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Received - 2021-12-30 09:58:27 AM
Control Number - 52771
ItemNumber - 11

PROJECT NO. 52771

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

ONCOR ELECTRIC DELIVERY COMPANY LLC'S RESPONSE TO COMMISSION STAFF'S QUESTIONS FOR COMMENT

Oncor Electric Delivery Company LLC ("Oncor") appreciates the opportunity to provide this Response to the Questions for Comment filed by the Staff of the Public Utility Commission of Texas ("Commission Staff") on November 17, 2021. This response is timely filed by noon on December 30, 2021.

I. RESPONSES TO QUESTIONS FOR COMMENT

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?***

Response:

Yes, Oncor is currently using DLR technology or a similar technology on most of its transmission circuits as explained in more detail below.

Oncor determines transmission line conductor ratings using one of the following two methods: (1) the Static Rating Method ("Static"); or (2) the Ambient Adjusted Temperature Method ("AAR").

As referenced within IEEE Standard 738, *Standard for Calculating the Current-Temperature Relationship of Bare Overhead Conductors*, static steady-state ratings for overhead transmission line conductors must consider several variables, some of which include the following:

- ambient air temperature;
- maximum steady-state current;
- coefficient of emissivity;
- coefficient of absorption; and
- wind speed.

While some of these variables are essentially constant, other variables—such as the ambient air temperature and wind speed—obviously are not. Absent real-time measurements, conservative values are assigned to each variable for the purpose of calculating a Static rating. For ambient air temperature and wind speed calculations under the Static method, 104° Fahrenheit (F)

and two feet per second are the respective assigned values, which are based both on Oncor's internal standards and common industry practice as recognized in IEEE Standard 738. Static ratings are used for overhead transmission lines not wholly owned by Oncor (if the owner of the other portion so requests), jumpers or busses used to connect two separate stations, lines monitored by Remedial Action Schemes for thermal overloads, and lines where relays are the limiting factor.

Oncor uses the AAR method for the vast majority of its overhead transmission lines. The AAR method leverages a five-minute average ambient temperature, as measured in one of Oncor's seven weather regions, rather than an ambient temperature of 104° F, as is used to calculate the static rating of an overhead transmission circuit.

If the air is cooler than 104° F, holding all other parameters the same, the AAR for an overhead transmission line circuit is greater than the Static rating for the same circuit; however, in the rare circumstance where the ambient temperature is higher than the constant 104° F temperature assumed under the Static method, the AAR for an overhead transmission line circuit is less than the Static rating for the same circuit (again assuming all other parameters are the same). As ambient temperatures are generally substantially less than 104° F, AAR method ratings are nearly always greater than a Static method rating.

Oncor also has in-depth experience with more complex DLR technologies that go beyond use of the AAR method. As part of an effort which was partially funded by the U.S. Department of Energy ("DOE"), Oncor initiated a project in 2010 to evaluate the implementation of complex DLR technologies. Although a variety of complex DLR technologies were evaluated, the "CAT-1 DLR System" was selected for use in the initial DOE-funded effort. Oncor installed the CAT-1 DLR System on eight transmission circuits in central Texas. The CAT-1 DLR System calculated dynamic ratings through consideration of both ambient air temperatures and local wind conditions. The CAT-1 DLR System used sensors to measure real-time conductor tension, as shown below in Figure 1, as well as locally-collected temperature measurements.

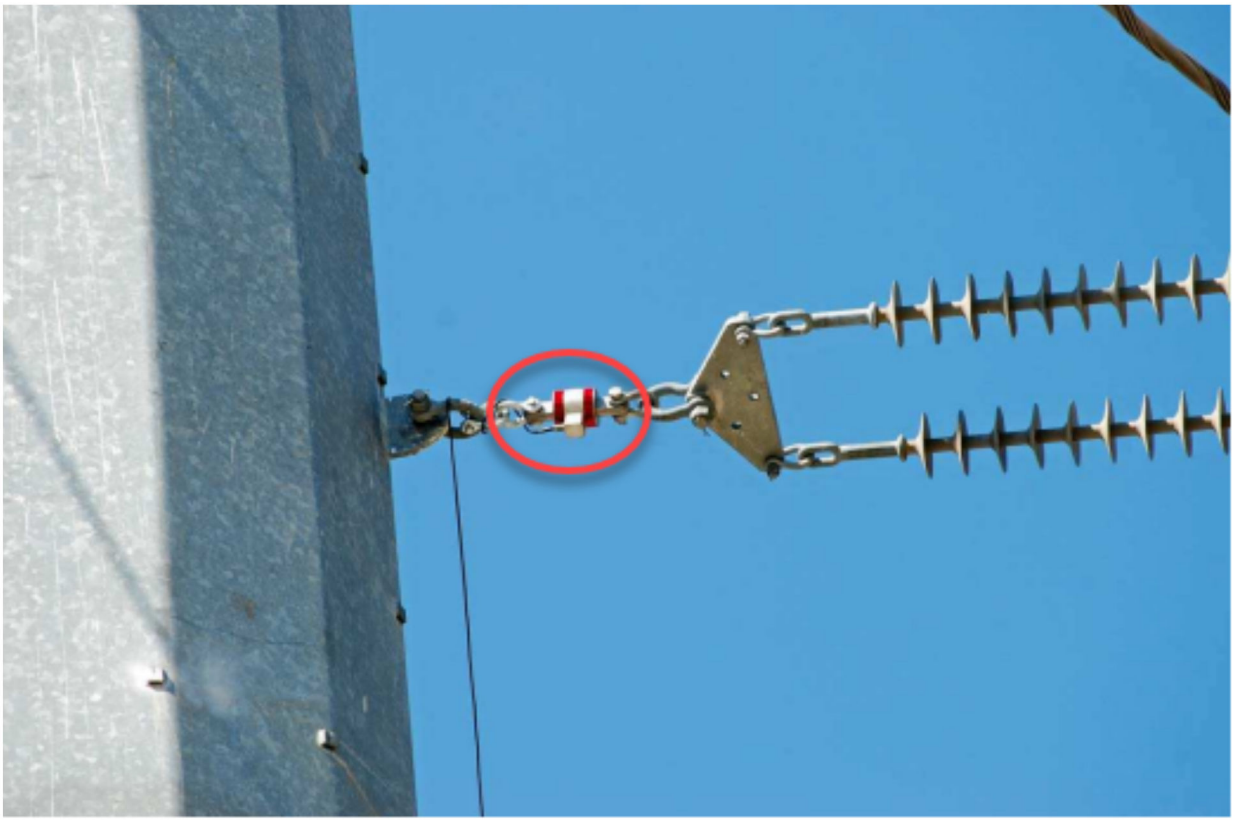

Figure 1 - Typical CAT-1 DLR System Load Cell (circled in red)

The dynamic ratings generated by the CAT-1 DLR System were nearly always greater than the ratings under the AAR or Static methods; however, these CAT-1 DLR System ratings did exhibit significant variability. Figure 2 shown below is an example of the variation which often exists among these different methodologies, as captured over a three-day period on one of the eight circuits which was part of the DOE project.

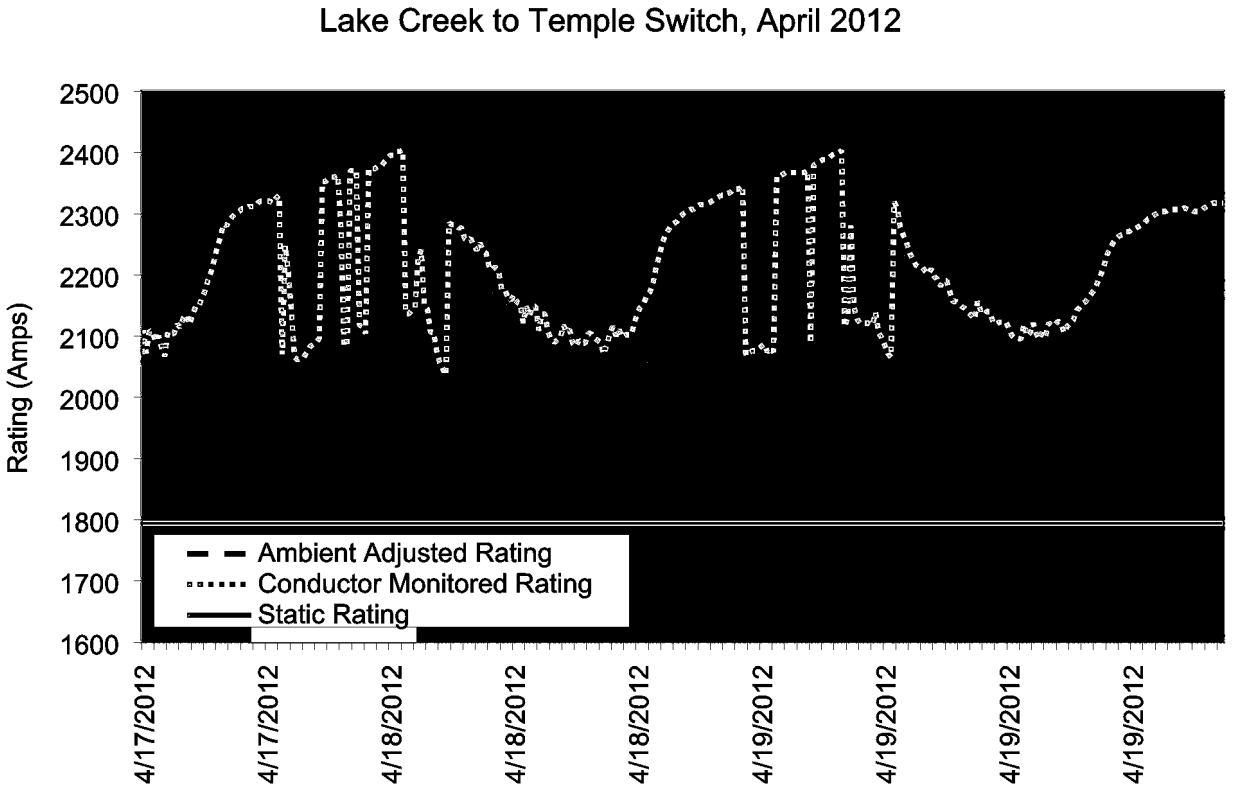

Figure 2 - Snapshot of various ratings calculated on a circuit with a CAT-1 DLR System

The solid line in Figure 2 represents the Static rating, which remains constant as this rating is based on assumed parameters.

The dashed line in Figure 2 represents the AAR rating, which changes with the ambient temperature. In this particular case, the AAR shown in Figure 2 was calculated by the CAT-1 DLR System, and it incorporates both ambient temperature and solar radiation. Incorporating solar radiation into this calculation can result in rapid AAR changes, such as during sunrise and sunset. Typically, this type of rating only includes ambient temperature. Note also the diurnal pattern reflecting the change in AAR throughout the time period shown in Figure 2—ratings typically reach a peak overnight and decrease over the course of the day.

The dotted line in Figure 2 represents the conductor-monitored CAT-1 DLR System rating. While the conductor-monitored rating calculated by the CAT-1 DLR System typically exceeds the AAR and Static rating, as is shown in Figure 2, there are still times where conductor-monitored rating is lower than one or both of the other methods—this occurs due to either an ambient

temperature greater than 104° F, wind speed of less than two feet per second, or a combination of both.

As noted in the final report submitted to the DOE in August 2013, ratings calculated through the CAT-1 DLR System were greater than the Static rating approximately 97% - 99% of the time, and greater than AAR method ratings 80% - 95% of the time.

Due to the results of the initial DOE pilot, additional CAT-1 DLR systems were installed on five circuits in west Texas during the summer of 2013; the short deployment time allowed Oncor to quickly mitigate congestion occurring in the area until more robust solutions – new and upgraded transmission lines and stations – could be implemented.

While the CAT-1 DLR System worked, it was not financially successful for the vendor. In January of 2018, only two years after purchasing the intellectual property for the CAT-1 DLR System, the vendor for that system notified Oncor that it would suspend manufacturing and support of the CAT-1 DLR System. Currently, Oncor is not communicating any ratings generated by the CAT-1 DLR System or any other complex DLR technology.

Overall, the cost, use and value of the AAR system has proven to be the best solution, and it is widely deployed by Oncor across its transmission system. The cost, use, and value of the CAT-1 System Oncor piloted, mostly through DOE funding, has become obsolete due to its vendor's discontinuance of manufacturing and support for that type of system. Oncor will continue to evaluate other commercially available DLR technologies based on these considerations.

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?***

Response:

While this is primarily a question for ERCOT to answer, in Oncor's experience, ERCOT does have the necessary tools and systems to use AAR and other types of DLR in real time. Oncor's AAR data is being used by ERCOT to maximize the effectiveness of existing transmission facilities while operating the system in a reliable manner.

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

Response:

Oncor has already deployed DLR capabilities across its system in the form of AAR. More complex forms of DLR could potentially be deployed in a targeted manner to provide slightly more capacity as a short-term bridge to address constraints while long-term solutions are being

implemented. The cost and value of these more complex DLR systems are discussed in Oncor's responses to Questions 1, 4, and 5.

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?***

Response:

TDUs will encounter different challenges based on the type of DLR technology that is being deployed. AAR can be deployed very quickly because it does not require the installation of additional physical devices, with the possible exception of a few simple weather monitoring devices if the TDU does not want to be dependent on external weather data for real-time ratings calculations. The TDU will need to perform an initial review of its facilities and develop ratings that account for a spectrum of ambient temperatures.

The implementation of DLR technologies that require the installation of various monitoring and sensing devices on the actual transmission facilities will be much more challenging, complex, and costly to implement on a widespread basis. The type of DLR technology being implemented will dictate a number of the variables discussed below:

Transmission Facility Outages – Outages will be required for the installation of certain technologies. This is problematic in that the ERCOT system is already stressed from an outage management perspective due to load growth, construction outages and maintenance outages. Additionally, any devices installed in the field will eventually require maintenance which will drive further outage needs. Oncor's previous experience with the CAT-1 DLR System, which used conductor tension measurements to calculate real-time dynamic ratings, indicates that many components of a DLR technology will likely require regular maintenance, or replacement, while the system is in use. Although the CAT-1 DLR System technology was only installed on 13 transmission circuits, and was operational for less than 10 years, a variety of items—load cells, communication equipment, equipment wiring, and SCADA hardware—failed during this time frame and required replacement or maintenance. While a variety of DLR technologies are commercially available today, it is reasonable to expect that any deployed system will require regular maintenance, regardless of the monitor and sensor design

Communication Facilities – Complex DLR devices only provide benefit when the real-time ratings information can be consumed by the emergency management system ("EMS"). This requires the installation of robust and secure communications infrastructure to ensure this data has a high level of availability. Because more complex DLR technologies are typically installed

intermittently along transmission facilities, the amount and complexity of communication facilities necessary to operate them also increase accordingly.

EMS Integration – Integration of DLR would be a low to moderate level of effort if the TDU's EMS contains "out of the box" functionality to allow for calculated equipment ratings. If that functionality does not exist, then a significant upgrade would be required, or complex scripting would be needed, to fully deploy DLR. With any DLR solution, appropriate alarming and system monitoring would be required, which could be a large-scale effort.

Vendor Support – It is critical to have long-term expert support for tools that are implemented outside of a pilot or trial initiative. As explained above in response to Question 1, if the DLR vendor no longer manufactures and/or supports the DLR system that has been implemented by the TDU, then that DLR system might become functionally obsolete.

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

Response:

There are both benefits and drawbacks to utilizing this technology in ERCOT, that are further detailed below.

Benefits

There are certainly benefits of using certain types of DLR, such as AAR, in the ERCOT market. The use of AAR makes substantial additional transmission line capacity available to the system with very little risk or cost. This additional capacity provides benefits in unexpected load growth scenarios where overloads and constraints would be pervasive and consistently occur until more substantial system upgrades are completed. In this situation, the additional capacity serves to lessen the constraint and associated congestion impacts to the grid until those longer-term solutions can be implemented.

Similarly, in a situation when the grid is in an abnormal state due to construction, maintenance and/or unplanned outages, the broad use of AAR can mitigate some of the impacts to the grid and reduce the amount of required generation re-dispatch needed to alleviate the short-term constraint.

The use of AAR is an Oncor best practice to maximize the effectiveness of existing infrastructure. More complex methods of DLR can provide the same, or slightly better, capacity benefits, but at a much higher up-front and ongoing cost due to additional system, communication,

and configuration complexities. These other technologies are better suited to targeted, short-term use, whereas AAR can and should be adopted on a widespread basis.

Drawbacks

One drawback on the use of any type of DLR for purposes of system capacity increase is that the system is inherently allowed to operate closer to the edge of design limits. Using DLR to allow higher loadings on existing facilities will magnify the impacts of outages on the system, whether they are planned or unplanned, because as higher utilization occurs due to DLR, less margin exists to absorb outages when they occur.

As a caution, it is important to note that DLR should not be used as a solution for addressing system growth. Care must be taken to ensure the higher dynamic ratings do not serve as a screen to obscure the need for more substantial system improvements that would then serve to exacerbate system constraints.

While the use of DLR/AAR will result in higher ratings a very large percentage of the time, there are times where using DLR/AAR will result in lower and more constraining ratings when ambient temperatures are high, as shown in Figure 2 above.

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

Response:

As discussed throughout these responses, Oncor has already implemented the AAR version of DLR onto its transmission system and supports adoption of this technology throughout ERCOT. Current rate structures in ERCOT should be sufficient for this relatively inexpensive form of DLR technology to be adopted. Therefore, the remainder of this response is focused on more complex forms of DLR.

The current rate structures in ERCOT neither encourage nor discourage investment in more complex DLR technology. In other words, they treat the potential installation of more complex DLR technology in the same way any other transmission investment is treated. Investment in complex DLR technology would be initially recovered through an interim transmission cost of service ("ITCOS") update, and then subsequently reviewed for prudence in a base-rate case. Without a high degree of certainty of cost recovery for more complex DLR installations, a utility may have little incentive to make such investments.

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

Response:

No. Any additional equipment providing information to a utility's EMS will increase the cybersecurity risk to some degree, but this risk is perceived to be very low and can be mitigated. One risk would be allowing a point of entry for a malicious entity, but that risk could be mitigated through proper architecture using a defense-in-depth strategy. Another risk would be a scenario where a DLR component, such as a weather collection system, fails or is otherwise compromised. This risk could result in an inaccurate real-time rating, causing incorrect grid configurations leading to false congestion or actual line overloads. With proper data quality checks, the risk associated with failed or manipulated DLR components could be avoided or greatly minimized.

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

Response:

Please refer to Oncor's response to Question 5 for a discussion of drawbacks associated with DLR technology.

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

Response:

Oncor encourages use of the AAR form of DLR on all transmission lines within ERCOT. New transmission lines should be built with adequate capacity such that more complex forms of DLR are not necessary at any time in the near future. Based on Oncor's experience with the vendor discontinuing support for the CAT-1 DLR System, more complex DLR systems may also face functional obsolescence issues as they age.

10. ***[Are] there system reliability [or], situational awareness benefits to utilizing this technology?***

Response:

System Reliability Benefits – Increasing transmission line facility ratings to take advantage of margin related to actual ambient temperatures (*i.e.*, using the AAR method) versus design temperatures (i.e., using the Static method) can provide reliability benefits in the form of avoided load shed (in extreme constraint situations), reduced market congestion, and improved abilities to take system outages for maintenance and construction purposes.

Situational Awareness – Real-time ratings information is already set up to factor in to situational awareness tools such as real-time contingency analysis.

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

Response:

Oncor has already deployed DLR across its system in the form of AAR. The benefits of this form of DLR outweigh the costs associated with it, as discussed throughout these responses. Oncor has not performed a formal cost-benefit analysis for the broader deployment of more complex forms of DLR.

Federal assessment of DLR technologies, meanwhile, has recently reached a conclusion that aligns with Oncor's experience. In 2019, the Federal Energy Regulatory Commission ("FERC") opened a proceeding to evaluate DLR technologies, and FERC held a two-day technical conference in September 2019.[1] FERC has recently approved a rule that requires all transmission providers[2] to use AARs as the basis for (i) evaluating transmission service requests that will end within 10 days of the request, and (ii) determining the necessity of certain curtailment, interruption, or redispatch of transmission service anticipated to occur within those 10 days (subject to certain exceptions),[3] with the goal of increasing the accuracy of near-term line ratings and maximizing efficiency of the transmission system.[4] The rule further requires organized market operators to establish and maintain systems and procedures necessary to allow transmission owners in their regions the ability to use more complex DLR should a transmission owner choose to do so, but no entities are mandated to use more complex DLR.[5] FERC is also opening a proceeding to continue exploring the potential for further action on DLR.[6]

II. CONCLUSION

Oncor appreciates this opportunity to respond to Commission Staff's Questions for Comment.

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[1] *Managing Transmission Line Ratings*, FERC Docket No. AD19-15-000.

[2] In the final rule, FERC uses the term "transmission provider" to mean "any public utility that owns, operates, or controls facilities used for the transmission of electric energy in interstate commerce." *Managing Transmission Line Ratings*, 177 FERC ¶ 61,179, at P 1, FN 2 (2021) (Order No. 881) (citing 18 CFR § 37.3 (2021)).

[3] *See id.* at P 4.

[4] *See* FERC Press Release, *FERC Rule to Improve Transmission Line Rating Will Help Lower Transmission Costs* (Dec. 16, 2021) (quoting Chairman Glick), *available at* https://www.ferc.gov/news-events/news/ferc-rule-improve-transmission-line-ratings-will-help-lower-transmission-costs (last visited Dec. 21, 2021).

[5] *See* 177 FERC ¶ 61,179 at P 9.

[6] *See id.* at P 8 (referencing new FERC Docket No. AD22-5-000).

Respectfully submitted,

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Executive Summary – Oncor's Responses to Commission Staff's Request for Comments

1. Oncor uses the Ambient Air Temperature Rating ("AAR") method of dynamic line rating ("DLR") on most of its transmission system. Oncor limits use of the "Static" method of rating transmission lines, which generally assumes an ambient air temperature of 104° F and two miles per second of wind speed, to certain narrow classes of facilities. Oncor also has prior experience with more complex forms of DLR, including installation of a "CAT-1 DLR System" on several transmission line circuits in central and west Texas in the 2010-2013 timeframe—this system used locally-collected measurements, including line tension sensors installed on those lines, to compile real-time data on temperature and wind speed. However, vendor support for the more complex CAT-1 DLR System terminated soon afterward, so Oncor no longer uses that or any other complex form of DLR to rate its transmission facilities.

2. In Oncor's experience, ERCOT has the necessary tools and systems to incorporate the AAR form of DLR in real time.

3. The AAR form of DLR is deployed across Oncor's transmission system. More complex DLR forms could potentially be deployed in a targeted manner as a short-term solution, while longer-term system solutions are being implemented.

4. TDU challenges in implementing DLR will depend on the type of DLR system installed. The AAR version of DLR will likely be less expensive and resource intensive to install compared to more complex forms of DLR. Depending on the type of DLR technology, a TDU's challenges will likely include: (i) the extent and duration of transmission outages that may be necessary to install certain types of DLR; (ii) the communications facilities necessary to relay the real-time data; (iii) the ability of the TDU's emergency management system to integrate real-time DLR data; and (iv) the level of vendor support provided for the DLR technology.

5. Using the AAR form of DLR provides substantial benefits, including the availability of additional transmission line capacity during most times, at little risk or cost. More complex forms of DLR can provide benefits similar to, or slightly higher than, AAR, but come with higher upfront and ongoing costs. Drawbacks of using any form of DLR include increased reliance on a

transmission system that operates closer to the edge of its design limits, which can magnify the effect of outages when less system margin exists to absorb those outages. No form of DLR, however, should be used to supplant or obscure longer-term transmission system solutions that may be needed.

6. ERCOT rate structures view DLR investments similar to any other transmission investment. The AAR form of DLR is inexpensive to adopt, whereas more complex forms of DLR have higher costs associated with them. DLR investments would receive subsequent prudence review in a base rate case.

7. DLR does not present an unwarranted cybersecurity risk, though measures to mitigate its risk would need to be implemented.

8. As stated in response to Question 5, widespread adoption of DLR could increase reliance on a transmission system that operates closer to the edge of its design limits, which can magnify the effect of outages when less system margin exists to absorb those outages.

9. Oncor encourages widespread adoption of the AAR form of DLR across the ERCOT transmission grid, though more complex DLR forms should not be necessary.

10. DLR can provide reliability benefits through avoided load shed, reduced market congestion, and improved ability to take outages for maintenance and construction purposes. Real-time ratings information can also be factored into situational awareness tools, such as real-time contingency analysis.

11. While Oncor has performed no formal analysis, the benefits of AAR outweigh its minimal costs. This aligns with FERC's recent analysis in adopting a new rule requiring use of AAR in certain situations, without mandating that an entity use more complex forms of DLR.