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February 4, 2022

Board of Commissioners of Public Utilities
Prince Charles Building
120 Torbay Road, P.O. Box 21040
St. John's, NL A1A 5B2

Attention: Ms. Cheryl Blundon
Director of Corporate Services & Board Secretary

Dear Ms. Blundon:

Re: Reliability and Resource Adequacy Study Review – Additional Considerations of the Labrador-Island Link Reliability Assessment and Outcomes of the Failure Investigation Findings – Additional Information

In December 2021, Newfoundland and Labrador Hydro ("Hydro") filed its report, "Additional Considerations of the Labrador-Island Link Reliability Assessment and Outcomes of the Failure Investigation Findings,"[1] ("December Filing") with the Board of Commissioners of Public Utilities ("Board"). The December Filing provides the findings related to additional considerations associated with the reliability of the Labrador-Island Link ("LIL"), information related to the findings of the failure investigation reports,[2] and updates to the LIL emergency response plan. On January 20, 2022, the Board requested Hydro provide, by February 4, 2022, additional information to facilitate a more fulsome understanding of the issues surrounding the reliability of the LIL, the implications for reliability of supply for customers, and the actions Hydro plans to take.[3]

The following responses provide the additional information as requested by the Board.

1) A detailed description of the actions Hydro is taking in response to each recommendation made in Haldar Report #2, including the scope of work to be done, whether any third party is being retained to complete any portion of work and the schedule for the work with identified milestones. If Hydro does not plan to accept a recommendation and complete the recommended additional work, explain why not.

Hydro's Response:

Haldar & Associates Inc. ("Haldar & Associates") has provided valuable insight into the key considerations that have the potential to underpin the reliability of the LIL and its structures. Hydro now has an improved understanding of these key technical concepts, including the concerns raised over combined wind and ice loading, wind speed-up factors, and unbalanced ice loading. The results

[1] "Reliability and Resource Adequacy Study Review – Additional Considerations of the Labrador-Island Link Reliability Assessment and Outcomes of the Failure Investigation Findings," Newfoundland and Labrador Hydro, December 22, 2022.
[2] "Failure Investigation Report – L3501/2 Tower and Conductor Damage Icing Event January 2021 in Labrador," Nalcor Energy, May 28, 2021 and "Failure Investigation Report – L3501/2 Pole Assembly Turnbuckle Failure Failure Event February 2021 in Labrador," Nalcor Energy, May 28, 2021.
[3] "Newfoundland and Labrador Hydro ("Hydro") – Reliability and Resource Adequacy Study Review - December 22, 2021 Report," Board of Commissioners of Public Utilities, January 20, 2022.

presented by Haldar & Associates also provide an effective basis for the development of operating procedures, monitoring initiatives, and response plans based on criticality of structures.

The findings of the "Assessment of Labrador Island Transmission Link (LIL) Reliability in Consideration of Climatological Loads – Phase II," ("Phase II LIL Reliability Report)[4,5] provide foundational information for Hydro to use to evaluate the effectiveness of potential future structural investments in the LIL with a clear understanding of reliability implications. This will ensure compliance with capital budget guidelines for the proposal of any modification work to structures that are be deemed critical.

It is noted that the findings associated with the more extreme value assessment completed by Haldar & Associates would impact approximately 2% of LIL structures. This important finding allows Hydro to take a strategic approach in terms of monitoring and design review.

Hydro fully agrees with the concepts presented with respect to weather monitoring and the potential for improved reliability of the LIL and will continue to take action on this initiative based on the recommendations put forth by Haldar & Associates. These tasks will permit Hydro to effectively and quantitatively assess the reliability of the LIL in contemplation of the technical considerations that have been presented in the analysis.

Through operational experience and strategic monitoring, Hydro will gain an understanding of the effectiveness of potential investments to upgrade the LIL structures. Such investments would be made after consideration of risk and value-based assessments that include other critical factors that impact system reliability. Such factors would include any additional generation that may be required on the Island Interconnected System as well as response times for emergency repairs.

Please see below for a summary of Hydro's plan of action on each of the specific Haldar & Associates recommendations.

Recommendations and Responses

Haldar & Associates Recommendation:

Measure wind speed after an ice storm and during line inspections in validating combined wind and ice load and ice plus wind loads for the critical sections of LIL, particularly the line sections in the Labrador Region where the reliable data is currently unavailable.[6]

Hydro's Response:

Hydro is in full agreement with this recommendation and will continue to measure and monitor wind speeds in areas where icing has been identified through forecasted weather, visual inspections of the infrastructure, and weather stations. Specifically, a full aerial patrol of all structures is targeted for completion on a three-month interval. As part of Hydro's Severe Weather Preparedness Plan, operating crews conduct specific line patrols for localized areas of the LIL following severe

[4] "Assessment of Labrador Island Transmission Link (LIL) Reliability in Consideration of Climatological Loads – Phase II," Haldar & Associates Inc., December 12, 2021.
[5] Filed as Attachment 1 to the "Reliability and Resource Adequacy Study – Additional Considerations of the Labrador-Island Link Reliability Assessment and Outcomes of the Failure Investigation Findings," Newfoundland and Labrador Hydro, December 22, 2021.
[6] "Assessment of Labrador Island Transmission Link (LIL) Reliability in Consideration of Climatological Loads – Phase II," Haldar & Associates Inc., December 12, 2021, s 3.5, at p. 34/914–916.

weather events. All weather data and conditions observed during these patrols are recorded for engineering assessment.

From an inspection and maintenance perspective, operating teams conduct an annual program involving a ground patrol of 90% of LIL structures and a climbing inspection of 10% of the structures. As detailed in "Emergency Response & Restoration Planning – Labrador-Island Link – Overland Transmission,"[7] Hydro plans to expand on its current quantity of Alpine meteorological test spans in 2022, with the construction of a newly designed test span planned for central Labrador, which will collect weather data for evaluation. This is an especially important area as Hydro has limited operating experience in this location and the recorded data will aid to validate assumptions and modelling conducted during the original design.

Haldar & Associates Recommendation:

Assess the mitigation option of upgrading the capacities of several towers in Section 3a, either by redesigning the A1 tower or by installing mid span towers to upgrade the line in Section 3a and the other sections where similar problems may be encountered.[8]

Hydro's Response:

Hydro acknowledges the damage that occurred on the LIL during the winter of 2020–2021 in Section 1, and has been monitoring this region closely. It is noted that this event was attributed to significant ice accumulation as opposed to a combined wind and ice loading effect. Hydro will continue to monitor meteorological loading in this area.

Haldar & Associates has indicated that, before a decision is made to use the combined wind and ice loading data from CSA 22.3 No. 60826-10 as a basis to perform modifications to the 2% of towers that do not meet the increased load requirements, additional data should be collected over the long term. This will ensure that any potential modifications are based on a consistent statistical approach and provide reliable design load envelope data validated by observed ice loads from past failure events in these regions and future data collected through increased monitoring.

With respect to the towers in Section 3A deemed to be the most critical and governing the overall reliability of the LIL, no failures have been reported to date. The Phase II LIL Reliability Report noted that these findings are based on extreme weather events (85/40 Combined Wind & Ice).

As referenced in the December Filing:

> CSA 22.3 No. 60826-10 provides a range between 0.6–0.85 for the upper limit of wind and ice loading but does not provide clear direction on when the upper or lower limits should be utilized. As such, the Phase II LIL Reliability Report indicated that it may be overly conservative to accept the extreme impact on the resultant probability of failure. If a lower wind and ice combination (70/40 or 60/40) is utilized, the number of structures exceeding 100% utilization would be reduced to four structures and the

[7] "Reliability and Resource Adequacy Study – Additional Considerations of the Labrador-Island Link Reliability Assessment and Outcomes of the Failure Investigation Findings," Newfoundland and Labrador Hydro, December 22, 2021, att. 2.
[8] "Assessment of Labrador Island Transmission Link (LIL) Reliability in Consideration of Climatological Loads – Phase II," Haldar & Associates Inc., December 12, 2021, s 3.5, at p. 34/918–920.

probability of failure will decrease thereby providing a higher return period ranging from 21 to 53 years.[9]

As further noted within the December Filing, ". . . the extreme combined wind and ice load scenarios are not supported by historical data."[10] An assessment of wind speeds in Section 3A is provided below.

Section 3A is located near the southern coast of Labrador. Historical wind data taken from nearby weather stations confirms that the maximum wind recorded in the area was approximately 94 km/hr based on a ten-minute average (comparable to 120 km/hr as per Table 1). The data reviewed extends back to the early 1950s. As seen in Table 1, the loading utilized during the assessment completed by Haldar & Associates in accordance with extreme values presented in CSA 22.3 No. 60826-10 is over and above the historical wind speeds. This indicates that a lower wind and ice combination would be more appropriate as, to date, weather patterns for the area in question result in a 23% lower wind speed than specified in CSA 22.3 No. 60826-10. However, Hydro acknowledges the impact of climate change as well as increases in the frequency and intensity of extreme weather events. On this basis, ongoing monitoring and assessments will continue as part of operational programs.

Table 1: 10-Minute Average Wind Speed (km/h)

Load Cases	CSA Wind	Historical Data
Max Wind CSA 50 Years - Zone 3A	120	94
W+I 85/40 CSA 50 Years - Zone 3A	102	79
W+ I 60/04 CSA 50 Years - Zone 3A	72	56

Haldar & Associates Recommendation:

Consider monitoring LIL remotely for ice and wind loads and validate this by occasional in field measurements, particularly for loads on the "wire support system" (OPGW, electrode and pole conductor etc.); one objective should be to validate whether the pole conductor collects less ice compared to the other two cables during a storm. This may also provide data to clarify whether in the future, the OPGW should be designed for the conductor design ice loads as stipulated in CSA 60826-10.[11]

Hydro's Response:

As stated earlier in this response, Hydro fully agrees with the Haldar & Associates' recommendation to complete monitoring of wind and ice, especially in areas with limited operating experience.

[9] "Reliability and Resource Adequacy Study – Additional Considerations of the Labrador-Island Link Reliability Assessment and Outcomes of the Failure Investigation Findings," Newfoundland and Labrador Hydro, December 22, 2021, s 2.3, at p. 4.
[10] "Reliability and Resource Adequacy Study – Additional Considerations of the Labrador-Island Link Reliability Assessment and Outcomes of the Failure Investigation Findings," Newfoundland and Labrador Hydro, December 22, 2021, s 5.0, at p. 9.
[11] "Assessment of Labrador Island Transmission Link (LIL) Reliability in Consideration of Climatological Loads – Phase II," Haldar & Associates Inc., December 12, 2021, s 3.5, at p. 34/922–927.

The findings issued by Haldar & Associates are inclusive of equivalent icing on both the pole conductor and the OPGW,[12] although the author suggests that there is a potential reduction on ice accumulation on the pole conductor due to the larger size, thereby providing a conservative outlook on LIL reliability. Monitoring of such ice accretion over time will provide Hydro with the ability to validate such assumptions and provide increased certainty with respect to the design of the LIL and its overall reliability.

Haldar & Associates Recommendation:

The author has checked a few critical A1 towers outside of the Labrador region. It is suggested that NLH check all the A1 towers in the Island Part of the line in addition to the ones in the Labrador region to ensure that all these A1 towers where UF are considerably higher (>100%) are fully identified.[13]

Hydro's Response:

Hydro has completed a structural review of all A1 towers as part of the ongoing investigation into the LIL. This has been instrumental in identifying potential areas of concern along the line that may be exposed during extreme weather events that exceed design values.

This enables Hydro to prioritize inspection efforts and structure emergency response planning in the event that such circumstances occur. Towers were characterized as "critical" where potential extreme loading events could exceed design parameters. Hydro does not yet have evidence to understand the reality or probability of such conditions. However, Hydro is taking precautions in such areas and targeting these "critical" towers for increased inspections during winter storm events. Further commentary on Hydro's operating experience with Island transmission lines is provided below.

Haldar & Associates Recommendation:

NLH may want to consider developing a better statistical procedure in determining the combined wind and ice loads that include the NLH's operational experiences for the past fifty (50) years supported by the icing that has been observed during past line failures. This requires further investigation and it is outside the scope of this study. It must also be understood that the combined ice and wind load prediction method (post storm event) often produces loads that are more conservative and higher than the loads based on the historical storm method. One of the reasons for this is that the correlation between the ice thickness and wind speed is totally ignored in the combined probability method and this is the reason, a factor or factors for various NLH service regions must be developed to correct these loads with respect to the historical storm method. This can only be done based on calibration with measured data during ice storm events or based online field monitoring (Haldar, 2007).[14]

[12] Optical ground wire ("OPGW").
[13] "Assessment of Labrador Island Transmission Link (LIL) Reliability in Consideration of Climatological Loads – Phase II," Haldar & Associates Inc., December 12, 2021, s 3.5, at p. 34/929–932.
[14] "Assessment of Labrador Island Transmission Link (LIL) Reliability in Consideration of Climatological Loads – Phase II," Haldar & Associates Inc., December 12, 2021, s 3.5, at p. 34/934–944.

Hydro's Response:

For areas with limited operational experience, Hydro will accumulate weather-monitoring data through the expanded programs described above and will assess long-term trends. As stated above, Hydro will use this data to re-evaluate LIL reliability and develop design criteria for future line designs and standards. Hydro agrees with recommendations made by Haldar & Associates with respect to the development of a more comprehensive statistical analysis of combined wind and ice loads based on site-specific wind and ice data for the province and not just parameters taken from a national standard. It would be highly beneficial, not just to re-evaluate the LIL reliability but also to assess past designs of the existing system and to ensure overall reliability.

CSA 22.3 No. 60826-10 provides a wide range of combined wind and ice loads based on statistical analysis of climatic data from Environment Canada. In past communication with the Board, it was identified that the extreme loading, as specified per CSA 22.3 No. 60826-10, significantly exceed design loads used by Hydro in the past. This is contrary to Hydro's operating experience.

As an example, Table 2 contains the Avalon Peninsula transmission line data as presented during the latest technical conference.[15] CSA 22.3 No. 60826-10 specifies a substantial increase in wind load for combined wind and ice scenarios despite when compared to design standards used for upgraded structures that were installed after the ice storms of the 1990s. These structures have been subject to severe loading conditions, including several hurricanes, and have operated reliably. As indicated, the combined wind and ice loading of these structures is 60 km/hr as opposed to the 122 km/hr limits that could be applied in accordance with CSA 22.3 No. 60826-10. For sections of the LIL that traverse areas with limited operational experience, Hydro will monitor and assess the conditions in consideration of LIL design levels and potential upgrades.

Table 2: Avalon Peninsula Transmission Line Data

Load Case	Wind Speed (km/hr)	Ice Thickness (mm)
Avalon Upgrade - Design Wind + Ice	60	45
CSA 150 Years Wind + Ice 65/40	86	42
CSA 150 Years + Ice 85/40	122	42

Haldar & Associates Recommendation:

With respect to wind plus ice load, correlation effect among the ice thickness, concurrent wind speed and the duration of the event needs to be understood. The data from Environment Canada for nearby weather stations coupled with field observation data and the data from Hydro's operational experience should be used to develop this wind plus ice map for the regions identified in Haldar report (2021). This analysis can also be validated by NWP[16] model along the line route and NLH has already used this numerical modelling technique in predicting combined rime loads. Once validated by measured data, this can be considered in the future possible upgrading of this LIL line.

Hydro's Response:

Hydro will undertake monitoring and long-term analysis, as summarized above.

[15] *Reliability and Resource Adequacy Study Review* – Technical Conference #3 was held on June 9, 2021.
[16] Numerical weather prediction ("NWP").

2) A detailed description of all studies/reports being completed to provide the information on potential generation additions on the Island Interconnected system and potential structural LIL enhancements, including the scope of each report/study, whether an expert has been retained and the schedule to complete the work with identified milestones.

Hydro's Response:

Hydro has completed an extensive review of its Long Term Resource Plan as part of this proceeding.[17] Hydro is currently reviewing previous studies and cost estimates pertaining to generation options and will ensure that any additional engineering, if required, will be completed in advance of the submission of the updates to Volumes I and III, which will be filed on August 31, 2022.

As per Hydro's response to Item 1), Hydro's priority will be to perform monitoring activities as there is no immediate basis to quantify the effectiveness of structural enhancements for the LIL. Rather, monitoring activities will provide Hydro with an improved understanding of the reliability of the LIL in consideration of the findings presented by Haldar & Associates. Through this process, Hydro would also develop an understanding of the effectiveness of potential investments to improve reliability through value-based assessments.

3) The date Hydro plans to stop utilizing the Holyrood plant as a generating facility. In correspondence dated September 28, 2020 Hydro advised that it had always intended to maintain a two-year period of standby generation operation of the Holyrood plant following the in-service of the LIL and at that time extended the date for operation to March 31, 2023 based on the then schedule for the LIL. Has this date now been extended to March 31, 2024 given the current LIL schedule?

Hydro's Response:

The schedule for construction and commissioning of the Muskrat Falls Project has changed over time for various reasons, as communicated with the Board in prior correspondence. Additionally, in Hydro's most recent Near-Term Reliability Report,[18] it identified deficiencies in forecast system reliability as compared to planning criteria during the winter of 2023–2024, resulting from the planned transition of the Holyrood Thermal Generating Station ("Holyrood TGS") to post-steam operations in the early years of operation of the LIL. The identified deficiencies can be remedied by extending the operation of the Holyrood TGS to March 31, 2024. As such, in exercising prudence and caution in its planning and preparedness, Hydro is proceeding to extend the operation of the Holyrood TGS for an additional year, shifting the planned transition date of post-steam operation to March 31, 2024. This will allow the Holyrood TGS to serve as a backup facility during the winters of 2022–2023 and 2023–2024, providing a two-year period of standby operation of the Holyrood TGS during early operation of the Muskrat Falls Project assets, consistent with prior commitments to the Board.

[17] "Reliability and Resource Adequacy Study - November 2018" Newfoundland and Labrador Hydro, November 16, 2018.
[18] "Reliability and Resource Adequacy Study Review – Near-Term Reliability Report – November 2021," Newfoundland and Labrador Hydro, November 15, 2021.

Hydro has made the determination to extend the Holyrood TGS operations at this time for three key reasons:[19]

1. It is critical that Hydro retain skilled staff that are focused on the safe and reliable operation of the Holyrood TGS, necessitating the provision of notices of extension of employment at the earliest possible opportunity;
2. To ensure sufficient time remains to plan and execute the appropriate maintenance required within the annual system outage and maintenance schedule; and
3. To ensure sufficient time remains to apply to the Board for necessary capital investment required as a result of this decision.

Balancing Cost and Reliability

Hydro will continue to monitor the performance of the Muskrat Falls Project assets and, based on the demonstrated reliability of the assets, will determine: (i) the degree to which the Holyrood TGS units must be operated or maintained in standby mode, and (ii) the level of capital investment to be incurred. If the Holyrood TGS is required to operate during the extension period, Hydro will use lower-cost alternatives (e.g., Maritime Link imports, standby unit operation over peak periods) where it is technically and economically feasible, to offset thermal generation from the Holyrood TGS that would have otherwise been required to secure the power system. This is consistent with Hydro's approach in recent years. Hydro believes that, should the successful integration and demonstrated reliability of the Muskrat Falls Project assets occur prior to March 31, 2023, there may be opportunity to mitigate some portion of operating and capital costs.

Hydro believes its decision to extend the short-term operation of the Holyrood TGS to be in the best interests of its customers and the provision of reliable service.

Next Steps

Hydro is in the process of completing the condition assessment of the Holyrood TGS, which will be filed with the Board in the first quarter of 2022. This assessment will help Hydro and stakeholders fully understand the capital and operational requirements for the following options, if they are considered for the Holyrood TGS:

- Continued extension of the Holyrood TGS, whether online in full generation mode or standby mode beyond the current March 31, 2023 retirement period, for an additional two years (i.e., 2025), four years (i.e., 2027), and six years (i.e., 2029); and
- The viability and suitability of the Holyrood TGS to be used as a backup generating facility to support the Island system in the event of a prolonged outage of the LIL until End of Economically Feasible Life for the Holyrood TGS.

Hydro will use the outcomes of the condition assessment as inputs to its analysis supporting the update to Volumes I and III of the Reliability and Resource Adequacy Study, which it intends to file by August 31, 2022. The update will provide Hydro's recommendation on the role of the Holyrood TGS beyond March 31, 2024.

[19] As previously communicated in "Extension of Holyrood Thermal Generating Station as a Generating Facility," Newfoundland and Labrador Hydro, February 14, 2020, at. p. 2.

4) An explanation as to why the report Network Additions Policy Incremental Load Requirements and System Impact Studies, initially scheduled for completion in Q4/2021, then rescheduled to Q1/2022, has been delayed again until Q3/2022.

Hydro's Response:

Delays associated with the progression of system impact studies associated with the Network Additions Policy have been due to complexities associated with the volume of requests that were received. In response to theses requests, incremental analysis and coordination with proponents were required. As a result, Hydro was forced to adjust estimated timeframes for completion of the system impact studies.

Hydro's initial time frame for producing the system impact studies, the fourth quarter of 2021, was estimated prior to the approval of the Network Additions Policy.[20] Upon Board approval, Hydro began implementation of the policy, including formalizing customer requests and undertaking preliminary analyses. At the time of its July 30, 2021 update to the Board,[21] Hydro had a better understanding of the number of interested applicants and the complexity of the high-level impact analysis. On this basis, Hydro specified the first quarter of 2022 as a more realistic timeframe for completion of the system impact studies.

The impact analysis was completed and the results were communicated to applicants in the fall of 2021. At the time of the December Filing, Hydro was awaiting confirmation of interest and deposits from customers by January 2022. Given the 24-week timeframe associated with completion of the system impact studies, the third quarter of 2022 was determined to be the most realistic timeframe for completion.

As of February 1, 2022, Hydro has received confirmation from 25 customers for firm loads of approximately 2,000 MW. Incremental load of this magnitude would result in a significant cost of supply for applicants. Prior to applying the customer deposits to the system impact studies, Hydro will engage in further communication with applicants to discuss potential rates associated with generation. Hydro is working expeditiously to advance these discussions to allow system impact studies to be undertaken as soon as possible.

As per its February 3, 2022 update to the Board,[22] Hydro acknowledges the significant impact of load additions in Labrador to the *Reliability and Resource Adequacy Study Review* proceeding. Additional sources of capacity and energy within the provincial power system, particularly if located within the Island Interconnected System, could help to improve the reliability of supply for customers in consideration of potential risks associated with the LIL. Hydro also acknowledges that it is not acceptable to delay the advancement of the *Reliability and Resource Adequacy Study Review* proceeding while awaiting the outcomes of detailed system impact studies and facilities studies. To ensure the effective progression of the *Reliability and Resource Adequacy Study Review* proceeding toward a conclusion, Hydro will take the following actions:

- Generation planning analyses that will be completed as part of the *Reliability and Resource Adequacy Study Review* proceeding will include sensitivity cases where incremental customer

[20] *Public Utilities Act*, RSNL 1990, Board Order No. P.U. 7(2021), Board of Commissioners of Public Utilities, March 17, 2021.
[21] "Reliability and Resource Adequacy Study Review – Update on Additional Considerations Regarding Labrador-Island Link Reliability Assessment," Newfoundland and Labrador Hydro, July 30, 2021.
[22] "Network Additions Policy – Implementation Update," Newfoundland and Labrador Hydro, February 3, 2022.

load is added to forecasts. These cases will be established on the basis of ongoing discussions with the firm load applicants described above.

- The sensitivity cases will be developed and assessed such that requirements for incremental energy and capacity will be determined on the basis of planning criteria and parameters that will be presented and reviewed as part of study outcomes. All analyses, results, and planning considerations will be presented in Hydro's updates to Volumes I and III of the Reliability and Resource Adequacy Study that will be submitted in accordance with timelines described herein.
- As described above, Hydro will advance engineering efforts associated with options for additional generating sources for the provincial power system. This includes the completion of the detailed condition assessment for the Holyrood TGS and continued efforts associated with new sources of generation in support of the planning analysis.
- Hydro will continue to progress discussions with firm load applicants throughout the system impact study process. As applicants are provided with detailed estimates of transmission expansion and supply costs, interconnection agreements would be established. If interconnection agreements reflecting material load additions are executed, Hydro would proceed to seek Board approval for additional generation. Such an application would be founded on the expansion plans, planning criteria, and parameters presented and reviewed as part of the submission described herein.

5) The date in the summer of 2022 that updates to Volume I and III of the Reliability and Resource Adequacy Study will be filed with the Board.

Hydro's Response:

As detailed in its response to Item 3), Hydro intends to file its updates to Volumes I and III of the Reliability and Resource Adequacy Study by August 31, 2022.

Should you have any questions or comments, please contact the undersigned.

Yours truly,

NEWFOUNDLAND AND LABRADOR HYDRO

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Senior Legal Counsel, Regulatory
SAW/sk

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