

# Modeling Dynamic Line Ratings Market Efficiency Planning Process

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DLR technology does not modify the physical characteristics of a transmission line, but rather provides a means for determining instant line ratings more precisely by using specialized sensors that provide a more precise indication of the current ratings.

## **Market Efficiency Base Case** is based on the Planning powerflow

MMWG model that uses Planning seasonal ratings

- Summer Normal & Emergency
- Winter Normal & Emergency

## **DA/RT Markets** models are based on the EMS model

Use ambient-adjusted ratings

- 8 Rating steps between 32 F° and 95 F°
- Ratings may change hourly according to the forecasted temperature

- For lines equipped with DLR devices, Planning seasonal ratings will be adjusted to reflect DLR benefits expected to be realized in the markets.
- Adjustment using a DLR Hourly Ratings Modifier added to the Planning seasonal ratings
  - DLR Hourly Rating Modifier calculated as the difference between backcasted\* DLR ratings and ambient-ratings for the DLR line

This method balances several objectives, including:

- Modeling hourly incremental transmission capacity of DLR installation
- Avoiding DLR congestion impact overestimation
- Minimizing additional model complexity

\*Based on historic hourly ambient temperature

- Historic Weather Hourly Data:
  - Wind Speed
  - Wind Direction
  - Ambient Temperature
  - Solar Irradiance
  
- Line Ambient Adjusted Ratings

Line Ambient Adjusted Ratings				
Temp	Day		Night	
Deg (F°)	Norm	Long	Norm	Long
95	674	803	701	825
86	685	815	712	837
77	697	826	723	848
68	708	838	734	859
59	719	849	744	870
50	730	860	755	881
41	740	870	765	891
32	751	881	775	901

Where ambient ratings are determined solely based on ambient temperature, DLR devices report the change in line ampacity due not only to ambient temperature, but also to solar irradiance and perpendicular wind.

- Market Efficiency production cost simulations will use the following hourly line rating set for dynamically rated transmission lines:

$$R_{HRM} = R_{DLR} - R_{AAR}$$

$$R_{DLR-eq} = R_{W/S} + R_{HRM}$$

Item	Description
$R_{AAR}$	Ambient adjusted rating calculated using forecasted ambient temperature, solar irradiance (time of day to determine day vs. night temperature sets), and the line's ambient temperature rating set.
$R_{DLR}$	Dynamic line rating calculated using the same inputs as used above plus forecasted wind direction/speed data.
$R_{W/S}$	Planning Winter/Summer peak rating currently used in PJM's Planning Processes.
$R_{DLR-eq}$	Equivalent line rating to be used for the dynamically-rated transmission line in the Market Efficiency planning process.

1

- Backcast hourly DLR Ratings:  $R_{DLR}$
- (Based on historic hourly ambient temperature, wind speed, wind direction and solar irradiance)

2

- Calculate hourly Ambient Adjusted Ratings:  $R_{AAR}$
- (Based on hourly ambient temperature profile used for the DLR calculation)

3

- Develop Hourly Ratings Modifier:  $R_{HRM} = R_{DLR} - R_{AAR}$
- (Difference between 'backcasted' DLR Ratings and Ambient Ratings for each hour)

4

- Determine Planning Winter/Summer Static Ratings for the DLR line: Ratings  $R_{W/S}$

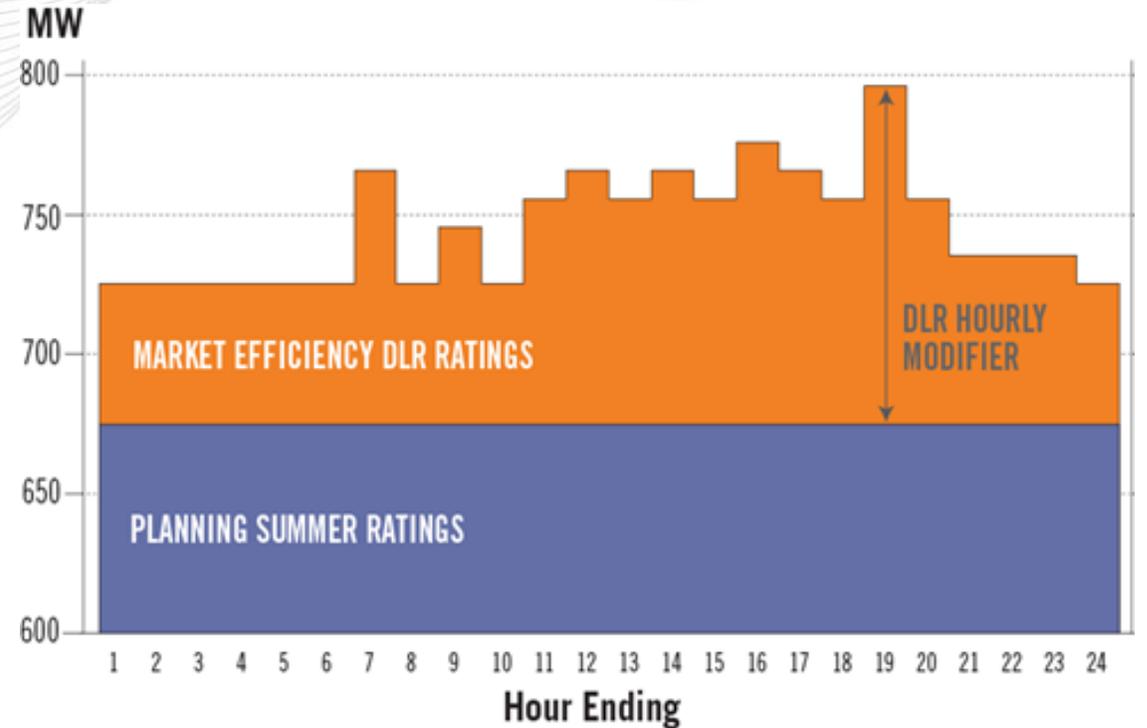
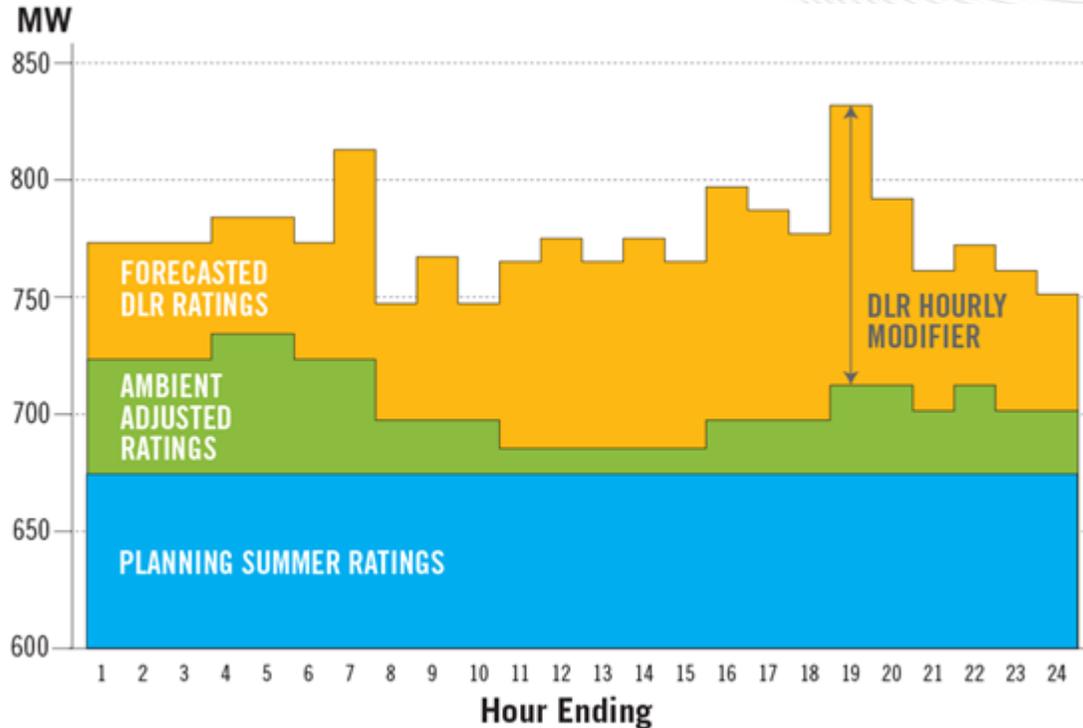
5

- Apply Hourly Ratings Modifier to the Planning Winter/Summer Ratings

6

- Market Efficiency Hourly DLR Ratings for the DLR line:  $R_{DLR-req} = R_{W/S} + R_{HRM}$

*Note: Reliability analyses required as part of the Market Efficiency process will continue to use the planning static seasonal ratings.*



This approach avoids overestimating in the planning models the additional transmission capacity realized by Dynamic Line Ratings, by isolating the technology's added value as expected to be realized in the markets.

## Market Efficiency Modeling

PJM will continue to monitor the deployment of the DLR technology and will refine the Market Efficiency modeling approach as necessary.

## Competitive Window

PJM to update congestion drivers posted for the competitive window as applicable.

## Communication

Further information to be shared at future TEAC (Transmission Expansion Advisory Committee) meetings.

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