision.

January 27, 2021 | Panelist WebEx Link

Welcome Remarks — 1:00–1:15 p.m.

Brian Slocum, ITC Holdings
Mark Lauby, Senior Vice President and Chief Engineer, NERC

Opening Keynote — 1:15–1:45 p.m.

Jacinda B. Woodward, Senior Vice President, Power Operations, Tennessee Valley Authority

Panel 3 – Security Risks — 1:45–2:45 p.m. - Panel; 2:45–3:00 p.m. - Q&A

Panelists
Michele Guido, Southern Company
Tom Galloway, CEO, NATF
Dr. Marilyn Brown, Georgia Tech
Manny Cancel, CEO, E-ISAC
Michael Russell, Manager Energy, Finance, and Telecommunications Sectors, Canadian Centre for Cyber Security

Moderator
Sylvain Clermont

Operational security is an essential component of a highly reliable Bulk Power System. Cyber and physical security are interdependent aspects as exploitation of either physical or cyber security risks could be used to compromise the other dimension. Resulting impacts could cause asset damage or loss of functionality and situational awareness needed to reliably operate or restore the Bulk Power System. Exploitation could occur directly against equipment used to monitor, protect, and control the Bulk Power System or indirectly through supporting systems, such as voice communications or interdependent critical infrastructure sectors[8] 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 Bulk Power System may impact operations and result in damaged equipment that may require an extended period of time to replace.

This panel will focus on these risks, its evolution, and potential mitigations.

Break — 3:00–3:15 p.m.

Panel 4 – Critical Infrastructure Interdependencies

3:15–4:15 p.m. – Panel
4:15–4:30 p.m. – Q&A

Panelists
Joy Ditto, CEO, APPA
Bruce Walker, Head of Energy Risk Operations / Energy Chief Risk Officer, ARC
Rod Kalbfleisch, Director Substation Technical Engineering, Eversource
Dena Wiggins, President and CEO, Natural Gas Supply Association

Moderator
Peter Brandien

Significant and evolving critical infrastructure sector (e.g., communications, water/wastewater) and subsector (e.g., oil, natural gas) interdependencies are not fully or accurately characterized, resulting in incomplete information about prospective Bulk Power System response to disruptions originating from or impacting other sectors or subsectors and resultant reliability and security implications.

This panel will explore the implications of the increased interdependencies, and how best to address the jurisdictional issues that need to be tackled to address the risks they present.

Open Discussion

4:30–4:45 p.m.

Moderators
Teresa Mogensen and Woody Rickerson

In this open-format discussion, Summit attendees will share thoughts and ideas on the priority and significance of BPS reliability risks. This discussion will concentrate on distilling the observations and themes discussed in the earlier panels, identifying potential blind spots or risks not revealed during the Summit panels or from general industry experience, and outlining strategic approaches for consideration by the ERO Enterprise, industry, policy makers, regulators, and other stakeholders in addressing significant emerging reliability risks. Discussion items can be, but are not limited to, practical BPS operations and planning, policy development at the FERC, NERC, or Regional Entity level (*e.g.*, standards and requirements), critical infrastructure protection, etc. *See* reference material: 2019 ERO Reliability Risk Priorities Report.

Conduct real-time poll on any missing links, any reprioritization based on discussion from the Summit.

Closing Remarks

4:45–5:00 p.m.

Jim Robb, NERC President and CEO

2021 Reliability Indicators

Action
Review

Summary
As part of NERC's effort to represent the current status of critical indicators to bulk power system (BPS) reliability, the Reliability Issues Steering Committee (RISC) formed a subcommittee to review the existing metrics that have been reported to the Corporate Governance and Human Resources Committee (CGHRC) and the Board of Trustees (Board) on an on-going basis. The efforts of this subcommittee have resulted in some modifications to those key indicators as well as the formulation of some new indicators.

Previously the data was presented as "Metrics". Beginning in 2020 the data began to be referred to as key indicators which is more representative of what is being presented. These indicators provide insight into the state of the grid as well as providing a lens into certain trends and patterns that may indicate a necessity for further analysis, study, or stakeholder engagement to drive industry toward potential solution sets. Hence the term "indicators" rather than "metrics".

The RISC subcommittee recommended that rather than a dashboard for each indicator, relevant charts and graphs that demonstrate the actual data and the associated trends be depicted. This will allow for better understanding of the key data points and trends. A further discussion of each indicator and changes from 2020 are discussed below:

- **Indicator 1** – It will be important to continue to monitor events and the severity of events including those that are Category 3 and above. This indicator will be similar to 2020.
- **Indicator 2** – Compliance violations will continued to be measured as an indicator and will be similar to 2020.
- **Indicator 3** – Protection System Misoperations rate will continue to be studied as a key industry indicator. This rate will be shown as a graphical depiction using a bar chart to demonstrate relative trending of this indicator.
- **Indicator 4** – This indicator will be modified in 2021 to provide insight into forced outage rates across all fuel types, not natural gas only as was the case in 2020. The indicator will be visually enhanced to show timing, trends, and key events that have been associated with forced outage rates.
- **Indicator 5** – This indicator will continue to report on TADS data as well as vegetation encroachment. The graphics have been visually enhanced for 2021.
- **Indicator 6** – this indicator is being modified in 2021 to show BPS disruptions as a result of physical or cyber events rather than previously where it indicated physical and cyber events without tying them to a BPS disruption.

- **Indicator 7** – This indicator will show real power balancing control performance (BAAL). This previously showed disturbance control events greater than the single most severe contingency.
- **Indicator 8** – This indicator will show interconnection frequency response. It will be shown as starting frequency less nadir versus 2020 which showed interconnection frequency response versus the interconnection frequency response obligation.
- **Indicator 9** – This new indicator will show distributed energy resources along with a forward projection which will demonstrate the need for such things as inertial support and ramping capability. It serves as a potential indicator to have a forward look of potential BPS risks.
- **Indicator 10** – This new indicator will demonstrate a long term view of the resource mix, providing more insight into the effects of grid transformation on BPS reliability.

The updated 2021 ERO Enterprise Reliability Indicators will be presented at the February 2021 open Board meeting. 2020 ERO Enterprise Reliability Indicators are available on NERC's website.

NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Reliability Indicators Primers

Proposed November 2020

RELIABILITY | RESILIENCE | SECURITY




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

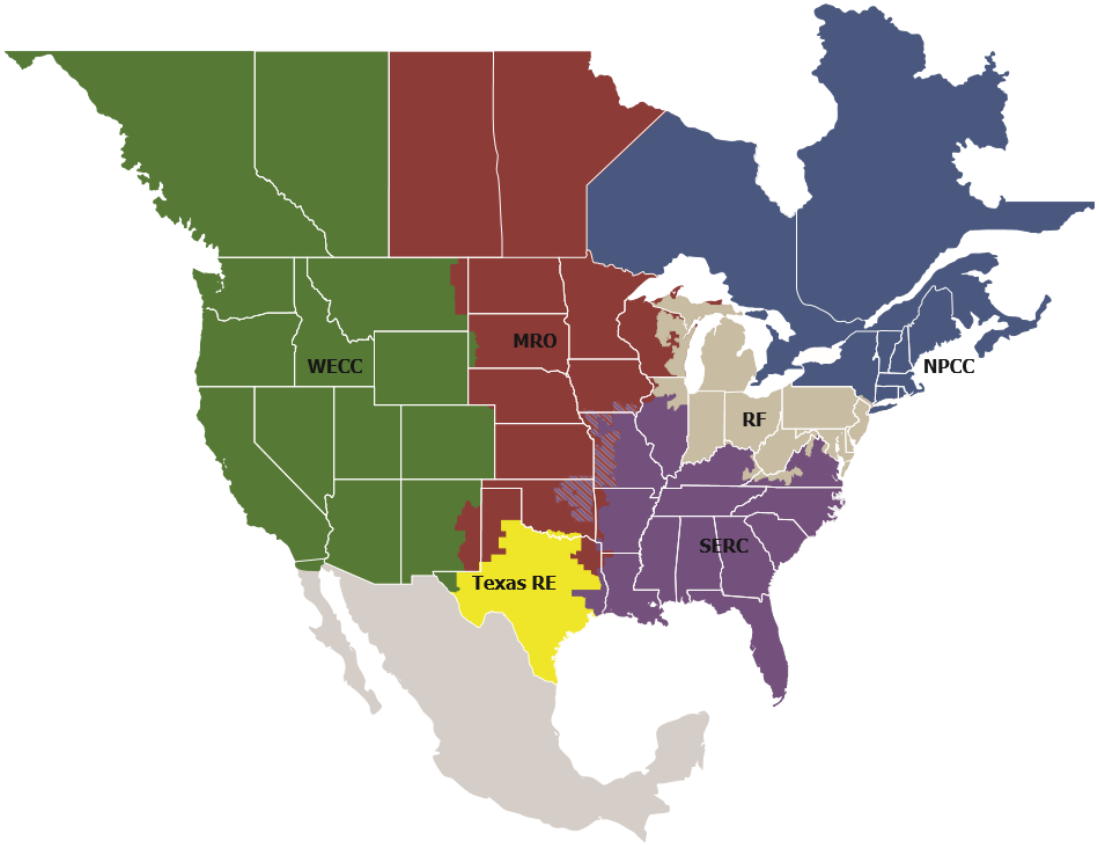
Table of Contents

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 (REs), 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 RE 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	WECC

Indicator 1: (Fewer, Less Severe Events) Primer

The ERO Event Analysis Process (EAP) defines certain categories of events that meet a threshold considered significant enough to capture lessons learned that can inform risk monitoring and mitigation of daily operations on the BPS. Quantifying the potential impact of these events improves the global risk picture of BPS operation. This indicator is one way to acknowledge proportional contributions from generation and transmission to loss of load.

The daily event severity risk index (eSRI) is a composite daily measure of the load loss due to transmission and/or generation resources on the BPS. It is calculated for each event on a given day with a cumulative value of all events assigned to that day. The index uses weighted load loss, transmission loss, and generation loss based on importance to risk. The eSRI equation is as follows:

$$eSRI=1000 * (RPL * w_L * (MW_L) + w_T * (N_T)+ w_G * N_G)$$

Where
w_L = 60%, weighting factor load loss
w_T = 30%, weighting factor transmission lines lost
w_G = 10%, weighting factor generators lost

MW_L = normalized MW of Load Loss in percent,
N_T = normalized number of transmission lines lost in percent,
N_G = normalized number of generators lost in percent,
RPL = load Restoration Promptness Level:
RPL = 1/3, if restoration < 4 hours,
RPL = 2/3, if 4 ≤ restoration < 12 hours,
RPL = 3/3, if restoration ≥ 12 hours

A linear regression is performed by using a rolling five-year period of daily eSRI calculations in an effort to describe the correlation of event occurrence with any given day on the operating the system. The regression line provides a means to predict the average value for a chosen date of the eSRI. A lower eSRI is considered more favorable, so it is best to maintain a flat to negative slope of the regression line, meaning there are fewer events with less overall severity occur. Confidence intervals (95%) are calculated in an effort to provide assurance that event occurrence based on the sample defined by the EAP category definitions statistically characterizes the true population of event occurrences associated with operating the BPS. Statistically significant changes to the sample are identified and evaluated if the regression line and bounding confidence intervals all become positive.

The direction of the regression line drives the status modification of the risk indicator as follows:

- A falling slope indicates increasing performance (green).
- A flat slope indicates neutral (white).
- A rising slope indicates decreasing performance (red).

The EAP provides a mechanism to influence the improvement of system performance as well as captures lessons learned and system performance trending. Performance trending supports identifying the need for potential action(s) (e.g., a NERC alert), provides data for reports (e.g., the annual State of Reliability report), or may initiate the need for the development/revision of Reliability Standards. The outcomes from event analysis and cause coding assignment help to inform the industry in a way that facilitates improved reliability of daily operations and thus the maintenance of a falling slope for the eSRI curve.

Indicator 1 supports the following RISC identified risk profiles:

- Changing Resource Mix
- Bulk-Power System Planning
- Resource Adequacy and Performance
- Human Performance and Skilled Workforce
- Loss of Situational Awareness
- Physical Security Vulnerabilities
- Cybersecurity Vulnerabilities

Data Source: The Event Analysis Management System

Indicator 2: Compliance Violations

Maintaining compliance with NERC Reliability Standards is one of the key components of risk management. Indicator 2 reflects the registered entities' efforts to maintain compliance with these standards as a means to reduce risk to BPS reliability. In the majority of reported violations, there has been no actual harm to the reliability of the BPS.

The three subsets of Indicator 2 are the following:

- Moderate and serious risk noncompliance with a relevant history of similar past conduct[1] and measured as the percentage of moderate and serious risk violations with a relevant compliance history of similar past conduct compared with total noncompliance filed with FERC[2]
- The number of violations discovered through self-reports and measured as the percentage of noncompliance self-reports[3]
- The risk to the BPS based on the severity of standard violations and measured as a three-year rolling average of the percentage of serious risk violations filed compared to the total noncompliance field with FERC in a given year[4]

The Compliance Monitoring and Enforcement Program (CMEP) quarterly report provides more insight about these three subsets of Indicator 2 and includes additional information for clarity and context.

The 2020 ERO Enterprise Compliance Monitoring and Enforcement Program Implementation Plan[5] also describes how identified risks from various resources, including the ERO Reliability Risk Priorities Report (Board Accepted November 5, 2019)[6] are translated into risk elements that are used in the reshaping of registered entities' compliance oversight plan. In that respect, this indicator supports three of the four high-level risks: grid transformation, extreme natural events, and security risks.[7] This indicator supports all of the RISC profiles identified in the *Reliability Risk Report*.

[1] To measure the effectiveness of the risk-based CMEP in reducing noncompliance, NERC reviews moderate and serious risk violations and includes them in one of three categories: noncompliance with no prior compliance history, noncompliance with prior compliance history that does not involve similar conduct, and noncompliance with compliance history that includes similar conduct.
[2] Enforcement filings and postings https://www.nerc.com/pa/comp/CE/Pages/Enforcement-and-Mitigation.aspx
[3] Data source: NERC Compliance Reporting and Tracking System
[4] *Supra fn 1*
[5] 2020 ERO Enterprise Compliance Monitoring and Enforcement Program Implementation Plan
[6] ERO Reliability Risk Priorities Report (Board Accepted November 5, 2019)
[7] The four high-level risks from the *ERO Reliability Risk Priorities* report are grid transformation, extreme natural events, security risks, and critical infrastructure interdependencies.

Indicator 3: Protection System Misoperations Rate Primer

Sub indicator 3a: Annual Misoperations Rate

The protection systems misoperations rate indicator provides the performance of protection systems for both generation and transmission on the BPS. The Misoperations Information Data Analysis System collects counts of protection system operations and details on the misoperation events of protection systems from registered entities. The data for this indicator is reported quarterly (60 days after the end of each quarter) and requires all four quarters to compute. This indicator will only be updated in the Q3 dashboard each year.

Calculation: The indicator is calculated as the ratio of misoperations to total protection system operations both at the Regional Entity level and overall for NERC.

Regional Entities work with registered entities to analyze misoperations events and provide valuable lessons learned to the industry. The results of such analyses have also informed the development of detailed data reporting instructions and other reference materials to improve clarity and consistency in reporting misoperations; the data reporting instructions are available on the Protection System Misoperations page of the NERC website.[8]

This indicator supports Focus Area 2 of *the ERO Long-Term Strategy*[9] and the *ERO 2020 Work Plan Priorities*.[10]

Key Objective 1: Identify performance trends and develop lessons learned, recommendations, and/or implement mitigations

Data Source: Misoperation Information Data Analysis System

[8] https://www.nerc.com/pa/RAPA/Pages/Misoperations.aspx

[9] https://www.nerc.com/AboutNERC/StrategicDocuments/ERO%20Enterprise%20Long-Term%20Strategy%20(Approved%20December%2012,%202019).pdf

[10] https://www.nerc.com/AboutNERC/StrategicDocuments/FINAL_ERO%20Performance%20Objectives_Board_Approved_Feb_6_2020.pdf

Indicator 4: Forced Outage Rate during Cold Weather Months and Potential Production MWH Loss Due to Lack of Fuel

Sub Indicator 4a: No Firm Load Loss Due to Natural-Gas-Fired Unit Outages during Cold Weather

The annual measurement for no firm load loss due to natural-gas-fired unit outages during cold weather will be captured for immediate forced outages that occur during the months of January, February, March, and December of the same calendar year.

This indicator captures immediate firm load loss on forced unit outages for natural-gas-fired units during cold weather months. This indicator will be captured using energy emergency alerts (EEA3) as well as the OE-417 and EOP-004 reports and will be reported on a quarterly basis for the annual report.

Sub indicator 4b: No Firm Load Loss Due to Natural Gas Unavailability

This sub indicator is the annual measurement for no firm load loss on natural-gas-fired generation units due to natural gas unavailability indicator. It captures natural-gas-fired unit unavailability for the entire calendar year.

This indicator captures immediate firm load loss on forced natural gas units due to natural gas unavailability across the entire year. This indicator will be captured with EEA3s, OE-417, and EOP-004 reports and will be reported on a quarterly basis for the annual report.

Situation awareness allows for an opportunity to analyze information on system disturbances and other incidents that impact the North American BPS. Situation awareness also allows for the dissemination of information to internal departments, registered entities, regional organizations, and other stakeholders within the industry as necessary. Trending and early detection of events within the first 24–48 hours allows for sustained events to be shared with the Events Analysis team for further monitoring and analysis to ensure safe and reliable BES operation. Early detection of events is also shared with the RA group for input into the State of Reliability report and NERC alerts if deemed necessary. The outcome of increased situation awareness helps inform the industry of potential trends and impacts on the BES and provides improved reliability of the daily operation of the BES during extreme weather and other impactful events maintaining the green status on the indicator (see **Figure 4.1**).

Figure 4.1: Indicator

Sub Indicator 4c: Weighted Equivalent Forced Outage Rate by Fuel Type during Cold Weather Season (December–March)

The weighted equivalent forced outage rate (WEFOR) shows outage rates by cold weather season. The WEFOR is a holistic availability indicator that includes forced outages and derates during the evaluation period; the lowest available granularity is monthly. This indicator shows a comparison of the WEFOR chronologically for the past five cold weather seasons for major fuel types.

Due to the seasonal nature of this indicator, it will only be updated in the Q1 and Q2 dashboards each year.

Calculation: The WEFOR is calculated, as shown below for each cold weather season, includes the consecutive months of December, January, February, and March.

$$\mathbf{WEFOR} = \Sigma\ ((\mathbf{FOH} + \mathbf{EFDH})\ \mathbf{x}\ \mathbf{NMC}) \Sigma\ ((\mathbf{FOH} + \mathbf{SH} + \mathbf{Synchronous\ Condensing\ Hours} + \mathbf{Pumping\ Hours} + \mathbf{EFDHRS})\ \mathbf{x}\ \mathbf{NMC})\ \mathbf{x}\ 100\%$$

Training materials and data reporting instructions provide details to increase quality of the causes of forced outages due to cold weather. The ERO Enterprise conducts training, outreach, and education annually to support generation in combating cold weather outages.

Sub Indicator 4d: Quarterly Potential Production MWH Lost by Fuel Type Due to Lack of Fuel Over a Five-Year Period

This indicator shows the percentage of potential production MWH lost for periods when production was needed, but the unit was unavailable due to lack of fuel. It is the sum of each unit's net maximum capacity multiplied by the duration of each outage by fuel type caused by the two lack of fuel cause codes divided by the sum of each unit's net maximum capacity multiplied by the unit service hours by fuel type. Unit service hours include hours when the units were needed.

The following cause codes are included in this indicator:

- 9130 LACK OF FUEL: physical supply failures, or where the operator is not in control of contracts or interruption of fuel delivery
- 9131 LACK OF FUEL: contract or tariff allows for interruption
- SUM: (NMC*[Lack of Fuel Outages])/SUM(NMC*[Unit Service Hours])
- Calculation: SUM(NMC*[Lack of Fuel Outages])/SUM(NMC*[Unit Service Hours])

Improved descriptions and examples of cause codes associated with fuel availability have been added to the data reporting instructions to provide clarification on the appropriate use of these cause codes.

This indicator supports Focus Area 1 of the *ERO Long-Term Strategy*[11] and the *ERO 2020 Work Plan Priorities.*[12]

- Key Objective 1: Implement strategy for fuel assurance standards (including cold weather)
- Data Source: EOP-004, OE-417 and Energy Emergency Alerts (EEA3) (4a, 4b)
- Data Source: Generating Availability Data System (GADS) (4c, 4d)

[11] https://www.nerc.com/AboutNERC/StrategicDocuments/ERO%20Enterprise%20Long-Term%20Strategy%20(Approved%20December%2012,%202019).pdf
[12] https://www.nerc.com/AboutNERC/StrategicDocuments/FINAL_ERO%20Performance%20Objectives_Board_Approved_Feb_6_2020.pdf

Indicator 5a–5b: Reduce AC Transmission Line Forced Outages

Sub Indicator 5a: Operator or Other Human Performance Issues

Calculations:

- **Outages Per Circuit:** This indicator is calculated as the number of transmission line outages caused by human error divided by the total inventory of circuits, resulting in the number of outages per circuit. The indicator year number of outages per circuit is compared to a five-year rolling average.
- **Statistical Significance:** Changes over the five-year period will be evaluated for statistical significance.

The data for this indicator is reported quarterly (45 days after the end of each quarter) and requires a complete year of data. This indicator will only be updated on the Q3 dashboard each year.

Improved descriptions and scenarios associated with human performance are included in the data reporting instructions and training materials to provide clarification on the appropriate use of these cause codes. The ERO Enterprise conducts training, outreach, and education annually to support the industry in the area of human performance and human and organizational error reduction.

This sub indicator supports the following RISC identified risk profiles (ERO Reliability Risk Priorities, February 2018):

- Risk Profile #5: Human Performance and Skilled Workforce
- Risk Profile #7: Extreme Natural Events
- Data Source: Transmission Availability (TADS)

Sub Indicator 5b: Substation Equipment Failures or Failed AC Circuit Equipment

Calculations:

- **Outages Per Circuit:** This indicator is calculated as the number of transmission line outages caused by ac substation equipment failures (such as transformers) and failed ac circuit equipment divided by the total inventory of circuits, resulting in the number of outages per circuit. The number of outages per circuit for the indicator year is compared to a three-year rolling average.
- **Statistical Significance:** Changes over the three-year period will be evaluated for statistical significance.

The data for this indicator is reported quarterly, 45 days after the end of each quarter, and this indicator requires a complete year of data. This indicator will only be updated on the Q3 dashboard each year.

Improved descriptions and scenarios associated with equipment failures are included in the data reporting instructions and training materials to provide clarification on appropriate use of these cause codes. Additionally, valuable lessons learned are published from events that occur on the system involving equipment failure and associated shortcomings.

This sub indicator supports the following RISC identified risk profiles (*ERO Reliability Risk Priorities*, February 2018):

- Risk Profile #4: Increasing Complexity in Protection and Control Systems
- Risk Profile #5: Human Performance and Skilled Workforce
- Risk Profile #7: Extreme Natural Events
- Data Source: Transmission Availability Data System (TADS)

Indicator 5c: Vegetation Encroachment

Ineffective vegetation management was identified as a major cause of the August 14, 2003, blackout and was cited as a major causal factor in other large-scale North American outages. The ERO Enterprise has observed an increase in encroachments into the minimum vegetation clearance distance (MCVD) that result in FAC-003 R2 violations. These violations result from vegetation management programs that have less than adequate procedures to address identified problems or that fail to adapt to changing conditions (e.g., increased precipitation that accelerates vegetation growth).

Indicator 5c monitors the number of sustained outages from vegetation fall-ins into the transmission right-of-way (this is not a violation of the FAC-003 Reliability Standard but is required periodic data reporting per FAC-003) and vegetation encroachments into the MVCD observed, including those in real time and absent a sustained outage (i.e., a violation of the FAC-003 Reliability Standard).[13]

FAC-003 is one of the standards included in the ERO Enterprise's current and past CMEP annual implementation plans that is also related to two of the four high-level risks in the *ERO Reliability Risk Priorities Report*:[14] Extreme Natural Events and Grid Transformation (Human Performance and Skilled Workforce, and Bulk Power System Planning).

The CMEP quarterly report also includes a section that discusses reported vegetation-related sustained outages.

The number of vegetation-related outages from encroachments into the MVCD has been very small, and the outage duration has been very short in all cases.

NERC monitors both vegetation-related sustained outages from inside and outside of the right-of-way. A five-year rolling average is used as monitoring indicator for the number of vegetation contacts or encroachments from inside the right-of-way.[15]

[13] Vegetation Management Reports: https://www.nerc.com/pa/comp/CE/Pages/vegetation-management-reports.aspx

[14] ERO Reliability Risk Priorities Report

[15] While the goal is to have no vegetation encroachments into the MVCD, it is expected that both vegetation-related sustained outages from inside and outside of the right-of-way to stay within or below one standard deviation of their respective five-year averages.

Indicator 6: (Disruptions due to Unauthorized Physical or Electronic Access) Primer

This indicator measures the risk and impact on the BPS from cyber or physical security attacks. The measurement is based on industry submissions of the mandatory NERC Event Reporting (EOP-004) and Department of Energy Electric Emergency Incident and Disturbance Reporting (OE-417) forms. The measurement variable is the number of disruptions of BES facilities due to cyber attacks or physical attacks. For the purposes of this indicator, disruption means that a BES facility was removed from service as a result of the cyber or physical incident.

The term "cyber and physical attacks" is not defined for the purpose of this indicator but is understood to broadly include any reported occurrences generally involving cyber or physical security. The indicator's clarification of the term "disruption" still leaves room for interpretation but is understood here to be limited to a BES facility removed from service by automatic or manual means either as a direct result of the attack or as an immediate operational mitigation of the attack's effects. Future controlled or planned outages for inspection or repairs are not considered to be a disruption for the purpose of this indicator since, by definition, the system can be operated appropriately around constraints imposed by planned outages.

While the indicator's meaning is inconsistent with how many security professionals define "attack," this larger aperture allows the Electricity Information Sharing and Analysis Center (E-ISAC) to review all submissions of the reports to understand the reported issue and the impact to the BES while working in close coordination with NERC's BPS Awareness group. The E-ISAC also receives and reviews voluntary event reports, but these voluntary reports are not included in this indicator.

This indicator supports the following RISC identified risk profiles:

- Physical Security Vulnerabilities
- Cyber Security Vulnerabilities

Indicator 7: Real Power Balancing Control Performance

The NERC Reliability Standard BAL-001-3 states that each Balancing Authority (BA) shall operate such that its clock-minute average of reporting area control error (ACE) does not exceed its clock-minute BA ACE limit (BAAL) for more than 30 consecutive clock-minutes. The purpose of this metric is to measure risk to the BPS by monitoring the trend in the number of clock minutes in which BAs return their ACE to within their BAAL after an exceedance has occurred.

Indicator performance is determined by the statistical significance of the slope of a linear regression line and tested at the significance level of 5% for the number of BAAL exceedances greater than or equal to 15 minutes as reported by BAs on a quarterly basis for a rolling 16 quarters (i.e., four years).

The BAAL exceedance data used for evaluation of Indicator 7 is obtained from BAs via voluntary quarterly submittals that are requested by the fifteenth day following the end of each quarter. Data collection began in the fourth quarter of 2016 for BAAL excursions that occurred in the third quarter of 2016. The data is reviewed and compiled by the NERC Resources Subcommittee (RS) and presented at their quarterly meetings that occur in the third week following the end of each quarter. When BAs fail to submit data on time, the RS representatives perform outreach to those BAs. Due to the timing in BA data submittals and compilation by the RS, the indicator is updated one quarter in arrears.

Indicator 7 is evaluated on a quarterly basis to determine an annual result by using the aforementioned measurement method. An example is shown in **Figure 7.1**.

Success (green) is achieved when the linear regression line of the most recent four years of quarterly BAAL exceedances greater than or equal to 15 clock minutes has a statistically significant negative slope or when the slope of the time trend is statistically neither increasing nor decreasing. This equates to either improvement or no decline in performance. Failure (red) occurs if slope of the time trend is increasing with statistical significance.

Figure 7.1: Real Power Balancing Control Performance

Indicator 8: Interconnection Frequency Response

Indicator 8 measures risk and impact to the BPS by evaluating the trend in the magnitude of the decline in Interconnection frequency experienced in each Interconnection during low frequency events selected for BAL-003-1 compliance. This metric will evaluate whether the risk of activating under frequency load shed devices is increasing or decreasing in each Interconnection.

The magnitude of the decline will be calculated as the mean difference between the Value A starting frequency and the Point C frequency nadir. As defined in the *2012 Frequency Response Initiative Report* and NERC Standard BAL-003-1, Value A represents predisturbance frequency, the mean frequency from t = -16 seconds to t = -1 seconds, and Value C represents the lowest frequency experienced during the arresting period, t = 0 seconds to t = +12 seconds. The mean difference between Value A and Value C for each Interconnection is reported each year in the *Frequency Response Annual Analysis* (FRAA) report.

Figure 8.1 is a frequency graph that shows the typical low frequency event that results from the loss of a generation resource.

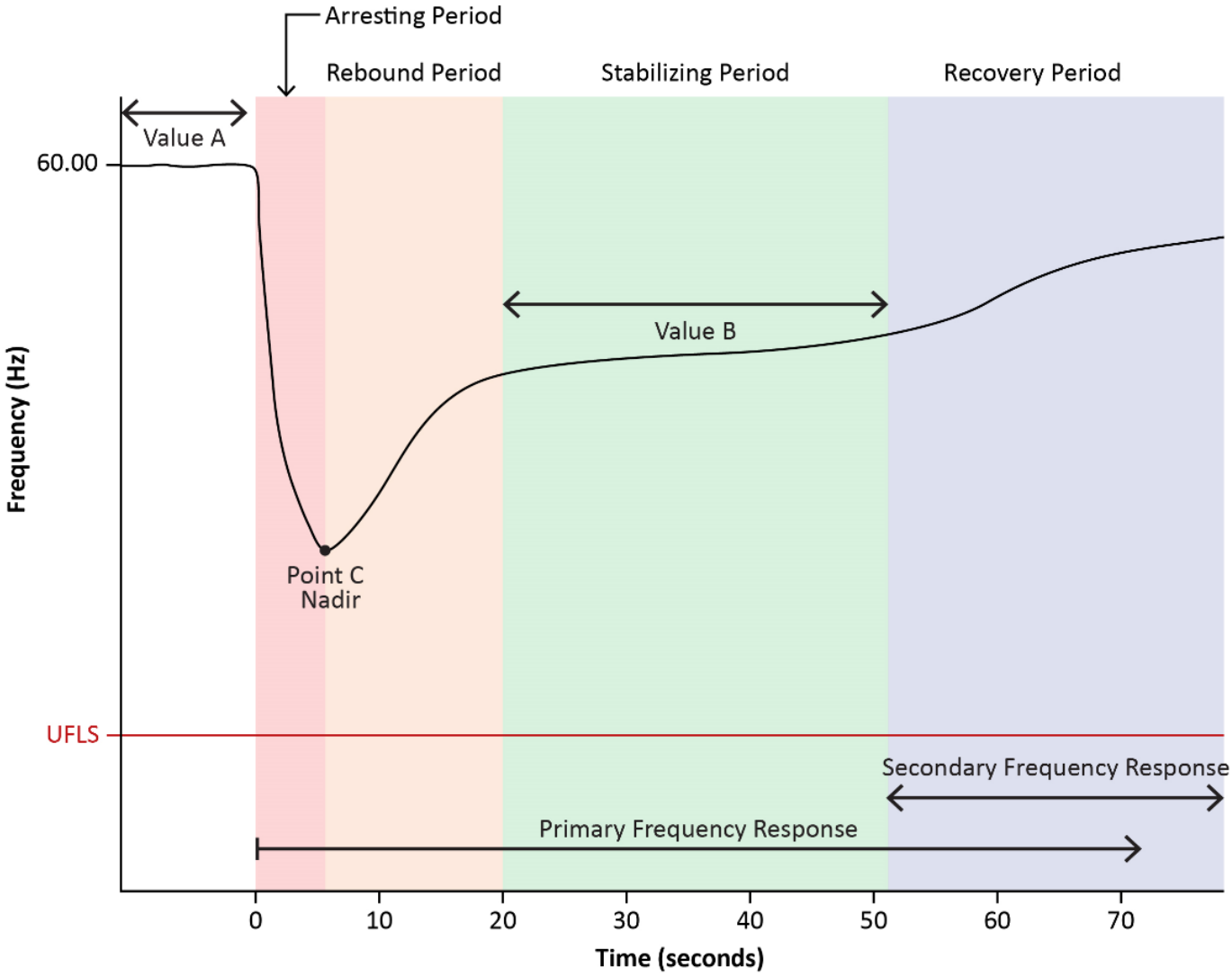


Figure 8.1: Frequency Response

Candidate frequency events are reviewed quarterly by the NERC Frequency Working Group, and events are selected based on Interconnection-specific criteria defined in the BAL-003-1.1 Reliability Standard and supporting documents.

Indicator 8 is evaluated on a quarterly basis to determine an annual result. Due to the timing in selection of events, the indicator is updated one quarter in arrears. An example is shown in **Figure 8.2**.

Success (green) is achieved when the linear regression line of the most recent four years of quarterly mean values of Frequency A minus Frequency C has a statistically significant negative slope or when the slope of the time trend is statistically neither increasing nor decreasing. This equates to either improvement or no decline in performance where Interconnection risk has not changed or declined.

Failure (red) occurs if the slope of the time trend is increasing with statistical significance or if under frequency load shedding is activated for any single BAL-003 frequency event in any Interconnection.

Figure 8.2: Interconnection Frequency Response

Indicator 9: Growth in Distributed Energy Resources

As distributed energy resources (DERs) become more common, they will have a larger effect on BPS reliability. DER trends will provide forward-looking insights into system inertia, frequency response, and the need for ramping requirements. DERs have the potential to be a significant load modifier. As a result, effective forecasting and modeling of DERs becomes critical. This indicator supports the following RISC priorities:

- Changing Resource Mix
- Resource Adequacy and Planning
- Bulk Power System Planning

Data for this indicator comes from the NERC Long-Term Reliability Assessment conducted every year with a ten-year forecast.

An example of what this data might look like is shown in **Figure 9.1**.

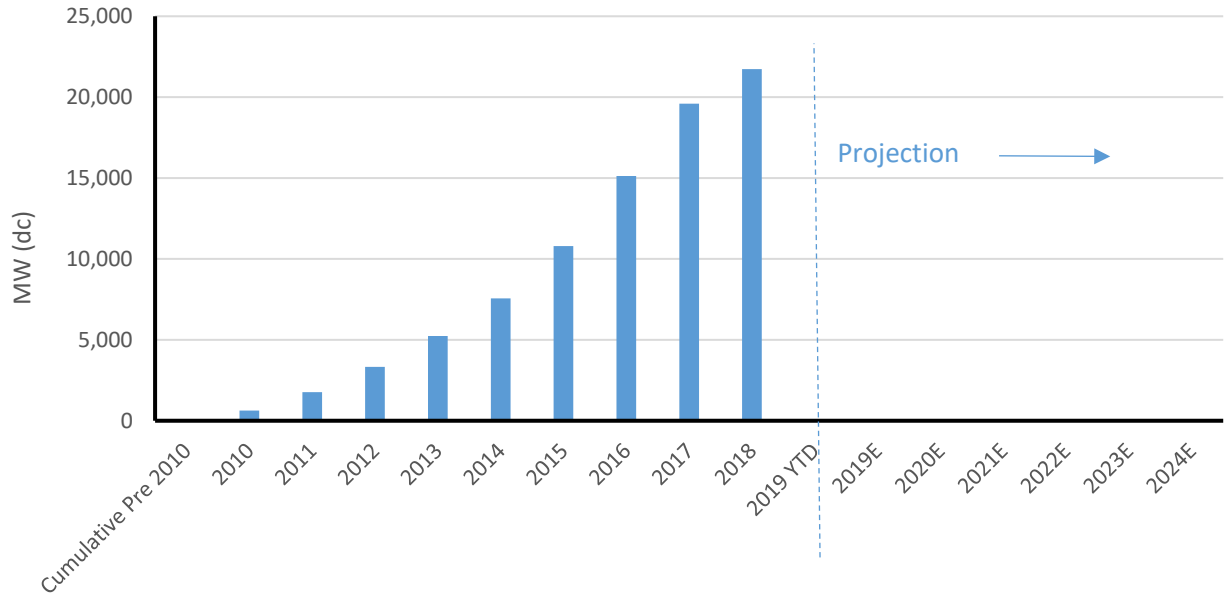


Figure 9.1: U.S. Cumulative Total Amount of Distributed Solar PV 2010–2023

Indicator 10: Monitoring the Change in the Resource Mix

The North American BPS is in the midst of a significant transformation of the resource mix. Emerging technologies (e.g., wind, solar, and battery storage) are increasing their penetrations at a rapid pace. Coal and nuclear continue to retire while natural gas generation continues to grow at unprecedented levels. This transformation in the resource mix poses potential challenges for maintaining essential reliability services, such as frequency response and system inertia. It is important to monitor the change in the resource mix in order to stay informed of potential system challenges. In order to maintain system reliability as a result of a change in the resource mix, NERC continues to evaluate the need for additional reliability guidelines and/or Reliability Standards. This indicator supports the following RISC priorities:

- Changing Resource Mix
- Resource Adequacy and Planning
- Bulk Power System Planning

An example of what this data may look like is shown in **Figures 10.1**, **10.2**, and **10.3** showing the resource mix presently as well as ten years ago and projections for ten years forward.

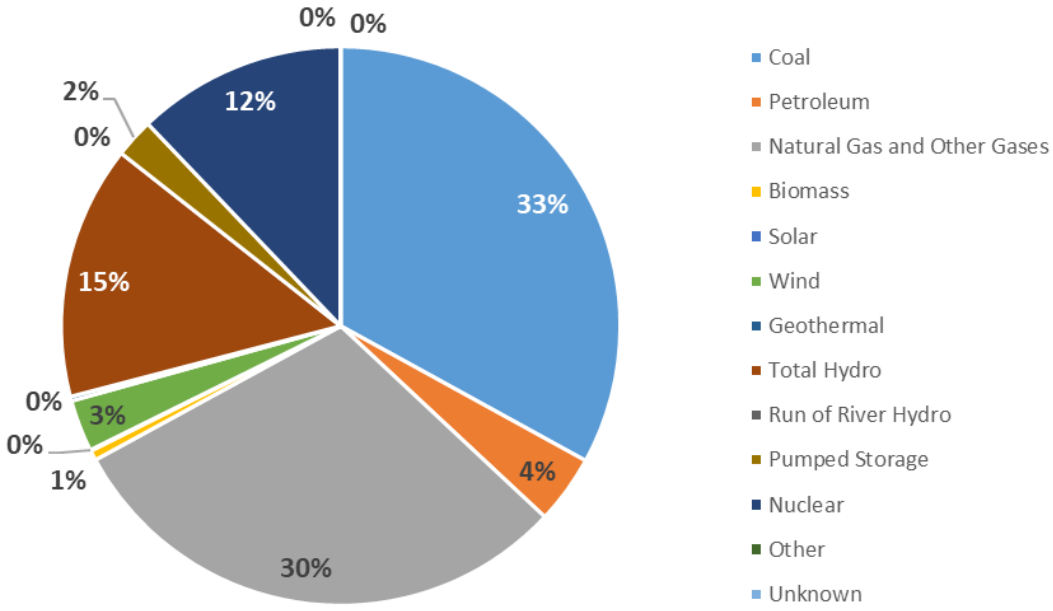


Figure 10.1: Resource Mix 2009

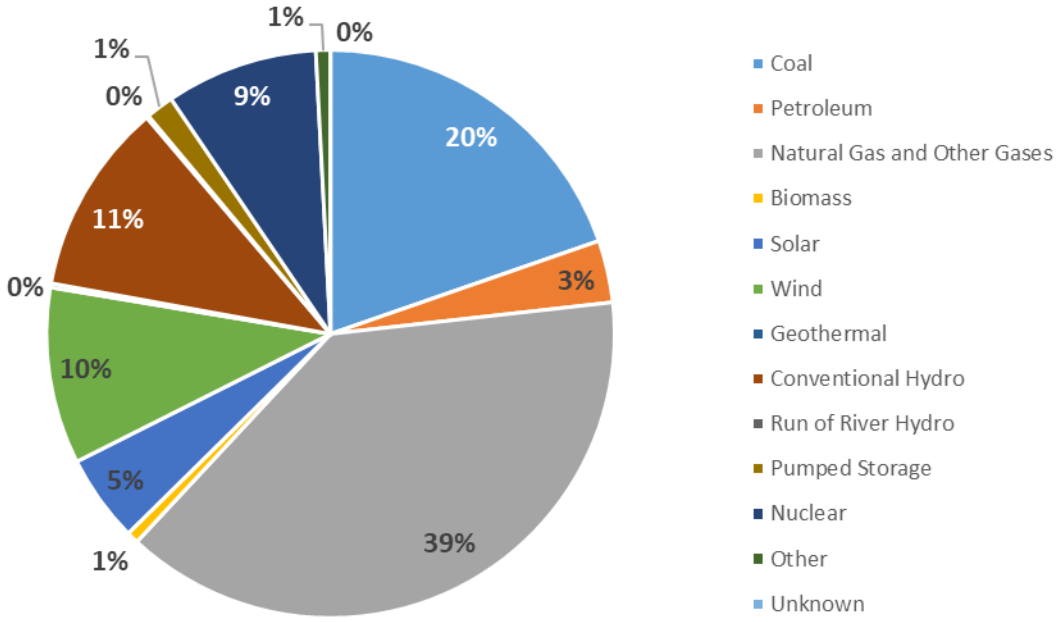


Figure 10.2: Resource Mix 2019

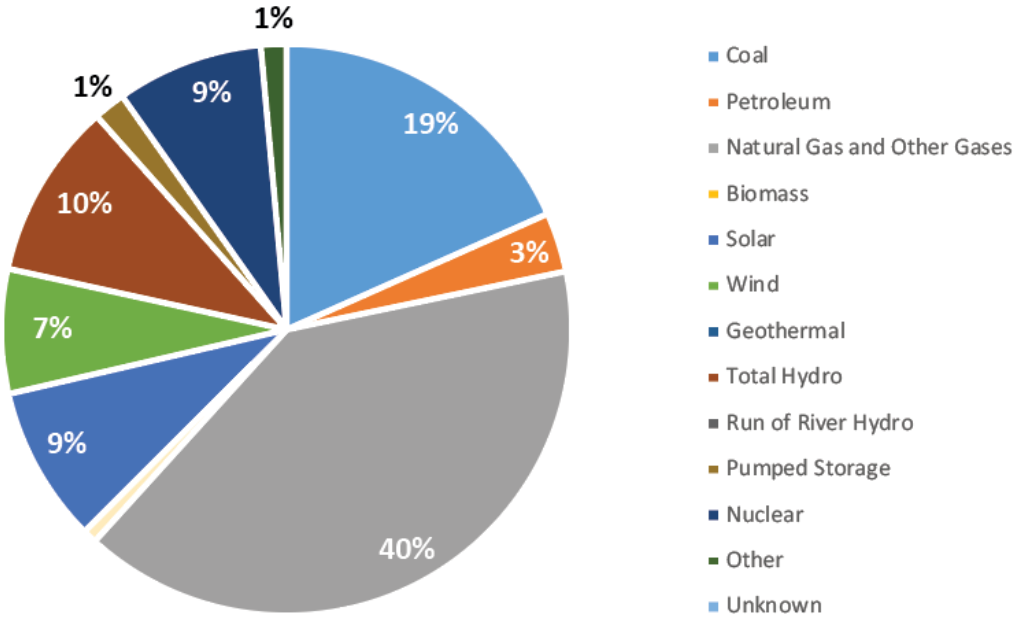


Figure 10.3: Resource Mix 2029