UNITED STATES OF AMERICA

BEFORE THE

FEDERAL ENERGY REGULATORY COMMISSION

Transmission System Planning Performance Requirements for Extreme Weather	**)** **)** **)** **)**	**Docket No RM22-10-000**

The Union of Concerned Scientists ("UCS") appreciates the opportunity to submit comments on Commission's proposed rulemaking, Docket No, RM22-10 issued June 16, 2022 regarding electric transmission planning performance requirements for extreme weather. UCS supports the Commission's effort and offers these comments and observations in furtherance of the Commission's deliberations. We encourage the Commission to address the issues identified here and institute reforms that will provide the industry and consumers with increased reliability under changing conditions and protection from excessive costs.

I. Introduction

This rulemaking follows the Commission's June 1-2, 2021 technical conference on Climate Change, Extreme Weather, and Electric System Reliability, and the collection of over 70 sets of pre-conference and post-conference comments. That technical conference followed the February 2021 extreme cold and associated deadliest electric power outage in the continental U.S. The Commission observed a consensus among panelists that planners cannot simply project historical weather patterns forward to effectively forecast the future, since climate change has

made the use of historical weather observations no longer representative of future conditions.[1] The Commission supported the importance of preparation for changing weather with evidence that seven extreme weather incidents since 2011 resulted in controlled load shedding by grid operators to avoid widespread blackouts and maintain overall system operations.[2]

In this NOPR, the Commission proposes to direct North American Electric Reliability Corporation (NERC) submit modifications to Transmission System Planning Performance Requirements (Reliability Standard TPL-001-5.1) to require: (1) development of benchmark planning cases based on information such as major prior extreme heat and cold weather events or future meteorological projections; (2) planning for extreme heat and cold events using steady state and transient stability analyses expanded to cover a range of extreme weather scenarios including the expected resource mix's availability during extreme heat and cold weather conditions, and including the broad area impacts of extreme heat and cold weather; and (3) corrective action plans that mitigate instances where extreme heat and cold events disrupt grid reliability.

[1] NOPR paragraph 3.
[2] NOPR paragraph 4.

II. COMMENTS

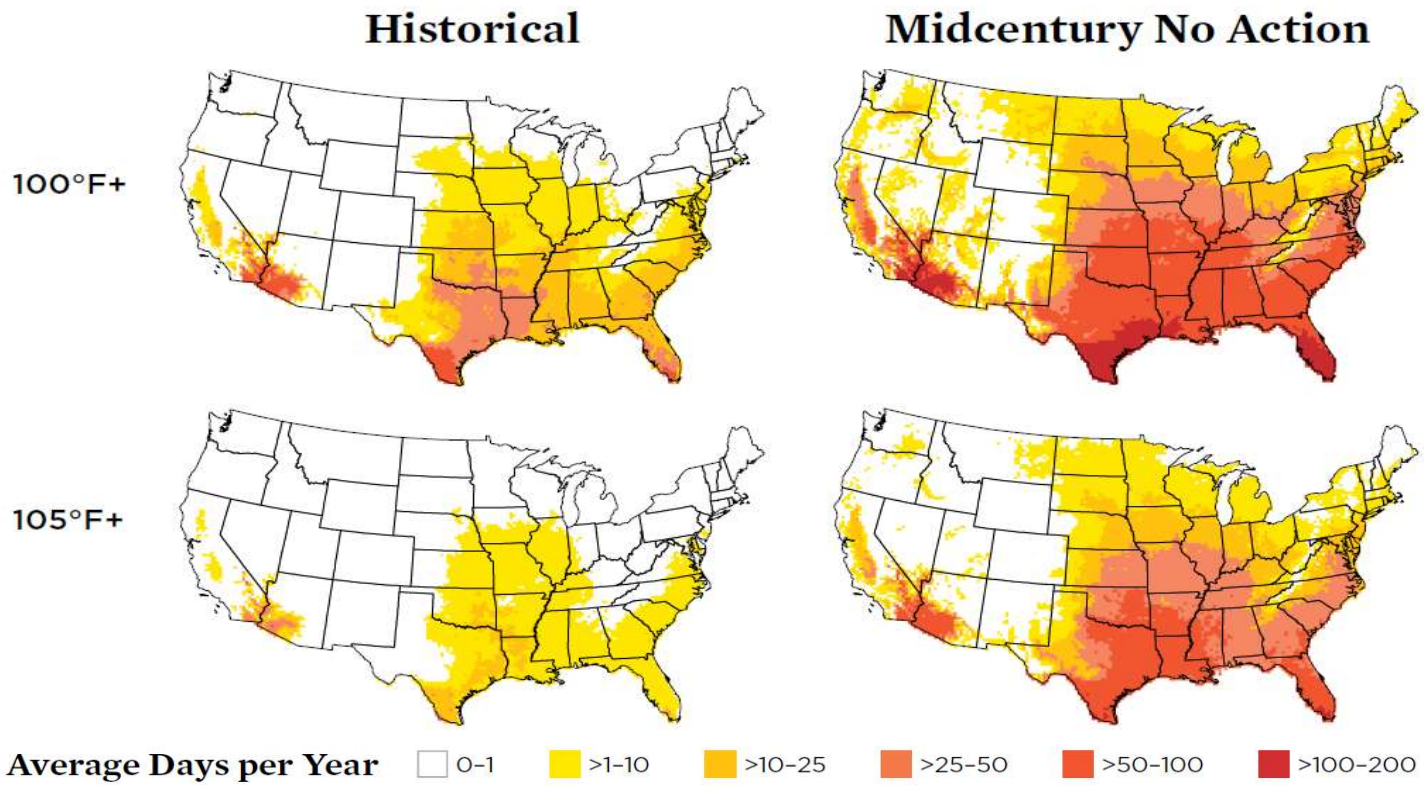

Figure 1. By midcentury (2036–2065), regions of the United States with little to no extreme heat in an average year historically—such as the upper Midwest and New England—would begin to experience such heat on a regular basis. Heat conditions across the Southeast and Southern Great Plains regions are projected to become increasingly oppressive, with previously unseen extremes happening an average of once or more annually. Source: *Killer Heat in the United States - Climate Choices and the Future of Dangerously Hot Days*. Kristina Dahl et al 2019 available at https://www.ucsusa.org/resources/killer-heat-united-states-0.

A. Summary

Changes in the frequency and severity of extreme weather are predicted by science to affect nearly all regions of the United States. The Commission must direct the utility industry to adapt transmission planning for the continuity of electric service in response to this information. The graphic in Figure 1 above shows anticipated changes in extreme heat through mid-century.

Grid operations, including the reliability experienced by consumers and prices for energy in times of shortage, are significantly defined and constrained by transmission planning. To

paraphrase a common remark made by operators: the grid provided from planning is the grid we have to operate. Planning the grid to address reliability in extreme weather, the subject of this rulemaking, will determine operators' ability to maintain grid service in such weather.

Addressing the planning for investment requires addressing the planning assumptions. This inquiry into transmission planning performance requirements correctly begins with information that establishes the starting point, or benchmark planning cases. In simple terms, planners can only define the needed investment and adequate transmission performance when the planners have a definition of the conditions that are anticipated. This rulemaking can give transmission planners the means to establish what conditions they should prepare to meet in terms of weather, transmission system characteristics, and scope for corrective action.

A. NERC should Develop Benchmark Planning Cases, with direction on how to use Prior Extreme Heat and Cold Weather Events

The need for this rulemaking stems from the Commission observation that planners cannot simply project historical weather patterns forward to effectively forecast the future, since climate change has made the use of historical weather observations no longer representative of future conditions.[3] Hence, the NOPR proposal to provide NERC with flexibility in defining one or more appropriate benchmark events[4] must be clear regarding the use and interpretation of historical weather events – they are informative to the task at hand, but not indicative of the full breadth of challenges extreme weather will present to grid operators over the coming decades.

[3] NOPR paragraph 3.

[4] NOPR paragraph 53.

To that end, we urge the Commission to require NERC's consideration of both historical events *and* forecasts of future conditions in the development of its extreme weather planning standards.

Extreme weather events are occurring with frequencies and intensities that were previously unseen and are expected to continue to increase in number and severity.[5] Projections of extreme heat indicate that by mid-21st century (2036–2065), more than 25% of the US by area would experience previously unseen conditions an average of once or more annually. In addition, the annual numbers of days with heat indices exceeding 37.8 °C (100 °F) and 40.6 °C (105 °F) are projected to double and triple, respectively, compared to a 1971–2000 baseline.[6] The graph below makes a simplified display of how climate change affects the occurrence and the severity of hot weather extremes.

[5] "The impacts and costliness of weather disasters—resulting from floods, drought, and other events such as tropical cyclones—are expected to increase in significance as previously "rare" events become more common and intense due to anticipated changes in the global climate system." Extreme Weather Events -Limiting Federal Fiscal Exposure and Increasing the Nation's Resilience. United States Government Accountability Office GAO-14-364T, February 2014 citing Thomas R. Karl, Jerry M. Melillo, and Thomas C. Peterson, eds. *Global Climate Change Impacts in the United States* (Cambridge University Press: 2009).

[6] *Increased Frequency of and Population Exposure To Extreme Heat Index Days In The United States During The Century.* Kristina Dahl et al 2019 Environ. Res. Commun. 1 075002 available at https://iopscience.iop.org/article/10.1088/2515-7620/ab27cf

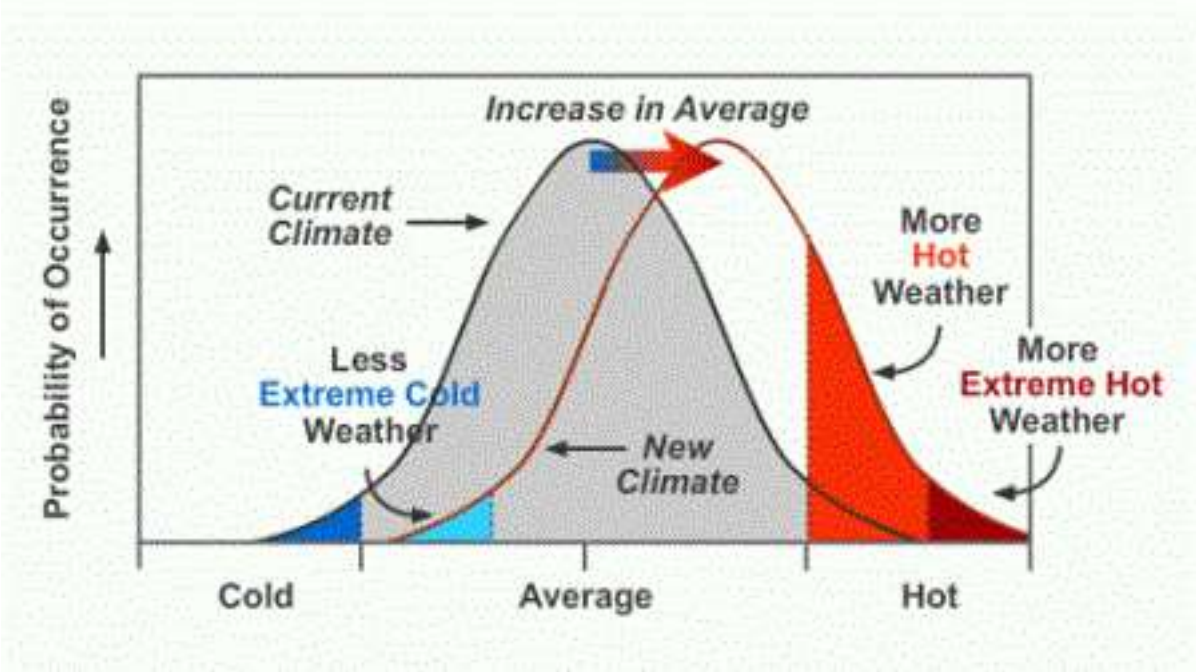

Figure 2. As the distribution of temperatures shifts warmer there are more and more of the days that we consider hot now, and, in addition, the hottest days become even hotter. Graph courtesy U.S. Environmental Protection Agency.

The record-breaking extreme cold and extreme heat experienced in recent years also demonstrate that the range of anticipated weather events has been underestimated. The Commission should direct NERC's standards development process to modify Reliability Standard TPL-001-5.1 to include climate and weather patterns based on the best-available scientific projections given current global carbon emission trends and the anticipated climate impacts of those emissions in order to avoid repeating the planning assumptions and level of preparations that exposed consumers to the system failures seen in recent years. If climate change has made the use of historical weather observations no longer representative of future conditions, then the NERC standards to prepare for future weather conditions cannot be based solely on historical weather conditions.

The Commission should also address the need to periodically update key aspects of the benchmark events. The final rule and resulting NERC standards must allow and require updating of the conditions anticipated in the future for which the grid designs are expected to meet. The Commission has seen the consensus that climate change is changing extreme weather conditions. The changes in extreme weather are unfortunately neither finished nor are they perfectly predicted. Hence, allowing and requiring the updating of key aspects of the benchmark events and system conditions is prudent and reasonable.

C. Transmission System Planning for Extreme Heat and Cold Weather Events needs steady state, stability and wide area analyses

The Commission in the NOPR describes the importance of using the existing tools and practices that characterize grid conditions, specifically steady state and stability analyses to maintain and improve the reliability of the Bulk-Power System.[7] The Commission further observes that planning for extreme heat and extreme cold with these tools is consistent with Reliability Standard TPL-001-5.1.[8] The reforms to NERC planning standards should adopt the proposed rule, directing planning coordinators and transmission planners to perform both steady state and stability analyses using extreme heat and cold cases. The supply mix and its sundry characteristics should not be ignored for such studies. As discussed below, common mode failures and the effects of extreme heat and extreme cold are relevant to system performance and need to be included in such studies. Further, where state programs, utilities, aggregators or market participants have contracted customers to provide demand response, there should be no

[7] A steady-state analysis models generators, transmission lines, transformers and their ratings and constraints.

[8] NOPR paragraphs 58, 59.

discrimination or exclusion of this resource type from system studies of transmission performance.

Transmission modeling recognizes the interconnected nature of the power system and the potential for abnormal system conditions to affect, or be affected by, neighboring planning or balancing areas. The effects of extreme weather are not bound by jurisdictions or authorities that separate planning and balancing areas. These facts implicate the need for study of the wide-area impact of extreme heat or extreme cold weather conditions.

We encourage the Commission to direct NERC to include the effects of extreme weather over a wide area. The improvement of models for weather impacts is not stagnant, and the final rule should direct the sharing of modeling information between planning areas regarding extreme weather benchmark events. In real time operations, the system will experience issues that simultaneously affect wide areas. Reliability, and the resulting impacts on consumers, will be shaped by the extent which neighboring systems have shared expectations, established routine and emergency energy transfer protocols and built transmission capacity that allow awareness and mutual support across wide areas.

While progress in the electric power industry can be measured in many ways, the economic and reliability benefits of expanded geographic scope for system planning and operations is arguably the most clear and pronounced. Experience under normal and extreme conditions demonstrate the enhanced reliability and lower cost of running a system with access to a greater number of sources, a greater diversity of loads, and the sharing of reserves.

A recent review of power system reliability and correlated generator outages provides a perspective on generator diversity and planning principles. When assessing the types of risks and

quantifying size, frequency, duration, and timing of capacity shortfalls, the report found "infrequent, long events may be best handled through coordination with neighboring grids…". [9]

The Commission should direct the industry to improve transmission system performance in extreme weather in a manner that raises reliability in the event of region-wide combination of peak demand and abnormally high generation outages. Planners can improve grid operators' ability to maintain grid service in extreme weather by providing transmission capacity that can reach a diversity of both supply and demand across a wider area. Increasing both the planning and the transfer capacity on an inter-regional scale should be part of the scope for corrective actions available to transmission planners addressing transmission reliability in extreme heat and extreme cold. Reliability coordinators should be given authority to oversee and coordinate the wide-area planning models, studies *and* corrective action to improve transmission performance in extreme weather conditions.

The Commission's direction to NERC should assign clear responsibility to address the results of extreme weather performance studies. NERC rules for wide area planning for extreme weather should provide a performance benchmark. To simplify and expedite the process of inter-regional coordination for extreme weather, (but only regarding inter-regional coordination), the Commission should direct the NERC reforms to allow actions to increase inter-regional transfer capacity as a "safe harbor" for compliance with aspects of new extreme weather performance standard for inter-regional coordination. Where transmission planners and regulators do not adopt and use definitions of extreme conditions in inter-regional planning and effective

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[9] Redefining Resource Adequacy Task Force. 2021. Redefining Resource Adequacy for Modern Power Systems. Reston, VA: Energy Systems Integration Group. Page 20. Available at https://www.esig.energy/wp-content/uploads/2021/08/ESIG-Redefining-Resource-Adequacy-2021.pdf

corrective action, an alternative should be available. The Commission can direct the NERC to establish a minimum import capability for every region.[10] Such a minimum interregional transfer capability should be established through a thorough risk assessment on a nationwide, and region to region basis.[11]

D. Study Concurrent Generator and Transmission Outages

The Commission observed in the NOPR that "Extreme cold effects on generators vary by generator type, cooling systems, and fuel sources".[12] A corollary of this is the documented historical events that show multiple coincident outages due to the same cause. These can be due to common designs that are vulnerable to freezing or extreme heat, or common mode failures in fuel supply systems.

The Winter Storm Uri impacts in Texas and MISO between February 8 and February 20, 2021, revealed approximately 44% of generator outages were caused by freezing issues.[13] Correlated cold weather impacts on generation occur in colder regions as well. Unusually cold weather created operational problems with fuel supply demand and generator outages, as seen in December 2017- January 2018 data displayed by ISO-New England in Figure 3, below.[14]

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[10] The provision in BAL-002-WECC-2 provides an example of a reliability standard setting a performance requirement. "The amount of Contingency Reserve equal to the sum of three percent of hourly integrated Load plus three percent of hourly integrated generation."

[11] Post-Conference Comments of American Electric Power, Docket No. AD21-13, at 10 (filed Sept. 27, 2021).

[12] NOPR paragraph 70 citing Polar Vortex Review at 12.

[13] NOPR paragraph 70.

[14] *Cold Weather Operations: December 24, 2017 – January 8, 2018*. ISO-New England. January 12, 2018. Available at https://www.iso-ne.com/static-assets/documents/2018/01/20180112_cold_weather_ops_npc.pdf

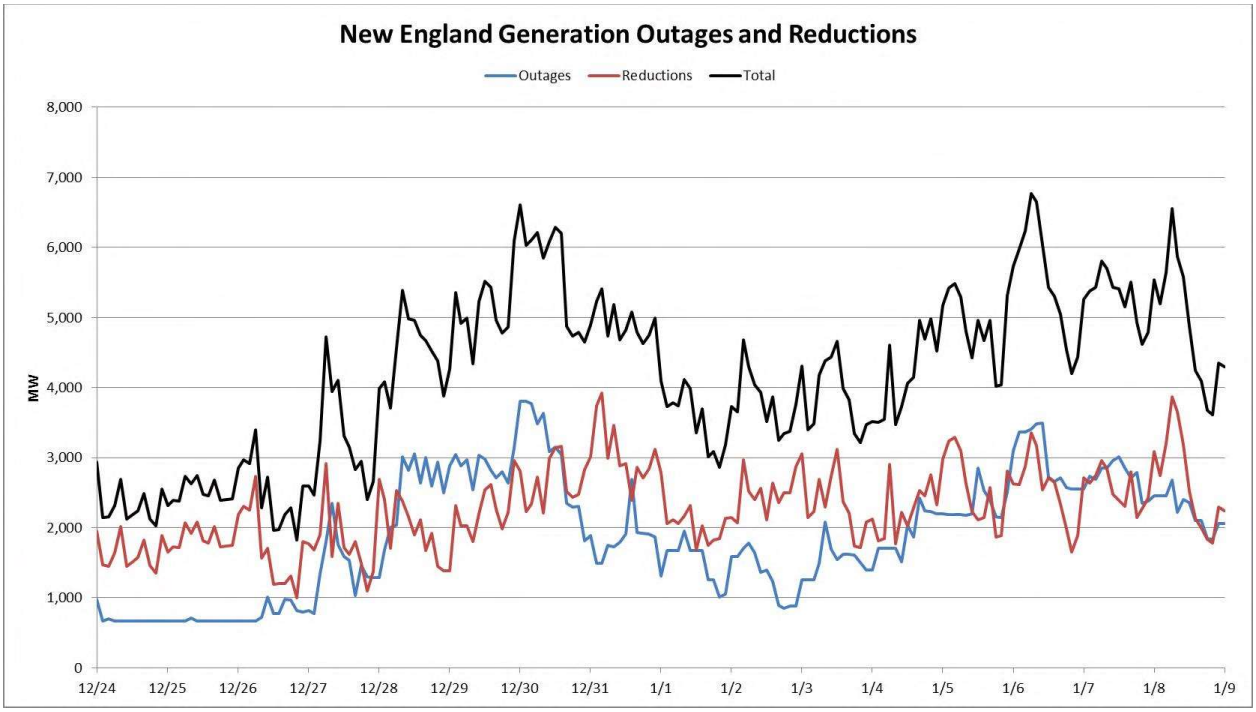

Figure 3. Extreme cold weather impacts in 2018 on the New England generation fleet.

Correlated outages or derates will also occur during extreme heat events where the performance of thermal generators, for example, is strongly dependent on ambient temperatures.[15] Petrakopoulou et al investigated the effect of rising ambient temperatures on power-plant performance and water use of a natural gas combined-cycle and a coal power plant, finding that both ambient air temperature and cooling water temperatures can impact efficiency and output capabilities of both coal and fossil gas units. Common system design and cooling

[15] Fontina Petrakopoulou, Alexander Robinson, Marina Olmeda-Delgado. Impact of climate change on fossil fuel power-plant efficiency and water use. Journal of Cleaner Production, Volume 273. 2020. Available at: https://www.sciencedirect.com/science/article/pii/S0959652620328614

processes affect these impacts.[16] A review of summer and winter ratings in the Energy Information Administration database EIA Form 860 illustrates the widespread recognition of summer weather causing lower plant output than winter weather. Ambient conditions affect the performance of solar, wind, and all thermal plants to some extent, and the effects increase as temperatures increase.[17]

Extreme cold and heat will impact generators of all types, affecting output levels and efficiency in different ways that will need to be managed by operators concurrently with transmission system conditions during these extreme weather events. The experience of extreme cold and extreme heat affecting power system reliability in unanticipated ways suggests that modeling concurrent generator and transmission outages would allow planners to better identify appropriate solutions to be incorporated into corrective action plans. [18]

The final rule should direct NERC and transmission planning entities to include a description and study of how the impact of concurrent loss of generator and transmission capacity sensitive to extreme heat and cold should be factored into long-term planning. The most direct approach to this is an extrapolation of generator deratings for equipment to the temperature and humidity conditions that are projected and used in defining the study cases. The final rule should also direct modelling in transmission planning studies use the same thermal deratings on neighboring systems' or planning areas' transmission.

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[16] Id.

[17] Energy Information Administration. Form EIA-860 detailed data at https://www.eia.gov/electricity/data/eia860/.

[18] See for example the work plan of EPRI's Climate READi's Energy System & Asset Vulnerability Assessment program. https://www.epri.com/research/programs/116583/overview

III. Conclusion

UCS supports the Commission's effort update reliability planning for the era of the changing climate and the impact of extreme weather on transmission performance and planning. The proposed reforms will determine how the transmission system will perform in extreme weather.

The reforms here must be made with recognition of the time and effort that is required to make a change to transmission planning. We urge the Commission to weigh the pace of change in extreme weather events, both frequency and severity, and the extraordinary costs of grid events. This rulemaking can and should lead to distinct and readily adopted set of practical changes.

We encourage the Commission to address the issues identified here and institute reforms that will provide the industry and consumers with increased reliability under changing conditions and protection from excessive costs during times when reliability is jeopardized.

Respectfully submitted on this 23rd day of August 2022.

-Michael Jacobs -

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