NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Consideration of FERC Order 896 Directives

Project 2023-07 Transmission System Planning Performance Requirements for Extreme Weather
March 2024

On June 15, 2023, FERC issued a Final Rulemaking to direct NERC to develop a new or modified Reliability Standard to address a lack of a long-term planning requirement(s) for extreme heat and cold weather events. Specifically, FERC directed NERC to develop 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. The below provides FERC Order 896 Directive language along with the drafting teams consideration of the directives.

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Directive Language	**Consideration of Directives**
P35. "[W]e 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." **P 36**: "…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). NERC may also consider other approaches that achieve the objectives outlined in this final rule."	The ERO will work with respective subject matter experts, including climate experts, the six regions, etc., and develop extreme heat and extreme cold weather benchmark events. An ERO-maintained library will be created, and all developed extreme heat and extreme cold weather benchmark events will be retained. From this library, responsible entities will be able to review and select the appropriate benchmark events to assist with the development of its benchmark planning cases. The drafting team developed requirements within TPL-008-1 to require responsible entities to select one extreme heat benchmark event and extreme cold benchmark event from the approved ERO library

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	(Requirement R2). After selecting its benchmark events, the responsible entity is required to develop and implement a process for coordinating the development of benchmark planning cases among the respective entities (Requirement R3) and develop and maintain System models (Requirement R4).
P38. "[I]n developing extreme heat and cold benchmark events, NERC shall ensure that benchmark events reflect regional differences in climate and weather patterns."	The ERO will work with respective subject matter experts, including climate experts, the six regions, etc., to ensure regional differences in climate and weather patterns are reflected within the developed benchmark events.
P39. "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."	The directive is addressed in proposed TPL-008-1 through Requirement R3, R4, and R8. Requirement R3 obligates the Planning Coordinator to develop and implement a process to coordinate the development of the benchmark planning cases. Requirement R4 obligates the responsible entity to develop and maintain System models for performing the Extreme Temperature Assessment which represents projected System conditions based on the selected benchmark events Requirement R8 obligates the responsible entity to assess and complete an Extreme Temperature Assessment for one of the years in the Long-Term Transmission Planning Horizon, for the benchmark planning cases as well as sensitivity analysis which includes changes to one of these conditions: generation, real or reactive forecasted Load, or transfers.
P40. "We also direct NERC to ensure the reliability standard contains appropriate mechanisms for ensuring the benchmark event reflects up-to-date meteorological data."	The drafting team discussed a similar process to how BAL-003 gathers data. It was determined that the ERO is in the best situation to provide a review with the respective subject matter experts, including climate experts, the

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	six regions, etc., and update the benchmark events to reflect up-to-date meteorological data every 5 years via a NERC process document.
P50. [W]e…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…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."	The SDT reviewed all the extreme weather events mentioned within the FERC Order 896. The selected benchmark event will determine the impacted wide area. The directive is addressed in proposed TPL-008-1 through requirement R2 and R3 Part 3.1.
P58. "[W]e…direct NERC to develop benchmark events for extreme heat and cold weather events through the Reliability Standards development process."	The ERO will work with respective subject matter experts, including climate experts, the six regions, etc., to develop benchmark events. These events will be uploaded to an ERO library where responsible entities will then select their respective benchmark events from the ERO library to develop the benchmark planning cases. The directive is addressed in proposed TPL-008-1 through requirement R2. Requirement R2 obligates the responsible entity to select one extreme heat benchmark event and extreme cold benchmark event for performing the Extreme Temperature Assessment, from the approved benchmark library, maintained by the ERO.
P60. "[W]e…direct NERC to designate the type(s) of entities responsible for developing benchmark planning cases and conducting wide-area studies under the new or modified Reliability Standard…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."	The drafting team discussed that the Transmission Planner (TP) and/or Planning Coordinator (PC) would be the responsible entities to address TPL-008-1 Requirements. Requirement R1 obligates both the TP and PC to identify individual and joint responsibilities.

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P 61: "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." **P 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.	The drafting team reviewed all the extreme weather events mentioned within the FERC Order 896. The selected benchmark event will determine the impacted wide area. Requirement R3 Part 3.1 obligates each the responsible entity to define the planning study area boundary based on the selected benchmark events.
P72. "[W]e 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."	The directive is addressed in proposed TPL-008-1 through requirement R3 and R11. R3 obligates the Planning Coordinator to develop and implement a process for coordinating the development of benchmark planning cases among impacted Planning Coordinator(s), Transmission Planner(s), and other designated study entities. R11 obligates Planning Coordinator(s), Transmission Planner(s), and other designated study entities to provide its Extreme Temperature Assessment results within 60 calendar days of a request to any functional entity that has a reliability related need and submits a written request for the information.
P73. "Because in this final rule we direct NERC to determine the responsible entities that will be developing benchmark planning cases and	The drafting team discussed and determined that data needed to address the Extreme Temperature Assessment would still be appropriate through

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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."	MOD-032 and additional functional entities are not needed throughout this standards development process to address FERC Order 896. The directive is addressed in proposed TPL-008-1 through Requirement R1, R3 Part 3.1, R4 and R8. Requirement R1 obligates the Planning Coordinator, in conjunction with its Transmission Planner, to determine and identify each entity's individual and joint responsibilities for performing the studies needed to complete the Extreme Temperature Assessment.
P76: "[W]e…direct NERC to address the requirement for wide-area coordination through the standards development process, giving due consideration to relevant factors identified by commenters in this proceeding."	The drafting team reviewed all the extreme weather events mentioned within the FERC Order 896. The selected benchmark event will determine the impacted wide area. Requirement R3 Part 3.1 obligates each the responsible entity to define the planning study area boundary based on the selected benchmark events.
P77. "[W]e 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."	This directive is addressed in proposed TPL-008-1 Requirement R11. Requirement R11 obligates each responsible entity to provide the wide area study results within 60 calendar days of a request to any functional entity that has a reliability related need and has submitted a written request for the information.
P88. 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.	This directive is addressed in proposed TPL-008-1 through Requirement R3 Part 3.2. The responsible entity is obligated to modify the benchmark planning cases to include seasonal and temperature dependent adjustment for Load, generation, Transmission, and transfers which represent the selected benchmark events.

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P111. "[W]e 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. 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." (internal citations omitted).	This directive is addressed in proposed TPL-008-1 through Requirement R8 and Table 1. Requirement R8 requires the documentation of results of both steady state and stability analyses. Table 1 obligates each responsible entity to perform both steady state and stability analyses and compare the study results against performance criteria.
P112. "[W]e 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." **P113:** "[T]he contingencies required in the new or revised Reliability Standards should reflect the complexities of transmission system planning studies for extreme heat and cold weather events."	TPL-008-1 meets this directive by requiring each responsible entity to identify Contingencies for performing the Extreme Temperature Assessment. (See R7 and Table 1.) The Contingency categories in Table 1 of TPL-008 correspond to the well-established Contingency events defined in TPL-001.

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P116. "[W]e 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." **P 117:** "[I]n 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."	TPL-008-1 meets this directive by requiring each responsible entity to develop and maintain System models within its planning area consistent with that of MOD-032 standard. (See R4.) Specifically, Attachment 1 of MOD-032 requires information requested by the Planning Coordinator or Transmission Planner necessary for modeling purposes.
P124. "[W]e 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 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." **P125**. "We…believe that responsible entities should be free to study additional sensitivities relevant to their planning areas…cooperation will be	TPL-008-1 meets this directive by requiring each responsible entity to perform steady state and stability analyses on benchmark planning cases (R8.1) and sensitivity cases (R8.2). Furthermore, R8.2 provides a baseline set of variable conditions that include changes to generation, load, or transfers that are expected to change with extreme heat or extreme cold temperatures. .

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necessary between responsible entities conducting extreme heat and extreme cold weather studies and other registered entities within their extreme weather study footprints to ensure the selection of appropriate sensitivities."	
P134. "[W]e 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."	The Standard Drafting Team discussed probabilistic elements and determined while probabilistic analysis would be a good step forward, it would be better suited for the future as the methodology, process, and tools mature. A specific example could be that future updates or revision to TPL-008 may provide an avenue for incorporating probabilistic elements into the planning process, allowing for a more robust and accurate assessment of system reliability and resilience. Probabilistic assessment of generation and transmission facilities for the benchmark planning cases was discussed during the process of drafting the TPL-008-1 standard. However, based on the actual extreme heat and extreme cold events that have occurred, outages for generation and transmission facilities were unique for each of these events. Thus, it was challenging to draw correlation for the outages that occurred for different extreme heat and cold events for different regions and different timeframe. In addition, the data that were available from these events were limited to perform an adequate probabilistic assessment. Due to these reasons, the Standard Drafting Team has decided not to pursue any probabilistic assessment for the current TPL-008-1 standard. This, however, does not preclude future development of probabilistic assessment when having additional data, as well as mature methodology, process and tools that can provide meaningful probabilistic assessment for generation and transmission outages under extreme temperature conditions.
P138. "[W]e direct NERC to identify during the standard development process any probabilistic planning methods that would improve upon	Please see the response above for P134.

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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."	
P152. "[W]e direct 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." **P155**: "[T]he Commission is not directing any specific result or content of the corrective action plan."	The directive is addressed in the proposed TPL-008-1 Requirement R9. When the benchmark planning case study results indicate the System is unable to meet performance requirements for P0 and P1 Contingencies, Corrective Action Plans must be developed. Additionally, the responsible entities shall share their Corrective Action Plans with, and solicit feedback from, applicable regulatory authorities or governing bodies responsible for retail electric service issues.
P157. "[W]e 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." **P158**: "[W]e give NERC in this final rule the flexibility to specify the circumstances that require the development of a corrective action plan."	The directive is addressed in the proposed TPL-008-1 Requirement R9. When the benchmark planning case study results indicate the system is unable to meet performance requirements for P0 and P1 Contingencies, Corrective Action Plans must be developed.
P165. "[w]e 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."	The directive is addressed in the proposed TPL-008-1 Requirement R9.

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	R9 obligates the responsible entities shall share their Corrective Action Plans with, and solicit feedback from, applicable regulatory authorities or governing bodies responsible for retail electric service issues.
P167. "Further, because an important goal of transmission planning is to avoid load shed, 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."	This directive is addressed in proposed TPL-008-1 Requirement R9. Where Load shed is allowed as an element of a Corrective Action Plan for the Table 1 P1 Contingency, the responsible entity shall document the alternative(s) considered, as mentioned in Requirement R10, and notify the applicable regulatory authorities or governing bodies responsible for retail electric service issues.
P188. "[W]e 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."	The directive is addressed with the publication of TPL-008-1 and will be filed with the regulatory government no later than December 15, 2024, within 18 months of the date of publication of Order 896.
P193. "[W]e 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."	The implementation plan addresses Requirement R1 becoming effective 12 months from the effective date of the Commission order approving the TPL-008-1. In addition, phased-in approaches have been provided for other Requirements needing additional time. See the TPL-008-1 Implementation Plan.