EB-2018-0165

Toronto Hydro Electric System Limited

Witness Panel 1

Distribution Capital and Maintenance

<u>SYSTEM RELIABITY/SCORECARD COMPENDIUM</u>

Energy Probe Research Foundation

June 28, 2019

SYSTEM RELIABILITY/SCORECARD

EP COMPENDIUM OF EVIDENCE, INTERROGATORIES AND UNDERTAKINGS

TOPIC	REFERENCES
1. HISTORIC SYSTEM RELIABILITY	
SR Definitions and EDS Scorecard	**Exhibit U Tab 1B, Sched 1, p. 2;** **1B-EP-1;** **1B SEC-17**
TH Historic SR Performance 2013-2017 and 2018 EDS Scorecard	**Exhibit U Tab 1B, Sched 1, p. 2;** **Exhibit 1B, Tab 2, Sched 5 ORIGINAL**
MAIFI Performance	**Exhibit 1B, Tab 2, Sched 2, page 18 Figure 2: MAIFI;** **2B-EP-32**
Ontario Peer Group SR Comparisons 2017	**U-EP-64**
2. CIR PLAN 2020-2024	
Customer Preferences	**Exhibit 1BTab 3 Schedule 1 Appendix A**
CIR Plan SR Performance and Metrics	**U-SEC-105;** **Technical Conference Schedule JTC2.10**
CIR Plan Scorecard Measures and Targets 2020-2024.	**Exhibit 2B, Sect C2.3 Table 4** **Exhibit 2B, Sect E2.3.1.1, p 48/49.** **1B-EP-4** **Tech Conference Schedule JTC2.9**

Historic System Reliability Metrics and Performance 2013-2018

Exhibit U, Tab 1B, Schedule 1

Table 1: Toronto Hydro EDS Performance – 2014-2018

Performance Outcomes	Performance Categories	Measures		2014	2015	2016	2017	2018	Target: Industry	Target: Distributor	Average
Customer Focus	Service Quality	New Residential/Small Business Services Connected on Time		91.50%	96.90%	97.70%	98.32%	99.80%	90.00%		96.84%
		Scheduled Appointments Met On Time		99.80%	99.90%	99.50%	99.37%	99.66%	90.00%		99.65%
Services are provided in a manner that responds to identified customer preferences.		Telephone Calls Answered On Time		71.90%	76.80%	64.70%	77.92%	80.15%	65.00%		74.29%
	Customer Satisfaction	First Contact Resolution		81.00%	84.00%	86.00%	88.00%	89.00%			85.60%
		Billing Accuracy		96.62%	97.54%	98.86%	99.24%	99.25%	98.00%		98.30%
		Customer Satisfaction Survey Results		91.00%	91.00%	83.00%	83.00%	92.00%			88.00%
Operational Effectiveness	Safety	Level of Public Awareness			71.00%	71.00%	69.00%	69.00%			70.00%
		Level of Compliance with Ontario Regulation 22/04		C	C	C	C	C		C	N/A
Continuous improvement in productivity and cost performance is achieved; and distributors deliver on system reliability and quality objectives.		Serious Electrical Incident Index	Number of General Public Incidents	3	0	0	1	6		2	2.00
			Rate per 10, 100, 1000 km of line	0.295	0	0	0.035	0.209		0.074	0.108
	System Reliability	Average Number of Hours that Power to a Customer is Interrupted		0.89	0.99	0.91	0.91	0.81		1.11	0.90
		Average Number of Times that Power to a Customer is Interrupted		1.18	1.31	1.28	1.18	1.14		1.36	1.22
	Asset Management	Distribution System Plan Implementation Progress		147%	100%	101%	99%	95%			108.40%
	Cost Control	Efficiency Assessment		5	5	5	5				
		Total Cost per Customer		$967	$1,000	$1,044	$1,042				
		Total Cost per Km of Line		$70,688	$73,309	$27,819	$27,825				
Public Policy Responsiveness	Conservation & Demand Management	Net Cumulative Energy Savings			12.51%	34.58%	63.11%			1,576.05 GWh	
Distributors deliver on obligations mandated by government (e.g., in legislation and in regulatory requirements imposed further to Ministerial directives to the Board).	Connection of Renewable Generation	Renewable Generation Connection Impact Assessments Completed On Time		97.12%	100.00%	100.00%	81.08%	100.00%			95.64%
		New Micro-embedded Generation Facilities Connected On Time		100.00%	100.00%	100.00%	92.41%	100.00%	90.00%		98.48%
Financial Performance	Financial Ratios	Liquidity: Current Ratio (Current Assets/Current Liabilities)		0.68	0.67	0.61	0.64	0.53			0.63
Financial viability is maintained; and savings from operational effectiveness are sustainable.		Leverage: Total Debt (includes short-term and long-term debt) to Equity Ratio		1.65	1.57	1.45	1.34	1.2			1.44
		Profitability: Regulatory Return on Equity	Deemed (included in rates)	9.58%	9.30%	9.30%	9.30%	9.30%			N/A
			Achieved	7.41%	10.71%	12.18%	9.08%	9.33%			N/A

Exhibit 1B,Tab 2, Schedule 5 ORIGINAL

OEB Appendix 2-G
Service Reliability Indicators
2013 - 2017

Index	SAIDI					SAIFI				
	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017
Including all events	21.07	1.44	1.45	0.95	1.13	2.91	1.73	1.59	1.40	1.49
Excl. LoS	17.70	1.14	1.36	0.91	1.05	2.38	1.36	1.40	1.28	1.24
Excl. MED's	1.14	1.00	1.06	0.95	0.99	1.44	1.39	1.45	1.40	1.43
Excl. LoS and MED's	1.12	0.89	0.99	0.91	0.91	1.34	1.18	1.31	1.28	1.18
Excl. LoS, MED's & Sch. Outages	1.05	0.84	0.95	0.85	0.88	1.30	1.13	1.29	1.24	1.16

	5 Year Historical Average SAIDI	5 Year Historical Average SAIFI
Including all events (1)	5.21	1.82
Excl. LoS (2)	4.43	1.53
Excl. MED's (3)	1.03	1.42
Excl. LoS and MED's (4)	0.96	1.26
Excl. LoS, MED's & Sch. Outages (5)	0.91	1.22

SAIDI = System Average Interruption Duration Index
SAIFI = System Average Interruption Frequency Index
(1) including all events
(2) excluding events related to Loss of Supply ("LoS")
(3) excluding events related to Major Event Days (MEDs)
(4) excluding Major Event Days ("MEDs") and LoS
(5) excluding MEDs, Loss of Supply, and Scheduled Outages

Exhibit U Tab 1B, Schedule 1.Page 38

Table 5: 2018 Corporate Scorecard

Key Performance Indicator	2018 Target		2018 Result
New Services Connected on Time	96.5%		99.8%
Bill Accuracy	98.8%		99.3%
First Contact Resolution	86%		89%
Total Recordable Injury Frequency (TRIF)	1.45		0.83
Employee Engagement	6.0		7.1
SAIFI (# - Defective Equipment Only)	0.54		0.40
SAIDI (Minutes - Defective Equipment Only)	29.00		21.08
1-Year Distribution System Plan Investment ($M)	Lower Target	Upper Target	435.8
	418.0	451.0	
5-Year CIR Distribution System Plan Investment ($M)	Lower Target	Upper Target	1943.8
	1928.0	1957.2	
Consolidated Net Income ($M)	148.0		167.3

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES

INTERROGATORY 1:

Reference(s): Exhibit 1B, Tab 2, Schedule 2, p. 3

a) Please expand on the definitions used for SAIDI and SAIFI in the above reference.

b) Please provide a Table and graphical presentation of the SAIDI and SAIFI reliability measures with the 2017 and 2018 data added

c) Please reconcile the data to the following

i) TH evidence at Exhibit 1B, Tab 2, Schedule 5 and other evidence

ii) PSE Evidence

RESPONSE:

a) In Exhibit 1B, Tab 2, Schedule 2, page 3, Table 1: "Toronto Hydro EDS Performance 2013-2017", SAIDI and SAIFI definitions are as per the OEB Electricity Reporting and Record Keeping Requirements[1] where:

- "Average Number of Hours that Power to a Customer is Interrupted" is SAIDI Excluding Loss of Supply and Major Event days; and
- "Average Number of Times that Power to a Customer is Interrupted" is SAIFI Excluding Loss of Supply and Major Event days.

b) Please refer to Toronto Hydro's response to interrogatory 1 1B-BOMA-35(b).

c) (i) SAIFI and SAIDI as reported in the EDS (Exhibit 1B, Tab 2, Schedule 2, p. 3), can be compared to SAIFI and SAIDI in the SRI (Exhibit 1B, Tab 2, Schedule 5), "Excl. LoS and MED's", which refers to Excluding Loss of Supply and Major Event Days.

There may be differences between the 2013-2018 SAIFI results reported in the EDS and other parts of the evidence. These differences will depend on the context and the varying filters used, similar to the ones in the SRI.

(ii) 2013-2017 SAIDI and SAIFI results reported in the EDS and in PSE evidence[2] are not comparable due to the different thresholds used to define momentary interruptions:

- EDS reliability data (and all of Toronto Hydro's reliability data) follows OEB's RRR and defines an interruption as a complete loss of voltage for one minute or more; and
- Consistent with utility reporting in the United States, the PSE results are based on a five minute threshold for an interruption.

[2] Exhibit 1B, Tab 4, Schedule 2, page 9.

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES

INTERROGATORY 6:

Reference(s): Exhibit 1B, Tab 2, Schedule 2, p. 17, Figure 1

a) Please discuss why the CAIDI trend in Figure 1 is "Flat"?

b) Please provide the CAIDI Metrics for each year 2013-2017

c) Please provide the latest SAIDI/SAIFI/CAIDI data for 2018

RESPONSE:

a) Toronto Hydro notes that there is actually a slight improvement in the trend line for CAIDI from 2013 to 2017. CAIDI is a function of both SAIFI and SAIDI, such that when there is a corresponding improvement in SAIDI and SAIFI metrics, it has a null effect on CAIDI. Because SAIDI has improved marginally faster than SAIFI over the 2013-2017 period, there is a slight improvement in CAIDI over this period.

b) Please refer to Toronto Hydro's response to interrogatory 1B-SEC-17.

c) Toronto Hydro does not currently have this data finalized for 2018.

RESPONSE TO 1B SEC-17

Table 1: 2015-2019 DSP Measures Results (2013-2017)

Measure	2013	2014	2015	2016	2017
SAIDI (Hours)	1.12	0.89	0.99	0.91	0.91
SAIFI (# of times)	1.34	1.18	1.31	1.28	1.18
MAIFI (# of times)	2.37	2.55	2.72	2.64	2.52
CAIDI (Hours)	0.84	0.75	0.76	0.71	0.77
FESI 7 (# of feeders)	33	36	23	25	12
Outages Caused by Defective Equipment (# of outages)	636	711	572	519	484
Distribution System Plan Implementation Progress (%)	105%	147%	100%	101%	99%
Stations Connection Capacity Availability (# of stations)	5	0	0	1	1
Planning Efficiency: Engineering and Support Costs (%)	7%	8%	8%	9%	9%
Supply Chain Efficiency: Materials Handling On-Cost (%)	11%	14%	11%	11%	10%
Construction Efficiency: Internal vs. Contractor Cost (%)*	[redacted]				
Construction Efficiency: Asset Assembly Labour Input	NA				

*Note: This information is being field confidentially, in accordance with the OEB's Decision on Confidentiality in this case, (December 14, 2018) at pages 2 and 3.

Exhibit 1B,Tab 2. Schedule 2 ORIGINAL

4. MOMENTARY AVERAGE INTERRUPTION FREQUENCY INDEX ("MAIFI")

MAIFI measures the average frequency of momentary interruptions (i.e. less than one minute) that affect Toronto Hydro's customers. Figure 2, below, shows the utility's performance for this measure over the 2013-2017 period. The five-year annual frequency value for the period 2013 to 2017 is 2.56 compared to the corresponding value of 2.74 reported in the utility's last Rate Application (for the period 2009 to 2013). For 2017, MAIFI was 2.52. This result represents a marginal improvement from the prior year and is generally consistent with recent historical results.

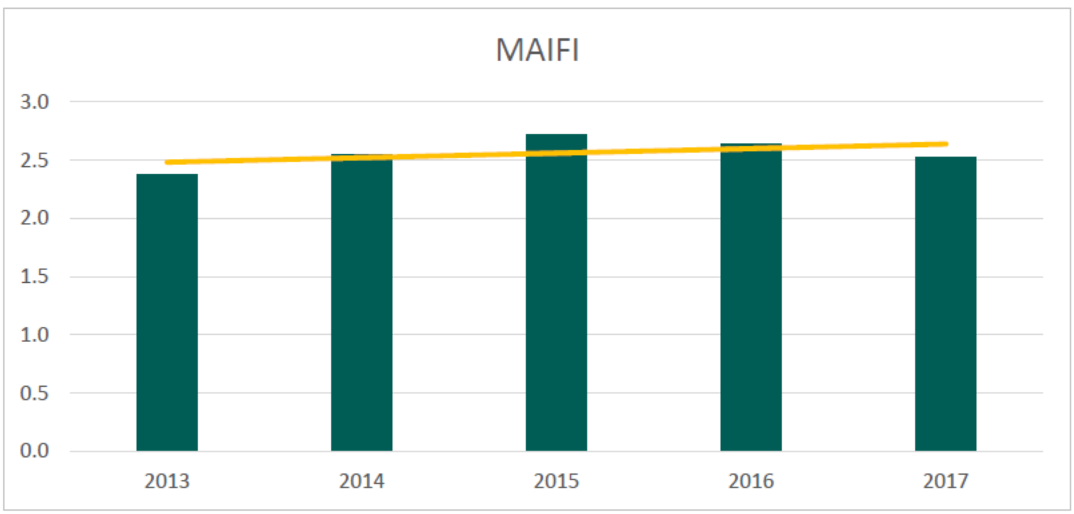

Figure 2: MAIFI Performance from 2013-2017

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES

INTERROGATORY 7:

Reference(s): Exhibit 1B, Tab 2, Schedule 2, p. 18, Figure 2

a) Please provide more information on Momentary Interruptions since 2013 Specifically,

ii) Please explain Why MAIFI is/is not improving with replacement of defective equipment.

b) Is the definition/use of one minute interruption appropriate, given customers' sensitive power equipment such as Computers/Modems, Microwaves, Digital Clocks, Smart TVs etc.?

c) Please comment and specifically indicate if Toronto Hydro is advocating battery back-up for all such equipment.

d) In EB-2013-0116 in its IR responses TH indicated it would monitor and track momentary interruptions. Please provide a summary of the Data 2013-2018E.

e) Please discuss if Toronto Hydro is able to measure momentary interruptions of less than one minute? Please define/indicate current technical limits

RESPONSE:

a)

i) MAIFI uses the same cause codes as SAIFI and SAIDI as per OEB Electricity Reporting and Record Keeping Requirements. Please refer to Toronto Hydro's response to interrogatory 2B-EP-32 part (d) for MAIFI cause codes.

ii) As illustrated in Toronto Hydro's response to interrogatory 2B-EP-32 part (d), defective equipment is a small contributor to MAIFI (approximately 16% based on the 5 year average). The majority of MAIFI is due to unknown causes (approximately 61 percent based on the 5 year average) or external causes.

b) Toronto Hydro uses the one minute interruption definition as per the OEB Electricity Reporting and Record Keeping [1]Requirements.

c) As per Toronto Hydro's Conditions of Service, Section 2.3.1 "***Toronto Hydro will endeavour to use reasonable diligence in providing a regular and uninterrupted supply of electricity but does not guarantee a constant supply*** ", and "***Consumers or Customers requiring higher degree of security than that of normal electricity supply are responsible to provide their own back-up or standby facilities. Consumers or customers may require special protective equipment at their premises to minimize the effect of momentary power interruptions***."

While Toronto Hydro does not advocate any particular technological approach to enhancing the reliability, power quality, or other attributes of the electricity that a customer receives from the grid, per the foregoing, Toronto Hydro is mindful that

some customers may choose to do so. In some instances, 1 Toronto Hydro can assist individual customers or groups of customers on a particular feeder in doing so, such as through Energy Storage Systems, as described in Exhibit 2B, Section 7.2.

d) Historical MAIFI results are available in Exhibit 1B, Tab 2, Schedule 2, page 18, Figure 2: MAIFI. Toronto Hydro does not currently have this data finalized for 2018.

e) Toronto Hydro is able to measure momentary interruptions of less than one minute on feeders that have SCADA-enabled relays at the station circuit breakers. However, not all station circuit breakers have SCADA-enabled relays.

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES

INTERROGATORY 8:

Reference(s): Exhibit 1B, Tab 2, Schedule 4, p. 10

a) Confirm Figures 11 and 12 show a reduction in outages due to defective equipment of ~8% (SAIFI) and ~5% (SAIDI).

b) Discuss reasons why Toronto Hydro attributes this improvement to increased Replacement Capital investment.

c) Confirm that for SAIFI, unknown cause events have increased from ~20% to 30% apparently offsetting gains from replacing defective equipment.

d) Has Toronto Hydro attempted to determine the reasons/causes for this trend? Please discuss.

e) Discuss if the "unknown" designation used by TH is appropriate.

f) Please discuss how TH is attempting to diagnose and remedy increased frequency

RESPONSE:

a) Please note that the numbers shown in Figures 11 and 12 are not percentages but rather the SAIFI and SAIDI results.

- SAIFI had a ~15% improvement between 2013 [1] and 2017 (From 0.53 to 0.45)
- SAIDI had a ~9% improvement between 2013 and 2017 (From 0.46 to 0.42)

b) The replacement of aging infrastructure and equipment in Toronto Hydro's distribution system has a direct effect on the number of failures as newer equipment has a lower likelihood of failure.

c) Please note that the numbers shown in Figure 11 are not percentages but rather the SAIFI results (Average Number of Interruptions per Customer). SAIFI with 'Unknown' cause code has increased from 0.20 Outages to 0.30 Outages between 2013 and 2017. They have offset some gains in other categories leading to an overall flat SAIFI.

d) Toronto Hydro regularly reviews feeders for outage patterns and trends over a period of time, and even individual outages. In many of these cases, these 'Unknown' outages do not have any patterns. For example, in 2017, there were over 150 outage incidents with an 'Unknown' cause code. These outages were spread out across 115 distinct feeders, with very few feeders having repeated issues. The causes of these outages are typically attributed to tree contacts, weather events, animal contacts, or even contamination causing flash overs. However, once the fault condition has cleared and the power is completely restored, there is no easy way to identify the root cause.

e) Toronto Hydro follows the OEB Electricity Reporting and Record Keeping

Requirements, and Canadian Electricity Association rules for the reporting of unknown events.

f) As described in part d), Toronto Hydro regularly reviews outage 1 patterns and trends to minimize outage impacts to customers. Also, as part of Toronto Hydro's Preventative and Predictive Maintenance programs (see Exhibit 4A, Tab 2, Schedule 1 and 2) and Reactive and Corrective Capital program (see Exhibit 2B, Section E6.7), Toronto Hydro regularly performs inspections and addresses deficiencies thereby having a positive impact on system reliability.

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATIONINTERROGATORIES

INTERROGATORY 66:

Reference(s): Exhibit U, Tab 1B, Schedule 1, Pages 16 and 17; Figure 13
Response to Interrogatory 2B-EP-32

Preamble:

"The five-year annual frequency value for the period 2014 to 2018 is 2.64 compared to the corresponding value of 2.74 reported in the utility's last Rate Application (for the period 2009 to 2013). For 2018, MAIFI was 2.78. This result represents an increase from the prior years, which is due to a number of drivers including weather."

a) Please update for the last 5 years 2014-2018 Table 1 and Figure 1 provided inresponse to 2B-EP-32.

b) Why is the cause for approximately 61% of momentary interruptions unknown? How does TH distinguish momentary interruptions from System interruptions?

c) Please compare MAIFI to SAIDI and SAIFI in terms of annual customer interruptions.

d) Please discuss whether momentary interruption events are more localized compared to system interruption events and is there a connection or correlation with lower voltage feeders and/or with defective equipment more or less than with system events?

e) Please provide OEB peer group, CEA and FERC data on average utility MAIFI and comment on how TH relates to these data.

f) Why is TH MAIFI getting worse despite the large infrastructure investment? Explain the reasons in detail with reference to response to interrogatory 2B-EP-32.

g) What is TH doing to stabilize and improve MAIFI over the 2020-2024 CIR period including how much is TH investing specifically to reduce MAIFI events?

RESPONSE:

a) Please see the updated table and figure below.

Table 1: MAIFI Cause Codes

	2014	2015	2016	2017	2018	5-Year Avg.
Adverse Environment	0.01	0.06	0.01	0.01	0.00	0.02
Adverse Weather	0.19	0.23	0.19	0.15	0.20	0.19
Defective Equipment	0.49	0.37	0.36	0.27	0.31	0.36
Foreign Interference	0.26	0.21	0.24	0.20	0.22	0.23
Human Element	0.01	0.01	0.01	0.01	0.01	0.01
Lightning	0.05	0.02	0.04	0.04	0.02	0.04
Loss of Supply	0.00	0.04	0.01	0.10	0.07	0.05
Tree Contacts	0.03	0.05	0.02	0.04	0.06	0.04
Unknown	1.50	1.74	1.74	1.68	1.88	1.71
TOTAL	**2.55**	**2.72**	**2.64**	**2.52**	**2.78**	**2.64**

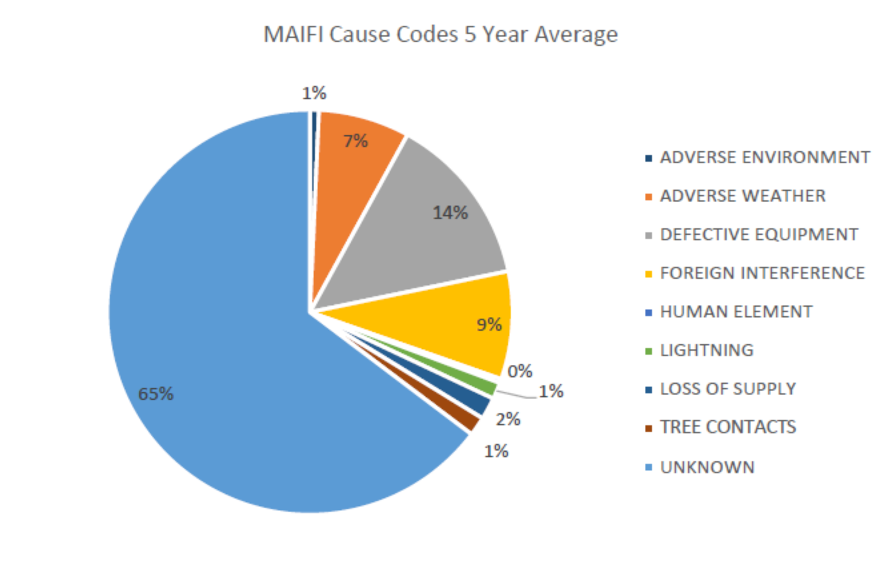

Figure 1: MAIFI Cause Code Breakdown 5-Year Average

b) Toronto Hydro follows the OEB Electricity Reporting and Record Keeping Requirements. Outages less than one minute in duration are categorized as momentary interruptions. When a breaker trips and recloses without any persistent or apparent cause, the outage would be categorized as an Unknown.
Please see Toronto Hydro's response to Interrogatory U-VECC-62 for additional discussion regarding Toronto Hydro's MAIFI results and how the utility is managing MAIFI performance.
c) MAIFI cannot be compared to SAIDI and SAIFI as these measure different aspects of reliability. SAIDI measures the duration of interruptions experienced by customers, while both MAIFI and SAIFI measure the frequency of outages experienced by customers. MAIFI measures interruptions that are less than a minute, and SAIFI

measures interruptions that are a minute or longer. Added together, these two measures would cover all outages that customers experience. However, as described in Toronto Hydro’s response to Interrogatory 1B-Staff-14, the utility’s ability to measure MAIFI accurately is limited by manual processes and incomplete SCADA coverage. This precludes a meaningful comparative analysis of MAIFI and SAIFI results.

d) For the purpose of this response, Toronto Hydro has taken “System Events” to mean sustained interruptions (i.e. interruptions lasting one minute or longer).

Momentary interruption events are not necessarily more localized compared to sustained interruption events (system interruption events). Generally, momentary interruption events result from the operation of a circuit breaker at a station. Sustained interruption events could result following the operation of a circuit breaker at a station, or following the operation of a protective device (e.g. a switch or fuse) on a feeder emanating from a station. The operation of a station breaker generally interrupts a greater number of customers than the operation of a protective device on the same feeder.

Due to the current limitations in tracking MAIFI, mentioned in response to part (c), Toronto Hydro does not have the data necessary to accurately assess whether there is a correlation between feeder voltage and the frequency of momentary interruptions.

As shown in response to part (a), Defective Equipment is the second largest cause of Momentary Interruptions behind “Unknown”. Toronto Hydro would expect a positive correlation between the amount of defective equipment and the frequency

of all interruptions caused by defective equipment. Toronto Hydro would also expect defective equipment outages to have a larger effect on sustained interruptions than momentary interruptions. This is because a piece of failed equipment will most often require crews to make a repair or replacement.

e) The OEB does not require utilities to track MAIFI. As a result, there is limited data availability within the OEB peer groups and the CEA. Toronto Hydro is also unable to make a correlation between feeder voltage and the frequency of momentary interruptions.

As shown in response to part (a), Defective Equipment is the second largest cause of Momentary Interruptions behind “Unknown”. Toronto Hydro would expect a

U-EP-66
Page 5 of 5

of all interruptions caused by defective equipment. Toronto Hydro would also expect defective equipment outages to have a larger effect on sustained interruptions than momentary interruptions. This is because a piece of failed equipment will most often require crews to make a repair or replacement.

e) The OEB does not require utilities to track MAIFI. As a result, there is limited data availability within the OEB peer groups and the CEA. Toronto Hydro is also unable to find a compiled repository of MAIFI results from FERC for comparison.

f) As can be seen in the table in response to part (a), Defective Equipment has declined slightly as driver of MAIFI since 2013. However, Unknown causes have increased over this period and are by far the largest contributor to momentary interruptions. Please refer to Toronto Hydro's response to interrogatory U-VECC-62 for details on Toronto Hydro’s efforts to reduce momentary interruptions of unknown cause.

g) Please refer to Toronto Hydro’s response to Interrogatory 2B-EP-33, part (e), and U 17
VECC-62 for the utility’s initiatives for managing MAIFI.

RESPONSES TO ENERGY 1 **PROBE RESEARCH FOUNDATION INTERROGATORIES**

INTERROGATORY 64:

Reference(s): Exhibit U, Tab 1B, Schedule 1, p. 4, 2.10 System Reliability: SAIDI/SAIFI

Preamble:

"Toronto Hydro achieved improvements in both SAIDI and SAIFI in 2018. SAIDI was measured at 0.81, which is a reduction from the 0.91 in 2017 and 2016. SAIFI in 2018 reduced to 1.14 versus the 1.18 in 2017 and 1.28 in 2016."

a) At a high level please provide a short narrative with the reasons that SAIDI and SAIFI (CAIDI) have improved over 2015-2018 period, including system renewal investment.

b) Please comment if TH is an average performer relative to its Ontario peer group, and if system reliability will continue to improve, given continuing investment over the 2020-2024 CIR Plan Period?

c) Please confirm that TH provided 2020-2024 reliability projections/outlook to PSE and PEG for their Econometric models.

d) Please provide a copy of this projection/outlook.

e) Please comment if the reliability improvement in 2018 is material relative to the projection/outlook provided to PSE and PEG.

RESPONSE:

a) As illustrated in Exhibit U, Tab 1B, Schedule 1, pages 23 and 24 (in Figures 16 and 17), reliability performance has improved over the 2015-2018 period. For example, after excluding major event days (i.e. MEDs) and loss of supply (i.e. LOS), SAIFI and SAIDI have improved by an average of approximately 4 percent and 6 percent respectively each year. Although some of the improvement can be attributed to reductions in contributions from cause codes such as Adverse Environment, Human Element, and Scheduled Outages, the majority of the improvement is attributed to reductions in interruptions caused by Defective Equipment.

The reductions in Defective Equipment interruptions have been achieved predominantly through investment in System Renewal. Between 2015 and 2018, Toronto Hydro invested $1,066 million in this category of capital expenditures. Although $204 million of this was for Reactive Capital, the remainder was directed to planned investments that addressed aging, deteriorated, and obsolete assets that posed elevated reliability (and other) risks. (Please see Exhibit U, Tab 2, Schedule 2, at pages 9 and 16 for Tables 9 and 15 for expenditure details between 2015 and 2018.)

With respect to 2018, please note that although SAIFI and SAIDI results bettered

2015-2017 results, they benefited from performances in some areas that are considered to be anomalies. For example, SAIFI benefited from its best performance in the past 15 years for the cause codes of Lightning and Scheduled Outages. Within the Defective Equipment cause code, contributions from assets such as non-direct buried cables, overhead insulators, and poles were lower than expected and are also considered to be anomalies.

b) The following two graphs compare the SAIFI and SAIDI performance 1 (excluding Loss of Supply and Major Event Days) of Toronto Hydro to the other Ontario utilities using OEB RRR data for the most recently availably year, 2017. The charts highlight Toronto Hydro’s performance in orange, other utilities that serve the Greater Toronto Area (GTA) in green, and the remaining utilities in grey. Toronto Hydro’s reliability performance is worse than average for SAIFI (i.e. third quartile) and better than average for SAIDI (i.e. second quartile) when compared to all other Ontario utilities.

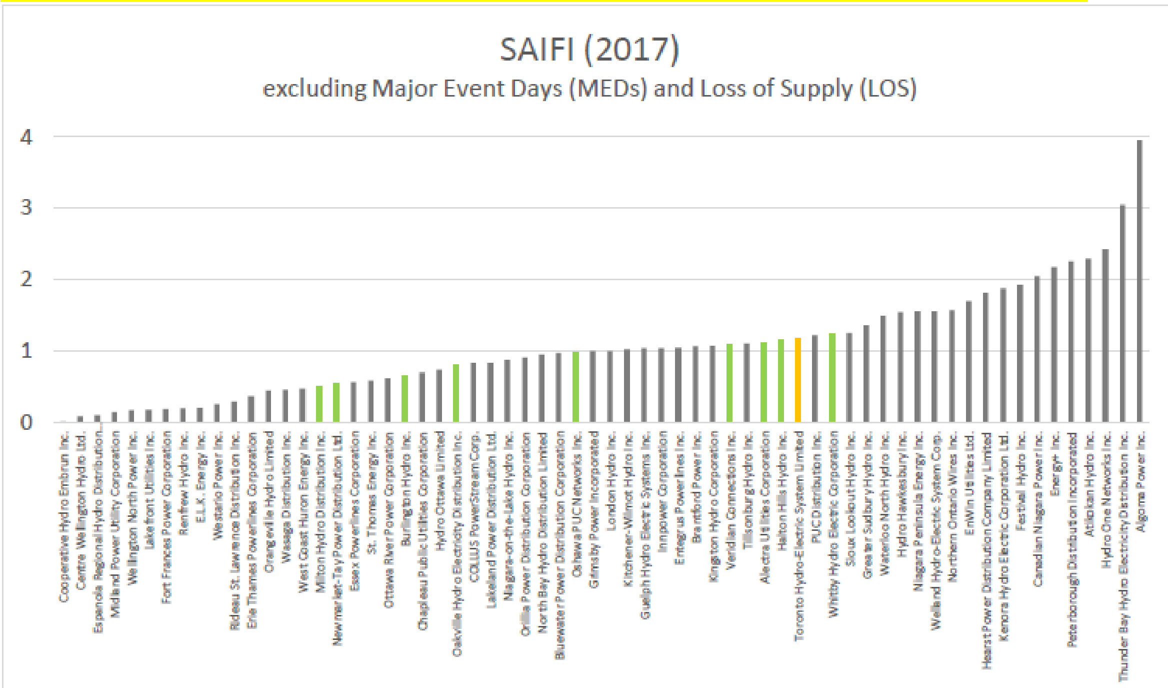

Figure 1: 2017 SAIFI (excluding MEDs and LoS)

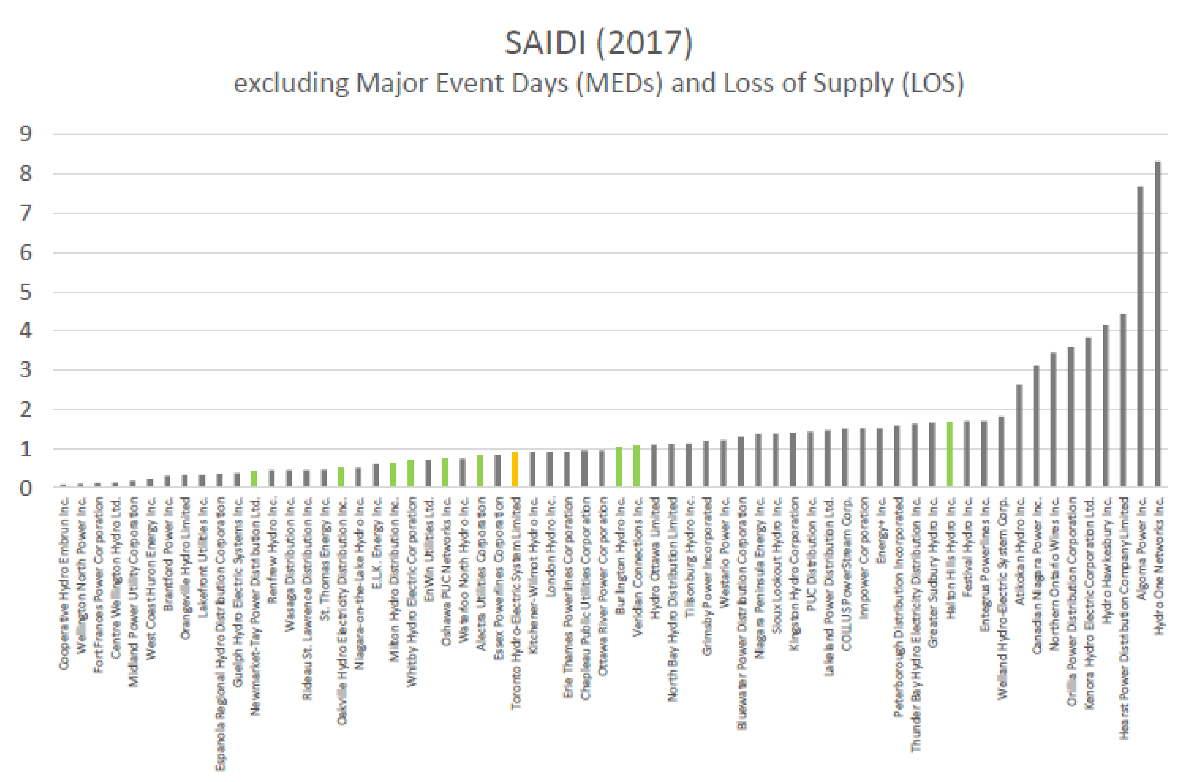

Figure 2: 2017 SAIDI (excluding MEDs and LoS)

These findings are directionally similar to the findings in PSE's reliability benchmarking study, which used an econometric approach to compare Toronto Hydro to a broader set of U.S. utilities. That study found that Toronto Hydro is worse than its predicted benchmark on SAIFI performance and better than its benchmark on SAIDI performance.

The results above do not speak to the customer's perspective on Toronto Hydro's reliability performance and whether that performance aligns with customer priorities. As explained in Exhibit 2B, Section E2.3.1, feedback received during the first phase of customer engagement indicated that the average customer was satisfied with current reliability performance. Customer priorities were to keep distribution price increases

to what is necessary to maintain long-term performance for customers experiencing average or better reliability service, and improve service levels for customers experiencing below average service. In response to this feedback, Toronto Hydro designed a plan that would achieve these objectives.

As illustrated in Toronto Hydro's response to U-SEC-105, Toronto Hydro does not expect continued improvement in SAIDI and SAIFI results through the 2020-2024 period. As detailed throughout the DSP, the utility has relied on various indicators of future asset performance (e.g. asset health) and other indicators of system need (e.g.

weather and climate analyses) to develop an expenditure plan that is paced to prevent asset failure risk from increasing over the period (e.g. by seeking to maintain the number of assets in HI4 and HI5 condition). Toronto Hydro is generally not planning to invest at a pace that will reduce asset failure risk from current levels, with a few exceptions for areas where risk accumulation has reached unacceptably high levels (e.g. Stations Renewal). In addition, the utility used its Reliability Projection methodology – which compiles asset demographics data, historical reliability performance, and planned program investments – to guide the development of the proposed plan and ultimately ensure that the proposed investment program would be of the right pace and mix to sustain system reliability. The results of this analysis are shown at Exhibit 2B, Section E2, Figures 8 and 9.
Toronto Hydro's proposed increase in total capital expenditures relative to the 2015-2019 period is necessary to deliver not only on its proposed reliability outcomes, but also to manage a number of other critical needs and objectives that drive material investment requirements. Some examples are provided below.

System Renewal
Although System Renewal as a proportion of the overall Distribution System Plan is remaining consistent at approximately 57 percent in 2020-2024 (relative to 2015-2019), the mixture of planned work is shifting to address significant needs on parts of the distribution system that contribute less to system average reliability, and more to critical drivers such as safety, resiliency and environmental impacts. For example:

- Toronto Hydro is planning to invest $122 million in the new Underground System Renewal – Downtown program, which replaces obsolete lead and asbestos cables that pose environmental risks. The program also manages a growing population of deteriorating civil assets such as cable chambers, which present safety risks. (Please see Exhibit 2B, Section E6.3, Table 1.)
- Toronto Hydro is planning an increase of $56 million from 2015-2019 in Stations Renewal to address deteriorating assets that generally have a lower probability of causing an outage, but that can lead to significant consequences (e.g. widespread customer outages; extended weakening of system contingency capabilities) if a failure is to occur. (Please see Exhibit 2B, Section E6.6, Table 1.)
- Based in part on historical trends, the plan includes projected increases in Reactive Capital, which often replaces equipment after it has failed and has contributed to unreliability, instead of prior to failure. (Please see Exhibit 2B, Section E6.7, Table 1.)
- The plan includes an increased proportion of spot replacements, particularly for transformers containing, or at-risk of containing PCBs, in both the Overhead System Renewal and Underground System Renewal (Horseshoe)

Program. Spot replacements of transformers mitigate less 1 reliability risk than area rebuilds, which target clusters of deteriorated assets in an area. (Please see Exhibit 2B, Section 6.5, page 20, lines 1 to 3 and Section 6.2, page 32, lines 26 to 30.)

System Service

System Service investments that have the potential to contribute to improvements in reliability have either been reduced in 2020-2024 (e.g. System Enhancements, discussed in Exhibit 2B, Section E7.1, Table 1) or in the case of Network Condition10 Monitoring and Control (i.e. Exhibit 2B, Section 7.3), are being directed to the Network System, which on a day-to-day basis is highly reliable (given its inherent design), to address safety and resiliency needs. (Please see Exhibit 2B, Section C2, 13 page 11, for details related to Toronto Hydro's Network Units Modernization objectives15

System Access

Toronto Hydro is forecasting an increase in System Access investments in 2020-2024 to address demand and compliance-based projects that are largely unrelated tosystem average reliability. For example, the utility anticipates greater investments in Customer Connections, Externally Initiated Plant Relocations, and Metering.

c) Toronto Hydro confirms that it provided 2020-2024 reliability projections for SAIFI and SAIDI to PSE. These same projections were provided to PEG via the request for PSE's working papers. These projections used a momentary interruption definition of five minutes or less (as opposed to Ontario's one minute or less) for comparison with U.S. 26

Page 8 of 8

d) Please refer to Toronto Hydro's response to Technical Conference undertaking JTC2.10 for projections of SAIFI and SAIDI provided to PSE.

RESPONSE (PREPARED BY PSE):

e) Toronto Hydro's 2018 reliability results would improve the model result for SAIFI by an estimated 3 percent and would worsen the CAIDI results by about 2 percent. PSE does not consider this to be a material change within the context of our findings.

CIR PLAN SYSTEM RELIABILITY 2020-2024

Phase I: Toronto Hydro Customer Priorities

PRIORITIES	Residential & GS <50 KW	GS >50 KW	Key Accounts (Large Users)
Price	**HIGH (1st Priority)** • Containing price increases is the top priority for most residential and small business customers. • Increasing rates must be justified (i.e. there is a clear need and ratepayers dollars will be spent efficiently).	**HIGH (1st Priority)** • Containing price and providing short-term rate predictability is the top priority.	**HIGH (2nd Priority)** • Prioritizing reliability over price is of high importance (i.e. cost of power interruptions outweighs the cost of rate increases).
Reliability	**HIGH (2nd Priority)** • Maintaining current "good" level of reliability is a key priority.	**HIGH (2nd Priority)** • Maintaining current level of reliability is a key priority for this group of customers. • Providing outage communications and responsive service is valued more highly among this rate class (than others).	**HIGH (1st and 3rd Priority)** • #1 Maintaining reliability (including power quality) is the top priority. • #3 Implementing strategies to mitigate outages caused by extreme weather is a top 3 priority.
Safety	**HIGH (3rd Priority)** • Setting public safety as a top priority is assumed and expected.	• Setting public safety as a top priority is assumed and expected.	• Setting public safety as a top priority is expected.
Customer Service	• Provide accurate ETOR, proactive information on CDM programs and energy management. • Provide tools to make billing, account management, and usage information easily accessible.	**HIGH (3rd Priority)** • Providing accurate ETOR and proactive communications is a key priority. • Enhance customer service to match emerging technological capabilities and needs (e.g. allow customers to get bills by emails, create master accounts to manage multiple bills).	• Maintaining current "very good" levels is expected. • Helping customers take advantage of CDM programs is seen as a valued priority.
Public Policy Response	• Incentivize adoption of innovative technologies that enable conservation and consumption management.	• Pursue value-for-money investments where long-term cost savings can be realized (e.g. spend now to save later). • Avoid premature investments in unproven or untested technologies that impact customer rates.	• Investing in technology that helps customers save money is valued.
Environmental	• Make programs combatting climate change known to customers. • Show customers how such programs impact their bills.	• Maintain equipment and infrastructure in adverse weather.	• Actualize other priorities, before focusing on environmental concerns.
Methodology ▸▸	Quantitative and Qualitative	Qualitative	Quantitative

Stakeholder Groups (Key Issues)

Housing & Social Services

- Reliability outweighs cost
- Quality and consistency of power is a key need
- Incentive programs need to be more accessible and may not be targeted at greatest returns
- Conservation efforts constrained by bulk meter buildings
- Building renewal and retrofitting are priorities

Large Commercial

- Reliability is needed 24/7
- Reliability is a competitive advantage
- System resilience is a concern
- Cybersecurity is a priority
- Behind the meter innovation is a need
- Cost is not a significant factor

Small Commercial

- Reliability is needed 24/7
- Customer service is the key need – lampposts, local development, outages
- Cost is primarily a concern among local, micro businesses

Small / Mid-sized Manufacturing

- Cost is a significant factor
- Reliability seen as less of a concern
- ICI program ineligible
- Global adjustment is a friction point, impairs budgeting

Qualitative

Source: **Innovative Research Group** (Customer Research - December 2016, March 2017, June 2017)

RESPONSES TO SCHOOL ENERGY COALITION INTERROGATORIES

INTERROGATORY 105:

Reference(s): Evidence Overview Presentation, p. 15

a) Please expand the SAIFI chart to include (a) 2018 data, and b) forecast 2019 to 2022 SAIFI levels.

b) Please provide a similar chart as requested in part (a) for SAIDI.

c) Please provide a table showing numerical values for the charts requested in parts (a) and (b).

RESPONSE:

a) Please see the chart below with a projection for 2019-2024.

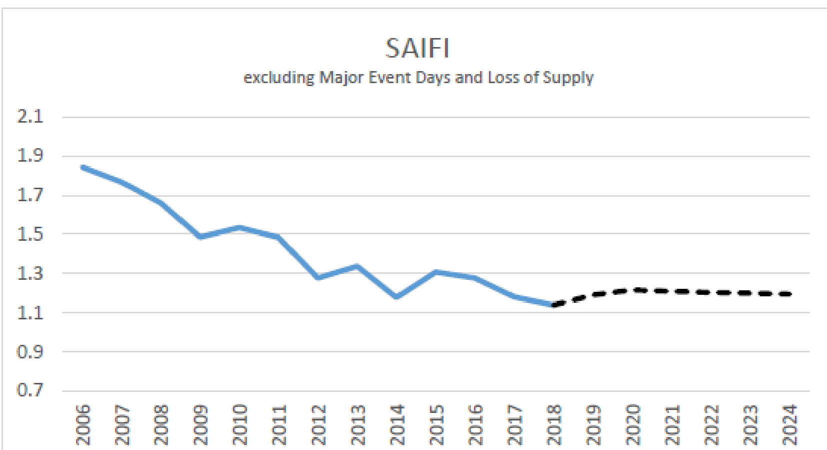

Figure 1: SAIFI Projections for 2019-2024 (excluding MED and LoS)

b) Please see the chart below with a projection for 2019-2024.

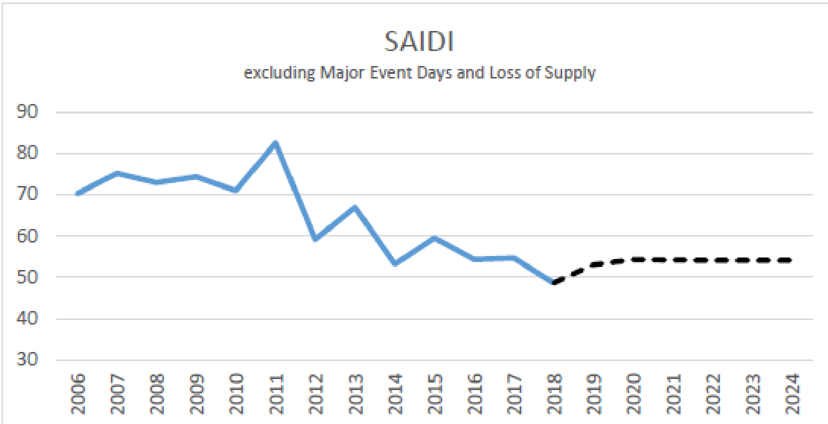

Figure 2: SAIDI Projections for 2019-2024 (excluding MED and LoS)

c) Please see Table 1. Please note that:
1. 2018 performance is considered to be an outlier due to performance in some cause codes (e.g. Lightning and Scheduled Outages for SAIFI) and the exclusion of five major event days (i.e. 1.4 percent of the year) from the statistics.
2. The projections reflect expected trends for performance and are not intended to be targets. Toronto Hydro's experience has been that due to considerable volatility from one year to the next with specific cause codes – including Tree Contacts, Adverse Weather, Foreign Interference, Human Element, and Unknown – it is very likely that actual performance will fall within a broader band than illustrated by the charts in part (a) and (b). For example, volatility experienced between 2015 and 2018 suggests that performance may vary by as much as, or more than, 10 percent from one year to the next.

Please see
Exhibit U, Tab 1B, Schedule 1, pages 30 and 31 for additional details in respectof cause code volatility and trends.

Table 1: SAIDI and SAIFI Data for Figure 1 and Figure 2

Year	SAIFI Historical	SAIFI Projection	SAIDI Historical	SAIDI Projection
2006	1.84		70.21	
2007	1.77		75.12	
2008	1.66		72.89	
2009	1.49		74.33	
2010	1.53		70.94	
2011	1.48		82.53	
2012	1.28		59.20	
2013	1.34		66.92	
2014	1.18		53.19	
2015	1.31		59.49	
2016	1.28		54.34	
2017	1.18		54.64	
2018	1.14		48.67	
2019		1.19		53.03
2020		1.21		54.26
2021		1.21		54.16
2022		1.20		54.06
2023		1.20		54.02
2024		1.19		54.06

TECHNICAL CONFERENCE UNDERTAKING RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION

UNDERTAKING NO. JTC2.10:

Reference(s): Exhibit 1B, Tab 2, Schedule 2

To provide the reliability projections.

RESPONSE:

See Appendix A for the reliability projections provided to PSE by Toronto Hydro in 2018. Also, refer to 1B-Staff-37 for updated values.

Toronto Hydro notes that the SAIDI and SAIFI results reported in Electricity Distributor Scorecard ("EDS") and in PSE benchmarking report are not comparable due to the different thresholds used to define momentary interruptions:

- Reliability results included in the EDS are based on the complete loss of voltage for one minute or more; [1] and
- Consistent with utility reporting in the United States, the PSE results are based on a five-minute threshold for an interruption.

[1] As defined in the section 2.1.4.2 System Reliability of OEB's RRR Filing Guide for Electricity Distributors.

Undertalking JTC 2.10 - Appendix A

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
SAIFI	0.93	1.11	1.14	1.08	0.95	0.98	1.05	0.88	0.95	0.92	0.97	0.93	0.94	0.94	0.92	0.92	0.91	0.91	0.91	0.91
SAIDI (in hours)	1.19	1.20	1.31	1.22	1.34	1.26	1.40	1.00	1.12	0.98	1.03	0.93	0.96	0.97	1.01	1.01	1.01	1.01	1.01	1.01

Note: The results are for 5 minutes or more momentaries outage

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES

INTERROGATORY 33:

Reference(s): Exhibit 2B, Section C2.3, Table 4, and Figures 6&7

Preamble:

Toronto Hydro states its proposed investments during the 2020-2024 plan period, are aimed at improving asset condition and demographics in order to mitigate reliability risks associated with defective equipment. Reliability results, as measured by SAIDI and SAIFI Defective Equipment, are expected to decrease if the requisite investments are not made. How much is invested to achieve each of the 4 reliability goals in the Reliability Scorecard?

a) Please provide the linkage to investment and estimated 5-year cumulative amounts for each.

b) Confirm that according to PSEs Benchmarking Study, TH SAIFI is above that of the peer group.

c) Please provide the levels in # hours/customer for the Peer group and TH.

d) Why is maintaining SAIFI and SAIDI an appropriate Goal for 2020-2024 What investment levels were examined? Please provide the data and discussion.

e) What is TH's Strategy and Goal to address momentary interruptions (MAIFI) in the CIR period? Please discuss.

RESPONSE:

a) All programs driven by "Failure", "Failure Risk", "Reliability", or "Functional Obsolescence" will help achieve the four reliability goals. Within these programs, asset replacements, system upgrades, and reconfigurations will help to improve reliability. This represents the majority of spending within the System Renewal category (discussed in Exhibit 2B, Section E4.2.2, Table 4) and the System Service category (discussed in Exhibit 2B, Section E4.2.3, Table 5).

In addition, programs that do not have these drivers but contribute to the "Reliability" outcome, as identified in the outcomes tables at the beginning of each expenditure program, are also expected to contribute to reliability goals. This includes various programs within System Access (discussed in Exhibit 2B, Section E5), System Service (Exhibit 2B, Section E7), General Plant (Exhibit 2B, Section E8) and also OM&A programs (Exhibit 4A, Tab 2).

Many of the aforementioned programs have additional drivers besides reliability (e.g. safety) and contribute to more than one outcome (e.g. reliability and environment). For this reason, it is not possible for Toronto Hydro to create a simple one-to-one relationship between the proposed amounts invested and the four reliability measures.
b) PSE's econometric reliability benchmarking analysis resulted in a finding that Toronto Hydro's historical SAIFI metrics are higher than the benchmark SAIFI values.1

Page 3 of 3

c) Please refer to the PSE working papers in the 1 Excel spreadsheet, "Modeling Dataset.xls". Column BF contains the SAIDI values for the entire sample, including Toronto Hydro. The values are in minutes; dividing by 60 will convert them to hourly values.
d) Toronto Hydro's objective of maintaining SAIFI and SAIDI over the 2020-2024 period is one of a balanced set of strategic objectives that was informed by, and aligns with, customer preferences identified during the utility's extensive and iterative Customer Engagement activities for this application. Exhibit 2B, Section E2, provides a full discussion of this topic, including a summary of the investment levels considered.
e) An overview of how Toronto Hydro's plan aligns with customers' needs and preferences for reliability – including power quality and momentary interruptions – can be found at
In addition to the specific initiatives mentioned
therein, Toronto Hydro expects many of its planned reliability investments in various System Renewal and Service programs to support improvements in both sustained and momentary outages.

Exhibit 2B Section C2.3

C2.3 Reliability

Table 4: Reliability Custom Performance Measure

OEB Reporting Category	2020-2024 Custom Performance Measures	Historical Performance (2013-2017)	Target (2020-2024)
System Reliability	SAIDI- Defective Equipment	0.45 hours of interruption	Maintain
	SAIFI- Defective Equipment	0.52 hours of interruptions	Maintain
	FESI-7 System	26 feeders (avg.)	Improve
	FESI-6 Large Customers	18 feeders (avg.)	Maintain
Asset Management	System Capacity	17 in 2013 and 13 in 2017	Maintain
	System Health (Asset Condition)-Wood Poles	N/A	Monitor
	Direct Buried Cable Replacement	809 KM as of end of 2017	Improve

Exhibit 2B, Section E2.3.1.1, page 48/49

Page 48

2. Alignment of the Plan with Customer Preferences for Reliability and Safety

Toronto Hydro’s Reliability and Safety objectives for its 2020-2024 Capital Expenditure Plan are aligned with and responsive to the customer feedback summarized above. When it comes to Reliability performance, the utility is seeking to minimize price increases by investing only what is necessary to maintain system reliability at current levels while

(i) improving the experience for customers with poor reliability and power quality; and

(ii) (ii) improving the resiliency of the distributionsystem in light of increasing weather-related risks. As discussed in E2.1 and E2.2 above, the utility’s capital expenditure plan is projected to maintain overall SAIDI and SAIFI over the plan period. Toronto Hydro is also proposing the incremental Custom Performance Scorecard measures in Table 10 to track its 2020-2024 reliability performance

Table 10: Custom System Reliability Measures

Toronto Hydro Outcome	OEB Reporting Category	2020-2024 Custom Performance Measure	Target
Reliability	System Reliability	SAIDI - Defective Equipment	Maintain
		SAIFI - Defective Equipment	Maintain
		FESI-7 System	Improve
		FESI-6 Large Customers	Maintain

The utility added SAIDI and SAIFI for Defective Equipment outages as these measures are an indicator of the age, health, obsolescence, and modernization of system assets, all of which are key drivers of System Renewal and System Service investments during the period. The utility has also included Feeders Experiencing Sustained Interruptions (“FESI”) measures to reflect the need, expressed by customers, to improve performance for customers experiencing below-average reliability. Refer to Section C for more information on these measures.

RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION INTERROGATORIES

INTERROGATORY 4:

Reference(s): Exhibit 1B, Tab 2, Schedule 1, p. 6, 7, Table 1

a) For Reliability Targets please provide the numeric targets associated with "Maintain" or "improve" for SAIDI, SAIFI, FESI-6 and FESI-7.

b) Please compare the result to the data for SAIDI, SAIFI/CAIDI provided to PSE for its 2020-2024 reliability projections.

c) Does TH have Targets for the following reliability measures? If so please provide these. If not please discuss why not:

i) CAIDI,

ii) MAIFI and

iii) Worst/poor Performing Circuits

RESPONSE:

a) Please refer to Toronto Hydro's response to Interrogatory 2B-VECC-11 (a) for reasons why Toronto Hydro has provided targets without specific (numeric) values.

b) Please refer to Toronto Hydro's response to interrogatory 1B-EP-1 (c).

c)

i) Please refer to Toronto Hydro's response to interrogatory 1B-Staff-14 (a) Table 1 for why THESL does not have target for CAIDI.

ii) Please refer to Toronto Hydro's response to interrogatory 1B-Staff-14 (a) Table 1 for why THESL does not have target for MAIFI.

iii) THESL measures worst/poor performing circuits using FESI-7 and FESI-6. Please refer to part (a) of this question for why THESL hasn't quantified the targets.

Response to Board Staff 14 a)

Table 1: List of DSP measures being replaced

Measure	Summary Notes
MAIFI	As discussed in EB-2014-0116 (Exhibit 2B, Section C2.3.2), Toronto Hydro's ability to measure MAIFI is limited and restricted by manual processes and incomplete SCADA coverage. Given the limitations, Toronto Hydro has removed this measure.

Measure	Summary Notes
CAIDI	In light of the inclusion of SAIDI and SAIFI, Toronto Hydro's position is that including CAIDI as a third measure would be redundant given that CAIDI is derived by dividing SAIDI by SAIFI. Utilities typically choose to report one of CAIDI or SAIDI.
Outages Caused by Defective Equipment	Given the inclusion of SAIDI and SAIFI Defective Equipment measures, this measure was replaced as it is less sophisticated (i.e. only tracks raw numbers of interruptions) and does not capture the customer experience (e.g. customer interruptions or customer minutes of interruption).
Stations Connection Capacity Availability	Given the inclusion of System Capacity Measure, which considers both station capacity and the availability of feeder breaker positions, this measure was replaced as it is less sophisticated. Stations with capacity may still be constrained by a lack of feeder positions, which will challenge large customer connections.
Planning Efficiency	The four efficiency measures were replaced as Toronto Hydro works towards developing a broad unit cost framework for measuring efficiency, productivity, and costs. Toronto Hydro is proposing to monitor unit costs for poles and vegetation management during the 2020-2024 period. Given that the unit cost framework contemplated naturally includes planning, supply chain, and construction elements, the continued inclusion of more granular measures is redundant. Furthermore, Toronto Hydro's experience with each of the measures was that each had substantial weakness such as considerable volatility for Construction Efficiency.
Supply Chain Efficiency	
Construction Efficiency – Internal vs. Contractor	
Construction Efficiency – Asset Assembly Project	

TECHNICAL CONFERENCE UNDERTAKING RESPONSES TO ENERGY PROBE RESEARCH FOUNDATION

UNDERTAKING NO. JTC2.9:
Reference(s): 1B-EP-4 (a)
2B-VECC-11

To clarify on the record what will be used for SAIDI, SAIFI and the other metrics in the scorecard. (Supplemental): to advise whether THESL will use numeric targets for the two categories of performance metrics, that are improve or maintain quarterly

RESPONSE:

Table 1 provides a consolidated summary of Toronto Hydro's proposed custom performance measures, associated baselines, and targets. Further details for these measures are provided in Exhibit 2B, Section C. The utility's performance objectives for the OEB's Electricity Distributor Scorecard measures are discussed in Exhibit 1B, Tab 2, Schedule 2. It is not Toronto Hydro's proposal to establish specific numeric targets. The utility is proposing directional targets relative to specific numeric baselines. As summarized in the table below, for the majority of its "improve" targets, the utility has provided estimated forecasts of performance for the 2020-2024 period. Toronto Hydro's ability to deliver on these outcomes is contingent on the OEB's approval of the rates proposed to fund the capital and operational plans detailed throughout the application. Therefore, Toronto Hydro will not be in a position to make any final commitment with respect to its targets until it after it has received the OEB's Decision in this application, and conducted a business planning cycle having regard for that Decision.