DEPARTMENT OF ENERGY

Federal Energy Regulatory Commission

18 CFR Part 40

[Docket No. RM22–10–000; Order No. 896]

Transmission System Planning Performance Requirements for Extreme Weather

AGENCY: Federal Energy Regulatory Commission, Department of Energy.

ACTION: Final rule.

SUMMARY: The Federal Energy Regulatory Commission directs the North American Electric Reliability Corporation, the Commission-certified Electric Reliability Organization, to develop a new or modified Reliability Standard no later than 18 months of the date of publication of this final rule in the **Federal Register** to address reliability concerns pertaining to transmission system planning for extreme heat and cold weather events that impact the Reliable Operation of the Bulk-Power System. Specifically, we direct the North American Electric Reliability Corporation to develop a new or modified Reliability Standard that requires the following: development of benchmark planning cases based on prior extreme heat and cold weather events and/or future meteorological projections; planning for extreme heat and cold events using steady state and transient stability analyses that cover a range of extreme weather scenarios, including the expected resource mix's availability during extreme weather conditions and the broad area impacts of extreme weather; and corrective action plans that include mitigation activities for specified instances where performance requirements during extreme heat and cold events are not met.

DATES: This rule is effective September 21, 2023.

FOR FURTHER INFORMATION CONTACT:

Mahmood Mirheydar (Technical Information), Office of Electric Reliability, Federal Energy Regulatory Commission, 888 First Street NE, Washington, DC 20426, (202) 502–8034, *mahmood.mirheydar@ferc.gov*

Gonzalo E. Rodriguez (Legal Information), Office of the General Counsel, Federal Energy Regulatory Commission, 888 First Street NE, Washington, DC 20426, (202) 502–8568, *gonzalo.rodriguez@ferc.gov*

SUPPLEMENTARY INFORMATION:

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I. Introduction

1. Pursuant to section 215(d)(5) of the Federal Power Act (FPA),[1] the Commission directs the North American Electric Reliability Corporation (NERC), the Commission-certified Electric Reliability Organization (ERO), to submit a new Reliability Standard or modifications to Reliability Standard TPL–001–5.1 that addresses concerns pertaining to transmission system planning for extreme heat and cold weather events that impact the Reliable Operation [2] of the Bulk-Power System.[3]

2. We take this action to address challenges associated with planning for extreme heat and cold weather events, particularly those that occur during periods when the Bulk-Power System must meet unexpectedly high demand.[4] Extreme heat and cold weather events have occurred with greater frequency in recent years, and are projected to occur with even greater frequency in the future.[5] These events have shown that load shed during extreme temperature result in unacceptable risk to life and have extreme economic impact.[6] As such, the impact of concurrent failures of Bulk-Power System generation and transmission equipment and the potential for cascading outages [7] that may be caused by extreme heat and cold weather events should be studied and corrective actions should be identified and implemented.

3. At the Commission's June 1–2, 2021 technical conference on Climate Change, Extreme Weather, and Electric System Reliability, there was 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.[8] For example, extreme summer heat in regions like the Pacific Northwest and extreme winter cold in regions like Texas have increased demand for electricity at times when historically demand has been low.[9] As events such as these will likely continue to present challenges in the future, transmission planners and planning coordinators must account for this new reality in their planning processes.[10]

4. Since 2011, the country has experienced at least seven major extreme heat and cold weather events,[11] each of which put stress on the Bulk-Power System and resulted in some degree of load shed. In some cases, these events nearly caused system collapse

[1] 16 U.S.C. 824o(d)(5).

[2] The FPA defines ''Reliable Operation'' as ''operating the elements of the Bulk-Power System within equipment and electric system thermal, voltage, and stability limits so that instability, uncontrolled separation, or cascading failures of such system will not occur as a result of a sudden disturbance, including a cybersecurity incident, or unanticipated failure of system elements.'' 16 U.S.C. 824o(a)(4).

[3] The Bulk-Power System is defined in the FPA as ''facilities and control systems necessary for operating an interconnected electric energy transmission network (or any portion thereof), and electric energy from generating facilities needed to maintain transmission system reliability. The term does not include facilities used in the local distribution of electric energy.'' *Id.* 824o(a)(1).

[4] Technical Conference June 1–2, 2021, *Climate Change, Extreme Weather, and Electric System Reliability,* Docket No. AD21–13–000 (June 1–2, 2021), June 1, 2021 Tr. 26: 3–7 (Derek Stenclik, Founding Partner, Telos Energy, Inc.), 31:7–8 (Judy Chang, Undersecretary of Energy, Massachusetts).

[5] *See e.g.,* Environmental Protection Agency, *Climate Change Indicators: Weather and Climate* (May 12, 2021) (EPA Climate Change Indicators), *https://www.epa.gov/climate-indicators/weather-climate* (showing an upward trend in extreme heat and cold weather events). NOAA, Adam Smith, *2022 U.S. Billion-dollar Weather and Climate Disasters in Historical Context* (Jan. 10, 2023), *https://www.climate.gov/news-features/blogs/2022-us-billion-dollar-weather-and-climate-disasters-historical-context.*

[6] FERC, NERC, and Regional Entity Staff, *The February 2021 Cold Weather Outages in Texas and the South Central United States,* at 9, 192 (Nov. 16, 2021), *https://www.ferc.gov/media/february-2021-cold-weather-outages-texas-and-south-central-united-states-ferc-nerc-and* (2021 Cold Weather Event Report).

[7] NERC Glossary of Terms Used in Reliability Standards (Updated Mar. 8, 2023) (NERC Glossary). NERC defines ''cascading'' as, the ''uncontrolled successive loss of System Elements triggered by an incident at any location. Cascading results in widespread electric service interruption that cannot be restrained from sequentially spreading beyond an area predetermined by studies.''

[8] June 1, 2021 Tr. 30:2–3 (Chang), 31:12–18 (Lisa Barton, Executive Vice President/Chief Operating Officer, American Electric Power).

[9] June 1, 2021 Tr. 31:1–6 (Chang); June 2, 2021 Tr. 72:8–10 (Amanda Frazier, Senior Vice President of Regulatory Policy, Vista Corp.); 9:1–5 (Wesley Yeomans, Vice President of Operations, New York Independent System Operator, Inc. (NYISO)) (noting that in New York the majority of the extreme conditions were cold weather related but that there can be heat waves in New York City, and more heat waves are expected).

[10] June 1, 2021 Tr. 35:1–6 (Chang). *See also* US News, *Blackouts in US Northwest Due to Heat Wave, Deaths Reported* (June 29, 2021), *https://www.usnews.com/news/business/articles/2021-06-29/rolling-blackouts-for-parts-of-us-northwest-amid-heat-wave;* Judah Cohen et al., *Linking Arctic Variability and Change With Extreme Winter Weather in the United States,* 373 Sci. 1116, 1120 (2021), (a study connecting the 2021 extreme cold weather event in Texas and the South-central United States to global warming-induced weather anomalies that are likely to continue to produce severe winter storm events).

[11] *See Transmission System Planning Performance Requirements for Extreme Weather,* Notice of Proposed Rulemaking, 87 FR 38,020 (June 27, 2023), 179 FERC ¶ 61,195 at PP 24–36 (2022) (NOPR) (discussing these prior events in detail).

and uncontrolled blackouts, which were avoided due to system operator actions.

5. Given the reliability risks associated with extreme heat and cold weather events, including the potential for widespread blackouts, maintaining the reliability of the Bulk-Power System requires transmission system planning to account for the potential impact of extreme heat and cold weather over wide geographical areas, and to consider the changing resource mix. Reliability Standard TPL–001–4 [12] was developed to establish transmission system planning performance requirements that ensure that the Bulk-Power System operates reliably over a broad spectrum of system conditions and following a wide range of probable contingencies.[13] Both it and its successor, TPL–001–5.1, include provisions for transmission planners and planning coordinators to study system performance under extreme events based on their experience; [14] however, neither standard specifically requires entities to conduct performance analysis for extreme heat and cold weather, despite the fact that such conditions have clearly demonstrated a risk to the Reliable Operation of the Bulk-Power System, thus leaving a reliability gap in system planning.

6. To address this reliability gap, we direct NERC to develop a new or modified Reliability Standard that requires the following: (1) the development of benchmark planning cases based on information such as major prior extreme heat and cold weather events and/or future meteorological projections; (2) planning for extreme heat and cold weather events using steady state and transient stability analyses expanded to cover a range of extreme weather scenarios, including expected availability of the resource mix during extreme heat and cold weather conditions, and including the broad area impacts of extreme heat and cold weather; and (3) the development of corrective action plans that mitigate specified instances where performance requirements during extreme heat and cold weather events are not met. In directing NERC to develop a new or modified Reliability Standard, we are not proposing specific requirements. Instead, we identify concerns that should be addressed by the proposed Reliability Standard. NERC may propose to develop a new or modified Reliability Standard that address our concerns in an equally efficient and effective manner; however, NERC's proposal should explain how it addresses the Commission's concerns.[15]

7. We direct NERC to submit the proposed new or modified Reliability Standard no later than 18 months from the publication of this final rule in the **Federal Register**. We believe that an 18-month deadline provides sufficient time for NERC to develop a responsive Standard in consideration of the issues involved and the steps in NERC's standards development process. Further, we direct NERC to ensure that the proposed new or modified Reliability Standard becomes mandatory and enforceable beginning no later than 12 months from the effective date of Commission approval of the new or modified Reliability Standard.

II. Background

A. Legal Authority

8. Section 215 of the FPA provides that the Commission may certify an ERO, the purpose of which is to develop mandatory and enforceable Reliability Standards, subject to Commission review and approval.[16] Reliability Standards may be enforced by the ERO, subject to Commission oversight, or by the Commission independently.[17] Pursuant to section 215 of the FPA, the Commission established a process to select and certify an ERO,[18] and subsequently certified NERC.[19]

9. Pursuant to section 215(d)(5) of the FPA, the Commission has the authority, upon its own motion or upon complaint, to order the ERO to submit to the Commission a proposed Reliability Standard or a modification to a Reliability Standard that addresses a specific matter if the Commission considers such a new or modified Reliability Standard appropriate to carry out section 215 of the FPA.[20] Further, pursuant to § 39.5(g) of the Commission's regulations, the Commission may order a deadline by which the ERO must submit a proposed or modified Reliability Standard, or when ordering the ERO to submit to the Commission a proposed Reliability Standard that addresses a specific matter.[21]

B. Reliability Standard TPL–001–5.1 (Transmission System Planning Performance Requirements)

10. Transmission system planning refers to the evaluation of future transmission system performance and creation of corrective action plans that include mitigation to remedy identified deficiencies.[22] The planning horizon associated with transmission system planning covers near term (one to five years), long-term (six to ten years), and beyond.[23]

11. Reliability Standard TPL–001–5.1 establishes minimum transmission system planning performance requirements to plan a Bulk-Power System that will operate reliably over a broad spectrum of system conditions and following a wide range of probable contingencies.[24] Under Requirement R2 of Reliability Standard TPL–001–5.1, each transmission planner and planning coordinator must prepare an annual planning assessment for its portion of the Bulk-Power System.[25] This planning assessment is required for both near-term and long-term transmission planning horizons.[26]

12. Requirements R3 and R4 of Reliability Standard TPL–001–5.1

[12] Effective July 1, 2023, Reliability Standard TPL–001–4 will be replaced by Reliability Standard TPL–001–5.1. Unless otherwise specified, the use of Reliability Standard TPL–001–5.1 in this final rule also refers to its predecessor, Reliability Standard TPL–001–4.

[13] Reliability Standard TPL–001–5, at 1.

[14] *Id.* at tbl. 1.

[15] *See e.g., Mandatory Reliability Standards for the Bulk-Power Sys.,* Order No. 693, 72 FR 16416 (Apr. 4, 2007), 118 FERC ¶ 61,218, at PP 186, 297, *order on reh'g,* Order No. 693–A, 72 FR 40717 (July 25, 2007), 120 FERC ¶ 61,053 (2007) (''where the Final Rule identifies a concern and offers a specific approach to address the concern, we will consider an equivalent alternative approach provided that the ERO demonstrates that the alternative will address the Commission's underlying concern or goal as efficiently and effectively as the Commission's proposal'').

[16] 16 U.S.C. 824o(c).

[17] *Id.* 824o(e).

[18] *Rules Concerning Certification of the Elec. Reliability Org. & Procedures for the Establishment, Approval, & Enf't. of Elec. Reliability Standards,* Order No. 672, 71 FR 8662 (Feb. 17, 2006), 114 FERC ¶ 61,104, *order on reh'g,* Order No. 672–A, 71 FR 19814 (Apr. 18, 2006), 114 FERC ¶ 61,328 (2006).

[19] *N. Am. Elec. Reliability Corp.,* 116 FERC ¶ 61,062, *order on reh'g and compliance,* 117 FERC ¶ 61,126 (2006), *aff'd sub nom. Alcoa, Inc.* v. *FERC,* 564 F.3d 1342 (D.C. Cir. 2009).

[20] 16 U.S.C. 824o(d)(5).

[21] 18 CFR 39.5(g) (2022).

[22] NERC Glossary (defining ''Planning Assessment'' as ''documented evaluation of future Transmission System performance and Corrective Action Plans to remedy identified deficiencies'').

[23] *Id.* (defining ''Near-Term Transmission Planning Horizon'' and ''Long-Term Transmission Planning Horizon'').

[24] Reliability Standard TPL–001–5.1, Purpose.

[25] *Id.,* at Requirement 2. Further, steady-state analyses are a snapshot in time where load and system conditions (*e.g.,* generators, lines, facilities) are modeled as constant (not as changing over time). The analysis will either solve (converge numerically) or not solve (diverge numerically). *See* IEEE, *Transactions on Power Systems,* Vol. 19, No. 2, (May 2004) (power system stability is the ability of an electric power system, for a given initial operating condition, to regain a state of operating equilibrium after being subjected to a physical disturbance, with most system variables bounded so that practically the entire system remains intact); *see also,* Kundur, Prabha, *Power System Stability and Control,* McGraw Hill, at 26 (1994).

[26] *See* Reliability Standard TPL–001–5.1, at Requirement 2.1 (Near-Term Transmission Planning Horizon) and Requirement R.2.2 (Long-Term Transmission Planning Horizon).

require in part that planning coordinators and transmission planners conduct steady state and stability studies of pre-specified extreme events and evaluate possible actions designed to reduce the likelihood or mitigate the consequences and adverse impacts of the event(s), if the analysis concludes that the pre-selected extreme events cause cascading outages.

13. Table 1 of Reliability Standard TPL–001–5.1 includes a list of examples of planning events (*i.e.,* Category P1 through P7) [27] for which specific studies may be required based on the entity's own evaluation that such an event could occur within its operating area. Section 3.a of Table-1 (Steady State & Stability Performance Extreme Events) states that steady state analysis should be conducted for wide-area events affecting the transmission system based on system configuration and how it can be affected by events such as wildfires and severe weather (*e.g.,* hurricanes and tornadoes). In addition, section 3.b serves as a catch-all provision, stating that steady state analysis should be performed for ''other events based upon operating experience that may result in wide-area disturbances.''

C. Prior Commission Actions To Address the Reliability Impacts of Extreme Weather

14. On June 1 and 2, 2021, the Commission convened a staff-led technical conference on Climate Change, Extreme Weather, and Electric System Reliability.[28] The Commission sought to understand, among other things, whether further action from the Commission is needed to help achieve an electric system that can withstand, respond to, and recover from extreme weather events.[29]

15. In the pre- and post-conference comments, industry experts agreed that extreme weather events are likely to become more severe and frequent in the future.[30] They also acknowledged the challenges associated with planning for extreme events, including shifting scheduled maintenance and canceling or recalling transmission and generation assets from scheduled maintenance to meet demand under unexpected circumstances.[31] Further, commenters discussed potential changes to the Reliability Standards to address planning and operational preparedness for energy adequacy risks,[32] contingencies related to extreme weather events, and wide-area transmission planning and development challenges, among others.[33] Comments also addressed more directly the potential reliability gaps in the existing set of Reliability Standards, including Reliability Standard TPL–001–4, and identified potential solutions.[34]

16. On August 24, 2021, and February 16, 2023, the Commission approved revised Reliability Standards to address some of the reliability risks posed by extreme cold weather.[35] These Reliability Standards, among other things, require generators to implement plans for cold weather preparedness and implement freeze protection measures to mitigate the reliability impacts of extreme cold weather on their generating units. The new and revised standards also require the balancing authority, transmission operator, and reliability coordinator to plan and operate the grid reliably during cold weather conditions by requiring the exchange of certain information related to the generator's capability to operate under such conditions.[36]

D. Notice of Proposed Rulemaking

17. On June 26, 2022, the Commission issued the Notice of Proposed Rulemaking (NOPR) proposing to direct NERC to develop a new or modified Reliability Standard to address a lack of a long term planning requirement for extreme heat and cold weather events.[37] Specifically, the Commission proposed to direct NERC to develop either modifications to Reliability Standard TPL–001–5.1 or a new Reliability Standard, to require the following: (1) development of benchmark planning cases based on major prior extreme heat and cold weather events and/or meteorological projections; (2) planning for extreme heat and cold weather 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 wide-area impacts of extreme heat and cold weather; and (3) development of corrective action plans that mitigate any instances where performance requirements for extreme heat and cold weather events are not met.[38]

18. The NOPR preliminarily found that, based on the wide geographic impacts on the Bulk-Power System of previous extreme heat and cold weather events, the study criteria for extreme heat and cold events should include a consideration of wide-area conditions affecting neighboring regions and their impact on one planning area's ability to rely on the resources of another region during the weather event.[39]

19. The NOPR sought comments on all aspects of the proposed directives, including among others: (1) the development of benchmark planning cases; (2) requiring transmission planning studies of wide-area extreme heat and cold events; (3) the study of concurrent generator and transmission outages; (4) the analysis of sensitivities; (5) modifications to current deterministic planning approaches; (6) coordination among registered entities and sharing of study results; (7) requiring entities to implement corrective action plans if performance standards are not met; and (8) whether the final rule should address other extreme weather events beyond heat and cold events. The comment period for the NOPR ended on August 26, 2022, and the Commission received 33 sets of comments.[40]

III. The Need for Reform

20. Extreme weather-related events that spread across large portions of the country over the past decade demonstrate the challenges to transmission planning from extreme heat and cold weather patterns. The NOPR discussed seven major extreme heat and cold weather events that had

[27] Categories P1 through P7 are defined in TPL–001–5.1 in Table 1—Steady State & Stability Performance Planning Events.

[28] *Climate Change, Extreme Weather, and Electric System Reliability,* Notice of Technical Conference, Docket No. AD21–13–000, at 1 (Mar. 5, 2021).

[29] *Id.* at 2.

[30] CAISO Pre-Conference Comments at 1–3; California Public Utilities Commission Pre-Conference Comments at 4; Oregon Public Utilities Commission Pre-Conference Comments at 2–3; NYISO Pre-Conference Comments at 4; AEP Pre-Conference Comments at 5.

[31] June 2, 2021, Tr. at 21–23 (Wesley Yeomans, Vice President of Operations, NYISO).

[32] ISO-New England Inc. Pre-Conference Comments at 10.

[33] Midcontinent Independent System Operator (MISO) Pre-Conference Comments at 4–5, 14–17.

[34] *See e.g.,* NERC Pre-Conference Comments at 6; MISO Post-Conference Comments at 20; Pacific Gas & Electric Company Pre-Conference Comments at 19–20; PJM Post-Conference Comments at 21; CAISO Post-Conference Comments at 10.

[35] *N. Am. Elec. Reliability Corp.,* 176 FERC ¶ 61,119 (2021). The Commission approved proposed Reliability Standards EOP–011–2 (Emergency Preparedness and Operations); IRO–010–4 (Reliability Coordinator Data Specification and Collection); and TOP–003–5 (Operational Reliability Data) (collectively, the Cold Weather Reliability Standards) and *Order Approving Extreme Cold Weather Reliability Standards EOP–011–3 and EOP–012–1 and Directing Modification of Reliability Standard EOP–012–1,* 182 FERC ¶ 61,094 (2023).

[36] *Id.* P 3.

[37] NOPR, 179 FERC ¶ 61,195 at P 47.

[38] *Id.* P 51.

[39] *Id.* P 67.

[40] A list of commenters to the NOPR and the abbreviated names used in this final rule appear in Appendix A.

occurred since 2011.[41] Of these, four (2011, 2013, 2018, and 2021) were extreme cold weather events that nearly caused system collapse if the operators had not acted to shed load.[42] The remaining three events (2014, 2020, and 2021) were extreme heat weather events that resulted in generation losses and varying degrees of load shedding.[43] Since the issuance of the NOPR, another extreme cold weather event indicated reliability challenges faced by the Bulk-Power System. In December 2022, Winter Storm Elliott caused extreme cold conditions that significantly stressed the Bulk-Power System, forcing some utilities to deploy rolling blackouts to preserve Bulk-Power System reliability.[44] These extreme heat and cold events demonstrate a risk to Reliable Operation of the Bulk-Power System.

21. While wide-area extreme heat and cold weather events may not occur every year, their frequency and magnitude are expected to increase. The National Oceanic and Atmospheric Administration's (NOAA) data and analyses show an increasing trend in extreme heat and cold weather events,[45] and the U.S. Environmental Protection Agency climate change indicators also show upward trends in heatwave frequency, duration, and intensity.[46] NOAA states that climate change is also driving more compound events, *i.e.,* multiple extreme events occurring simultaneously or successively, such as concurrent heat waves and droughts, and more extreme heat conditions in cities.[47]

22. These conditions have created an urgency to address the negative impact of extreme weather on the reliability of the Bulk-Power System. To that end, the directives to NERC in this final rule aim to improve system planning specifically for extreme heat and cold weather events. The potential impact of widespread extreme heat and cold events on the reliability of the Bulk-Power System can be modeled and studied in advance as part of near-term and long-term transmission system planning. Responsible entities could then use the studies to develop transmission system operational strategies or corrective action plans with mitigations that could be deployed in preparation for extreme heat and cold events.

23. The current transmission planning Reliability Standards, however, do not obligate transmission planners and planning coordinators to consider extreme hot and cold weather in their transmission assessments. In particular, Reliability Standard TPL–001–5.1 requires steady state and stability analyses to be performed for certain extreme events but does not require steady state and stability analyses for extreme heat and cold conditions.[48] Likewise, while Reliability Standard TPL–001–5.1 Table 1, provisions 2.f (stability) and 3.b (steady state), requires responsible entities to study events based on operating experience that may result in a wide-area disturbance,[49] the Standard does not specify the study of extreme heat or cold conditions.

24. System planning measures alone will not eliminate the reliability risk associated with extreme heat and cold events. The directives to improve transmission planning discussed in this final rule will prepare the Bulk-Power System for extreme weather events in the long term and will work together with the requirements in the Cold Weather Reliability Standards to mitigate the near-term reliability impact of extreme weather events. Improved system planning will limit the impact of such events and reduce the risk to the reliability of the Bulk-Power System, which prior events demonstrate is significant.

IV. Discussion

A. Directive to NERC To Develop New or Modified Reliability Standard

25. Pursuant to FPA section 215(d)(5), we adopt the NOPR proposal and direct NERC to submit a new Reliability Standard or modifications to Reliability Standard TPL–001–5.1 requiring transmission system planning for extreme heat and cold weather events that impact the Reliable Operation of the Bulk-Power System. For the reasons discussed in section III above, we conclude that it is necessary to update the transmission planning Reliability Standard to reflect the impact of extreme heat and cold weather events on the reliability of the Bulk-Power System. Most commenters support the NOPR proposal to develop mandatory transmission system planning requirements for extreme heat and cold weather events.[50] Commenters also agree that Commission action is necessary to address the reliability gaps pertaining to the consideration of extreme heat and cold weather events that exist in current transmission planning processes.[51]

26. Although supportive of the need to consider extreme weather in the transmission planning process, PJM Interconnection, L.L.C. (PJM) is critical of the Commission's proposed ''piecemeal'' approach and suggests that the Commission harmonize this rulemaking with other Commission actions on transmission planning.[52] While we agree that it is important for NERC and applicable planning entities to consider how requirements implemented pursuant to this rulemaking may interact with processes carried out pursuant to other Commission actions on transmission planning, we disagree with PJM's suggestion that this proceeding is not an appropriate forum for directing changes to the NERC Reliability Standards. While there is undoubtedly a nexus between the long-term planning for expected changes in resources and demand as contemplated in Docket No. RM21–17–000 and Reliability Standards for extreme weather, each set of reforms is subject to differing statutory schemes and other considerations, and each aims at related but distinct challenges. The Commission's transmission planning reform efforts require individual consideration, as they each concern different transmission planning objectives, time horizons, and areas of Commission jurisdiction. This proceeding is conducted pursuant to the Commission's jurisdiction under section 215 of the FPA and contemplates transmission planning entity actions that may be needed in the planning timeframe of six to ten years and beyond to mitigate the impacts of extreme weather, whereas the proceeding in Docket No. RM21–17–000 was initiated

[41] For a full discussion of these extreme weather events, *see* NOPR, 179 FERC ¶ 61,195 at PP 24–33.

[42] *See e.g.,* FERC and NERC Staff Report, *Outages and Curtailments During the Southwest Cold Weather Event of February 1–5, 2011,* at 7 (Aug. 2011), *https://www.ferc.gov/sites/default/files/2020-05/ReportontheSouthwestColdWeatherEventfromFebruary2011Report.pdf* (impacting nearly 4.4 million electric customers in ERCOT); 2013 PJM Heat Wave Analysis at 5 (impacting approximately 45,000 customers in PJM).

[43] *See, e.g.,* 2021 Cold Weather Event Report at 133.

[44] FERC, *FERC, NERC to Open Joint Inquiry into Winter Storm Elliott* (Dec. 2022), *https://www.ferc.gov/news-events/news/ferc-nerc-open-joint-inquiry-winter-storm-elliott.*

[45] *See* NOAA., Nat'l Centers for Envtl. Info., *U.S. Billion-Dollar Weather and Climate Disasters* (2023), *https://www.ncei.noaa.gov/access/billions/.*

[46] U.S. EPA, *Climate Change Indicators in the United States* (last updated May 2, 2023), *https://www.epa.gov/climate-indicators.*

[47] NOAA, *2022 U.S. Billion Dollar Weather and Climate Disasters in Historical Context* (2023), *https://www.climate.gov/news-features/blogs/2022-us-billion-dollar-weather-and-climate-disasters-historical-context.*

[48] *See* Reliability Standard TPL–001–5.1, at Requirements R3 and R4 and Table 1.

[49] *Id.* at Table 1, provisions 2.f and 3.b.

[50] *See, e.g.,* MISO Transmission Owners Comments at 1–2; Indicated Trade Associations Comments at 1–2; NYISO Comments at 1–2; AEP Comments at 1; ACP Comments at 1; PIOs Comments at 1.

[51] *See, e.g.,* EPRI Comments at P 4.

[52] PJM Comments at 3–4, 7.

pursuant to the Commission's jurisdiction under section 206 of the FPA, considers a more fulsome range of practices that may be required to render rates just and reasonable, and contemplates a planning horizon of 20 years.[53] While addressing these related efforts in a single proceeding may have benefits, it also would risk complicating the development of solutions and making the process more unwieldy. The Commission has thus determined to take this step to facilitate solutions to one aspect of the extreme weather challenge, as part of a series of actions that build on each other by seeking to address the many areas that affect extreme weather reliability.

27. Accordingly, we adopt the NOPR proposal and direct NERC to develop a new or modified Reliability Standard to require the following: (1) development of benchmark planning cases based on major prior extreme heat and cold weather events and/or meteorological projections; (2) planning for extreme heat and cold weather 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 wide-area impacts of extreme heat and cold weather; and (3) development of corrective action plans that mitigate specified instances where performance requirements for extreme heat and cold weather events are not met.[54] We also direct NERC to identify the responsible entities for developing benchmark planning cases and conducting wide-area studies under the new or modified Reliability Standard.

28. Given the importance of timely addressing the identified reliability gap, we direct NERC to submit the responsive new or modified Reliability Standard within 18 months of the date of publication of this final rule in the **Federal Register**. We further direct NERC to develop a phased-in implementation timeline for the different requirements of the new or modified Reliability Standard (*i.e.,* developing benchmark planning cases, conducting studies, developing corrective action plans) that shall begin within 12 months of the effective date of a Commission order approving the proposed Reliability Standard.

29. We address below in further detail issues raised in the NOPR and in comments regarding: (1) development of benchmark events and planning cases; (2) definition of ''wide-area;'' (3) entities responsible for developing benchmark events and conducting transmission planning studies of wide-area events; (4) coordination among registered entities and sharing of data and study results; (5) concurrent/correlated generator and transmission outages; (6) conducting transmission system planning studies for extreme heat and cold weather events; (7) corrective action plans; (8) other extreme weather events; and (9) Reliability Standard development and implementation timeline.

B. Develop Benchmark Events and Planning Cases Based on Major Prior Extreme Heat and Cold Weather Events and/or Meteorological Projections

30. In the NOPR, the Commission proposed to direct NERC to include in the new or modified Reliability Standard benchmark events that responsible entities must study.[55] The NOPR proposed basing such benchmark events on prior events (*e.g.,* the February 2011 Southwest Cold Weather Event and the January 2014 Polar Vortex Cold Weather Event) and/or meteorological projections. Recognizing that extreme weather risks may vary from region to region and change over time, the NOPR proposed to direct NERC to consider approaches that would provide a uniform framework for developing benchmark events while still recognizing regional differences; for example, NERC could define benchmark events around a projected frequency (*e.g.,* 1-in-50-year event) or probability distribution (95th percentile event).[56] Although the NOPR did not specify how these benchmark events should be developed, the NOPR provided two examples: (1) NERC could develop the benchmark event or events during the standard development process; or (2) NERC could include in the new or modified Reliability Standard a framework establishing a common design basis for the development of benchmark events. The NOPR also suggested including in the modified standard the primary features of the benchmark event(s) while designating NERC or another entity to periodically update benchmark events.[57]

31. The NOPR also proposed that establishing one or more benchmark planning cases, based on benchmark events, should form the basis for sensitivity analysis. In addition to providing valuable case study information to be applied to preparing for possible comparable future events, these events would also serve as a basis for effectively using assets and resources. Specifically, once developed, responsible entities would use the benchmark events to develop benchmark planning cases to conduct studies to assess the limitations of the transmission system locally and over a wide-area, and to understand resource availability and potential firm load shedding requirements under stressed conditions.[58] The NOPR sought comments on all aspects of the proposed directive.

1. Comments

32. Commenters generally agree with the NOPR proposal to direct NERC to develop requirements that address the types of extreme heat and cold weather scenarios that responsible entities are required to study.[59] Indicated Trade Associations caution, however, that universal benchmark events would be hard to implement given regional differences.[60] As such, and consistent with the NOPR proposal, Indicated Trade Associations, APS, Bonneville Power Administration (BPA), and Idaho Power, among others, agree that regional differences (*e.g.,* climate, topology, electrical characteristics) should be considered in developing benchmark events.[61]

33. Regarding how benchmark events should be developed, NERC notes that significant work will be necessary to develop a uniform planning approach that properly accounts for regional differences in climate and weather patterns, among other considerations. Accordingly, NERC asks for flexibility in developing benchmark events, including considering options beyond those identified in the NOPR.[62] Indicated Trade Associations recommend that NERC consider all the examples of benchmark events identified in the NOPR.[63] PJM indicates that developing benchmark events will require scientific and meteorological expertise to ensure that NERC guidelines and criteria reflect statistically valid scenarios for the meteorological projections and their possible impacts on transmission planning. As such, PJM recommends that the Commission engage the national

[53] *See Building for the Future Through Elec. Reg'l Transmission Planning & Cost Allocation & Generator Interconnection,* Notice of Proposed Rulemaking, 87 FR 26504, (May 4, 2022), 179 FERC ¶ 61,028 (2022).

[54] NOPR, 179 FERC ¶ 61,195 at P 51.

[55] *Id.*

[56] *Id.* P 52.

[57] *Id.* P 53.

[58] *Id.*

[59] *See, e.g.,* NERC Comments at 7–8; AEP Comments at 7; Indicated Trade Associations Comments at 8; NARUC Comments at 5.

[60] Indicated Trade Associations Comments at 8.

[61] *See id.;* APS Comments at 3; BPA Comments at 3; Idaho Comments at 2.

[62] NERC Comments at 8–9.

[63] Indicated Trade Associations Comments at 8.

labs, Regional Transmission Organizations (RTO), NOAA, and other agencies to develop extreme weather ''design threshold'' metrics, as well as investigate targeted planning thresholds (e.*g.,* 1-in-50-year events).[64] Other commenters highlight the necessity of ensuring that benchmark events are not only developed using historical extreme heat and cold event data, but more importantly use future meteorological projections in order to prepare for plausible extremes in future years.[65]

34. All those who submitted comments regarding the NOPR proposal to require periodic updates to benchmark events agree with the need to do so. For example, Union for Concerned Scientists (UCS) points to the scientific consensus that climate change is altering the intensity and frequency of extreme weather conditions as a reason to require the periodic update of benchmark events.[66] American Electric Power Service Corporation (AEP) recommends updating the benchmark events every three years, consistent with the Commission's proposed planning cycle for regional transmission planning, based on the most up-to-date data.[67] In contrast, Midcontinent Independent System Operator, Inc. (MISO) suggests that, consistent with similar requirements in Reliability Standard TPL–007–4 (Transmission System Planned Performance for Geomagnetic Disturbance Events) and Reliability Standard PRC–006–5 (Automatic Underfrequency Load Shedding) extreme heat and cold weather benchmark events should be updated every five years.[68] Other commenters recommend that the key aspects of the benchmark be updated periodically, without opining on the periodicity of updates.[69]

2. Commission Determination

35. Pursuant to section 215(d)(5) of the FPA, we adopt the NOPR proposal and direct NERC to: (1) develop extreme heat and cold weather benchmark events, and (2) require the development of benchmark planning cases based on identified benchmark events. Without specific requirements describing the types of heat and cold scenarios that responsible entities must study, the new or modified Reliability Standard may not provide a significant improvement upon the *status quo.* Benchmark events will provide a defined event that will form the basis for assessing system performance during extreme heat and cold weather events. Benchmark events will also form the basis for a planner's benchmark planning case—*i.e.,* the base case representing system conditions under the relevant benchmark event—that will be used to study the potential wide-area impacts of anticipated extreme heat and cold weather events.

36. Although the NOPR outlined some of the Commission's expectations for the development of benchmark events, including that benchmark events be based on prior extreme heat and cold events and/or meteorological projections,[70] there is currently no established guidance or set of tools in place to facilitate the development of extreme heat and cold benchmark events for the purpose of informing transmission system planning. As recommended by commenters, NERC should consider the examples of approaches for defining benchmark events identified in the NOPR (*e.g.,* the use of projected frequency or probability distribution).[71] NERC may also consider other approaches that achieve the objectives outlined in this final rule. Further, as recommended by PJM, we believe there is value in engaging with national labs, RTOs, NOAA, and other agencies and organizations in developing benchmark events. Considering NERC's key role, technical expertise, and experience assessing the reliability impacts of various events and conditions, we encourage NERC to engage with national labs, RTOs, NOAA, and other agencies and organizations as needed. To that end, as discussed in section IV.J below, we have modified the NOPR proposal to allow more time for NERC to consider these complex issues and engage additional expertise where necessary.

37. Because the impact of most extreme heat and cold events spans beyond the footprints of individual planning entities, it is important that all responsible entities likely to be impacted by the same extreme weather events use consistent benchmark events. Doing so is important to ensuring that neighboring planning regions are assuming similar weather conditions and are able to coordinate their assumptions accordingly. As a result, defining the benchmark event in a manner that provides responsible entities significant discretion to determine the applicable meteorological conditions would not meet the objectives of this final rule.

38. At the same time, because different regions experience weather conditions and their impacts differently, a single benchmark event for the entire Nation is unlikely to meet the objectives of this final rule. Accordingly, in developing extreme heat and cold benchmark events, NERC shall ensure that benchmark events reflect regional differences in climate and weather patterns.

39. We also direct NERC to include in the Reliability Standard the framework and criteria that responsible entities shall use to develop from the relevant benchmark event planning cases to represent potential weather-related contingencies (*e.g.,* concurrent/correlated generation and transmission outages, derates) and expected future conditions of the system such as changes in load, transfers, and generation resource mix, and impacts on generators sensitive to extreme heat or cold, due to the weather conditions indicated in the benchmark events. Developing such a framework would provide a common design basis for responsible entities to follow when creating benchmark planning cases. This would not only help establish a clear set of expectations for responsible entities to follow when developing benchmark planning events, but also facilitate auditing and enforcement of the Standard.

40. We also direct NERC to ensure the reliability standard contains appropriate mechanisms for ensuring the benchmark event reflects up-to-date meteorological data. The increasing intensity, frequency, and unpredictability of extreme weather conditions requires that key aspects of the benchmark events be reviewed, and if necessary, updated periodically to ensure the corresponding benchmark planning cases reflect updated meteorological data. For example, a requirement that defines a fixed benchmark event with no provision for future updates (*e.g.,* defining the benchmark event for a responsible entity as the most severe heat wave in the last twenty years measured from the effective date of the standard) may not provide an accurate indicator of future risks. To the extent NERC determines that the benchmark event should be fixed or only updated

[64] PJM Comments at 9.

[65] *See, e.g.,* EPRI Comments at P 5; Entergy Comments at 3.

[66] UCS Comments at 7.

[67] AEP Comments at 3–4 (citing Docket No. RM21–17–000).

[68] MISO Comments at 3.

[69] *See, e.g.,* APS Comments at 3; Entergy Comments at 4; Indicated Trade Associations Comments at 8.

[70] For instance, a benchmark event could be constructed based on data from a major prior extreme heat or cold event, with adjustments if necessary to account for the fact that future meteorological projections may estimate that similar events in the future are likely to be more extreme.

[71] *See supra* P 33.

periodically,[72] we agree with MISO that including a mechanism to update the benchmark event at least every five years would strike a reasonable balance between the benefits of using the most up-to-date meteorological data and administrative the burdens of collecting and analyzing such data.

C. Definition of ''Wide-Area''

41. In the NOPR, the Commission proposed to direct NERC to require in a new or modified Reliability Standard that transmission planning studies consider the wide-area impacts of extreme heat and cold weather.[73] The NOPR explained that the impacts of extreme weather events on the Reliable Operation of the Bulk-Power System can be widespread, potentially causing simultaneous loss of generation and increased transmission constraints within and across regions.[74] The NOPR also pointed out that failure to study the wide-area impact of extreme heat or cold weather conditions in transmission planning could result in reliability issues affecting multiple regions or multiple planning coordinator areas remaining undetected in the long-term planning horizon. This, in turn, could lead to otherwise avoidable system conditions that would be only one contingency away from voltage collapse and uncontrolled blackouts.[75]

42. The NOPR proposed that, based on prior events, the study criteria for extreme heat and cold weather events should consider wide-area conditions affecting neighboring regions and their impact on one planning area's ability to rely on the resources of another region during the weather event.

43. To identify opportunities for improved wide-area planning studies and coordination, the NOPR sought comments on whether wide-area planning studies should be defined geographically or electrically.[76]

1. Comments

44. AEP, MISO Transmission Owners, and Tri-State Generation and Transmission Association, Inc. (Tri-State) favor defining wide-area geographically.[77] MISO Transmission Owners assert that wide-area must be defined by geography to address issues in each region as best suited for that region, given that extreme heat and cold weather risks, and the appropriate responses thereto, vary by geography.[78] Tri-State explains that ''wide-area'' should be defined geographically, because for a transmission planner to evaluate a large area weather event, it would need to be modeled within the transmission planner's area, as well as neighboring entities.[79]

45. Although MISO Transmission Owners support a geographic definition, they also caution that RTO regions, Order No. 1000 planning regions, and NERC Regional Entities do not have identical footprints. Therefore, MISO Transmission Owners recommend that the final rule direct NERC to propose modifications to Reliability Standards to provide appropriately flexible provisions to address scenarios where those inconsistent footprints may introduce conflicts.[80]

46. Idaho Power, on the other hand, comments that ''wide-area'' should be defined electrically to better capture the interdependency of systems.[81]

47. LCRA Transmission Services Corporation (LCRA), Electric Power Research Institute (EPRI), and PJM prefer that ''wide-area'' be defined both geographically and electrically. LCRA explains that this is necessary to represent the geographic correlation of extreme weather events and the electrical connectivity of the transmission system.[82] EPRI cautions that ''geographic definitions of wide area events will need to be developed for inclusion in resource adequacy or production cost models'' for purposes of identifying the snapshot conditions that should serve as the primary inputs to the transmission planning assessments.[83] Further, EPRI explains that ''wide area events defined electrically can be used to represent acute switching events that occur over much shorter timescales and can be used to capture discrete impacts defined as contingency events, which occur concurrent with the extreme temperature condition.'' [84]

48. Other commenters, while not indicating a preference between electrical or geographical definition, highlight that extreme heat and cold weather events are not bound by the footprint of utilities or authorities that separate planning and balancing areas.[85] Indicated Trade Associations recommend that the Commission invest the NERC standard drafting team with substantial discretion in addressing whether and how wide-area planning studies should be defined geographically or electrically.[86]

49. Although also not stating a preference as to whether to define ''wide-area'' electrically or geographically, Entergy Services, LLC (Entergy) cautions against expecting transmission planners and coordinators ''to overlap benchmark events between regions'' because ''[s]uch overlapping could result in modeling of extreme heat and cold events over regions that are much larger than the areas in which such events are likely to occur.'' [87]

2. Commission Determination

50. Pursuant to section 215(d)(5) of the FPA, we adopt the NOPR proposal and direct NERC to require that transmission planning studies under the new or revised Reliability Standard consider the wide-area impacts of extreme heat and cold weather. We direct NERC to clearly describe the process that an entity must use to define the wide-area boundaries. While commenters provide various views in favor of both a geographical approach and electrical approach to defining wide-area boundaries, we do not adopt any one approach in this final rule. Rather, we believe that this technical matter deserves a more fulsome vetting in the Reliability Standards development process. NERC should consider the comments in this proceeding when developing a new or modified reliability standard that considers the broad area impacts of extreme heat and cold weather.[88]

D. Entities Responsible for Developing Benchmark Events and Planning Cases, and for Conducting Transmission Planning Studies of Wide-Area Events

51. The NOPR proposed to direct NERC to develop requirements that address the types of extreme heat and

[72] *See, e.g.,* Reliability Standard EOP–012–1 (Extreme Cold Weather Preparedness and Operations), at Requirement 4 (requiring generator owners to calculate the generator extreme cold weather temperature every five years).

[73] NOPR, 179 FERC ¶ 61,195 at P 64.

[74] *Id.*

[75] *Id.* P 66.

[76] *Id.* P 67. The NOPR also solicited comment on which entities should oversee and coordinate the wide-area planning models and studies, as well as addressing the results of the studies, and how they should communicate those results among transmission planners. *Id.* These comments are addressed below in the sections D and E.

[77] AEP Comments at 16; MISO Transmission Owners Comments at 4.

[78] *Id.* at 4.

[79] Tri-State Comments at 5–6.

[80] MISO Transmission Owners Comments at 4.

[81] Idaho Power Comments at 4.

[82] LCRA Comments at 3; EPRI Comments at P 18; PJM Comments at 10.

[83] EPRI Comments at P 18.

[84] *Id.* at 12.

[85] UCS Comments at 8; Entergy Comments at 5; EDF at Comments 23; MISO Transmission Owners Comments at 4.

[86] Indicated Trade Associations at 10.

[87] Entergy Comments at 5–6.

[88] *Cf.,* Order No. 693, 118 FERC ¶ 61,218 at P 188 (directing NERC to address NOPR comments suggesting specific new improvements to the Reliability Standards in the standards development process, noting that it ''does not direct any outcome other than that the comments receive consideration.'').

cold scenarios responsible entities are required to study, including the development of benchmark events and benchmark planning cases.[89] The NOPR solicited feedback on which entities should be responsible for updating benchmark events and whether, and to what extent, it may be appropriate to allow designated entities to periodically update key aspects of the benchmark events.[90]

52. As a separate matter, the NOPR proposed to require that transmission planning studies that consider the wide-area impacts of extreme heat and cold weather.[91] To inform this directive, the NOPR solicited comment on which entities should oversee and coordinate the wide-area planning models and studies, as well as which entities should have responsibility to address the results of the studies.[92]

1. Comments

a. Entity Responsible for Development of Benchmark Events

53. There is no consensus among the commenters regarding which entities should be tasked with developing the benchmark events. Indicated Trade Associations suggest that the subject matter experts on the NERC standard drafting team should develop the benchmark events.[93] Entergy also suggests that the NERC develop the benchmark events, as NERC will be able to tailor the benchmark events to reflect regional variations in extreme weather risk.[94] All other commenters on this issue proposed that other entities be responsible for benchmark event development.[95] For example, New York Independent System Operator, Inc. (NYISO) and MISO Transmission Owners posit that entities registered with NERC as planning coordinators or transmission planners should be given the latitude to develop the benchmark events.[96] AEP recommends that each planning coordinator should develop individualized benchmark events for its planning area, except in regions that lack the necessary resources or expertise, in which case the Regional Entities should coordinate and review the benchmark event process in collaboration with these smaller planning coordinators in that region.[97] American Clean Power Association (ACP) suggests that the Regional Entities should develop the benchmark events that will be evaluated by all transmission planners and planning coordinators in a given region.[98]

b. Entity Responsible for Development of Planning Cases and Conducting Transmission Planning Studies of Wide-Area Events

54. Regarding development of benchmark planning cases, beyond existing registered entities, Arizona Public Service Company (APS) recommends ''that a regional planning entity would be the appropriate entity to determine the benchmark planning cases and develop the scenarios that constitute an extreme event in their region.'' [99]

55. Further, commenters suggest a variety of entities to *perform* the wide area studies. NERC suggests that a registered entity subject to the Reliability Standard, such as a planning coordinator or transmission planner, should be responsible for performing the wide-area studies.[100] AEP asserts that the planning coordinators should oversee and coordinate the wide-area planning models and studies, communicate the results, and work to mitigate issues that require corrective action.[101]

56. APS and MISO Transmission Owners express concern that an individual transmission planner or planning coordinator would not be positioned to perform a wide-area assessment of extreme weather conditions because of its limited geographical visibility.[102] Similarly, Entergy also questions whether a single transmission planner would be able to model a wide-area event on its own. Entergy believes that the responsibility for performing the analysis should lie with the RTOs or Regional Entities, with input provided by member transmission owners and transmission planners.[103] Alternatively, APS suggested a regional planning entity, such as those created under Order No. 1000, would be appropriate to oversee and coordinate wide-area planning models and studies.[104] Idaho Power Company (Idaho Power) asserts that regional planning groups such as Western Power Pool are the ones best positioned to coordinate and perform the wide-area planning studies.[105]

57. Environmental Defense Fund (EDF), Tri-State, and Eversource Energy Service Company (Eversource) propose that reliability coordinators should have the responsibility to perform wide-area planning and coordination in collaboration with other impacted reliability coordinators.[106]

2. Commission Determination

a. Entity Responsible for Establishing Benchmark Events

58. Pursuant to section 215(d)(5) of the FPA, we adopt the NOPR proposal and direct NERC to develop benchmark events for extreme heat and cold weather events through the Reliability Standards development process. We agree with Indicated Trade Associations that the development of adequate benchmark events is critical and should be committed to the subject matter experts on the standards drafting team. We also agree with Entergy that NERC will be able to tailor benchmark events to capture regional differences and the different risks that each region faces during extreme heat and cold weather events. While Regional Entities and reliability coordinators are encouraged to participate in the NERC Reliability Standards development process to develop the benchmark events, we disagree with AEP and other commenters who recommend that entities other than NERC take the lead in the development of benchmark events.

59. Further, requiring NERC to develop the new or modified Reliability Standard's benchmark events is consistent with the approach the Commission took in Order No. 779, when the Commission directed NERC to develop benchmark events for geomagnetic disturbance analyses.[107] For the same reasons, we also conclude that NERC is best positioned to define mechanisms to periodically update extreme heat and cold weather benchmark events, as discussed above.[108]

b. Entities Responsible for Development of Planning Cases and Conducting Transmission Planning Studies of Wide-Area Events

60. We also direct NERC to designate the type(s) of entities responsible for

[89] NOPR, 179 FERC ¶ 61,195 at PP 50–51.

[90] *Id.* P 53.

[91] *Id.* P 64.

[92] *Id.* P 67.

[93] Indicated Trade Associations Comments at 8.

[94] Entergy Comments at 4.

[95] *See. e.g.,* EDF Comments at 8.

[96] NYISO Comments at 13; MISO Transmission Owners Comments at 5.

[97] AEP Comments at 9.

[98] ACP Comments at 3.

[99] APS Comments at 3.

[100] AEP Comments at 20; NERC Comments at 9–10.

[101] AEP Comments at 16.

[102] APS Comments at 4; MISO Transmission Owners Comments at 4.

[103] Entergy Comments at 6.

[104] APS Comments at 4.

[105] Idaho Power Comments at 4.

[106] EDF Comments at 23; Tri-State Comments at 6; Eversource Comments at 5.

[107] *Reliability Standards for Geomagnetic Disturbances,* Order No. 779, 143 FERC ¶ 61,147, at P 2 (2013).

[108] *See supra* P 40.

developing benchmark planning cases and conducting wide-area studies under the new or modified Reliability Standard. The scope of extreme weather event studies will likely cover large geographical areas far exceeding the smaller individual transmission planner or planning coordinator planning areas. Accordingly, we agree with APS that the benchmark planning cases should be developed by registered entities such as large planning coordinators, or groups of planning coordinators, with the capability of planning on a regional scope.[109]

61. We also disagree with assertions that reliability coordinators should be responsible for developing benchmark planning cases or conducting wide-area studies. We believe the designated responsible entities should have certain characteristics, including having a wide-area view of the Bulk-Power System and the ability to conduct long-term planning studies across a wide geographic area. The responsible entities should also have the planning tools, expertise, processes, and procedures to develop benchmark planning cases and analyze extreme weather events in the long-term planning horizon. Under the NERC functional model, however, reliability coordinators have responsibility for the real-time operation of the bulk-power system. Accordingly, we conclude that reliability coordinators are not well suited for developing benchmark planning cases or conducting wide-area studies.

62. To comply with this directive, NERC may designate the tasks of developing benchmark planning cases and conducting wide-area studies to an existing functional entity or a group of functional entities (*e.g.,* a group of planning coordinators). NERC may also establish a new functional entity registration to undertake these tasks. In the petition accompanying the proposed Reliability Standard NERC should explain how the applicable registered entity or entities meet the objectives outlined above.

[109] According to the NERC Registration Matrix, there are currently 211 transmission planners and 66 planning coordinators in the United States. While some of these entities operate over large geographic areas—for example, PJM and MISO are the only planning coordinators in the Reliability First footprint—the majority operate on a much smaller scale—WECC and SERC have 59 planning coordinators, some of which are small cities and counties. NERC, *NCR Active Entities List,* (last visited Apr. 7, 2023) *https://www.nerc.com/pa/comp/Registration%20and%20Certification%20DL/NERC_Compliance_Registry_Matrix_Excel.xlsx.*

E. Coordination Among Registered Entities and Sharing of Data and Study Results

63. The NOPR explained that Reliability Standard TPL–001–5.1 cross-references Reliability Standard MOD–032–1 (Data for Power System Modeling Analysis), which establishes consistent modeling data requirements and reporting procedures for the development of planning horizon cases necessary to support analysis of the reliability of the interconnected system.[110] Reliability Standard MOD–032–1 ensures an adequate means of data collection for transmission planning. It requires applicable registered entities to provide steady-state, dynamic, and short circuit modeling data to their transmission planner(s) and planning coordinator(s). The modeling data is then shared pursuant to the data requirements and reporting procedures developed by the transmission planner and planning coordinator as set forth in Reliability Standard TPL–001–5.1, Requirement R1.

64. The NOPR stated that, while balancing authorities and other entities must share system information and study results with their transmission planner and planning coordinator pursuant to Reliability Standards MOD–032–1 and TPL–001–5.1, there is no required sharing of such information related to extreme heat or cold weather events—or required coordination—among planning coordinators and transmission planners with transmission operators, transmission owners, and generator owners.[111] Sharing system information and study results and enhancing coordination among these entities for extreme heat and cold weather events could result in more representative planning models by better integrating and including operations concerns (*e.g.,* lessons learned from past issues including corrective actions and projected outcomes from these actions, evolving issues concerning extreme heat/cold) in planning models; and conveying reliability concerns from planning studies (*e.g.,* potential widespread cascading, islanding, significant loss of load, blackout, etc.) as they pertain to extreme heat or cold.[112]

65. The NOPR proposed to direct NERC to require system information and study results sharing and coordination among planning coordinators and transmission planners with transmission operators, transmission owners, and generator owners for extreme heat and cold weather events.[113] The NOPR solicited comments on whether existing Reliability Standards are sufficient to ensure that responsible entities performing studies of extreme heat and cold weather events have the necessary data, and/or whether the Commission should direct additional changes pursuant to FPA section 215(d)(5) to address the issue.[114] The NOPR also sought comments on the following: (1) the parameters and timing of coordination and sharing; (2) specific protocols that may need to be established for efficient coordination practices; and (3) potential impediments to the proposed coordination efforts.

1. Comments

66. There is no consensus among commenters on whether Reliability Standards TPL–001.5.1 and MOD–032–1 are adequate means of data collection for transmission planning, with some commenters raising concerns about the types of data that will be needed to conduct extreme heat and cold weather studies under the new or modified Reliability Standard and whether such data can be obtained through existing processes.

67. For example, NERC and Idaho Power believes that the existing standards are sufficient.[115] According to NERC, the Commission does not need to direct revisions to Reliability Standard MOD–032–1 to account for new data required for extreme heat and cold weather studies because the standard requires functional entities to provide ''other information requested by the Planning Coordinator or Transmission Planner necessary for modeling purposes'' for each of the three types of data required (steady-state, dynamics, and short circuit).[116] Thus, NERC asserts that planning coordinators and transmission planners are empowered to request any specific data needed for studies of extreme heat and cold conditions. According to Idaho Power, because (1) utilities currently share contingencies to be studied with neighboring entities to get feedback and make updates as needed and (2) utilities share TPL–001 reports with other utilities subject to the execution of a non-disclosure agreement, the Commission proposal would be redundant of current practice.[117]

[110] NOPR, 179 FERC ¶ 61,195 at P 80.

[111] *Id.* P 81.

[112] *Id.*

[113] *Id.* P 82.

[114] *Id.* P 63.

[115] NERC Comments at 13; Idaho Power Comments at 5.

[116] NERC Comments at 13.

[117] Idaho Power Comments at 5.

68. In contrast, Tri-State indicates that there is no requirement for transmission customers to provide data for extreme heat and cold weather conditions such as load forecast data.[118] AEP asserts that planning coordinators and transmission planners have limited insight into a generator's likelihood of availability during extreme weather events, particularly limited for inverter-based resources.[119] EPRI states that there is limited modeling of protection systems in dynamic assessments currently, and any dynamic simulation of extreme events would require significant modeling of protection systems to provide for convergence of the numerical simulation.[120] NYISO notes that Reliability Standard TPL–001 currently limits transmission planners or planning coordinators to requesting data pertaining to their own planning area.[121]

69. Other commenters suggest that it will be necessary to define the data needed by responsible entities to perform studies under the new or modified Reliability Standard. AEP proposes that the Commission hold a technical conference to help define the data needed to perform the extreme weather assessments and the avenue through which information will be shared.[122] Indicated Trade Associations recommend that, although Reliability Standard MOD–032–1 might be adequate as a data source, the Commission should recognize in any final rule that the standard drafting team should be tasked with identifying what data is already collected and specifying what new data is needed to perform the assessments for extreme heat and cold.[123]

70. Regarding the sharing of study results and coordination among entities, Tri-State suggests that the balancing authority should address the results of the studies and how they should communicate those results among the transmission planners. Tri-State also asserts that the balancing authority is responsible for resource adequacy and should communicate resource needs for the area with the responsible transmission planners who can evaluate system needs and ''provide access to remove'' resource needs.[124] EPRI does not opine on who should do the wide-area coordination, but states that some level of coordination will be required to ensure accurate assessments of wide area events that impact geographic footprints across multiple planning entities.[125] UCS suggests that the final rule should direct the sharing of modeling information between planning areas regarding extreme weather benchmark events, because ensuring reliability will depend on the extent to which neighboring regions cooperate.[126]

71. NERC asserts that while wide-area studies should be coordinated as appropriate for the area, the specific procedural details for coordination on wide-area studies do not need to be mandated in a Reliability Standard. NERC adds that other coordination requirements, such as those related to sharing of study results and coordination for corrective actions across multiple transmission planner areas, can be addressed through the standard development process with consideration of any factors identified by the commenters in this proceeding.[127] Similarly, Indicated Trade Associations recommend that the Commission empower the standards drafting team to consider whether coordination between a variety of functional entities, and across regions, would be the most effective means of addressing certain identified extreme heat and cold weather events.[128]

2. Commission Determination

72. Pursuant to section 215(d)(5) of the FPA, we adopt and modify the NOPR proposal and direct NERC to require functional entities to share with the entities responsible for developing benchmark planning cases and conducting wide-area studies the system information necessary to develop benchmark planning cases and conduct wide-area studies. Further, responsible entities must share the study results with affected transmission operators, transmission owners, generator owners, and other functional entities with a reliability need for the studies.[129]

73. We agree with commenters that Reliability Standard MOD–032–1 allows for data collection for extreme heat and cold weather events. However, only planning coordinators and transmission planners can request data from other entities through Reliability Standard MOD–032–1 processes. Because in this final rule we direct NERC to determine the responsible entities that will be developing benchmark planning cases and conducting wide-area studies, it is possible that the selected responsible entities under the new or modified Reliability Standard will not be able to request and receive needed data pursuant to MOD–032–1, absent modification to that Standard.

74. Regarding EPRI's statement of insufficiency of dynamic modeling of protection systems, we consider the insufficiency of protection system modeling to be an ongoing deficiency in the modeling process. The dynamics databases used for transient stability simulations by various interconnections typically do not include comprehensive dynamic models of relays installed in the interconnection. Thus, in addressing our directive above, NERC should evaluate this deficiency during the standard development process.

75. We disagree with UCS's recommendation that the final rule should direct the sharing of modeling information between planning areas regarding extreme weather benchmark events. We expect that the existing practice (*e.g.,* MOD–032–1) of responsible entities sharing modeling information between planning areas will continue, without the need for us to specifically direct that in this final rule.

76. Rather than predetermine each aspect of the coordination process, we believe the decision of which entities are best positioned for wide-area coordination should be left to NERC. We therefore direct NERC to address the requirement for wide-area coordination through the standard development process, giving due consideration to relevant factors identified by commenters in this proceeding.

77. We agree with NERC and Indicated Trade Associations that coordination requirements, such as those related to the sharing of study results and corrective actions across multiple transmission planner areas, are best addressed through the standard development process, which we expect will consider relevant factors identified by the commenters in this proceeding. Although this final rule does not specify how study results must be shared, we believe that the new or modified Reliability Standard must require responsible entities to share these studies with affected functional entities. The sharing of study results will alert entities of reliability concerns identified

[118] Tri-State Comments at 4–5.

[119] AEP Comments at 15.

[120] EPRI Comments at P 11.

[121] NYISO Comments at 14.

[122] AEP Comments at 4.

[123] Indicated Trade Associations Comments at 9–10.

[124] Tri-State Comments at 6.

[125] EPRI Comments at P 19.

[126] UCS Comments at 8.

[127] NERC Comments at 10.

[128] Indicated Trade Associations Comments at 5.

[129] The NOPR proposed to direct NERC to ensure that functional entities share necessary system information with planning coordinators and transmission planners, as these entities conduct current transmission planning studies under TPL–001–5.1. Because this final rule directs NERC to determine the entities that will be responsible for conducting studies under the new or modified Reliability Standard, we modify the NOPR accordingly to ensure the selected responsible entity has the means to request and receive necessary system information.

in wide-area studies.[130] Further, requiring responsible entities to share study results with functional entities with a reliability related need for the study is consistent with existing planning assessment sharing requirements under Reliability Standard TPL–001–5.1.[131] Therefore, we direct NERC to require in the new or modified Reliability Standard that responsible entities share the results of their wide-area studies with other registered entities such as transmission operators, transmission owners, and generator owners that have a reliability related need for the studies.

F. Concurrent/Correlated Generator and Transmission Outages

78. The NOPR stated that generation resources that are sensitive to severe weather conditions may cease operation during extreme heat and cold events, thus contributing to wide-area concurrent outages. In addition, the NOPR indicated that extreme heat could lead to significant derating, reduced lifetime, or failure of power transformers, while extreme cold could lead to at least temporary transmission facility outages.[132]

79. As such, the NOPR posited that modeling the loss of these generators and transmission equipment during extreme heat and cold weather events would allow planners to assess the effects of potential concurrent transmission and generator outages and study the feasibility (*i.e.,* availability and deliverability) of external generation resources that could possibly be imported to serve load during such events, thereby minimizing the potential impact of extreme heat and cold events on customers.[133] In addition, the NOPR indicated that modeling concurrent generator and transmission outages would also allow planners to better identify appropriate solutions to be incorporated into corrective action plans.[134]

80. The NOPR also proposed that accounting for concurrent outages including modeling the derating and possible loss of wind and solar generators, as well as natural gas generators sensitive to extreme heat and cold conditions in planning studies would provide a more realistic assessment of system conditions (*i.e.,* updated conditions based on historic benchmarked performance) during potential extreme heat and cold events and will help better assess the probability of potential occurrences of cascading outages, uncontrolled separation, or instability. Thus, the NOPR suggested that requiring transmission planners and planning coordinators to study concurrent generator and transmission failures under extreme heat and cold events to account for the expected resource mix's availability during these extreme conditions is one way to address the reliability gap in Reliability Standard TPL–001–5.1.[135]

81. To identify the scope of these planning studies, the NOPR sought comments on the following: (1) the assumptions (*e.g.,* weather forecast, load forecast, transmission voltage levels, generator types, multi-day low wind, and solar events) used in modeling of concurrent outages due to extreme heat and cold weather events; (2) what assumptions should be included when performing modeling and planning for generators sensitive to extreme heat and cold; (3) how the impact of loss of generators sensitive to extreme heat and cold should be factored into long-term planning; (4) the extent of neighboring systems' or planning areas' outages that should be modeled in transmission planning studies; and (5) whether a certain threshold penetration of wind, solar, and natural gas generation should trigger additional analyses.[136]

1. Comments

82. Commenters mostly agree with the NOPR that responsible entities should evaluate the risk of correlated or concurrent outages and derates of all types of generation resources (*i.e.,* conventional and renewables) as well as transmission facilities related to extreme weather events.[137] For example, the Federal Energy Advocate for the Public Utilities Commission of Ohio (Ohio FEA) recommends that the Standard incorporate asset correlations and interdependencies, and consider the extent to which they can be obviated or mitigated because asset performance or failure is highly correlated with their dependency on weather conditions and on the performance of nearby or related infrastructure.[138] Idaho Power notes that while Reliability Standard TPL–001–5.1 already addresses the loss of multiple generating stations resulting from conditions such as the loss of a large gas pipeline into a region or multiple regions that have significant gas-fired generation, the standard could be modified to include the impact of renewable energy resource response due to extreme weather as well.[139] While agreeing with the NOPR proposal, Public Interest Organizations (PIOs) and ACP argue that any requirement to study concurrent or correlated generation outages should be extended to conventional generators to account for the reliability risk and to eliminate undue discrimination caused by overstating the reliability contributions of conventional generators relative to renewable and storage resources.[140]

83. Some commenters assert that the NOPR proposal on modeling the effects of potential concurrent transmission and generator outages might be unnecessary. ISO New England Inc. (ISO–NE) takes issue with including the expected resource mix's availability during extreme weather conditions as part of extreme weather scenarios. ISO–NE asserts that resource mix availability should not be addressed in a transmission planning standard because it is addressed as part of resource adequacy assessment and other Reliability Standards, such as the Cold Weather Reliability Standards. Further, ISO–NE argues that transmission planning Reliability Standards need to consider resource availability in planning cases, because generators will be required to be ready to perform in extreme weather events under those other standards.[141] EPRI asks if the Commission intends for the concurrent outages of generation and transmission assets to be modeled as an acute event, and if so, requests clarification as to how it differs from the P3 category of contingency events from TPL–001–5.1.[142]

84. NYISO recommends that, as the extreme events in Reliability Standard TPL–001–5.1 are analogous to extreme contingencies rather than extreme system conditions such as heatwaves, cold snaps, droughts, etc., NERC planning events should be expanded to include the weather-related loss of generation across areas of the system in the design-basis contingencies rather than as an extreme contingency.[143]

[130] NOPR, 179 FERC ¶ 61,195 at P 81.

[131] *See* Reliability Standard TPL–001–5.1, Requirement R8.

[132] NOPR, 179 FERC ¶ 61,195 at P 68.

[133] *Id.* P 69.

[134] *Id.*

[135] *Id.* P 72.

[136] *Id.*

[137] EDF Comments at 22; ACP Comments at 5; PIOs Comments at 9; AEP Comments at 4; UCS Comments at 12; and Americans for Clean Energy Grid Comments at 6 (ACEG Comments).

[138] Ohio FEA Comments at 5.

[139] Idaho Power Comments at 4.

[140] PIOs Comments at 23–24.

[141] ISO–NE Comments at 2–4.

[142] EPRI Comments at PP 20–21. Category P3 requires the study of the loss of a generator unit followed by system adjustments, followed by a loss of one of the following: generator or transmission circuit or transformer or shunt device or single pole of a DC line as stated in Reliability Standard TPL–001.5.1, Table 1.

[143] NYISO Comments at 13.

85. Regarding modeling assumptions, LCRA asserts that the Standard should not be prescriptive regarding the modeling assumptions, particularly concerning generation availability, beyond developing the study base case when available generation is insufficient to meet the load with respect to extreme weather events.[144] LCRA also cautions that modeling too many outages will result in an unsolvable case that cannot be analyzed.[145]

86. While no comments recommended any specific threshold of penetration of renewable resources that would trigger additional analysis, PJM notes that special studies may be needed as greater numbers of renewable, inverter-based resources (IBR), connect to the Bulk-Power System. With a much higher IBR penetration level, a more material change to dynamic and steady state assessment will likely be needed to capture the impacts of higher penetration levels of IBRs and much reduced conventional generation support.[146] APS, however, suggests that the Commission should not set a penetration threshold, arguing that the entity performing the study should determine the threshold, which likely would differ depending on the characteristics of the particular system.[147]

87. Electric Power Supply Association (EPSA) suggests that the Commission direct NERC to examine how it defines and measures its resource adequacy benchmarks, including the impacts of non-dispatchable resources with increasing penetration in the system and the availability of dispatchable, flexible resources which are increasingly being replaced by new, less flexible resources or technologies.[148]

2. Commission Determination

88. Pursuant to section 215(d)(5) of the FPA, we adopt the NOPR proposal and direct NERC to require under the new or revised Reliability Standard the study of concurrent/correlated generator and transmission outages due to extreme heat and cold events in benchmark events as described in more detail below.

89. We disagree with comments suggesting that the modeling of concurrent/correlated generator and transmission outages is unnecessary.[149] As discussed in the NOPR, and reinforced by commenters, the failures of individual generators during extreme weather events are not independent.[150] Previous extreme weather events have demonstrated that there is a high correlation between generator outages and cold temperatures, indicating that as temperatures decrease, unplanned generator outages and derates increase.[151] Because of this correlation, it is necessary that responsible entities evaluate the risk of correlated or concurrent outages and derates of all types of generation resources and transmission facilities as a result of extreme heat and cold events, as commenters suggest.[152]

90. Further, we disagree with ISO–NE that resource mix availability should not be considered here because it is considered in resource adequacy planning and in other Reliability Standards. Although resource outages are an important input into the resource adequacy studies, they are also an important determinant in assessing the adequacy of the transmission system.[153] Therefore, it will be necessary to consider the impact of extreme weather events on generators anticipated to be connected to the subject transmission system during the study period. Similarly, although the Cold Weather Reliability Standards require generators to be prepared to be available and perform at or above their extreme cold weather temperature during extreme weather events, generator availability is not guaranteed by any Reliability Standard, and outages occur for many reasons. Accordingly, some generators may still be unavailable under extreme heat or cold conditions and thus their potential outages must be considered in extreme heat and cold weather planning scenarios.

91. Although several commenters ask for flexibility as to modeling assumptions, we believe that it is necessary for the Reliability Standard to strike a balance between allowing responsible entities discretion to ensure the study incorporates their operating experience and the need to create a robust framework that ensures extreme heat and cold events are adequately studied. Thus, while generation and transmission availability and concurrent outages must be included in the benchmark planning case, we defer to NERC to develop the framework and criteria that responsible entities shall use to represent potential weather-related contingencies (*e.g.,* concurrent/correlated generation and transmission outages, derates) in the relevant benchmark event planning cases.[154]

92. Regarding the comments of NYISO and EPRI on the difference between extreme events and contingencies covered under Reliability Standard TPL–001–5.1, we clarify that all contingencies included in benchmark planning cases under the new or modified Reliability Standard will represent initial conditions for extreme weather event planning and analysis. These contingencies (*i.e.,* correlated/concurrent, temperature sensitive outages, and derates) shall be identified based on similar contingencies that occurred in recent extreme weather events or expected to occur in future forecasted events.

93. Regarding PJM's comment regarding the likely need for additional studies to capture the impacts of higher penetration levels of renewables and much reduced conventional generation support, we note that the benchmark planning case will include this information pursuant to our directive above regarding benchmarking planning cases. Accordingly, we do not foresee the need for the additional studies suggested by PJM.

94. Lastly, regarding EPSA's comment requesting that we direct NERC to examine how it defines and measures its resource adequacy benchmarks, we note that resource adequacy benchmarks are outside the scope of this proceeding.

G. Conduct Transmission System Planning Studies for Extreme Heat and Cold Weather Events

1. Steady State and Transient Stability Analyses

95. The Commission proposed in the NOPR to require both steady state and transient stability analyses be conducted for extreme heat and cold weather events as part of transmission planning studies.[155] Consistent with Reliability Standard TPL–001–5.1, the NOPR stated that steady state and stability analyses of study cases modeled to reflect past and forecasted extreme heat and cold conditions would better prepare transmission operators for such

[144] LCRA Comments at 3.

[145] *Id.*

[146] PJM Comments at 11.

[147] APS Comments at 5.

[148] EPSA Comments at 3.

[149] *See, e.g.,* ISO–NE Comments at 2–4.

[150] NOPR, 179 FERC ¶ 61,195 at P 70.

[151] *Id.* PP 70–71.

[152] *See supra* P 82.

[153] This understanding is consistent with section 215(a)(1) of the FPA, 16 U.S.C. 824o(a)(1), which defines Bulk-Power System to include ''electric energy from generation facilities needed to maintain transmission system reliability.''

[154] *See supra* P 39. Reliability Standard TPL–001–5.1 Requirement 1.1.5 requires responsible entities to maintain system models that represent projected system conditions, including resources required for load. Because drought conditions may impact the availability of certain supply resources, we expect that the new or revised Reliability Standard will include a similar requirement that accounts for the impact of drought conditions on generation where appropriate.

[155] NOPR, 179 FERC ¶ 61,195 at P 69.

conditions.[156] The NOPR explained that a steady-state analysis is based on a snapshot in time where the bulk electric system facilities such as generators, transmission lines, transformers etc. are modeled as fixed and load is modeled as a constant.[157] On the other hand, transient stability or dynamic analyses simulate the time-varying characteristics of the system during a disturbance that occurs during an extreme heat or cold event.[158] The NOPR further stated that performing these studies in the long-term planning horizon period (*i.e.,* six to ten years and beyond) will provide an adequate lead time for entities to develop and implement corrective action plans to reduce the likelihood or mitigate the consequences and adverse impacts of such events.[159]

96. The NOPR noted that the use of dynamic studies is particularly important given the changing resource mix and the need to understand the dynamic behavior of both traditional generators and variable energy resources (VERs) (*i.e.,* wind and solar photovoltaic).[160]

97. The NOPR sought comments on all aspects of the proposal, and specifically, on whether responsible entities should include contingencies based on their planning area and perform both steady state and transient stability (dynamic) analyses using extreme heat and cold cases. In addition, the NOPR invited comments on the following topics: (1) the set of contingencies responsible entities must consider; (2) required analyses to assess voltage stability, frequency excursions and angular deviations caused as a result of near simultaneous outages or common mode failures of VERs; and (3) the role of demand response under such scenarios.[161]

a. Comments

98. All those who commented on the NOPR proposal to require both steady state and transient stability analyses agree with the NOPR that both steady state and transient stability analyses should be performed in order to understand the potential impacts of extreme heat and cold weather events.[162] Below, we discuss comments received on the following topics: (i) required contingencies; (ii) analyses of common mode failures; and (iii) demand response.

i. Required Set of Contingencies

99. Idaho Power supports the inclusion of contingencies listed in Table 1 of Reliability Standard TPL–001–4 such as the loss of two generating stations resulting from, among other events, severe weather, as it currently applies these contingencies in its severe weather studies.[163]

100. AEP recommends that the Commission direct NERC to revise and reclassify the contingency lists in Reliability Standard TPL–001–5.1 to ''reflect the unique challenges posed by extreme weather events'' and to ensure that the bulk electric system is operated to withstand N–1–1 contingencies ''without interruption of firm transmission service or non-consequential load loss.'' [164] NYISO recommends expanding NERC planning events to include the weather-related loss of generation across areas of the system in the design-basis contingencies rather than as an extreme contingency.[165] Southern California Edison Company (SCE) suggests that NERC determine whether additional contingencies should be developed to evaluate potential reliability risks from events occurring at the same or sequential times in the same region that have the potential to pose an aggregate impact on electricity assets, operations, and services, *e.g.,* an extreme heat event that reduces grid capacity while increasing demand for cooling.[166] LCRA suggests that performing contingency analyses similar to what is required under Reliability Standard CIP–014–3 (Physical Security) may be useful.[167] LCRA states, for example, that the analysis could study the outage of medium impact facilities (*e.g.,* single circuit, common tower). If the result of the analysis identifies instability, cascading, uncontrolled islanding, or excessive load shed, these facilities could be identified as ''weather critical'' and targeted for hardening as part of a corrective action plan.[168]

101. Other commenters state that responsible entities should be able to consider contingencies beyond those in Table 1 of Reliability Standard TPL–001.5.1 that will affect their study area.[169] For example, PJM emphasizes the need for regional variance for unique contingencies to be studied.[170] Eversource recommends that the Commission avoid prescription and allow details such as the types of required contingencies to be determined during the standard development process.[171]

102. EPRI asserts that clarification is needed to differentiate between events that impact the initial conditions of the benchmark scenario for which the contingency events will be analyzed, and the actual contingencies meant to be captured as acute impacts to the system that occur over a wide area and can be studied through the steady state and transient stability processes.[172]

ii. Analyses for Common Mode Failures

103. NERC and ACP agree that Reliability Standard TPL–001–5.1 should better address the risk posed by extreme heat and cold weather events and the associated common mode failure impacting resource availability and the transmission system.[173]

104. EPRI states that the benchmark planning cases, which serve as the basis for steady state and transient stability assessments, historically have not been developed to include the correlated impacts of common mode events based on the impact of extreme temperature on load and the availability of derated generation and transmission capacity. EPRI asserts that capturing extreme temperature conditions for both heat and cold would require a new approach that directly accounts for the correlated temperature-related impacts to supply and demand.[174] EPRI agrees with the Commission's proposal that dynamic models of VERs need to be included in the studies but states they would need to be sufficiently robust to accurately capture system performance under extreme weather conditions.[175]

[156] *Id.* P 70.

[157] *Id.* P 59.

[158] *Id.* P 60.

[159] *Id.* P 58.

[160] *Id.* P 61.

[161] *Id.* P 62. The NOPR also sought comment on whether existing Reliability Standards are sufficient to ensure that responsible entities performing studies of extreme heat and cold weather conditions have the necessary data, and/or whether the Commission should direct additional modifications pursuant to FPA section 215(d)(5) to address this issue. *Id.* P 63. This question is discussed in section IV.E of this final rule.

[162] *See, e.g.,* NERC Comments at 9; PJM Comments at 10; Tri-State Comments at 4; Eversource Comments at 5; WE ACT for Environmental Justice Comments at 4; LCRA Comments at 3; UCS Comments at 7.

[163] Idaho Power Comments at 3.

[164] AEP Comments at 4.

[165] NYISO Comments at 14.

[166] SCE Comments at 4.

[167] Reliability Standard CIP–014–3 requires entities to assess their transmission facilities to determine whether, if rendered inoperable or damaged, they could result in widespread instability, uncontrolled separation, or cascading. Reliability Standard CIP–014–3 (Physical Security), at 1.

[168] LCRA Comments at 2.

[169] AEP Comments at 4; Idaho Power Comments at 3; Tri-State Comments at 4, PJM Comments at 11.

[170] AEP Comments at 4; Idaho Power Comments at 3; Tri-State Comments at 4, PJM comments at 11.

[171] Eversource Comments at 4.

[172] EPRI Comments at P 21.

[173] NERC Comments at 6; ACP Comments at 9 n.23.

[174] EPRI Comments at PP 3–4.

[175] *Id.* P 11.

105. Indicated Trade Associations state that in any case modeling these scenarios will likely require additional resources in time, expertise, and enhanced software capabilities.[176] Indicated Trade Associations ask that the standard drafting team recognize the range and quantity of complexities layered into the modeling process, *e.g.,* whether concurrent generators must be in a single or multiple balancing authority area, how many generators are needed for a given study, and if there is a particular combination of generators needed for modeling.[177]

iii. Demand Response

106. EDF and UCS suggest that when evaluating relevant distribution system impacts, responsible entities should focus on the impacts of the extreme weather event on both electric demand and on the capability of the distribution system assets, including demand response, distributed storage and generation, and utility-scale storage, to mitigate reliability risks.[178]

107. APS comments that demand response should be used as a tool to resolve issues and only studied when it is relied on as a mitigation action.[179]

108. Eversource states that the Commission should encourage regional flexibility in any consideration of demand response. Eversource further comments that the Commission should not impose a ''one size fits all'' approach for resources that may significantly differ based on location. It is also concerned that during extreme weather events, demand response with heating or cooling-based load reduction may not be achievable due to safety concerns.[180]

109. EPRI asserts that steady state simulation cannot sufficiently capture demand response, and that there is limited capability to capture the aggregated dynamic response of demand in the load models used in positive sequence platforms. EPRI adds that ''the impacts of demand response are better represented through appropriate temporal and diurnal patterns that would inform the load and demand profile under a given extreme temperature condition. This information is best represented in operational assessments such as resource adequacy or production cost modeling.'' [181]

110. LCRA notes that while the role of demand response in its portion of the Bulk-Power System is negligible today, this could change in the future as additional large loads (*e.g.,* cryptocurrency mining and data centers) are energized. LCRA states that this trend should be observed for further consideration in the future.[182]

b. Commission Determination

111. Pursuant to section 215(d)(5) of the FPA, we adopt the NOPR proposal and direct NERC to require in the proposed new or modified Reliability Standard that responsible entities perform both steady state and transient stability (dynamic) analyses in the extreme heat and cold weather planning studies. In a steady state analysis, the system components are modeled as either in-service or out-of-service and the result is a single point-in-time snapshot of the system in a state of operating equilibrium. A transient stability (dynamic) analysis examines the system from the start to the end of a disturbance to determine if the system regains a state of operating equilibrium.[183] Performing both analyses ensures that the system has been thoroughly assessed for instability, uncontrolled separation, and cascading failures in both the steady state and the transient stability realms.

112. We also adopt the NOPR proposal and direct NERC to define a set of contingencies that responsible entities will be required to consider when conducting wide-area studies of extreme heat and cold weather events under the new or modified Reliability Standard. We believe that it is necessary to establish a set of common contingencies for all responsible entities to analyze. Required contingencies, such as those listed in Table 1 of Reliability Standard TPL–001–5.1 (*i.e.,* category P1 through P7), establish common planning events that set the starting point for transmission system planning assessments. Requiring the study of predefined contingencies will ensure a level of uniformity across planning regions—a feature that will be necessary in the new or revised Reliability Standard considering that extreme heat and cold weather events often exceed the geographic boundaries of most existing planning footprints.

113. Additionally, establishing a set of required contingencies will aide in the auditing and enforcement of the new or revised Reliability Standard. While we do not require in this final rule the inclusion of any particular contingency, we agree with commenters that the contingencies required in the new or revised Reliability Standard should reflect the complexities of transmission system planning studies for extreme heat and cold weather events. As such, NERC may determine whether contingencies P1 through P7 should also apply to the new or modified Reliability Standard, or whether a new set of contingencies should be developed.

114. Regarding the request for clarification from EPRI as to what outages should be included in the benchmark planning case versus modeled as contingencies, we believe the standard drafting team is best positioned to consider that specific question. By definition, the benchmark planning case will already include certain weather-related contingencies that therefore will not be studied as additional contingencies when conducting extreme weather studies.[184] For example, baseline drought conditions will be present in the benchmark planning case as part of the system models representing projected system conditions,[185] whereas the impacts of more severe droughts could be studied during sensitivity analysis as a variation to the benchmark planning case's generation assumptions.[186] As discussed in section IV.F above, we direct NERC to develop specific criteria for determining which outages should be considered in the benchmark planning case.

115. Regarding the study of common mode failures, we reiterate our above directives concerning the study of concurrent/correlated generator and transmission outages. We believe that, as suggested by Indicated Trade Associations, the standard development process will provide an adequate platform to address the concerns raised by commenters regarding common mode failures.

116. We also direct NERC to require in the new or modified Reliability Standard that responsible entities model demand load response in their extreme weather event planning area. As indicated by several commenters, because demand load response is generally a mitigating action that involves reducing distribution load during periods of stress to stabilize the Bulk-Power System, its effect during an extreme weather event should be modeled.

117. Regarding EPRI's comment that steady state simulation cannot

[176] Indicated Trade Associations at 9.

[177] *Id.*

[178] EDF Comments at 22–23; UCS Comments at 7–8.

[179] APS Comments at 4.

[180] Eversource Comments at 6.

[181] EPRI Comments at P 12.

[182] LCRA Comments at 2–3.

[183] Plots are created during the dynamic simulation from pre to post disturbance and are then examined for voltage, frequency, and rotor angle stability, which cannot be assessed using only a steady state analysis.

[184] *See supra* P 39.

[185] *See supra* note 155.

[186] *See infra* P 124.

sufficiently capture demand load response, we believe EPRI's comments are accurate for modeling in the operational timeframe for temporal and diurnal studies. However, we recognize that it is possible that the loads used to represent extreme heat and cold events will include the effects of demand load response because entities' load data obtained from historical data during these past extreme events will reflect the effects of demand load response. If that is the case, demand load response will be automatically factored into the benchmark planning case. Thus, in addressing this directive, we expect NERC to determine whether responsible entities will need to take additional steps to ensure that the impacts of demand load response are accurately modeled in extreme weather studies, such as by analyzing demand load response as a sensitivity, as is currently the case under Reliability Standard TPL–001–5.1.[187]

2. Sensitivity Analysis

118. In the NOPR, the Commission proposed directing NERC to establish a requirement for responsible entities to consider system models and sensitivity cases when assessing extreme heat and extreme cold weather.[188] The NOPR explained that, while Reliability Standard TPL–001–5.1 requires the use of sensitivity power flow cases, the Standard does not require responsible entities to model the simultaneous variation of load, generation, and transfers necessary to account for the impacts of extreme heat and cold weather events. This, in turn, could result in failure to detect in the planning horizon potential reliability issues such as widespread outages and cascading failures.[189]

119. The NOPR further stated that to accurately model the impacts of extreme heat and cold weather events it would be necessary to define and model in sensitivity analyses demand probability scenario cases, generators that are affected by these events (*i.e.,* wind tripping off, solar dropping off, gas plants not being operational due to gas restrictions/freeze-offs, etc.) and transfer levels.[190]

120. The NOPR requested comment on: (1) whether to require transmission planners and planning coordinators to assess reliability in the planning horizon for sensitivity cases in which multiple inputs (*e.g.,* load and generator failures) change simultaneously during extreme heat and cold events; and (2) the range of factors and the number of sensitivity cases that should be considered to ensure reliable planning.[191]

a. Comments

121. Some commenters support requiring the consideration of certain sensitivities. For example, AEP recommends that a baseline set of sensitivities should be defined by the NERC standard drafting team and there should be flexibility for planning coordinators to introduce further sensitivities if deemed necessary.[192] EPRI suggests that multiple hours may need to be studied over the course of the extreme temperature window to capture sensitivities related to generation and demand that can lead to differing steady state and dynamic stability impacts. EPRI also recommends that in addition to the sensitivities driven by the operational performance of the system, the standard should include other external drivers that may compound system conditions during the extreme temperature events, such as a concurrent lull in wind speeds that would limit wind generation outputs.[193]

122. Other commenters suggest reasons why it may not be necessary for the Commission to direct the study of additional sensitivities. NYISO and LCRA explain that extreme heat and cold weather impacts and unavailability of natural gas fuel are already studied as sensitivities under Reliability Standard TPL–001–5.1.[194] Similarly, Indicated Trade Associations assert that the extreme weather base case should already represent system conditions at or near possible seasonal extreme weather limits and that, as such, many additional sensitivities may not be necessary.[195] LCRA adds that the effect of changing inputs (*e.g.,* load and generation, including generation retirements and forced generation outages) should be captured in the contingency definitions, performance requirements, and analysis for the given region and extreme weather case.[196]

123. Idaho Power, APS, and Indicated Trade Associations indicate that given the diversity among utilities with respect to load profiles, geographic footprint, resource mix, particular utility, its resource mix, and geographic footprint, and available resources and needs, the Commission should allow entities to select the sensitivities they will study.[197]

b. Commission Determination

124. Pursuant to section 215(d)(5) of the FPA, we adopt the NOPR proposal and direct NERC to require the use of sensitivity cases to demonstrate the impact of changes to the assumptions used in the benchmark planning case. Sensitivity analyses help a transmission planner to determine if the results of the base case are sensitive to changes in the inputs. The use of sensitivity analyses is particularly necessary when studying extreme heat and cold events because some of the assumptions made when developing a base case may change if temperatures change—for example, during extreme cold events, load may increase as temperatures decrease, while a decrease in temperature may result in a decrease in generation. We agree with AEP, and we direct NERC to define during the Reliability Standard development process a baseline set of sensitivities for the new or modified Reliability Standard. While we do not require the inclusion of any specific sensitivity in this final rule, NERC should consider including conditions that vary with temperature such as load, generation, and system transfers.[198]

125. We do not agree with Idaho Power, APS, and Indicated Trade Associations that responsible entities alone should determine the sensitivity cases that must be considered in the responsible entity's study. Failure to consider variations in conditions necessary to reflect extreme heat or cold weather events could result in major reliability risks being overlooked and undetected in the planning horizon.[199] We do, however, believe that responsible entities should be free to study additional sensitivities relevant to their planning areas. Because wide-area studies conducted under the new or modified Reliability Standard will be likely based on footprints significantly larger than those typically concerned under Reliability Standard TPL–001.5.1, cooperation will be necessary between responsible entities conducting extreme heat and cold weather studies and other registered entities within their extreme weather study footprints to ensure the selection of appropriate sensitivities. EPRI's comment further highlights the need for coordination between

[187] Reliability Standard TPL–001–5.1, at Requirement 2.1.3.

[188] NOPR, 179 FERC ¶ 61,195 at P 73. Sensitivity analyses consider the impact on a base case by altering discrete variables.

[189] *Id.*

[190] *Id.*

[191] *Id.* P 74.

[192] AEP Comments at 12.

[193] EPRI Comments at P 22.

[194] NYISO Comments at 13; LCRA Comments at 3.

[195] Indicated Trade Associations Comments at 10.

[196] LCRA Comments at 3.

[197] Indicated Trade Associations Comments at 11; Idaho Power Comments at 4–5; APS Comments at 7.

[198] NOPR, 179 FERC ¶ 61,195 at P 73.

[199] *See id.*

registered entities to capture sensitivities related to variable energy resources and demand.

126. We disagree with NYISO and LCRA that extreme heat and cold weather impacts are already studied as sensitivities under Reliability Standard TPL–001–5.1. Although TPL–001–5.1 mandates sensitivity analysis by varying one or more conditions specified in the standard such as load, generation, and transfers, this analysis alone cannot capture the complexities of extreme heat and cold weather conditions. Sensitivity analyses consider the impact on a base case of the variability of discrete variables. Extreme heat and cold weather impacts, on the other hand, may include numerous concurrent outages and derates which cannot be studied as part of a single-variable sensitivity analysis. Under the new or modified Reliability Standard, however, these outages will be captured in the benchmark planning case upon which sensitivity analyses will be performed.

3. Modifications to the Traditional Planning Approach

127. In the NOPR, the Commission proposed to direct NERC to consider alternative planning methods and techniques that diverge from past Reliability Standard requirements to better capture the challenges posed by extreme heat and cold events.[200]

128. The NOPR stated that Reliability Standard TPL–001–5.1 is based on a deterministic approach, which uses planned contingencies and specific performance criteria to study system response to various conditions. This approach yields accurate planning when the power supply is highly dispatchable, weather is predictable, and near-record peak demand is reached only a few days a year.[201] However, as noted in the NOPR, the current planning approach applied in Reliability Standard TPL–001–5.1 likely is not sufficient to accurately characterize the reliability risk from extreme heat and cold weather given the high degree of uncertainty inherent in predicting severe weather and its impact on generation resources, transmission, and load.[202]

129. The NOPR explained the value of establishing a new or modified planning approach to better capture the impacts of, and ensure reliable planning and operation in response to, extreme heat and cold events.[203] Specifically, the NOPR mentioned as an option expanding current deterministic studies to include probabilistically developed scenarios as an option to better account for uncertainties during extreme heat and cold weather conditions, since probabilistic tools can capture ''random uncertainties in power system planning, including those in load forecasting, generator performance, and failures of system equipment.'' [204]

130. Finally, the NOPR sought comments on combining or layering probabilistic and deterministic approaches when planning for extreme heat and cold weather conditions in the context of Reliability Standard TPL–001–5.1. Specifically, the NOPR sought comments on the use of a hybrid deterministic/probabilistic planning approach and the following: (1) the assumptions from the deterministic and probabilistic approaches that should be applied to study extreme heat and cold weather events; (2) the potential planning challenges from combining the two planning approaches; (3) the costs associated with adjustments to the currently applied deterministic approach; (4) the implementation period necessary for proposed changes; and (5) the reliability benefits that could result.[205]

a. Comments

131. Many commenters support the use of probabilistic methods in transmission planning to account for uncertainty in availability of transmission and generation in extreme weather conditions.[206] For example, PJM states that the use of probabilistic modeling ''would help establish the baseline and sensitivity system conditions upon which deterministic approaches for go/no-go corrective action transmission build decisions would be made.'' [207] EPRI discusses potential deficiencies in traditional deterministic approaches in planning studies in cases where uncertainty and variability will increase on both the generation and demand side across a variety of temperature extremes. EPRI raises concerns that scenarios or system conditions that result in consequential stability implications may not be adequately captured in the planning models using the traditional deterministic approach.[208] ACP states that there is precedent for using probabilistic tools in assessing electric reliability, as these methods are widely used by utilities and RTOs to assess resource adequacy and loss of load risk.[209]

132. Other commenters do not support a requirement to use probabilistic methods. For example, while AEP recognizes the value of probabilistic methods, it warns that the industry is not yet ready because the necessary methods, frameworks, and tools are not yet available to transmission planners.[210] Several other commenters warn that it would be premature to require the use of probabilistic methods.[211] Trade Associations express concern that probabilistic planning based on extremely low probability events is highly speculative and dependent on the judgment of planners, which increases the complexity and risk associated with the development of transmission projects, hampering the construction of needed transmission.[212] Idaho Power also does not think converting to a probabilistic approach is necessary as sensitivities with appropriate inputs will capture the impacts of extreme weather using deterministic techniques.[213] LCRA comments that probabilistic analysis requires large samples (*i.e.,* number of events), but given the infrequent occurrence of extreme weather events, it would be challenging to layer probabilistic assumptions into transmission planning analyses.[214]

133. Supporters of the use of probabilistic methods acknowledge that implementation poses challenges. For example, EPRI comments that implementation of probabilistic methods would require new processes to link and communicate data across models, such as linking generation and transmission expansion assessments, resource adequacy, production cost models, and transmission planning assessments.[215] Further, new statistical methods and processes will be needed to inform the selection of powerflow cases for planning assessments.[216] PJM states that the benefits of applying probabilistic methods would require knowing in advance pre-established bounded parameter ranges, so

[200] *Id.* P 75.

[201] *Id.*

[202] *Id.*

[203] *Id.* P 78.

[204] *Id.* P 79.

[205] *Id.*

[206] *See, e.g.,* NESCOE Comments at 9; EPRI Comments at P 24; PJM Comments at 11; EDF Comments at 20; PIOs Comments at 7; ACEG Comments at 7; NARUC Comments at 5–6; ACP Comments at 15; Entergy Comments at 6.

[207] PJM Comments at 11.

[208] EPRI Comments at P 24.

[209] ACP Comments at 16.

[210] AEP Comments at 22.

[211] APS Comments at 7 (requesting that the Commission hold ''robust industry-wide discussions to discuss probabilistic approaches''); Tri-State Comments at 8.

[212] Trade Associations Comments at 11.

[213] Idaho Power Comments at 5.

[214] LCRA Comments at 3–4.

[215] EPRI Comments at P 25.

[216] *Id.*

reasonable selection of probabilistic method assumptions lead to benchmark planning cases that reflect statistically credible scenarios.[217] PJM further states that this should be the result of coordinated analysis among RTOs, NOAA, DOE Labs, and NERC.[218] Entergy asserts that the probabilistic approach is significantly more complicated than deterministic planning and cautions that any requirement for probabilistic planning must have requirements that reasonably can be performed, are assessable, and are auditable for compliance.[219] Because of the potential challenges associated with implementing probabilistic planning requirements, Tri-State recommends the further study of and development of best practices for probabilistic planning.[220]

b. Commission Determination

134. Pursuant to section 215(d)(5) of the FPA, the Commission adopts and modifies the NOPR proposal and directs NERC to require in the new or modified Reliability Standard the use of planning methods that ensure adequate consideration of the broad characteristics of extreme heat and cold weather conditions. We further direct NERC to determine during the standard development process whether probabilistic elements can be incorporated into the new or modified Reliability Standard and implemented presently by responsible entities. If NERC identifies probabilistic elements which responsible entities can feasibly implement and that would improve upon existing planning practices, we expect the inclusion of those methods in the proposed Reliability Standard.

135. Including probabilistic scenarios in the planning process could result in a planning approach that better captures the uncertainties of extreme weather events, thus better preparing responsible entities to ensure Reliable Operation under stressed conditions.[221] Further, we agree with commenters that the use of probabilistic methods by responsible entities would help ensure Reliable Operation of the Bulk-Power System as probabilistic methods better characterize multi-day wide-area events such as extreme heat and cold events.[222]

136. However, we recognize, as certain commenters point out, that a prescriptive requirement to add probabilistic planning methods to better understand reliability implications could be met by significant challenges. Some of the challenges identified by commenters include lack of commercially available tools required for probabilistic modeling and lack of planning staff trained in the use of these tools and in carrying out probabilistic studies. Further, there may be a need to develop and maintain probabilistic databases that include, for example, outage data from extreme weather-dependent grid components and generation resources.

137. Because of these implementation concerns, we believe that the best course of action is to allow NERC to use its expertise and the standard development process to address the concerns identified by commenters and develop proposed modifications to existing planning methods that address the Commission's directive to use transmission planning methods that adequately characterize the effects of extreme heat and cold weather conditions on the transmission system, including incorporating probabilistic elements where possible. The standard development process will also provide an adequate forum in which to evaluate the many recommendations that commenters have presented in response to the NOPR.

138. We also direct NERC to identify during the standard development process any probabilistic planning methods that would improve upon existing planning practices, but that NERC deems infeasible to include in the proposed Reliability Standard at this time. If any such methods are identified, NERC shall describe in its petition for approval of the proposed Reliability Standard the barriers preventing the implementation of those probabilistic elements. We intend to use this information to determine whether and what next steps may be warranted to facilitate the use of probabilistic methods in transmission system planning practices.

H. Implement a Corrective Action Plan if Performance Standards Are Not Met

139. The NOPR noted that under the currently effective Reliability Standard TPL–001–5.1, planning coordinators and transmission planners are required to evaluate possible actions to reduce the likelihood or mitigate the consequences of extreme weather events, but are not obligated to develop corrective action plans, even if such events are found to cause cascading outages.[223] Because of the potential severity of extreme heat and cold weather events and their likelihood to cause system instability, uncontrolled separation, or cascading failures as a result of a sudden disturbance or unanticipated failure of system elements, the NOPR proposed to direct NERC to require corrective action plans that include mitigation for any instances where performance requirements for extreme heat and cold events are not met.[224]

140. Consistent with the existing requirements of Reliability Standard TPL–001–5.1, the NOPR proposed to provide responsible entities with the flexibility to determine the actions to include in their corrective action plans to remedy identified deficiencies in performance. The NOPR included several examples of actions that could be included in a corrective action plan: planning for additional contingency reserves or implementing new energy efficiency programs to decrease load, increasing intra- and inter-regional transfer capabilities, transmission switching, or adjusting transmission and generation maintenance outages based on longer-lead forecasts. The NOPR observed that well-planned mitigation and corrective actions that account for some of these contingencies will minimize loss of load and improve resilience during extreme heat and cold weather events.[225]

141. The NOPR explained that increases in interregional transfer capability could be considered as one option to address potential reliability issues during extreme weather events.[226] The NOPR noted that such transfer capability would allow an entity in one region with available energy to assist one or more entities in another region that is experiencing an energy shortfall due to the extreme weather event.[227] Increasing interregional transfer capability may be a particularly robust option for planning entities attempting to mitigate the risks associated with concurrent generator outages over a wide area.[228]

[217] PJM Comments at 11.

[218] *Id.*

[219] Entergy Comments at 9.

[220] Tri-State Comments at 8.

[221] NOPR, 179 FERC ¶ 61,195 at P 76.

[222] EPRI Comments at 4.

[223] NOPR, 179 FERC ¶ 61,195 at P 83. Reliability Standard TPL–001–5.1, Requirements R3.3.5 and R4.4.5 require computer simulation analyses of extreme events listed in Table 1 of the standard (some listed are examples and are not definitive), and if the analysis concludes there is cascading caused by the occurrence of extreme events, an evaluation of possible actions designed to reduce the likelihood or mitigate the consequences and adverse impacts of the event(s) shall be conducted.

[224] *Id.*

[225] *Id.* P 84.

[226] *Id.* P 85.

[227] *Id.*

[228] *Id.* In this proceeding, we refer to interregional transfer capability strictly in the context of improving the reliability of the Bulk-Power System through improved transmission system planning

Continued

142. To ensure the timely development and implementation of corrective action plans, the NOPR sought comments on the timeframe for developing such corrective action plans and sharing of the corrective actions with other interconnected planning entities.[229] In addition, to identify opportunities for improved wide-area planning studies and coordination, the NOPR requested comment on how to develop corrective action plans that mitigate issues that require corrective action by, and coordination among, multiple transmission owners.[230]

1. Comments

a. Jurisdictional Issues

143. Several commenters raise jurisdictional concerns regarding corrective action plans.[231] While Indicated Trade Associations support the NOPR proposal to require corrective action plans addressing vulnerabilities identified in the study process, they also urge that the Commission ''remain mindful'' of the statutory limitation set forth in FPA section 215(i) that NERC and the Commission do not have authority ''to order the construction of additional generation or transmission capacity or to set or enforce compliance with standards for adequacy or safety of electric facilities or services.'' [232] In particular, Indicated Trade Associations express concern that certain examples of potential corrective action plans mentioned in the NOPR, including ''planning for additional contingency reserves . . . or increasing intra- and inter-regional transfer capabilities,'' exceed the Commission's authority under section 215 of the FPA.[233] Similarly, Electric Reliability Council of Texas, Inc. (ERCOT) opines that ''[r]equiring transmission planners to address what is fundamentally a resource adequacy concern through the transmission planning process would usurp the authority of the states, which are responsible for ensuring the adequacy of the generation supply.'' [234]

b. Corrective Action Plans

144. Most commenters agree that corrective action plans should be required to address system performance issues identified in studies under extreme heat and cold weather conditions.[235] NERC agrees that any revised Reliability Standard directed under a final rule issued in this proceeding should require that entities develop corrective action plans for instances where performance requirements for selected extreme weather and environmental conditions are not met for at least some of the planning scenarios.

145. BPA asserts that several of the corrective action plan examples listed in the NOPR, such as transmission switching/reconfiguration, or adjusting transmission and generation maintenance outages, would likely be covered by Reliability Standard EOP–011–2, requiring transmission operators and balancing authorities to have operating plans to mitigate operating emergencies including determining the reliability impacts of extreme weather conditions. Therefore, BPA cautioned, any modifications to Reliability Standard TPL–001–5.1 should be careful not to encroach upon the authority and discretion of transmission operators and balancing authorities.[236]

146. Some commenters do not support the NOPR proposal to require the development and implementation of corrective action plans for all instances where performance requirements for extreme heat and cold events are not met. APS asserts that ''corrective action plans should be focused on the most likely and impactful events, which may not include extreme weather scenarios,'' and that as such, it disagrees that corrective action plans ''should be required for results that come out of sensitivity analysis, which includes extreme weather scenarios.''

147. With regard to costs, National Association of Regulatory Utility Commissioners (NARUC) asserts that mitigation and corrective actions to minimize loss of load and improve resilience should be subjected to a cost/benefit analysis.[237] Entergy suggests that the Commission ''provide additional guidance regarding the level of performance it expects during extreme heat and cold events,'' including consideration of ''the cost effects on customers relative to the potential risks and the time-frame in which those risks are likely to arise.'' [238]

c. Generation and Transmission Capacity Increase and Resource Adequacy Issues

148. Most commenters agree that the responsible entities developing corrective action plans should evaluate a range of solutions, including transmission upgrades to increase interregional transfer capability and/or building generation to address generation deficiency under extreme weather events.[239] Some commenters, however, question the efficacy of corrective action plans and suggest that alternative approaches are preferable.

149. With regards to transmission capacity, and specifically interregional transfer capabilities, many commenters agree that adequate interregional transfer capability would help address reliability challenges posed by extreme heat and cold weather conditions.[240] Some commenters urge the Commission to set a minimum interregional transfer capability requirement.[241] However, most commenters addressing this topic opine that interregional transfer requirements, including setting necessary or minimum transfer levels and direction, should be addressed outside of the Reliability Standard TPL–001–5.1 planning process.[242] For example, MISO Transmission Owners suggest that interregional transfers could be better dealt with under Order No. 1000 Regional Transmission Planning processes.[243] MISO recommends that corrective action plans require meaningful mitigation, such as investment in transmission solutions, to address issues identified in an extreme weather event study.[244] Conversely, Idaho Power states that if regional transmission facilities are to be considered as corrective actions, Idaho Power would have concerns with the efficacy of those corrective actions given the amount of time necessary to build new transmission.[245]

150. Most commenters who disagree with the NOPR proposal to allow entities to consider additional generation capacity as a corrective action plan measure disagree on the

and associated modifications to NERC's Reliability Standards.

[229] *Id.*

[230] *Id.* P 67.

[231] Indicated Trade Associations Comments at 11–12; ERCOT Comments at 5.

[232] Indicated Trade Association Comments at 12 (citing 16 U.S.C. 824o(i)).

[233] *Id.* at 11–12; ERCOT Comments at 5.

[234] ERCOT Comments at 5.

[235] *See, e.g.,* NERC Comments at 10; NARUC Comments at 6; NESCOE Comments at 3; MISO Comments at 4.; PJM Comments at 12.

[236] BPA Comments at 4.

[237] NARUC Comments at 6.

[238] Entergy Comments at 2.

[239] *See, e.g.,* NARUC Comments at 6; UCS Comments at 9; PIOs Comments at 15; AEP Comments at 5; ACEG Comments at 8; ACP Comments at 11; Entergy Comments at 8.

[240] AEP Comments at 2; ACP Comments at 19; ACEG Comments at 9; PJM Comments at 12; *see* MISO Transmission Owners Comments at 5–6.

[241] EDF Comments at 27; AEP Comments at 2; ACP Comments at 19; ACEG Comments at 9; PJM Comments at 12.

[242] MISO Transmission Owners Comments at 5–6; ACP Comments at 19; ACEG Comments at 9; AEP Comments at 2.

[243] MISO Transmission Owners Comments at 5.

[244] MISO Comments at 4.

[245] Idaho Power Comments at 4, 6.

basis that resource adequacy is not a matter that should be dealt with within the transmission planning process.[246] For example, ISO–NE asserts that the purpose of Reliability Standard TPL–001–5.1 is not to ensure resource adequacy, but to ensure that load can be served.[247] ACP and PIOs question the efficacy of building new generation as part of a corrective action plan because such new generation may be subject to the same issues as existing generation—for example, if an extreme cold event leads to the outage of weather-sensitive generators, adding more weather-sensitive generators will not resolve the resource deficiency.[248]

d. Notification to Applicable Regulatory Authorities or Governing Bodies Responsible for Retail Electric Service Issues

151. ACP, New England States Committee on Electricity (NESCOE), and Entergy comment that entities must coordinate with state and local authorities in the development of corrective action plans involving generation and transmission capacity.[249] For example, NESCOE suggests that corrective action plans be informed by state officials' perspectives, consider a variety of mitigation options, and include a detailed explanation of how the entity weighed the various options.[250] Additionally, NESCOE points out that given the likelihood that corrective action plans will include load shed, state officials should be involved in the corrective action plan process.[251] NESCOE proposes that responsible entities seek input from state regulators during their planning process. Alternatively, NESCOE recommends the adoption of the Joint Federal-State Task Force on Electric Transmission model to create a similar task force focusing on extreme weather and grid reliability.[252]

2. Commission Determination

152. Pursuant to section 215(d)(5) of the FPA, the Commission adopts and modifies the NOPR proposal and directs NERC to require in the new or modified Reliability Standard the development of extreme weather corrective action plans for specified instances when performance standards are not met. In addition, as explained below, we direct NERC to develop certain processes to facilitate interaction and coordination with applicable regulatory authorities or governing bodies responsible for retail electric service as appropriate in implementing a corrective action plan.

153. We adopt our rationale set forth in the NOPR and conclude that the directive to require the development of corrective action plans is needed for Reliable Operation of the Bulk-Power System. Under the currently effective Reliability Standard TPL–001–5.1, planning coordinators and transmission planners are required to evaluate possible actions to reduce the likelihood or mitigate the consequences of extreme weather events, but are not obligated to develop corrective action plans, even if such events are found to cause cascading outages. Experience over the past decade has demonstrated that the potential severity of extreme heat and cold weather events exacerbates the likelihood to cause system instability, uncontrolled separation, or cascading failures as a result of a sudden disturbance or unanticipated failure of system elements. Thus, we conclude that entities should proactively address known system vulnerabilities by developing corrective action plans that include mitigation for specified instances where performance requirements for extreme heat and cold events are not met.

a. Jurisdictional Issues

154. We reject the arguments that our directive to require responsible entities to develop corrective action plans may exceed the Commission's jurisdiction. Section 215(i)(2) of the FPA states that the Commission and ERO are not authorized to order the construction of additional generation or transmission capacity as part of a Reliability Standard.[253] Consistent with this limitation, the final rule does not require any responsible entity to engage in the construction of additional generation or transmission capacity. Moreover, while the final rule directs NERC to include in a new or modified Reliability Standard a requirement for entities to develop a corrective action plan to address extreme heat and cold weather events during the transmission planning process, the final rule does not mandate the use of any specific mitigation measure.[254]

155. As noted by commenters, the NOPR provided examples of various activities that may be appropriate under a corrective action plan, some of which may require state or local authorizations (*e.g.,* generation or transmission development).[255] Other examples mentioned in the NOPR include ''implementing new energy efficiency programs to decrease load, . . . transmission switching, or adjusting transmission and generation maintenance outages based on longer-lead forecasts,'' [256] none of which involve the construction of generation or transmission capacity. In addition, responsible entities have the option to use controlled load shed as a mitigation measure. In sum, while responsible entities would have the obligation to develop and implement a corrective action plan, the Commission is not directing any specific result or content of the corrective action plan. In such circumstances, the Commission's directive does not exceed the jurisdictional limits set forth in section 215(i) of the FPA.[257]

156. In response to ERCOT and other commenters, the Commission's action does not usurp state authority with regard to resource adequacy. As explained above, the directive that responsible entities develop corrective action plans in certain circumstances does not require the construction of additional generation or transmission capacity. Further, as discussed below, responsible entities that *elect* mitigation activities that involve increased transmission or generation capacity will of course be subject to the authority of such state agencies or others with legal jurisdiction over the construction of transmission or generation facilities.

b. Circumstances That Require Corrective Action Plans

157. As stated above, we adopt and modify the NOPR proposal and direct NERC to require in the new or modified Reliability Standard the development of corrective action plans that include mitigation for specified instances where performance requirements for extreme heat and cold events are not met—*i.e.,* when certain studies conducted under the Standard show that an extreme heat or cold event would result in cascading outages, uncontrolled separation, or instability.[258] We agree with APS that

[246] *See, e.g.,* PJM Comments at 12; ERCOT Comments at 5; ISO–NE Comments at 4.

[247] ISO–NE Comments at 4.

[248] ACP Comments at 6; PIOs Comments at 16.

[249] *See* ACP Comments at 18; NESCOE Comments at 3; *see also* Entergy Comments at 9 (stating in the context of the development of corrective action plans that ''[t]he Commission also should ensure that the relevant retail regulators have input into the level of risks versus costs a transmission owner should accept.'').

[250] NESCOE Comments at 3.

[251] *Id.* at 5.

[252] *Id.* at 6.

[253] 16 U.S.C. 824o(i)(2).

[254] NOPR, 179 FERC ¶ 61,195 at P 84 (''we believe it is appropriate to provide responsible entities with the flexibility to determine the best actions to include in their corrective action plan to remedy any identified deficiencies in performance'').

[255] *Id.*

[256] *Id.*

[257] *S.C. Pub. Serv. Auth.* v. *FERC,* 762 F.3d 41, 80 (D.C. Cir. 2014).

[258] NOPR, 179 FERC ¶ 61,195 at P 83.

neither version 4 nor 5.1 of Reliability Standard TPL–001–5.1 require corrective action plans for extreme heat and cold weather events. Extreme heat and cold weather events, which pose a serious risk to the Reliable Operation of the Bulk-Power System, are increasing in frequency and intensity. We believe that in taking steps to avoid occurrences of cascading outages, uncontrolled separation, or instability under extreme heat and cold, corrective action plans would also minimize the extent and duration of loss of load and improve Bulk-Power System resilience during extreme heat and cold weather events.[259]

158. Although the NOPR proposed requiring the development of corrective action plans for *any* instance where performance requirements for extreme heat and cold events are not met, we give NERC in this final rule the flexibility to specify the circumstances that require the development of a corrective action plan. For example, NERC should determine whether corrective action plans should be required for single or multiple sensitivity cases, and whether corrective action plans should be developed if a contingency event that is not already included in benchmark planning case would result in cascading outages, uncontrolled separation, or instability.[260] Because we also direct NERC to establish required study contingencies and baseline sensitivities,[261] we believe it is necessary for NERC to develop those aspects of the Standard prior to determining the instances under which corrective action plans must be developed.

159. With regard to BPA's suggestion that Reliability Standard EOP–011–2 already addresses certain mitigation measures listed in the NOPR as examples, we clarify that nothing in the final rule affects the responsibilities or obligations of registered entities under that Reliability Standard and note that there are important differences in the scope and intent of EOP–011–2 and the Reliability Standard we are directing be developed here. Specifically, while Reliability Standard EOP–011–2 includes provisions to determine reliability impacts of extreme cold conditions and extreme weather conditions,[262] it does not require the transmission operator to mitigate the condition. In addition, Reliability Standard EOP–011–2 addresses the issues within the operating time frame. Corrective action plans, as proposed in the NOPR, would be developed in the planning horizon to address the issues in the long-term planning time frame. Simultaneously, such issues would be addressed by Reliability Standard EOP–011–2 in the operating time frame should the studied extreme weather condition occur. As such, there would not be any encroachment or conflict between the two standards.

160. With respect to arguments from NARUC and Entergy that the Commission should require cost-benefit analysis for corrective action plans or otherwise provide additional guidance as to the cost impacts on customers, we decline to do so. FPA section 215 does not require the use of cost-benefit analysis and, given the flexibility allowed to responsible entities in crafting a corrective action plan, we are not persuaded such a requirement would be warranted in this instance. Regarding the cost impact on customers more generally, we believe that NERC should have an opportunity in the first instance to balance such impacts and present a new or modified Reliability Standard for Commission approval. As articulated in Order No. 672, the cost of compliance is but one factor in determining whether to approve a proposed Reliability Standard and we will consider the potential cost impacts in the context of the larger record.[263]

c. Generation and Transmission Capacity Increase and Resource Adequacy Issues

161. As discussed above, corrective action plans are not required to use any specific mitigation measure and responsible entities are not required to build transmission or generation. Nevertheless, some entities may choose to include additional transmission or generation capacity as a mitigation measure in their corrective action plan, subject to the approval of relevant regulatory authorities.

162. With respect to the use of transmission as a mitigation measure, as stated in the NOPR and echoed by commenters, interregional transfer capability can be a solution to some extreme weather-related reliability concerns. We recognize that a proposal by a planning entity to increase its interregional transfer capability to address the impact of extreme heat and cold conditions on its portion of the Bulk-Power System may be acceptable in a corrective action plan, and we expect that the benchmark planning cases developed, and wide-area studies conducted under this Standard could be beneficial for purposes of determining interregional transfer needs. However, we decline to set a minimum interregional transfer capability requirement in this proceeding and note the Commission's ongoing pending proceeding addressing such a requirement in Docket No. AD23–3.

163. Regarding Idaho Power's concern given the amount of time necessary to build new transmission,[264] we note that corrective action plans address deficiencies identified in a long-term transmission planning timeframe (*i.e.,* six to ten years and beyond). The period associated with a transmission project will inform whether and when that project may be included in an extreme weather corrective action plan. For example, a transmission project that is not expected to be operational in the six-to-ten-year long-term horizon may not be relied upon in an extreme weather corrective action plan to mitigate identified system deficiencies within that time horizon. In that circumstance, the responsible entity will have to develop an extreme weather corrective action plan that includes other measures that can be implemented to ensure Reliable Operation of its portion of the Bulk-Power System.

164. With respect to concerns that generation capacity is not appropriately included in corrective because it should be addressed through resource adequacy processes, we reiterate our findings above in section IV.F that the purpose of the new or modified Standard is to address transmission system deliverability and not to supplant or duplicate resource adequacy processes. With respect to concerns from PIOs and ACP that generation may be ineffective as a mitigation measure, we note that responsible entities have the flexibility to determine the appropriate mitigation measure for their circumstances.

d. Notification to Applicable Regulatory Authorities or Governing Bodies Responsible for Retail Electric Service Issues

165. We direct NERC to require in the new or modified Reliability Standard that responsible entities share their corrective action plans with, and solicit feedback from, applicable regulatory authorities or governing bodies responsible for retail electric service issues. We agree with commenters that relevant state entities should have the opportunity to provide input during the

[259] *Id.* P 84.

[260] Under Reliability Standard TPL–001–5.1, corrective action plans are not required for single sensitivity cases.

[261] *See supra* PP 111, 124.

[262] Reliability Standard EOP–011–2, Requirement 1.2.6.

[263] *See* Order No. 672, 114 FERC ¶ 61,104 at P 330.

[264] Idaho Power Comments at 4, 6.

development of corrective action plans. Just as this final rule seeks to ensure Reliable Operation of the Bulk-Power System during extreme heat and cold weather events, regulatory authorities and governing bodies responsible for retail electric service are taking actions to ensure reliability for local stakeholders. As such, we believe that requiring responsible entities to seek input from applicable regulatory authorities or governing bodies responsible for retail electric service issues when developing corrective action plans could help ensure that shared opportunities to increase system reliability are not missed. Further, as NESCOE points out, such consultation may allow these entities to better understand ''the cost implications of various approaches'' and, therefore, provide ''better insight into the considerations and tradeoffs inherent in the options available.'' [265]

166. We also agree with NESCOE that sharing corrective action plans with applicable regulatory authorities or governing bodies responsible for retail electric service is necessary given the possibility that corrective action plans could include load shedding.[266] As the Commission has stated in the past, we believe that the public should have notice and understanding of a responsible entity's plans to shed non-consequential load.[267] Therefore, just as Reliability Standard TPL–001–5.1 requires planning coordinators and transmission planners to notify stakeholders, including applicable regulatory authorities or governing bodies responsible for retail electric service, of their intent to include non-consequential load loss in corrective action plans for certain single-contingency events,[268] the new or modified Reliability Standard must also require responsible entities to similarly communicate their intent to use non-consequential load shed in their extreme weather corrective action plans.

167. Further, because an important goal of transmission planning is to avoid load shed,[269] any responsible entity that includes non-consequential load loss in its corrective action plan should also identify and share with applicable regulatory authorities or governing bodies responsible for retail electric service alternative corrective actions that would, if approved and implemented, avoid the use of load shedding. Examples could include building additional generation and/or transmission capacity, energy efficiency programs, and demand load response programs.[270]

168. While we direct NERC to require registered entities to communicate the results of their studies and share their extreme weather corrective action plans with applicable regulatory authorities or governing bodies responsible for retail electric service, NERC should not attempt to mandate that entities which are not under the Commission's jurisdiction participate in the development of corrective action plans.

I. Other Extreme Weather-Related Events and Issues

169. While the NOPR focused on extreme heat and cold weather events, the NOPR recognized that long-term drought, particularly when occurring in conjunction with high temperatures, could also pose a serious risk to Bulk-Power System reliability over a wide geographical area. In the NOPR, the Commission raised a concern that drought may cause or contribute to conditions that affect reliable operation of the Bulk-Power System such as transmission outages, reduced plant efficiency, and reduced generation capacity. The Commission sought comment on whether drought should be included along with extreme heat and cold weather events within the scope of the Reliability Standard.[271] Additionally, the Commission invited comment on whether other extreme events with significant impact on the reliability of the Bulk-Power System could also be considered and modeled in the future.[272]

1. Comments

170. Indicated Trade Associations, EDF, and ACP support including the consideration of drought with extreme heat and cold weather events within the scope of the new or modified Reliability Standard.[273] NERC agrees, suggesting that drought conditions be studied in drought-prone areas of the country.[274] EDF notes that drought events can significantly impact the capacity and operation of water-cooled fossil and nuclear generators and other water-cooled assets, as well as hydroelectric generators. EDF also asserts that drought events are also highly correlated with high temperature and wildfires. Therefore, according to EDF, a failure to consider drought impacts could result in an overestimation of generation availability during an extreme heat weather event and understate the risks of that event.[275]

171. Similarly, Indicated Trade Associations note that they support the study of long-term drought impacts on relevant generation (*e.g.,* hydro-electric, geothermal, and nuclear generation) in regions where drought has been, or may plausibly become, an issue. They add that droughts are sustained long-term conditions that may be fundamentally studied and addressed differently—for example, as a fuel supply sensitivity—than a short-term extreme heat or cold weather event.[276] However, Indicated Trade Associations believe that the Commission should not attempt to address all types of extreme weather events at once in the Reliability Standard, but rather take a phased approach.[277]

172. ACP states ''[b]ecause drought events are already widespread across all regions, and climate change will make them even more frequent and widespread, it would be prudent for the Commission and NERC to require all regions to include drought in their analysis of severe weather benchmark events under TPL–001.'' [278]

173. Tri-State notes that drought is already sufficiently included in the resource forecasts developed by Resource Planners.[279]

174. Certain commenters support the inclusion of extreme weather events beyond heat, cold and drought. For example, NERC identifies extreme weather conditions for inclusion in required studies, such as high winds, diminished winds, dust, smoke, fog, and increased cloud cover.[280] According to NERC, such long-term, widespread weather and environmental conditions can impact resource availability and the transmission system. Other commenters suggest the inclusion of other extreme weather events such as wildfires, hurricanes, and tornadoes; [281] rain and wind (including derechos), and ice storms; [282] debris flow (landslide risk following wildfire scars and heavy

[265] NESCOE Comments at 4.

[266] *Id.* at 5.

[267] *Transmission Planning Reliability Standards,* Order No. 762, 77 FR 26686 (May 7, 2012), 139 FERC ¶ 61,060, at P 65 (2012).

[268] Reliability Standard TPL–001–5.1, at attach. 1.

[269] Order No. 693, 118 FERC ¶ 61,218 at P 1,795.

[270] To be clear, responsible entities may also pursue such mitigating actions in the first instance, subject to the approval of relevant regulatory authorities. *See supra* P 161.

[271] NOPR, 179 FERC ¶ 61,195 at P 92.

[272] *Id.* P 93.

[273] Indicated Trade Associations Comments at 13; EDF Comments at 19; ACP Comments at 18–19.

[274] NERC Comments at 12.

[275] EDF Comments at 24.

[276] Indicated Trade Associations Comments at 13.

[277] *Id.*

[278] ACP Comments at 10.

[279] Tri-State Comments at 8.

[280] NERC Comments at 12.

[281] EDF Comments at 25.

[282] AEP Comments at 5.

precipitation) and rain-on-snow events that may lead to dam overtopping.[283]

175. EPRI points out that certain extreme weather events such as hurricanes or flooding can and do often occur independent of extreme heat and cold events. As such, EPRI states that the standard should identify climate and weather-related threats that occur concurrently or independently based on the planning area's local footprint and develop scenarios accordingly.[284]

176. In contrast, MISO and LCRA comment that the Reliability Standard should be limited to extreme heat and cold events. MISO also comments that there is a fundamental difference between extreme heat and cold events and other extreme weather events: extreme temperature events would likely result in the load increasing and continuing to stay online, while other extreme weather events such as hurricanes or tornados create the possibility of load loss. MISO also points out that the operation horizon will continue to prepare for situations like hurricanes, tornados, or ice storms.[285] Likewise, LCRA adds that drought and other extreme weather events beyond extreme temperature are already modeled by existing extreme event contingencies.[286]

2. Commission Determination

177. We decline to direct NERC to create or modify a Reliability Standard to specifically require the assessment of the impacts of drought conditions as part of extreme heat and cold transmission system planning. As explained above, the type of long-term meteorological study involved in extreme heat and cold event transmission planning necessarily includes examining the extreme weather impact on base climate conditions over the study period, conditions that would have to include anticipated drought conditions in relevant planning areas.[287]

178. We agree with various commenters that drought conditions may impact reliability,[288] and drought impacts on generation are already studied in the resource forecasts developed by resource planners and mitigated by operating procedures. Additionally, droughts that may occur concurrently with extreme heat and cold events will be included in the benchmark planning case, as drought conditions would be present in the meteorological data that feeds the benchmark planning case,[289] and the possibility of more severe drought could be reflected as part of a sensitivity analysis.[290]

179. Regarding other extreme weather events such as NERC's concern with high winds, diminished winds, dust, smoke, smog fog, extreme snowstorms, flooding and increased cloud cover, and extreme snowstorms, or other commenters recommendations to include hurricanes, tornados, heavy rain and wind, and ice storms; and adjacent events such as wildfires, debris flow, and flooding, we agree that these conditions may affect the Bulk-Power System. However, we are not persuaded that a directive to address these events in the new or modified Reliability Standard is warranted at this time.

180. As MISO indicates, there are fundamental differences between extreme heat and cold events and other extreme weather events that cast doubt as to whether this Reliability Standard is the correct vehicle for addressing their impacts.[291] For instance, extreme heat and cold events generally affect large geographic areas, while other extreme weather and adjacent events such as tornadoes, hurricanes, storms, floods, and wildfires tend to have more localized impacts. Moreover, as MISO points out, extreme heat and cold weather events are typically characterized by potential sustained load increases, while other extreme weather events typically result in load losses.

J. Reliability Standard Development and Implementation Timeline

181. The Commission proposed to direct NERC to develop a new or modified Reliability Standard within one year of the effective date of a final rule in this proceeding, with compliance obligations beginning no later than 12 months from Commission approval of the proposed Reliability Standard.[292]

1. Comments

182. NERC raises no concerns with the proposed 12-month proposal to create a new or modified Reliability Standard; however, NERC requests that the Commission consider coordinating the timing of this final rule to allow NERC to benefit from the informational filings in Docket Nos. RM22–16–000 and AD21–13–000, as information obtained from these reports ''may prove useful to the NERC standard development process.'' [293]

183. PJM and MISO Transmission Owners state that one year will not be enough time to develop the proposed Reliability Standard.[294] PJM states that such a short timeframe will hamper stakeholder input.[295] PJM further comments that the NOPR's proposed timeline for standard development is not ''sequenced with any of the other activities associated with ensuring enhanced reliability planning'' and will thus ''divert resources from the more comprehensive work that is needed in this area.'' [296] MISO Transmission Owners agree that ''one year's time is not long enough'' to modify or create a new Reliability Standard, and the Commission should give NERC ''more time.'' [297]

184. Regarding the effective date of any resulting Reliability Standard, NERC requests that the Commission clarify the proposed implementation schedule, *i.e.,* ''whether entities must begin to comply with all new study requirements within one year of Commission approval (*i.e.,* completed studies with Corrective Action Plans developed), or whether a phased-in approach beginning no later than one year is permitted for entities to coordinate on the development of new models, collect new data, and perform the necessary coordination to study wide area impacts before completing studies and developing any associated Corrective Action Plans.'' [298]

185. PJM also states that one year is not enough time for responsible entities to implement the new or revised Reliability Standard, because after Commission approval ''Transmission Providers like PJM will have responsibility to translate it into workable planning process methodologies and related stakeholder-approved manual language.'' [299]

186. PJM further calls for flexibility on setting start dates for the implementation period for different

[283] SCE Comments at 6–7.

[284] EPRI Comments at P 29.

[285] MISO Comments at 2.

[286] LCRA Comments at 4.

[287] *See supra* P 114

[288] *See e.g.,* EDF Comments at 24.

[289] *See supra* note 155.

[290] *See supra* P 114 and note 155.

[291] MISO Comments at 2.

[292] NOPR, 179 FERC ¶ 61,195 at P 48.

[293] NERC Comments at 14. In Docket Nos. RM22–16–000 and AD21–13–000, the Commission proposes directing transmission providers to submit one-time informational reports describing their current or planned policies and processes for conducting extreme weather vulnerability assessments. *One-Time Informational Reports on Extreme Weather Vulnerability Assessments; Climate Change, Extreme Weather, & Elec. Sys. Reliability,* Notice of Proposed Rulemaking, 87 FR 39414 (July 1, 2022), 179 FERC ¶ 61,196 (2022) (Informational Reports NOPR).

[294] PJM Comments at 14; MISO Transmission Owners Comments at 7.

[295] PJM Comments at 14.

[296] *Id.*

[297] MISO Transmission Owners Comments at 7.

[298] NERC Comments at 14–15.

[299] PJM Comments at 14–15.

entities given variances in regional planning cycles.[300] APS echoes the call for flexibility as to the timeframe for developing a corrective action plan as the potential mitigation strategies may vary or include neighboring entities.[301]

187. AEP proposes that the Commission provide responsible entities ''at least two years to implement stability analysis'' after the proposed Reliability Standard takes effect, and that corrective action plans be developed ''within one year of the assessment of reliability deficiency.'' [302]

2. Commission Determination

188. We direct NERC to submit a new or modified Reliability Standard within 18 months of the date of publication of this final rule in the **Federal Register**. Further, we direct NERC to propose an implementation timeline for the new or modified Reliability Standard, with implementation beginning no later than 12 months after the effective date of a Commission order approving the proposed Reliability Standard.

189. We agree with NERC that it is important to coordinate the timeline for the development of a Reliability Standard under this proceeding with that of the extreme weather one-time informational reports required under Docket Nos. RM22–16–000 and AD21–13–000.[303] The Informational Reports Final Rule, which is being issued concurrently with this final rule, directs responsible entities to develop and file with the Commission within 120 days of that order's publication in the **Federal Register** a one-time informational report ''describing their current or planned policies and processes for conducting extreme weather vulnerability assessments.'' [304] The Informational Reports Final Rule further states that public comments will be due 60 days after the reports are filed.[305] These informational reports may assist the standard drafting team's efforts in developing the proposed Reliability Standard, as they will be helpful for determining whether and to what extent transmission providers are already considering the impacts of extreme weather events. We believe that extending the NOPR's proposed standard development timeline is appropriate to ensure that NERC can benefit from the information obtained from these reports, as well as from public comments on the reports.

190. With regards to PJM and MISO Transmission Owners' comments, we recognize that the NOPR proposed an ambitious development timeline for the proposed Reliability Standard. As we indicated in the NOPR, the negative impact of extreme weather on the reliability of the Bulk-Power System demands an urgent response. Further, we note that NERC, the entity responsible for the development of the Reliability Standard, did not raise concerns about the NOPR's proposed development timeline. As such, we are not persuaded that there is a present need to extend the deadline to submit a proposed Reliability Standard further than what is necessary to ensure that NERC can benefit from the data obtained as a result of the one-time informational reports.

191. Accordingly, we direct NERC to submit a proposed Reliability Standard within 18 months of the date of publication of this final rule in the **Federal Register**. We believe that extending the development timeline by six months should be sufficient to ensure that the standard drafting team will be able to take advantage of the one-time reports required by the Commission under Docket Nos. RM22–16–000 and AD21–13–000.

192. We decline to direct NERC to ensure that entities fully comply with all new requirements within one year of Commission approval (*i.e.,* completed studies with corrective action plans developed). As AEP and PJM note in their comments, the new or modified Reliability Standard will require significant implementation efforts. Given the complexities and multiple stages of activity that would be involved in compliance with the directives in this final rule, we believe that a more flexible implementation approach is appropriate.

193. We therefore direct NERC to establish an implementation timeline for the proposed Reliability Standard. In complying with this directive, NERC will have discretion to develop a phased-in implementation timeline for the different requirements of the proposed Reliability Standard (*i.e.,* developing benchmark cases, conducting studies, developing corrective action plans). However, this phased-in implementation must begin within 12 months of the effective date of a Commission order approving the proposed Reliability Standard and must include a clear deadline for implementation of all requirements.

V. Information Collection Statement

194. The information collection requirements contained in this final rule are subject to review by the Office of Management and Budget (OMB) under section 3507(d) of the Paperwork Reduction Act of 1995.[306] OMB's regulations require approval of certain information collection requirements imposed by agency rules.[307] Upon approval of a collection of information, OMB will assign an OMB control number and expiration date. Respondents subject to the filing requirements of this rule will not be penalized for failing to respond to this collection of information unless the collection of information displays a valid OMB control number.

195. The directives to NERC to develop a new Reliability Standard or modify existing Reliability Standard TPL–001 (Transmission System Planning Performance Requirements), are covered by, and already included in, the existing OMB-approved information collection FERC–725 (Certification of Electric Reliability Organization; Procedures for Electric Reliability Standards; OMB Control No. 1902–0225), under Reliability Standards Development.[308] The reporting requirements in FERC–725 include the ERO's overall responsibility for developing Reliability Standards, such as the TPL–001 Reliability Standard, which is designed to ensure the Bulk-Power System will operate reliably over a broad spectrum of system conditions and following a wide range of probable contingencies.[309] The Commission will submit to OMB a request for a non-substantive revision of FERC–725 in connection with this final rule.

VI. Environmental Analysis

196. The Commission is required to prepare an Environmental Assessment or an Environmental Impact Statement for any action that may have a significant adverse effect on the human

[300] *Id.*

[301] APS Comments at 8.

[302] AEP Comments at 13, 24.

[303] Final Rule, Order No. 897, 183 FERC ¶ 61,192 (2023) (''Informational Reports Final Rule'').

[304] *Id.* PP 1, 3.

[305] *Id.* P 104.

[306] 44 U.S.C. 3507(d).

[307] 5 CFR 1320.11.

[308] Reliability Standards Development as described in FERC–725 covers standards development initiated by NERC, the Regional Entities, and industry, as well as standards the Commission may direct NERC to develop or modify. The information collection associated with this final rule ordinarily would be a non-material addition to FERC–725. However, an information collection request unrelated to this final rule is pending review under FERC–725 at the Office of Management and Budget. To submit this final rule timely to OMB, we will submit this to OMB as a temporary placeholder under FERC–725(1A), OMB Control No. 1902–0289.

[309] Reliability Standard TPL–001–4, Purpose.

environment.[310] The Commission has categorically excluded certain actions from this requirement as not having a significant effect on the human environment. Included in the exclusion are rules that are clarifying, corrective, or procedural or that do not substantially change the effect of the regulations being amended.[311] The actions directed here fall within this categorical exclusion in the Commission's regulations.

VII. Regulatory Flexibility Act

197. The Regulatory Flexibility Act of 1980 (RFA) [312] generally requires a description and analysis of final rules that will have significant economic impact on a substantial number of small entities.

198. This final rule directs NERC, the Commission-certified ERO, to develop a new or modified Reliability Standard that requires long-term transmission system planning designed to prepare for extreme heat and cold weather events. Therefore, this final rule will not have a significant or substantial impact on entities other than NERC. Consequently, the Commission certifies that this final rule will not have a significant economic impact on a substantial number of small entities.

199. Any Reliability Standards proposed by NERC in compliance with this rulemaking will be considered by the Commission in future proceedings. As part of any future proceedings, the Commission will make determinations pertaining to the Regulatory Flexibility Act based on the content of the Reliability Standards proposed by NERC.

VIII. Document Availability

200. In addition to publishing the full text of this document in the **Federal Register**, the Commission provides all interested persons an opportunity to view and/or print the contents of this document via the internet through the Commission's Home Page (*http://www.ferc.gov*). At this time, the Commission has suspended access to the Commission's Public Reference Room due to the President's March 13, 2020 proclamation declaring a National Emergency concerning the Novel Coronavirus Disease (COVID–19).

201. From FERC's Home Page on the internet, this information is available on eLibrary. The full text of this document is available on eLibrary in PDF and Microsoft Word format for viewing, printing, and/or downloading. To access this document in eLibrary, type the docket number excluding the last three digits of this document in the docket number field.

202. User assistance is available for eLibrary and the FERC's website during normal business hours from FERC Online Support at (202) 502–6652 (toll free at 1–866–208–3676) or email at *ferconlinesupport@ferc.gov,* or the Public Reference Room at (202) 502–8371, TTY (202) 502–8659. Email the Public Reference Room at *public.referenceroom@ferc.gov*.

IX. Effective Date and Congressional Notification

203. This rule will become effective September 21, 2023. The Commission has determined, with the concurrence of the Administrator of the Office of Information and Regulatory Affairs of OMB, that this rule is not a ''major rule'' as defined in section 351 of the Small Business Regulatory Enforcement Fairness Act of 1996.

By the Commission. Commissioner Danly is concurring in part.

Issued: June 15, 2023.

Debbie-Anne A. Reese,

Deputy Secretary.

The following appendix will not appear in the Code of Federal Regulations.

Appendix A: Commenter Names

Acronyms	Commenter name
ACP	American Clean Power Association.
ACEG	Americans for a Clean Energy Grid.
AEP	American Electric Power Service Corporation.
Ampjack	Ampjack Industries Ltd.
APS	Arizona Public Service Company.
BPA	Bonneville Power Administration.
EDF	Environmental Defense Fund.
Indicated Trade Associations	The Edison Electric Institute (EEI), the American Public Power Association (APPA), the Large Public Power Council (LPPC), the National Rural Electric Cooperative Association (NRECA), and the Transmission Access Policy Study Group (TAPS).
Entergy	Entergy Services, LLC.
EPRI	Electric Power Research Institute.
EPSA	Electric Power Supply Association.
ERCOT	Electric Reliability Council of Texas, Inc.
Eversource	Eversource Energy Service Company.
Idaho Power	Idaho Power Company.
ISO–NE	ISO New England Inc.
LCRA	LCRA Transmission Services Corporation.
Louisiana PSC	Louisiana Public Service Commission.
MISO	Midcontinent Independent System Operator, Inc.

[310] *Regul. Implementing the Nat'l Env't Pol'y Act,* Order No. 486, 52 FR 47897 (Dec. 17, 1987), FERC Stats. & Regs. ¶ 30,783 (1987) (cross-referenced at 41 FERC ¶ 61,284).

[311] 18 CFR 380.4(a)(2)(ii) (2022).

[312] 5 U.S.C. 601–612.

Acronyms	Commenter name
MISO Transmission Owners	Ameren Services Company, as agent for Union Electric Company d/b/a Ameren Missouri, Ameren Illinois Company d/b/a Ameren Illinois and Ameren Transmission Company of Illinois; American Transmission Company LLC; Big Rivers Electric Corporation; Central Minnesota Municipal Power Agency; City Water, Light & Power (Springfield, IL); Cleco Power LLC; Cooperative Energy; Dairyland Power Cooperative; Duke Energy Business Services, LLC for Duke Energy Indiana, LLC; East Texas Electric Cooperative; Entergy Arkansas, LLC; Entergy Louisiana, LLC; Entergy Mississippi, LLC; Entergy New Orleans, LLC; Entergy Texas, Inc.; Great River Energy; GridLiance Heartland LLC; Hoosier Energy Rural Electric Cooperative, Inc.; Indiana Municipal Power Agency; Indianapolis Power & Light Company; International Transmission Company d/b/a ITCTransmission; ITC Midwest LLC; Lafayette Utilities System; Michigan Electric Transmission Company, LLC; MidAmerican Energy Company; Minnesota Power (and its subsidiary Superior Water, L&P); Missouri River Energy Services; Montana-Dakota Utilities Co.; Northern Indiana Public Service Company LLC; Northern States Power Company, a Minnesota corporation, and Northern States Power Company, a Wisconsin corporation, subsidiaries of Xcel Energy Inc.; Northwestern Wisconsin Electric Company; Otter Tail Power Company; Prairie Power, Inc.; Republic Transmission, LLC; Southern Illinois Power Cooperative; Southern Indiana Gas & Electric Company (d/b/a CenterPoint Energy Indiana South); Southern Minnesota Municipal Power Agency; Wabash Valley Power Association, Inc.; and Wolverine Power Supply Cooperative, Inc.
NARUC	National Association of Regulatory Utility Commissioners.
NERC	North American Electric Reliability Corporation.
NESCOE	New England States Committee on Electricity.
NMA	National Mining Association.
NYISO	New York Independent System Operator, Inc.
NYSRC	New York State Reliability Council.
Ohio FEA	Federal Energy Advocate for the Public Utilities Commission of Ohio.
PG&E	Pacific Gas and Electric Company.
PIOs	Public Interest Organizations (Sustainable FERC Project, Natural Resources Defense Council, American Council on Renewable Energy, Sierra Club, Southern Environmental Law Center, Western Resource Advocates).
PJM	PJM Interconnection, L.L.C.
SCE	Southern California Edison Company.
Sunflower	Sunflower Electric Power Corporation.
Tri-State	Tri-State Generation and Transmission Association, Inc.
UCS	Union of Concerned Scientists.
WATT	Working for Advanced Transmission Technologies.
WE ACT	WE ACT for Environmental Justice.

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