

SMARTLINE® AAR/881™

Ambient Adjusted Rating Platform

Building on 10-years experience in providing transmission line ratings, Lindsey Systems has added Ambient Adjusted Rating (AAR) capability to the SMARTLINE platform. This sensor free system supports all the requirements for AAR as set forth in FERC Orders 881 and 881-A, “Managing Transmission Line Ratings.”

Easily Comply with FERC Order 881

The AAR/881 product addition to the SMARTLINE line rating platform provides transmission operators with a simple, unified solution to implement the ambient adjusted line rating requirements as set forth in FERC Order 881. This system can be implemented on any line or lines within days and provides:

- The required 10-days of hourly AAR ratings with the required duration and frequency of updates
- The use of all required environmental parameters
- The ability to provide ratings directly to system operators as well as RTOs/ISOs
- A traceable, proven, rating methodology
- The SMARTLINE AAR/881 system develops ambient adjusted ratings for any line. No sensors are required to be installed on the transmission line.

FERC Orders 881 and 881-A

FERC Order 881 is a Final Rule that requires¹ “Public utility transmission providers to implement ambient-adjusted ratings (AAR) on the transmission lines over which they provide transmission service.”

This Order became effective on March 14, 2022², and all requirements of the Order must be implemented no later than July 11, 2025³.

NOTE: This Order is binding only to USA transmission entities which fall under U.S. FERC jurisdiction. While not specific to SMARTLINE users outside of the USA or within ERCOT, this capability is available to any user.



SMARTLINE® AAR/881™ Ambient Adjusted Rating Platform

Methodology

FERC Order 881 requires line ratings be "computed in accordance with a written transmission line rating methodology." SMARTLINE AAR/881 ratings are developed using a comprehensive and easily documented method based on a combination of required elements, industry standards, and time proven processes. These are as follows:

Elements Required by Order 881:

Order 881 requires the use of continuously updated ambient and forecast ambient temperatures. It also requires a distinction in ratings developed during daytime and nighttime hours.

IEEE Standard 738:

The standard heat exchange formulas identified in IEEE Standard 738 are used to ensure the developed rating will not heat the conductor beyond its maximum average conductor temperature (MACT) limit.

CIGRE Technical Brochure TB299:

Developed by an IEEE and CIGRE joint task force, this guide defines other parameters to be used in developing ambient adjusted ratings and how these parameters may need to be adjusted.

Utility Analysis:

Consistent with the process described in CIGRE TB299, any parameters used in developing a line's rating can be modified to reflect the transmission operator's own engineering analysis of a line.

SMARTLINE Method:

Proven in use by utilities for over a decade, the SMARTLINE method includes the use of multiple AAR computations over the path of the line to ensure ratings reflect the impact of temperature and solar radiation differences across the length of the line.

Next Limiting Elements:

SMARTLINE supports ambient adjusted rating tables for other elements associated with a line and includes those elements in determining the rating of each transmission line.

No Sensors Required:

No Sensors are required to be installed to develop ambient adjusted ratings.

Making the Most of AAR with SMARTLINE AAR/881

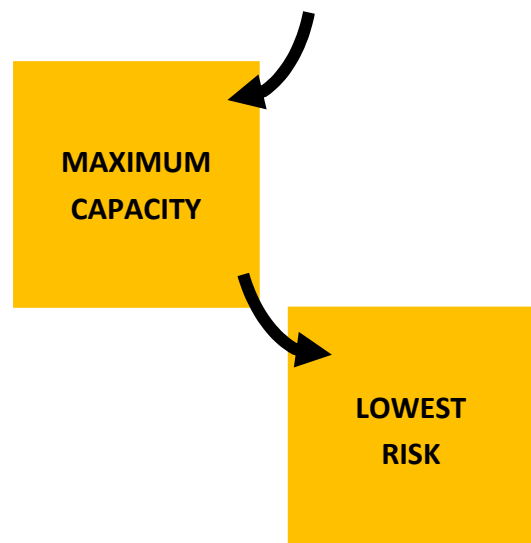
Typical AAR implementations treat transmission lines as sharing common geography and behavior. The result is both increased risk in over-stating capacity from inadequate modeling and missed opportunity by understating capacity from assumptions on the uniformity of line behavior.

SMARTLINE AAR/881 treats each transmission line as a unique entity. Specific parameters are entered in SMARTLINE for each line, considering both individual line parameters and line geography. Time-of-day to the hour, and the documented relationship between ambient and other weather parameters are also used. Both current and forecast ambient temperatures along the length of the line are updated hourly in the system.

SMARTLINE AAR/881 computes AAR ratings for each line uniquely. The result is an optimal picture of the entire transmissions system's ambient adjusted capabilities.

SMARTLINE Treats Each Line as a Unique Entity

SMARTLINE analyzes and models each line using its unique physical and geographic parameters.



Secure Cloud-based Software

SMARTLINE AAR/881 is provided as a highly secure cloud-based system that is easy to integrate into utility applications, while providing useful graphical tools for engineering analysis.

Cyber Security

- Two-factor authentication ensures access is granted only to the person authorized. SMARTLINE provides for unlimited users.
- Regular penetration testing assesses the effectiveness of SMARTLINE's security controls by simulating real-world cyber-attacks.
- All databases and software have full redundant backup ensuring minimal disruption in the event of failure.
- Independent databases are maintained for all customers ensuring no commingling of data.

Web-based Display

A visual display of the developed ambient adjusted ratings is provided for simple examination by engineering and operations personnel (See Figure 1).

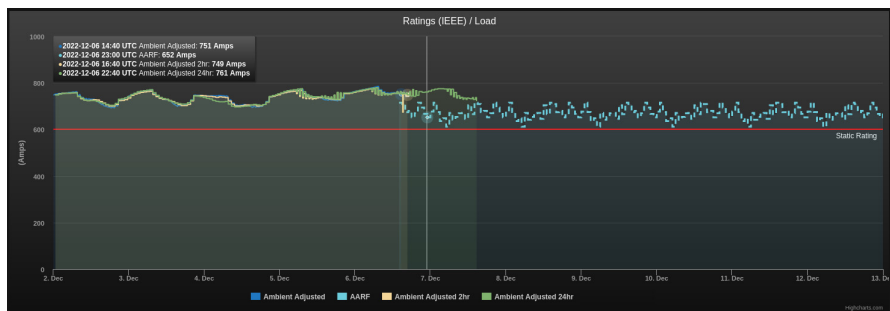


Figure 1: SMARTLINE AAR/881 provides a simple visual display of all 240 1-hour line ratings required by FERC Order 881.

Application Programming Interface Included

- SMARTLINE AAR/881 includes an easy to use application programming interface (API) which allows for quick integration into EMS, system historian, or other applications (See Figure 2).
- All ratings and underlying data are easily accessible using a minimum of data requests.
- Designed as a RESTful API that uses https requests to collect data, the API uses less bandwidth than other methods making it ideal for internet usage.

Weather Data

SMARTLINE AAR/881 includes the use of both primary and secondary weather feeds. Users may choose to use SMARTLINE's default weather feed service or may choose to specify alternate or more local weather services for primary and/or backup.

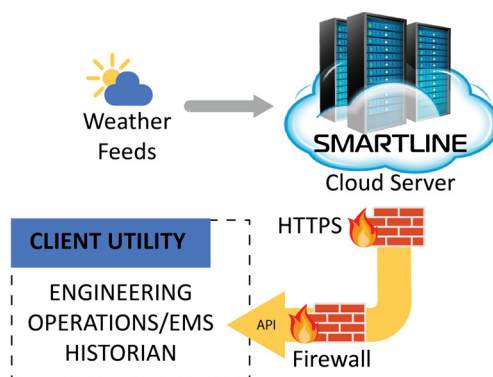


Figure 2: Secure API provides encrypted transmission of ratings.

Summary of SMARTLINE® AAR/881™ Features:

Order 881 details the obligations with which Transmission Providers must comply.

The following table compares these requirements with those functions provided by SMARTLINE AAR/881.

SMARTLINE AAR/881 and FERC Order 881 Comparison		
Order 881 Requirement	SMARTLINE AAR/881	Note
Implement AAR, defined as:		
- One-hour rating durations	YES	
- Use up-to-date ambient forecasts	YES	AAR/881 has provisions for both back-up and user selected weather services
- Reflect the difference in day and nighttime solar heating at least on a monthly basis	YES	Uses daily data based on GPS location
- Calculated hourly	YES	
Provide 10 days' worth of hourly AAR calculations	YES	240 ratings total
Provide for computing emergency AAR ratings as above	YES	
Provide a defined AAR methodology and make it available for sharing	YES	AAR/881 is based upon: 1) CIGRE TB 299 produced by a joint IEEE and CIGRE JTF, <i>and</i> 2) the SMARTLINE line rating methodology Rules used by these methods may be customized by the user based on their system conditions.
Provide for electronic transfer of the set of 240, hourly AAR calculations on an hourly basis to RTO/ISOs	YES	
<i>If DLR is deployed, implement DLR as:*</i>		
One-hour rating durations	YES	
Use up-to-date forecasts of at least ambient, wind, solar heating intensity, and line tension or sag	YES	
*DLR requires the installation of Lindsey type TLM sensors at defined locations		

¹ <https://www.federalregister.gov/d/2021-27735> (Order 881), and <https://ferc.gov/media/e-1-rm20-16-001> (Order 881-A), both accessed on December 7, 2022.

² <https://www.federalregister.gov/documents/2022/01/13/2021-27735/managing-transmission-line-ratings>.

³ This is 3 years and 120 days after the effective date, per paragraph 12 of Order 881.