

Pathways to FERC Order 881 Compliance

A Grid Operator's Guide



July 12, 2024

Chapter 1: The FERC 881 Compliance Journey

Two and a half years ago, Order 881 was greenlit by the Federal Energy Regulatory Agency (FERC). It feels like just yesterday, but now the deadline of July 12, 2025, is just around the corner. Let the one-year countdown begin!

Through Order 881, FERC hopes to find underutilized line capacity on our nation's current transmission infrastructure using Ambient Adjusted Ratings (AAR). AAR provides precise data about factors that affect line capacity and often identifies an additional 15%- 40%. FERC 881 mandates compliance by July 12, 2025, creating urgency for utilities and transmission service providers to implement AAR.

Order 881 Compliance Timeline



Empowering Clean Energy Interconnection

Embracing this order will alleviate the interconnection backlog that hampers the integration of clean power generation and storage resources. In fact, Lawrence National Laboratory reported that the interconnection backlog reached a staggering 2600 gigawatts at the end of 2023, surpassing all previous records. The drive to comply with FERC 881 stems from regulatory requirements and the desire to optimize the existing energy grid, prolong its lifespan, and contribute significantly to a greener future.



Chapter 2: FERC 881 Quick Review

FERC Order 881 mandates transmission service providers, transmission owners, and system operators to embrace accurate and dynamic methods of transmission line ratings, adjustable on an hourly basis. Transmission line ratings represent the maximum transfer capability of each transmission line and can change based on weather conditions.

The Order requires transmission service providers to use Ambient-Adjusted Ratings (AAR) as the basis for evaluating near-term transmission service to increase accuracy. Before FERC 881, utilities set line ratings based on Static Ratings or conservative assumptions about worst-case, long-term air temperature, and weather conditions. This method has resulted in underutilization of the transmission grid.

FERC 881 is comprehensive. It outlines essential compliance factors, including implementing AAR software, hourly updates, reporting protocols, and emergency ratings.

- **Ambient Adjusted Ratings (AAR):** FERC 881 mandates the use of AAR for all power lines affected by air temperature. Transmission providers are obligated to apply AAR and seasonal ratings for short-term transmission service requests (within 10 days), as well as seasonal ratings for longer-term transmission service requests.
- **Hourly Updates:** Service providers are required to develop automated systems and procedures that allow for precise line data to be integrated into capacity analysis. This can be accomplished through Ambient Adjusted Ratings (AAR) and/or Dynamic Line Ratings (DLR). Transmission providers must electronically update transmission line capacity ratings hourly and provide hourly capacity estimates for the next ten consecutive days.
- **Reporting:** Transmission providers must maintain a database of each line rating within an operational range of +/- 10 degrees fahrenheit, compliant with IEEE-738 line ratings standard, and its unique rating methodology. Data must be kept on a password-protected website or its Open Access Same-Time Information System (OASIS) account.
- **Emergency Ratings:** Transmission providers must also establish contingency ratings for use in emergency situations.

FERC 881 Review (continued)

Compliance Enforcement



"We have to figure out as regulators at both the state and the federal level how to help utilities take advantage of this opportunity. It's real and it's exciting – we can take these big old clunky not-smart wires and turn them into more dynamic assets on the system. It will save customers money, and now is the time to do it as we are thinking about larger investments in bigger, more expensive, backbone transmission."

FERC Commissioner, Allison Clements

Compliance is no joke. The FERC Office of Enforcement encourages compliance with the Commission's statutes, rules, and orders. The enforcement program gathers information about utility market behavior and individual utilities and providers through audits. It then works to bring providers into compliance. Where violations occur, the Office works to remedy each instance with compliance commitments, disgorgement of unjust profits resulting from the violations, and/or civil penalties.

<https://www.ferc.gov/enforcement>

Capacity to Ease Interconnection Roadblocks

Embracing this order will alleviate the interconnection backlog that hampers the integration of clean power generation and storage resources. In fact, Lawrence National Laboratory reported that the interconnection backlog reached a staggering 2600 gigawatts at the end of 2023, surpassing all previous records. The drive to comply with FERC 881 stems from regulatory requirements and the desire to optimize the existing energy grid, prolong its lifespan, and contribute significantly to a greener future.

Chapter 4: Achieving FERC 881 Compliance

Transmission Line Rating Factors and Types

Before widely available dynamic line rating methodologies such as Ambient Adjusted Ratings (AAR) and Dynamic Line Ratings (DLR), transmission line capacity was calculated using Static Line Ratings (SLR) or Seasonally Adjusted Ratings (SAR). Because these ratings are based on area weather data, they don't account for real-time changes in wind speed, solar radiation, or current weather conditions on each line. A significant amount of capacity is left unused due to these factors, which dramatically affect the actual capacity of transmission lines.

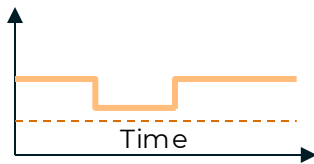
AAR, DLR, or a combination of the two can provide more precise ratings that take into account real-world environmental variations, allowing utilities to choose the best combination of solutions for their environment.

Considers only worst case least cooling



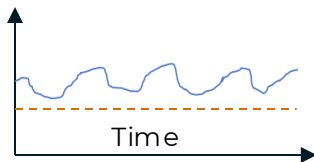
Static Line Rating (SLR)

Considers seasonal worst case



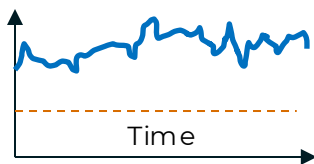
Seasonally Adjusted Rating (SAR)

Considers ambient air temperature from weather stations



Ambient Adjusted Rating (AAR)

Considers air temp, weather, solar, and real-time wind on the line.

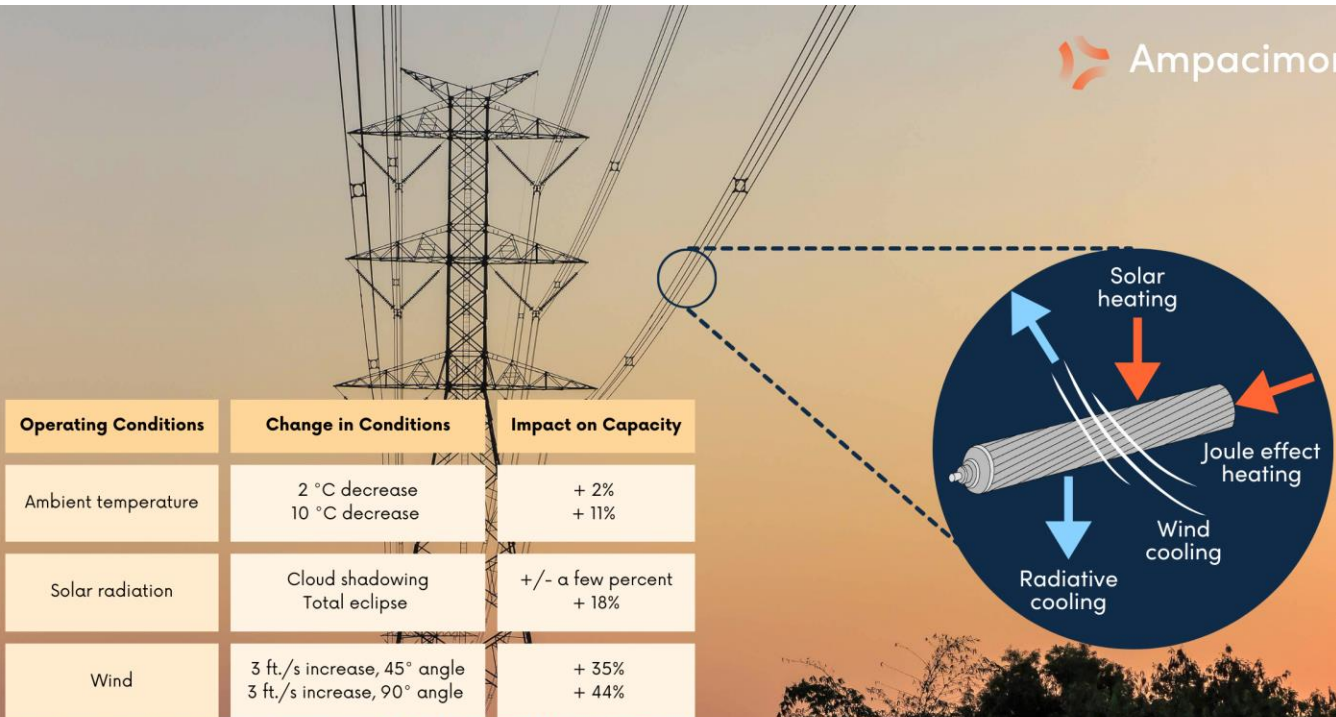


Dynamic Line Rating (DLR)

Chapter 4: Achieving FERC 881 Compliance

AAR and DLR in Focus

Ambient-Adjusted Rating, Dynamic Line Rating, or a combination of the two can provide more precise line ratings that take into account real-world environmental variations. These precise ratings allow operators to safely identify and utilize transmission line capacity that could not be utilized with SAR or SLR. Depending on load and environmental factors, utilities can select AAR or DLR or a combination of solutions for their environment.



Source: Dynamic Line Rating Systems for Transmission Lines Topical Report, US Dept of Energy, April 25, 2014

Ambient-Adjusted Rating (AAR) solutions calculate line capacity using ambient temperature models that consider ambient temperature, solar radiation, conductor type, and a predetermined maximum operating. Assumptions about windspeed are based on local weather station data. Compared to static line ratings, AAR provides a clearer picture of transmission capacity limits and often reveals significant improvements to grid capacity.

Dynamic Line Rating (DLR) solution considers real-time data from line sensors that constantly collect data. DLR solutions consider air temperature, solar radiation, wind speed, and direction. Using this data, DLR can accurately determine the effects of critical transmission line factors like conductor temperature and line sag on the transmission line. DLR can reveal transmission line capacity more precisely than any other method by analyzing this crucial, real-time data.

Chapter 5: Measuring FERC 881 Compliance Benefits


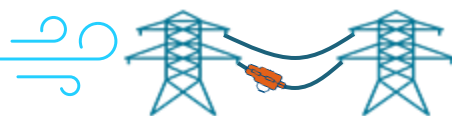
Beyond regulatory compliance, there are benefits to FERC 881. Incorporation of AAR/DLR technology delivers several business advantages for utilities. Increased capacity, improved reliability, and reduced costs to consumers are just a few of the projected direct outcomes.

Increased capacity: DLR is projected to increase the known safe capacity of transmission lines, thereby increasing the ability to meet growing demand. DLR can help service providers prioritize physical grid upgrades. Newly revealed capacity paves the way for interconnection of clean energy sources and allows utilities to meet increasing demand.

Improved reliability: Utilities will reduce the impact of outages and blackouts with increased, action-oriented understanding of precise transmission line capacity. With this data, operators can make informed decisions regarding interconnection of additional power generation resources.

Reduced costs to consumers: Increased transmission line capacity reduces line congestion and accelerates renewable energy interconnection. Clean energy is a proven source of affordable energy.

Dynamic Line Ratings (DLR) are projected to expand the known safe capacity of transmission lines, allowing for integration of new clean energy sources, and simplifying compliance to future FERC rulings.

Methods and Benefits	Ambient Adjusted Rating  Sensorless calculation of line ratings based on 3 rd party weather data and fixed wind input	Dynamic Line Rating  Sensors installed on critical spans of the line provide the most accurate local measurements
Typical Additional Capacity	+10% to 15%	+20 to 40%
Weather Data	Weather Station Temp Solar Radiation	Ambient Temp Solar Radiation Conductor Temp Real-time Wind
Sensors & Software	Ambient Adjusted Rating Software	Dynamic Line Sensors Adjusted Line Rating Software
Real-time Ratings	Updated every 1 hour Includes emergency ratings	Updated every 5 minutes Includes emergency ratings
Forecast Ratings	10-day forecast Updated every 1 hour Includes emergency ratings	10-day forecast Updated every 1 hour Includes emergency ratings
Fallback mode	Seasonal Line Rating	Historical Adjusted Line Rating

Chapter 6: Navigating the Path to Compliance

As FERC 881 compliance deadlines approach, transmission service providers are under pressure to evaluate and accurately assess existing transmission infrastructure to identify areas that require adjustments. Compliance can be designed in less than six months. The following is an example timeline:

Months 1-2:

- Evaluate each line on the transmission system to identify the greatest potential for grid capacity and reliability improvement. Select several lines for a pilot program.
- Evaluate DLR and AAR methodologies and vendors. Select the best option for specific geography, topography, and composition of the transmission lines.

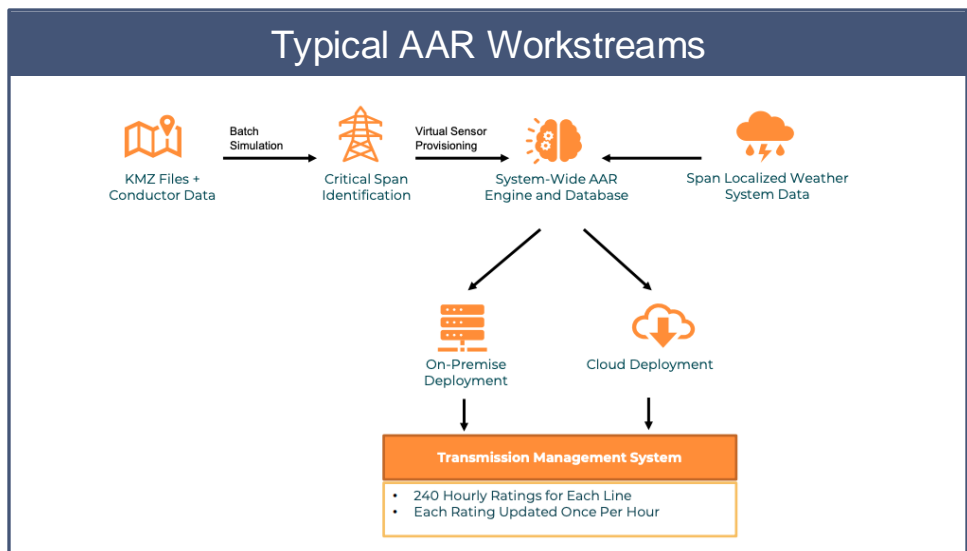
Month 3:

- Select a vendor that can provide an accurate initial evaluation, guidance, support, and a measurable pilot program.
- Conduct a complete evaluation of the existing transmission infrastructure to pinpoint congested lines and areas that are most likely to benefit from AAR/DLR technology.
- Create a plan that not only meets FERC 881 compliance, but provides optimal service, cost, efficiency and opportunities for efficiency and ROI in the future.

Month 4:

- Develop a plan to implement DLR, AAR, or a combination including a trusted vendor, budget, timeline, and staffing requirements.
- Communicate with stakeholders including customers, employees, and regulators about plans to implement ARR/DLR or a combination.

Month 5-6+: Implement AAR/DLR solutions, as appropriate, to achieve FERC 881 compliance.



Summary

FERC Order 881 is an important step forward to cleaner, safer, more affordable energy. July 12, 2024 marks the one year countdown to FERC 881 compliance. Utilities can achieve compliance by acting now to evaluate and test Ambient-Adjusted Rating (AAR) software and Dynamic Line Rating (DLR) sensors. While FERC 881 only specifies the implementation of AAR, operators should select AAR software solutions that are DLR ready, as DLR mandates are sure to come from FERC in the near term. Finally, a combination of AAR and DLR will mitigate line congestion as it identifies unused line capacity, thereby not only providing greater utility from existing grid infrastructure, but also paving the way for more connection of clean energy resources to the grid.

The countdown has begun. Our nation's transmission infrastructure must align with the new FERC 881 regulations in just twelve months. It is crucial for utilities to carefully select partners and solutions that will enable them to meet these requirements efficiently.

With dedication, innovation, and collaboration, we can embrace this new era of cleaner energy and shape a brighter future for generations to come.

About Ampacimon

Ampacimon is a global leader in transmission and distribution electricity grid optimization solutions. Our solutions increase the capacity of existing transmission and distribution grids by as much as 40%, monitor critical assets, analyze grid health conditions, and identify mechanical and electrical faults. Our patented sensors and advanced analytics enable operators to maximize grid capacity, optimize maintenance priorities, and maximize grid modernization investments.

Ampacimon solutions make it possible for grid operators to achieve FERC 881 compliance in the U.S., NERC's FAC-008 data-intensive standard to ensure facility ratings and other important regulatory requirements around the globe. Headquartered in the US and Belgium with offices in Spain, Ampacimon has a global presence with systems installed in most tier-one transmission and distribution grids worldwide. To learn more, visit www.ampacimon.com



"Before construction of new transmission lines, Grid Enhancing Technologies, such as AAR and DLR, can reduce congestion by 40% or more, that is worth over \$5 billion per year to U.S. ratepayers. GETs often pay for themselves within the first year of operation."

WATT Coalition [Report](#), 2023



For more information, visit www.Ampacimon.com

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