WECC

Extreme Natural Events, Associated Risks, and Possible Mitigation Activities

Reliability Risk Strike Team

April 10, 2024

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Introduction and Background

As part of the Reliability Risk Committee (RRC) Three-Year Work Plan, an activity was identified specific to addressing strategic initiatives for Extreme Natural Events. In response, the RRC agreed to develop a Strike Team composed of RRC members. Steve Ashbaker, WECC Reliability Initiative Director, was assigned as point person for the Work Plan activity.

A request for volunteers was sent out early February 2023. The strike team was organized in late March that same year. The following members made up the Reliability Risk Strike Team (RRST):

- Greg Park—Western Power Pool/Western Electricity Coordinating Council
- Kevin Conway—Pend Oreille County PUD #1/Western Power Pool
- Chris Hofmann—Salt River Project
- Grace Anderson—California Energy Commission
- Tim Beach—RC West
- Brett Hallborg—BC Hydro
- Margaret Albright—Bonneville Power Administration
- CJ Ingersoll—Gridforce Energy Management, LLC

The RRST held their kick-off meeting on April 25, 2023. The purpose of this meeting was to review and finalize the RRST scope of work.

There were four Strategic Initiatives provided by the Reliability Risk Committee (RRC):

1. Identify specific risk areas within the broader topic of "extreme natural events" that pose unique risks to the reliability of the Western Interconnection (WI) Bulk Power System (BPS) that, if addressed, would add the most value to stakeholders. Determine how best to collaborate with the RAC on this initiative.

   Status: The Strike Team identified two categories of Extreme Natural Events; Events related to changing climate and events related to physical forces in Earth and Space. During 2023, the Strike Team collaborated with Staff liaisons of the Y-20 Extreme Hot – 2023 Study Program Assessment and the Y-10/Y-20 Extreme Cold Weather – 2023 Study Program Assessment. The liaisons attended Strike Team monthly calls where they provided updates on the work of these activities and the Strike Team shared work and activities in regard to extreme cold and heat related events.

2. Determine whether and how these specific risk areas are being addressed in the industry and determine how to share these learnings most effectively with stakeholders.

   Status: Please see mitigation activities noted in the mitigation section of each listed Extreme Natural Event.

3. Based on this research, and ranking process of identified risks, determine one or more specific risks the RRC should address via the RRC Risk Management Process.

   Status: The ranking and identification of risks were processed through the RRC Risk Management Process. In coordination with the RRC, and after a call to participate to the broader stakeholder community, WECC Staff has developed a Risk Register consisting of 31 risks; four of the risks in the RRST White Paper are included within that register and have a Risk Analysis Weighting score of 22.0-24.0 on a 25-point scale with a weighting value of High to Extreme. It is the desire of the Strike Team that the Category B events (Events Physical Forces in Earth and Space) be added to the Registry and ran through the Risk Management Process.

4. Identify a Strike Team by February 2023, followed by development of a plan to identify specific tasks that can be completed within 12 months.

   Status: Completed in March 2023, and the RRST began meeting monthly starting in April 2023. The Strike Team informed the RRC at the February 28 meeting that their work is completed and if no further work is required, the RRC should consider sunsetting the group.

The RRST was asked to consider the following questions as part of their identification of specific events and risks associated with Extreme Natural Events:

1. What reliability impacts of Extreme Natural Events exist for system operations?
2. What best practices already exist or are needed to address extreme natural events?
3. What types of system characteristics and conditions expose the interconnection to the greatest risk from natural events?

The RRST began by reviewing several industry publications regarding Reliability and Security Risks, starting with the NERC 2021 RISC Report. The next step was identification of Extreme Natural Events and associated risks for the final process of determining and ranking which risks should be recommended to run through the RRC Risk Assessment Process. The RRST submitted its work to the RRC for consideration.

Extreme Natural Events, Risks, and Mitigation

The earth's climate is changing, and trending toward higher global ambient air temperatures and increasing severe weather events. In addition, basic physical forces in Earth and Space will continue to create extreme risks. These two categories of natural events, changing climates and physical forces in Earth and Space, are useful umbrellas under which to enumerate specific risks to reliable operation of the western electric system.

Category A: Higher global ambient air temperatures cause electricity system risk events that include extreme heat/cold events, atmospheric rivers/flooding, haboobs (the basis for these occurrences in part

are from desertification of land due to aridification), melting of earth's land ice and subsequent sea level rise, and sustained high temperatures that tax the existing generation/transmission system due to widespread increases to average and peak demand electricity usage. Specific potential risks are described in greater detail starting on page 5, Category A – Events Related to Changing Climates.

Category B: Physical forces in Earth and Space can cause disruptions such as earthquakes, tsunamis, volcanic eruptions, and geomagnetic disturbances. The shifting of the earth's crust has been a force of the natural world and continues to be so. Movement of tectonic plates affect the electrical system reliability through potential destruction of existing generation and transmission facilities. Tectonic plate movement also spawn tsunamis that could inundate coastal generators. Geomagnetic storms can create harmful geomagnetic induced currents in the power grid and energy pipelines. Specific risks are described in greater detail on page 10, Category B – Events related to Physical Forces in Earth and Space.

The next step for the RRST was to identify distinct risks for the Western Interconnection associated with these Extreme Natural Events which are or are not being addressed by industry or stakeholder groups.

Category A—Events Related to Changing Climates

Extreme Weather-Related Events

Extreme weather can either be weather related or climate related. Weather related extreme weather events are shorter incidents like tornadoes, deep freezes, or heat waves. Climate related extreme weather events last longer or are caused by a buildup of weather-related events over time. Examples include droughts caused by long dry spells or wildfires caused by an extended drought. Extreme weather events can be caused by natural cycles like La Niña or more immediate influences like high pressure systems.

Risks

- Insufficient resource and energy adequacy
- Higher demand
- Net demand (total electricity demand minus utility-scale solar and wind generation at a given time) is the critical period generally occurring later in the day or early evening when renewable energy is ramping down and load continues to increase
- Required energy transfers from remote resources
- Ambient condition de-rates of generators, transmission lines, solar, and battery resources
- Current legacy planning frameworks are slow to respond to new extremes and changing resource mix

- Expansion of summer and extreme heat; extreme heat occurring during traditional shoulder months (e.g., June and September)
- Increased surface winds damaging power lines, dry conditions, and rapid wildfire spread
- Challenges with seasonal maintenance scheduling

Mitigation

The RRST determined there are multiple mitigation measures underway for risks identified in the NERC RISC Report. The Western Resource Adequacy Program (WRAP) is looking at resource adequacy for the west in the context of developing markets. The System Reliability Assessment, for both current, long term and interregional transfer capabilities touch on energy transfers. Regional planning efforts may shift to enable significant levels of renewable generation to be interconnected to the grid. The RRST encourages collaborating with Regional Planning Groups to learn more about proposed updates to legacy planning frameworks.

During August 2020, the western United States experienced an intense and prolonged heatwave affecting many areas across the WI. Due to above-average temperatures, generation and transmission capacity was strained to keep up with record high electricity demand and in some cases, load shedding occurred to maintain reliability of the grid.

Again, in September 2022, the WI experienced a heatwave that lasted 10 days and drove record demands in many areas of the WI. As a result of changing climate trends, these types of extreme heatwave events are becoming more common and forcing grid operators and planners to rethink how they plan and operate the grid. Multiple cities in California broke 100-year-old records for maximum and minimum temperatures. Several lessons learned and enhancements were implemented because of the detailed analysis of both types of events.

NERC developed the Cold Weather Reliability Standards, EOP-011-2 which requires generator owners and operators to put in place cold weather preparedness plans subject to annual inspections by the Reliability Coordinators and Balancing Authorities, TOP-003-5, and IRO-010-4 which direct the establishment of new databases reflecting the operational limitations of generation resources during cold weather conditions. These standards became effective on April 1, 2023.

FERC Order 896 directs NERC to develop a new or modified standard to address reliability concerns pertaining to transmission system planning for extreme heat and cold weather events that impact the reliable operations of BPS.

The 2023 ERO Reliability Risk Priorities Report was recently approved by the NERC Board of Trustees (BOT) that identified five risk profiles. Specifically, Risk Profile #3, Resilience to Extreme Events, identified risk descriptors and recommendations for mitigating the risks associated with resilience to extreme events.

In May of this past year, NERC issued a Level 3 Alert that focused on essential actions for cold weather preparations and winter weather readiness. This included data submissions that identified plant operating parameters during extreme cold conditions.

The CAISO/Reliability Coordinator West Cold Weather Task Force actively assisted their members in the implementation of EOP-11-2, TOP-003-5 and IRO-010-4 Cold Weather Standards that went into effect April 1, 2023.

From February 8 through February 20, 2021, extreme cold weather and precipitation caused large numbers of generating units to experience outages, derates or failures to start, resulting in energy and transmission emergencies. The total event firm load shed was the largest controlled firm load shed event in U.S. history and was the third largest in total megawatts (MW) of load loss after the August 2003 Northeast blackout and the August 1996 West Coast blackout. A joint inquiry was conducted resulting in a Joint Inquiry Report and subsequent two-phase project to address recommendations to develop new or enhanced NERC Reliability Standards. The results of this project were the development of EOP-12-1, which is effective October 1, 2024, and EOP-012-2, currently in balloting. These standards contain enhanced requirements for generator preparedness for extreme cold weather conditions.

In November 2023, FERC and NERC released the final report on Winter Storm Elliot that contributed to power outages for millions of electricity users in the Eastern half of the country. Within that report, recommendation 1(b) stated NERC should work with the Regional Entities to identify the generating units that are at the highest risk during extreme cold weather and perform cold weather verifications of those generating units. Through analysis of historical information (GADS data) on generator performance, WECC staff identified the high-risk units and associated entities. A series of questions were created to collect information from the identified entities to verify specific cold weather activities. Staff collected and analyzed the responses and will determine if additional outreach is required either through virtual visits with each of the entities or in some cases, on-site visits may be conducted during Q1 2024.

NERC, WECC and other Regional Entities conduct annual Winter Preparation for Severe Cold Weather events and activities through workshops and webinars that are distributed to WECC entities and shared through WECC social media.

The following link will take you to the NERC site where multiple Cold Weather preparedness documents and reports can be found: Cold Weather Training Materials (nerc.com)

Haboobs/Extreme Dust Storms

A haboob is an extreme dust storm that can last for multiple hours. Dust storms of this size can take down trees, power lines, bury equipment, fill reservoirs and rivers with dirt, damage buildings, and cause extreme health issues in livestock and people. A secondary effect of haboobs is the dust, after the

storms, preventing or reducing the output of both commercial and customer owned solar panels. This reduction of output could last several days beyond the storms, as owners work to clean the panels. Delays can be extended during drought conditions with local governmental programs limiting water usage. Haboobs and debris flows are expected to increase annually. On December 13, 2020, the WI experienced an event on a major section of the Pacific AC Intertie due to the loss of three critical 500-kV lines, effectively opening the path (i.e., open loop configuration). One of the findings was dust storm contamination of the line insulators and subsequent high humidity caused the lines to flash and fault.

Risks

- Equipment contamination
- Electrical facility outages
- Major Path interruption (Open Loop)

Mitigation

The most common mitigation used by utilities is proactive communication to the public about damage caused by unsecured objects during dust storms and monsoons. Input from all affected entities within those areas of the WI that have a higher risk from haboobs and extreme dust storms would be valuable in determining what planning and mitigation efforts are underway.

Wildfire Events

A wildfire, forest fire, brushfire, wildland fire or rural fire is an unplanned, uncontrolled, and unpredictable fire in an area of combustible vegetation. Depending on the type of vegetation present, a wildfire may be more specifically identified as a bushfire, desert fire, grass fire, hill fire, peat fire, prairie fire, vegetation fire, or veld fire. Wildfires can encroach or overrun rural and urban located BPS facilities, water resource infrastructure, highways and roads, rural homeowner dwellings, rural housing subdivisions and businesses, hamlets, villages, and cities. The cause of any wildfire can be either natural (lightning) or human (arson, human inadvertent actions, intentional prescription, electrical system malfunction) but once ignition happens, increasingly extreme fire behaviors and risks occur. It should be noted that the initial cause is not limiting/indicative of severity or impacts.

Potential risks from wildfires are the reduction of output on utility scale and behind the meter solar resources due to smoke; damage to electrical infrastructure and subsequent power flow limitations; transmission line outages due to smoke related arcing between phases and tracking caused by sediment buildup on insulators. In addition, extreme wildfires can create their own climates and weather causing unsafe conditions that slow restoration, or exacerbate the impact and damage caused.

Risks

- Fire, heat, smoke (interrelated, simultaneous outages, multiple subregions)

- Impacts to utility scale solar and roof top solar (cloud cover and smoke causing immediate reduction in output)
- Loss of resources due to fire threat to facilities
- Infrastructure impacts (conditionally credible double line contingencies; equipment damage; reduced energy transfers; loss of resources)

Mitigation

Wildfires can pose a direct threat to the Bulk Power System (BPS) equipment by causing faults and destruction to transmission lines and infrastructure. They present an indirect threat when utilities must deenergize equipment to prevent ignition sources, enable firefighting activities in transmission corridors, and modify planned system configurations. Entities in the West have implemented preemptive actions (e.g., Public Safety Power Shutoff programs) where equipment is deenergized in a high-risk area to minimize the risk of equipment failure igniting a wildfire. Entities have implemented robust vegetation management programs, hazard tree inventory and removal programs, communication programs, fire modeling programs and technology to reduce impacts through rapid detection and mitigation of wildfires.

WECC currently conducts an Annual Wildfire Data Request with applicable Transmission Operators (TOPs) where information is collected consisting of outages to facilities, 100-kV and above, due to wildfires. This information includes adverse system conditions (e.g., RAS action, hi/low frequency, hi/low voltage, load/customer loss, and generation outages). The analysis of the data includes mapping the parameters of named fires to determine the potential risk and the degree wildfires are propagating across the entire WI. The analysis helps to determine if there is a particular voltage class of facilities being impacted and if there are identified common corridors where there is a recurring or increased wildfire risk. Preliminary analysis of the data suggests there is no real correlation between the number of acres burned and the number of electrical facility outages. Location of the wildfire in relation to the electrical facilities is key to the degree of system impact. Like most Extreme Natural Events, there is really no assurance or limited ways to prevent or avoid wildfires, but grid operators can react to conditions (e.g., de-energizing electrical facilities in high-risk fire areas), and position the grid to be more resilient allowing for faster recovery and restoration of the system.

Aridification/Drought

Aridification is the process of a region becoming drier through sustained decreased precipitation and/or rising temperatures. It refers to long term change, rather than seasonal variation. This results in hotter climate extremes; drier soil conditions; more severe drought; and impacts of hydrologic stress on rivers, forests, agriculture, and other systems. Conditions associated with aridification in the Southwest United States have impacted precipitation and runoff to major waterways such as the Colorado River. Higher average temperatures cause snowmelt to be absorbed into the soils located in runoff areas,

greater evaporation rates, and higher water consumption by plants rather than providing runoff for refilling major reservoirs.

Risks

- Increasing air temperature
- Hotter climate extremes
- Drier soil conditions reduce runoff percentage in dry and wet years
- Exacerbates severe drought
- Impacts of hydrologic stress on rivers, forests, agriculture, and other systems
- Flooding (due to extreme storms with high moisture content and dry soil)
- Water restrictions by local, state, or federal governmental authorities
- Extreme drought and loss of groundwater increases potential for seismic activity

Mitigation

The 2023 NERC ERO Reliability Risk Priorities Report is silent to this topic within the discussion on Resilience to Extreme Events Risk Profile. While there are no effective ways for the utility industry to prevent severe and extended drought conditions or aridification due to rising temperatures, we can take actions to become more climate resilient to minimize the impacts to the electrical grid and critical infrastructure. The RRST recommends continued dialogue with all affected entities within those areas of the WI that have a higher risk from aridification/drought conditions in order to identify what planning and mitigation efforts are underway or in place.

Atmospheric Rivers and Flooding

The term “atmospheric river” is used to indicate narrow, elongated corridors of concentrated moisture transport associated with extratropical cyclones. Atmospheric rivers are the largest transport mechanisms of freshwater on Earth. This moisture transport occurs under combinations of wind, temperature, and pressure conditions. In December 2022 and January 2023, California experienced nine back-to-back atmospheric rivers; the longest stretch of continuous atmospheric river conditions in the 70 years that records have been collected. The 2022–2023 family of atmospheric rivers led to impressive rainfall and snowfall totals and record-breaking floods. This extreme weather phenomena created catastrophic mud and debris flows where recent wildfires created burn scar areas.

Risks

- Reduced hydro resources
- Forced run of river
- Impacts to snowmelt cycle
- Electrical equipment/infrastructure damage

- Interruptions to the supply chain, and the ability to get people and materials to locations needing repair
- Severe landslide/mudslides

Mitigation

There is very little information from industry or stakeholder mitigation activities associated with atmospheric rivers. The 2023 NERC ERO Reliability Risk Priorities Report is silent to this topic within the discussion on Resilience to Extreme Events Risk Profile. The RRST recommends continued dialogue with all affected entities within those areas of the WI that have a higher risk from atmospheric rivers and flooding conditions to determine what planning and mitigation efforts are underway or in place.

Rising Oceans and Coastal Erosion

Sea level can rise by two different mechanisms with respect to global temperature increases. First, the oceans absorb heat and warm seawater expands—taking up more space in the ocean basin and causing a rise in water level. Second, the melting of land ice adds water to the oceans. Rising water causes beaches to recede and makes structures (including coastal power plants and transmission lines) near them much more vulnerable to storm damage.

Risks

- Threat to coastal power plants and associated electrical facilities as waters encroach closer to these facilities
- Erosion that causes the loss of a facility's footprint, eventually undermining an elevated location
- The increased loss of transmission and distribution infrastructure during storm surges that encroach to inland areas not previously affected by this type of flooding

Mitigation

The RRST could find no data addressing the relocation of plants and transmission assets due to rising oceans and coastal erosion. Reconstruction and relocation of these types of facilities have been reactive as storm surges and damage occurs. The Bonneville Power Administration's climate vulnerability assessment and resilience plan, or VARP, is designed to ensure that BPA anticipates the risks climate change poses to its critical systems. This includes hazards related to coastal flooding due to sea level rise. The RRST recommends continued dialogue with all affected entities within those areas of the WI that have a higher risk from rising oceans and coastal erosion conditions to determine what planning and mitigation efforts are underway or in place.

Extreme Winds

Extreme winds are wind events that threaten to damage utility equipment or disrupt regional and/or local electric utility operations. Examples of extreme wind types are straight line, wind shear, gale

force, terrain induced, gusts, downdraft, macro, and microburst. Typical weather events that contain extreme winds are thunderstorms, derechos, tornados, hurricanes, haboobs, blizzards, and gales.

Risks

- Extreme winds increase mechanical stress on turbine components, leading to potential structural damage, higher fatigue loads on the blades, reducing their lifespan, and increasing wear and tear on bearings and other moving parts
- Line sway, conductor contact and line faults
- Blown limbs or downed trees
- Damage to structures

Mitigations

Infrastructure hardening such as covered conductors and stronger poles to withstand high winds and vegetation management programs are mitigation activities that are being utilized. Wind turbines are designed to automatically shut off to avoid major stress on the blades and mechanisms inside the turbines that can cause friction and long-term damage. Cut out speeds vary by turbine but generally initiate when wind speeds are higher than 55 mph. The RRST recommends continued dialogue with all affected entities within those areas of the WI that have levels of wind resources subject to extreme winds to determine what planning and mitigation efforts are underway or in place.

Category B—Physical Forces in Earth and Space Causing Disruptions

Earthquakes

An earthquake is the shaking of the surface of the Earth resulting from a sudden release of energy in the Earth's lithosphere that creates seismic waves. Earthquakes can range in intensity, from those that are so weak that they cannot be felt, to those violent enough to propel objects into the air, damage critical infrastructure, and wreak destruction across entire cities. Increased seismic activity can result from the massive loss of groundwater that has been experienced since the western drought began. Oceanic earthquakes can generate tsunamis causing extensive damage along the coastal regions where generation may be located. In the WI, there are specific areas more prone to earthquake events than others. These areas are primarily along the west coast and in the Pacific Northwest. The Cascadia Subduction event is very significant for the Pacific Northwest and disruption there can have extreme implications.

Risks

- Dam failure
- Key infrastructure damage

- Flooding and loss of transmission, generation, and substation facilities
- Damage to major highways and bridges (subsequently complicating and/or preventing access inspection and repair of damaged critical infrastructure)

Mitigation

There is no comprehensive approach for the interconnection when dealing with these types of events. Some common practices are transformer strapping and bus work flex joints. BPA shared their Climate Vulnerability Assessment and Resilience Plan (VARP) with the RRST. The RRST recommends that WECC consider using the work of BPA to create a VARP template for members to use for their own preparation. The RRST recommends continued dialogue with all affected entities within those areas of the WI that are at higher risk from earthquakes in order the determine what planning and mitigation efforts are underway or in place.

Tsunamis

A tsunami is a series of waves in a water body caused by the displacement of a large volume of water, generally in an ocean or a large lake. Earthquakes, volcanic eruptions, and other underwater explosions above or below water all have the potential to generate a tsunami. Unlike normal ocean waves, which are generated by wind, or tides, which are in turn generated by the gravitational pull of the moon and the sun, a tsunami is generated by the displacement of water from a large event. With the 600-mile Cascadia subduction zone, (that runs from Vancouver Island, Canada down to northern California) and the threat of a major earthquake creating colossal waves, significant coastal damage and disruption to critical infrastructure, communities, homes, structures, and lives is possible.

Risks

- High-level flooding events that can reach far inland
- Disruption of transportation, power, and other critical services
- Disruption of fresh water supplies
- Loss of lives

Mitigation

The RRST has not identified any information on mitigation activities of the grid operators in the WI. There is no real way to prevent tsunamis. The question that remains is whether there are actions that can be taken to minimize the impact and facilitate more timely restoration and repair of damaged infrastructure. The RRST recommends continued dialogue with all affected entities within those areas of the WI that are at higher risk from tsunamis to determine what planning and mitigation efforts are underway or in place.

Volcanic Eruptions

A volcanic eruption is a rupture in the crust of a planetary-mass object, such as earth, that allows hot lava, volcanic ash, and gases to escape from a magma chamber below the surface. On earth, volcanoes are most often found where tectonic plates are diverging or converging, and most are found underwater. Known volcanos in the Northwest are Mount Rainier, Mount Hood, Mount Adams, Mount St. Helens, and Glacier Peak located in the Cascade Range. The western part of North and South America make up the extreme eastern edge of the area known as the "Ring of Fire", "Circum-Pacific Belt" or the "Circum-Pacific Ring" which is known for tectonic plate movement, volcanos, and subduction areas.

Risks

- Risks and impacts associated with volcanic eruptions will likely be very similar to those from an earthquake
- Damage/failure to hydro dams and facilities
- Key infrastructure damage, including generation and transmission facilities
- Depending on geographical location, there could be damage to major highways and bridges which could potentially complicate and/or prevent access, inspection, and repair of damaged critical infrastructure

Mitigation

Volcanic eruptions are types of extreme natural events we have no control of. We can take actions to make the system more resilient, develop emergency procedures to facilitate timely restoration and repair of critical infrastructure. The RRST recommends continued dialogue with all affected entities within those areas of the WI that are at higher risk from volcanic eruptions to determine what planning and mitigation efforts are underway or in place.

Geomagnetic Disturbances

A geomagnetic storm, also known as a magnetic storm, is a temporary disturbance of the Earth's magnetosphere caused by a solar wind shock wave and/or cloud of magnetic field that interacts with the Earth's magnetic field. Utilities are increasing the use of satellite communications in remote areas for obtaining substation and electrical equipment data via remote telemetering units (RTUs) and geomagnetic storms can disrupt/delay communication of critical data. GMD events in the west are presently not a significant concern but should not be overlooked. GMD is not unique to the West and there are national efforts addressing the issues. GMD events should not be ignored but the focus should be on educating stakeholders.

Risks

- Loss of reactive power sources

- Voltage disruptions leading to power outages
- Changes in soil voltage that enhance corrosion in oil and gas pipelines
- Disruption in cellular communications networks
- Exposure to elevated levels of radiation
- Transformer hot-spot heating or damage
- Massive power outages
- Interruption of radio communications and satellite operations
- Increased corrosion in oil and gas pipelines

Mitigation

NERC has established reliability standards to evaluate Transmission System Planned Performance for Geomagnetic Disturbance (GMD) Events (TPL-007) and EOP-10-1 applicable to RCs and TOPs that requires them to have GMD Operating Plans designed to mitigate the effects of GMD events on the reliable operation of the interconnected transmission system. NERC has posted the Geomagnetic Disturbance Monitoring Reference Document on their website. This procedure outlines responsibilities of Reliability Coordinators serving as Geomagnetic Disturbance (GMD) monitors in the North American Interconnections.

In the WI, the Reliability Coordinators rotate the GMD monitor responsibilities on an annual basis. Each of the four RCs have a GMD Operating Plan that identifies specific responsibilities in monitoring and communicating information.

The Critical Infrastructure Protection Act (CIPA) was passed by Congress. This Act is intended to protect the electric grid and other critical infrastructure from man-made or natural electromagnetic pulse. Some of the mitigating steps grid operators and the industry are taking involves the evaluation of harmonics, protection schemes and electromagnetic pulse hardening. Continuing collaboration with industry and grid operators in identifying resilient technologies is critical.