SMARTLINE-TCF®

Transmission Line Power Capacity Forecasting Platform
The SMARTLINE-TCF platform develops highly accurate forecasts of transmission line power carrying capacity. The platform ensures capacity forecasts comply with electrical clearance limits and will avoid conductor thermal overloads. Forecasts can be provided in one-hour to one-week increments with 98% or better confidence. SMARTLINE-TCF is ideal for engineering, operations, and planning functions, as well as for integration with EMS systems in both day-ahead and real-time markets.

**Firm, Fixed Forecasts**

Firm transmission line power capacity forecasts from 1-hour to seven days ahead. For example, a 2-hour forecast indicates the line may be operated at the forecast level for the next two hours, while a 24-hour forecast allows operation at the forecast level for the next 24 hours.

**Flexible Forecast Scheduling**

Forecasts can be scheduled to be run once a day, or updated periodically. For example, a 12-hour forecast could be run once at midnight and then be updated hourly starting at 8am.

**Forecast Bundles**

Sets of forecasts can be set to run on a regular basis. Define one set of forecasts to support the day-ahead market, another for the real-time market, and another for transmission engineering and planning departments.

**High Confidence**

By default, SMARTLINE-TCF forecasted ratings are set to ensure a 98% confidence factor is achieved for the forecast rating. This means the instantaneous DLR during the forecast period has only a 2% likelihood of being below the forecast rating for that moment in time. If desired, higher or lower confidence factors may be used.

**Clearance Complaint**

The use of real-time, LiDAR-based measurements of conductor clearance to ground ensures forecast ratings maintain compliance to clearance limits in addition to adhering to all conductor thermal limits.

**Selective Data Presentation**

SMARTLINE-TCF provides detailed interactive graphic display for engineering analysis, simple numeric display for EMS operator screen display, and flexible discrete data import into EMS systems.

### Why Transmission Line Capacity Forecasting?

**Forecasting is not the same as DLR**

Seasonally adjusted ratings (SAR) and ambient adjusted ratings (AAR) are commonly used today to increase a line’s static rating by acknowledging different environmental conditions exist at different times of the year. Dynamic Line Rating, or DLR, is a transmission line’s actual, real-time, power carrying capacity. This is based on the conductor’s actual operating temperature using actual line behavior and weather data. While studies have shown DLR techniques can reveal up to 100% additional line capacity, dynamic line ratings are only available in real-time and exhibit highly erratic behavior. Neither characteristic is ideal for operation of a smart, modern power grid.

SMARTLINE-TCF eliminates these limitations and provides stable forecasts of transmission line power carrying capacity with very high reliability (i.e., confidence factor). Unlike DLR, the stability and high confidence factors of these ratings make them suitable for a wide range of operational applications.

Numerous studies have shown this additional capacity provides opportunities in economic dispatch, trading, operations, and congestion mitigation. Application of DLR is also a powerful tool for improving contingency planning, cost effectively addressing lines with slow load growth, and deferring or eliminating the need for line upgrades or reconductoring.

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**Unique advantages of SMARTLINE-TCF:**

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<th>&lt;1%</th>
<th>3 months</th>
<th>10-25%</th>
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<td>A complete SMARTLINE-TCF implementation on a line is typically less than 1% the cost of reconductoring the line. ¹</td>
<td>Typical time for a SMARTLINE-TCF implementation from decision to full operation.</td>
<td>The additional power transfer capacity made available 95% of the time. ²</td>
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**Forecasting Platform Process**

**STEP 1**
- Live weather data
- Live conductor data from TLM monitors

**STEP 2**
SMARTLINE- DLR Engine
SMARTLINE-DLR is the underlying DLR engine that feeds SMARTLINE-TCF. Instantaneous DLR ratings are developed using real-time weather data and conductor behavior learned from the measured conductor parameters. No lookup tables are used. This results in consistent, less sporadic ratings.

**STEP 3**
Engine
Forecast Section Ratings
The SMARTLINE-TCF engine develops future DLR ratings for the desired forecast time-period based on forecasted weather data. These are compared to the corresponding instantaneous DLR at the forecasted time. Statistical analysis of the results over time allows SMARTLINE-TCF to calibrate the forecasts and ensure a 98% confidence factor. Forecasts are generated for each monitored line section.

**STEP 4**
Line Power Capacity Forecast
The overall line forecast is set at the lowest level forecast of all line sections during the forecast window. This conservative approach mimics procedures currently in use by system operators.

Lindsey TLM® Conductor monitors provide direct measurement of conductor current, conductor spot temperature, ground temperature, and actual conductor-to-ground distance via built-in LiDAR. The latter eliminates the need for sag estimations and avoids issues associated with differences between plan profile drawings and actual as-built conditions.
SMARTLINE-TCF

Meaningful Output

SMARTLINE-TCF provides both detailed graphical information showing line information, forecasts, and weather parameters, and simple numeric only ratings for use on EMS screens. Any data may also be imported directly to EMS with ease via an API. All data collected by the conductor monitors, and real-time or forecasted weather data may be viewed graphically or exported for off-line analysis.

EMS Operator Screen:
Forecast ratings

Detailed Forecast Display

Instantaneous DLR graph: The shape is representative of the rapidly fluctuating nature of dynamic line ratings.

Transmission Capacity Forecasts: SMARTLINE-TCF’s unique algorithm indicates the line may be operated at the forecast level with a 98% confidence factor. Two-hour (orange) and 24-hour (green) forecasts shown.

Utility Provided: 2-Hour Emergency (red) and Static Line (gold) ratings provide a familiar frame of reference.

Real-time power: Display of the actual power being carried by the line.