

Dynamic Ratings

Chris Callaghan
Sr. Business Solution Engineer,
Applied Innovation
Operating Committee
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Static vs Dynamic Ratings

STATIC RATINGS

Transmission lines are typically operated using a Static Rating calculated using near worst-case values for assumed weather conditions.

DYNAMIC RATINGS

The rating can be calculated in real-time if the variables in the conductor heat balance equation are known.

Wind Speed Increase
3 ft/s, 90° angle

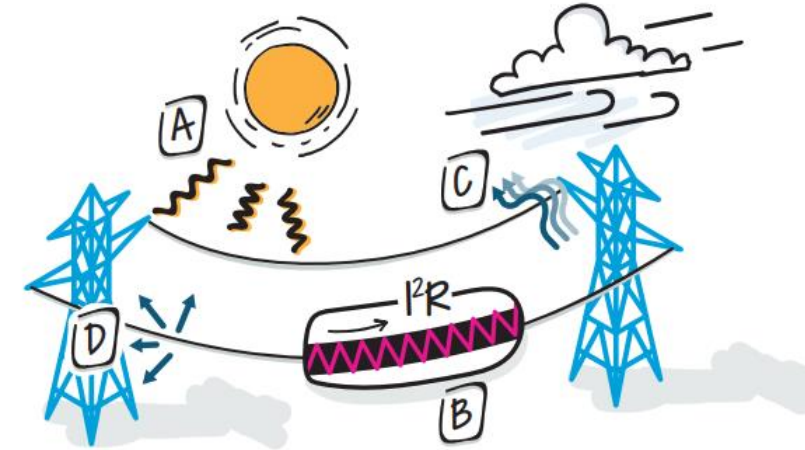


Capacity Increase
+ 44%

Wind cools the conductor allowing more power to safely be transmitted on the line

What are Dynamic Ratings?

Temperature of Overhead Conductors¹



Conductor temperature is determined by:

- Sunlight warming the conductor surface
- Resistive heating (I^2R)
- Convective cooling by wind
- Blackbody (radiative) cooling of the conductor
- Heat capacity of the conductor*

1. IEEE Standard 738-2012

Generally speaking, dynamic rating deployments will involve the installation of a data collection sensor on or near an **existing** transmission line asset to collect real-time conductor temperature information.

Sensor technologies include:

- Weather Stations
- Electromagnetic Field
- Light Detection And Ranging (LiDAR)
- Vibration
- Tension
- Thermal Cameras

Dynamic Rating project installations should target:

- Congested transmission facilities where:
- The transmission conductor is the most limiting element



- Early 2000s: EMS enhancements made to receive telemetered ratings for a small group of transmission lines in PJM. This project lasted ~2 years, and this EMS functionality was last tested in 2015.
- 2016/ 2017: PJM, AEP, and Genscape (LineVision) conducted a DLR pilot on a 345kV transmission line AEP. The focus of this pilot was to gain understanding of:
 - Design & Installation process
 - Passive data collection
 - Estimated economic impacts in an RTO
- 2017/2018: PJM, AEP, and Lindsey conducted a DLR pilot on a 138 kV transmission line in AEP located near a large wind unit with focus on:
 - Simultaneous benefit (co-convection) between DLR and wind unit output
- 2020 and beyond: Dynamic Rating deployments on three 230 kV in the PPL transmission zone.
 - Juniata to Cumberland
 - Hardwood to Susquehanna 1 & 2

PJM Stakeholder Presentations:

- Emerging Technologies Forum (ETF)
 - DLR Primer (8/27/2020)
 - Review of PJM's DLR impacts (11/13/2020)
 - Modeling DLR in Market Efficiency (1/11/2021)

- Transmission Expansion Advisory Committee (TEAC)
 - Modeling DLR in Market Efficiency (12/23/2020)

- Operating committee
 - OC Special Session on Dynamic Rating Education (3/20/2021)
 - [https://pjm.com/-/Dynamic Rating Impacts](https://pjm.com/-/Dynamic%20Rating%20Impacts)
 - [https://pjm.com/-/Dynamic Rating Market Efficiency](https://pjm.com/-/Dynamic%20Rating%20Market%20Efficiency)
 - [https://pjm.com/-/Emergent Technologies Modeling Overview](https://pjm.com/-/Emergent%20Technologies%20Modeling%20Overview)
 - [https://pjm.com/-/Dynamic Line Ratings](https://pjm.com/-/Dynamic%20Line%20Ratings)

PJM has identified that the following manuals may require guidance language on Dynamic Line Ratings:

- Manual 01, Section 3: Member Control Center Requirements
- Manual 03, Section 2: Thermal Operating Guidelines
- Manual 03A, Appendix A: TERM Equipment Ratings Update Process

Presenter:

Chris Callaghan

Sr. Engineer, Applied Innovation

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DynamicLineRatingsTm@pjm.com



Member Hotline

(610) 666 – 8980

(866) 400 – 8980

custsvc@pjm.com