



Evolving Grid Ratings for a More Efficient Energy System

As the energy transition accelerates, so does the need for grid transparency and effective operation. Last December, the FERC released Order 881 calling for all federally regulated Transmission Operators (TOs) to develop and implement Ambient Adjusted Ratings (AARs). For these TOs AARs are to serve “as the basis for evaluating near-term transmission service” on the lines that they operate [1]. The order is aimed to increase the accuracy of line ratings to better utilize the transmission system, and provide further insight into real-time operations. FERC order 881 was then followed by a February FERC Notice of Inquiry (NOI) into Dynamic Line Ratings (DLRs). This NOI is intended to measure the effectiveness of DLRs at increasing the accuracy of near-term line ratings, while maintaining just and reasonable customer rates. The deadline for filings compliance with the FERC under Order 881 is coming up (July 12, 2022), and ISO’s are currently meeting to discuss their steps towards compliance and implementation. Some regions are already utilizing AARs and DLRs, but mandating these across the board is a tall order for Transmission Operators and providers. While the implementation deadline itself is still far ahead of us (July 2025), the push to modernize our real-time operations while facing the realities of the current grid is being felt across the country.

Order 881

The FERC is making their objectives known with the recent FERC Order 881: To reduce transmission and congestion costs, improve the accuracy and transparency of Transmission Line Ratings (TLRs), and to more effectively and efficiently utilize the nation's existing power grid through the use of AARs. The FERC defines an Ambient Adjusted Rating as a “Transmission Line Rating that applies to a time period not greater than one hour, reflects an up-to-date forecast of ambient air temperature across the time period to which the ratings applies, and is calculated at least each hour, if not more frequently.” [2]. Under the mandate, we will see hourly Line Ratings that are adjusted due to ambient temperatures (and possibly other ambient factors) for a current operating day, and at least 10 days into the future. Compared to our current Line ratings methodologies, this will be a substantial increase in the data TOs are reporting and ISOs are collecting, housing and relaying. To truly understand this recent FERC order, how it will affect transmission providers and the grid as a whole, let’s start with a bit of background.

Transmission Line Ratings

As electric power flows across the transmission system, each line has an assigned transmission line rating. Transmission Line Ratings represent the maximum Available Transfer Capability (ATC) of a transmission line at any given moment, and are measured in MW’s of available flow along that line. Available flow is determined by a number of limiting factors, with thermal ratings being the most variable. Thermal ratings vary based on the ambient factors

acting upon a line and its conductors, and can change quickly due to changes in ambient factors. Historically, we have measured these TLRs under static, near worst-case values for assumed weather conditions, assigning a seasonal rating to a line based on high or low temperatures through that 'season'. While this method is useful for a static and stable view of the transmission system, it does not reflect the changes in ATC that occur on a transmission line in real-time. This is a very limiting perspective of our power grid, and its capabilities. The recent FERC order drives home a point many of us already know, it is time for a new method of measuring TLRs.

Ambient Adjusted Ratings

Order 881 calls specifically for an improved methodology, Ambient Adjusted Ratings. The implementation of AARs moves past the static view of the transmission system, and enables us to rate lines under an expanded criteria - principally, ambient influences like conductor temperature, wind factors, and solar radiation. The higher the temperature of a transmission line or its conductor at any given time, the less ATC that line has. When wind cools, or clouds reduce the solar radiation on the conductor during daytime, the transmission line has a higher ATC, and can carry more energy. Integrating this expanded view of ambient factors into our line ratings models allows for more accurate ratings of transmission lines and the transmission system as a whole. Utilizing hourly AARs gives transmission operators a higher level of transparency into how much power we can send along the grid under certain conditions, improving real-time dispatch and operations. Also, forecasting with AARs allows us to better understand and prepare for grid conditions in the future. These benefits lead to increases in the transmission system's ATC, and decreases in transmission and congestion costs (directly affecting end-use customer rates). TLRs directly affect wholesale rates: Higher line ratings (higher ATC) means lower wholesale rates. And increased ATC means more efficient dispatch and fewer constrained equipment across the whole transmission system. AARs represent one of the methods to more accurately rate the transmission lines that make up the system as a whole. Another method, which FERC is currently investigating with their recent Notice of Inquiry (NOI), is Dynamic Line Ratings.

Dynamic Line Ratings

Dynamic Line Ratings (DLRs) take the benefits of AARs a step further. DLRs are 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." [3]. FERC order 881 and the NOI into DLRs both call for hourly updated values of ratings. But DLRs take into account a larger set of ambient factors, and use these as inputs for a real-time model of the transmission system. When it comes to a mechanism for real-time transparency into the grid, DLR's are pretty much the holy grail of line ratings. DLR's offer a more granular and robust method of forecasting what grid conditions will look like in the future, and why. Utilizing DLRs as the method to rate transmission lines has many benefits and many costs. The physical production and installation of the sensors that measure line flow in real-time is expensive (though these costs are marginal compared to annual congestion costs, coming in at \$528 million in 2020 for PJM). Similarly, there are high costs for TOs and firms to collect and store all

of the data purported under the FERC NOI into DLRs, and even higher costs to maintain the sub-hourly data that would be required for close to real-time grid transparency from DLRs. There are some firms that currently offer installation and calibration of these technologies. Our partner, Live Power, being one of them. Live Power offers on-site installation of Dynamic Line Rating sensors, as well as real-time feeds of transmission flow data. While FERC order 881 does not require DLR's, their NOI that followed is at least exploring the feasibility and benefits of mandating DLR's. Some regions are ahead of the curve here, PJM and ERCOT both have DLR programs that they have been developing within the past few years. ISO's have been submitting their comments to the order and hosting informational sessions regarding 881 and the NOI. The dialogues happening during these sessions help direct the development and discussion of line rating methodologies.

System Operator Comments and Discussion

The sessions currently in progress discussing line ratings give us further insight into how these programs will be developed and implemented, as well as some of the costs and barriers associated with implementation. In a recent CAISO session, attendees questioned the marginal benefits of DLRs over AARs, requirements for reporting the data, and which transmission lines could qualify as an exception to Order 881. If there is one thing that is clear about this order, transmission owners and operators have a lot of questions. Recently SPP responded with comments to FERC order 881. One of SPP's main points is that they do not have enough operational data to say for sure if DLRs "are needed to increase the level of transmission line rating accuracy to ensure wholesale rates are just and reasonable." [4]. This is a fair argument, and outlines the need for further study in this area before developing a program like this. Their recommendation to the FERC is to implement a "DLR pilot program to aid with a benefit and impact assessment that DLRs will have on reliability and wholesale markets." [4]. This suggestion would allow entities to gain experience using AAR's that were implemented in FERC order 881, and direct development and implementation of a future DLR program. Another challenge has to do with the scale of data that TO's would need to submit under a robust DLR program. SPP states that 'Currently SPP systems allow for the use of DLRs, and no barrier exists for any TO/TOP to submit DLRs.'. However, a full scale DLR program would require SPP to audit their current informational technology systems to determine whether or not SPP currently even has the ability "to perform its current functions while also receiving substantial information, updated sub-hourly because of an exponential increase in the number of transmission lines utilizing DLRs." [4]. Installing and maintaining the information systems it takes to run an ISO is expensive and demanding. Exponentially increasing the amount of data that a TO or ISO is expected to manage would require system upgrades or new application installations. This highlights a main barrier to implementing a comprehensive DLR program. Data can be inexpensive, but the systems to house and transmit it can be expensive, especially when the data must be retained for a 5 year period. There are many further questions and comments market participants are bringing forth to address the recent rulings. Within the next few months we will see ISO's submit compliance filings to the FERC outlining next steps and further questions for the Commission. During this process we will see what answers the FERC offers, and how the different ISOs and TOs will meet the orders handed down to them.

Conclusion

FERC Order 881 and the NOI into DLRs are still in their earlier stages of review and discussion, but the compliance filing deadline is coming up. These mandates have come at a crucial time, and the value of new line rating methodologies will only continue to grow. The FERC wants to keep customer rates just and reasonable during a time of inflation and rate hikes, as well as support a more robust and efficient transmission system. This all in a time where thousands of new generation projects are stuck in interconnection queues, transmission projects are facing added scrutiny, and supply chain woes are being felt across the entire industry. Soaring gas prices stress our ability to meet ever increasing demand. More frequent emergency weather events highlight the benefits of a transparent energy grid. Higher peak demand and hotter summers stress the importance of a resilient and efficient grid, one that we can hopefully rely on. While development and implementation of Order 881 compliance will not be seen for a few years, the more discussions and programs analyzing our line rating methodologies are steps in the right direction towards a modern and efficient energy grid. As the power grid evolves, so do our demands of it. The better we understand the pros and cons of these line rating methodologies, the more precisely we can implement them, and reap the rewards.

References

[1] FERC Order 881 -

<https://www.ferc.gov/news-events/news/ferc-rule-improve-transmission-line-ratings-will-help-lower-transmission-costs>

[2] FERC Managing trans line ratings -

<https://www.federalregister.gov/documents/2021/01/21/2020-26107/managing-transmission-line-ratings>

[3] FERC implementation of DLRs -

<https://www.federalregister.gov/documents/2022/02/24/2022-03911/implementation-of-dynamic-line-ratings>

[4] SPP comments to NOI -

https://www.spp.org/documents/67003/20220425_spp%20comments%20in%20response%20to%20notice%20of%20inquiry_ad22-5-000.pdf