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PROJECT NO. 52771

INVESTIGATION INTO THE USE OF DYNAMIC LINE RATINGS FOR TRANSMISSION LINES IN TEXAS	§ § §	PUBLIC UTILITY COMMISSION OF TEXAS

COMMENTS OF
LINEVISION

Opening Comments on Commission Staff's Questions:

LineVision is a Grid-Enhancing Technology company that provides electric utilities with the real-time monitoring and analytics needed to secure the future of the grid. LineVision's patented non-contact sensors collect critical information to unlock additional capacity on existing lines, provide insight into conductor health, and detect anomalies and risks.

Based on experience working with some of the leading electric utilities around the world including National Grid, Xcel, and Dominion, LineVision supports the utilization of (DLR) in Texas and appreciates the opportunity to provide responses to the specific staff questions below.

1. **Are you currently using Dynamic Line Rating (DLR) technology or a similar technology on any circuits? If so, how many? What is your experience on the cost, use and value of these investments?**

Transmission owners in RTO's/ISO's currently use either Seasonal Ratings or Ambient-Adjusted ratings (AARs) to calculate thermal transmission line ratings. Seasonal ratings are similar to static ratings but use a different set of ambient condition assumptions for summer and winter. AAR line ratings are modified based on changes in ambient temperature only (often daily or hourly) and are more variable than static and seasonal. In ERCOT, which utilizes AARs to calculate thermal transmission line ratings, real-time transmission line ratings are automatically updated based on temperature fluctuations according to temperature tables provided by each transmission owner and which reside within the ERCOT network model.[1]

Wind speed is the most significant factor affecting line capacity; Dynamic Line Rating, or DLR, takes wind speed and associated conductor cooling impacts into account to better inform operations, while AAR does not. As a DLR technology provider, LineVision's platform, which utilizes patented non-contact sensors, is able to collect critical information to unlock additional capacity on existing electric power transmission lines, provide insight into conductor health, and detect anomalies and risks.

[1] https://www.ercot.com/mktrules/nprotocols/current

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A US Department of Energy report demonstrated that a 3 ft/sec increase in wind speed perpendicular to the conductor will increase its carrying capacity by 44%, indicating that significant increases in transmission capacity can be realized by utilizing DLR.[2]

2. **Does ERCOT have the appropriate system to take advantage of this real-time technology and is it utilizing this data to expand the use of the power system in a reliable manner?**

As funded through the American Recovery and Reinvestment Act of 2009, the Department of Energy's Smart Grid Demonstration Project (SGDP) helped fund a DLR project in Texas. Nexans developed the DLR system for Oncor, which is the largest regulated transmission and distribution entity within ERCOT; the project covered five 345 kV and three 138 kV transmission lines. Oncor's goal was to test the commercial viability of DLR technology and also incorporate DLR's into real time operations, which it successfully completed[3]. Oncor's project also identified the potential for DLR's to integrate wind resources, observing a relative increase in wind generation at the same times when DLR systems increased study lines' transmission capacities. Lastly, ONCOR calculated DLR's of, on average, 30 to 70 percent greater than static line ratings. Successful completion of the Texas DLR demonstration project proves that DLR technology can be a potential key component of improving the resiliency of the existing Texas power grid.

3. **Where on your system could additional DLR systems be deployed and at what cost and value to the system and market?**

DLR tends to be most beneficial on congested, thermally limited lines and on neighboring or contingent lines. It is therefore suggested that the transmission distribution utilities (TDU's) be required, for each line that has or is forecast to become congested, to be assessed for the applicability of DLR and implement DLR if certain criteria are met. In comments of the WATT Coalition in the Line Ratings NOPR at FERC (RM20-16-000), the following minimum criteria were suggested for determining when DLR should be required.[4]

<u>Sensor-Based DLR required on thermally limited lines/circuits >=69kV when:</u>

- Market congestion totaling over $1 million has occurred in the last year OR
- The line is identified as being a constraint projected to have market congestion over $1 million over the coming three years as part of the current ISO/RTO transmission planning process, which can be economic or reliability-based OR
- Thermally limited lines show up as limiting in generator interconnection system impact studies OR
- Generation curtailed by more than 10% on average for 1 year due to factors that include line capacity

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[2] U.S Department of Energy, "Dynamic Line Rating Systems for Transmission Lines Topical Report," in Smart Grid Demonstration Program, 2014.
[3] https://www.smartgrid.gov/document/dynamic_line_rating_systems_transmission_lines
[4] https://watt-transmission.org/wp-content/uploads/2021/03/Comments-of-the-WATT-Coalition-on-line-ratings-NOPR.pdf

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Furthermore, transmission customers often know what constraints are leading to congestion or curtailment; those customers should be able to request a utility implement DLR to alleviate a known constraint, especially if they are willing to pay for the application.

4. **What are the challenges that a transmission distribution utility (TDU) may encounter when trying to install or implement this technology on a widespread basis?**

Challenges unique to DLR implementation include sensor placement and maintenance given that the line rating methodology requires field-based equipment. LineVision can remove these barriers by providing simplified installations which require no outages and no live-line work as LineVision's technology is tower-mounted and not conductor-mounted. Work related to the integration of DLR data into system operations is another consideration; however, many utility Energy Management Systems currently have the ability to accept DLRs, or can be updated to do so, and many RTO's/ISO's have also indicated this type of automation is possible.[5]

5. **Are there drawbacks or benefits to utilizing this technology in the ERCOT market?**

ERCOT serves 90% of the electric load in Texas. This power region has experienced consistent load growth in recent decades due to a strong economy and increasing population, unlike some other U.S. markets which have experienced little growth. Currently, 26 million people within Texas receive electric service via the electric grid managed by ERCOT.[6]

Accurate line ratings increase the efficiency of the transmission system and enable the increased use of low-cost renewable generation dispatch. DLR can serve as a rapidly deployable source of transmission capacity for renewables that might be stuck in an interconnection queue or subject to curtailment as new transmission projects move through a longer-term process that is often subject to regulatory/permitting challenges and delays.

ERCOT is relatively unique in that it is an "energy-only market" and thus does not operate a capacity market or impose resource adequacy targets in order to maintain a target reserve margin. The utilization of DLR can help ensure that the needs of ERCOT's market structure are addressed in a cost effective, efficient manner. As the Organization of MISO States noted in FERC's NOPR on Managing Line Ratings, "customers are harmed when transmission line ratings do not reflect the actual capabilities of the facilities based on ambient conditions. This can lead to higher energy prices and increased levels of congestion due to sub-optimal flows on the system."[7]

6. **Does the current rate structures in ERCOT reward/encourage grid investments such as DLR?**

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[5] Managing Transmission Line Ratings, A Staff Paper: Federal Energy Regulatory Commission. August 2019, Docket No: AD19-15-000

[6]https://www.puc.texas.gov/agency/resources/reports/UTAustin_(2021)_EventsFebruary2021TexasBlackout_(002)FINAL_07_12_21.pdf

[7]http://www.misostates.org/images/PositionStatements/OMS_Position_Statement_Enhanced_Line_Ratings.pdf

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Texas is the nation's leader in wind capacity; in 2020, it installed the most land-based wind capacity in the country and now has nearly 20% of its electricity coming from wind. As of the end of 2020, approximately 25,000 MW of wind and 4,000 MW of solar photovoltaic capacity were installed in ERCOT.[8]

That is what makes DLR such a critically needed missing component of the Texas energy grid: conductor temperature and sag are the primary limiters for power line capacity, and wind speed is the primary environmental factor in cooling conductor temperatures. Furthermore, the times when wind farms are at their peak generating capacity is inherently during windy times when conductors will benefit from this convective wind cooling. This underscores the need to move beyond the common practice of selecting extremely conservative assumptions for the environmental operating conditions of a power line, which essentially serves as a fixed speed limit for how much power can be transmitted. A DLR is the transmission line's actual real-time or forecasted power carrying capacity. It is based on measurements of the conductors actual operating temperature using real-time line measurements of the conductors sag and nearby ambient weather conditions. DLR allows us to safely increase the speed limit of the power line so we can put more electricity on existing assets.

Results from deploying LineVision systems on existing transmission infrastructure have demonstrated that we can safely and reliably increase powerline capacity by as much as 40%. This means that utilities can effectively double the current rate of renewable integration on our existing grid; a summation confirmed in a study conducted by the Brattle Group.[9]

7. Is there an unwarranted cybersecurity risk associated with this technology?

The results from the SGDP project with Oncor concluded that Cybersecurity assessments and Interoperability integration into transmission system operating functions were achieved showing minimal risk or difficulty.[10]

Furthermore, as per current best practices, the Commission could clarify that the operator's EMS system would be directed to default to a static rating if there is a lapse or suspected corruption of the information being sent.

8. Will widespread utilization of this technology exacerbate other constraints on the system?

In PJM, LineVision was involved in a DLR pilot study on the 345kV Cook-Olive transmission line, located in AEP territory spanning from southwest Michigan to northern Indiana. In the first phase, LineVision designed sensors were installed to measure power flow, conductor position/sag, and

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[8] ERCOT "Resource Capacity Trend Charts" at http://www.ercot.com/gridinfo/resource (e.g, December 2020: http://www.ercot.com/content/wcm/lists/219848/Capacity_Changes_by_Fuel_Type_Charts_December_2020.xlsx

[9] https://watt-transmission.org/unlocking-the-queue/

[10] Oncor Electric Delivery Smart Grid Program, Contract ID: DE-OE0000320, Dynamic Line Rating. Final Report. August 1, 2013.

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weather conditions in order to calculate DLR's on the line. The results of the first phase highlighted that Cook-Olive's DLR was significantly greater than static ratings.[11]

In Phase two, LineVision, AEP and PJM worked to quantify the financial impact of DLR by identifying a line similar to Cook-Olive that was heavily congested with a straight transmission path. Working with AEP and PJM, the analysis determined that $11.1 million of congestion on the target line was eliminated with DLR. However, several downstream 230kV lines saw an increase in congestion, resulting in a net of $4.2 million of congestion reduction. This pilot led to the recommendation to equip multiple circuits in a congested area with DLR.[12] The implementation of DLR was shown to have provided a net economic benefit to the grid.

9. Should this technology be included in all new high voltage lines within ERCOT?

The recently passed Infrastructure Investment and Jobs Act (IIJA) creates a $2.5 billion revolving loan fund for proposed electric power transmission lines.[13] When evaluating proposed projects within the transmission facilitation loan program, DOE has stated that priority and favorable evaluations will be provided to projects that include DLR as a part of their new transmission line proposals. As stakeholders work to develop and deploy new transmission lines, the utilization of DLR should be mandatory in order to help equip transmission owners and grid operators with the most advanced technology solutions to provide better situational awareness and real-time visibility, which help increase the resilience of the system overall. LineVision provides these benefits as part of a new model for building grid capacity, using low-cost sensors and analytics to enable up to 40% additional capacity on existing lines through DLR.

Transmission will also be key to delivering an electrified future. Texas has the third most registered EV's in the country[14]; the need for DLR is great as the electrification of transportation in Texas accelerates. A recent study from the Princeton Adlinger Center concluded that the grid will need to double by 2035 and triple by 2050 to support the required renewable integration and load growth from electrification.[15] DLR will be a critical solution to ensure that existing grid capacity is maximized as load growth from electrification enhances the ability of the electric grid to provide a critical commodity for the transportation sector.

10. Is there system reliability, situational awareness benefits to utilizing this technology?

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[11] Marmillo, J.; Mehraban, B; Murphy, S; Pinney, N. A Non-Contact Sensing Approach for the Measurement of Overhead Conductor Parameters and Dynamic Line Ratings. CIGRE US National Committee 2017 Grid of the Future Symposium

[12] S. Murphy; N. Dumitriu; N. Pinney; J. Marmillo; B Mehraban. "Simulating the Economic Impact of a Dynamic Line Rating Project in a Regional Transmission (RTO) Environment." CIGRE US National Committee 2018 Grid of the Future Symposium

[13] https://www.natlawreview.com/article/electricity-transmission-provisions-bipartisan-infrastructure-bill

[14] https://insideevs.com/news/530258/total-ev-registrations-by-state/

[15] https://www.princeton.edu/news/2020/12/15/big-affordable-effort-needed-america-reach-net-zero-emissions-2050-princeton-study

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LineVision's platform provides multiple value solutions among three application categories: Line Aware, LineRate, and Line Health:

- LineAware provides utility and grid operators with situational awareness, which helps to inform operators with clearances and horizontal motion data, triggering alerts on exceedances
- LineRate provides DLR, which increase the capacity on lines with Forecasted and Real-Time DLR and Ambient Adjusted Ratings (AAR+)
- LineHealth provides utility and grid operators with Asset Health Monitoring, which helps improve maintenance strategies by creating a digital twin to determine conductor health

The additional information about a transmission line provided by LineVision's platform can increase situational awareness, helping an RTO/ISO or transmission owner to monitor the condition/health of a line in real time. For example, information provided by LineVision's LineAware application can allow an RTO/ISO or transmission owner to detect risk of line slap, clearance violations, icing, storm damage, or other asset health issues.

Furthermore, the Federal Energy Regulatory Commission (FERC) also acted recently to address the accuracy and transparency of transmission line ratings, issuing Order 881 on December 16, 2021.[16] Regarding DLR, it requires RTO's and ISO's to establish the systems and procedures needed to accommodate DLR if transmission owners wish to implement them. It also established a separate proceeding (Docket No. AD22-5-000) to further consider DLR issues.

11. Please provide an overall cost-benefit analysis to addition of this technology.

An example with compelling cost-benefit findings can be found in the Southwest Power Pool. AEP had identified a 2.1mile line for a rebuild project, which would cost ~$4 million over a 3-year construction timeline. LineVision installed 1 system unit to create 1 monitored location at a cost of $50,000 and 0.5 day install. Using the LineRate application, LineVision found that extra capacity was available during periods of market congestion and that redispatch and renewable curtailments were not necessary as DLR was above the static rating 99.9% of the time over 4 summer months. [17]

Conclusion:

LineVision appreciates the Commission's interest and consideration of DLR. LineVision welcomes the opportunity to work with the Commission, Staff, and other stakeholders to advance policy solutions like DLR that will help enable a more dynamic and resilient Texas grid.

[16] FERC Order No. 881, Managing Line Ratings, Docket No. RM20-16-000; https://www.ferc.gov/news-events/news/ferc-rule-improve-transmission-line-ratings-will-help-lower-transmission-costs
[17] N Pinney et Al. An Analysis on the Economic Impacts of Dynamic Line Ratings on a Congested Transmission Line in Southwest Power Pool. CIGRE Grid of the Future 2018.

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Respectfully submitted,

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Executive Summary

The electric utility industry is experiencing a transformation across all aspects of the business - from power generation to customer engagement.

Transmission lines are the vital arteries at the core of the electric grid, reliably delivering power from varied sources of generation to customers. Most of these lines were built decades ago for predictable one-way delivery of power from large coal, gas and nuclear plants. Today, with the growth of distributed and renewable power, utilities need to transform their grid to accommodate variable generation and growing demand. In addition, with aging infrastructure and the growing risk of storm damage and wildfires, utilities need enhanced visibility on the condition of these key assets to ensure system reliability and public safety.

LineVision's transmission line monitoring uses non-contact sensors to collect real-time data on a line's electrical properties and physical condition. It then leverages that data with advanced analytics and machine learning to give utilities the most accurate data on the line's dynamic capacity, asset health and situational awareness available today.

Transmission line monitoring gives utilities confidence that they are getting the most out of their existing transmission infrastructure while ensuring their lines are being operated safely and reliably.

LineVision appreciates the opportunity to provide written comment on the questions identified related to Dynamic Line Rating (DLR) technology in Project No. 52771.

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