Report Requirements (as described in the NOPR RM22-16-000):

We propose to require transmission providers to submit one-time informational reports describing their current or planned policies and processes for conducting extreme weather vulnerability assessments and mitigating identified extreme weather risks within 90 days of the publication of any final rule in this proceeding in the *Federal Register*. We propose to seek public comment on the reports 30 days after they are filed.

For the purposes of this proposed rulemaking, we propose to define an extreme weather vulnerability assessment as any analysis that identifies where and under what conditions jurisdictional transmission assets and operations are at risk from the impacts of extreme weather events, how those risks will manifest themselves, and what the consequences will be for transmission system operations. Such assessments can take different forms: they may be qualitative or quantitative; they may be performed on a periodic or ad hoc basis; and they may cover a narrower or broader range of extreme weather threats. The extreme weather threats analyzed by these reports may include those extreme weather events exacerbated by climate change (e.g., extended heat waves or storm surge due to sea level rise).

Transmission providers may then use such extreme weather vulnerability assessments to develop mitigation in the form of extreme weather resilience plans, which outline measures to reduce the risk to vulnerable assets and operations. Extreme weather resilience efforts can take many forms, but generally involve both measures to prevent or minimize damage to vulnerable assets (e.g., investments in asset hardening or relocation) and to manage the consequences of such damage when it occurs (e.g., investments in system recoverability).[1]

To be clear, we do not intend in this NOPR to require transmission providers to conduct extreme weather vulnerability assessments where they do not do so already, or to require transmission providers to change how they conduct or plan to do such assessments.[2] Instead, the goal of this proceeding is to gather information, not to establish new requirements. In addition, we do not propose that transmission providers submit the results of their extreme weather vulnerability assessments or include lists of affected assets and operations, specific vulnerabilities, or asset- or operation-specific mitigations in the informational reports proposed by this NOPR. Rather, we propose that the one-time informational reports focus on describing the current or planned policies and processes that respondents have in place, or plan to implement, to assess and mitigate

[1] R.M. Webb, M. Panfil, and S. Ladin, *Climate Risk in the Electric Sector: Legal Obligations to Advance Climate Resilience Planning by Electric Utilities* 10 (Dec. 2020), https://perma.cc/V25A-KBNP.

[2] Similarly, while we propose that transmission providers may describe what they "plan" to do with respect to various issues, this is meant only to capture plans that have been made, but not yet been implemented; transmission providers are not required to speculate on how they would conduct extreme weather vulnerability analysis where they have no plans to do so.

extreme weather risks. We believe that this focus of the proposed one-time informational reports should avoid the need for respondents to file Critical Energy/Electric Infrastructure Information. However, to the extent transmission providers believe that information they will submit warrants protections, they may make a request for such treatment pursuant to §§ 388.112 and 388.113 of the Commission's regulations.[3]

Although commenters in Docket No. AD21-13-000 have referenced previously published guidance on conducting vulnerability assessments,[4] insufficient data exists to establish best practices. Therefore, we seek comments on our approach in directing such one-time informational reports, the proposed topics and questions discussed below, and the burden associated with submitting these reports. As further described below, we propose the one-time reports to address: (1) Scope; (2) Inputs; (3) Vulnerabilities and Exposure to Extreme Weather Hazards; (4) Costs of Impacts; and (5) Risk Mitigation.

While not all extreme weather vulnerability assessments must follow the same processes or include the same analyses, we understand the aforementioned topics to reflect typical practices and considerations in the development of extreme weather vulnerability assessments. Therefore, should respondents' processes and policies for developing their own extreme weather vulnerability assessments differ from those we describe below, we propose to require that transmission providers still describe in their one-time reports the processes and policies which most closely align with the intent or aim of the topics discussed below.

Scope

Background

Determining the scope of an extreme weather vulnerability assessment depends on the breadth of assets, operations, and extreme weather hazards that a transmission provider faces in its specific area. A narrower scope (i.e., examining a subset of assets and operations, extreme weather hazards, or geographic regions in greater depth) can produce

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[3] 18 CFR 388.112-113. Section 388.112 of the Commission's regulations specifies that any person submitting a document to the Commission may request privileged treatment for some or all of the information contained in a particular document that it claims is exempt from the mandatory public disclosure requirements of the Freedom of Information Act, and that should be withheld from public disclosure. *See* 5 U.S.C. 552. Section 388.113 of the Commission's regulations governs the procedures for submitting, designating, handling, sharing, and disseminating Critical Energy/Electric Infrastructure Information submitted to or generated by the Commission.

[4] Department of Energy, Office of Energy Policy and Systems Analysis, *Climate Change and the Electricity Sector: Guide for Climate Resilience Planning* (Sept. 2016), https://toolkit.climate.gov/sites/default/files/Climate%20Change%20and%20the%20Electricity%20Sector%20Guide%20for%20Climate%20Change%20Resilience%20Planning%20September%202016_0.pdf (DOE Guide); CPUC, *Climate Adaptation in the Electric Sector: Vulnerability Assessments & Resiliency Plans* (Jan 2016), https://perma.cc/R6NW-F6GV (CPUC Guide); J. Gundlach and R. Webb, *Climate Change Impacts on the Bulk Power System: Assessing Vulnerabilities and Planning for Resilience* (Feb 2018), http://columbiaclimatelaw.com/files/2018/02/Gundlach-Webb-2018-02-CC-Bulk-Power-System.pdf.

important insights related to specific facilities, systems, or regions, whereas a broader scope is more likely to identify system- and company-wide risks. For example, although Hurricane Sandy in 2012 initially motivated Consolidated Edison, Inc. (ConEd) to conduct its 2019 climate change vulnerability assessment, ConEd sought in its study to understand the broader impact of a changing climate on its service area and identified additional climate vulnerabilities including sea level rise, inland flooding due to increased precipitation, and extreme heat events.[5]

As part of scoping the extreme weather vulnerability assessment, transmission providers have the flexibility to choose the assets and operations to examine for their assessment. For example, some transmission providers focus their analyses on assets and operations related to critical electric infrastructure and/or assets and operations that meet or exceed some MW or other threshold.[6] Furthermore, transmission providers may use discretion to determine what extreme weather hazards and geographic scope to consider in their vulnerability assessment. Transmission providers could also consider external vulnerabilities in their assessment, such as those related to consumers, interconnected utilities, and supply chains. For example, with respect to external vulnerabilities, PG&E examined not only its own assets, but upstream interdependencies, including regional bulk electric and natural gas systems, water availability, telecommunication utilities, and supply chains, as well as downstream interdependencies like community- and customer-level resiliency.[7] With respect to geographic scope, although Entergy's service territory and assets extend across multiple states, its assessment, conducted with partners, focused exclusively on the 77 counties bordering the Gulf of Mexico. This specific geographic scope allowed Entergy and its partners to study the hazards unique to the Gulf region, driven by sea level rise, land subsidence, and increasing hurricane intensity.[8] A wider geographic scope may consider wide-area and long duration extreme weather events, such as the August 2020 West-wide extreme heat event described above.

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[5] ConEd, *Climate Change Vulnerability Study* 4 (Dec. 2019), https://www.coned.com/-/media/files/coned/documents/our-energy-future/our-energy-projects/climate-change-resiliency-plan/climate-change-vulnerability-study.pdf.

[6] National Grid and Dominion Energy Virginia, for example, have focused specifically on substation flooding risk resulting from sea level rise and severe storms because of the relatively higher impact of substation loss compared to other assets like individual distribution lines. DOE Office of Energy Policy and Systems Analysis, *A Review of Climate Change Vulnerability Assessment: Current Practices and Lessons Learned from DOE's Partnership for Energy Sector Climate Resilience* 8 (May 2016), https://toolkit.climate.gov/sites/default/files/A%20Review%20of%20Climate%20Change%20Vulnerability%20Assessments%20Current%20Practices%20and%20Lessons%20Learned%20from%20DOEs%20Partnership%20for%20Energy%20Sector%20Climate%20Resilience.pdf (DOE Vulnerability Assessment Review).

[7] PG&E, *Climate Change Vulnerability Assessment and Resilience Strategies* 18 (Nov. 2016), https://www.pgecurrents.com/wp-content/uploads/2016/12/PGE_climate_resilience_report.pdf.

[8] Entergy, *Building a Resilient Gulf Coast: Executive Report* (2010), https://www.entergy.com/userfiles/content/our_community/environment/GulfCoastAdaptation/Building_a_Resilient_Gulf_Coast.pdf.

Finally, a transmission provider may engage a broad set of stakeholders early in the scoping process to identify particularly susceptible regions in their footprint and increase support for any resilience actions that result from the extreme weather vulnerability assessment.[9] The Oregon Department of Energy, for example, engaged stakeholders from vulnerable and underserved communities in its climate vulnerability assessment in order to incorporate equity concerns and examine the extent to which underserved and vulnerable groups are disproportionately impacted by these risks.[10]

Proposal

As a threshold matter, we propose that each transmission provider state whether it conducts extreme weather vulnerability analyses. Further, we propose to require each transmission provider to provide the following information on the policies and processes they employ, or plan to employ, for determining the scope of extreme weather vulnerability assessments:

Q1) A description of the types of extreme weather events for which the transmission provider conducts, or plans to conduct, extreme weather vulnerability assessments, if any. For transmission providers that conduct, or plan to conduct, such assessments, a description of how the transmission provider determined which extreme weather hazards to include in the assessment (e.g., extreme storms such as hurricanes and the associated flooding and high winds, wildfires, extreme prolonged heat or cold, or drought conditions);

Q2) A description of how the transmission provider selects, or plans to select, the set of assets and operations that will be examined;

Q3) A description of how the transmission provider determines, or plans to determine, the geographic or regional scope of the analysis;

Q4) A description of whether and to what extent the transmission provider considers, or plans to consider, external interdependencies, such as interconnected utilities, other critical infrastructure sectors (e.g., water, telecommunications) and supply chain-related vulnerabilities, in the assessment;

Q5) A description of whether and to what extent the transmission provider coordinates, or plans to coordinate, with neighboring utilities

[9] DOE Guide at 8-15.

[10] Oregon Department of Energy, *2020 Biennial Energy Report* 28 (Nov. 2020), https://www.oregon.gov/energy/Data-and-Reports/Documents/2020-Biennial-Energy-Report.pdf.

and/or entities in other sectors that could potentially be relevant to the assessment;

Q6) A description of whether and to what extent the transmission provider engages, or plans to engage, with stakeholders in the scoping phase of the assessment, including the processes used to identify and engage relevant stakeholder groups and incorporate stakeholder feedback into the extreme weather vulnerability assessment, especially with regard to disadvantaged or vulnerable communities.

Inputs

Background

As noted above, the processes for conducting extreme weather vulnerability assessments may vary; however, there are several types of key inputs that are likely to be part of such assessments. First, most assessments require meteorological data that support and describe how the extreme weather hazards selected for study during the scoping phase may specifically manifest in the study region (e.g., local storm surge projections for the next 50 years, historical drought data, projected temperature data). In some cases, such data may be readily available, or in cases where existing extreme weather projections are inadequate to support a transmission provider's vulnerability assessment, new projections may be generated by consulting a modeling group (typically academic institutions or consulting firms).

Second, transmission providers can elect to use scenario analyses to explore how the set of potentially vulnerable assets and operations may vary across a range of assumed extreme weather hazards and other modeling inputs. Transmission providers may opt to study a single scenario or multiple scenarios based on previous modeling efforts; for example, in its internal climate vulnerability assessment, San Diego Gas & Electric Company (SDG&E) compiled multiple projections for temperature, rainfall patterns, drought, and sea level rise in its service territory to explore potential impacts in 2050 and 2100.[11] Alternatively, transmission providers may take a probabilistic approach whereby probability distributions are developed and forecast for each parameter (e.g., precipitation, windspeed). This approach is more computationally advanced but can help produce granular, quantitative risk assessments that capture a wider range of potential variation and outcomes.

Third, the relevant attributes of the assets and operations that will be studied are additional key inputs into an extreme weather vulnerability assessment that may affect whether, and to what extent, these assets and operations exhibit vulnerabilities under the conditions being studied. For example, the potential vulnerability of a transmission tower

[11] DOE Vulnerability Assessment Review at 14.

to extreme wind may vary based on its height, age, and other known or foreseeable parameters. Example asset attributes could include, among others, age, design lifetime, location, elevation, and replacement costs, while example operations attributes could include type and number of staff, locations of critical staff and facilities, and maintenance schedules.

Fourth, transmission providers have the flexibility to decide the timeframe(s) to be considered by the vulnerability assessment (e.g., the next 10 years, or a sampling of specific one-year periods).[12] The selected timeframe(s) may affect or be affected by the transmission provider's choices with other study inputs (e.g., relevant datasets may not be available for a study of potential vulnerabilities 100 years into the future).

Lastly, if transmission providers analyze the potential financial implications of extreme weather impacts, they could use a discount rate that will convert the costs of potential impacts on identified vulnerable assets and operations at different points in time into equivalent values in a base year (i.e., present dollars).[13] Discount rates could also inform transmission provider efforts to compare the costs of extreme weather events to the benefits of mitigation actions over time.

Proposal

We propose to direct each transmission provider to provide the following information about the inputs it uses, or plans to use, for any extreme weather vulnerability assessments.

Q9) A description of methods and processes the transmission provider uses, or plans to use, to determine the meteorological data needed for its assessment. In particular, how the transmission provider determines whether it can rely on existing extreme weather projections, and if so, whether such projections are adequately robust;

Q10) A description of how the transmission provider determines whether to use scenario analysis, and if so, whether to do so with multiple scenarios;

Q11) The extent to which it reviews neighboring transmission providers' extreme weather vulnerability assessments, if available, to evaluate the consistency of extreme weather projections between transmission providers;

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[12] For example, in their internal climate vulnerability assessments, Entergy studied the following 45 years while Seattle City Light studied years 2030 and 2050. *Id.* at 6.

[13] William Pizer and Richard Newell, *Discounting the Benefits of Climate Change Mitigation: How Much Do Uncertain Rates Increase Valuations?* 2 (Dec. 2001), https://www.c2es.org/wp-content/uploads/2001/12/econ_discounting.pdf.

Q12) The timeframe(s) and discount rate(s) selected for the extreme weather vulnerability assessment;

Q13) A description of the methods and processes the transmission provider uses, or plans to use, to create an inventory of potentially vulnerable assets and operations.

Vulnerabilities and Exposure to Extreme Weather Hazards

Background

Extreme weather vulnerability assessments can include an analysis of the assets or operations exposed to the types of extreme weather hazards established in the assessment's scope (e.g., hurricanes and associated flooding, and high winds, wildfires, extreme prolonged heat or cold, drought conditions), the sensitivities of transmission assets and operations to extreme weather events, and the magnitude of any impacts to the transmission system caused by extreme weather events. In assessing the exposure to extreme weather events, transmission providers may estimate the likelihood and extent of damage or disruption to their transmission assets and operations if various extreme weather events occur.

In extreme weather vulnerability assessments, transmission providers generally use probability distributions or other quantitative estimates to examine how a particular asset or operation would be affected under a specific extreme weather event or combination of events.[14] The sensitivity of an asset or operation to a specific extreme weather event depends on both the type and severity of the event (e.g., the force of a wave during a hurricane or temperature during a heat wave) and the type, configuration, or attributes of the asset or operation itself (e.g., the physical resilience of a transmission tower to increased wind speeds or wave force).[15] In cases where it is difficult to estimate the likelihood or severity of damage or disruption given the occurrence of an extreme weather impact, transmission providers may provide a best estimate.

Rather than attempting to analyze the likelihood of damage, disruption or failure for all transmission assets and operations, transmission providers may instead use a screening analysis to identify critical thresholds at which extreme weather hazard(s) would likely render an asset or operation vulnerable based on the relevant attributes determined in the sensitivity analysis. If a screening analysis identifies potential vulnerabilities among assets and operations considered especially significant or critical, transmission providers conducting vulnerability assessments could supplement their analysis with a more detailed review of the specific assets and operations.

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[14] CPUC Guide at 15.

[15] DOE Guide at 39.

Once these vulnerabilities are identified, transmission providers may estimate the magnitude of the impacts that would cause damage or disruption to assets or operations triggered by various extreme weather hazards. For example, NERC acknowledges that various conditions could lead to loss of resources, including extreme cold temperatures and wind that can cause wellhead, processing plant, or compressor station freezing or ambient temperature conditions that are outside the operating temperatures for the asset.[16]

Proposal

We propose to direct each transmission provider to provide the following information about the methods or processes it uses, or plans to use, in its extreme weather vulnerability assessment to assess the vulnerability of its transmission assets and operations to extreme weather events.

Q14) A description of how the transmission provider identifies the transmission assets or operations vulnerable to the extreme weather events for which it conducts assessments;

Q15) A description of how the transmission provider uses, or plans to use, screening analyses to test for potential vulnerabilities, as well as how the transmission provider examines, or plans to examine, the sensitivities of the transmission assets and operations being studied to types and magnitudes of extreme weather events.

Costs of Impacts

Background

The aggregate economic effects of climate change and extreme weather on energy infrastructure could be trillions of dollars over the next few decades, including the costs of power outages to utility customers and costs to rebuild from storm damage, among others.[17] These costs are a function of the estimated exposure of the impacted assets, their geographical locations, the severity of associated extreme weather impacts, other potential location-specific factors, and the study's timeframe and assumed discount rate (used for converting costs to net present value). These costs may be further broken up into direct and indirect costs.

In this proceeding, we define direct costs as the economic losses borne by the transmission provider. Direct costs may include expenditures and administrative and labor costs associated with responding to and resolving extreme weather impacts, such as

[16] NERC Post-Conference Comments at 6.

[17] GAO Report at 19; Deloitte, *The Turning Point: A New Economic Climate in the United States* 15 (Jan. 2022), https://www2.deloitte.com/content/dam/Deloitte/us/Documents/about-deloitte/us-the-turning-point-a-new-economic-climate-in-the-united-states-january-2022.pdf.

the costs of repairing, replacing, or relocating an asset. Direct costs may also include the transmission provider's opportunity costs of lost sales during an outage.[18] Transmission providers may arrive at a rough estimate of direct costs by assuming that impacted vulnerable assets would be damaged beyond repair and calculating their associated replacement costs. Alternatively, a more detailed analysis could examine how costs vary as a function of impact severity for specific assets and operations.[19]

Depending on the scope of the extreme weather vulnerability assessment, transmission providers may also consider indirect costs, which we define in this proceeding as costs associated with loss of service to utility customers.[20] For example, relevant indirect costs may include equipment damage, spoilage, and health and safety effects.[21] Value of lost load calculations, which estimate the value that customers place on reliable electricity service, are a common method for quantitatively estimating indirect costs.[22]

Proposal

We propose to direct each transmission provider to provide the following information on how it estimates, or plans to estimate, the costs associated with extreme weather impacts in its extreme weather vulnerability assessments:

Q16) A description of the methodology or process, if any, the transmission provider uses, or plans to use, to estimate the potential costs of extreme weather impacts on identified vulnerable assets and operations;

Q17) If the transmission provider estimates such potential costs, a description of the types of: (a) direct costs, such as replacements or repair costs, restoration costs, associated labor costs, or opportunity costs of lost sales, and (b) indirect costs, such as costs associated with loss of service to electric customers and other utilities that purchase power from the transmission provider, including equipment damage, spoilage, and health and safety effects,[23] in calculating the costs of extreme weather impacts.

Risk Mitigation

[18] DOE Guide at 43.

[19] *Id.* at 44.

[20] Relatedly, transmission providers may also consider induced costs that do not directly affect their ratepayers, such as increased prices for consumer goods and effects on interdependent sectors like water and transportation. However, we assume that induced costs would likely be beyond the scope of most transmission providers' extreme weather vulnerability assessments because they do not directly affect ratepayers or the prudence of transmission provider investments. *Id.* at 45.

[21] *Id.* at 45-46.

[22] *See, e.g.*, *Wholesale Competition in Regions with Organized Electric Markets*, Order No. 719, 73 FR 64100 (Oct. 28, 2008), 125 FERC ¶ 61,071, at P 208 (2008) (describing the Commission's contemplated reforms "to ensure that the market price for energy accurately reflects the value of such energy during an operating reserve shortage").

[23] DOE Guide at 43-46.

Background

In general, the overall vulnerability of the transmission system is a function of the estimated exposure of vulnerable assets and operations to extreme weather threats and the estimated impact of those threats. For example, the failure of an asset that is highly exposed to a particular extreme weather risk may not materially increase the overall vulnerability of the system if there are other redundant assets that perform similar system functions. Conversely, the failure of a pivotal asset (i.e., not backed by redundant assets) with relatively low exposure to a particular extreme weather risk may nonetheless pose significant operational challenges if such failure were to occur.

Some transmission providers consider the potential degradation or failure of key assets and operations due to various extreme weather threats by using likelihood-consequence matrices to categorize vulnerable assets and operations based on: (1) the likelihood that the asset or operation is impacted by an extreme weather event or change in climatic parameter (e.g., severe storms and flooding, ambient heat increase, sea-level rise); and (2) the estimated associated consequences for overall system performance. This approach can reveal the need to replace certain assets, deficiencies in current asset and operational performance standards, or the potential for stranded assets.[24]

Under this approach, transmission providers may further define illustrative anchors for these categories to foster a consistent interpretation under this approach. For example, Public Service Electric & Gas Company (PSE&G) chose to map vulnerabilities onto a likelihood-consequence matrix composed of six likelihood categories—with its highest likelihood category as those events expected to occur more than once per year, and its lowest likelihood category as those which are expected to never occur—and six consequence categories ('inconsequential,' 'minimal,' 'minor,' 'moderate,' 'considerable,' and 'severe').[25] PSE&G then assigned numeric ratings to each likelihood and consequence category and scored each extreme weather vulnerability by multiplying the two ratings together. This approach enabled PSE&G to rank the severity of extreme weather and climate risks to its assets and further prioritize actions to mitigate these risks.[26]

After assessing the relative risks to assets and operations, the transmission provider can then determine appropriate mitigation. Example solutions for mitigating risks to vulnerable assets may include hardening or relocating, while example solutions for mitigating risks to vulnerable operations may include improved load management practices that reduce outages and expedite restoration.

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[24] CPUC Guide at 15-16.

[25] DOE Vulnerability Assessment Review at 16-17.

[26] *Id.*

Proposal

We propose to direct each transmission provider to provide the following information on the processes and policies it uses, or plans to use, to determine and implement appropriate measures for mitigating extreme weather risks identified in its extreme weather vulnerability assessment:

Q18) A description of how the transmission provider uses, or plans to use, the results of its assessment to develop measures to mitigate extreme weather risks, including:

i. How the transmission provider determines which risks should be mitigated and the appropriate time horizon for mitigation;

ii. How the transmission provider determines appropriate extreme weather risk mitigation measures, including any analyses used to determine the lowest-cost or most impactful portfolio of measures;

Q19) A description of how the transmission provider informs, or plans to inform, relevant stakeholders—such as neighboring transmission providers, RTOs/ISOs of which the transmission provider is a member, electric customers, affected and frontline communities, shareholders and investors, emergency management agencies, local and state administrations, and state utility regulators—of identified extreme weather risks and selected mitigation measures;

Q20) A description of the extent to which the transmission provider incorporates, or plans to incorporate, identified extreme weather risks and mitigation measures into local and regional transmission planning processes;

Q21) A description of how the transmission provider measures, or plans to measure, the progress and success of extreme weather risk mitigation measures (e.g., through reduced outages) and how it incorporates these observations into ongoing and future extreme risk mitigation actions.