NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Quick Reference Guide: Energy Scenarios

Transmission Planning Energy Scenarios
November 2023

INSIDE THIS QUICK REFERENCE GUIDE

Introduction

The *2023 ERO Reliability Risk Priorities Report*[1] highlighted the need to consider three transmission planning energy related scenarios to mitigate risks to the Bulk Power System (BPS). The NERC Board of Trustees ("Board") made mitigating these issues a part of NERC's 2023 work plan priorities to create or revise an existing Reliability Standard focused on transmission planning energy-related scenarios. Additionally, the increasingly complex cyberattacks that highlight the need to increase the resilience of our essential infrastructure against possible catastrophic effects on the BPS. The three areas listed below address the Board's concern and cyber concerns[2] that consider the following at minimum:

- Normal and extreme natural events[3]
- Gas-Electric interdependencies
- Distributed Energy Resource (DER) events

[1] ERO Reliability Risk Priorities Report: RISC Recommendations to the NERC Board of Trustees, August 2023
[2] Cyber-Informed Transmission Planning Roadmap for Integrating Cyber Security into Transmission Planning Activities, May 2023,
[3] Extreme heat and cold weather events are being addressed by another initiative in response to FERC Docket RM22-10-000, Order No. 896, document number 2023-13286 at https://www.federalregister.gov/documents/2023/06/23/2023-13286/transmission-system-planning-performance-requirements-for-extreme-weather.

Cyber-informed transmission planning was considered as a part of addressing the above three areas and during the development of the technical justification. Since ERO Enterprise (i.e., NERC and the six Regional Entities) is currently piloting the use of the Cyber-informed transmission planning framework (CITPF) with stakeholder involvement, the cyber portion of this energy scenario effort is being deferred pending the pilot results. The (CITP) Roadmap for Integrating Cyber Security into Transmission Planning Activities [4] introduces the CITPF for including cyber security threats, particularly from coordinated attacks, into transmission planning studies that are most commonly conducted by Transmission Planners (TPs) and Planning Coordinators (PCs). The CITPF is intended to drive investments in cyber security where warranted and can be used by various entities—NERC, Regional Entities, industry stakeholders, regulators, and policymakers—to perform reliability studies; these studies will uncover unacceptable risks to the BPS that should be addressed with appropriate mitigations.

Transmission Planning Energy Scenarios

Transmission planning energy scenarios, sometimes broadly referred to as "Scenario-based" transmission planning, are needed to ensure adequate performance of the BPS for a given electrical and/or geographic area and analyzing potential future energy supply requirements on the transmission system. Transmission planning energy scenarios compliment the work done in the energy assessment space and are not duplicative of the effort. Energy assessments are focused on the fuel[5] mixture and supply of the generation fleet to ensure enough generation resources are not compromised to serve the energy needs of the BES. Transmission energy scenarios use the risks, projections, and assumptions found in the energy assessment to build multiple planning cases that identify the "risk hours" where the energy assessment indicates stressed conditions in the generation fleet. While energy assessments do take into account the state of the transmission system in the evaluation, they are not the focus and generally do not study "acceptable" performance under a degraded transmission state. Thus, transmission planning energy scenarios can be used to inform the buildout of the transmission infrastructure, changes operational procedures, and conditions not revealed in traditional transmission planning (TPL) studies (e.g., TPL-001-5.1) and in the energy assessments mentioned above. The purpose of these scenarios is to ensure the performance of the BPS,[6] and to understand how the energy needs of the region can be met reliably under normal and stressed conditions.[7] Transmission planning energy scenarios are an important part of the overall planning process, inform the feasibility of policy decisions, and to potentially drive investment in transmission infrastructure.

[4] Cyber-Informed Transmission Planning Roadmap for Integrating Cyber Security into Transmission Planning, May 2023 is being applied to this initiative under Energy Scenarios: https://www.nerc.com/comm/RSTC_Reliability_Guidelines/ERO_Enterprise_Whitepaper_Cyber_Planning_2023.pdf
[5] In some instances, the "fuel" for a resource are things like irradiance, wind speed, etc. These are not combustible but are the primary energy source of the generation resource.
[6] Including lines, substations, and Protection Systems.
[7] For example, establishing the performance under normal conditions versus under credible Contingencies that are all centered on the "risk profile" from an energy assessment.

Defined energy scenarios are a useful tool to standardize the common risk profiles in the NERC footprint. These can be applied to regional specific benchmark transmission planning events and cases will reveal areas of the BPS that need to be mitigated to meet performance criteria. The following energy scenarios are examples for the areas of extreme natural events, natural gas interdependencies, and distributed energy resource impacts.

- **De-carbonization and policy**: This scenario assumes a significant increase in energy demand due to increasing electrification. Transmission planners use this scenario to identify issues where the gross load growth can constrain the transmission system.
- **High renewables penetration scenario**: This scenario assumes a significant shift towards low-carbon energy sources such as wind, solar, and hydro. Transmission planners use this scenario to identify stability issues with the changing resource mix.
- **High demand scenario**: This scenario assumes a significant increase in energy demand due to increasing electrifications. Transmission planners use this scenario to identify issues where the gross load is masked by renewable resources.
- **Technology-driven scenario**: This scenario assumes significant advancements in energy storage, demand response, or other energy management technologies that have not reached full integration.
- **Control and Communication Scenario**: This scenario assumes potential interruption in the ability to control portions of the BPS that could be due to an equipment or communication backbone issue.
- **Loss of Output Scenario**: This scenario assumes that the output of certain resources can become disrupted due to widespread fuel constraints.

Considering a range of energy scenarios ensures that the BPS infrastructure is resilient, reliable, and flexible enough to meet the energy demands of the future.

Related TPL Activities

Table 1 below clarifies how the energy scenario justification and associated SAR effort differs from other NERC Standards and subcommittee activities involving the suite of TPL Reliability Standards.

Table 1: Related Transmission Planning Activities														
Description		Fuel	Data	Energy Scenarios					Planning Models/Tools		Time Horizons (years)			CAP[8]
Effort	Focus			Heat and Cold	Natural Events	Gas-Elec	DER	Cyber	Network Model	Probabilistic	Ops (<1yr)	Near (1-5)	Long (6-10)	
TPL-001-5.1 (Extreme Only)	Performance during contingencies				X	X		X	X			X	X	NR[9]
Energy Scenarios	Energy				X	X	X	X	X				X	X
Project 2020-02[10]	Consideration of DER in TPL-001-5.1		X						X			X	X	NR
Project 2022-03[11]	Energy Reliability Assessments for Constrained Resources	X								X	X	X	X	NR
Project 2023-07[12]	Energy			X					X				X	X
ERAWG[13]	Energy Assessments													
Subcommittees: SPIDERWG[14] IRPS[15]	Data, parameters, and treatment of DER		X						X		X[16]	X	X	X
ERO Enterprise	Cyber security						CITP[17]		X				X	X

[8] Corrective Action Plan (CAP) is not required for extreme events in TPL-001-5.1 and is defined by the Glossary of Terms Used in NERC Reliability Standards, March 8, 2023: https://www.nerc.com/pa/Stand/Glossary%20of%20Terms/Glossary_of_Terms.pdf.

[9] NR – A CAP is not required for extreme events in TPL-001-5.1.

[10] Modifications to TPL-001 and MOD-032. See: https://www.nerc.com/pa/Stand/Pages/Project2022-02ModificationstoTPL-001-5-1andMOD-032-1.aspx

[11] Energy Reliability Assessment Task Force (ERATF), Project 2022-03–Energy Assurance with Energy-Constrained Resources. See: https://www.nerc.com/pa/Stand/Pages/Project2022-03EnergyAssurancewithEnergy-ConstrainedResources.aspx.

[12] Transmission System Planning Performance Requirements for Extreme Weather (i.e., Order No. 896). See: https://www.nerc.com/pa/Stand/Pages/Project-2023-07-Mod-to-TPL00151.aspx

[13] Energy Reliability Assessment Working Group: https://www.nerc.com/comm/RSTC/Pages/ERAWG.aspx

[14] System Planning Impacts from Distributed Energy Resources Working Group (SPIDERWG). See https://www.nerc.com/comm/RSTC/Pages/SPIDERWG.aspx.

[15] Inverter-Based Resource Performance Subcommittee (IRPS). See https://www.nerc.com/comm/RSTC/Pages/IRPS.aspx.

[16] While not the focus of the working group, operational time horizon work is being added to their white papers, guidelines, and ongoing work item products.

[17] Cyber-Informed Transmission Planning Roadmap for Integrating Cyber Security into Transmission Planning, May 2023. See: https://www.nerc.com/comm/RSTC_Reliability_Guidelines/ERO_Enterprise_Whitepaper_Cyber_Planning_2023.pdf

Table 1: Related Transmission Planning Activities														
Resource Adequacy	Forecasting and procurement to meet demand/load									X			X	
Interregional Transfer Capability Study	Forecasting capacity and procurement to meet demand/load								X			X	X	

Frequently Asked Questions

Question: Why is NERC embarking on so many topical areas concerning transmission planning?

Answer: The three risk areas above, identified in 2022 and previously, were made a part of NERC's work priorities for 2023 due to continuing risks to the BPS. This effort is a part of NERC's ongoing transmission reliability and resilience strategy.

Question: Why are natural events included in this initiative when FERC Order No. 896 is addressing extreme heat and cold weather?

Answer: Extreme heat and cold weather scenarios were in the process of being included as part of NERC's work priorities; however, due to the release of the FERC Order No. 896[18] in June 2023, NERC staff removed the objectives directed in the Order due to the compressed timeline and heightened concern to study temperature related reliability impacts.

Question: Why is this initiative duplicating much of the work already underway at NERC regarding transmission risks?

Answer: This initiative is actually addressing a different set of risks, which seem similar on the surface. The above **Table 1** provides a breakdown of how the various NERC activities and other processes are different from this initiative.

Question: With all of the active NERC work, given the regulatory Order, why not put this initiative on hold?

Answer: At this moment, the priority of these risk areas will be prioritized by NERC Standards Development once the proposed Standards Authorization Request (SAR) is accepted by the NERC Standards Committee. NERC staff will consider stakeholder comment provided during comment period to determine the most appropriate timeline balancing regulatory deadlines and the urgency to mitigate the study of energy scenario related reliability risks.

[18] FERC Docket RM22-10-000, Order No. 896, document number 2023-13286 | Transmission System Planning Performance Requirements for Extreme Weather

Question: Why are these extreme conditions (i.e., energy scenarios) not just added to the P7 requirements or TPL-001-5.1, for example?

> **Answer**: The TPL-001-5.1 study of the specific extreme conditions for a planning area is for awareness only and the energy scenarios require the planner to develop a corrective action plan in response to benchmark event simulation that result in cascading outages, uncontrolled separation, or instability.

Schedule

Date	Schedule Activity
Q2 2023	Draft technical justification document and SAR (complete)
6/9-6/30	Circulate draft technical justification document and SAR drafts to Regional Entities (Complete)
7/12-8/4	Circulate draft technical justification document and SAR drafts to the APPA, EGWG, EEI, ISO/RTO, RSTC, FERC, NATF, NAGF, Trades, and E-ISAC stakeholder groups (Complete)
8/11	Deliver draft technical justification document to NERC publications staff for editorial review (Complete)
8/22-10/6	Post draft technical justification document and SAR drafts to APPA, EGWG, EEI, ISO/RTO, RSTC, FERC, NATF, NAGF, Trades, and E-ISAC for comment (Complete)
9/19	Informational update the RSTC on the SAR status (Complete)
10/30	Submit the technical justification document and SAR to NERC Standards staff for inclusion on the November Standards Committee November meeting agenda (Complete)
11/15	Present technical justification and SAR to the Standards Committee for authorization to post the SAR for public comment (deferred to the December meeting)
12/13	Present technical justification and SAR to the Standards Committee for authorization to post the SAR for public comment
12/6-7	Informational update the RSTC on the SAR status

Resources and Other Information

Cyber-Informed Transmission Planning – Roadmap for Integrating Cyber Security into Transmission Planning Activities, May 2023[19]

[19] See document at: https://www.nerc.com/comm/RSTC_Reliability_Guidelines/ERO_Enterprise_Whitepaper_Cyber_Planning_2023.pdf.

Project 2022-02 Modifications to TPL-001-5.1 and MOD-032-1[20]

2023-07 Modifications to TPL-001-5.1 Transmission System Planning Performance Requirements for Extreme Weather[21]

Response to FERC Order No. 896 (Extreme Heat and Cold Weather Energy Scenarios)[22]

TPL-001-5.1 Transmission System Planning Performance Requirements (Effective July 1, 2023 with a phased implementation)[23]

Getting Plugged Into ERO Activities

Electricity is a key component of the fabric of modern society and the Electric Reliability Organization (ERO) Enterprise serves to strengthen that fabric. The vision for the ERO Enterprise, which is comprised of NERC and the six Regional Entities, is a highly reliable, resilient, and secure North American BPS. Our mission is to ensure the effective and efficient reduction of risks to the reliability and security of the grid.

Reliability | Resilience | Security

Because nearly 400 million citizens in North America are counting on us

NERC encourages everyone who has a stake in ensuring reliability to become engaged with all of NERC's activities. To receive notifications of Standards Development projects, subcommittee activities, or just general NERC information, please submit a request to the NERC help desk to be added to the desired distribution list(s). Steps to submitting a request:

1. Navigate to the NERC helpdesk.
2. Enter the letters, numbers, or symbols displayed in the captcha box and click "validate" to advance to the submittal form page.
3. Under the "Service" drop list, select "NERC Email Distribution List."
4. Complete your personal information.

[20] See project page at: https://www.nerc.com/pa/Stand/Pages/Project2022-02ModificationstoTPL-001-5-1andMOD-032-1.aspx.
[21] https://www.nerc.com/pa/Stand/Pages/Project-2023-07-Mod-to-TPL00151.aspx
[22] Order No. 896, *Transmission System Planning Performance Requirements for Extreme Weather*, 183 FERC ¶ 61,191 (2023), available at https://elibrary.ferc.gov/eLibrary/filelist?accession_number=20230615-3100&optimized=false.
[23] See NERC Reliability Standard TPL-001-5.1 at: https://www.nerc.com/pa/Stand/Reliability%20Standards/TPL-001-5.1.pdf.

5. In the description enter the lists you would like to join (e.g., list the Standards Development project number, subcommittee name acronym 'ERATF' or spelled out, or other descriptive information such as 'NERC Alerts' or 'Lessons Learned'). If the helpdesk staff are unclear about your request, look for a clarification request from NERC staff.

Activities

October 2023 Final Documents to the Standards Committee

Click here for: Technical Justification Document (Clean) – "Transmission Planning Energy Scenarios"
Click here for: SAR (Clean) – "Transmission Planning Energy Scenarios"

August 2023 Request for Comments (August 22 through October 6)

Click here for: Technical Justification Document (Clean) – "Transmission Planning Energy Scenarios"
Click here for: Technical Justification Document (Redline to 2nd posting) – "Transmission Planning Energy Scenarios"
Click here for: Responses to Comments (2nd posting)
Click here for: SAR (Clean) – "Transmission Planning Energy Scenarios"
Click here for: SAR (Redline to 2nd posting)– "Transmission Planning Energy Scenarios"
Click here for: SAR – Responses to Comments (2nd posting)

July 2023 Comments Received and Redlines (July 12 through August 4)

Click here for: Technical Justification Document (Redline to initial posting) – "Transmission Planning Energy Scenarios"
Click here for: Responses to Comments (1st posting)
Click here for: SAR (Redline to initial posting) – "Transmission Planning Energy Scenarios"
Click here for: SAR – Responses to Comments (1st posting)