UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Implementation of Line Ratings	)))	**Docket No. RM24-6-000**

INITIAL COMMENTS OF PUBLIC INTEREST ORGANIZATIONS

I. Introduction

Pursuant to Rule 212 of the Rules of Practice and Procedure of the Federal Energy Regulatory Commission (the Commission), 18 C.F.R. § 385.212 (2020), Sustainable FERC Project, Natural Resources Defense Council, National Wildlife Federation, RMI, Environmental Law & Policy Center, the National Audubon Society, Southern Environmental Law Center, Clean Wisconsin, Renewable Northwest, Conservation Law Foundation, Environmental Defense Fund, Acadia Center, and Iowa Environmental Council (together "Public Interest Organizations" or "PIOs") hereby submit these initial comments in response to the Federal Energy Regulatory Commission's ("FERC" or "the Commission") regarding the Implementation of Dynamic Line Ratings Advanced Notice of Proposed Rulemaking ("ANOPR").[1]

The ANOPR explores reforms to enhance the accuracy of transmission line ratings. If implemented, the proposed reforms would require transmission line ratings to account for solar heating based on the sun's position and forecasted cloud cover and forecasted wind conditions on specific transmission lines. Additionally, the proposed reforms aim to increase transparency in the development and implementation of Dynamic Line Ratings ("DLR") sensors and improve

[1] Implementation of Dynamic Line Ratings Advanced Notice of Proposed Rulemaking, 89 Fed. Reg. 10349 (June 27, 2024); 187 FERC ¶ 57,690 (2024) (hereinafter "ANOPR").

congestion data reporting in non-RTO/ISO regions to identify which transmission lines require wind forecasting.

II. Background

A. The U.S. Urgently Needs a Smart and Modernized Transmission Grid

Fifteen years ago, the American Reinvestment and Recovery Act ("ARRA") provided critical funding to accelerate the development and adoption of smart grid technology throughout the distribution grid.[2] This investment sparked a shift from manual and semi-manual operations to fully automated, real-time processes through the use of Advanced Metering Infrastructure ("AMI"). Today, AMI has been adopted by the majority of utilities, covering approximately 72% of all electric customers in the U.S.[3] AMI implementation has significantly enhanced grid reliability and resilience with automated detection of maintenance issues and immediate identification of outages and their scope, leading to faster repair. Prior to AMI, utilities relied heavily on customer reports of outages to map the extent of service disruptions, with little to no electronic visibility into the actual changes in power flow in the distribution grid.[4]

Importantly, over the past 15 years, technological advancements, along with increasing recognition of AMI benefits by utilities and regulatory commissions, have led to the widespread adoption of AMI and the modernization of the distribution grid.[5] Today, some utilities are going further with second-generation smart meters and back-office systems. Federal funding from the

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[2] *American Investment Recovery Act*, 123 Stat. 115, 165-166 (Feb. 17, 2009).
[3] *How many smart meters are installed in the United States, and who has them?* US Energy Information Administration (last updated Oct. 20, 2023), https://www.eia.gov/tools/faqs/faq.php?id=108&t=3.
[4] *Voices of Experience Leveraging AMI Networks and Data* Advanced Grid Research Office of Electricity US Dept' of Energy at 12 (Mar. 2019), https://www.energy.gov/sites/default/files/2024-02/01-03-2019_doe-voe-leveraging-ami-networks-and-data-report_508.pdf.
[5] *See generally* U.S. Department of Energy, *Advanced Metering Infrastructure and Customer Systems: Results from the Smart Grid Investment Grant Program* (Dec. 2016); Federal Energy Regulatory Commission, *Assessment of Demand Response & Advanced Metering* (2020); Edison Electric Institute, *Electric Company Smart Meter Deployments: Foundation for a Smart Grid* (2021).

Bipartisan Infrastructure Law and the Inflation Reduction Act have provided the necessary financial boost for utilities of all sizes to invest in innovative infrastructure. These investments, in turn, spurred technological advancements that reduced costs and enhanced the efficiency of AMI technology over time.

Today, the U.S. faces a similar challenge with its outdated transmission grid. Traditionally, line ratings are static and based on worst-case scenario planning. While this protects the grid, it underestimates the actual capacity of the lines during cooler or windier conditions when grid operators may add more load. The problems are clear, and so are the pathways to the solutions. The U.S. needs a smart transmission grid equipped with sensors on all transmission lines to modernize grid operations, maintenance, and repair. With comprehensive sensor coverage, grid operators can correlate weather forecasts with real-time impacts on capacity, allowing for continuous improvement in grid performance. DLR sensors would enable grid operators to reduce capacity losses across *all* transmission lines, not just lines incurring substantial financial losses. The cost-benefit ratio for deploying DLR sensors has already proven favorable in Europe.[6] In Pennsylvania, when PPL Electric Utilities deployed DLR sensors, the utility successfully reduced congestion by over $60 million year-over-year on a single transmission line. Without the DLR sensors, the alternative upgrade would have cost $50 million and required a prolonged outage, demonstrating the cost-effectiveness and operational benefits of DLR technology.[7]

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[6] *See ENTSO-E Technopedia (ENTSO-E),* https://www.entsoe.eu/Technopedia/; *See also Dynamic Line Rating Landscape Brief,* International Renewable Energy Agency at 15 (2020), https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2020/Jul/IRENA_Dynamic_line_rating_2020.pdf#:~:text=Dynamic%20line%20rating%20(DLR)%20reduces%20congestion%20on,and%20makes%20power%20generation%20dispatch%20more%20cost%2Deffective; ANOPR at 41.

[7] *Unlock Power Line by Line: Dynamic Line Ratings,* WATT Coalition (2022), https://watt-transmission.org/about-dynamic-line-ratings/.

Mandating DLR sensors to account for factors such as solar heating, wind speed, and wind direction is a crucial first step to transitioning to a smarter transmission grid. PIOs urge FERC to consider the broader implications of developing a smart Bulk Energy System, which would significantly enhance grid safety and reliability and ensure just and reasonable rates. This approach will likely play a pivotal role in fire mitigation, expedite recovery from hurricanes, and reduce the impact of anthropogenic development and increasingly severe weather.

B. FERC Order No. 881

In Order No. 881, the Commission required the use of ambient-adjusted ratings ("AARs") and seasonal adjusted ratings.[8] The Order also required regional transmission organizations and independent system operators ("RTOs/ISOs") to enable transmission owners to electronically update their transmission line ratings in real-time.[9] These changes aim to better reflect current operating conditions, allowing for more efficient use of the grid and reducing congestion while enhancing grid reliability and safety. Order No. 881 found that transmission line ratings directly affect wholesale rates because transmission line ratings and wholesale rates are inextricably linked.[10] The Commission emphasized that transmission line ratings directly influence wholesale rates because they define the maximum transfer capability of a transmission line, which determines the amount of energy that can be transmitted from suppliers to consumers. As transfer capability decreases, wholesale rates tend to rise. The Commission highlighted that inaccurate ratings could lead to the underutilization or overutilization of transmission facilities, giving misleading signals about available transfer capacity.[11] Further, it

[8] *Managing Transmission Line Ratings,* Order No. 881, 87 Fed. Reg. 2244 (Jan. 13, 2022), 177 FERC ¶ 61,179 (2021) (hereinafter "Order No. 881").
[9] *Id*.
[10] *Id.*
[11] *Id*.

found that inaccurate transmission line ratings may result in Commission jurisdictional rates that are unjust and unreasonable.[12]

III. The Commission Has Jurisdiction to Require the Use of More Accurate Line Ratings

The Federal Power Act (FPA), as amended by the Energy Policy Act of 2005, grants FERC the authority to regulate the reliability of the electric grid and to establish and enforce mandatory reliability standards, ensuring the safe and reliable operation of the nation's bulk power system.[13] Additionally, under Section 206 of the FPA, FERC has jurisdiction over the rates, terms, and conditions of wholesale electricity sales in interstate commerce, ensuring that they are just, reasonable, and not unduly discriminatory or preferential. Further, under its Section 206 authority, FERC is required to investigate and modify any rate, charge, classification, rule, regulation, practice, or contract that it finds to be unjust, unreasonable, unduly discriminatory, or preferential, ensuring that such provisions are made just and reasonable.[14]

The Commission has held that “[d]enials of access (whether they are blatant or subtle), and the potential for future denials of access, require the Commission to revisit and reform its regulation of transmission in interstate commerce.”[15] Lack of transparent, consistently applied line ratings create the potential for future denial of access, as inaccurate line ratings could be used to provide discriminatory service for preferred customers. These undue discrimination concerns become acute when a transmission owner or a transmission owner’s affiliate also owns generation, creating a risk that artificially low ratings may be used to protect incumbent generation. Action to require more accurate transmission line ratings is consistent with the

[12] *Id*.
[13] Federal Power Act, 16 U.S.C. § 824(b)(1) (2012).
[14] *Id*. § 824e(a).
[15] Order 888, 75 FERC ¶ 61,080 (April 1996) at 50.

Commission's mandate under sections 205 and 206 of the Federal Power Act to ensure that rates for interstate transmission are not unduly discriminatory or preferential.

Further, accurate line ratings are needed for precise reliability assessments, particularly during episodes of extreme weather, such as the August 2020 heatwave in California[16] and the February 2021 Texas polar vortex which each resulted in load interruptions to millions of people. During the 2021 Texas polar vortex, extremely low temperatures and wind chill caused high electricity demand and fuel prices and caused many generators to unexpectedly go offline due to equipment failures and fuel-supply constraints.[17] Accurate line ratings allow grid operators to take advantage of cooling from cold temperatures and high winds that increase thermal limits of transmission lines.[18] Finally, accurate line ratings are necessary to ensure just and reasonable spending on resource adequacy, namely, to ensure that planning regions do not overspend on unnecessary capacity resources because of artificially low line ratings. For these reasons, the Commission has jurisdiction to propose rules to improve the accuracy and transparency of line ratings used by transmission providers.

IV. The Value of DLRs

The benefits of DLRs to ratepayers and the grid are well-established. As the ANOPR explains, "DLRs have been deployed nationally and internationally, with resulting benefits to the transmission system and customers, including increased transmission capacity, reduced congestion, and reduced costs."[19] The ANOPR provides real-world examples of deployments

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[16] Final Root Cause Analysis Mid-August 2020 Extreme Heat Wave, California ISO at 19 (Jan. 13, 2021), https://www.caiso.com/Documents/Final-Root-Cause-Analysis-Mid-August-2020-Extreme-Heat-Wave.pdf.
[17] *Extreme Cold & Winter Weather Update #6,* Dept. of Energy (Feb. 21, 2021), https://www.energy.gov/sites/default/files/2021/02/f83/TLP-WHITE_DOE%20Situation%20Update_Cold%20%20Winter%20Weather_%236.pdf
[18] *Dynamic Line Ratings*, Dept. of Energy at 7 (June 2019), https://www.energy.gov/oe/articles/dynamic-line-rating-report-congress-june-2019.
[19] ANOPR at 36-37.

that demonstrate these benefits, with examples from Pennsylvania, Massachusetts, Texas, Indiana, and Ohio showing that DLRs increase transmission capacity, reduce costs, and accelerate deployment timelines as compared with other transmission solutions like reconductoring.[20] In addition, modeling efforts like one performed by RMI have shown the significant benefits that grid-enhancing technologies could bring, including but not limited to DLR.[21] Even within the limited scope of RMI's report, DLR deployment in PJM could contribute to a $1B/year in production cost savings to ratepayers.[22]

Those capacity increases, in turn, have reliability benefits. The ANOPR provides as an example the experience of PJM during Winter Storm Elliot.[23] PJM found that "the presence of DLRs on its system during Winter Storm Elliott contributed to system reliability because the higher transmission line ratings allowed it to avoid re-dispatching its system."[24] Winter storms have become a regular challenge for grid operators in recent years, causing rolling blackouts in Texas in 2021 and in PJM in 2022, forcing PJM to implement emergency measures to avoid blackouts.[25] DLRs may be particularly useful during these episodes because they provide the greatest capacity increases during times of low temperatures and high wind speeds.

The reliability value of DLRs goes beyond their ability to provide cost-effective increases in capacity. DLRs also improve the reliability of the transmission system by providing transmission operators with more accurate data regarding their lines. As the ANOPR explains:

> DLR systems also give transmission providers a more complete picture of how the system is operating, particularly in contingency situations, which allows

[20] *Id.* at 37-41.
[21] *GETting Interconnected in PJM: Grid-Enhancing Technologies (GETs) Can Increase the Speed and Scale of New Entry from PJM's Queue* (Feb. 2024), https://rmi.org/insight/analyzing-gets-as-a-tool-for-increasing-interconnection-throughput-from-pjms-queue.
[22] *Id.* at 3.
[23] *Id.* at 47.
[24] *Id.* (discussing Order No. 881, 177 FERC ¶ 61,179 at P 58).
[25] Dana Ammann, *Winter Storm Elliott Report Highlights the Risk of Natural Gas Failures*, NRDC (July 20, 2023), https://www.nrdc.org/bio/dana-ammann/winter-storm-elliott-report-highlights-risk-natural-gas-failures.

> transmission providers to maximize their system's performance while maintaining a safe, reliable, and efficient system. DLRs can also improve reliability by monitoring the condition of transmission lines and alerting utilities to hazardous conditions or potential failures on transmission lines, which may otherwise go undetected.[26]

With static and ambient line ratings, transmission operators are forced to manage the grid with incomplete data about the state of their system, similar to a pilot flying without information on the aircraft's altitude or ground speed. DLR sensors provide additional, real-time data so that grid operators have accurate information and can make better informed decisions.

Real-time data would provide enormous value in areas of the United States that are prone to wildfires, as PIOs discuss in further detail below. In wildfire-prone areas, grid operators—without accurate, real-time information—may prematurely shut off certain transmission lines, as a precaution to avoid faults caused by swinging lines. Alternatively, grid operators may fail to shut down lines when a fault is likely. In both instances, incomplete information creates a reliability risk. DLR sensors reduce these risks—and the overall risk that transmission lines will cause a wildfire—by providing more accurate data.[27]

Lastly, the reforms proposed in the ANOPR would significantly enhance transparency and data availability. The Commission emphasizes in the ANOPR that these reforms would ensure greater visibility into how transmission line ratings are developed and implemented.[28] Additionally, enhanced data reporting practices related to congestion in non-RTO/ISO regions would help identify candidate transmission lines for the wind requirement, allowing for more targeted improvements and efficient use of transmission capacity. This transparency is crucial for

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[26] *Id.* at 47.

[27] *Connected West Exploring "Next Generation" Transmission Investments to Support a Clean, Electrified, and Reliable Western Grid Final Report* at 9 (Sept. 2024), https://gridworks.org/wp-content/uploads/2024/09/Connected-West-Final-Report-240918.pdf (finding DLRs are often suited for incremental or developing issues on the system, likely to be identified in nearer term studies focused on a subset of issues).

[28] ANOPR at 44.

optimizing grid performance, ensuring reliability, and making informed decisions on future grid enhancements.[29] Currently, ISOs/RTOs are not required to disclose their line rating methodologies to the public. This creates a significant transparency gap impeding policymakers, investors, and advocates from fully understanding the limitations of existing practices and to develop practical solutions. Enhanced transparency in line rating methodologies would foster more informed decision making and grid optimization.

V. Discussion

A. FERC Must Establish Solar Requirements for All Transmission Lines

PIOs support requirements that all transmission lines that are limited by thermal constraints should reflect granular forecasts for solar heating of transmission lines, based on the sun's position and based on up-to-date forecasts of cloud cover.[30] Currently, with Ambient Adjusted Ratings (AAR), solar heating of lines is guided only by day/night differences, typically estimated at noon and midnight.[31] There are two types of solar transmission line heating that should be addressed: clear sky solar heating[32] and forecastable cloud cover.[33] Both can lead to more accurate capacity ratings and should be mandatory as discussed below.

1. Clear Sky Solar Heating is an Important Factor to Inform Solar Requirements

There is ample evidence that a more granular (hourly or less) forecast of solar line heating can increase line ratings by around 12 percent in the hours immediately after sunrise and before sunset.[34] The additional capacity will have economic benefits to both generation and load,

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[29] *Id.* at 50.
[30] *Id.* at 51.
[31] *Id.*at 53-54.
[32] *Id.* at 56.
[33] *Id.* at 57.
[34] *Id.* at 55.

lowering prices and providing a more robust system. Further, the additional transmission capacity will help meet afternoon peak energy use and help charge Battery Energy Storage Systems (BESS) in the morning hours, when load is typically lower. Clear sky solar heating of transmission lines can be forecasted with precision based on geographic location, date and hour. This may occur weeks in advance, with a minimum of 10 days in advance as suggested in the ANOPR.[35] The calculation is simple, and the ability to use the data and translate it into capacity increases is analogous to what already occurs under the AAR regime. Greater accuracy of line ratings will result in cost savings and rates that are more just and reasonable.

2. Forecastable Cloud Cover is an Important Factor to Inform Solar Requirements

Solar heating of transmission lines based on forecastable cloud cover can occur on the same set of transmission lines that receive DLRs for clear sky solar heating. Given that perfect cloud cover forecasting is unattainable, the requirement must emphasize the use of the best available forecasting models and real-time data to optimize line ratings with a reasonable degree of accuracy. Most of the value in adjusting line ratings is realized in the day-ahead market, where generation prices are established. Therefore, PIOs recommend implementing a requirement for grid operators to use the most accurate cloud cover forecasts available 48 hours in advance to set transmission line ratings, allowing for more generation to compete and lowering prices for consumers.

PIOs recommend applying a relatively conservative approach in estimating capacity increases 48 hours ahead when relying solely on forecasts without real-time sensors. As sensors are installed, grid operators may use more aggressive forecasting since real-time data can validate or adjust the predictions, mitigating the risks associated with optimistic forecasts. This

[35] *Id.* at 56.

framework supports immediate capacity enhancements and underscores the long-term goal of equipping all transmission lines with sensors. DLR sensors will ensure grid operators may dynamically adjust and optimize the system based on real-time conditions.

B. FERC Must Establish Wind Requirements for All Transmission Lines

PIOs advocate for a wind requirement[36] that transmission line ratings incorporate timely reporting of wind speed and direction, as these factors are crucial in determining line ratings, as demonstrated by examples in the ANOPR.[37] First, FERC must mandate DLR for transmission lines that exceed established thresholds for wind speed and congestion. Second, FERC must require DLR implementation on all new transmission lines during their construction. Third, FERC must extend DLR requirements for wind speed and direction to existing transmission lines that do not currently meet the congestion threshold, allowing a longer timeframe for compliance.

To fully harness the cooling benefits of wind on transmission lines, two critical components need to be addressed: accurate forecasting of wind speed and direction, and the installation of sensors on the lines for real-time verification of wind conditions and real-time monitoring of line sag or tension. Both forecasting and sensor deployment are essential and should be pursued aggressively. Accurate forecasting of wind speed and direction, using the best available weather predictions and historical data on the lines in question, is necessary for markets to capitalize on increased transmission capacity. PIOs agree with the ANOPR's proposal that a 48-hour forecasting horizon is the most practical for integrating this data into market decisions, particularly for the day-ahead market, where generation and load decisions are set.[38] While forecasts beyond 48 hours are generally less precise and may offer limited additional market

[36] *Id.* at 39.
[37] *Id.* at 49.
[38] *Id.* at 60.

value, they could still play a crucial role in resource adequacy planning, especially during anticipated peak load events. Therefore, longer-term wind speed and direction forecasts should be considered as a secondary objective of DLR to aid in resource adequacy assessments.

For achieving real-time operational accuracy, high-quality sensors and robust back-office systems that continuously monitor wind speed and direction are indispensable. Although the installation of sensors and metering systems can involve significant costs, they enable the use of more aggressive 48-hour forecasting models in market operations, leading to substantial gains in transmission capacity. The benefits of DLR sensors extend beyond increased transmission capacity; they also play a crucial role in wildfire mitigation and post-disaster restoration, such as following hurricanes, which will be explored further in a subsequent section. Successful sensor deployment necessitates reliable communication channels between sensors and back-office systems, along with advanced software capable of processing and analyzing the data efficiently and intelligently.

Integrating 48-hour forecasting with real-time data from sensors can progressively align weather forecasts with actual, real-time capacity on individual transmission lines. Initially, transmission owners, utilities, and market participants may approach wind speed and direction forecasts with caution, likely resulting in conservative use of the available capacity. However, as confidence grows in the accuracy and reliability of these forecasts, a greater portion of the additional capacity can be harnessed, thereby lowering energy prices without compromising real-time grid reliability.

In summary, PIOs recommend that FERC mandate the forecasting of wind speed and direction, supplemented by real-time verification through sensors installed on transmission lines according to the schedule outlined below. Additionally, PIOs suggest that all new transmission lines be equipped with sensors during construction, as further detailed below. Our concern is that relying solely on forecasting without sensors carries significant risks: overestimating capacity if wind conditions do not provide the expected cooling effect, and underestimating capacity, which would unnecessarily maintain higher prices.

1. Speed of Implementation and Criteria for Addressing Transmission Lines Subject to a Wind Requirement

a. Number of Lines Addressed Annually that Meet Threshold Criteria

PIOs express significant concern with the ANOPR's proposed implementation rate of DLR on qualifying transmission lines at a mere 0.25% per year, rounded up, which PIOs consider unacceptably slow.[39] This pace would result in an installation timeline stretching up to 400 years for entities managing 400 or more lines that meet the threshold criteria. While PIOs acknowledge initial start-up challenges related to the siting and installation of sensors, the proposed timeline is clearly insufficient.

PIOs advocate for a much more expedited approach, aiming for the complete implementation of wind speed and direction forecasting, backed by real-time sensors, across all transmission lines that meet the threshold criteria within seven years. This accelerated schedule is crucial in addressing the current transmission scarcity, fostering just and reasonable costs, and enhancing safety and reliability in the grid:

Implementation Date (by end of)	Lines Required for DLR Forecasting and Sensors that Meet the Threshold Criteria (Cumulative percent)
Year 1	5%
Year 2	10%
Year 3	20%
Year 4	40%
Year 5	60%

[39] *Id*. at 69-71.

Year 6	80%
Year 7	100%

b. Transmission Lines that Do Not Meet the Criteria

As highlighted in the introduction to these comments, a modern transmission grid necessitates the installation of DLR sensors on all transmission lines to equip Transmission Owners, utilities, and RTO/ISOs with enhanced real-time visibility into grid conditions. Beyond unlocking additional capacity within the Bulk Energy System, the deployment of DLR sensors on all lines will significantly bolster safety, reliability, and resilience, as further detailed in the subsequent section.

To achieve this, PIOs recommend that the Commission require transmission operators to start installing DLR sensors on transmission lines that do not meet the threshold criteria beginning in Year 8, following the completion of installation on lines that do meet the criteria, deploying sensors and forecasting on 10% of the remaining transmission lines per year. This approach will ensure that all transmission lines are equipped with operational sensors within 18 years from the publication of the final rule.

c. New Transmission Lines

The installation of DLR type sensors and sensor systems is significantly more cost-effective and efficient when incorporated during the construction of transmission lines. To serve the public interest, all new transmission lines should include DLR sensors from the onset, starting four years after the implementation of a new rule. This timeline provides transmission operators sufficient time to incorporate sensor installations into their construction plans, ensuring that DLR technology is integrated into the operation of the line from its first day of service.

d. Wind Speed Threshold

PIOs support a wind speed threshold of 3 meters per second measured at 10 meters above the ground, over 75% of the line length, as proposed in the ANOPR.[40]

e. Congestion Threshold

PIOs agree that a congestion threshold of $500,000 per year, as suggested by WATT/CEE and Clean Energy Parties,[41] is a reasonable level that balances the cost of implementing sensors with the expected savings from reduced curtailment and lower market prices. PIOs further anticipate that the costs of implementing sensors will decrease over time as more installations occur, and new technological innovations enter the market. This trend is similar to when AMI technology became more widespread in the distribution grid, driving down costs and improving efficiency through economies of scale and technological advancements.[42]

C. DLR Sensors are an Opportunity to Prioritize Grid Reliability

FERC is responsible for regulating the reliability of electric service and enforcing mandatory reliability standards.[43] Order No. 881 sought to enhance grid reliability by implementing more accurate and transparent Ambient-Adjusted Ratings (AARs) for transmission lines.[44] As emerging technologies become integral to grid operations, FERC has required resources to take on new roles in supporting grid reliability.[45] Additionally, under Section 219, FERC has interpreted its authority to include expanding the grid and enhancing its operational

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[40] *Id*. at 73-74.
[41] *Id*. at 76.
[42] *Advanced Metering Infrastructure and Customer Systems,* Office of Electricity Delivery and Energy Reliability Dept. of Energy at 6-7
(Sept 2016), https://www.energy.gov/sites/prod/files/2016/12/f34/AMI%20Summary%20Report_09-26-16.pdf.
[43] Energy Policy Act of 2005, Pub. L. No. 109-58, § 1211(a) (2005); Section 215 of Federal Power Act.
[44] Order No. 881.
[45] *See* Order No. 842, Essential Reliability Services and the Evolving Bulk Power System—Primary Frequency Response, 162 F.E.R.C. ¶ 61,128 (2018) (to be codified at 18 C.F.R. pt. 35) (requiring all new generators, both synchronous and non-synchronous, to install equipment to provide primary frequency response as a condition of interconnection); *See also* Order No. 827, Reactive Power Requirements for Non-Synchronous Generation, 155 F.E.R.C. ¶ 61,277 (2016) (codified at 18 C.F.R. pt. 35) (revising the Commission's pro forma large and small generator interconnection agreements to require non-synchronous generators, e.g. wind and solar resources, to provide reactive power).

efficiency, which plays a critical role in managing severe weather events and speeding recovery after natural disasters.[46] The current ANOPR aligns with these efforts, further supporting initiatives to bolster grid reliability and resilience.

Severe weather exacerbated by climate change has changed precipitation patterns, and increased the difference between how much moisture there is in the air and the amount of moisture in the air at saturation (vapor pressure deficit). This, in turn, has driven the desiccation of fuels that inform wildfire patterns and behavior across the United States.[47] In the West, particularly the Southwest, climate change is the clear cause of fires becoming larger, more frequent, and, in many areas, more severe.[48] Seven of the ten largest wildfires in the U.S. from 2020 to 2021 occurred in the West. Notably, 22 of the 50 largest wildfires in 2020 occurred in

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[46] *See* Order No. 679, Promoting Transmission Investment through Pricing Reform, F.E.R.C. STATS. & REGS. ¶ 31,222 at P 42 (2006) ("[W]e interpret section 219 to promote capital investment in a wide range of infrastructure investments that can have either reliability or congestion benefits rather than investments that have both reliability and congestion benefits.").

[47] Duane, A., M. Castellnou, and L. Brotons, 2021: Towards a comprehensive look at global drivers of novel extreme wildfire events. *Climatic Change,* 165 (3), 43. https://doi.org/10.1007/s10584-021-03066-4; Goss, M., D.L. Swain, J.T. Abatzoglou, A. Sarhadi, C.A. Kolden, A.P. Williams, and N.S. Diffenbaugh, 2020: Climate change is increasing the likelihood of extreme autumn wildfire conditions across California. *Environmental Research Letters,* 15 (9), 094016. https://doi.org/10.1088/1748-9326/ab83a7; Mueller, S.E., A.E. Thode, E.Q. Margolis, L.L. Yocom, J.D. Young, and J.M. Iniguez, 2020: Climate relationships with increasing wildfire in the southwestern US from 1984 to 2015. *Forest Ecology and Management,* 460, 117861. https://doi.org/10.1016/j.foreco.2019.117861; Swain, D.L., 2021: A shorter, sharper rainy season amplifies California wildfire risk. *Geophysical Research Letters,* 48 (5), e2021GL092843. https://doi.org/10.1029/2021gl092843; Williams, A.P., J.T. Abatzoglou, A. Gershunov, J. Guzman-Morales, D.A. Bishop, J.K. Balch, and D.P. Lettenmaier, 2019: Observed impacts of anthropogenic climate change on wildfire in California. *Earth's Future,* **7** (8), 892–910. https://doi.org/10.1029/2019ef001210; MacDonald, G., T. Wall, C.A.F. Enquist, S.R. LeRoy, J.B. Bradford, D.D. Breshears, T. Brown, D. Cayan, C. Dong, D.A. Falk, E. Fleishman, A. Gershunov, M. Hunter, R.A. Loehman, P.J. van Mantgem, B.R. Middleton, H.D. Safford, M.W. Schwartz, and V. Trouet, 2023: Drivers of California's changing wildfires: A state-of-the-knowledge synthesis. *International Journal of Wildland Fire*, 32 (7), 1039–1058. https://doi.org/10.1071/WF22155.

[48] Westerling, A.L., 2016: Increasing western US forest wildfire activity: Sensitivity to changes in the timing of spring. *Philosophical Transactions of the Royal Society B: Biological Sciences,* 371 (1696), 20150178. https://doi.org/10.1098/rstb.2015.0178; Westerling, A.L., H.G. Hidalgo, D.R. Cayan, and T.W. Swetnam, 2006: Warming and earlier spring increase western U.S. forest wildfire activity. *Science,* 313 (5789), 940–943. https://doi.org/10.1126/science.1128834.

California.[49] Wildfires pose a notable risk to transmission infrastructure.[50] To minimize ignitions caused by transmission lines, grid operators deenergize power lines during windy weather.[51] Fire forecasting exists in two categories. The first category is predicting where and when fires will start.[52] The second is predicting how fires will spread once they have started.[53] Risk metrics and historical data inform predictions of where and when fires will start and how they will spread.[54] Unfortunately, the response to fire risks by transmission system operators lacks standardization across the industry.[55]

DLR type sensors should be prioritized in grid modernization because they provide critical real-time data about transmission line conditions, including wind speed, direction, and conductor sag, which are essential for fire risk mitigation. Currently, the lack of precise information forces utilities to make conservative decisions, such as turning down transmission lines during high wind conditions to prevent fires caused by "line slap" (when sagging conductors blow together) or structural failures. While these measures help reduce fire risks, they also result in power outages that disrupt communities. By installing DLR sensors, utilities would gain the ability to make better informed decisions, turning lines down only when necessary and

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[49] CalFire, 2021: Top 20 Deadliest California Wildfires. California Department of Forestry and Fire Protection. https://www.fire.ca.gov/our-impact/statistics; NICC, 2021: Wildland Fire Summary and Statistics Annual Report 2020. National Interagency Coordination Center. https://www.predictiveservices.nifc.gov/intelligence/intelligence.htm; NICC, 2022: Wildland Fire Summary and Statistics Annual Report 2021. National Interagency Coordination Center. https://www.predictiveservices.nifc.gov/intelligence/intelligence.htm.

[50] Ostoja, S.M. et al., *Focus on western wildfires*, *Fifth National Climate Assessment,* Global Change Research Program, (2003), https://doi.org/10.7930/NCA5.2023.F2.

[51] Muhs, J.W., M. Parvania, and M. Shahidehpour, 2020: Wildfire risk mitigation: A paradigm shift in power systems planning and operation. *Journal of Power and Energy,* **7**, 366–375. https://doi.org/10.1109/oajpe.2020.3030023.

[52] Nadia Panossian and Tarek Elgindy, *Power System Wildfire Risks and Potential Solutions: A Literature Review & Proposed Metric*, NREL at 3 (June 2023), https://www.nrel.gov/docs/fy23osti/80746.pdf.

[53] *Id.*

[54] *Id.*

[55] *Id.* at 5.

restoring them as soon as conditions improve. This approach would minimize unnecessary outages and enhance both grid reliability and public safety.

DLR type sensors can also significantly enhance utility response and recovery efforts following natural disasters like hurricanes and tornadoes. Currently, the absence of real-time information on transmission line conditions slows down the accurate dispatch of repair crews. This prolongs outages and delays the overall restoration process. With DLR sensors, utilities would have immediate visibility into the status of transmission lines, enabling faster and more precise assessments of grid conditions and the extent of damage. This real-time data would streamline recovery operations, reduce downtime, help restore power to affected areas more efficiently, and improve overall grid resilience during and after disaster events.

The benefits of implementing DLR sensors to enhance grid reliability and resilience provide strong justification for the proposed timelines for integrating DLR systems that monitor wind speed and direction. While it may be challenging to quantify the economic advantages of improved reliability, resilience, and safety, these benefits are tangible and can be effectively modeled to demonstrate their long-term value to the grid and consumers.

D. DLR Sensors Have an Important Role in Implementing DLR

Sensors, and the selection of appropriate sensor types, are crucial considerations for implementing DLR.[56] As highlighted in the introduction and reiterated throughout our comments, PIOs strongly advocate for the installation of sensors on transmission lines at an accelerated pace to maximize the benefits of DLR, enhancing grid capacity, safety, and reliability.

[56] ANOPR at 19.

Two primary types of sensors are available for DLR: weather sensors, which measure factors like wind speed, direction, and cloud cover, and conductor sensors, which assess the condition of transmission lines, including temperature, sag, or tension.[57] PIOs strongly recommend the use of conductor sensors as they provide essential data on the real-time condition and health of the Bulk Energy Grid—information that weather sensors alone cannot capture. While weather sensors offer valuable insights into real-time weather conditions, they fall short in monitoring actual conductor performance. Conductor sensors that also measure wind speed and direction would be the ideal solution, offering comprehensive visibility into both environmental and grid conditions.

PIOs do not have a preference regarding whether sensors are installed on the ground, on the transmission lines, or on towers.[58] However, PIOs strongly advocate for a requirement that conductor sensors, regardless of their location, must at a minimum provide data on the condition of the conductors—be it visual, electrical, or thermal. This ensures that the sensors deliver critical insights into the health and performance of the transmission infrastructure.

PIOs concur with the assessment that real-time data from conductor sensors is invaluable for DLR systems and transmission providers, as it enhances operational awareness and helps grid operators detect unexpected shifts in transmission line capacity.[59] One key advantage of these sensors is "forecast training," where real-time sensor data is continually compared with weather forecasts. This process not only improves the accuracy of weather predictions over time but also refines how those forecasts correlate with the actual capacity of transmission lines. As more data

[57] *Id*.
[58] *Id*.
[59] *Id*. at 20.

is gathered and analyzed, this ongoing comparison will enable more confident and aggressive capacity forecasting, optimizing grid performance and reliability.

Transmission providers should be required to meet the schedule we have proposed in these comments for the implementation of sensor-based DLR. Relying solely on wind forecasts without sensor verification significantly raises the risk of overly optimistic ratings that may lead to outages or overly conservative ratings that leave valuable transmission capacity unused.[60] The combination of sensors with weather forecasts allows for ongoing forecast validation and training, providing the most reliable tool for achieving optimal transmission capacity in the long term by continuously refining forecast accuracy based on real-time data.[61]

In addition to meeting the schedule for the application of sensors that we are proposing, utilities should be encouraged to use sensor-less technologies on a faster timeline so that they can start accumulating data on the accuracy of forecasted wind speed and direction on a broad geographical basis. This information will be helpful in planning new transmission that will be needed to meet loads that are growing quickly.

VI. Conclusion

For the foregoing reasons, Sustainable FERC Project, Natural Resources Defense Council, National Wildlife Federation, RMI, Environmental Law & Policy Center, the National Audubon Society, Clean Wisconsin, Renewable Northwest, Conservation Law Foundation, Environmental Defense Fund, Acadia Center, and Iowa Environmental Council respectfully request that the Commission consider these comments in developing a final rule from this proceeding.

[60] *Id*. At 67.
[61] *Id*. at 65-67.

Respectfully submitted,

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