



Simulating the Economic Impact of a Dynamic Line Rating Project in a Regional Transmission Operator (RTO) Environment

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- November 2016 – August 2017: PJM, AEP, and Genscape (LineVision) collaborate on a Dynamic Line Rating (DLR) pilot project - *A Non-Contact Sensing Approach for the Measurement of Overhead Conductor Parameters and Dynamic Line Ratings [1]*
- Genscape LineVision product installed at three strategic locations of the Cook – Olive 345 kV line in AEP
- *Note: At the time this project was initiated, LineVision was a business unit within Genscape, Inc. that has subsequently been since spun-out of Genscape, Inc. into its own standalone company, LineVision Inc.*

SPAN & SITE SELECTION



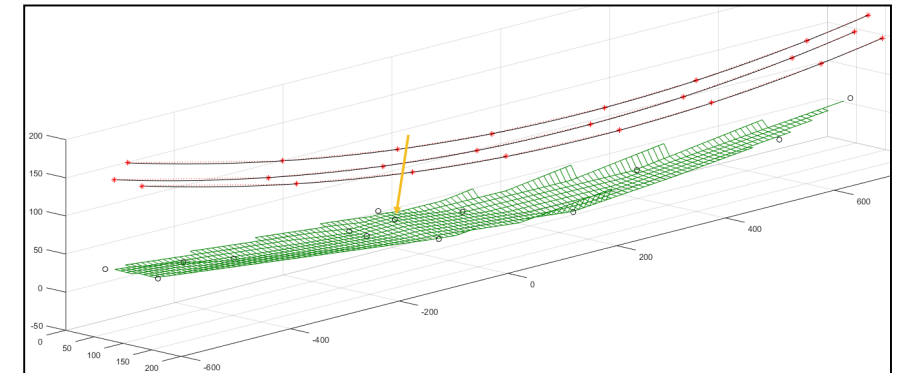
- Select based on topography and criticality

MONITORS INSTALLED USING HAND TOOLS

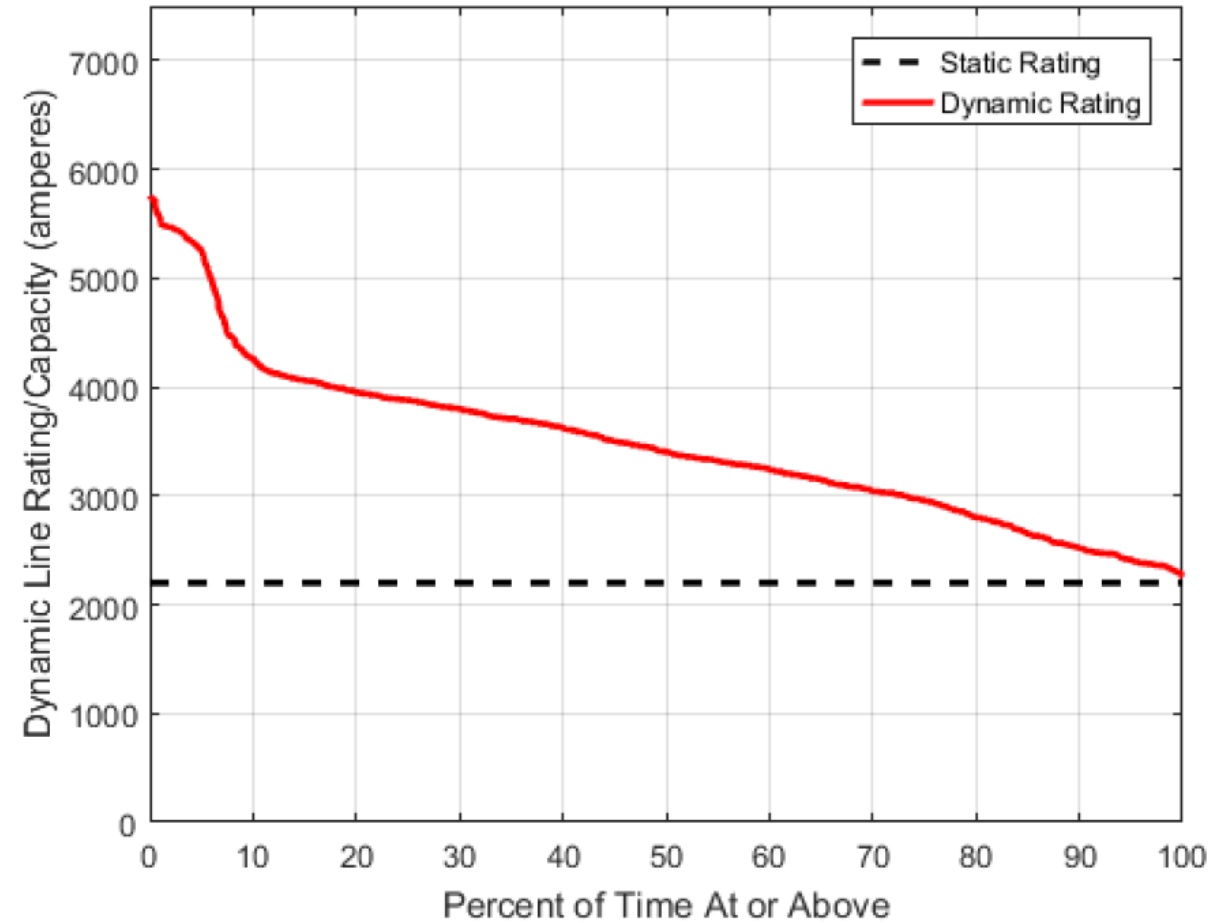


- Installation done without utility crews or line outages

SITE SURVEY & CALIBRATION



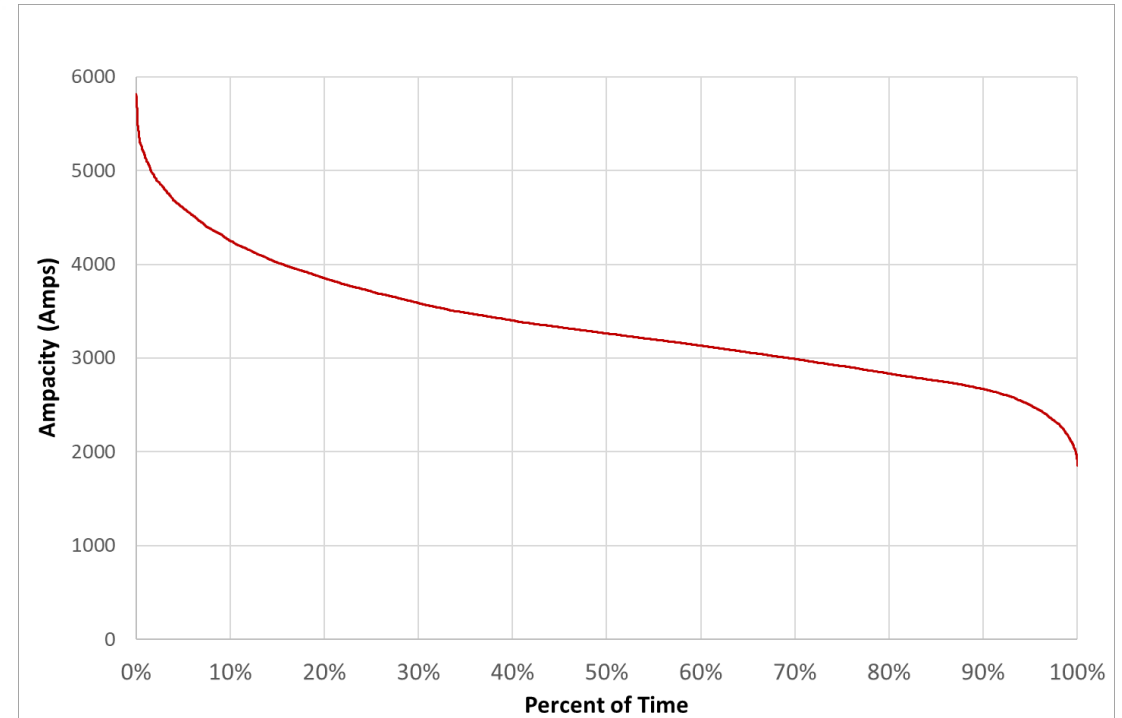
- Span geometry digitally reconstructed and critical point of sag identified



- Transmission projects submitted to address system congestion
- Proposed projects analyzed by PJM in an economic PROMOD simulation
- Benefits must exceed cost by 25% over 15 year period

... What is the economic impact of DLR on PJM congestion?

- ABB PROMOD economic forecasting tool used
 - Target line: most thermally congested line in PJM
 - Back-casted DLR ratings from NOAA historic weather data
 - Hourly security-constrained dispatch for one year
- PJM Market Efficiency 2018 AS-IS Base Case was used: 2018 Summer Peak MMWG transmission system topology; 2018 PJM Load Forecast; PJM queue generation as of October 2017



- A DLR technology will only bring benefit when the transmission conductor is the most thermally limited element in the line – assumed acceleration of an equipment rating upgrade project
- DLR installations should be prioritized on the most heavily congested areas of a power system.
- Ambient air temperatures were computed as average of the six stations.
- Wind speed and direction treated more conservatively by adopting the lowest observed wind speed at each hour (with the accompanying direction)
- Solar irradiance calculated using a conservative approximation - zero cloud coverage and was calculated for each hour of the day based the sun's position in the sky above the Target Line path

- 2 PROMOD simulations were employed:
 - a Base simulation using planning ratings 2800 MVA normal and 3500 MVA emergency for the 500 kV Target Line;
 - a PROMOD DLR simulation using dynamic hourly ratings

Total Annual Congestion			
Circuit	Base Case	DLR Case	Congestion Savings
Target Line 500 kV	\$ (11,118,805)		\$ 11,118,805
Target Line Terminus Substation Transformer 500/230 kV	\$ (10,011,856)	\$ (9,780,911)	\$ 230,945
Downstream Line #1 230 kV	\$ (20,386,483)	\$ (22,773,039)	\$ (2,386,555)
Downstream Line #2 to Downstream Reactor 230 kV	\$ (13,491,444)	\$ (16,180,653)	\$ (2,689,209)
Downstream Reactor - Target Line Terminus 230 kV	\$ (1,145,829)	\$ (2,492,945)	\$ (1,347,115)
Downstream Line #3 - Target Line Origin 230 kV	\$ (2,867,503)	\$ (3,336,319)	\$ (468,816)
Downstream Line #4 230 kV	\$ (19,570,723)	\$ (19,824,341)	\$ (253,619)
			\$ 4,204,436

- Assuming \$500k installation cost: 8.4:1 benefit to cost ratio for one year
- All congestion on Target Line eliminated
- Residual congestion pushed “downstream”

- Better monitoring of existing transmission assets
- More reliability assurance during extreme weather
- Benefits to asset health monitoring: icing, galloping and annealing

- Forecasting for Day-Ahead Generation Dispatch
 - Alignment between real-time and day-ahead markets
 - Balancing congestion incurred when ratings deviate from forecast
- Integrating advanced transmission technologies into Market Efficiency process



ACKNOWLEDGEMENT

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