

Transmission Line Ratings: Seasonal, AAR, and DLR

Purpose

In the rapidly evolving energy landscape, ensuring the reliability and efficiency of the electrical grid is a focus for all organizations that own, operate, and oversee the operation of the bulk electric system. With increasing demands from changing generation mix, increasing load, aging infrastructure, and extreme events, the Federal Energy Regulatory Commission (FERC) is implementing new frameworks for calculating transmission line ratings. FERC Order 881 *Managing Transmission Line Ratings* (RM20-16-000) [1] requires use of ambient adjusted ratings (AAR) for transmission lines under some circumstances, and ANOPR *Implementation of Dynamic Line Ratings* (RM24-6-00) [2] would require the use of dynamic line ratings (DLR). With these actions, FERC seeks to change the common approach of calculating transmission line ratings using static methods (e.g., seasonal ratings) and require the use of dynamic methods, such as AAR and DLR. This overview identifies the differences between seasonal, AAR, and DLR ratings systems, as defined by FERC.

Seasonal Line Ratings

In Order 881, FERC refers to “seasonal”, or “static” ratings as the traditional approach to determining transmission line capacity based on fixed weather assumptions. Seasonal ratings do not change frequently (e.g., four sets of seasonal ratings might be used each year) and are calculated periodically using assumptions for variables that affect ratings, including temperature and wind speed. Order 881 states that “...the continued use of seasonal and static temperature assumptions may result in transmission line ratings that do not accurately represent the transfer capability of the transmission system.”¹

Ambient Adjusted Ratings

Implementing AAR, as defined by Order 881, requires the utility to calculate transmission line ratings on an hourly basis using forecast ambient air temperature. Such hourly ratings must be calculated for the near-term (i.e., 10 days), while seasonal ratings can be used beyond that. In addition, Order 881 requires separate day and night ratings, thus including some consideration of the effect of solar heating on transmission line capacity.² As defined, AAR does not account for short-term changes in other weather variables, such as wind speed or cloud cover, therefore limiting the number of variables that must be considered in ratings calculations.

Dynamic Line Ratings

The term “dynamic line ratings” is generally understood to mean transmission line ratings that reflect real-time or near real-time changes in several variables that influence line ratings. In the ANOPR, FERC suggests that ambient air temperature, solar heating based on the sun’s position, forecastable cloud cover, wind speed, and wind direction could be considered as inputs for DLR.³ Some of these variables (temperature and solar heating) are already considered in FERC 881-compliant AAR, but the ANOPR proposes that the solar heating variable could change more frequently than once per day.⁴

¹ Order No. 881 *Managing Transmission Line Ratings* (RM20-16-000) Paragraph 3

² Ibid Paragraph 4

³ ANOPR *Implementation of Dynamic Line Ratings* (RM24-6-00) Paragraph 81

⁴ Ibid Paragraph 85

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FERC states, “...the benefits of more accurate transmission line ratings outweigh the cost of implementation for DLRs that reflect more detailed solar heating based on the sun’s position and forecastable cloud cover and, for certain transmission lines, that reflect forecasts of wind conditions.”⁵ A small number of transmission owners with limited DLR deployments estimate capacity increases on individual lines of 10-25% above seasonal line ratings.⁶ However, the likely targets for such deployments are lines where the need is greatest and where the rating is not limited by terminal equipment or system operating conditions. Therefore, these results may not be typical and are unlikely to indicate gains for the bulk power system overall.

Not all methods used for calculating AAR in accordance with Order 881 (e.g., lookup tables) may be practical for calculating DLR due to the large number of variables to consider. Therefore, implementing DLR would require some utilities to make additional investment in ratings calculation tools. In addition, field sensors and associated communication networks may be needed for some DLR systems (e.g., to collect wind speed, wind direction, conductor sag, or local temperature data). Although the ANOPR states that field equipment may not be required in the final rule,⁷ any assessment of the cost of DLR implementation must consider the initial and on-going maintenance costs of any sensors and communications systems required for the selected implementation.

Comparison of the Three Ratings Methods

Seasonal Line Ratings	Ambient Adjusted Ratings	Dynamic Line Ratings
<ul style="list-style-type: none"> • Static ratings, updated periodically • Fixed assumptions • Generally conservative line ratings • Simple implementation 	<ul style="list-style-type: none"> • Hourly ratings adjustments based on forecast ambient temperature and simple solar heating assumptions • Fixed wind speed and direction assumptions • Line rating may be higher or lower than seasonal ratings, depending on conditions • Requirements allow varying implementation methods and tools investment • Ratings gain may be modest due to limits of terminal equipment or system operating conditions 	<ul style="list-style-type: none"> • Frequent ratings adjustments based on ambient temperature, solar heating, cloud cover, wind speed, and wind direction • Field sensors and communication networks may be required • Maximizes line capacity for some conditions • Relatively complex implementation • Ratings gain may be modest due to limits of terminal equipment or system operating conditions

References

[1] Federal Energy Regulatory Commission, "Order No. 881 Managing Transmission Line Ratings," 16 December 2021. [Online]. Available: <https://www.ferc.gov/media/e-1-rm20-16-000>.

[2] Federal Energy Regulatory Commission, "ANOPR Implementation of Dynamic Line Ratings," 27 June 2024. [Online]. Available: <https://www.ferc.gov/media/e-1-rm24-6-000>.

⁵ Ibid Paragraph 79

⁶ NATF Survey on readiness for grid enhancing technologies, August 26, 2024

⁷ ANOPR *Implementation of Dynamic Line Ratings* (RM24-6-00) Paragraph 107-110