UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Implementation of Dynamic Line Ratings	**)**	**Docket No. AD22-5-000**
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COMMENTS OF THE NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION, MIDWEST RELIABILITY ORGANIZATION, NORTHEAST POWER COORDINATING COUNCIL, INC., RELIABILITYFIRST CORPORATION, SERC RELIABILITY CORPORATION, TEXAS RELIABILITY ENTITY, INC., AND WESTERN ELECTRICITY COORDINATING COUNCIL ON THE NOTICE OF INQUIRY

The North American Electric Reliability Corporation ("NERC"), along with Regional Entities Midwest Reliability Organization, Northeast Power Coordinating Council, Inc., ReliabilityFirst Corporation, SERC Reliability Corporation, Texas Reliability Entity, Inc., and Western Electricity Coordinating Council (collectively, the "ERO Enterprise") hereby provide comments on the Notice of Inquiry issued by the Federal Energy Regulatory Commission ("FERC" or the "Commission") in this proceeding on February 17, 2022.[1]

The collective mission of the ERO Enterprise is to assure the effective and efficient reduction of risks to the reliability and security of the grid. NERC is the Electric Reliability Organization ("ERO") certified by the Commission under Section 215 of the Federal Power Act and the Commission's implementing regulations.[2] As the ERO, NERC is responsible for developing and enforcing mandatory Reliability Standards, subject to Commission approval, and

[1] *See* Notice of Inquiry, *Implementation of Dynamic Line Ratings*, 178 FERC ¶ 61,110 (Feb. 17, 2022) at 12 (Q15 and Q16) [hereinafter NOI].

[2] 16 U.S.C. § 824o, 18 C.F.R. part 39 (2021); *Rules Concerning Certification of the Electric Reliability Organization; and Procedures for the Establishment, Approval, and Enforcement of Electric Reliability Standards*, Order No. 672, 114 FERC 61,104 (2006), *order on reh'g*, Order No. 672-A, 114 FERC 61,328 (2006). NERC was certified by the Commission as the ERO, pursuant to § 215(c) of the Federal Power Act, by Commission order issued July 20, 2006. *N. Am. Elec. Reliability Corp.*, 116 FERC ¶ 61,062 (2006).

assessing the reliability and adequacy of the Bulk-Power System ("BPS") in North America.[3] The six Regional Entities have delegated authority under regional delegation agreements approved by the Commission.[4]

In the Notice of Inquiry, the Commission seeks comment on whether and how the required use of dynamic line ratings (or "DLRs") is needed to ensure just and reasonable wholesale rates and other market and technical related considerations for mandatory DLR requirements. Relevant to the reliability mission of the ERO Enterprise, the Commission seeks specific comment on the potential cybersecurity challenges of DLR implementation (Question 15) and considerations for BPS reliability (Question 16).[5] The ERO Enterprise supports the Commission's consideration of the potential security and reliability considerations associated with a market-related rule to require the use of DLRs, and it appreciates the opportunity to provide comments on these matters in this proceeding.

Consistent with its mission and statutory mandate, the ERO Enterprise would study closely the potential reliability risks associated with any DLR rule that is ultimately adopted by the Commission, regardless of any specific Commission directive to do so. Working closely with its stakeholders, the ERO Enterprise would then identify what, if any, new or revised Reliability Standards would be required to address those risks and ensure the continued reliable operation of the BPS. The ERO Enterprise understands that a number of entities are currently using or testing

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[3] Section 215(a)(2). *See also* Section 215(c) (providing the ERO certification criteria). *See also* Pub. L. 109–58, title XII, §1211(b), Aug. 8, 2005, 119 Stat. 946 (clarifying, "[t]he Electric Reliability Organization… and any regional entity delegated enforcement authority… are not departments, agencies, or instrumentalities of the United States Government.").

[4] 18 C.F.R. § 39.8; *N. Am. Elec. Reliability Corp.*, 173 FERC ¶ 61,277 (2020) (conditionally approving revised regional delegation agreements to be effective January 1, 2021 and directing compliance filing), *order on compliance*, *N. Am. Elec. Reliability Corp.*, Docket No. RR20-5-001 (Aug. 31, 2021) (delegated letter order).

[5] NOI at 12.

the use of DLRs. The experiences of these entities will provide useful insights to evaluate the risks, challenges, and benefits to reliability from DLR implementation.

I. BACKGROUND

On February 17, 2022, the Commission issued a Notice of Inquiry in this proceeding seeking information on whether it should amend its market regulations to require the use of dynamic line ratings, or DLRs. A dynamic line rating is defined as a transmission line rating that: "(1) applies to a time period of not greater than one hour; and (2) reflects up-to-date forecasts of inputs such as (but not limited to) ambient air temperature, wind, solar heating intensity, transmission line tension, or transmission line sag."[6]

In Order No. 881, issued December 2021, the Commission mandated the use of ambient-adjusted ratings, or "AARs", but declined to mandate the use of DLRs, finding that the record was not sufficient to evaluate the costs and potential benefits.[7] The Commission incorporated the record of the Managing Transmission Line Ratings proceedings leading up to Order No. 881 into the instant proceeding,[8] which includes prior NERC comments on a Notice of Proposed Rulemaking,[9] comments on a 2019 Notice of Inquiry,[10] and technical conference remarks.[11]

In the Notice of Inquiry, the Commission seeks comment on 30 questions relating to the costs and benefits of DLR implementation, including whether the lack of DLR requirements

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6 NOI at 1 n.1 (citing *Managing Transmission Line Ratings*, Order No. 881, 177 FERC ¶ 61,179 at P 7 (2021) [hereinafter Order No. 881]).

7 Order No. 881 at P 254.

8 *See* NOI at P 4.

9 *Comments of NERC in Response to Notice of Proposed Rulemaking,* Docket No. RM20-16-000 (Mar. 22, 2021).

10 *Comments of NERC in Response to Notice Inviting Post-Technical Conference Comments*, Docket No. AD19-15-000 (Nov. 1, 2019).

11 *Remarks of Howard L. Gugel, NERC Vice President and Director of Engineering and Standards*, Managing Transmission Line Ratings Technical Conference, Docket No. AD19-15-000 (Sep. 10, 2019).

renders current wholesale rates unjust and unreasonable; potential criteria for DLR requirements; the benefits, costs, and challenges of implementing DLRs; the nature of potential DLR requirements; and potential timeframes for implementing DLR requirements.[12]

Relevant to the reliability mission of the ERO Enterprise, the Commission seeks comment on cybersecurity and reliability considerations associated with a potential rule to require the use of DLRs, and the role of NERC to develop Reliability Standards to address any potential risks that may arise from DLR implementation. Specifically, the Commission seeks comment on the following:

> Q15) Please describe the cybersecurity challenges of DLR implementation. What are the potential impacts to reliable operations if the digital devices that monitor or communicate line conditions used for establishing DLRs are manipulated or rendered inoperable by a cyber event? What relevant procedural or technical cybersecurity controls exist that would mitigate such risk?
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> Q16) If the Commission were to require DLR implementation, should the Commission direct NERC to evaluate how this requirement could introduce new risks to the reliable operation of the BES and whether any standards require modification to address any risks?

The ERO Enterprise submits comments on these questions below.

II. COMMENTS

The ERO Enterprise submits comments regarding the cybersecurity and reliability challenges of DLR implementation in response to Questions 15 and 16 of the Notice of Inquiry. As noted below, mandating the use of DLRs would increase the challenge of maintaining a cyber secure environment while also introducing complexities for reliable operations. While the ERO Enterprise does not necessarily believe that these challenges would be insurmountable, reliability and security issues should be carefully considered as the Commission determines whether to adopt

[12] *See generally* NOI at P 1.

a rule to require the use of DLR for some or all bulk electric system transmission lines. The ERO Enterprise has identified the following issues as potential considerations for cybersecurity and reliability as it relates to the required use of DLR, and it looks forward to the submissions of other commenters in this proceeding for additional considerations for study should the Commission ultimately determine to adopt a rule requiring the use of DLR.

A. The Cybersecurity of DLR Systems is an Important Implementation Consideration

Question 15 of the Notice of Inquiry seeks comments on cybersecurity considerations associated with DLR implementation. The ERO Enterprise appreciates the Commission's attention to this important consideration for reliability. DLR systems depend on measurements from a number of distributed devices. Implementing such systems could increase the threat landscape for malicious attacks or increase the reliability risk associated with the failure of sensor devices or communications systems. As such, DLR components and communications must be cyber secure. If DLR sensor data became unavailable, or data or associated communications compromised or spoofed, the entities relying on these systems for an accurate representation of current line conditions could make misinformed operating decisions that could threaten the reliable operation of the grid. For example, the compromise of DLR data or communications could result in a transmission provider selling capacity it thinks is available but is not, resulting in a line becoming dangerously overloaded. If such data unavailability or compromise affected DLR systems near transmission line seams, it could create widespread congestion management challenges for reliable operations. All of these circumstances, combined with a lower margin for safety than what might have been used historically,[13] could increase significantly the challenge of maintaining reliable operations.

[13] *See* discussion in Section II.B.

The risks associated with DLR system unavailability or compromise can be mitigated through certain controls and practices. As discussed in response to Question 16, below, entities should design controls so that they can validate that sensors are operating correctly and that any changes in ratings based on DLR sensor data are appropriate for that particular line, taking all relevant considerations into account. Entities should also have a backup or other means to acquire the data or establish line ratings if the DLR systems are compromised or not functioning properly. These considerations are especially important where DLR systems are part of real-time operations.

NERC Reliability Standards may also provide protections to help mitigate cyber risks associated with DLR equipment. NERC registered entities must perform an evaluation of their DLR elements to determine the appropriate CIP Reliability Standard applicability based on CIP-002 impact rating criteria (high/medium/low). Depending on that determination and how the different elements are used, other Reliability Standards may provide protections. Depending on the specific rule adopted by the Commission, there may be opportunity to evaluate what, if any, further cybersecurity controls or other modifications should be implemented in NERC Reliability Standards for DLR systems. Applying existing or modified CIP Reliability Standards to new assets would increase the volume of assets requiring CIP protections, which may require additional compliance resources from NERC registered entities and the ERO Enterprise alike.

B. Potential Reliability Issues Should be Considered in Determining Whether to Mandate the use of DLRs

Question 16 of the Notice of Inquiry seeks comments on reliability considerations associated with requiring the use of DLR, and whether the Commission should direct NERC to evaluate how such a requirement could introduce new risks to the reliable operation of the bulk electric system and whether any standards would require modification to address any risks.

The mission of the ERO Enterprise is to ensure the reliability of the BPS, and we appreciate the Commission's attention to the potential risks a rule to require DLR implementation could have on reliable operations. Should the Commission ultimately determine to adopt a rule to require the use of DLRs, the ERO Enterprise would closely examine the reliability implications and considerations for NERC Reliability Standards, regardless of any specific Commission directive to do so. Close coordination between the ERO Enterprise and the Commission's Office of Electric Reliability could help identify and prioritize the specific reliability issues to be addressed, whether through new or revised Reliability Standards or other means within the ERO Enterprise reliability toolkit such as Reliability Guidelines.

Generally speaking, a rule to require DLR implementation could present a number of considerations for reliability. The ERO Enterprise has identified a number of these reliability considerations below. Several of these considerations relate to other Questions from the NOI that are not specifically addressed by NERC in these comments.

1. NERC Reliability Standards Are Neutral Regarding DLR

NERC Reliability Standards neither require nor prohibit the use of DLR. Reliability Standard FAC-008-5 – Facility Ratings requires Transmission Owners and Generator Owners to establish Facility Ratings in accordance with an established methodology.[14] The mandatory use of DLRs by transmission providers would fit within the existing FAC-008 framework, provided the methodologies used by the Transmission Owners also incorporate DLR. DLR data would be considered real-time operating data subject to other currently effective Reliability Standards. As such, new DLR-based Facility Ratings would need to be carried forward into real-time tools,

[14] The *Glossary of Terms Used in NERC Reliability Standards* defines "Facility" as "a set of electrical equipment that operates as a single Bulk Electric System Element (e.g., a line, a generator, a shunt compensator, transformer, etc.)." The *Glossary* is available at https://www.nerc.com/files/glossary_of_terms.pdf.

shared with Reliability Coordinators and neighboring Transmission Operators, and used appropriately in the determination of System Operating Limits and Interconnection Reliability Operating Limits.[15] They may also need to be carried forward into simulations or studies, depending on the timeframe for DLR use that is ultimately adopted by the Commission.

The use of DLR will introduce complexities for maintaining and assessing compliance with existing Reliability Standards. Some of these additional complexities, and potential considerations for Reliability Standards, are discussed in the following sections. The ERO Enterprise would need to evaluate what, if any, changes to Reliability Standards or other guidance is necessary to account specifically for these reliability considerations, depending on whatever proposal is ultimately adopted by the Commission.

2. Operators Should Account for the Added Complexities of Mandatory DLR Requirements

The mandatory use of DLR would likely increase the complexity of operating the system, especially during system event conditions. The system is typically operated with a measure of safety or reliability margins; the increased variability of new resources, along with variable ratings, introduces new complexities into system operations. This complexity is compounded by the fact that operators will also be working with tighter margins and shorter timeframes for action.

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[15] The *NERC Glossary* currently defines the term System Operating Limit as:

> The value (such as MW, Mvar, amperes, frequency or volts) that satisfies the most limiting of the prescribed operating criteria for a specified system configuration to ensure operation within acceptable reliability criteria. System Operating Limits are based upon certain operating criteria. These include, but are not limited to:
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> • Facility Ratings (applicable pre- and post-Contingency Equipment Ratings or Facility Ratings)
> • transient stability ratings (applicable pre- and post- Contingency stability limits)
> • voltage stability ratings (applicable pre- and post-Contingency voltage stability)
> • system voltage limits (applicable pre- and post-Contingency voltage limits).

The *NERC Glossary* defines the term Interconnection Reliability Operating Limit as "A System Operating Limit that, if violated, could lead to instability, uncontrolled separation, or Cascading outages that adversely impact the reliability of the Bulk Electric System."

Operating the system reliably post DLR implementation will require consideration of the complexity of DLR systems themselves, including ensuring that DLR information is fed properly into systems used for real-time operations, having checks in place to ensure validity, and having processes in place for when those data inputs fail. Entities may need to complete a comprehensive review of operations procedures, applications in energy management systems ("EMS"), and data exchange capabilities to account for added complexities stemming from the use of DLRs. Entities may also need to consider impacts to modeling and study assumptions to generate operating plans for the system operator, and review existing operating procedures and real-time System Operating Limit/Interconnection Reliability Operating Limit calculations.

As a foundational matter, entities must have accurate System Operating Limits. DLRs have the potential to yield transmission line ratings that can exceed the maximum ambient-adjusted rating or seasonal rating for a given line. There may be times when adjacent, parallel extra high voltage lines simultaneously receive DLRs that, when combined, yield a transfer capability that has never been previously studied or result in non-typical flows and flow patterns. Voltage and angular stability limits may be exceeded and will need to be reassessed with DLRs. More robust EMS models and real-time contingency analysis tools may be needed to accurately monitor voltage limits and assure accurate solutions are attained during contingency analysis. Present operating practices often revert to an off-line dynamics model (that reflects real-time system conditions) to analyze non-converged cases when EMS models become unable to reliably determine a stable transfer limit. DLRs may require more use of off-line (or on-line if available) dynamics models to assure the system is in a secure operating state.

Operators should also consider that wind speeds are not as predictable as temperatures; attention needs to be paid to assumptions, so that there are not mismatches between overly optimistic operating plan assumptions and DLRs experienced in real-time.

3. Entities Implementing DLR Should Account for the Complexities of those Systems and Implement Backup Procedures

DLR systems are complex, in that they must take sensor data accounting for various parameters and then compute those inputs into a line rating that allows for safe and reliable operations. Technologies used to implement DLRs need to be tested, parameters adjusted, and settings verified on a regular basis to ensure proper implementation. There should be consideration of proper calibration, testing, and maintenance of DLR equipment. The ERO Enterprise looks forward to the comments of those entities with experience implementing DLR for appropriate testing and maintenance cycles and other technical considerations.

To ensure reliable operations, entities must ensure that backup systems or processes are in place in the event communication is lost to all or some sensors on a DLR line (whether due to malicious actions or not), and that entities have a way to determine the Facility Rating when DLR systems are not operating as intended or a communication failure is occurring. In the event of the failure or loss of a DLR communication, the EMS system should be designed to default automatically to an appropriate set of static ratings (e.g., AARs that reside as a static data set in the EMS). There should also be some type of measure in place to compare the static against the dynamic ratings, so entities know the DLR sensors are working accurately.

Independently, Reliability Coordinators and Transmission Operators need to be empowered to review DLR results, evaluate the validity of these results in real-time against measurable criteria, then have the flexibility to operate to a default rating based on overall system reliability.

4. Entities Implementing DLR Should Account for Potential Impacts of Changing Use Patterns

Entities may need to consider impacts on equipment and historical maintenance needs as a result of changing usage patterns from the use of DLR (i.e., understanding the Facility Rating and all associated elements). There should also be consideration of substation terminal equipment loading. One potential outcome of implementing DLR is that typical line loadings and system flows may change, introducing unfamiliar system responses. This may require more in depth day-ahead analysis and preparation for the development of the next day operating plans/solutions.

Additionally, changing use patterns may require changes in how entities approach vegetation maintenance. Many DLR technologies utilize conductor sag calculations to determine maximum loading capabilities, which increases risk associated with conductor sag. Due to this increased risk, entities that own facilities that do not meet the current applicability thresholds of Reliability Standard FAC-003-4 – Transmission Maintenance may nevertheless find it necessary to check periodically for vegetation growth near those transmission lines.

5. Other Reliability Related Considerations for DLR Implementation

The ERO Enterprise has also identified several other areas for deeper examination and consideration as entities implement DLR:

- Entities may need to consider the potential impacts of higher ratings generated by DLR on relays and special protection systems/remedial action schemes, and make adjustments where necessary.
- The challenges for coordinating DLR across seams could be more significant than AAR given the added variables; enhanced coordination and communication is necessary.
- Entities should consider the need for mechanisms to reduce power flows quickly when a DLR drops suddenly and dramatically due to changes in wind conditions. As noted above, wind conditions are less predictable than temperature conditions.
- To the extent not addressed by the CIP Reliability Standards, entities implementing DLR should consider cybersecurity when procuring, operating, and maintaining DLR devices and systems and establishing DLR communications.

- Planners should consider the extent to which DLR or resulting effects from implementation (e.g., changing use patterns) should be incorporated into longer-term planning studies.

The ERO Enterprise looks forward to reviewing the submissions of other commenters in these proceedings for additional reliability considerations and other information in support of the considerations identified above.

III. CONCLUSION

The ERO Enterprise thanks the Commission for the opportunity to submit comments on the cybersecurity and reliability questions in the Notice of Inquiry and respectfully requests that these comments be considered as the Commission considers whether to propose or adopt a rule to require the use of DLR.

Respectfully submitted,

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Date: April 25, 2022

CERTIFICATE OF SERVICE

I hereby certify that I have served a copy of the foregoing document upon all parties listed on the official service list compiled by the Secretary in this proceeding. Dated at Washington, D.C. this 25th day of April, 2022.

/s/ Lauren A. Perotti

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