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toronto hydro electric system

September 17, 2010

via RESS e-filing – original to follow by mail

Ms. Kirsten Walli, Board Secretary
Ontario Energy Board
2300 Yonge St, 27th Floor
P.O. Box 2319
Toronto, ON M4P 1E4

Dear Ms. Walli:

Re: Initiative to Develop Electricity Distribution System Reliability Standards
Board File Number EB-2010-0249

This letter is in response to the Board's August 23, 2010 letter to licensed electricity distributors, and other interested parties, requesting information related to existing practices for system reliability performance. Toronto Hydro-Electric System Limited (THESL) provides the following responses to the Board's questions:

Attachment A

Questions to Discuss - For Electricity Distributors

Current Practices

1) In addition to SAIDI, SAIFI and CAIDI, what, if any, other system reliability measures do you use?

- Toronto Hydro-Electric System Limited (THESL) uses "Feeders Experiencing Sustained Interruptions" (FESI) as a reliability measure. FESI is a frequency index and counts the number of sustained interruptions experienced anywhere on a feeder during the 12-month rolling period.

Two thresholds, FESI-7 and FESI-12 are monitored by THESL monthly.

FESI-7 refers to feeders that are interrupted 7 or more times during the 12-month rolling period. A threshold of 7 was chosen because this threshold encompassed approximately 3% of THESL feeders contributing 30% – 40% to SAIFI and SAIDI.

A smaller subset of FESI-7 feeders is FESI-12 feeders which are interrupted 12 or more times during the 12-month rolling period. A threshold of 12 was chosen because it represents an outage every month over the course of a year and this level of performance is considered a maximum benchmark by THESL.

2) Provide a detailed description of your methodology utilized to record SAIDI and SAIFI. Please include information such as:

The degree of use of automated event tracking from SCADA systems, as well as reliance on manual observations.

Whether planned outages are tracked separately.

The level of detail captured throughout a stepped restoration process to record the total customer duration impact.

Interruption events are logged from several sources, including customer calls, breaker operation notification via SCADA, and loss of voltage alarm from a SCADA switch. All outages, i.e. forced interruptions, planned interruptions and momentary interruptions are entered manually into the Interruption Tracking Information System (ITIS) by the operations controller. Each step of the restoration process is recorded in the ITIS report. Each outage entry has a time of operation, name of the operated device, interruption duration and the number of customers interrupted (CI) or restored.

After power restoration is completed, CI during any part of the outage are aggregated to give a total CI for the outage. Outage duration is multiplied with the CI and summed for all entries to give the total Customer Minutes Out (CMO) for the outage. Table 1 shows a sample outage. Total CI for this outage is 3258: (1711 + 1547), and the total CMO is 44,574: ((1711 x 6) + (164 x 84) + (1711 x 12)).

Table 1

Operation	Customers Interrupted	Customers Restored	Customers Off	Duration (mins)
Circuit breaker operated	1711		1711	
Isolate and close a switch restore partial feeder		1547	164	6
Circuit breaker opened	1547		1711	84
Repaired and restore all customers		1711	0	12

SCADA alarms, when available, are used for identifying that an outage has occurred, however, entries into the ITIS are not automated. ITIS reports are reviewed by the operations team before being finalized.

SAIFI and SAIDI values are calculated and monitored monthly. The number of customers used for SAIFI and SAIDI calculations corresponds to the number of billed customers on the first day of each month. Annual SAIFI and SAIDI reported to the OEB is the sum of the monthly values.

All outages are categorized into one of the ten major cause codes as required in the Distribution Rate Handbook. Scheduled (Planned) Outage is one of the cause codes and is used to track planned interruptions. SAIFI and SAIDI values include scheduled interruptions as well.

3) Do you use system reliability performance results in planning, investment and maintenance expenditures, as well as establishing operation and maintenance procedures? Please explain.

Yes, the planning process, capital and maintenance investments include reliability performance results as one of the decision making parameters.

<u>Standard Project Planning and Investment</u>

THESL utilizes Asset Condition Assessment (ACA), Feeder Investment Model (FIM) and Asset Investment Strategy (AIS) to evaluate performance of asset classes and prioritize projects.

ACA is a condition assessment methodology, fundamental to asset management for electric utilities. ACA represents the physical condition of an asset through a single numerical value known as the Health Index (HI). HI for direct buried cables is calculated using the frequency of failures, CI and CMO. This HI then feeds into the FIM.

FIM is a risk model for identifying which assets have reached the end of their economic life. FIM produces the optimal timing for replacing an asset, which is determined through balancing the cost due to the increasing risk of failures with the benefit of extending service life of the asset for as long as possible. Costs incurred due to increasing risk of failure are evaluated using the probability and the impact of failures. HI is one of the parameters used to determine the probability of failure. To determine impact of failure, various costs such as the cost of customer interruption, emergency repair and asset replacement are taken into account. Customer interruption costs for direct buried cable are dependent upon the magnitude and duration of customer interruptions, i.e. CI and CMO.

AIS is a high-level value model that uses THESL's Business Pillars to facilitate comparison of spending proposals across portfolios. AIS compares projects based on different criteria, which include:

- Benefit cost ratio from FIM
- Health Index from ACA
- Frequency of momentary interruptions
- FESI count
- CI and CMO

Thus, reliability measures are used at different steps of the planning process.

Urgent Project Expenditures

To manage system reliability, planned projects are supplemented by the Worst Performing Feeder (WPF) program. Projects initiated through the WPF program are intended for immediate execution with a faster turn around time to improve reliability of rapidly deteriorating feeders.

WPF methodology was chosen because it identifies feeders that make a high contribution to SAIFI and SAIDI.

WPF program uses the FESI-12 and FESI-7 thresholds to select feeders. Projects on feeders with the largest FESI count are given the highest priority.

Maintenance and Operation

THESL has a Reliability Centered Maintenance (RCM) program. There are four types of maintenance classifications: predictive, preventive, corrective and emergency.

Predictive maintenance is a planned cyclical activity based on the Mean Time between Failures (MTBF) based on outage activities and failure modes of assets. The tree pruning

program at THESL takes into account the reliability performance (frequency, CI and CMO) of each feeder from tree related outages along with the cost of pruning. This analysis is done using a tree trimming model which yields a trim cycle for each feeder that delivers optimum reliability performance for the amount of resource spent.

Corrective maintenance involves repairing or replacing equipment after a failure has occurred. Defective equipment is the most significant cause of outages at THESL. Restoration of equipment to normal operation is emphasized and managed through the Defective Equipment Tracking System (DETs).

4) Do you identify and track the impacts of extraordinary events?

Yes, THESL calculates a threshold for Major Event Days annually as per the 2.5 Beta method described in the IEEE 1366-2003 standard. Any day on which daily SAIDI exceeds this threshold is identified as a MED. SAIDI and SAIFI are calculated and reported both including and excluding MED.

5) What other actions do you take to manage system reliability performance?

One of the main objectives of THESL's long-term capital plan is to maintain system reliability. As such all activities take reliability performance into consideration and the general strategy is to identify areas that are under performing and take measures to address those. Some key programs to manage system reliability are listed below:

- UG direct buried cable replacement program will facilitate faster restoration by reducing the time to locate and repair faults in event of an outage and it will also reduce the frequency of cable failures.
- Downtown contingency program will permit the installation of new tie switches between feeders in the former City of Toronto, such that an open loop design can be established. In the event of a partial or complete station outage, customers would be switched to an alternative supply from an adjacent substation thus reducing outage duration.
- Program to standardize SCADA switches which involves replacing manual switches at feeder tie points with SCADA switches will reduce both number of customers impacted and the outage duration.
- Feeder automation (FA) involving intelligent SCADA switches, will allow for the restoration of customers on healthy sections of feeders within 60 seconds of the fault occurrence and will thus reduce both SAIDI and SAIFI.
- Transformer Smart Meters (TSM) will provide loading information of the transformers which can be leveraged to proactively replace transformers before failure.

- Remote monitoring and automated control for the underground secondary network. This network has been traditionally reliable, however, it remains one of the oldest and most complicated systems in Toronto. Outages on this system tend to be low-probability, but will produce high impacts.
- Installation of sensors within Network Vaults will permit the remote monitoring of transformer loading, temperature and flooding. Communication capabilities will also be added to these network vault locations, through the installation of microprocessor relaying and SCADA communications. Collectively, these initiatives will allow for a reduction of impacts to the customer, as well as overall improvement to system reliability and performance.
- Feeder patrols being carried out under the WPF program identify potential failures and thus improve reliability.

Please contact me if you require any additional information.

Yours truly,

(Original signed by)

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