Toronto Hydro-Electric System Limited EB-2018-0165 Exhibit 2B Section D Appendix D ORIGINAL (204 pages)

Toronto Hydro-Electric System Limited
Climate Change Vulnerability Assessment
Application of the Public Infrastructure Engineering Vulnerability Assessment Protocol to Electrical Distribution Infrastructure
Final Report - Public
6031-8907
June 2015
Pg 656 pdf Table ES-1 Climate Parameters and Probability of Occurrence

2B-hann-64 What are THESL design standards including overload factor for wind and ice with overload factoring KPH and mm?
2B-hann-65 What are the dates, actual wind or Ice values have exceeded the design standards including overload the from 2008-2017?

2B-hann-66 What were the actual historical dates from the earliest available data to 2018 that the wind and Ice climate parameter values in Table ES-1 were reached or exceeded?

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Pg 657 pdf Figure ES-1 Example Maps Based on Risk Ratings for High Heat, Freezing Rain and Lightning

2B-hann-67 It appears from the maps that there may be a coorelation between tree density and High Ambient Temperatures, Freezing Rain and Lighting risk rating. Please provide a vegetation density map as well from the 1960.s and 2014.

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2B-hann-68 How often has THESL experienced ," ice storms (up to 25 mm) and high winds (up to 90 km/h) in the past." Please provide yearly data in a table format.

2B-hann-69 A)How does this statement “These events are projected to continue in the future, but continue to occur on a less than annual, or even decadal frequency.” prove as stated throughout the evidence that “extreme storms” are more frequent? B) Is it the processes from design to construction to maintenance that need to be re-evaluated and addressed in light of the changing urban environment, especially the growth, aging and disease of the urban forest? If yes, what action is being undertaken?

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2B-hann-70 The study took into account the environment of “road salt” on the poles, yet did not include the changes in the urban forest which appears to have a much larger impact on the reliable operation of the system. What is the opinion of THESL on the changing urban forest and what is being done to mitigate the interruptions these changes causes?

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2B-hann-71 Fuses and Circuit breakers are in typical stations. What work has been done to coordinate the fuses on the feeders to prevent interruptions that should be captured that affect only a few customers going back to the station switch and taking out many customers?

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2B-hann-72 Load projections are provided by Former Toronto and Horseshoe stations. Please provide the Number of interruptions, number of customer interruptions and durations and customer durations by station feeders for 2008-2017 in table format.

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2B-hann-73 Are trees trimmed properly to prevent mid span contact?
2B-hann-74 Are the conductors sagged and tensioned properly to prevent mid span contact?

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2B-hann-75 A) What is the CSA standard for wind load with overload? B) If they are 120 km/h or greater, why are "wind gusts at 90 km/h and 120 km/h were judged to be a high risk to overhead feeder systems." since the system is design to withstand this external loading?

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2B-hann-76 Do the lightning storms cause "electrical" or "mechanical" interruptions? E.g. how many lightning arrestors were damaged, vs fuse links replaced, how many poles were replaced during lightning storms due to a lightning strike vs trees falling on the conductor? Did the lightning storms actually cause the damage to the assets?

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2B-hann-77 Why does THESL state throughout the evidence and public consultation that there are and will be more extreme weather while the consultants report states "These events are projected to continue in the future, but continue to occur on a less than annual or even decadal frequency. More severe ice storms (60 mm), high winds (over 120 km/h) and tornadoes (EF1+) have been extremely rare in the past, and while there is a lack of scientific consensus on projected future frequencies for these extreme events, they are likely to remain rare in the future."?

2B-hann-78 A) Is THESL planning to implement the recommendation in Affected Infrastructure 10 "Toronto Hydro is already experiencing outages caused by tree contacts and is planning to increase its vegetation management activities. This study supports the need for increased tree trimming practices around overhead power lines and use of tree proof conductors in areas where outages due to tree contacts have been frequent."? B)When and by C)how much?

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2B-hann-79 A) How many crews were available to respond on days with 20 or more reports? B) What impact did this have on restoration time? C) Were the interruptions restored in most customers out

order, or by the time the call came in, or buy restoring everything in an area or any combination of the above?

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2B-hann-80 A) Is there a recurring weather cycle of say 7 years? B) Is this related to tree growth/trimming? Reference "*It may also be possible to anticipate a particularly severe damage year since the "major" events producing over 150 reports tend not to occur in isolation but usually occur in years with a number of less severe but still significant events, although the consistency of this pattern requires further research".*
2B-hann-81 Did the consultant challenge what the actual root cause was of lightning reported interruptions? What was the result of that challenge? Reference "Lightning - Customer interruptions due to lightning striking the distribution system, resulting in an insulation breakdown and/or flash-overs Pg 25 of RRR_Electricity_20130101"

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2B-hann-82 " The majority of power outage events identified in the 2000-2006 period were extended events lasting up to 48 hours, representing the need for sustained operational response, but the characteristics of these events differed depending on season:"

A) What impact did the available crews have on restoration time? B
B) What impact did the time of day or day of week have on the restoration time?
C) What impact did dispatch process have on restoration time?

2B-hann-83 " Overall, larger metropolitan LDCs appear to be more vulnerable to climatic events than smaller LDCs, particularly when considering overall restoration times; this is likely due a culmination of factors, not the least of which include the state and age of equipment, difficulty of access for system repair in an urban environment, and the relative proportion of staff available with respect to total number of customers and the size of a geographical area of responsibility."
How is this conclusion supported in the evidence that "age of equipment" is an issue?

2B-hann-84 "Certain regions within the city appear to be more susceptible to weather related power outages; potential regional differences in vulnerability should be investigated further. It is not clear at this time if these vulnerabilities are due to aging infrastructure, proximity to aged canopies, difficult to access infrastructure (e.g. back-lots) or some other combination of factors."
What action has been taken with respect to this conclusion?

2B-hann-85 "Changes in tree health conditions such as disease and pests may also be playing a role in increasing sensitivity to damage, as suggested by analyses of the December 2013 ice storm.

These represent very complex interactions, since the extent of certain disease and pests will also be affected by changing climate regimes, and their interaction with the structural integrity of trees and limbs is still unknown."
What is vegetation management doing to address "Changes in tree health conditions such as disease and pests may also be playing a role in increasing sensitivity to damage" and that the trees (canopy) grow taller and older each year?

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2B-hann-86 " Is the design of the THESL for ice loading based on the design strength of conductors, poles and pole hardware or the strength of tree branches as stated "load is based on tree branches that usually start to break with a 15 mm of freezing rain."?

2B-hann-87 A) Is the risk ".The future overall ''capacity'' will decrease (or vulnerability to damage will increase) because of new or exacerbated disease and pest conditions and possibly, because of the tree faster growth (extended growing season, more branches) or on proper vegetation management? B) Will proper and appropriate vegetation management mitigate this risk? Why and by how much?

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2B-hann-88 Given the consultants report and statements on lack of accurate/complete records, using newspaper reports for numbers of customer and focus on tree branches being the cause of interruptions,
a) how confident is THESL that defective equipment is a prominent cause?
B) That aging equipment is the main root cause of defective equipment?
C) That the main root cause is not tree branches causing fuses to operate?
D) Please provide evidence of training in cause code identification for reporting staff.
E) Please provide stores information of damaged equipment numbers that have been replaced as part of an interruption event.

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Pg 21 lines 1-6
Pg 876 in pdf

2B-hann-89 What was the life span of the mechanical meters that were replaced by the smart meters?
2B-hann-90 Why is the life span expected to be 15 years for the smart meters?

2B-hann-91 What is the life span of the new replacement meters?

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Page 22 23 lines 1-21 1-17
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2B-hann-92 a) How many poles (by year) failed due to age from 2008 to 2017 on days without storms? B)How many poles (by year) failed on days with storms where the pole was broken due to strictly wind or ice load on the conductor?

2B-hann-93 In the photo in Figure 12: "Deterioration 1 at the base of a pole" provided,

a) What is the estimated % reduction in load carrying capacity? What is the estimated % reduction of load carrying capacity for the "approximately 11,000 poles in each of the 6 HI4 ("material deterioration") and HI5 ("end-of-serviceable life") condition bands."?
b) For the conductor sizes and class of pole used by THESL,
    i) what are the maximum span the poles can be set at according to maximum design loads with overload?
    ii) What is the average span on the THESL system?

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Page 24 lines 2-7
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2B-hann-94 A)How many pole top transformers (by year) failed due to age from 2008 to 2017 on days without storms or high temperatures? B) How many pole top transformers (by year) failed on days with storms where the transformer failed without any external forces? C) How many transformers (by year) failed on high temperature days?

2B-hann-95 a) What is the performance (by age) of pole top transformers younger and older than 35 years on non storm and non high temperature days? B) Are they failing at the same rate? C) What are the modes of failure?

Toronto Hydro-Electric System Limited EB-2018-0165 Exhibit 2B Section E4 ORIGINAL
Page 13 lines 6-15
Pag 939,
pg 1317 line 12-21

2B-hann-96 A) How does Feeder Automation operations input to MAIFI reporting? B) What impact did Feeder Automation have from 2015-2018 on MAIFI?

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Page 5 line 1-13
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2B-hann-97 a) What accounted for the dramatic increase in customers from 2007 to 2015 (Figure 2: Historical and Forecast Number of Toronto Hydro Customers)? B) Where were the new customers predominantly connected? C) Were these new customers the result of new construction or changes in

metering (from central to unit metering)? D) How many were new construction, how many changes in metering by year?

Toronto Hydro-Electric System Limited EB-2018-0165 Exhibit 2B Section E5.3 ORIGINAL
Page 12 lines 11-25
Page 996

2B-hann-98 A) How will feeder automation (2B-hann-96) Reduce the switching time?
What impact will it have on SAIDI and CAIDI?

Toronto Hydro-Electric System Limited EB-2018-0165 Exhibit 2B Section E6.2 ORIGINAL
Page 17 18 Figure 13: Age of Transformers 1 at Time of Failure
Page 1106 1107

2B-hann-99 a) Why does external, other and unknown stop at age 35? b) It would be expected that external damage, other and unknown would happen randomly, Is the data being reported proplerly?

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Pg 7 line 1-13
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2B-hann-100 a) What is being done to prevent trunk outages interruptions? B) What is being done to prevent the interruptions on the feeder being captured by the protective device at the station?